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The 4th Decennial International Conference on Nosocomial and Healthcare-Associated Infections, sponsored by the Centers for Disease Control and Prevention and held in conjunction with the 10th Annual Meeting of the Society for Healthcare Epidemiology of America, will be held March 5-9, 2000, in Atlanta, Georgia. The conference is cosponsored by the Association for Professionals in Infection Control and Epidemiology Inc, the National Foundation for Infectious Diseases, and the Society for Healthcare Epidemiology of America.

Of submitted abstracts, 671 were accepted and were offered for publication by their authors; all are listed, alphabetically by subject category and corresponding author, in the index that begins on page 166. All the abstracts are published either herein or in the February 2000 issue of the *American Journal of Infection Control*, as shown below. In addition, abstracts (including those that were accepted but declined to be published herein) can be viewed at the Decennial Conference web site, located at (www.decennial.org).

Acute Care

NUMBER AND CHARACTERISTICS OF ISOLATION ROOMS IN VICTORIAN PUBLIC HOSPITALS. Kainer MA. Western Hosp, Melbourne, Australia.

OBJECTIVE: To determine the number and characteristics of isolation room facilities in Victorian public hospitals. METHOD: Questionnaire completed by infection control practitioners in Feb 1997. RESULTS: 503 single rooms (SR) with staff handbasin (SHB) suitable for contact or droplet isolation (overall ratio 44:1000acute beds). The median ratio of Group A (major metropolitan teaching) hospitals was 47 per 1000 compared to 8 per 1000 in Group (Gp) B (regional base and metropolitan community) hospitals. 29% of Gp A and 5% of Gp B hospitals had a ratio of greater than 1 in 10. There were 485 SR appropriate for isolating patients with VRE (SRVRE) defined as SR with SHB and sanitizer or ensuite facilities (EF). The median SRVRE/acute bed ratio was 1 per 39 in Gp A hospitals. 53% of Gp A hospitals had a SRVRE/acute bed ratio of greater than 1 in 50; only 7 (out of 107) had a ratio of greater than 1 in 10. There were 27 monitored negative pressure rooms (NPSR) that directly exhausted to the outside (DETO) and which had EF—10 were located in one Gp A hospital. An additional 46 SR were unmonitored, but capable of negative pressure. Most NPSR were of the alternating type. There were 5 monitored NPSR in intensive/coronary care units within Victoria and only one unmonitored NPSR with DETO in an emergency department. CONCLUSION: Appropriate isolation facilities are essential to reduce the likelihood of epidemiologically important antibiotic resistant organisms to become endemic. As the number of infections per hospital requiring additional precautions (contact and droplet) or requiring NPSR for suspected or confirmed airborne infections is unknown at present and modeling for future needs is not currently available, the extent of any inadequacies in the system cannot be determined.

HOW A CANADIAN ACUTE CARE HOSPITAL ACHIEVED 84% VOLUNTARY STAFF INFLUENZA VACCINATION. Klochnyk B,* Klein J. St. Mary's General Hosp, Kitchener, Ontario, Canada.

Vaccination of healthcare providers plays an important role in limiting the transmission of influenza within the hospital, reducing both associated morbidity in high-risk patients, and staff absenteeism. In an effort to boost staff immunization rates, a 168-bed acute care community hospital in southwestern Ontario hosted a flu-shot campaign with a response of 84% (645 of 884 staff vaccinated), a 50% improvement over previous years. Prior to the arrival of the vaccine, infection control and occupational health launched an intense influenza awareness campaign. Educational sessions aimed at dispelling myths associated with the vaccine were held, in conjunction with the opportunity to raise questions and concerns via the hospital e-mail. Hospital e-mail was also utilized to post an influenza fact sheet, a schedule of flu-shot clinics, and the location of a mobile vaccination cart. Regional guidelines were developed for the management of influenza. In the event of an outbreak, hospital policy outlined potential restriction of unvaccinated staff from work without pay. October 12th marked the arrival of the vaccine, and an announcement welcomed all staff to a "floating coffee pot" to kick-off the flu-shot campaign of 1999. Staff flocked into the cafeteria to find two huge slabs of cake, coffee, and an array of prizes donated by local businesses, including a day off with pay donated by the hospital. Flu-shots were administered on the scene, and "Flu-Free-Zone" stickers were awarded to those who braved the shot. A local TV station filmed highlights of the event, including a group of administrators and physicians receiving their vaccinations. Less than three weeks later, an overwhelming staff immunization rate of 84% had been achieved. The regional medical officer of health and local infectious disease consultant came to the hospital to commend the staff on setting a "benchmark" for staff immunization, for acute care hospitals across Canada. After their address, the draw prizes were awarded and cake was consumed by a staff dedicated to making their hospital a "Flu-Free-Zone."

SEPTICEMIA IN A WISCONSIN COMMUNITY TEACHING HOSPITAL - 1998: A 25-YEAR FOLLOW-UP. Scheckler WE, Bobula JA, Beamsley MB, Hadden ST. Univ of Wisconsin Med School and St. Marys Hosp Med Ctr, Madison, WI.

Prior comprehensive chart reviews of all inpatients with blood culture positive septicemia were reported from a 300-bed Wisconsin community teaching hosp for 1970-73, 1982-87. This current review, using the same methodology, describes the status of septicemia for all 1998 inpatients. Of 19,289 patients discharged in 1998, 185 patients had a blood culture-documented episode of septicemia for a rate of 96 cases per 10,000 inpatients. This compares to a rate of 87 in 1982 and 103 in 1987 per 10,000 patients. Both incidence of septicemia and cases where septicemia caused or contributed to an in-hospital fatality increased as the severity of underlying illness increased from nonfatal to ultimately fatal to rapidly fatal. Incidence of septicemia was 3 times more frequent in patients 65 years and older compared to younger patients. Septicemia caused or contributed to the deaths of 22 patients for a mortality rate of 11.9% overall compared to a rate of 20.7% overall in 1982. Striking decreases were noted for in-hospital patient mortality in 1998 compared to 1982 for ultimately fatal 14.6% versus 35.9% and rapidly fatal 22.2% versus 42.1% categories of underlying illness. 84% of the infections were acquired in the community or nursing homes and were most frequently secondary to urinary tract, gastrointestinal tract, lung or pelvic primary sites of infection. Primary bacteremia decreased compared to 1982. The principal organisms were similar to prior years with Escherichia coli, Staphylococcus aureus and all aerobic streptococci accounting for 59% of the 211 organisms identified. Despite vigorous antibiotic use in these patients, with a median number of 4 different antibiotics per patient, antibiotic resistance in the organisms cultured whether nosocomial, nursing home, or community acquired, was modest and changed little compared to 1982 and 1987. The demographics of the patient population served by this hospital have been stable over the past 10 years, and the experience reported may resemble that in other community hospitals from which published reports are infrequent.

LESSONS LEARNED FROM A WATER-MAIN BREAK IN AN ACUTE-CARE FACILITY. Weidman JR, Nappier JC, Golden CP, Jones CM, Mathews WH, Rejent AJ, Rich MM. Shriners Hosps for Children, St. Louis, MO.

Potable water is essential to the health and safety of all members of the hospital population, from patients to staff members. Contaminated water has been associated with nosocomial spread of waterborne organisms. Maintenance of water quality depends on good design, preventive maintenance, and adequate planning for unexpected events. This abstract addresses issues related to such unexpected events. On Sep 28, 1999, Shriners Hosp for Children suffered a break in the water main providing the supply of water from the county water system. Excavation was complicated and lengthy, so that the break was not repaired until the morning of Sep 30. During this time, all surgeries were cancelled. Patients stable for discharge or passes were sent home with their parents. Acute-care patients were transferred to another area children's hospital. A team effort was required to overcome the difficulties presented by the water main break. The local fire department hooked up their pumper truck to attempt to maintain line pressure during the repair, and at least allow water for flushing needs. Cases of drinking water were brought in for staff and patients, as well as drums of water for cleaning. Antiseptic foams were made available for handwashing, and bath-packs were used for bathing those patients remaining at the hospital. Infection Control, in conjunction with Plant Operations, Med Staff, and Administration, consulted with the local health department regarding potability of the water once it was restored. Recommendations included rigorous flushing procedures, testing, and monitoring of water temperatures. Upon completion of these activities, the water was determined to be potable on Oct 3, 1999.

Alternative Care Settings

AIR MEDICAL CREW COMPLIANCE WITH INFECTION CONTROL PRACTICES. Cumming MC, Sulis CA. Boston MedFlight, Bedford, MA; Boston Univ School of Medicine, Boston, MA.

The air medical environment provides a unique opportunity to assess compliance with infection control (IC) practices during patient care activities. Industry-wide compliance with IC standards has not been assessed. Boston MedFlight (BMF) is a critical care transport service providing air and ground transport in the greater Boston area. Med crew includes a critical care paramedic and a critical care nurse. BMF crewmembers receive extensive IC training and updates as part of an ongoing education program. A prospective observational survey of BMF crewmembers was conducted to assess compliance with IC practices

during 28 consecutive patient missions. Gloves were worn during 100% of 4 airway intubations and 100% of 2 orogastric tube (OGT) insertions, but only 64% of 28 initial patient contacts, 66% of 3 oral secretion aspirations, and 60% of 5 intravenous (IV) attempts. Eye and face protection was used in 33% of oral secretion aspirations and 25% of the intubations but in none of the OGT insertions or IV attempts. Although available to BMF crewmembers, safety needles were used in only 40% of the IV attempts. The variety and acuity of illness combined with the diverse and often uncontrolled environments from which these patients are transported place the crewmember at risk for an unprotected blood or body fluid exposure. The results of this limited survey indicate that compliance among crewmembers could be improved. A remediation plan that addresses risk perception and risk reduction training as well as availability and usability of personal protective equipment has been initiated and will be described.

LEAKING UROGYNECOLOGICAL PROBES AND POTENTIAL INFECTION TRANSMISSION IN AN OUTPATIENT SETTING. Lafferty SH, MacDonald D, Tracy M, Flood CG, Joffe AM. Royal Alexandra Hosp, Capital Health, Edmonton, Alberta, Canada; Women's Health Program, Royal Alexandra Hosp, Capital Health, Edmonton, Alberta, Canada; Univ of Alberta, Royal Alexandra Hosp, Capital Health, Edmonton, Alberta, Canada; Univ of Alberta, Royal Alexandra Hosp, Capital Health, Edmonton, Alberta, Canada.

PROBLEM: Frequently, users of medical devices are unaware of the risks of infection transmission when they acquire a medical device. The urogynecology outpatient clinic commenced using a reusable endovaginal probe Oct 17, 1997. The purpose of the probe was to produce electrical muscle stimulation and for electromyographic biofeedback in the assessment and treatment of female urinary incontinence. The device was designed to operate with a probe shaft cover dedicated to single patient use. During a therapy session, the presence of blood was noted beneath the cover, contaminating the reusable probe shaft. Until this point in time, it was believed that the covers were leakproof. Upon recognition of the risk of potential cross infection, use of the probe ceased May 29, 1998. METHODS: A committee was formed with representation from administration, medical staff, physiotherapy, Clinical Engineering, Infection Control and legal counsel. Twenty-one (21) female patients, aged 38 to 74 years, were identified as potentially exposed through the use of the probe and their own individual covers. It was agreed that all exposed women should be notified immediately. Testing of vaginal or cervical specimens for chlamydia and gonorrhea as well as blood tests for HIV, Hepatitis B, Hepatitis C and syphilis were recommended. Blood tests were to be repeated 6 months following the last exposure. All women were contacted and tested, free of charge, in the clinic. Infection Control staff were available for consultation and patient counseling. RESULTS: All microbiological and serological tests were negative, immediately and 6 months postexposure. Incident reports were filed with the device manufacturer, Health Canada, and ECRI (Emergency Care Research Institute). The manufacturer no longer markets the device. Patients and the therapists involved experienced concern and anxiety, which was alleviated with timely provision of information and support. CONCLUSIONS: 1. Prior to purchase or use, new, invasive, reusable devices must be assessed by personnel with expertise in reprocessing, infection control, and clinical engineering. 2. In the event of potential exposure of patients or clients to an infectious risk, a multidisciplinary team of experts should be assembled to identify and address the issues. 3. Caring, personalized notification and confidential testing of patients reduces the likelihood of a hostile or litigious response. Support and education of staff assists in alleviating guilt and/or anxiety.

DIFFERENCES IN SKIN FLORA BETWEEN INPATIENTS AND CHRONICALLY ILL OUTPATIENTS. Larson EL, Cronquist AB, Whittier S, Lai L, Lyle CT, Della Latta P. Columbia Univ School of Nursing, New York, NY; Columbia Univ School of Public Health, New York, NY; Columbia Univ Med Ctr, New York, NY; 3M Health Care, St. Paul, MN.

BACKGROUND: Changes in skin flora have been reported among hospitalized and critically ill patients, but little is known about whether these changes are associated with hospitalization or with chronic, serious illness. The purpose of this survey was to compare skin flora of chronically ill outpatients and inpatients. METHODS: Aerobic skin flora of forearm and mid-sternum of 250 ICU patients and 251 outpatients was sampled by contact plates. RESULTS: Mean CFU were: 160.6, forearm; 229.4, sternum ($p<.000$). Significantly more likely to have high counts were non-diabetics compared with diabetics on arm ($p=.04$) and blacks compared with other ethnic groups on sternum ($p=.006$). On the forearm, inpatients had higher counts than outpatients ($p=.01$), and patients in medical ICU had higher counts than patients in other ICUs ($p=.01$). There were no differences between inpatients or outpatients in prevalence of methicillin-sensitive S. aureus, but inpatients were more likely to carry MRSA (arm: $p=.007$; sternum: $p=.02$). Outpatients had a higher prevalence of micrococci and gram-negative bacteria at both skin sites (all $p<.01$) and of yeast at the sternal site ($p=.007$). CONCLUSIONS: Hospitalized patients and outpatients with similar chronic diseases have significant differences in their skin flora.

INFECTION PREVENTION AND CONTROL PRACTICES FOR PERSONAL SERVICES: TATTOOING, EAR/BODY PIERCING, AND ELECTROLYSIS. Onno S, Paton S, Braithwaite J, Fast M, Robinson D, Honish A, Dupont M, Fenton T, Karolyn Jeffries, Meharg E, Peak G. Lab Centre for Disease Control, Ottawa Canada; Toronto Dept of Public Health, Toronto, ON, Canada; Margaret Fast, City of Winnipeg Community Services, Winnipeg, MB; CEO Ambient Inc, Vankleek Hill, ON, Canada; Infection Control Consultant, Edmonton, AB, Canada; Regie regionale de la Sante et des Services sociaux de Montreal-Centre, Montreal, PQ, Canada; Chrysalis Professional Electrolysis, Edmonton, AB, Canada; Smiling Buddha Tattoo, Calgary, AB; Maharg Intl School of Electrolysis, Scarborough, ON; Canadian Assn of Professional Tattooists, Victoria, BC.

INTRODUCTION: Thousands of young people and others risk exposure to bloodborne pathogens when they undergo body-piercing activities such as tattooing, body/ear piercing, and electrolysis. As part of a broader strategy to reduce the transmission of hepatitis B, C and HIV, the Lab Centre for Disease Control (LCDC), Health Canada is pleased to release a new guideline on Infection Prevention and Control Practices for Personal Services: Tattooing, Ear/body Piercing, and Electrolysis. Written for practitioners of tattooing, ear/body piercing, and electrolysis, these guidelines are essential reading for those who strive to protect clients and practitioners. METHODOLOGY: These "skin piercing" guidelines were developed as part of LCDC's ongoing series of Infection Prevention and Control Guidelines. An expert working group representing tattooers, body piercers, electrologists, infection control practitioners, environmental and public health professionals discussed, debated and finally developed consensus on a wide range of evidence-based recommendations that affect "skin piercers" practice. RECOMMENDATIONS: An in-depth review of the literature was undertaken to assess the risk posed by body piercing practices. This review lead to specific practice recommendations. Strong emphasis was placed on effective handwashing and Infection Control Practices before providing service to each client. Wearing healthcare quality gloves were recommended for all practitioners in all settings. Detailed directions on cleaning, disinfecting and sterilizing for practitioners' equipment including recommendations on one-time needle use and on chemical, steam and dry heat sterilization. CONCLUSIONS: Copies of this English and French guideline can be purchased by calling 1-888-855-2555 or by downloading from LCDC's Web site (www.hc-sc.gc.ca/hpb/lcdc).

Antimicrobial Controls

SUSCEPTIBILITY OF ACINETOBACTER INFECTION IN THE NICU-2 YEARS AFTER CHANGE TO THE HOSPITAL FORMULARY. Ang BSP, Soon M, Tee N, Chen SL. Tan Tock Seng Hosp, Singapore.

Acinetobacter is an important cause of hospital-acquired infections in Tan Tock Seng Hosp where it is one of the top 2 causes of nosocomial infection in the intensive care units. In 1996, a major outbreak of Acinetobacter resistant to all antibiotics except Polymixin B started in the Neurosurgical Intensive Care Unit (NICU) and led eventually to its closure for 2 weeks. In May 1997, amoxycillin-clavulanate was added to the hospital formulary and usage of ampicillin/sulbactam (AmS) was discouraged except in cases of known or suspected Acinetobacter infection. The resulting decrease in usage of AmS was accompanied by an increase in the percentage of Acinetobacter isolates sensitive to it. In the NICU specifically, the percentage of Acinetobacter infections susceptible to AmS increased from 41.2% in the second quarter of 1997 to 62.5% for the fourth quarter of 1997, and 88.9% for the fourth quarter of 1998. This increase in percentage of sensitive isolates appears to be sustained up to May 1999, 2 years after revision of hospital formulary. This, coupled with regular rounds by an Infectious Disease physician and stricter adherence to infection control policies, has succeeded in improving the situation in NICU and there have been no new outbreaks of such an extremely resistant Acinetobacter strain.

EDUCATION AND POLICY CHANGE CAN INFLUENCE ANTIBIOTIC USE. Cherry CL,* Ware GJ, Kainer MA, Spelman DW. The Alfred Hosp, Melbourne, Australia; Monash Univ, Melbourne, Australia.

AIM: To improve the utilization of broad-spectrum intravenous (IV) antibiotics. SETTING: Tertiary, university affiliated teaching hospital. METHODS: Data were collected on overall hospital use of broad-spectrum IV antibiotics for six months following the intervention. This was compared with hospital-wide use of the same drugs for the preceding 21 months using incidence density ratios (total daily defined doses [ddd] divided by total patient bed days). INTERVENTION: An Antibiotic Action Group was formed in 1998. The Antibiotic Policy of the hospital was rewritten following consultation with all medical and surgical units. A multifaceted education campaign was undertaken, including education of medical staff and pharmacists on the new Antibiotic Policy and how to obtain permission to use a restricted antibiotic. The new policy was implemented in Feb 1999. RESULTS: There was a 19% (95% CI=18%-20%) reduction in overall use of broad spectrum IV antibiotics from 291 ddd per 1000 patient bed days before the intervention, to 236 ddd per 1000 patient bed days following the intervention [23% (95% CI=21%-24%) reduction from 306 to 236 ddd per 1000 patient bed days seasonally adjusted]. This was highly significant ($p<.001$). CONCLUSION: A large reduction in use of broad-spectrum IV antibiotics was observed following an education campaign and policy change. This reduction was sustained over the study period (six months following the policy change). All interventions were inexpensive and could be adapted for use in most healthcare institutions.

SUCCESSFUL REDUCTION OF VANCOMYCIN USAGE IN A MRSA ENDEMIC HOSPITAL WITH NO ADVERSE EFFECTS ON MRSA BACTEREMIA MORTALITY. Ching P, Seto WH. Queen Mary Hosp, Pokfulam Road, Hong Kong, China.

Effective reduction of glycopeptides prescriptions using the Centers for Disease Control (CDC) guidelines for appropriate use of vancomycin in hospitals have been reported mainly in hospitals where MRSA is not endemic. When MRSA is endemic, the pressure for empirical treatment will be enhanced and intervention can be ineffective. This is evaluated in Queen Mary Hosp, 1,400-bed teaching hospital in which 58% of Staphylococcus aureus are MRSA. An 8 week hospital-wide audit revealed that 151/182 (83%) of prescriptions did not conform with CDC guidelines and of these 99 (54.1%) was for empirical therapy. The audit was followed by education (ward rounds, bulletins) directed at relevant clinical staff about the appropriate prescribing of vancomycin and teicoplanin. Thereafter, a programme of immediate feedback directed at prescribing of these two drugs for inpatients was gradually introduced throughout the hospital. This entailed review of respective patient records of all those prescribed either drug on the previous day. Whenever prescribing was deemed not conforming to CDC guidelines, the corresponding doctor was immediately issued a memo (with a copy to the supervising Med Officer): I) detailing the incident, ii) describing appropriate usage based on CDC guidelines, and iii) giving explicit advice to desist from such prescribing and if necessary prescribe alternative therapy. Where feedback was instituted, the extent of prescribing which did not conform to CDC guidelines over the ensuing 19 months dropped to 254/883 (29%) and of these 130 (14.7%) were for empirical therapy. Throughout this period there was not a single complain that the feedback aversely affected the treatment of MRSA infections. Furthermore the mortality of 50% (30/60) for MRSA bacteremia in 1998 does not differ ($p=.53$) from the 49% (21/22) of 1996 before the intervention. It is possible therefore to effectively reduce vancomycin usage even in a MRSA endemic area.

A RANDOMIZED CONTROLLED TRIAL OF A COMPREHENSIVE ANTIMICROBIAL MANAGEMENT PROGRAM. Gross R, Kinky DE, Weiner M, Morgan AS, Gibson GA, Fishman NO. Univ of Pennsylvania Med Center, Philadelphia, PA; Hosp of the Univ of Pennsylvania, Philadelphia, PA; Philadelphia College of Pharmacy, Univ of the Sciences, Philadelphia, PA.

Antimicrobial Management Programs (AMPs) are being implemented to improve the use of antimicrobial agents, curb the rising costs of healthcare, and limit the emergence of resistant pathogens. However, the ability to accomplish these goals has never been demonstrated conclusively, and physicians frequently view control mechanisms as punitive and unnecessary. We conducted a randomized controlled trial to evaluate the clinical and economic outcomes of a comprehensive AMP compared to usual practice (UP) at our institution. Antimicrobial therapy was more appropriate as determined by health system guidelines [90% vs 32%, RR(95%CI)=2.8 (2.1,3.8)], there was an increased cure rate [91% vs 55%, 1.7(1.3-2.1)], and a decreased failure rate [5% vs 31%, 0.2(0.1-0.4)] for the AMP compared to UP. Additionally, there was a trend toward decreased emergence of resistant organisms [1%

vs 9%, 0.13(0.02-1.0)]. The most frequent reasons for recommendations being classified as inappropriate in the UP group were use of agents with overly broad spectra of activity (35%) and lack of evidence of infection (39%). We constructed 3 models to assess economic outcomes of the AMP—drug costs alone, a limited model (antibiotic costs, administration costs, monitoring costs, microbiology costs, and cost of an ID consult), and total cost of hospitalization from the time of the intervention. The median cost per recommendation was $50, $74, and $594 lower for each of the three models respectively for the AMP compared to UP. Using a probability pathway model, projected total annual savings are $360,000, $533,000, and $4.3 million for each of the three models respectively based upon the current rate of 600 interventions per month. A comprehensive AMP can improve both clinical and institutional outcomes. Further studies are needed to assess the impact of these programs on emergence of resistance.

DEVELOPEMENT OF AN ANTIMICROBIAL MONITORING PROGRAM TO OPTIMIZE PRESCRIBING. Lee CE, Zembower TR, LaRosa MP, Noskin GA, Peterson LR. Northwestern Memorial Hosp, CDC Prevention Epicenter, Chicago, IL.; Northwestern Memorial Hosp, CDC Prevention Epicenter, Northwestern Univ, Chicago, IL.; Northwestern Healthcare Network, Stragic Performance Improvement.

In order to address the problem of emerging resistance to antimicrobial agents (AAs), many institutions have developed guidelines for their use. However, obtaining adherence to these guidelines is a difficult task. When we assessed adherence to guidelines in two different areas at our institution, we discovered a 55% compliance rate. Pharmacists contacting physicians via phone when AAs were not by guidelines was less than 40% effective. Therefore, we devised an antimicrobial management team, pairing pharmacists and physicians knowledgeable in the treatment of infectious diseases, to review a computer generated list of non-guideline prescribing with subsequent real time chart review for therapeutic assessment. The team would be aided by a customized Data Collection Tool to encompass data from pharmacy, microbiology and inpatient records. We initially piloted this approach over a two-week period and found 141 patients whose AAs were outside of guidelines. Of these, 82 (58%) were candidates for intervention based on lack of evidence supporting the need for AA therapy (46%) or because there was no identifiable reason as to why the patient could not receive a guideline AA (17%). From the 82 documented interventions, 48 (59%) would result in a lower treatment cost. In this feasibility pilot, the projected cost savings of the program, if 90% of the recommendations were accepted, would be approximately $120,000/yr. This would cover the personnel expense to implement the program. This direct person to person approach to monitoring and promoting appropriate AA use can be medically and economically feasible in the fight against emerging microbial resistance.

OVERALL ANTIMICROBIAL USE AND CONTROL STRATEGIES IN INTENSIVE CARE UNITS FROM 6 EUROPEAN COUNTRIES. Monnet DL, Suetens C, Jepsen OB, Burman LG, Carsauw H, Gastmeier P, Jurkuvenas V, Sainz A, ESAP Project Team. National Centre for Hosp Hygiene, Statens Serum Inst., Copenhagen, Denmark; ESAP Project Team; ESAP Project Management Group.

BACKGROUND: The ESAP project was implemented in Sep, 1996 in Belgium, Denmark, Germany, Lithuania, Spain and Sweden. As part of this project, we examined the relationship between overall, i.e. prophylactic, empiric and documented, antimicrobial use in intensive care unit (ICU) patients, and ICUs' practices and control strategies. METHODS: ICUs were asked to collect patient and antimicrobial use data on consecutive patients staying at least 24 hours in the ICU. The overall antimicrobial use rate was calculated as the total number of daily administrations (DA) per 1,000 patient-days. At the end of this period, ICU chief physicians or their delegate were asked, with the help of Project Team members, to fill a questionnaire on guidelines, policies, surveillance, education and control activities in the ICU. RESULTS: Between Oct, 1998 and Feb, 1999, 21 ICUs collected data on 30 to 71 patients. The overall antimicrobial use rate varied from 355 to 1,686 DA/1,000 patient-days, depending on the ICU. An antimicrobial use rate below the median was associated with 1) having a list of antimicrobials for which use is restricted (univariate analysis, Fisher Exact test, p=.002), 2) requiring approval from a senior physician or a microbiologist for delivery of restricted antimicrobials (p=.002), 3) having an antibiotic committee or a pharmacy committee active on antibiotic issues (p=.02), 4) having an ICU-specific policy requiring mention of antimicrobial information in patient chart (p=.05), 5) having a local guideline for surgical antibiotic prophylaxis (p=.05), 6) having an ICU-based surveillance of nosocomial infections (p=.05). CONCLUSION: Among a variety of practices and strategies, these preliminary results suggest directions to ICUs trying to control their level of antimicrobial use.

POPULATION-SPECIFIC ANTIBIOGRAMS TO EVALUATE DIFFERENCES IN THE PREVALENCE OF ANTIMICROBIAL RESISTANCE IN THE SAN FRANCISCO COMMUNITY HEALTH NETWORK. Steele L,* Rose D, Charlebois ED, Bangsberg DR, Chambers HF, Gerberding JL. Centers for Disease Control and Prevention, Atlanta, GA; Univ of California at San Francisco and San Francisco General Hosp, San Francisco, CA.

Hosp antibiograms (based on aggregate susceptibility data for patient clinical isolates) are often used to guide empiric antimicrobial treatment decisions. However, as patient care is conducted throughout the healthcare delivery system, it may be more relevant to base decisions on population-specific susceptibility data. This study was conducted to measure population-specific susceptibility among patients in an integrated delivery system. METHODS: San Francisco General Hosp (SFGH) has an integrated database that includes administrative, clinical, pharmacy, and microbiological data from hospital, chronic care facility, mental rehabilitation facility, ambulatory, and home health patients. Patient characteristics in administrative and clinical databases were used to define 10 populations, and antimicrobial resistance for unique clinical isolates was evaluated for 1996-97. RESULTS: Antimicrobial resistance varied markedly among the target population groups (see TABLE). CONCLUSIONS: Population-specific antibiograms may promote better empiric antimicrobial treatment and aid therapeutic decisions for populations at high risk for drug-resistant infections. Population-specific antibiograms can be further refined by stratifying into community-acquired versus healthcare-acquired isolates. The value of using population-specific antibiograms in addition to (or in lieu of) facility-specific antibiograms merits evaluation as a strategy to reduce unnecessary antimicrobial exposure and prevent drug resistance throughout the integrated delivery system.

THE MICROFRIBRE CLEANING SYSTEM: A STUDY BASED ON MICROBIAL CONTROL IN A HOSPITAL FOR ACUTE CARE. Tessarin M, Rigoli R, Scotton G, Dametto M, Ramon R, Pietrobon F, Bertic C, Morciano S, Niero M. Treviso Hosp, Treviso, Italy.

The purpose of this study is to compare the efficacy of conventional cleaning system with a low-chemical cleaning method in a big hospital for acute cases with 1,100 beds.

Steele et al.		% Resistant (# of clinical isolates from non-urine sources)						
Patient Population	N	Penicillin - *S. pneumococcus*	Methicillin - *S. aureus*	Vancomycin - *E. faecium*	Ceftazidime - *Pseudomonas*	Erythromycin - Group A *Streptococcus*	Trimethoprim-Sulfa - *E. coli*	Fluoroquinolone - *E. coli*
HIV/AIDS	4,397	32	18	48	4	0	79	7
		(321)	(608)	(29)	(133)	(7)	(124)	(124)
Trauma	5,308	32	31	79	24	47	35	2
		(131)	(817)	(42)	(218)	(20)	(197)	(197)
COPD	312	0	30	50	12	—	74	32
		(19)	(33)	(6)	(16)	(1)	(19)	(19)
Diabetic	5,142	33	28	77	22	—	37	6
		(58)	(452)	(44)	(83)	(4)	(108)	(108)
Dialysis	193	—	23	79	25	—	34	17
		(0)	(310)	(14)	(46)	(0)	(29)	(29)
Homeless	5,688	19	25	75	0	0	50	3
		(127)	(416)	(16)	(70)	(20)	(66)	(66)
Alcoholic	10,960	21	25	72	6	0	40	3
		(310)	(695)	(57)	(112)	(26)	(174)	(174)
Injection Drug User	5,101	23	28	70	29	18	56	6
		(263)	(700)	(33)	(109)	(29)	(115)	(115)
Pediatric	3,752	45	2	33	0	0	21	0
		(95)	(500)	(21)	(69)	(8)	(107)	(107)

The main principles of this study are based on criteria of efficacy, ergonomy, economy and ecology. The objective was to determinate the level of cleaning quality by evaluating bacterial level, patient and staff concerns for each method after cleaning. Conventional cleaning methods employ detergents such as ammonium and disinfectants based on dichloroisocyanides. This low-chemical cleaning method employs wet cloths that are based on dirt being sucked up through capillary action and natural chemicals are used as needed. This study was in progress for two months (Sep and Oct 1999) and involved two departments of internal medicine and another one of nephrology: these wards have similar features for the kind of patients, rooms and toilets. 330 samples for bacterial culture were taken in two months. Measurements of the total number of bacteria were made of floor surfaces, as well as on surfaces such as tables in the surgeries, ward rooms or toilets, dining tables and kitchen counters in the staff rooms. Every sample was diluted in Ph solution, spread into standard agar. Preliminary results show there are not significant differences in bacterial level after cleaning for each method. The staff concerns in one occasion were not satisfactory. Certainly, this method guarantees more economy, ergonomy and ecology than conventionals.

RATIONALIZING USE OF ANTIBIOTICS: IMPROVING USE AND REDUCING HEALTHCARE COSTS. Trabasso P.* Campinas State Univ, Campinas, Brazil.

OBJECTIVE: To assess the impact of a Program adopted to optimize antimicrobial use. METHODS: descriptive study of Rationalization Use of Antibiotics Program performed in a public, teaching, acute, 3rd care hosp with 403 beds. Restricted drugs are Ampicillin/Sulbactam, Cephalosporins, Imipenem (IPM), Meropenem (MEM), Vancomycin (VAN) and Clindamycin (CLI). Major problems were: (1) widespread use of 3rd generation Cephalosporins (3CEF), MEM, IPM and VAN; (2) use of surgical prophylaxis-drug longer than necessary; (3) use of VAN in surgical prophylaxis; (4) a increase in prevalence of MDR Enterobacter cloacae (MREC) from 0.5% in 1997 to 1.8% in 1998 (p=.000) and MDR E. aerogenes (MREA) from 0.1% to 0.7% respectively (p=.038). Interventions: We distributed treatment protocols to medical staff to face widespread use of antibiotics and linked the solicitation for surgical prophylaxis-drug to the computerized surgical procedure form (SPF) to solve the prescribing it longer than necessary. Letters were sent to surgeons, updating them about antibiotic prophylaxis regimens. RESULTS: there were statistically significant decreases in daily means of patients using antibiotics (pts/d) comparing periods pre-and post-intervention: Cefazolin (CFZ), from 65.7 pts/d to 55.9 pts/d; Ceftriaxone, from 27.2 to 13.2 pts/d and Ceftazidime, from 14.0 to 4.1 pts/d. There were reductions in use of VAN and IPM, without statistically significant difference. Linkage of solicitation of antibiotic for surgical prophylaxis in the computerized SPF reduced the use of CFZ from 5,781 to 4,592 vials/month, as well the use of VAN. Reduction in 3CEF and Carbapenems use could had contributed to the decrease in prevalence of MREA (from 0.7% in 1998 to 0.3 in 1999, p=0,000), MREC (from 1.8% in 1998 to 0.2% in 1999, p=.000) and MDR Pseudomonas aeruginosa (from 2.8% in 1998 to 1.4% in 1999, p=.000). The procedures reduced the spent with antibiotics from US$80,851 to US$64,641/month, or US$192,000 in savings per year, an amount that can be used to improve quality of assistance in other areas of the hospital.

Antimicrobial Prophylaxis of Nosocomial and Healthcare-Associated Infections

MRSA DECOLONIZATION PROTOCOL AND VANCOMYCIN USAGE. Beneda HW, Finney MS. Vencor Hosp-Orange County, Westminster, CA.

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OBJECTIVE: To determine the effects of a decolonization protocol in patients with known MRSA colonization on subsequent infection rates and Vancomycin use. DESIGN: Prospective study with concurrent case controls. Patients: Twenty-nine (29) patients with known MRSA colonization or upon completion of a course of Vancomycin from Jan-Oct 1999. Twenty (20) patients with known colonization or serious infection with MRSA with usual care served as concurrent case controls. INTERVENTIONS: MRSA and VRE cultures (nares, rectum and sputum) of all patients were obtained at baseline and monthly for 2 months. Study group patients were started on TMP/SMX and Rifampin for a period of 7 days along with Mupiricin to nares and any tube site (trach, G-tube). Routine care included chlorhexadine mouth care twice daily and bathing with triclosan bath soap. These measures were repeated for 5 days on a monthly basis without antibiotic accompaniment. Cultures were obtained at the end of each month from the same sites. RESULTS AND CONCLUSIONS: (1) There was a 45% (40/87 sites)decrease in the incidence of positive cultures for MRSA in the study group at the end of decolonization. (2) The control group demonstrated major nosocomial infections with MRSA. (3) Vancomycin use was reduced from a baseline of 46.1% Vancomycin-patient days in the control group to 10.1% in the study group. This represented a reduction from 2.3 Vancomycin courses per patient to 1.2 courses in the study group. (4) The decolonization state was durable for the entire study period for the study group. (5) A 66% success rate for decolonization was demonstrated. (6) The incidence of serious infections, VRE colonization or other resistant organisms did not increase as a result of the protocol.

Group	Ventilator-Associated Pneumonia	Bacteremia	VRE colonization
Study Group	0	0	2
Control Group	8	2	4

IMPACT OF A LEGAL REIMBURSEMENT SYSTEM FOR PERIOPERATIVE ANTIMICROBIAL PROPHYLAXIS. Carsauw H, Suetens C, Lauwers S, Glupczynski Y, Monnet DL, Jepsen OB. Scientific Institute of Public Health, Brussels, Belgium; Free Univ of Brussels, Belgium; Clin Univ UCL - Mont Godinne, Belgium; Natl Centre for Hosp Hygiene, Statens Serum Institute, Copenhagen, Denmark.

OBJECTIVE: To evaluate the impact of a legal reimbursement system for perioperative antimicrobial prophylaxis (AP), providing a fixed budget according to the type of surgical procedure and varying from 0 to 48 US$, on AP patterns in Belgium. METHODS: We compared AP patterns (indication, duration and molecule choice) before and after introduction of the reimbursement system (May 1997). "Before data" were provided by the national surgical site infection (SSI) surveillance system (1992-96, N=2724), "after data" by the European Strategy for Antibiotic Prophylaxis (ESAP) study (Oct 1998-Apr 1999, N=1090). Only hospitals that participated in both studies (N=14) and surgical procedure types included in both studies (abdominal, cardiovascular and orthopaedic interventions) were considered. RESULTS: For procedures for which AP is recommended, AP was used more frequently in the ESAP than in the SSI study (95.3% vs 92.5%, p<.01). Prolonged administration of AP (>2 days) and use of more than one molecule per procedure were significantly more frequent in the SSI than in the ESAP study (respectively 19.8% vs 9.9%, p<.001 and 16.3% vs 5.5%, p<.001). Cefazolin was the single most frequently used drug (66.5%) in the ESAP study, and only five different molecules (1st + 2nd generation cephalosporins and metronidazole) accounted for 95.3% of AP. In the SSI study, these molecules accounted for only 81.8% of AP. CONCLUSION: Institution of a legal reimbursement system for perioperative antimicrobial prophylaxis seems to have contributed to a more rational use of antimicrobial prophylaxis in Belgium, especially regarding duration and molecule choice.

THE EFFICACY OF A TAUROLIDINE-CONTAINING INTRAVASCULAR CATHETER LOCK SOLUTION. Mermel LA, Parenteau S. Brown Univ. School of Medicine, Rhode Island Hosp, Providence, RI.

Taurolidine is a unique antimicrobial compound metabolized to taurinamide, taurine and water. Bloodstream isolates of S. aureus, S. hominis, E. faecalis, E. agglomerans, P. aeruginosa, and C. albicans were grown overnight to concentrations of 50-600 CFU/ml and inoculated into Dialock® hemodialysis access ports. Catheters were then attached and infused, in duplicate, with preservative-containing heparin flush solution (5000U/ml) or Biolink Catheter Lock Solution (CLST) containing taurolidine (13.5 mg/ml). After incubation (72 hours, 37°C), samples were taken from inside the access port, intraluminal fluid from the connected catheter, and sonicated catheter segments. CLST was highly protective (see table) for the access port (OR of contamination=0.01, 95% CI 0 0.20), sonicated catheter segments (OR of contamination=0, 95% CI 0 0.06), and intraluminal fluid (OR of contamination=0, 95% CI 0 0.09). CLST holds promise as a strategy to prevent intravascular catheter-related infections.

Access Port

Organism (CFU/ml Inoculum)	Growth w/ Heparin Flush Solution (CFU/ml)		Growth w/ CLS (CFU/ml)	
S. aureus (160)	12,000	5,000	0	0
E. faecalis (350)	32,000	20,000	0	0
C. albicans (500)	30,000	8,800	0	0
S. hominis (600)	4,400	40,000	0	0
E. agglomerans (100)	600	0	0	0
P. aeruginosa (50)	400,000	1,200,000	0	100

Sonicated Catheter Segment

Organism (CFU/ml Inoculum)	Growth w/ Heparin Flush Solution (CFU/ml)		Growth w/ CLS (CFU/ml)	
S. aureus (160)	10,000	25,000	0	0
E. faecalis (350)	50,000	100,000	0	0
C. albicans (500)	1,000	1,500	0	0
S. hominis (600)	20,000	40,000	0	0
E. agglomerans (100)	2000	1000	0	0
P. aeruginosa (50)	200,000	500,000	0	0

Intraluminal Catheter Fluid

Organism (CFU/ml Inoculum)	Growth w/ Heparin Flush Solution (CFU/ml)		Growth w/ CLS (CFU/ml)	
S. aureus (160)	100,000	50,000	0	0
E. faecalis (350)	20,000	30,000	0	0
C. albicans (500)	25,000	20,000	0	0
S. hominis (600)	Dried	100,000	0	0
E. agglomerans (100)	30,000	Dried	Dried	Dried
P. aeruginosa (50)	5,000,000	3,500,000	0	0

APPROPRIATE TIMING OF ANTIMICROBIAL PROPHYLAXIS IN SURGERY IS DIFFICULT WITH VANCOMYCIN. Michels MA, Firary SA, Agger WA, Glasser JE, Hafeman DS. Gundersen Lutheran Med Ctr, La Crosse, WI.

Effective antibiotic prophylaxis requires adequate antibiotic serum and tissue concentrations prior to surgical incision and throughout the procedure. Several studies suggest that infusion just prior to incision time may have better outcomes. Two hours is usually considered the maximum amount of time acceptable between the administration of prophylactic antibiotics and the initiation of surgery but for some antibiotics 30 minutes may be optimal. The optimal time period varies with the drug half life, pharmacodynamics, duration of surgery, and the rate of IV infusion. The purpose of this project was to improve the timing of prophylactic antibiotics with surgery while restricting the use of vancomycin. The anesthesia records of patients following specific surgical procedures were reviewed to determine the antibiotic administered, incision time, antibiotic start time and finish time. Although education is essential for change, it did not result in improved practice. Changing to an antibiotic with a rapid infusion rate is essential but does not improve timing alone. Starting the antibiotic prior to transport contributed to poor documentation, incomplete infusion, and double dosing. Sending the first dose of cephalosporin to surgery with the patient improved the rates initially but the effect was not sustained until a visual cue for consistent documentation of start time and stop time was implemented. Antibiotics were started within two hours prior to incision at least 90% of the time since implementing these changes two years ago. The dose is completely infused prior to incision 89.1% (2905/3260) of the time for cefazolin and 51.5% (53/103) for vancomycin. The desired infusion rate for vancomycin (45-75 minutes) was met only 32.3% (34/105) of the time. Patients receiving vancomycin risk a rapid infusion or tend not to have the dose completely infused prior to incision. Surgeons resistant to the standard use of cephalosporins for surgical prophylaxis need to be informed that appropriate timing is difficult with vancomycin. Since 1997, vancomycin was used for prophylaxis in surgery only 1.9% (281/14770) of the time at our institution.

WOUNDCARE AND INFECTION CONTROL BEYOND 2000. Mitchell DC. Maersk Med Limited, Redditch, Worcestershire, England.

It is well documented that microorganisms are winning the infection war. The era of guaranteed antibiotic effectiveness is over and those antibiotics that remain effective must be reserved for cases of greatest need. Totally new strains of antibiotics are not expected before 2005-2010. Woundcare must therefore take advantage of alternative technologies to offer the best patient care programmes. Arglaes, a new woundcare technology, offers effective bacterial control without resistance build-up, tissue reaction or other adverse side effects. Arglaes combines best technology and medical practice to offer effective and reliable woundcare with infection control of resistant strains into the millennium.

COMPARISON OF VANCOMYCIN AND CEFUROXIME FOR PERIOPERATIVE PROPHYLAXIS IN OPEN HEART SURGERY. Moehlemann K,* Wengi S, Althaus U, Täuber MG. Institute of Med Microbiology, Univ of Berne, Berne, Switzerland; Univ Hosp, Univ of Berne, Berne Switzerland.

Perioperative prophylaxis with cefuroxime has been the standard during open heart surgery at the Univ. hospital. Due to a cluster of sternal wound infections and endocarditis with methicillin-resistant staphylococci vancomycin prophylaxis was used since 1993 for heart valve surgery while cefuroxime prophylaxis was maintained for other types of open heart surgery. We evaluated retrospectively whether vancomycin prophylaxis decreased infections with methicillin-resistant staphylococci as compared to cefuroxime. 179 patients receiving vancomycin for heart valve surgery and 229 patients with cefuroxime prophylaxis for coronary artery bypass surgery were selected randomly from patients hospitalised for open heart surgery between 1.1.1995 and 31.12.1997. Data were abstracted from patients' charts. CDC definitions were used for nosocomial infections. The two patients' groups were comparable for age and chronic underlying illnesses and multiple vari-

ables regarding surgery. The overall percentage of nosocomial infections was higher in the vancomycin group (23%) as compared to the cefuroxime group (14%; p=0.02). Sternal wound infections occurred in 7 (3.9%) patients with vancomycin and in 11 (4.8%) patients with cefuroxime (p=0.84); methicillin-resistant coagulase-negative staphylococci were isolated from 3 (27%) patients with sternal wound infections who received cefuroxime and from in the vancomycin group. The percentage of infections due to gram-negative pathogens was higher in the vancomycin group (66.6%) than in the cefuroxime group (34.3%, p=0.01). Women receiving vancomycin prophylaxis had a higher risk of postoperative urinary tract infections (UTI) (17/58, 29.3%) compared to women with cefuroxime prophylaxis (2/45, 4.4%; odds ratio 5.61, 95% CI 1.16-27.02, p=0.03; adjusted for urinary catheter days). Therefore, sternal wound infections due to methicillin-resistant staphylococci tended to be less frequent after vancomycin prophylaxis, while certain nosocomial infections due to gram-negative pathogens were more frequent.

EVIDENCE-BASED ANTIMICROBIAL PROPHYLAXIS IN SURGICAL PROCEDURES. Pereira,* CR, Beer, I, Vallone, CV, Kawagoe, JY, Cardoso, MFS, Souza, RCP. Hosp Albert Einstein, Sao Paulo, Brasil; Hosp das Clínicas da USP.

BACKGROUND: Antimicrobial Prophylaxis (AP) can decrease the incidence of infection, particularly surgical site infections. Professional societies generally recommend AP only for procedures with high infection rates, those involving implantation of prosthetic material and when consequences of infection are especially serious. The present study was conducted to evaluate AP against the Standard proposed by the IDSA in 1994. METHODS: All surgical procedures for inpatients performed in our hospital during Feb 1999 were included using the NNIS surgical procedures definitions to identify the denominators. For each procedure the expected use was checked against the IDSA categories reflecting the strength of each recommendation for or against its use (A, B, C, D, E) and those reflecting the quality of evidence on which recommendations are based (I, II, III). RESULTS: 537 surgical procedures were included and the proportions of conformity in relation to recommended use for each category of evidence were, 94.2%, 87.5%, 54.2% and 72.7% for AI, BI, BIII and CIII categories, respectively. Overall, 58% of the use was evidence-based (AI-BI). Timing of antimicrobial start was classified as appropriate in 58.4% (246/421) of the patients who received a drug and in only 48.0% of those submitted to procedures classified as category AI. First and 2nd gen. Cephalosporins accounted for 80% of the drugs used but only 42% of patients received either cephazolin (38.0%) or cefoxitin (4.4%) for clean and clean-contaminated procedures. Of the 271 medical files fully reviewed, in 47% of the 212 who received a drug the prophylaxis lasted 24 hours or less (BII). COMMENT: According to this scenario we found many opportunities for improvement and are implementing the Plan -Do- Check and Act cycle as a working tool especially an administrative intervention to transfer all use to the surgical suite just before anesthesia induction.

Antimicrobial Utilization

MONITORING OF PROPHYLACTIC ANTIBIOTIC USAGE PATTERNS AMONG NEUROSURGICAL PATIENTS: CONTINUOUS QUALITY IMPROVEMENT. Admas A, Francis C, Huvane B, Mullaney K, Currie P. Montefiore Med Ctr, Bronx, NY.

Monitoring of prophylactic antibiotic use was incorporated into the surgical surveillance program at our 650-bed teaching hospital in 1995, and included neurosurgery (NS), cardiothoracic, vascular, and orthopedic surgical services. Surveillance of NS is performed on alternate years due to their historically low surgical site infection (SSI) rates. During 1997 and 1999, surveillance was conducted for four months on NS patterns of antibiotic prophylaxis (including selection of agent, timing, and duration), and was compared to institutional standards adopted from national guidelines. Comparison of 1997 and 1999 data demonstrated excellent compliance with selection of appropriate agents (95% and 90%) and with adequate timing of <2 hours prior to incision (100% and 94%). A trend towards optimal timing (defined as œ30 minutes prior to incision) was observed with 89% and 88% of patients treated <1 hour prior to incision. Following 1997 surveillance, the duration of post-operative prophylaxis was targeted for quality improvement initiatives. In 1997, all patients received post-operative doses; 87% of patients (136) received a range of 1-6 doses (70% 4-6 doses) of naf/cef/kef. Of the 29 patients receiving vancomycin, 25 (86%) received 1-3 post-operative doses and 4 (14%) received 4-6 doses. By contrast, 1999 data indicated that only 19% of patients prophylaxed with naf/cef/kef (23) received post-operative dosing. Furthermore, there was no post-operative dosing for 17 of 19 patients receiving vancomycin (89%) and 2 patients (11%) received only 1-3 doses. In conjunction with the dramatic improvement in post-operative dosing the SSI rate decreased from 2.7% in 1997 to 1.3% in 1999. Our experience demonstrates that prophylactic antibiotic monitoring and feedback to the surgeons can contribute to a continuous quality improvement program with an objective to improve compliance with recommended antibiotic prophylactic guidelines, resulting in decreased cost and usage of antibiotics.

FLUOROQUINOLONE EXPOSURE AND THE DEVELOPMENT OF NOSOCOMIAL MRSA BACTEREMIA. Graham KK,* Hufcut RM, Copeland CM, Stone JE, Lai LL, Villano JR, Droller DG. Nova Southeastern Univ/Broward General Med Center, Ft. Lauderdale, FL; Broward General Med Center, Ft. Lauderdale, FL; Nova Southeastern Univ, Ft. Lauderdale, FL; Nova Southeastern Univ/North Broward Hosp District, Ft. Lauderdale, FL.

OBJECTIVE: To evaluate prior antibiotic exposure and the development of nosocomial MRSA bacteremia in patients admitted to a 750-bed tertiary care hospital. METHODS: We evaluated all patients with nosocomial bacteremias from Jan 1, 1996-Jun 30, 1999. For each patient, we documented all antibiotics administered prior to the development of the bacteremia. We performed a case-controlled evaluation comparing fluoroquinolone (FQ)-exposed patients to non-FQ-exposed patients in relation to the development of MRSA bacteremia. A chi-squared analysis and relative risk (RR) were calculated. RESULTS: A total of 514 nosocomial bacteremias occurred over the study period with 78 (15%) MRSA. The % MRSA bacteremias/nosocomial bacteremias increased from 10% in 1996 to 22% in 1999 (p<0.05). MRSA as a percent of all S. aureus clinical isolates increased from 29% to 40%. Prior FQ exposure and MRSA bacteremia rose significantly from 25% in 1996 to 65% of cases in 1999 (40% FQ alone and 25% FQ and other antibiotics) (p<0.05). Cephalosporin © exposure alone and the development of MRSA bacteremia dropped significantly from 50% in 1996 to 0% of cases in 1999 (p<0.01). Overall, 52% of FQ-exposed patients developed MRSA bacteremia vs 8% methicillin-sensitive S. aureus (MSSA) bacteremia (p<0.05). In 1996 the RR of FQ exposure and the development of MRSA bacteremia was 2.27 (ns), whereas over 1997-99 the RR of FQ exposure was significant ranging from 3.25 to 4.68 (p <0.05). Fluoroquinolone usage increased hospital-wide over the study period. CONCLUSIONS: We noted a significant increase in nosocomial MRSA bacteremias in FQ-exposed patients and a significant decrease in patients with C exposure over the study period. FQ-exposed patients had a 3-4 times greater risk of developing nosocomial MRSA bacteremia than non-FQ-exposed patients. Our increasing FQ usage may have contributed to the increased selection and development of MRSA bacteremias. We are now implementing policies to limit FQ utilization to attempt to control the selection and development of nosocomial MRSA bacteremias in the future.

USE OF INTRAVENOUS ANTIMICROBIALS IN CHRONIC HEMODIALYSIS PATIENTS. Grohskopf LA, Tokars JI, Parrish J, Armistead N, Gehr T, Light P, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Mid-Atlantic Renal Coalition, Richmond, VA; Virginia Commonwealth Univ, Richmond, VA; Univ of Maryland, Baltimore, MD.

Antimicrobial use in chronic hemodialysis (HD) patients is believed to be frequent, increasing pressure for emergence of antimicrobial resistance in this population. However, few data describe antimicrobial use in this setting. We studied intravenous (IV) antimicrobial use in 18 HD centers in Virginia, West Virginia, Maryland, and Washington, DC, during February-April 1999. We recorded the number of patients treated, number of IV antimicrobial starts, whether a blood culture was done, and blood culture results and antimicrobial susceptibilities. Overall, 2,028 patients were observed (median 107.5, range 50-209 patients/center) for 5,682 patient-months. There were 326 antimicrobial starts, with an overall rate of 5.7 starts/100 patient-months. The rate of antimicrobial starts varied by center (mean 5.5, range 1.1-11.4 starts/100 patient-months). On average, starts included 1.4 (range 1-3) antimicrobials. The most frequently started antimicrobials were vancomycin (included in 58.6% of starts), gentamicin (included in 31.3% of starts), and cefazolin (included in 24.9% of starts). The most frequent reasons for antimicrobial start were non-access site infection (46.3% of starts), access site infection (39.8% of starts), and unknown (7.1% of starts). Only 115 (35.3%) of starts were accompanied by blood culture; 39.1% of cultures were positive. Among centers reporting at least 10 starts, median percent of starts for which a blood culture was done was 31.6% (range 12.0%-75.0%). These data suggest that use of blood cultures and IV antimicrobials vary greatly among HD centers. More widespread use of blood cultures to document infection and etiologic agents may allow more judicious use of antimicrobials such as vancomycin and help prevent development of antimicrobial-resistant organisms.

APPROPRIATENESS OF GLYCOPEPTIDE UTILIZATION IN UNITS FOR THE CRITICALLY ILL PATIENTS. Guimaraes, JM, Pereira, CR, Silva, CV, Kawagoe, JY, Cardoso,* MFS, Beer, I. Albert Einstein Hosp, Sao Paulo, Brasil.

BACKGROUND: Considering the pre-epidemic state of glycopeptide resistant enterococci among us, the present study was conducted to compare vancomycin and teicoplamin use at HIAE with the guidelines proposed by the CDC in 1995 for the prevention of vancomycin resistant enterococci. METHODS: All patients admitted from Nov 1998-Aug 1999 to the ICUs (adult, pediatric and neonatal) and to the oncology ward including BMT unit were assessed for glycopeptide use from Nov/1998 to Aug/1999. A form was completed prospectively by an infection control (IC) nurse for each patient who received at least one day of treatment. In sequence, an ID physician evaluated surveillance registries and patient records to classify appropriateness of a) initiation and b) ongoing use after 72. RESULTS: We followed up 272 (84%) of 323 courses of treatment. Initial appropriateness according to the CDC guideline was 66% (varying from 46% to 100% for the different units).Treatment without evidence of β-lactam-resistant gram-positive infection accounted for 66% (61/93) of inappropriate initial use. Continued use was classified as appropriate in 22% out of 234 patients who remained on use after 72 hours. Including empirical use for high index of suspicion of infection this figure would increase to 57%. In the univariable analysis, predictors of initial appropriate use were a) care in the oncology and BMT units (RR: 1.27 [95% CI: 1.08-1.49]) and b) hospital stay 7 days before treatment (1.33 [95% CI: 1.12-1.59]). COMMENT: An intervention has been proposed for the electronic identification, supervision and counseling by pharmacy IC control services mainly of the patients undergoing glycopeptide use for more than 72 hours besides continuing our current practice of screening strains of enterococci for vancomycin resistance.

INFLUENCING INPATIENT ANTIBIOTIC PRESCRIBING PATTERNS: COST-EFFECTIVENESS OF AN ANTIBIOTIC STREAMLINING TEAM. Herrington JD, Holmes GP,* Moore CW, Church CA, George KW, Polansky MA, Parker S, Avants C. Scott & White Memorial Hosp, Texas A&M Univ Health Science Center, Temple, TX.

Inappropriate inpatient antibiotic use is an ongoing problem in most hospitals, affecting quality of patient care, antibiotic susceptibility patterns, and costs. Antibiotics account for approximately one-third of the inpatient pharmacy medication budget each year in our institution. METHODS: An Antibiotic Streamlining Team (AST) was established in 1995 to improve the use of intravenous (IV) antibiotics in our hospital. This multidisciplinary group of four patient care pharmacists, a doctor of pharmacy, and an adult infectious disease (ID) physician meets five days per week to discuss patients receiving IV antibiotics, review culture/susceptibility data, and recommend antibiotic changes as appropriate. The pharmacists make direct recommendations to primary physicians for dosage corrections, adjustments for renal/hepatic insufficiency, and IV to oral conversions. More complicated cases are presented in detail to the ID physician, treatment options are discussed, and a pharmacist presents any recommended changes to primary physicians. In 1999, the AST reviewed its recommendations and outcomes over a four-month period using CliniTrend computer software (American Society of Health-System Pharmacists), along with major outcome measures including physicians' acceptance rates for pharmacist- and ID physician-initiated recommendations, and the overall institutional cost savings as assessed by the CliniTrend program. RESULTS: Of 1332 patients screened by the AST, 408 had pharmacist-initiated recommendations, of which 335 (82%) were accepted. Of 158 ID physician recommendations, 116 (73%) were accepted. Estimated cost savings resulting from the accepted changes for the four-month study period were $88,946. CONCLUSION: The AST is effective in making direct improvements in antibiotic use on a real-time basis. The estimated annual cost savings, over $250,000, are more than sufficient to pay for its cost, in addition to the unmeasured benefits on reduction of antibiotic resistance pressures and improved quality of care.

REDUCING INAPPROPRIATE EMPIRIC USE OF PIPERACILLIN/TAZOBACTAM: AN ONGOING EDUCATIONAL PROGRAM. Herrington JD, Holmes GP,* Polansky MA, Moore CW, Church CA, George KW, Parker S, Avants C. Scott & White Memorial Hosp, Texas A&M Univ Health Science Center, Temple, TX.

Piperacillin/tazobactam (P/T) is an injectable, broad-spectrum antibacterial combination product consisting of the semi-synthetic antibiotic piperacillin and the β-lactamase inhibitor, tazobactam sodium. In 1997, P/T was added to the formulary. A medication use evaluation (MUE) for appropriateness of P/T use was performed over a 103-day period in fall 1997. P/T use was felt to be inappropriate in 40% of cases. Although our antibiotic streamlining team (AST) already conducted daily reviews of antibiotic orders and recommended therapeutic changes, we initiated a targeted educational effort to reduce excessive use of P/T. METHODS: Patient care pharmacists (PCPs) and the AST developed and distributed pocket cards on the proper use of P/T, and printed the MUE results in the pharmacy/therapeutics newsletter. One-on-one education was provided to staff and resident physicians who prescribed P/T inappropriately. A second MUE performed over 30 days in fall 1999 reviewed all adult inpatient P/T orders and collected data on indications, dosage, duration, adverse events, and clinical outcomes. RESULTS: Of 53 patients who received P/T in the 1999 study period, 58% were female, median age was 65 years, and mean estimated creatinine clearance was 63 ml/min. Initial P/T dosing was correctly adjusted for renal function in 79% of the patients in 1999, compared to 55% in 1997. P/T use was appropriately indicated in 92% of the 1999 cases, vs 60% in 1997. In 1999 vs 1997 respectively, 3 (6%) vs 19 (23%) had community-acquired pneumonia (p =.008 uncorrected), 0 (0%) vs 10 (12%) had uncomplicated urinary tract infections (p =.007, Fisher's exact, 2-tailed), and 1 (2%) vs 4 (5%) had community-acquired skin and soft tissue infections (p=NS). CONCLUSIONS: Ongoing educational efforts targeted to specific prescribing physicians, as well as broader efforts through pocket cards and newsletter articles, are effective in reducing inappropriate use of a broad-spectrum antibiotic.

IMPACT OF NATIONAL BENCHMARKS ON QUALITY IMPROVEMENT AND VANCOMYCIN USE. Lawton RM, Fridkin SK, Hill H, Gaynes RP, Edwards J, McGowan JE Jr. Ctrs for Disease Control and Prevention, Atlanta, GA; Emory Univ, Atlanta, GA.

We previously reported that high rates of methicillin-resistant Staphylococcus aureus (MRSA) and certain intensive care unit (ICU) types were associated with high vancomycin use in ICUs. Based on that analysis, project ICARE (Intensive Care Antimicrobial Resistance Epidemiology) provided comparative data to participants between Phase 2 (Jan 1996-Dec 1997) and Phase 3 (Apr 1998-Jul 1999). To assess the extent that hospitals utilized comparative data and determine any resulting practice changes, we conducted a phone survey of all hospitals participating in both phases of ICARE in fall 1999. Rates of antimicrobial use were compared between Phase 2 and Phase 3 in each ICU. Twenty-one (21) hospitals representing 55 ICUs submitted data in both phases, and 20 (95%) completed the survey. Infection control staff at all 20 hospitals provided comparative data to others in their hospital: ICU-specific committees (60%), pharmacy and therapeutic committees (35%), and infection control committees (35%). Many practice changes addressed vancomycin use and included a hospital-wide approach (3 required prior approval or order forms for vancomycin use, 2 conducted a drug utilization evaluation, and 2 redistributed the HICPAC guidelines on appropriate vancomycin use) or an ICU-specific approach (3 removed vancomycin as a surgical prophylaxis option for cardiac surgeons, and 2 conducted education on appropriate uses of vancomycin). To assess if practice changes were independently important in affecting change in vancomycin use, we performed a multi-variable analysis controlling for ICU type and changes in MRSA rate. Vancomycin use decreased significantly in ICUs removing vancomycin as surgical prophylaxis (t=-3.54, p=.001), and conducting ICU-specific education on appropriate uses of vancomycin (t=-3.86, p<.001). These results suggest that benchmarking vancomycin use data may be a powerful tool to guide interventions or practice changes. Our data suggest ICU-specific approaches may be more effective than hospital-wide approaches.

IMPACT OF INFECTIOUS DISEASE SERVICE IN A NEUROLOGICAL INTENSIVE CARE UNIT ON ANTIMICROBIAL USAGE AND EMERGENCE OF MULTIPLY RESISTANT PATHOGENS. Lemmen SW, Toepper WD. Univ Hosp, Aachen, Germany.

To standardize and possibly improve antibiotic therapy an infectious disease service was established in Jan 1998 at a neurological intensive care unit of the University Hospital, Aachen, Germany. Antibiotic guidelines for the most common community and nosocomial acquired infections were outlined according to the local resistance pattern. Indications for treatment were discussed at the bedside during weekly rounds. Antibiotic use could be reduced from 3.5 defined daily doses in 1997 to 2.1 defined daily doses, respectively in 1998 (p<.05). Costs were reduced by 46% (32.000 Euro). During the study period there was no statistical significant difference in length of stay (7.2d in 1997 vs 7.0d in 1998, ns) or mortality (7.9% in 1997 vs 9.7% in 1998, ns). Since the intervention period multiply resistant pathogens like Stenotrophomonas maltophilia, Enterobacter spp. And Pseudomonas aeruginosa were isolated less often with statistical significance (copy strains were excluded); Candida spp. Could be found in 24.2% in at least one microbiological sample in 1997 and in only 13.3% in 1998. In conclusion, establishing an infectious disease service can improve antibiotic treatment and reduce costs significantly without interfering quality of medical care. Multiply resistant gram negative rods and candida spp. Will emerge less often due to a lower level of selection pressure.

COMPARISON OF THE LEVEL OF ANTIMICROBIAL USE IN HOSPITALS AND IN PRIMARY HEALTH CARE, DENMARK, 1997. Monnet DL, Soerensen TL, Johansen HL. Statens Serum Inst., Copenhagen, Denmark; Danish Medicines Agency, Copenhagen, Denmark.

OBJECTIVE: To compare the level of antimicrobial use in hospitals and in primary healthcare (PHC) using existing national databases. STUDY DESIGN: Population-based study. METHODS: In Denmark, data on each antimicrobial prescription redeemed by a patient at a PHC pharmacy are transmitted electronically to the Danish Medicines Agency (DMA). Although patient-level antimicrobial use data are not available from Danish hospitals, antimicrobial use by hospital ward must be reported to the DMA. For both settings, data are converted into Defined Daily Doses (DDD) as defined by WHO. Population and hospital activty data were obtained from the National Board of Health (1997 data only available in 1999). As recommended by WHO, antimicrobial use was expressed as an incidence density, i.e., in DDD per 1,000 person-days (1,000 inhabitant-days in PHC and 1,000 inpatient-days in hospitals). RESULTS: In 1997, the DMA reported a total of 21.8 million DDD of systemic antimicrobials (Anatomic Therapeutic Chemical classification group J01) in PHC and only 2.4 million DDD in hospitals. However, this picture was reversed when calculating incidence densities with 11.3 DDD/1,000 inh.-days in PHC and 400.8 DDD/1,000 pat.-days in hospitals. The overall hospital/PHC use incidence density ratio was 35.5. This ratio varied by county from 26.5 to 57.6. It also varied greatly according to the class of antimicrobial from 3.8 for tetracyclines (J01A) to 1,750 for β-lactams other than penicillins (J01D, mainly cephalosporins). CONCLUSION: It is, to our knowledge, the first time that antimicrobial use incidence densities are compared at a country level. Although most DDD were used in PHC, the antimicrobial use pressure was much higher in hospitals than in PHC. These results should now be compared to other indicators such as the proportion of patients or inhabitants who received antimicrobials.

ANTIMICROBIAL USE IN HEMATOLOGY/ONCOLOGY UNITS DIFFERS FROM USE IN OTHER HOSPITAL WARDS. Ostrowsky BE, Lawton R, Fridkin S, Gaynes R. Ctrs for Disease Control and Prevention, Atlanta, GA.

Project Intensive Care Antimicrobial Resistance Epidemiology (ICARE) of the National Nosocomial Infections Surveillance System (NNIS) focuses on antimicrobial resistance in hospitals, with an emphasis on intensive care units (ICU). In its third phase which included 3,689,603 patient days, it has addressed variations in antimicrobial usage in specialty wards. Between April 1998 and September 1999, data was collected at 17 hematology/oncology (hem/onc) related wards at 15 (37.5%) of 40 ICARE hospitals, representing 8 states and 147,800 (4%) phase three patient-days. The most commonly used antimicrobials were third generation cephalosporins (cef3) (pooled mean [pm]=182.6 defined daily doses/1000 patient-days [ddd/pd]) and parenteral vancomycin (45.7 ddd/pd). In preliminary analysis, comparison of ten antimicrobial drugs/classes, pooled mean usage was statistically higher in most cases in the hem/onc units than in the combined, non-ICU wards from the same facilities (e.g. aztreonam-pm=5.1 vs 3.2 ddd/pd, p <0.001; imipenem-pm=7.7 vs 3.6 ddd/pd, p <0.001; oral vancomycin-pm=2.5 vs 1.9 ddd/pd, p <0.001; parenteral vancomycin-pm=45.7 vs 37.2 ddd/pd, p < 0.001; cef3-pm=182.6 vs 86.5 ddd/pd, p <0.001). The exceptions were usage of first and second (cef2) generation cephalosporins which were statistically lower in the hem/onc units compared to the non-ICUs (pm=24.3 vs 82.7 ddd/pd, p <0.001 and pm=15.0 vs 33.3 ddd/pd, p <0.001, respectively). In contrast, antimicrobial usage was statistically lower in these hem/onc units when compared to ICUs from the same facilities (e.g., aztreonam-pm=5.1 vs 13.2 ddd/pd, p <0.001; imipenem-pm=7.7 vs 24.7 ddd/pd, p <0.001; parenteral vancomycin-pm=45.7 vs 95.7 ddd/pd, p <0.001; cef2-pm=15.0 vs 48.1 ddd/pd, p <0.001; cef3-pm=182.6 vs 315.9 ddd/pd, p <0.001). Our study suggests that monitoring antimicrobial usage for hem/onc wards separately from non-ICU and ICU populations may be helpful in optimizing facility antimicrobial use. These ICARE data may serve as a benchmark for other heme/onc units reviewing their antimicrobial usage patterns.

ANTIMICROBIAL USE IN SURGICAL PATIENTS AT A LARGE TERTIARY CARE HOSPITAL, HO CHI MINH CITY, VIETNAM, 1999. Parvez FM, Sohn AH, Vu TT, HH Hai, NN Bich, LTA Thu, LT Hoa, NH Thanh, Archibald LK, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Cho-Ray Hosp, Ho Chi Minh City, Vietnam.

With increasing emergence of antimicrobial (AMBL) resistance worldwide, appropriate use of AMBLs has become a priority. Since AMBL use in surgical patients has not previously been characterized in healthcare facilities in Vietnam, on 8/25/99, we conducted a point prevalence survey of AMBL use in surgical patients at Cho-Ray Hosp (CRH), a 1500 inpatient facility. All CRH surgical ward and intensive care unit patients who underwent a surgical procedure since admission were included. Med records were reviewed for perioperative AMBL use and blood or surgical site cultures. Of 395 surgical patients, 394 (99.7%) received AMBLs; 201 (51%) received pre-operative AMBLs, 110 (28%) received intra-operative/prophylactic AMBLs, and 394 (99.7%) received post-operative AMBLs. In 46 (42%) patients, prophylaxis was given correctly. Commonly used AMBLs included: pre-operative: cefotaxime (CTXM) (n=26; 13%), aminopenicillins (AP) (n=52; 26%), or gentamicin (GENT) (n=46; 23%); prophylactic: CTXM (n=37; 34%), or AP (n=23; 21%); post-operative: CTXM (n=62; 16%); AP (n=66; 17%); or GENT (n=210; 53%). During the post-operative period, 138 (35%) patients received 3rd generation cephalosporins and 246 (62%) received aminoglycosides. Of the 26 isolates from surgical site infection cultures, 18 (69%) were resistant to 3rd generation cephalosporins and 19 (73%) were resistant to GENT. Our data show that (1) surgical AMBL use is widespread and inconsistent with published guidelines; and (2) pathogens often are resistant to commonly used perioperative AMBLs. Further efforts are needed to encourage surgeons to utilize microbiology susceptibility data to guide AMBL use.

ICARE TAKE CARE: THE RISKS OF HAVING CHANGED THE DEFINED DAILY DOSES ASSIGNED BY THE WORLD HEALTH ORGANIZATION. Quirós R,* Clara L, Martinez C, Belloso W, Barcán L, De Cicco L, Stern L, Rozenek M, R Aleman and M Jofré. Hosp Italiano de Buenos Aires, Argentina.

The Defined Daily Doses (DDD) were introduced in the '70s by the Norwegian Medicinal Depot as a unit of measurement in drug utilization studies. Technically, the DDD is the assumed average maintenance dose per day for a drug used on its main indication in adults, representing a fixed unit of measurement and does not necessary reflect the recommended or actual used dose. The World Health Organization (WHO) Collaborating Centre for Drug Statistics Methodology carries out a conscientious procedure for assigning or changing a DDD every 3-5 years. Since 1996, the Ctrs for Disease Control and Prevention (CDC), through project ICARE (Intensive Care Antimicrobial Resistance Epidemiology), is monitoring the emergence of antimicrobial resistance related to antimicrobial use in U.S. hospital settings. Although the DDD concept was adopted, for several monitored drugs, the standard DDD were modified regardless those recommended by the WHO. To evaluate the impact of those changes, we reviewed the pharmacy data of a tertiary care teaching hospital, collected during a 24-month period (1994-95). The DDD were estimated applying the two sources, WHO (DDDw) and ICARE (DDDi). A total of 121,726.1 DDDw for 339,618 patient-days were collected. The results shown below represent the absolute and relative differences between both methods, for those groups that have significant variations. As each group represents a mix of different drugs, the percentage of variation cannot be used as a method for adjustment, due to the composition of those groups that can be dissimilar among different hospitals. Therefore most probably comparisons would be misleading. Finally, a unified DDD will help to take advantage of all sources available allowing more universal comparisons.

QUANTITATIVE INDICES OF BROAD SPECTRUM ANTIBIOTIC USAGE FOR INTER-INSTITUTIONAL ANALYSES. Samore MH, Harris AD, Pestotnik SL, Lo J, Gold HS, Lloyd J, Evans RS, Burke JP. Univ of Utah; Univ of Maryland; LDS Hosp, Univ of Utah;

ANTIMICROBIAL AGENTS	DDDw	DDDI	Difference (CI95%)	% of change
Penicillin group	5.3	9.7	-4.5 (-4.4 ; -4.6)	-45.9
Ampicillin group	138.4	89.5	48.9 (47.3 ; 50.5)	54.6
Antipseudomonal penicillins	8.3	7.7	0.6 (0.2 ; 1.0)	8.1
Second-generation cephalosporins	1.6	2.3	-0.7 (-0.4 ; -0.9)	-28.4
Third-generation cephalosporins	32.4	64.9	-32.4 (-31.4 ; -33.5)	-50.0
Fluoroquinolones	38.2	30.8	7.4 (6.5 ; 8.3)	24.0

College of Pharmacy, Univ of Utah; Beth Israel Deaconess Med Center, Harvard Med School; LDS Hosp.

We describe the application of several different indices of hospital broad-spectrum antibiotic (abx) usage, constructed from electronic databases containing individual patient-level data. The purpose was to identify variation in abx prescribing practices and facilitate analysis of abx resistance across different hospitals. Four classes of abx were defined as *broad spectrum: 3rd generation cephalosporins, carbapenems, β-lactam/β-lactamase* inhibitors, and fluoroquinolones [FQ]. Adult patients admitted to medical or surgical services with length of stay >2 days were studied. The indices were: 1) an overall measure of abx exposure, the percentage of patient admissions who received >1 dose of a broad spectrum abx; 2) a measure of heterogeneity, the Simpson diversity index, which ranges from 0 to 1; 3) an index of empiric abx use, represented by the percentage of patients receiving >3 doses of broad spectrum abx who had zero positive clinical cultures for gram negative or gram positive bacterial pathogens, excluding common skin flora. Data and temporal trends were first examined from a single institution. The initial study cohort consisted of 35,423 patients admitted between 1/94 and 12/98. Overall mean values for indices 1, 2, and 3 were 25%.97, and 50%, respectively. The diversity index demonstrated a decreasing trend during the 5 year period ($p<.05$), coincident with increasing use of FQ. In contrast, indices 1 and 3 were stable. A full comparison of data from three different institutions is in progress and will be presented. In conclusion, summary measures of broad-spectrum abx usage are feasibly derived from electronic data sources and are promising analytic tools to help dissect institutional-level characteristics predictive of abx resistance.

IMPACT OF CLINICAL FOLLOW-UP OF POSITIVE BLOOD CULTURES. Sebti A, Seo S, Badshah C, Ferreiro R, Itani S, Abdel Malak S, Angione K, Kiehn T, Sepkowitz KA. Memorial Sloan-Kettering Cancer Ctr, New York, NY.

BACKGROUND: Inappropriate selection of empiric antibiotics for a positive blood culture (BC+) may lead to increased morbidity. The contribution of immediate clinical intervention at time of BC+ has not been defined. We therefore evaluated the impact of immediate clinical intervention by ID fellows for patients with a BC+. PATIENTS AND METHODS: From June 1, 1999 to August 31, 1999, ID fellows followed up all BC+ at Memorial Sloan-Kettering Cancer Ctr, a tertiary care cancer center. Both disk diffusion (initial) and minimal inhibitory concentration (final) methods were used to determine drug susceptibility. The ID fellows performed chart review and spoke with the team caring for the patient. For each isolate, the ID fellows determined whether a patient was receiving appropriate antibiotics. Four outcomes were considered.

RESULTS:

[See TABLE]

CONCLUSION: In our study, initial antibiotics were appropriate in only 61.7% of patients with BC+. The impact of the intervention on specific clinical outcomes requires further study. We feel that immediate clinical intervention on all BC+ is an important part of routine patient care.

	Outcome of Antibiotic and Susceptibility Review Number (%)				
Organisms	Initial AB appropriate N (%)	AB adjusted N (%)	AB adjusted, final Susc. showed no need to adjust N (%)	AB adjusted after final Susc. Known N (%)	Total N (%)
GP Organisms	93 (64.1%)	34.4 (32%)	1 (0.6%)	1 (0.6%)	145 (64.4%)
GN Organisms	43 (60.5%)	25 (35.2%)	2 (2.8%)	1 (1.4%)	71 (31.5%)
Yeast	3 (33.3%)	6 (66.6%)	0	0	9 (4%)
Total	139 (61.7%)	81 (36%)	3 (1.3%)	2 (0.8%)	225 (100%)

LENGTH OF STAY PREDICTS ANTIMICROBIAL SUSCEPTIBILITY IN INTENSIVE CARE UNIT PATIENTS. Steele L,* Rose D, Charlebois ED, Bangsberg DR, Chambers HF, Gerberding JL. Centers for Disease Control and Prevention, Atlanta, GA; Univ of California at San Francisco and San Francisco General Hosp, San Francisco, CA.

Use of hospital antibiograms is recommended to aid rational selection of empiric antimicrobial agents. However, antibiograms usually are not stratified for characteristics likely to affect the probability of drug resistance in special populations. This study was conducted to evaluate the effect of duration of ICU care on microbial susceptibility in the surgical/trauma intensive care unit (ICU) at San Francisco General Hosp (SFGH). METHODS: The new SFGH integrated patient information system was used to relate microbiology, pharmacy, and administrative data. ICU length of stay was correlated with unique patient clinical isolates (defined as isolation of the same organism at the same site) for all ICU patients admitted between 1/1/96 and 12/31/97. RESULTS: Antimicrobial resistance prevalence varied with length of ICU stay for both gram-positive and gram-negative organisms (see TABLE). CONCLUSION: Stratifying antibiogram data by length of stay and/or other patient data may provide more accurate guidance for empiric therapy decisions in ICU patients and reduce unnecessary vancomycin/broad-spectrum antimicrobial therapy.

Gram-negative bacilli		% Resistant			
ICU Days	# Isolates	Ampicillin-Sulbactam	Ciprofloxocin	Ceftazidime	Gentamicin
0 - 3	115	20	17	29	16
4 - 7	120	20	12	23	16
8 - 14	154	24	10	37	16
>14	219	46	30	36	24
Chi square (pvalue)		40.5 (<0.001)	30.7 (<0.001)	8.1 (0.04)	6.2 (0.09)

Gram-positive cocci		% Resistant				
ICU Days	# Isolates	Ampicillin-Sulbactam	Ciprofloxocin	Clindamycin	Naficillin	Erythromycin
0-3	211	14	17	26	33	47
4-7	144	16	15	24	29	51
8-14	86	24	31	39	44	62
>14	96	38	52	66	68	77
Chi square (pvalue)		24.8 (<0.001)	53.6 (<0.001)	55.1 (<0.001)	42.5 (<0.001)	27.1 (<0.001)

ANTIBIOTIC USE AND ANTIMICROBIAL RESISTANCE IN NOSOCOMIAL PATHOGENS: LONGITUDINAL SURVEILLANCE DATA SUGGESTS THAT WE CAN GO BACK TO PREVIOUSLY POPULAR BUT CURRENTLY UNDER-USED REGIMES. Tambyah PA, Kumarasinghe G, Chow C, Liew HY, Yow KL. Nat'l Univ Hosp, Singapore.

It is widely believed that antibiotic overuse promotes the development of antimicrobial resistance. However, the converse question as to whether underuse of a class of antibiotics will allow for a reduction in antimicrobial resistance has also not been answered convincingly. For the last ten years, we have collected prospective surveillance data on antimicrobial susceptibility of important nosocomial pathogens using the Kirby-Bauer disk diffusion method. Data were also collected on antimicrobial usage in terms of defined daily doses per 1000 patient days (DDD) for major antibiotics. During the study period, usage of most major antibiotics increased, especially ceftazidime (11.3-20.6, p=0.005). The exception was aminoglycoside use which has declined (6.1-3.0, p=0.003) mainly due to increased fluoroquinolone use (3.8-9.4, p=0.03). The pattern of antimicrobial resistance in our hospital closely paralleled the direction of antibiotic usage. The rise in resistance was most marked in gram-negative bacilli, especially among Acinetobacter spp (to ciprofloxacin, from 13% to 43%, p=0.04) and Pseudomonas spp (to ciprofloxacin, 3% to 18%, p=.008). In contrast, resistance to amikacin declined in Acinetobacter spp (36% to 13%, p=0.07). A correlation could be established between increased ceftazidime use and ceftazidime resistance in Acinetobacter spp (p=.01) and declining amikacin use and declining amikacin resistance in Acinetobacter spp (p=.03) and Enterobacter spp (p=.06). Our data suggests that while increasing use of fluoroquinolone and cephalosporin antibiotics in our institution seems to be driving antimicrobial resistance to these agents, increased susceptibility of important nosocomial pathogens to aminoglycosides in response to declining aminoglycoside use in recent years may afford us the opportunity to "go back" to older antibiotics which have become less widely used with the advent of less toxic, broader spectrum alternatives.

FACTORS AFFECTING ANTIBIOTIC DECISIONS II: A SURVEY OF ADULT PATIENTS WHO PRESENTED WITH UPPER RESPIRATORY TRACT INFECTIONS IN FAMILY AND GENERAL PRACTITIONERS' OFFICES. Zoutman DE, Ford, BD, Bassili, A, Cosby J, Nakatsu K. School of Medicine, Faculty of Health Sciences, Queen's Univ, Kingston, ON, Canada; The Center for Evaluation of Medicines, St. Joseph's Hosp, Hamilton, ON, Canada.

Non-medical determinants influence physicians to write and patients to want an antibiotic prescription for upper respiratory tract infections (URTis). We sought to identify office visit events and patient factors leading to prescribing of antibiotics for URTIs of viral origin. A detailed 100-item patient survey focussed on patient demographics, health status, the doctor visit, how the patient generally cared for similar illnesses and patient knowledge of URTIs and antibiotics. The surveys were completed during the winter of 1998-99 in southern Ontario by 200 patients selected randomly from 40 Family/General practitioners' practices. The mean patient age was 45.1 (range 16 to 86);

68.5% were female. Eighty percent (80%) of patients visited their family doctor after being ill on average 5 days and the visits averaged 10 minutes. Logistic regression analysis indicated that if 1) non-antibiotic treatments such as nonprescription relief medications were not offered (OR 71.4, 95% CI 4.6-1,124), 2) the patients expected antibiotics (OR 21.6, 95% CI 3.3-142), 3) the patients felt stressed (OR 18.7, 95% CI 2.3-153) and 4) the patients were less educated (OR 17.5, 95% CI 1.4-250), antibiotics were more likely to be prescribed for viral URTIs. Antibiotics were prescribed to 31.1% of patients with viral URTIs and the antibiotics most frequently prescribed were amoxicillin, erythromycin, clarithromycin/azithromycin and co-trimoxazole. The results of this study support the findings of our concurrent polling of physicians: antibiotics are overused to treat viral URTIs in southern Ontario. The combined results of our studies indicate that education directed toward management of URTIs and treatment alternatives for viral URTIs would help decrease antibiotic overuse. Interventions to increase patient knowledge of antibiotics and treatment of viral URTIs would also be expected to decrease antibiotic use through increasing physicians' perceptions of relevant patient knowledge and by decreasing patients' expectations for antibiotics.

Antisepsis

COMPARISON OF THREE SURGICAL SCRUBBING WITH 2% CHLORHEXIDINE SOAP: SCRUB BRUSH, SPONGE AND SOAP ALONE: PRELIMINARY DATA. Cunha ER, Graziano KU, Strabelli TMV, Silva HL, Batistini GJ, Sinto SI, Mendes CMF, Uip DE. Univ School of Medicine Sao Paulo, Brazil.

BACKGROUND: Surgical hand scrubbing is a integral part of the presurgical preparation for operating room staff members. Brush use is a potential risk for skin irritation and an extra cost in the procedure. The difference between using a scrub brush, sponge, and soap alone in reducing hand bacterial counts were studied in a prospective laboratorial study. METHODS: Twenty-four volunteers were submitted to the glove juice technique to document and compare the baseline specimens (T0) and immediately after surgical scrubbing (T1) with 2% chlorhexidine soap. The sample were analyzed by quantitative counting colonies. Subjects were randomized to scrubbing with brush, sponge, and soap alone for at least 5 minutes. The experiment was repeated by use of a cross-over design after a 1-week washout period. RESULTS: The most frequent agent isolated was coagulase negative Staphylococcus. ANOVA analysis in baseline sets were not considered significant (p=0.7933). Scrub brush and soap alone techniques showed significant reduction from baseline (scrub brush T0 × T1 p=0.0492; sponge T0 × T1 p=0.0879; soap alone T0 × T1 p=0.0307). CONCLUSIONS: The effect of using scrub brush and soap alone in reducing hand bacterial counts was similar and preliminary data point out that soap can be used alone, once you guarantee that all steps and 5 minutes scrubbing are routinely performed.

Behavior Modification—Abstracts in this category appear in Am J Infect Control *February 2000.*

Bioterrorism Preparedness and Response

THERE IS NO COOKBOOK PLAN FOR A RESPONSE TO BIOTERRORISM OR ONE HOSPITAL'S APPROACH. Karanfil L, Kramer J, Gwon H, Catlett C, Deinert R, Bova G, Inglesby T, Nelson T, Perl T. The Johns Hopkins Hosp, Baltimore, MD.

In the event of an act of bioterrorism, a hospital system would need to react quickly and efficiently. The most concerning of the biologic agents is smallpox because it is highly infectious and not recognizable by most clinicians. Recognizing the need for a plan for a hospital response if an act of bioterrorism occurred, a task force was formed. The Task Force first met in 5/99 with key members from the institution, including representatives from the following departments: emergency medicine, safety, infectious disease, nursing, facilities, public affairs, security, critical incident stress team, materials management, pathology, occupational health, and respiratory therapy. A mission statement was developed that went beyond what was included in the existing disaster plan. The statement for this 1,000-bed hospital included planning for 100 potential victims. The hospital facilities were assessed to determine options for efficient and safe patient placement. The process for inventory management of supplies and pharmaceuticals was next assessed. While an overall draft policy was developed specific department plans were needed. To develop these plans the original task force then split into three smaller work groups: a nursing group to develop the nursing and stress incident response, a physician group to develop physician directives, and a third group to look at patient and staff support services. We then integrated members of the city and state in our planning. An oversight group formed that included the hospital epidemiologist, a senior infectious disease physician, an emergency medicine physician, nursing director, and the disaster administrator. While each hospital deciding to develop a bioterrorism policy will need to tailor their procedures to their own institutional needs, this is no time to re-invent the wheel. We plan to present some lessons learned by our trial and error!

THE RELATIONSHIP BETWEEN GLUTARALDEHYDE DISINFECTION AND CONTAMINATION OF MICROORGANISMS. Lin MY, Wong WW, Wang FD, Liu JH, Chang MS. Veteran General Hosp, Taipei, Taiwan.

Glutaraldehyde can effectively kill bacteria, fungus and majority of virus and is the most commonly used high-level disinfectant for medical equipment such as endoscopes. However, microbial contamination might occur when glutaraldehyde is used improperly. We carried out a survey to evaluate microbial contamination, and changes in concentration of glutaraldehyde solution within the recommendation period of 28 days according to manufacturer's instruction. A total of 516 glutaraldehyde solution samples were collected from ten endoscopy examining units in Veteran General Hospital - Taipei for microbial tests and measurement of glutaraldehyde concentration. Forty-six (46) samples were contaminated by microorganisms (giving a contamination rate of 8.9%). When we considered disinfection methods, automated disinfection samples produced a statistically significantly high contamination rate of microorganisms than that of manual samples (20.1% (39/194) versus 2.2% (7/322), $p < 0.0001$). Among 276 samples with measurements of glutaraldehyde concentration, 49 samples have concentration lower than the effective concentration of 1.7 % suggestive by manufacturer. Automated disinfection also showed a statistically significantly high proportion of concentration lower than 1.7% compared with manual disinfection (41.6% (42/101) versus 3.6% (7/195), p<.0001). Our results suggest that microbial contamination may occur according to the manufacturer's instruction, especially with automated disinfection. Frequent monitoring of glutaraldehyde disinfection solution and development a reliable and effective procedure of disinfection is required to avoid microbial contamination.

THE INFECTION CONTROL RESPONSE TO A NOVEL LETHAL EMERGING INFECTION: BIOTERRORISM PREPAREDNESS LESSONS FROM THE NIPAH VIRUS OUTBREAK. Tambyah PA, Ling AE, Ang BSP, Kumarasinghe G. Natl Univ Hosp, Singapore; Singapore General Hosp, Singapore; Communicable Disease Ctr, Singapore.

An outbreak of severe viral encephalitides among pig workers occurred recently in Malaysia. The major cause was a novel zoonotic paramyxovirus, the Nipah virus. Eleven abattoir workers in Singapore and one visiting pig farmer were also infected. As the transmissibility of the virus is unclear, infection control personnel at the hospitals taking care of the patients had no precedents to determine appropriate infection control measures. Important issues raised were: (1) Obtaining up to date virologic information from experts from Malaysia and international teams; (2) ethical issues on the optimal treatment of the individual patients versus the need to protect staff and prevent nosocomial transmission; (3) allocation of resources for management of a virus with unknown incubation period and transmissibility, and (4) addressing the concerns of healthcare workers without either causing undue panic or spreading misleadingly reassuring information. A total of 207 healthcare workers were screened in Singapore and tested positive by ELISA. The infection control management of these patients was thus largely successful without significant disruption to the normal flow of hospital activity. Reasons for this include: (1) The fortuitous fact that the virus does not appear to be readily transmissible from human to human. (2) The initial infection control measures included use of barrier precautions, including high filtration masks, labeling of laboratory specimens, and strict isolation and cohorting of infected and suspected patients. (3) Excellent communications were maintained between the laboratory, clinicians, local authorities, and international teams studying the virus. (4) The Internet proved a useful tool in disseminating information about the disease. (5) Extensive briefings were held with healthcare personnel to ensure that their concerns were being addressed. Lessons learned from this outbreak have potential applications not only to novel pathogens that are likely to emerge in the near future, but also to bioterrorist activity should that specter become a reality.

BSI

RISK FACTORS FOR CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS: PRELIMINARY ANALYSIS OF THE DETAILED INTENSIVE CARE UNIT SURVEILLANCE COMPONENT STUDY. Alonso-Echanove J, Edwards J, Richards M, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA; Univ of Melbourne, Melbourne, Australia.

The wide variation observed among central line-associated bloodstream infection (LA-BSI) rates, commonly used for comparison purposes, may reflect variation in the distribution of risk factors that are not routinely collected. To improve these rates for interhospital comparison, we attempted to identify potential risk factors for LA-BSI. The DISC study involves prospective, multicenter, cohort surveillance in eight adult general medical and/or surgical ICUs. Information on patients' potential intrinsic and extrinsic risk factors and central line (CL) characteristics is collected daily for the entire ICU admission on patients admitted >24 hours. In the first 20 of 24 months of data collection, 7,913 CL contributed 91,474 CL-days. Most CL were non-tunneled (59%) or Swan-Ganz (25%) catheters. Of these, 29% and 24%, respectively, were antibiotic impregnated. Most common insertion sites were jugular (43% of CL) or subclavian (38% of CL). There were 208 LA-BSI. In multivariate analysis, controlling for CL-days, we identified the following risk factors for LA-BSI: line insertion outside a special procedure room or operating room (SPR) (odds ratio [OR]=2.5; 95% confidence interval [CI]=1.6-4.0); total parenteral nutrition (TPN) (OR=2.3; CI=1.7-3.0); duration of CL 312 days (OR=1.8; CI=1.3-2.6); mechanical ventilation (MV) (OR=2.5; CI=1.7-3.9); pulmonary edema (PE) (OR=2.0; CI=1.3-3.1); transplant patient (TR) (OR=2.6; CI=1.2-4.7). Our results suggest that (1) certain intrinsic factors, perhaps represented by TR, MV, or PE, affect LA-BSI rates, and (2) inserting a CL outside an SPR, using TPN, and keeping CL 312 days are independent extrinsic risk factors that may in part explain the variation in reported LA-BSI rates.

CONTROL PROGRAM FOR CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTIONS INTWO PEDIATRIC INTENSIVE CARE UNITS. Andión E,* Bologna R, Battistezza J, Carbonaro M, Sasbón J, Weller G, Manterola AC . Hosp. Garrahan, Buenos Aires, Argentina.

INTRODUCTION: A control program for central line associated (CLA) nosocomial bloodstream infections (BSI) was developed, consisting of three main steps: problem diagnosis, solution, evaluation. The objective of the program was to decrease CLA BSI rates. OBJECTIVE: Data are presented on CLA BSI surveillance in two Pediatric Intensive Care Units (PICU A and B) between 1995 and 1998. MATERIAL AND METHODS: Infection rates were assessed by taking the number of BSI's in patients with central lines as the numerator and the number of patient/days with a central line multiplied by 1000 as the denominator. All statistical analyses were performed with SACIH data base program and EPIINFO 6.04. Infection site definitions of the NNIS were used. Infection rates were compared with NNIS data. The data were collected by infection control nurses together with infectologists and microbiologists. The control program included: revision of guidelines for prevention of nosocomial CLA BSI (e.g., handling, duration of catheter placement), interdisciplinary development of new guidelines, continuous surveillance and monthly interdisciplinary data-discussion meetings, placement on the PICU bulletin board of the expected number of CLA BSI's, training of healthcare providers and used-material control. RESULTS: (1) The average use of central lines was between 39.5 % and 53.7 % in Unit A and between 54.1 % and 65.2 % in Unit B. (2) CLA BSI rates (controlled and validated by retrospective studies) decreased in both Unit A (from 5 % to 1.7 %) and Unit B (from 6.3 % to 3.2 %). These numbers are below the 10th percentile of the NNIS report of 1998 for Unit A and between the 10th and 25th percentile for Unit B. CONCLUSIONS: The decrease of CLA BSI rates in both PICUs is a marker for the success of the control program and shows the importance of an interdisciplinary effort to enhance nosocomial infections control.

DECREASED INCIDENCE OF CENTRAL LINE-RELATED BLOODSTREAM INFECTIONS ASSOCIATED WITH USE OF SILVER-IMPREGNATED DRESSINGS AT CENTRAL VENOUS CATHETER SITES. Brooks KL, Dauenhauer SA, Evans JT. Overton Brooks VA Med Ctr, Shreveport, LA.

Normal skin flora becomes a principal source for over 200,000 nosocomial bloodstream infections (BSI) annually when intravascular devices are in place. Related morbidity and mortality nationwide account for millions of dollars of preventable healthcare costs. A five-month study of Med and Surgical Intensive Care Unit (MICU/SICU) patients having triple-lumen central venous catheters (CVC) was conducted at the Overton Brooks VA Med

Ctr. The purpose was to monitor the efficacy of a controlled-release silver-impregnated transparent dressing in reducing colonizing skin flora and subsequently decreasing the risk of CVC-related BSI. From a total of 31 patients, 35 silver-impregnated transparent dressing (SITD) sites and 39 control non-treated transparent dressing (NTD) sites were cultured. Each patient having a triple-lumen CVC in place had the opposing body site used as the control skin site. The study protocol consisted of the following: (1) Catheter and control sites prepared with chlorhexidine scrub; (2) Catheter inserted using aseptic technique and maximum barriers; (3) SITD applied to the catheter site, NTD applied to the control skin site; (4) At seven days, both sites cultured when dressings removed. Cultures from NTD sites revealed 41% (16/39) colonization with gram-positive bacteria; 5% (2/39) with gram-negative bacteria; 5% (2/39) with yeast; and 49% (19/39) with no growth. Cultures from SITD sites grew 26% (9/35) gram-positive bacteria; 3% (1/35) gram-negative bacteria; and 71% (25/35) no growth. SITD site cultures showed 15% less gram-positive bacteria, 2% less gram-negative bacteria, and 22% no more growth than the NTD site cultures. In the five months prior to the study, there were eight BSI with estimated Ctrs for Disease Control and Prevention extra cost of $35,170. During the five-month study period, there were three BSI, representing a 62% decrease, with an estimated extra cost of $13,189. In the five months following the study, there were seven BSI, a 233% increase over the study period, with an estimated extra cost of $30,774. Data from this study suggest that silver-impregnated transparent dressings potentially could result in a substantial cost savings impact for CVC-related BSI.

IMPACT OF SURVEILLANCE OF NOSOCOMIAL BLOODSTREAM INFECTIONS IN A UNIV HOSPITAL: A TEN-YEAR REVIEW. Byl B, Strale H, Rost F, De Gheldre Y, Struelens MJ*. Erasme Univ Hosp, Brussels, Belgium.

Hosp-wide surveillance of nosocomial bloodstream infections (NBSI) is conducted prospectively since 1983 in our 858-bed tertiary care hospital. We reviewed data for the 1988-98 period to determine the secular trends in incidence, pathogen distribution and associated underlying diseases and determine the impact of surveillance on the management of nosocomial infections. During this period, 3,061 episodes occurred in 297,457 admitted patients (2,739,462 patient-days) representing a mean incidence of 10.3/1,000 discharges (11.2/10,000 patient-days). The annual incidence ranged from 8.0 to 12.7/1,000 discharges (8.3-14.1 episodes/10,000 patient-days). NBSI incidence increased from 9.2 to 11.4/1,000 discharges (p value for linear trend: 0.0001). Among associated underlying diseases only cancer increased in frequency from 23 to 36% of cases. Specific-pathogen infection rates varied markedly from year to year without significant trend over the study period. Surveillance contributed to the detection of 11 nosocomial outbreaks for which control programs were implemented and monitored. For example, catheter-related NBSI decreased from 4.5 episodes in 1995 to 2.3 episodes/10,000 patient-days ($p<0.001$) over a 3 year period after implementation of a catheter care program. In conclusion, this surveillance program indicated a moderate increase in the incidence of NBSI over a decade, without major shift in the pathogen distribution, but with an increase in the frequency of associated cancer. It proved useful for outbreak detection and evaluation of control interventions.

CENTRAL VENOUS CATHETER-RELATED RHODOCOCCUS SPP. BACTEREMIA IN CANCER PATIENTS. Chatzinikolaou I, Rolston KVI, Raad II. The Univ of Texas M. D. Anderson Cancer Center.

Rhodococcus spp. Has been shown to cause pneumonia in immunocompromised patients, particularly AIDS patients. Between 1990 and 1999 we reviewed 50 cases of Rhodococcus spp. Bacteremia occurring in cancer patients. Thirty-one (31) cases were probable or definite central venous catheter (CVC) related bacteremias (CRB). All 31 CRB cases had (1) no apparent source for bacteremia except the CVC, (2) fever (temperature >38.1°C; median 38.8°C), (3) positive blood culture through CVC. There were two cases with definite CRB (catheter tip positive for Rhodococcus spp. Or greater than 100-fold the number of CFU from blood culture through CVC vs peripheral blood), and 29 cases with probable CRB (positive blood culture through CVC only). Most (25/31 or 81%) responded to antibiotic therapy without CVC removal, while only 6 cases (19%) responded to antibiotic therapy while their CVC were removed within 5 days of onset of bacteremia. Those patients whose CVC were retained did not differ from those whose CVC were removed in terms of (I) type of antibiotic therapy, (ii) duration of antibiotic therapy, (iii) frequency of neutropenia (< 500/mm3), (iv) recovery of neutropenia on therapy. In conclusion, the CVC is the most likely source of Rhodococcus spp. Bacteremia in cancer patients. Rhodococcus spp. CRB may be treated with antibiotic therapy without CVC removal.

THE CENTRAL VENOUS TUBING CHANGE ASSOCIATED WITH CATHETER-RELATED INFECTION. Chen YY, Lin M, Lin MY, Wang FD, Liu JH, Chang MS. Taipei Veterans General Hosp, Taiwan.

This study aims to examine the risk of tubing change associated with infusate-related infection and catheter-related infection respectively. A experimental study, targeting patients receiving central venous catheter at the medical and surgical intensive care units (ICUs) of Veterans General Hosp, Taipei. The patients were randomly divided into two groups. In group 1, patients received the change of central venous tubing every 3 days and in group 2, patients received the change of tubing every 7 days. Of the 204 patients who had in total 332 central venous catheters placed, 47 of them developed related infection, representing a crude infection rate of 23.04%. The number of infected patient in group 2 was 0.96 times that of group 1(95% CI 0.48-1.94). There were 2.25 patients infected per 100 catheter-days, and 1.38 patients infected per 100 ICU-days. Two patients had infusate and blood-related infection; the incidence in group 2 was 2.23 times that of group 1(95% CI 0.16-63.2), but there was no statistical difference between the two groups ($p>0.05$). In the unvariable analysis of the two groups, risk factors that showed significant difference between the group 1 and group 2 included the duration of ICU stay, recatheterization, placement site, catheter type, administering physician, number of insertion, insertion site, number of tubing, and number of triple-lumen piston ($p<0.05$). According to the logistic regression analysis, significant risk factors were found to be duration of ICU stay, catheter type and number of tubing. The 164 species were isolated from 3,149 specimens. The most common species isolated were Staphylococcus epidermidis 21.34%, Candida albican 17.68%, Staphylococcus aureus 5.49%, and Acinetobacter baumannii 5.49%. By the log-rank test of Kaplan-Meier survival analysis, there was no difference between the two groups in terms of the initial isolation to the duration of catheter use ($p>0.05$). CONCLUSION: There was no difference related-infection between the patient's receiver the change of tubing every 3 days and every 7 days.

HOSPITAL-ACQUIRED BACTERAEMIA IN ENGLAND. WHERE TO FOCUS PREVENTATIVE MEASURES. Coello R, Charlett A, Sedgwick J, Ward V, Wilson J, Pearson A. PHLS Central Public Health Lab, London, U.K.; PHLS Statistics Unit, London, U.K.

The English Nosocomial Infection National Surveillance Scheme was established in 1996 by the Public Health Lab Service and the Dept of Health. Three surveillance modules have now been developed, including hospital-acquired bacteraemia which is hospital-wide. Data for bacteraemic patients are obtained from the hospital's infection control team. Denominator data from all patients (infected and uninfected) are from the hospital's Information Department. From May 1997 to Apr 1999, 1,007,797 patients in 61 hospitals were surveyed and 3,824 bacteraemias reported. The highest rates of bacteraemia were in general and paediatric intensive care units (ICUs), haematology, nephrology, and oncology (9.5, 6.5, 5.8, 3.6, and 2.4 per 1000 patient-days, respectively). Of 31 specialties, six (general medicine, general surgery, haematology, general ICU, geriatrics, and nephrology) accounted for 75% of all bacteraemias. Of 2,771 bacteraemias with known source, 67% were associated with an intravascular (IV) device, or with an infection related to a urinary catheter or a ventilator. Central IV devices were the most common source in nephrology, haematology, oncology, paediatric ICU, general ICU, general surgery and medicine, accounting for 84%, 79%, 76%, 68%, 56%, 30% and 25% of bacteraemias, respectively. In geriatric medicine, catheter-associated urinary tract infections were the most common source. Ventilator-associated respiratory infections were the source of 17% of bacteraemias in general ICU. These results give indications for national priorities for re-enforcing known preventative measures.

IMPACT OF MINOCYCLINE/RIFAMPIN-IMPREGNATED CENTRAL VENOUS CATHETERS ON IN VITRO QUANTITATION OF CATHETER-ASSOCIATED BACTERIA. Corales RB, Geers TA, Tuohy MJ, Hall G, Procop, G, Modak S, Schmitt SK. Cleveland Clinic Foundation, Cleveland, OH; Northeast Ohio Univ College of Medicine, Akron, OH; College of Physicians and Surgeons of Columbia Univ, New York, NY.

Studies have shown that antiseptics elute from impregnated central venous catheters during culturing processes, making necessary addition of inhibitors of these compounds to culture media to accurately diagnose catheter-related infections (CRIs). We performed a series of in vitro experiments to assess whether a similar effect exists for newer antibiotic-impregnated catheters. Segments of minocycline/rifampin (MC) (Cook, Bloomington, IN) and silver chlorhexidine catheters (SC) (Arrow, Reading, PA) were sonicated and vortexed in thioglycollate broth (TB) or neutralizing medium (NM) and removed immediately. Catheter-exposed broths were inoculated with S. epidermidis (SE). Aliquots were removed at 0', 15', 30', 45', 1 hr, 3 hr, 6 hr, and 24 hr time intervals and inoculated on blood agar plates (BAP) and DE neutralizing agar plates (DEP). On both BAP and DEP, there was no significant difference in colony counts from TB exposed to SC and MC at any time interval. However, mean colony counts from NM broths exposed to MC were decreased when compared with broth exposed to SC for as few as 15'. Colony counts from NM broth exposed to MC were similar to control (TB and NM without catheter exposure). In experiment 2, segments of MC or SC were rolled on BAP and DEP, then inoculated with SE and incubated for 48 hours. Growth was absent from portions of the MC-exposed plates where catheters had been rolled, with colonies growing only at unexposed plate edges. In contrast, uniform growth was seen in all sectors of SC-exposed and control (no catheter) plates. In experiment 3, antimicrobial effects versus SE were detectable for MC after 14 d of suspension in buffer. These results suggest that antibiotics elute from MC catheters during catheter-culturing processes, artifactually lowering colony counts. Commonly-used neutralizing media fail to reverse these effects. Laboratories that rely solely on these methods for diagnosis of CRI may have difficulty recovering organisms from cultures of MC. Trials using other media to neutralize eluted antibiotics are ongoing.

RISK FACTORS FOR DEATH FROM COAGULASE-NEGATIVE STAPHYLOCOCCI NOSOCOMIAL BACTEREMIA. Correa L, Hugonnet S, Pittet D. Department of Internal Medicine, Univ of Geneva Hosps, Geneva, Switzerland.

BACKGROUND: Changing trends in practices and progress of medicine resulted in the emergence of coagulase-negative staphylococci (CNS) as the leading cause of nosocomial bacteremia. Although CNS bacteremias are common, their impact on patient mortality is not clearly established. We analyzed risk factors for death in CNS primary nosocomial bacteremia. DESIGN: Prospective cohort study in a teaching hospital. PATIENTS: All blood cultures that yielded CNS identified between Apr 1, 1995, and Apr 30, 1998, were reviewed for clinical significance. CNS primary bacteremia defined a patient older than 18 years with any species of CNS isolated in one or more blood culture set (blood culture set=pair of bottles, anaerobic and aerobic) associated with clinical signs of infection, and in the absence of CNS body site infection. Death was associated with CNS bacteremia if there was clinical evidence of persistent infection or a strong association between bacteremia and death; i.e., the bacteremia caused failure or further compromise of an organ system. RESULTS: A total of 236 patients were analyzed. Crude mortality was 24% (57/236); mortality was directly associated with bloodstream infection in 30 patients (13%). We compared patients who died from CNS bacteremia with those who survived. By univariate analysis, no differences were found regarding gender, primary diagnosis, presence of neutropenia, appropriateness of antibiotic therapy, ICU stay prior to bacteremia or number of positive blood culture sets. Multivariate analysis identified two variables that were independently associated with mortality: age (OR 1.04 per year; CI95 1.01-1.07), and rapidly fatal disease (OR 11.6; CI95 3.0-45). The number of positive blood culture sets was not an independent predictor of death due to CNS infection ($p=.39$). CONCLUSIONS: Age and severity of underlying disease were the main risk factors for death attributable to CNS bacteremia. The number of positive blood culture sets did not influence outcome.

WHAT IS THE SIGNIFICANCE OF SINGLE POSITIVE BLOOD CULTURE COAGULASE-NEGATIVE STAPHYLOCOCCI BACTEREMIA ? Correa L, Hugonnet S, Pittet D. Infection Control Program, Department of Internal Medicine, Univ of Geneva Hosps, Geneva, Switzerland.

BACKGROUND: Growth of coagulase-negative staphylococci (CNS) in one bottle, or pair of bottles, is traditionally considered as contamination while growth in two or more bottles most frequently defines true bacteremia. Is there clinical evidence supporting this interpretation? OBJECTIVE: To assess the importance on patient outcome of the number of positive blood culture sets in CNS primary nosocomial bacteremia. DESIGN: Prospective cohort study in a teaching hospital Patients: All blood cultures that yielded CNS identified over 3 years were reviewed for clinical significance. A case of CNS primary bacteremia was defined in an adult patient with any species of CNS isolated in one or more blood culture set (blood culture set=pair of bottles, anaerobic and aerobic) associated with clinical signs of infection, and in the absence of CNS body site infection. RESULTS: A total of 236 patients (median age, 58 y) with CNS primary bacteremia met the inclusion criteria. At time of CNS

bacteremia patients with growth in one set of blood culture (n=163): had higher median duration of hospitalization prior to the CNS bacteremia (11 vs 15 days, p=.009); had longer median time for growth of CNS (3 vs 2 days, p=.0008); stayed more frequently in ICU prior to bacteremia (97/163 vs 27/73, p=.001); and less frequently received adequate antibiotic therapy (53/163 vs 60/73, p<0.001) than patients with growth in two or more blood culture sets (n=73). There were no differences between the two groups with regard to primary diagnosis, Mc Cabe classification, presence of neutropenia or age. Crude mortality was higher (not statistically significant) among patients in group 1 than in group 2: 15 vs 6.9% at day 14 (p=.08), and 21 vs 11% at day 28 (p=.09). The attributable mortality was similar in two groups (14 vs 10%, respectively). CONCLUSION: In presence of clinical signs of infection, single positive CNS bacteremia has similar clinical significance, and similar crude and attributable mortality than multiple blood culture positive bacteremia.

DAPTOMYCIN TREATMENT OF PATIENTS WITH GRAM-POSITIVE BACTEREMIA. DeBruin MF, Tally FP. Cubist Pharmaceuticals, Cambridge, MA.

INTRODUCTION: Daptomycin is a novel lipopeptide antibiotic that is bactericidal (in vitro) against drug-susceptible and drug-resistant gram-positive bacteria, including enterococci. Two open-label clinical trials focus on evaluation of the safety and efficacy of daptomycin dosing regimens administered intravenously to bacteremic patients. METHODS: The bacteremia trial (BAC) randomizes adult patients with 2 or more positive blood cultures and clinical signs of systemic infection to one of three daptomycin dosing regimens or standard therapy. The daptomycin regimens are 6 or 4 mg/kg q24h, or 6 mg/kg as a loading dose followed by 3 mg/kg q12h. Patients randomized to standard therapy may receive either intravenous vancomycin 1 gm q12h or oxacilin/nfacillin 4-12 gm/day in divided doses. All patients may receive empiric aztreonam or metronidazole, as appropriate. Patients in shock, with severe neutropenia, creatinine clearance <30 mL/min, osteomyelitis, or clinically proven endocarditis are excluded. Planned duration of therapy is 7-14 days. The second trial (RRC) enrolls bacteremic patients with a gram-positive organism that is resistant or refractory to therapy, or for whom standard therapy is contraindicated. The exclusion criteria and the dosing regimens are the same as those outlined for the BAC trial. Planned duration of treatment is 7-14 days, with a maximum duration of 28 days. RESULTS: Enrollment in the BAC and RRC trials is progressing. To date, all dosing regimens have been well-tolerated. Updated safety and clinical outcome results from patients bacteremic with drug-susceptible and drug-resistant organisms (e.g., VRE) will be presented.

INCIDENCE OF NOSOCOMIAL BLOODSTREAM INFECTIONS BY HIV STATUS. Hahn OM, Zimmer D, del Rio C, Ray SM. Emory Univ School of Medicine, Atlanta, GA; Grady Memorial Hosp, Atlanta, GA; Emory Univ School of Medicine, Atlanta, GA.

An estimated 250,000 nosocomial bloodstream infections (NOSBSIs) are reported nationally each year. We analyzed rates of NOSBSI by HIV status for adults hospitalized in the medical and surgical wards (MSW), medical ICUs (MICU), and surgical ICUs (SICU) during a 52 month period in a 900 bed, inner-city hospital. Numerator data was obtained from a computerized database of NOSBSIs from Jan 1994 to Mar 1998. Total patient days were obtained from hospital information services. HIV+ patient days and CD4 counts for all hospitalized HIV+ patients were obtained from weekly census data. During the study period, there were 2030 NOSBSIs; 236 NOSBSIs were in HIV+ patients. NOSBSI rates for the combined adult areas (MICU + SICU + MSW) and MSW alone were significantly lower for HIV+ patients compared to HIV- patients (combined: 2.0 episodes/1000 patient days vs 4.1, p<0.0001; MSW: 1.4 vs 2.1, p<0.0001). In contrast, HIV+ patients in the SICU had a significantly increased risk of NOSBSI compared to HIV- patients (30.3 vs 16.2, p<0.001). Primary and secondary NOSBSI rates were higher for HIV+ patients (primary: 14.1 vs 7.3, p=.019; secondary: 16.3 vs 8.8, p=.019). For HIV+ patients in MSW, there was a significant increase in NOSBSI rates over time (1994: 0.6, 1995: 1.2, 1996: 1.8, 1997: 2.0, 1998: 2.3, p<0.05). The median CD4 count of HIV+ patients with NOSBSI was significantly lower than the median CD4 count for all HIV+ patients (23 cells/mm3 vs 60 cells/mm3, p=.001). In summary HIV status had a different effect on risk for NOSBSI for different hospital areas. HIV+ patients in the SICU had a higher risk of NOSBSI than HIV- patients did. This risk may be related to differences in catheter use and acuity of illness. An increasing trend over time of NOSBSI in the MSW for HIV+ patients may reflect an increasing degree of illness of hospitalized HIV+ patients over time. The lower NOSBSI rate in MSW for HIV+ may be due to the administration of antibiotics for the prophylaxis of opportunistic infections.

PROTECTION AND RISK FACTORS ASSOCIATED WITH LONG-TERM CATHETER INFECTIONS IN CANCER PATIENTS. Hanna HA, Raad II. The Univ of Texas M. D. Anderson Cancer Center.

The risk factors associated with long-term nontunneled silicone catheters (subclavian and peripherally inserted central catheters (PICC)) are not well defined in the cancer patient population. Between Feb and Nov 1991 we randomized 402 cancer patients to have their central venous catheters (CVC) inserted under maximal sterile barrier precautions (MSB) vs control (short drape and sterile gloves) (Raad et al., Infect Control Hosp Epidemiol 15:231;1994). Patients were followed up for up to 100 days postinsertion. Upon removal, catheters were cultured by roll plate (RP) and sonication (SON). Catheter-related bloodstream infection (CRBSI) was defined as bloodstream infection (BSI) associated with fever (> 38°C) and no apparent source for BSI except CVC with either (1) catheter segment having >15 CFU by RP or >103 by SON with same organism isolated from blood, or (2) at least 10-fold the number of CFU from blood culture through CVC vs peripheral vein. There were 7 episodes of CRBSI in the study group. Risk factors studied were age, number of catheter lumen, catheter site (subclavian vs peripheral), difficulty in insertion, total parenteral nutrition, blood products, thrombotic occlusion, underlying disease (hematologic vs solid tumor), neutropenia (<500/mm3), thrombocytopenia (<50,000/mm3), duration of catheterization, duration of hospitalization, duration of neutropenia, interleukin-2 therapy, and MSB. By univariate and multiple logistic regression analysis, three factors were significantly associated with CRBSI: (1) blood products, including platelet transfusions given through CVC (P=0.002), (2) platelet count >5 × 14 during course of study (P=0.01), (3) insertion without the use of MSB precautions (P=0.05). In conclusion, the use of blood products through the CVC is a significant risk factor for CRBSI, while thrombocytopenia during catheterization and insertion under MSB protect against CRBSI.

EVOLUTION OF NOSOCOMIAL BLOODSTREAM INFECTION INCIDENCE RATES IN BELGIAN HOSPITALS: RESULTS FROM THE NATIONAL SURVEILLANCE NETWORK: 1992-99. Jans B, Suetens C, Carsauw H, Morales I, Leens E, Selway P. Scientific Institute of Public Health, Brussels, Belgium.

OBJECTIVES: To study time trends in incidence rates in the national, hospital-wide surveillance of nosocomial bloodstream infections (BSI) in Belgian hospitals from 1992-99. Methods: Since Oct 1992 the Scientific Institute of Public Health in Brussels invites quarterly all Belgian hospitals to participate (voluntary basis) to the national, hospital-wide, nosocomial BSI surveillance. Surveillance data are transmitted by the hospitals to the Institute for analysis, national benchmarking and feedback. Data from Oct 1992-Mar 1999 were included in the analysis. Analysis for time trends was carried out using linear regression for repeated (min. 3 participation's) observations. Trends for year were examined adjusting for quarter, hospital size and frequency of blood culturing. POPULATION: During the study period 48 hospitals participated at least three times and were thus eligible for trend analysis. RESULTS: The overall incidence rate was 7.5 BSI episodes per 10000 patient-days (median: 6.9) and increased from 6.7 in 1992 to 7.4 in 1999 (p=.056). However this trend was accompanied by an increase of blood culturing from 24.0 blood culture sets/1000 patient-days in 1992 to 30.0 in 1999. Big hospitals (> 500 beds) had a higher BSI-incidence rate (9.2/10000 p-days) then medium size (250-500; 6.9/10000 p-days) and small hospitals (<250 beds; 5.0/10000 p-days). Trends for specific micro-organisms showed an increase in BSI with coagulase-negative staphylococci. CONCLUSIONS: The increase in the hospital-wide incidence of BSI in Belgian hospitals from 1992-99 may, at least in part, be explained by an increasing intensity of surveillance, as demonstrated by an even more pronounced increase in the frequency of blood culturing during the same period.

SECULAR TENDENCIES IN BLOODSTREAM INFECTIONS. Jukemura EM, Cappellano P, Ujivari S, Salomao R, Tajiki M, Correa L, Oliveira MA, Pereira CA. Federal Univ of Sao Paulo, Sao Paulo, Brazil.

Bloodstream infections (BSI) is a great concern associated with a high mortality (35%).The pattern of the isolates changes during the years, which make the periodic analyze of the BSI isolates is important for the empirical therapy. PURPOSE: Overview study of the BSI etiology since 1982 to 1998. PATIENTS AND METHODS: The study was done in a 600-bed teaching hospital in the period of 1982 to 1998. BSI were defined as systemic inflammatory response syndrome with a positive hemoculture. The data was organized in 4 periods: 85/86; 92/93; 94/95 and 97/98. RESULTS: Gram-positive cocci increased comparing 85/86 and 92/93 (42.5% to 53.8%, p=0.06) but decreased in 97/98 making 43.7% of the isolates. There were 32.8% of S. aureus in 92/93 which were progressive less associated with BSI, been responsible for only 18.8% in 97/98.(p=0.01). Whereas ScoN became the more important gram-positive cocci going from 3.1% in 85/86 to 16.6% in 97/98. The gram-negative bacilli had a not significant decrease of 53% in 85/86 to 46.8% in 97/98, and are nowadays more prevalent than the gram-positive pathogens. This was due the growing importance of Acinetobacter spp. From 4.7% (85/86) to 12.1% (97/98), p <0.001.The BSI caused by yeast arises from 2.9% to 6.3% between 85/86 and 95/96 and stabilized in 5.9% in 97/98.The polimycrobial episodes and incidence of the BSI were stable respectively 5% and 23/1.000 admissions. CONCLUSIONS: In BSI gram negative rods are the most important pathogens, and Acinetobacter spp. Is the most frequent isolate. The S. aureus are becoming less prevalent and are being superimposed by SCN. BSI caused by yeast increased until 94/95 and became stable.

FACTORS RELATED TO PERCUTANEOUS CENTRAL VENOUS CATHERTER BLOODSTREAM INFECTIONS IN NEONATES. Kaler WD, Chinn R, Henderson RW, Richards M. Sharp Mary Birch Hosp for Women, San Diego, CA.

A study was performed to evaluate factors related to the placement and care of percutaneous central venous catheters (PCVC) and subsequent line-related bloodstream infections (LR-BSI) in neonates. STUDY DESIGN: Charts of all infants admitted to the neonatal intensive care unit who had PCVC inserted during the two-year study period were reviewed daily for line insertion information and for determination of the number of PCVC manipulations and entries. Demographic, clinical, and baseline risk factor data was recorded. Each infant was then followed for signs of PCVC related BSI as defined by the National Nosocomial Infection Surveillance System. RESULTS: A total of 212 PCVC were followed for infection for a total of 4207 line-days. The infection rate was 3.1/1000 catheter days. Birthweight and gestational age were associated, but factors related to the insertion and the number of times per day that the line was entered were not associated with LR-BSI. CONCLUSION: The number of times per day that the PCVC was entered or manipulated and multi-purpose use were not invariably risk factors for PCVC line-related infection in neonates. It appears the use of proper infection control practices and the high level of skill among the staff handling these lines may be the most important determinants in the prevention of LR-BSI.

BLOOD STREAM INFECTION FROM CENTRAL VENOUS CATHETER INSERTION IN THE INTENSIVE CARE UNIT: A PROSPECTIVE STUDY AT A UNIVERSITY HOSPITAL IN A DEVELOPING COUNTRY 1998-99. Khuri-Bulos, N, Abu Khader I, Hatoog R. Jordan Univ Hosp, Amman, Jordan.

Blood stream infection (BSI) is a major cause of mortality and morbidity in the intensive care units (ICU). While these patients have intrinsic factors predisposing them to BSI, the use of central venous catheters (CVC) increases the risk of such events. In an ongoing prospective study such events were monitored at the ICUs at the Jordan Univ Hosp (JUH). This is a five hundred-bed hospital serving Amman, the capital of Jordan. In 1998, 193 CVCs were inserted and 573 CVC line days were followed. 4 BSIs occurred: 2 Klebsiella, 1 Pseudomonas aeruginosa and 1 Candida albicans. The BSI rate was 2% and 6.98/1000 line days. 5 BSI occurred in 175 catheters (2.85%) in 1999. The infection rate was 8.43/1000 patient days. The infections were due to Enterobacter 1, Klebsiella 1, staph coag neg 1, Candida kruseii 1. In the fifth patient polymicrobial infection with acinetobacter and E. coli occurred. The risk of BSI in our ICUs compares favorably with published National Nosocomial Infections Surveillance System (NNIS) rates. Such comparison helps us among other parameters to monitor the quality of care offered to these patients.

A META-ANALYSIS OF THE RISK OF INTRAVASCULAR DEVICE-RELATED BLOOD STREAM INFECTION BASED ON 223 PUBLISHED PROSPECTIVE STUDIES. Kluger DM, Maki DG. Univ of Wisconsin Med School, Madison, WI.

Intravascular devices (IVDs) are widely used worldwide in patient care, more than 200 million per year in the U.S., and represent the most common source of nosocomial bloodstream infection (BSI). In an effort to better understand the relative risks of IVD-related BSI associated with various types of IVDs, we undertook a meta-analysis of 223 published prospective studies which used microbiologically based criteria for IVD-related BSI. This analysis shows that the delineation of relative risk is best appreciated by analyzing rates of IVD-related BSI both per 100 IVDs (%) and per 1,000 IVD-days. Comparing cuffed (Hickman) and non-cuffed CVCs, nearly three times as many cuffed CVCs become infected

(10.8% vs 3.6%); however, the risk per 1,000 IVD-days is far lower with cuffed CVCs (1.2 vs 4.25). Although the risk per 100 catheters is very high with non-cuffed hemodialysis (HD) CVCs (13.4%), the risk is relatively low per 1,000 days (2.3). Antibiotic-coated non-cuffed CVCs (0.2 per 1,000 days), subcutaneous central venous ports (0.2), PICCs (0.4) and cuffed HD CVCs (0.7) showed the lowest rates per 1,000 days. For benchmarking, these data, based on studies in which every device is examined, can be used as an upper bound of acceptable risk for IVD-related BSI with the various IVDs used clinically at the present time. They further point up the benefit of new technologies for prevention of IVD-related BSI and support their wider use.

	Studies, n	Mean no. BSIs per 100 IVDs	Mean no. BSIs per 1,000 IVD-Days
PICCs	9	1.9	0.4
Cuffed CVCs	22	17.2	1.0
CV Ports	26	5.5	0.2
Noncuffed CVCs			
Non-medicated	66	3.6	2.2
Antiseptic coat	13	3.2	3.1
Antibiotic coat	5	0.2	0.2
PACs	17	2.5	4.3
Heparin coat	3	1.5	2.6
HD CVCs			
Uncuffed	20	13.4	2.3
Cuffed	2	2.4	0.5
Arterial	4	1.5	2.9
Peripheral IVCs	13	0.2	0.6

A META-ANALYSIS OF RISK FACTORS FOR CATHETER-RELATED BSI WITH PERCUTANEOUSLY INSERTED CENTRAL VENOUS CATHETERS. Kluger DM, Maki DM. Univ of Wisconsin Med School, Madison, WI.

Percutaneously inserted central venous catheters (CVCs) are widely used in clinical practice, with over 7 million sold each year in the U.S. alone. CVCs account for more than 75% of all IV device-related bloodstream infections (BSIs). We undertook a meta-analysis of published studies of CVC-related BSI which were prospective and used multivariate techniques of data analysis or were randomized trials: 56 studies provided data; unfortunately, many were small and had limited statistical power, addressed a limited number of potential risk factors or did not quantify risk. However, a number of risk factors were found to be consistently associated with a significantly increased risk of catheter-related BSI in the majority of studies that examined the factor: placement of the CVC in an old site by guidewire exchange, placement in the internal jugular rather than subclavian vein, multilumen rather than single-lumen catheters, heavy colonization of the insertion site or catheter hub, and duration of CVC placement >7d. Use of chlorhexidine rather than povidone iodine, tunneling a non-cuffed CVC or with hemodialysis catheters applying a topical anti-infective cream or ointment to the insertion site significantly reduced risk. Better prospective studies of risk factors that have sufficient size to address all potential risk factors, including insertion site and hub colonization, insertion technique and quality of follow-up care, would enhance our understanding of the pathogenesis of CVC-related BSI and guide efforts to develop more effective strategies for prevention.

STUDY OF FACTORS ASSOCIATED WITH THE DURATION OF CENTRAL VENOUS CATHETERIZATION AND CATHETER COLONIZATION. Lin M, Chen YY, Lin MY, Wang FD, Liu JH, Chang MS. Nosocomial infection control committee, Veterans General Hosp-Taipei, Taiwan.

Catheterization is the major factor associated bloodstream infection.The objective of this study is to examine the risk of catheter replacement frequency associated with catheter tip colonization, insertion site and catheter-related infection. A expermental study was employed, targeting patients receiving central venous catheter at the medical-surgical intensive care unit of Veterans General Hosp-Taipei. A total 309 patients were randomly assigned to three study groups classified by the frequency of catheter replacement 1-7 days group, 8-10 days group, and 11-14 days group.The number of patients with catheter tip colonization in the 8-10 days group was 1.32 times that of the 1-7 days group (95% CI: 0.44-3.77), and the 11-14 days group was 2.02 times the 1-7 days group (95% CI: 0.56-5.91). There was no statistical difference among the three groups in terms of number of patients with catheter colonization (p>0.05). The number of patients with catheter-relative infection in the 8-10 days group was 1.72 times that of the 1-7 days group (95% CI: 0.80-3.67), while 11-14 days group was 1.92 times the 1-7 days group (95% CI: 0.79-4.60), exhibiting no statistical difference (p>0.05). The patients with insert site infection in 8-10 days group was 3.91 times that of the 1-7 days group (95% CI: 0-145.56) which showed no statistical difference. But in the 11-14 days group with insertion site infection, which was 26.06 times that of the 1-7 days group (95% confidence level: 2.61-631.91), and showed statistically significant increase. CONCLUSION: There was no significant difference among the three study groups in terms of catheter tip colonization and related infections. The injection site infection of the 11-14 days group was significantly higher than that of the 1-7 days group,but there were only 4 patients with such infection in the 11-14 days group in a span of one year. Thus replacing central venous catheter every 11-14 days appears to be an acceptable practice.

PROSPECTIVE, RANDOMIZED, INVESTIGATOR-MASKED TRIAL OF A NOVEL CHLORHEXIDINE-IMPREGNATED DISK (BIOPATCH®) ON CENTRAL VENOUS AND ARTERIAL CATHETERS. Maki DG, Narans LL, Knasinski V, Kluger D. Univ of Wisconsin Med School, Madison, WI.

The Biopatch® is a novel chlorhexidine-impregnated disk which can be affixed about a newly inserted catheter, pressed firmly onto the skin about the insertion site, to suppress cutaneous colonization about the catheter by microorganisms that might invade the tract and cause catheter-related blood stream infection (CRBSI). We prospectively studied this novel infection control device in 413 patients hospitalized in a Univ hospital. Patients scheduled to receive a percutaneously inserted non-cuffed CVC, PICC or arterial catheter used for hemodynamic monitoring were randomized to have all of their catheters dressed with a polyurethane (PU) film dressing (controls) or the BiopatchÒ, covered with a PU dressing. The investigators and microbiologists processing all clinical specimens were masked to each patient's treatment assignment. All CRBSIs were confirmed by demonstrating concordance between microorganisms isolated from peripheral blood cultures and the catheter tip, a catheter hub or infusate by RFP DNA subtyping. Use of the chlorhexidine-impregnated disk was associated with a significant reduction in the incidence of CRBSI (1.2 vs 3.3%, RR 0.36, P<0.01; 3.3 vs 5.7 BSI/1000 catheter-days, RR 0.41, P<0.01). The greatest benefit was for prevention of CRBSI deriving from skin organisms gaining access extraluminally (RR 0.81, P<0.01). This simple and inexpensive device appears to significantly reduce the risk of CRBSI with short- and medium-term central venous and arterial catheters used in hospitalized patients.

	CHX PU	Control PU
Study population		
Patients	211	208
Catheters	544	491
Catheter-days	3133	2586
No. of patients with CRBSI	6	15
Rates: CRBSI		
Per 100 caths.	1.2%	3.3%
Per 1000 cath.-days	2.3%	5.7%

TRENDS IN SPECIES CAUSING CANDIDEMIA OVER 12 YEARS. Malani PN, Bradley SF, Little R. Kauffman CA, VA Med Ctr, and Univ of Michigan Health Systems.

Yeast bloodstream infections were assessed from 1988-1999 at the Univ of Michigan. 2,497 isolates were obtained from 943 episodes of fungemia in 902 unique patients (pt). The median age was 40 yr; 42 were <1 yr and 239 were greater than or equal to 60 yr; 54% were male and 46% were female. In 22 episodes, more than one species was isolated; 18 pt had 2 and 6 had greater than or equal to 3 fungemic episodes. The number of fungemic episodes/yr were similar, 73 ±3. Of all C. parapsilosis episodes, 39% were from children <10 yr, whereas 37% of C. glabrata were from adults greater than or equal to 60 yr. In the 3 yr prior to 1991, C. albicans caused 63% of episodes, C. glabrata 10%, C. parapsilosis 9%, and C. tropicalis 7%. Subsequent 3-yr time periods showed successive decreases in C. albicans (53%, 50%, 45%), increases in C. glabrata (15%,17%,18%) and C. parapsilosis (12%,16%,20%), and no change in C. tropicalis (9%,8%,7%). The proportion of fungemias due to non-albicans species increased over time, p=.0001. Over the same period, fluconzole use (in g/yr) increased from 116 prior to 1991, to 1,250 in 1991-93, 2,128 in 1994-96, and 2,030 in 1997-98. An association was found between increasing fluconazole use and an increase in C. glabrata, p=.017 and a decrease in C. albicans, p=.05, fungemias. Fungemia due to C. glabrata, but not other non-albicans species, has increased significantly in association with fluconazole use in our facility.

SEVEN CASES OF NATIVE VALVE ENDOCARDITIS DUE TO COAGULASE NEGATIVE STAPHYLOCOCCI: A ONE YEAR EXPERIENCE. Miele PS, Levy CS, Marcus KA, Rosenthal J, Gill VJ, Croxton M, Lucey DR. Washington Hosp Center, Washington, DC; Kaiser Permanente, Washington, DC; National Institutes of Health, Bethesda, MD.

Native valve endocarditis caused by coagulase-negative staphylococci is relatively rare but has become more common in recent years. Previously associated with community acquired infection, it is now increasingly associated with nosocomial acquisition. We report seven cases of coagulase-negative staphylococcal native valve endocarditis (CNS-NVE) seen at our institution over a ten month period. All seven cases came from the community, but four of the seven had indwelling intravenous access devices and a fifth had had a recent prostatectomy; two had no identifiable risk factors. Presentations varied from subacute and indolent in nature (4 cases) to acute with complications as presenting features (3 cases). Complications included cerebrovascular embolic phenomenon (1 case), congestive heart failure (3 cases) and third degree heart block (1 case). All seven cases required surgical intervention for incompetent valves. Diagnosis of CNS-NVE was made by a combination of blood cultures, valve culture and valve pathology. Pathology showed marked destruction in three cases, with moderate necrosis and inflammation in the rest; all seven valves demonstrated organisms by microscopic examination. Five of the seven isolates were identified as Staphylococcus epidermidis. All isolates were sensitive to vancomycin; two of the seven were resistant to methicillin. Significantly, five of the seven cases had blood cultures positive for coagulase negative staphylococci on admission, but in four cases the organism was initially felt to be a contaminant. Our series suggests that coagulase negative Staphylococcus can be a virulent, aggressive pathogen. The increasing use of intravascular access devices in the community may herald an increase in the incidence CNS-NVE, associated with a higher rate of acute disease, complications, and need for surgery.

NOSOCOMIAL BLOODSTREAM INFECTION AND COSTS ASSOCIATED WITH A CHANGING SURGICAL INTENSIVE CARE UNIT. Nacul FE, Tuberson P, Willey S, Duncan RA. Lahey Clinic, Burlington, MA.

SETTING: Catheter-related bloodstream infection (CR-BSI) rates increased in 1997 when our 12-bed SICU simultaneously incorporated a trauma center, neuro-interventional radiology, and a separate 5-bed cardiothoracic care unit. We reviewed all CR-BSI (defined as the same organism from blood and a catheter tip (>15 CFU)) from 1993-98.

RESULTS: SICU infection rates remained stable from 1993-96. In 1997, total infection rates rose 2.3-fold as length of stay (LOS) increased from 2.8 to 5.1 days (p<0.0001), coincident with new services. 84% of the infection increase was from IV/site and bloodstream infections (including CR-BSI); CR-BSI increased the most (2.7-fold, p=.001). Coagulase-negative staphylococcus (CNS) CR-BSI rose 2.9-fold (p=.019) (48% of the increase). S. aureus, GNR, enterococci, and yeasts caused smaller increases. Polymicrobial CR-BSI rose from 0% in 1993 to 25.6% of infections in 1997 (p<0.001). In 1998 total infections decreased 11%, but CR-BSI dropped 55% (p=.005), including CNS, enterococci, yeast, and polymicrobial CR-BSI. CONCLUSIONS: Increased infections in 1997 were temporally associated with changes in our SICU. Some excess CR-BSI can be attributed to increased LOS, yet improvement in 1998 (without further change in patients or LOS) suggests other factors contributed. Contamination by skin flora increased dramatically, implying suboptimal catheter care. This lends collateral support to our hypothesis that CR-BSI resulted from transient nursing staffing deficits (giving less time for catheter care) that occurred while restructuring our SICU (Duncan et al., SHEA 1998). We estimate 24.4 excess CR-BSI in 1997, adding 586 hospital and 195 SICU days and 8.5 deaths, costing $976,000; 12% was due to patient and LOS changes but 88% was related to other factors, includeing inadequate nursing staffing. Infection rates (especially CR-BSI) improved after staffing stabilized.

ETIOLOGY OF CELLULITIS, SEPSIS, AND DEATH IN A NEONATAL INTENSIVE CARE UNIT, INDONESIA 1999. Parvez FM, Roeshadi D, Irmawati L, Sidharta Y, Rosenthal SR, Padmidewi M, Irawan E, Hastuti R, Angsar D, Archibald LK, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Dr. Soetomo Hosp, Surabaya, Indonesia; World Health Organization, Jakarta, Indonesia; Balai Laboratorium Kesehatan, Surabaya, Indonesia.

From July 1, 1998-March 23, 1999, 60 patients in the neonatal intensive care unit (NICU) developed genital or perianal cellulitis and sepsis at Dr. Soetomo Hosp (DSH), Indonesia. Although most of these patients received empiric antimicrobial therapy with cefotaxime or Fosfomycinr, 24/60 (40%) died. Ten (17%) of 60 infants had blood cultures obtained prior to initiation of therapy. To determine the etiology of the outbreak, we initiated a prospective cohort study of all infants with suspected sepsis. A case-infant was defined as any DSH NICU infant who developed temperature <36.5°C or >38°C, apnea, bradycardia (heart rate <60), cyanosis, diarrhea or cellulitis from March 23-August 25, 1999 (study period). After a history and physical examination, a peripheral blood culture was drawn before initiation of antimicrobial therapy. During the study period, 386 infants met the case definition; 48 (41%) had perianal cellulitis; 208 (46%) had diarrhea; and 26 (7%) had meningitis. Case-infants had a median age of 4 (range: 0-10) days. Of 386 infants cultured, 166 (43%) had a bloodstream infection (BSI). Predominant BSI pathogens were non-typhi Salmonella spp. (n=76;46%), Staphylococcus spp. (n=43; 26%), and Klebsiella spp. (n=20; 12%). Fifty-nine (80%) of Salmonella spp. And 11 (73%) of Klebsiella spp. Were resistant to cefotaxime; 19 (26%) of Salmonella spp. And 4 (26%) of Klebsiella spp. Were resistant to Fosfomycinr. The initial 13 case-infant culture isolates of Salmonella spp. And Klebsiella spp. Were extended-spectrum β-lactamase producers. Our data show that (1) the BSI prevalence rate in DSH NICU patients is high; (2) Salmonella spp. And Klebsiella spp. BSI should be considered in the differential diagnosis of neonates with cellulitis or clinical sepsis; and (3) antimicrobial susceptibility patterns should be used to guide empiric antimicrobial therapy. We conclude that microbiologic capabilities at DSH should be enhanced using existing resources to facilitate diagnosis of emerging BSI pathogens and to provide susceptibility data to optimize patient treatment.

CLINICAL IMPACT OF AUTOMATED METHODS AND EVALUATION BY INFECTOLOGISTS IN BLOOD STREAM INFECTIONS. Pereira CA, Correa L, Castelo A, Wey SB, Oliveira MA, Pignatari AC. Federal Univ of Sao Paulo, Sao Paulo -SP, Brazil.

Blood stream infections (BSI) are highly lethal. Blood cultures are the only practical way to document them. Many physicians don't change therapy after the results, due to the delay in their release. To overcome this difficulty, automated methods for detection of growth, identification and susceptibility tests were developed. The aim of this study was to analyze the clinical impact of introduction of automated methods and the evaluation of the results by infectologists, in changes of the antimicrobial therapy and lethality. The study was conducted at the university hospital in two periods. In the 1st one (92/93), 250 BSI episodes were identified by classical methods, without evaluation by infectologists. In the 2nd one (94/95), there were 528 BSI episodes; BACTEC 9240 was used for isolation, Walk/Away for identification and two infectologists evaluated therapy. Partial and final results arrived, in average, in the 2nd period, within 2 and 5 days, respectively. With partial results, infectologists changed the antimicrobial treatment in 42% of BSI episodes; in 92% this change was correct. The lethality rate in the 14th day was statistically smaller in the second period (36% vs. 28%, p=0.02). Rapidly fatal (OR 4.29) and ultimately fatal underlying diseases (OR 3.80), age above 60 yr. (OR 3.48), infection caused by and Acinetobater spp or and Pseudomonas spp (OR 2.15), vascular catheter (OR 1.80), female sex (OR 1.48), and belonging to the first period (OR 1.47) were independently correlated with evolution to death until the 14th day after acquisition of BSI. Therefore, adjusted to other variables, which could justify the evolution to death, in the 2nd period, automated systems of blood culture and evaluation of results by infectologists, improved patients' survival significantly.

USE OF ANTIBIOTIC IMPREGNATED CATHETERS ASSOCIATED WTH SIGNIFICANT DECREASE IN NOSOCOMIAL BLOODSTREAM INFECTIONS IN CRITICALLY ILL CANCER PATIENTS. Raad II, Hackett B, Hanna HA, Graviss L, Botz R. The Univ of Texas M. D. Anderson Cancer Center.

Catheters impregnated with minocycline and rifampin (M/R-CVC) have been shown in prospective randomized studies to significantly decrease the risk of catheter-related bloodstream infections (Ann Intern Med 128:267, 1997 and NEJM 340:1, 1999). Prospective surveillance during fiscal year (FY) 1997-98 showed that most (>60%) of nosocomial bloodstream infections (NBSI) in the surgical (SICU) and medical intensive care units (MICU) at our institution were primary BSI caused by gram-positive (G+) organisms. M/R-CVC were introduced in FY98-99. Most (74%) of CVCs inserted in FY98-99 were M/R-CVC. The following difference in infection rates were noted before and after the introduction of M/R-CVC. Most (>80%) of the nosocomial VRE isolates were susceptible to either minocycline or rifampin. In conclusion, the use of M/R-CVC in critically ill cancer patients was associated with significant decrease in NBSI including nosocomial VRE BSI.

	SICU			MICU		
	FY 97/98	FY 98/99	P	FY 97/98	FY 98/99	P
NBSI*	3.0	1.2	<0.01	8.3	3.5	<0.01
G+NBSI*	4.2	1.0	0.001	5.6	2.2	0.02
Catheter infections* (BSI + exit site	3.4	0.5	<0.001	2.8	0.5	0.02
VRE bacteremia	—	—	2.2	0	<0.01	

VRE= vancomycin resistant enterococci, *all rates were calculated as units per 1000 ICU patient days

DIAGNOSIS OF CATHETER-RELATED BLOODSTREAM INFECTION: IS IT NECESSARY TO CULTURE THE SUBCUTANEOUS SEGMENT? Raad II, Hanna HA, Hachem RY, Darouiche RO. Univ of Texas M. D. Anderson Cancer Center; Univ of Texas M. D. Anderson Cancer Center; Baylor College of Medicine/VA Med Center.

A recent study on indwelling short-term central venous catheters (CVC) suggested that the sensitivity of diagnosing catheter-related bloodstream infection (CRBSI) is improved if both the catheter tip and subcutaneous segment (SQS) are cultured by roll-plate (RP) and sonication (SON-Sherertz et al., J Clin Microbiol 35:641; 1997). We reviewed data on uncoated CVC from two prospective randomized trials on (1) long-term silicone CVC (6 CRBSI-342 patients-Raad et al., Infect Control Hosp Epidemiol 15:231; 1994) and (2) short-term polyurethane CVC (7 CRBSI-266 patients-Raad et al., Ann Intern Med 127:267; 1997). The tip and SQS were cultured by RP and SON in all patients in the two studies. CRBSI was defined as (a) isolation of >15 CFU by RP or >103 CFU by SON from either tip or SQS, (b) same organism from blood, (c) fever and chills, (d) no other source for infection. The diagnostic accuracy of culturing only the tip by RP and SON vs both the tip and SQS were as follows: In general, because catheter cultures predict colonization more frequently than CRBSI, they were associated with low +PV for CRBSI. In conclusion, except for slight improvement in sensitivity for long-term CVC, culturing the SQS does not add to the diagnostic yield of tip cultures by RP and SON.

	Short-term CVC		Long-term CVC	
	Tip	Tip + SQS	Tip	Tip + SQS
Sensitivity	100%	100%	83%	100%
Specificity	75%	72%	97%	97%
+ PV	18%	17%	36%	40%
- PV	100%	100%	100%	100%

PV = predictive value

THE CLINICAL AND ECONOMIC IMPACT OF ANTIMICROBIAL RESISTANCE ON NOSOCOMIAL BLOODSTREAM INFECTIONS. Roghmann M, Bradham D, South B, Fridkin S, Perl TM. The VA Maryland Healthcare System, Univ of Maryland Med System and School of Medicine, Baltimore, MD; Ctrs for Disease Control and Prevention, Atlanta, GA; Johns Hopkins Med Institutions and School of Med, Baltimore, MD.

PURPOSE: To quantify the clinical and economic impact of antimicrobial resistance on nosocomial bloodstream infections (BSI) by comparing patients with primary BSI due to an antibiotic susceptible organism to patients with BSIs due to an antibiotic resistant organism in a cohort study of adult intensive care unit (ICU) patients. METHODS: BSI due to methicillin-susceptible S. aureus (MSSA), methicillin-resistant SA (MRSA), vancomycin-susceptible E. faecium (VSE) and vancomycin-resistant E. faecium (VRE) were identified through prospective surveillance in ICUs at three institutions. Patients were compared on 7-day and 30-day mortality, length of stay (LOS) and estimated direct healthcare costs (DHC) derived from DRG data during the 30 days after the BSI. RESULTS: Our preliminary analysis on 190 BSI episodes show than patients with MRSA BSI had a similar 7-day mortality (15% vs 11%, p=.6 ′ 2), 30-day mortality (38% vs 23%, p=.09) but a significantly higher in hospital mortality (47% vs 23%, p=.01) compared to patients with MSSA BSI. Patients with MRSA BSI had similar LOS (25 days vs 20, p=.31) but higher DHC ($50,440 vs 25,888, p=<.01) compared to patients with MSSA BSI. Patients with VRE BSI had a similar 7-day (48% vs 50%, p=.9), 30-day mortality (40% vs 47%, p=.5) and in hospital mortality (19% vs 28%, p=.3) compared to patients with VSE BSI. Patients with VRE BSI had similar LOS (23 days vs 23, p=1.0) but higher DHC ($60,798 vs 34,469, p=.02) compared to patients with VSE BSI. These results need to be adjusted for LOS prior to BSI, severity of illness and underlying co-morbidities. In addition, the final dataset will include ~400 BSI episodes. CONCLUSION: While LOS and mortality after BSI do not substantially differ between patients with resistant and susceptible organisms, unadjusted costs appear to differ greatly.

NOSOCOMIAL BLOODSTREAM INFECTIONS WITH PENICILLIN-RESISTANT STREPTOCOCCUS PNEUMONIAE IN DEPARTMENT OF VETERANS AFFAIRS FACILITIES. Roselle GA, Danks LH, Kralovic SM, Simbartl LA. DEPT. OF VETERANS AFFAIRS HQ, WASH, DC, VA MED CTR, CINCINNATI, OH, UNIV OF CINTI COLL OF MED, CINTI, OH; DEPT. OF VETERANS AFFAIRS HQ, WASH, DC, VA MED CTR, CINCINNATI, OH; VA MED CTR, CINCINNATI, OH.

As one of the largest healthcare systems in the U.S. (3.5 × 106 persons served, 6.12 × 105 discharges in fiscal year 1998), the DVA is an ideal location to assess the incidence and factors associated with PRSP NBSI. Using the automated Emerging Pathogens Initiative computer based data extraction package nationwide, PRSP NBSI were assessed. A

PRSP NBSI was defined as a positive blood culture for PRSP (MIC>0.12) occurring 2 days after admission with no prior positive culture for the same organism. Data for 23 months (10/97-8/99) were used. 30 patients were identified with PRSP NBSI (10 intermediate [I] and 20 fully resistant [R], MIC 0.12-2.0 and >2.0, respectively). The case rate was 0.024103 discharges. Mean age was 70.6 + 12.7 SD years, with ages of the I and R groups 63.6+15.5 and 74.1 + 9.7, respectively. Mean days from culture accession to result were 5.2 + 3.6. All patients were male. Race/ethnicity was reported as 18 White and 9 Black. 59.3% were WWII era veterans and 25.9% Vietnam. Discharge disposition was death in 11 of the 30 patients. Comparing patients with PRSP NBSI associated with I vs R susceptibilities, there were no statistical differences in gender, race/ethnicity, era of service, discharge disposition; age data was suggestive (p=.08). PRSP NBSI is an infrequent occurrence, but a harbinger for a negative outcome (death rate=37%). Pneumococcal immunization and early diagnosis and appropriate treatment could mitigate this poor prognosis.

PRIMARY BACTEREMIA IN PEDIATRIC LIVER/SMALL BOWEL TRANSPLANT RECIPIENTS. Rupp ME, Vondra DM, Wallace AM, Marion N, Kaufman SS, Horslen SP, Langnas AN. Univ of Nebraska Med Ctr, Omaha, NE.

BACKGROUND: Pediatric liver and small bowel transplant patients (L/SBTx) are at high-risk of primary bloodstream infection (PBSI). This study was performed to ascertain possible risk factors for development of PBSI. METHODS: PBSI was identified using CDC/NNIS criteria. A case control study was conducted on patients receiving L/SBTx surgery in 1996-99 comparing 5 control subjects (no PBSI) with 6 subjects who experienced 1 episode of PBSI and 3 subjects who experienced multiple episodes of PBSI. RESULTS: From 1/96-10/99, 32 L/SBTx procedures were performed. The crude rate of PBSI per year ranged from 18% to 50% for L/SBTx patients. In 1998-99 the rate of PBSI for patients in the pediatric solid organ transplant ICU was 7.6/1000 central venous catheter days. Risk factors examined at the time of transplant and first 14 postoperative days included: age, gender, race, gestational age at time of birth, body surface index, cold ischemia time, PRISM score, ICU days, inpatient days, organ rejection, enteral feeding, TPN, ulcer prophylaxis, blood products received, central venous catheter days, mechanical ventilation days, and lab data (WBC, Hgb, ALT/AST, Tbili, BUN/Cr, Albumin, FK506 level). In addition, these factors were compared for the 7 days prior to bacteremia between the patients who experienced single episodes and multiple episodes of PBSI. ANOVA testing did not reveal a significant difference between the groups at the time of surgery. Patients who experienced multiple episodes of PBSI had a significantly greater number of days of perioperative mechanical ventilation and a longer period of total hospitalization. CONCLUSIONS: Pediatric L/SBTx patients are at high-risk for PBSI. Patients experiencing multiple episodes of PBSI are more likely to receive longer courses of mechanical ventilation. We did not identify any risk factors present at the time of transplantation that predicted for a greater likelihood of PBSI. Efforts to decrease the incidence of PBSI in pediatric L/SBTx patients should be directed at all of these high risk patients.

NOSOCOMIAL COAGULASE NEGATIVE STAPHYLOCOCCI BACTERAEMIA: A FIVE-YEAR PROSPECTIVE DATA COLLECTION. Silva HL, Strabelli MV, Zeigler R, Cunha ER, Neres SF, Camargo LFA, Uip DE. Univ School of Medicine Sao Paulo, Brazil.

BACKGROUND: Over the last two decades, there has been an increasing documentation of infections due to coagulase-negative Staphylococcus (CoNS), specially S. epidermidis, the most common cause of nosocomial primary bloodstream infections nowadays. OBJECTIVE: To determine the frequency of CoNS isolates in blood cultures, to evaluate the meaning of this isolation (contaminant or pathogen) and its epidemiologic and susceptibility patterns (methicillin, ciprofloxacin, vancomycin, clindamycin and teicoplanin). METHODS: All strains of CoNS isolated from blood culture among adults and children from 1993 to 1998, were classified as contaminant or pathogenic according to NNISS criteria (1988). Infections were classified as primary or secondary bacteraemia, divided by sex and age. Susceptibility patterns were also studied in both groups. RESULTS: From 1993 to 1998, 1702 positive blood culture were listed, being CoNS isolated in 546 samples (32%); 306 (56%) were classified as contaminant and 240 (44%) as true bacteraemia. There were no differences in sex, age and susceptibility patterns (vancomycin=100%, teicoplanin=98.8%, methicillin=19.3%) when comparing patients with nosocomial primary and secondary bloodstream. Surgical endocarditis (47.4%) was the most frequent site of secondary bacteraemia. CONCLUSION: These results confirm the great importance of CoNS as causal agents of bacteraemia in hospitalized patients and its increasing methicillin resistance.

EMERGENCE OF INTRAVASCULAR CATHETERS AS A MAJOR CAUSE OF NON-HOSPITAL ACQUIRED BLOODSTREAM INFECTIONS. Steinberg JP,* Bryant C, Hackman BO. Emory Univ. School of Medicine, Atlanta, GA; Crawford Long Hosp, Emory Univ, Atlanta, GA.

The development of devices for long-term intravascular access and the expansion of medical care outside of hospitals have led to an increase in non-hospital acquired intravascular catheter-related bloodstream infections (C-BSIs). However, the epidemiology of such infections has not been well studied. Since 1980, our Infection Control department has conducted surveillance on community-acquired BSIs. Stratified into 4 intervals beginning with 1980, yearly rates of C-BSIs were: 1980-84,0.2/yr; 1985-89, 5.8/yr; 1990-94, 21.8/yr; and 1995-98, 33/yr. From 1990-98, we identified 240 C-BSIs of which 54% were confirmed by device tip or site cultures growing the same organism. During this decade, the devices most commonly associated with C-BSIs were hemodialysis catheters (43%), implanted ports (32%), and tunneled catheters (13%). In the last two years, hemodialysis catheter related infections increased dramatically with these catheters causing 53/86 (62%) C-BSIs. Since 1990, Staphylococcus aureus caused 46% (111/240) including 34 MRSA C-BSIs. Coagulase negative staphylococci (CNS) caused 26% while gram negative organisms caused 23%. Gram negative C-BSIs were more likely to occur in warmer months, May-Oct (p<0.01). Intravascular catheters have emerged as an important cause of non-hospital acquired bloodstream infections. The distribution of devices causing these infections continues to evolve. The microbiology of these infections, with S. aureus causing more infections than CNS and a seasonal variation of gram negative infections, may be different compared to nosocomial catheter-related infections.

ANTIBIOTIC-LOCK TECHNIQUE: AN ALTERNATIVE THERAPEUTIC APPROACH TO CENTRAL VENOUS CATHETER RELATED BACTEREMIA. Viale P, Pan A, Petrosillo N, Signorini L, Bombana E, Colombini P, Cristini F, Carosi G, GHIO. Clinica di Malattie Infettive, Université di Brescia, Italy; Istituti Ospitalieri di Cremona, Italy; IRCCS L Spallanzani, Rome, Italy.

OBJECTIVES: Removal of permanent central venous catheter (P-CVC) in patients with sepsis to pose a correct diagnosis may at times not be feasible, and a sterilization of the P-CVC could prove useful. We evaluated in an open, prospective, uncontrolled study the efficacy of the so called antibiotic-lock technique. METHODS: Immunosuppressed patients with a P-CVC related sepsis (CDC 1995 criteria) were enrolled in this study. The P-CVCs were trated with an antibiotic lock lasting >12 hours of 4+/- 0.5 mL of either Vancomicine (10 mg/ml), Teicoplanine (20 mg/ml), Amikacine (20 mg/ml), or Amphothericine B (2.5 mg/ml). When 2 drugs were used each was left in the P-CVC for >6 hours. If symptoms resolved within 72 hours, lock therapy was continued for a total of 7 to 14 days. RESULTS: 14 episodes were seen in 11 patients (6 AIDS, 4 tumors, 1 cystic fibrosis). S. epidermidis was isolated in 6 cases, S. aureus and P. aeruginosa in 2, Enterococcus spp., P. aeruginosa, K. pneumoniae, Enterobacter spp., Bacillus spp. And C.albicans in 1 instance each. 12 patients were treated with monotherapy and 2 with combination therapy. In 12 out of 14 patients the P-CVC infection was successfully treated. One patient relapsed 65 days after fever resolved. No side effects were recorded. CONCLUSION: Although the study sample was small, the results look interesting. The high rate of success, the low incidence of side effects, the simplicity of the execution, and the reduction in systemic antibiotic exposure permit to hypothesize a study on a bigger sample of this kind of approach to CVC related bacteremias.

CATHETER-RELATED BACTEREMIA IN ICU PATIENTS IN A COMMUNITY HOSPITAL. Warren DK, Zack JA, Woodward JA, Ferris VM, Cox MJ, Fraser VJ. Washington Univ School of Medicine, Saint Louis, MO; Missouri Baptist Hosp, Saint Louis, MO.

This study evaluated the epidemiology and risk factors of catheter-related bloodstream infections (CRBSI) in a community hospital ICU. Missouri Baptist Hosp is a 500-bed suburban hospital with a 10-bed MICU and 10-bed SICU. Demographic data was obtained on 2390 patients (pts.) admitted to the ICU's from 3/1/98-6/30/99. CRBSI and ventilator-associated pneumonia (VAP) were defined by NNIS criteria. Central venous catheters (CVC) placed in the ICU or <24 hrs. prior to ICU admission were included. 663 pts. Received CVC. Pts. Mean age was 68 (18-96). 348 (52%) were male, 617 (93%) were white, 303 (46%) were admitted to the MICU, 273 (41%) had CHF, 217 (33%) had COPD, 195 (29%) were diabetic, and 112 (17%) had cancer. 25 was the mean APACHE 2 score on admit. 376 (57%) were on a ventilator and 85 (13%) had VAP. 219 (33%) had multiple CVC insertions with the mean of 8.8 line-days/pt. 33/663 (5%) pts. Developed CRBSI at a rate of 5.6/1000 line-days. CHF (p=.01), steroid use (p=.004), multiple intubations (p<.001), multiple CVC insertions (p<.001), VAP (p<.001), and high APACHE 2 on admission to the ICU (p<.001) were associated with CRBSI on univariate analysis. VAP [odds ratio(OR)=6.8, 95% confidence interval(CI)=2.9-16.1] and multiple CVC insertions (OR=2.7, CI=1.1-6.5) were independently associated with having a CRBSI. Pts. With CRBSI vs uninfected pts. Had increased ICU length of stay (LOS) (24.1 vs 5.7 days(d.), p<.001), increased hospital LOS (42.0 vs 16.7 d., p<.001), and increased mortality [20/33 (61%) vs 162/468 (26%), p<.001]. Death in CVC pts. Was associated with multiple intubations (OR=3.8, CI=1.3-11.4), increasing age (OR=1.03, CI=1.01-1.05), increasing APACHE 2 (OR=1.06, CI=1.02-1.09), and sepsis (OR=2.4, CI=1.4-3.9). CRBSI rates in this community hospital are consistent with academic centers. Pts. With CRBSI where more likely to have VAP and multiple CVC insertions. Pts. With CRBSI have a high crude mortality, increased ICU and hospital LOS.

Clinical Laboratories—Abstracts in this category appear in* Am J Infect Control *February 2000.

Cost-Effectiveness—Abstracts in this category appear in* Am J Infect Control *February 2000.

Critical Care

DOES RESISTANCE AMONG NOSOCOMIAL PATHOGENS DIFFER BETWEEN PEDIATRIC AND ADULT INTENSIVE CARE UNITS?. Coignard B, Fridkin SK, Hill H, Lawton R, Edwards J, McGowan JE, Tenover FC, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA; Rollins School of Public Health at Emory Univ, Atlanta, GA.

Cumulative susceptibility reports are commonly used to guide empiric therapy. To determine if percentages of resistance (%R) for nosocomial pathogens should be generated for each specific ICU type, we analyzed data from 15 pediatric and 150 adult intensive care units (ICUs) from project Intensive Care Antimicrobial Resistance Epidemiology (ICARE). ICARE is an observational, ecologic study in 61 U.S. hospitals participating in the National Nosocomial Infections Surveillance (NNIS) System that reported data on susceptibility patterns of select bacteria isolated from patients in ICUs. We limited the analysis to the pediatric ICU and five adult ICU types (medical, surgical, medical-surgical, coronary care, and cardio-thoracic) that tested at least 10 isolates for each organism-antimicrobial combination. We compared the distribution of %R among ICU types using Kruskall-Wallis tests. From January 1996 to July 1999, 165 ICUs reported a median of 214 isolates over a median of 12 months. The %R differed significantly between pediatric and adult ICUs for methicillin-resistant Staphylococcus aureus (MRSA) (10.5% vs. 43.2%; p<0.001) and for quinolone-resistant Pseudomonas aeruginosa (6.1% vs. 20.0%; p<0.001); the %R did not differ among the five types of adult ICUs. No significant differences in %R were observed for methicillin-resistant coagulase negative staphylococci (75.3%), ceftazidime- (11.7%) or piperacillin-resistant (14.3%) P. aeruginosa, ceftazidime-resistant Enterobacter (27.5%), or ceftazidime- (1.4%) or quinolone-resistant (2.3%) Escherichia coli. These comparisons demonstrate that susceptibility patterns of select pathogens (e.g., MRSA) may be separately reported to clinicians in pediatric ICUs to maximize available information for best empiric therapy choices. No differences were seen in patterns from adult ICUs; however, unusual patterns at individual centers may justify separate reporting.

DAILY RATES OF VENTILATOR-ASSOCIATED PNEUMONIA: ANALYSIS OF TRENDS ACCORDING TO THE TYPE OF MICROBIOLOGICAL ISOLATES. Fabry J, Abidi H, Vanhems P, Carlet J. C.CLIN SUD-EST, CHLS Pierre-Benite, Lyon, France; Saint-Joseph Hosp, Paris, France.

BACKGROUND: Heterogeneity of nosocomial pneumonia (NP) is now widely recognized: several risk factors operate at various times during hospitalization and lead to different clinical and microbiological features. OBJECTIVE: To describe the dynamics of occurrence of NP over time related to the usual ecological reservoir of the microorganisms

isolated in the patient. METHODS: During a large European survey (EURO.NIS), 389 ICUs prospectively followed up all patients hospitalized during one month. Registered data included patient characteristics and NP defined according to CDC's clinical criteria. Time-dependent distribution of the risk of NP was estimated through cumulative survival analysis with production of instantaneous failure rate curves. NP were divided into 3 groups: Group 1 where at least one typically hospital organism was isolated (MRSA, Acinetobacter, Citrobacter or Enterobacter or K. pneumoniae cefotaxime-R, Pseudomonas spp., Candida, Aspergillus spp.), Gr. 2, with only normally community-acquired organisms (many susceptible Gram + cocci or Gram-bacilli), Gr. 3, with undetected, untested or ubiquitous organisms such as coagulase -staphylococci, Proteus spp., Seratia spp., Legionella spp., other fungi, virus. RESULTS: Overall, 661 ventilated patients (8.3%) acquired a NP, a device-specific rate of 33.1 cases per 1000 patient-ventilator days (pvd). NP of Group 1 occurred at a mean rate of 10.5 cases per 1000 pvd; their daily rates rapidly increase from Day1 to a maximum at D10, and then slowly decrease until D30. In Gr. 2 (7.0 cases per 1000 pvd), the shape of the failure rate curve is completely different with higher daily rates from D1 to D5, followed by stable lower daily rates until D20. Group3 NP show a mix of both previous figures with a regular decrease from D1 to D30. CONCLUSION: This analysis strongly supports the heterogeneity of NP and probably its variable relation with quality of care. Both the date of occurrence and the type of organisms should be considered in a refined epidemiological classification of these infections.

COMBINING CRITICAL CARE UNITS—AN INFECTION CONTROL HAZARD. Fleming J,* Clarvit JA, Lumish RM. Mercy Hosp, Pittsburgh, PA.

In 1997, a decline in cardiac surgery patient volumes was noted due to an increase in community hospital competition. As a result, the hospital combined its 15-bed Coronary Care Unit (CCU) with its 20-bed Cardiovascular Surgical Intensive Care Unit (CVSICU). The decision to combine the two units was made by administrators without medical staff or infection control input. Since the two units have been combined, infection rates have increased. Ventilator-associated pneumonia rates 9.43/1000 vent days (CCU '96) and 6.64/1000 vent days (CVSICU '96) increased to 21.5/1000 '98 and 19.6/1000 '99. Nosocomial MRSA and VRE increased from 3 (CCU '96) and 4 (CVSICU '96) to 26 in 1999 (combined unit). Efforts to segregate the medical patient from the surgical patient into two separate areas within the unit failed due to census fluctuating and nursing staffing. Risk factors thought to be associated with these increased rates were staffing problems and length of stay (LOS). Nineteen (19) nurses were displaced with the initial move. Cross training of these two nursing staffs and low staff morale led to additional resignations. Staffing shortages resulted in mandatory overtime. The shortage of critical care beds resulted in non-cardiovascular admissions to the unit and cardiac patients with post-operative respiratory complications remained in the unit. Control measures implemented included rehiring of nurses, education of staff, and infection control rounds with unit management. In spite of these measures, rates continue to be above acceptable levels. Informing medical staff leaders of the increased infection rates and LOS has resulted in the following recommendations to administration: (1) segregating critical care patients (2) opening critical care beds to accommodate the non-cardiovascular surgical patient. Administrative decisions affecting patient outcomes need a collaborative team approach that includes medical staff and infection control.

RAPID CYCLE IMPROVEMENT PROCESS TO DECREASE VENTILATOR-ASSOCIATED PNEUMONIA RATES. Flick GR, Church NB*. Providence St. Vincent Med Center, Portland, OR.

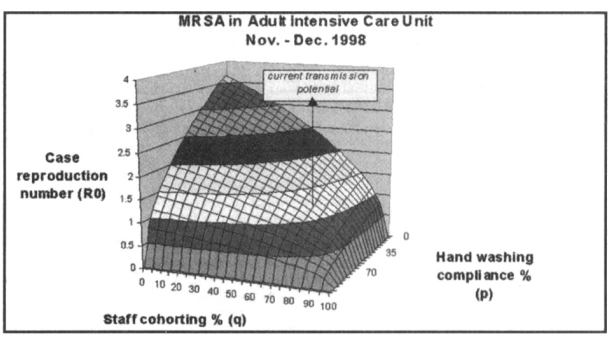
Often frustrated by an inability to change procedures which could benefit certain populations, Providence St. Vincent Med Center (PSVMC) enacted the PDSA model—Plan, Do, Study, Act—to effect more rapid change. The medical surgical ICU desired to decrease the ventilator-associated pneumonia rate. As a member of the National Nosocomial Infection Surveillance (NNIS) study, our hospital benchmark rates and quarterly intensive care pneumonia rates had been reported to the Critical Care Committee. Due to the high cost and morbidity associated with a ventilator-associated pneumonia, a PDSA committee formed to review current procedures and initiate changes which could potentially decrease our infection rate. The Critical Care Intensivist chaired the committee, consisting of pharmacy, critical care nursing, administration, respiratory therapy, pulmonology, infection control and critical care medicine. Using our own data and the CDC Guidelines for Prevention of Pneumonia, the committee focused on several areas: elevating the head of the bed at least 30 degrees unless contraindicated, suctioning protocols, and H2 blockers to preserve gastric acidity. Protocols were developed and posted for comment. Weekly reviews were held to determine what changes were needed in the protocols. The house staff was informed of the protocols and encouraged to enroll their patients. Protocol implementation began in Sep 1997. From Apr 1996 to Aug 1997, the mean ventilator associated pneumonia rate was 10.01 compared to the NNIS mean of 12.3. After institution of the protocols, the PSVMC mean was 4.65 from Sep 1997 to Jun 1998 (p=.02). The decreased infection rate has continued through Jun 1999.

RISK FACTORS FOR COLONIZATION WITH MULTI-RESISTANT GRAM-NEGATIVE BACILLI IN CLINICAL-SURGICAL ICU PATIENTS. Góngora-Rubio F,* Pignatari ACC, Wey SB, Almeida MG, de Góngora DVN. Hosp de Base - FUNFARME, Sao José do Rio Preto - SP, Brazil; Paulista Med School - UNIFESP - Sao Paulo, Brazil; Ospital de Base - FUNFARME. Sao José do Rio Preto - SP, Brazil.

A prospective cohort study was conducted to determine risk factors for MR-GNB colonization in the posterior oropharynx of patients admitted to the clinical-surgical ICU, throughout a one-year period. Swab was collected on the first and third hospitalization day, and every seven days until discharge or death. Classic methods were used for identification and antibiotic susceptibility tests. MR-GNB was established as I-R in at least three of four ATB (amikacin, ciprofloxacin, ceftazidime and imipenem). During study period, 1103 patients were admitted and 430 (39%) entered the study, 113 (26.3%) were colonized, and 317 (73.7%) were not. Of the 113 cases, 53 (46.9%) were colonized on the third hospitalization day. The prevalence of MR-GNB at ICU admission was 7.2%. Of the 317 non-colonized patients, controls were chosen and the population was divided: population 1 (P1) (175 controls and 113 cases), patients with >48 hours of hospitalization; population 2 (P2) (58 controls and 58 cases), patients with prior hospitalization <48 hours and population 3 (P3) (25 controls and 25 cases), patients on the third hospitalization day at ICU. Multivariate analysis for P1 showed five colonization-associated factors: males, previous antibiotic, previous H2 blocker, mechanical ventilation at ICU, and nasogastric catheter at ICU. Significant factors were antibiotic and mechanical ventilation in P2 and males, nasogastric catheter, use of antibiotics, and orotracheal intubation in P3. The most frequently isolated bacteria were Acinetobacter spp. 40.7% and P. aeruginosa 11.5%. Overall amikacin, ciprofloxacin, ceftazidime and imipenem resistance was 97.3%, 92%, 92.9%, and 32.7%, respectively.

UNDERSTANDING THE EPIDEMIOLOGY OF HIGHLY ENDEMIC METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN INTENSIVE CARE UNITS: IMPORT, TRANSMISSION, AND SCOPE FOR PREVENTIVE STRATEGIES. Grundmann H, Austin DJ, Hori S, Kelly T. Univ Hosp Nottingham, Queen's Med Centre, Nottingham, United Kingdom; Wellcome Trust Centre for the Epidemiology of Infectious Diseases, Univ of Oxford, United Kingdom.

Methicillin-resistant Staphylococcus aureus (MRSA) has emerged as a major infection control problem in hospitals throughout the U.K. Nationwide, the proportion of S. aureus bloodstream infections caused by MRSA has increased between 1991 and 1999 from 1% to 37% with the highest rates encountered in intensive care units (ICUs). The highly endemic nature of MRSA colonisation/infection among ICU patients makes it increasingly difficult to understand the underlying epidemiology and to predict the relative effectiveness of different interventions. In an attempt to identify the proportion of imported versus unit-acquired MRSA and risk factors associated with different routes of acquisition, we included all patients admitted to the adult intensive care unit (AICU) at the Univ Hosp Nottingham after May 1998 into a prospective cohort study. Concurrently, high density MRSA screening, PFGE typing of all isolates, and monitoring of handwashing compliance and staff cohorting levels was carried out. Mathematical modeling was used to estimate the impact of preventive measures. Stratification of 68 cases by MRSA genotype revealed a cluster of potential episodes of transmission associated with increased workload during winter months. Risk factors for non-clustered cases were consistent with imported MRSA. Fitting the collected data into a stochastic model, the case reproductive number for different observation intervals could be determined. The model predicts that during periods of highest prevalence improvement in hand hygiene by 16% or an increase of staff cohorting by 11% would have reduced the average number of secondary cases below one (the epidemic threshold). We conclude, that (1) the majority of MRSA cases are introduced into AICU at Univ Hosp Nottingham, and (2) handwashing compliance or cohorting of staff needs to increase in order to prevent outbreaks, especially during periods of peak prevalence.



RISK OF INFECTION DUE TO CENTRAL VENOUS CATHETERS: EFFECT OF DAYS AND SITE OF PLACEMENT AND TYPE OF DRESSINGS. Hoefel HHK, Delucis CM, Grillo MF, Konkewicz L, Kuplich NM, Machado ARL. Hosp de Clínicas de Porto Alegre, RS, Brasil.

OBJECTIVE: To determine the influence of catheter dressings type, in place, site of central catheter-placement, device-days on infection rates associated with central venous catheterization. DESIGN: prospective randomized study of nontunneled central venous catheter and dressings over a 10-month period. Dressings included gauze and three transparent (Bioclusive®, Opsite®, Tegaderm®). When necessary by bled the first transparent dress was changed definitively by gauze. SETTING: Intensive care unit of univ hosp in south of Brazil. RESULTS: 1129 dressings were placed in 448 catheters (58% single-lumen, 24% swan ganz and 18% double-lumen), of 331 patients. Three hundred nine (309, 69%) catheters were in subclavian vein, 92 (20,5%) in jugular vein and 47 (10,5%) in femoral vein. Gauze dressing were 461 (40,8%), Opsite® 245 (21,7%), Tegaderm® 220 (19,5%) and Bioclusive® 203 (18,0%). Catheters in subclavian vein infected more than jugular and femoral. Catheters without infection were 5 days in place and with 8 days (p<0.005). There was no difference to change dressings every 2 or 3 days. Infections occurred related to 10% catheters. Double-lumen was associated with infection (mostly of them using Tegaderm®). However, double lumen was significantly more associated to infection then type of dressing by multiple analysis (95% CI). CONCLUSION: There was no association with type or period of dressing changes. Although it is suggested that Tegaderm® was more associated to infection this study was not conclusive. Our data support association between infection and double-lumen catheters and extended period of catheter in place.

CAN ALCOHOL-BASED HANDRUB IMPROVE COMPLIANCE WITH HAND HYGIENE IN ICU ?. Hugonnet S, Perneger TV, Pittet D, Members of the ICP. Infection Control Program, Departement of Internal Medicine, Univ of Geneva Hosps, Geneva, Switzerland.

BACKGROUND: Hand hygiene (HH) is the single most important measure to prevent cross-infection. ICUs are crucial hospital areas, because the intensity of patient care, the number of high risk procedures and the incidence of nosocomial infection are high, and the compliance to HH usually low. We promoted HH and assessed risk factors for non-compliance in ICUs. METHODS: We performed biannual observational surveys from 1994 onwards in our medical, surgical and pediatric ICUs. We implemented an ongoing educational campaign starting after baseline survey, and aiming to improve HH with a special emphasis on hand disinfection through alcohol-based handrub (ABH). Healthcare workers were observed during routine patient care, and compliance to HH was recorded. FINDINGS: We observed 2,743 opportunities for HH during 248 observation periods, totaling 84 hours of observation. 21% of the opportunities were of high risk of cross-transmission. Overall compliance increased from 38 to 55% over the study period (p<.0001), and this was due to the

increase in ABH (5.4 to 22%, p<.0001). Compliance increased among nurses and hospital auxiliaries (both p<0.05), but remained stable among physicians. It did not change among low-medium, but increased among high risk opportunities (p=.003). Level of risk, high workload, and to be a physician as compared to a nurse independently predicted non-compliance (OR 3.2, 1.02 and 2.1 respectively, all p<.001). Compliance to handwashing was significantly decreasing with increasing workload (regression coefficient -0.004, p<.001), whereas no such association was found with ABH (p=.12). CONCLUSION: The campaign had a marked impact on compliance, notably among high risk opportunities. High workload remains a risk factor for non-compliance, but our data suggest that the less time-consuming ABH might be the solution to by-pass the obstacle of "being too busy" and "poor access to sinks."

FREQUENCY AND CHARACTERISTICS OF CANDIDA NOSOCOMIAL INFECTIONS IN INTENSIVE CARE UNITS. Lepape A, Arich C, Savey A, Bouletreau A, Ayzac L, Fabry J. Hosp Lyon Sud, France; Hosp Nimes, France; CCLIN Sud-Est, Hosp Lyon-Sud, France.

OBJECTIVE: An increased frequency of Candida nosocomial infections (NI) in ICUs has been recently reported by the NNIS (Richards. CCM 1999). The aim of this study was to evaluate the frequency and characteristics of patients with Candida NI in a French surveillance network. METHODS: Data were collected since 1995 through a continuous surveillance in 21 ICUs. On each patient, the units have recorded age, sex, severity on admission, diagnosis category, exposure to invasive devices, and NI (pneumonia and UTI, central venous and arterial catheter colonizations and candidemia/bacteremia). RESULTS: among the 18,155 patients included, 18% had at least one NI and in 17% of them at least once Candida was isolated (622 isolates, associated with bacteria in 16%). The distribution of Candida isolates was: urinary tract (62% of fungal infections), lungs (23%), blood culture (7%), central venous (7%) and arterial catheter (1%). In univariate analysis, patients with Candida infections compared to patients with bacterial NI were slightly older (p<0.05), had a significantly (p<0.001) longer length of stay and pre-NI duration of exposure to invasive devices except for bladder catheterization (14.3 vs. 14.4 d). They were more likely to be women (p<0.001) and have a medical primary diagnosis (p<0.001). The frequency of Candida NI remained stable in the period 1995-98. CONCLUSIONS: This study confirms the frequency in Candida isolates in patients considered as infected by the ICUs. Further study should determine if these infections were treated.

EVALUATING A PROGRAM TO REDUCE PRESSURE ULCERS IN CRITICAL PATIENTS. Pinheiro SMC,* Nogueira MGS, Couto BRGM, Almeida FF, Starling CEF. Hosp Felicio Rocho, Belo Horizonte, Brazil.

INTRODUCTION: Pressure ulcers (PU) increases the risk of secondary infection under higher morbidity and healthcare costs. The incidence of PU in critical patients varies between 2.7% to 29.5%. In a previous study we found that Douglas' score <12 points could be used in selecting patients who needs preventive measures. OBJECTIVE: (1) to evaluate the results of the program to reduce PU based on Douglas' scale. METHODS: Prospective cohort study of all the patients admitted in two intensive care units (ICU X; ICU Y): Mar-Apr/1998 (period A=before the program) and Nov/98 to Sep/99 (period B=after starting the program). The nurses of the ICUs collected the data. The program consisted of: evaluation of patients on admission and every 72 hours until ICU discharge; introduction of preventive measures for high-risk patient (score <12 points), such as: periodically patient repositioning, pressure relievers, skin hydration and transparent film on friction areas. For the low-risk patients (score and #61502; 12 points) only periodically repositioning was performed. RESULTS: In period A, 22/191 patients developed PU (incidence=12%). In period B, 88/1,262 developed PU (7%; p-value=0.039). The stratification by using the Douglas' scale showed a significant reduction of PU in low-risk patients: 16/177=9% (period A) versus 52/1,102=5% (period B, p-value=0.028). In high-risk patients the PU incidence was: 6/14=43% (A) versus 36/160=23% (B, p-value=0.106). The program was more effective in reducing PU in the ICU X than in the ICU Y. For the ICU X we observed about 50% reduction in the incidence. In high-risk patients of ICU X: 5/12=42% (period A) versus 25/135=19% (period B, p-value=0.069). In low-risk patients of ICU X: 8/97=8% (period A) versus 24/610=4% (period B, p-value=0.066). However, in the ICU Y the results were not so good in high-risk patients: 1/2=50% (period A) versus 11/25=44% (period B, p-value=1.000). In low-risk patients of ICU Y: 8/80=10% (period A) versus 28/492=6% (period B, p-value=0.221). CONCLUSION: the program proposed for reducing PU in critical care patients was shown be effective.

PREVALENCE OF INFECTIONS IN INTENSIVE CARE UNITS IN MEXICO: A MULTICENTER STUDY. Ponce de León Rosales S, Molinar-Ramos F, Domínguez-Cherit C, Rangel-Frausto MS,* V zquez-Ramos V. Natl Institute of Nutrition, Mexico City, Mexico; La Raza Med Ctr IMSS, Mexico City, Mexico; Hoechst Marion Roussel, Mexico City, Mexico.

OBJECTIVE: Determine the one-day prevalence of community-acquired (CA), hospital-acquired (HA) or ICU-acquired (ICUA) infections inpatients admitted to intensive care units (ICUs). Identify associated risk factors for nosocomial infections, predominant organisms and mortality rates. DESIGN: A 1-day point-prevalence study. SETTING: ICUs in Mexico. RESULTS: 254 ICUs participated in the study. There were 521 patients infected (58.2%). CA 214 (23.9%). HA occurred in 99 (11.1%), and 208 had ICUA infection (23.2%, 1.45 episodes/patient). Most frequently were pneumonia (39.7%), urinary tract (20.5%), wound (13.3%) and bacteremia (7.3%). Mortality rate after 6 weeks was 24%. Enterobacteriaceae (25.9%), P. aeruginosa (17.2%), S. aureus (10.9%), coagulase-negative staphylococci (4.1 %) and Candida spp. were the most common isolates (14.9%). After multivariate regression analysis, risk factors for ICUA infections were: neurological failure (OR 1.7, CI95% 1.0-2.8); length of stay in ICU (OR 1.1, CI95% 1.1-1.15); number of therapeutic/diagnostic interventions (OR 1.11, CI95% 1.01- 1.2); peripherally administered hyperosmolar solutions (OR 6.93, CI95% 2.45-21.66); sedatives (OR 1.75, CI95% 1.18-2.6); emergency surgery (OR 1.87, CI95% 1.25-2.81), multiple trauma (OR 1.7, CI95% 1-2.8) and catheters (OR 2.7, CI95% 0.9-8.1). Antimicrobial prophylaxis was founded protective (OR 0.63, CI95% 0.38-1.0). Factors significant in the multivariate regression model for mortality were: APACHE II score on admission (OR 1.19, CI95% 1.0-1.4), clinical data that supported the diagnosis of inflammatory processes (SIRS: OR 2.7, CI95% 1.7-4.2; severe sepsis: OR 4.2, CI95% 2.5- 7; and septic shock: OR 5.5, CI95% 2.9-10.45); number of organ failures (OR 1.3, CI95% 1.1-1.52), age (OR 1, CI95% 1.0-1.024), neurological damage (OR 2.05, CI95% 1.39-3), hemodialysis (OR 7.24, CI95% 1.8-31.67), steroid therapy (OR 1.73, CI95% 1.04-2.8). Antimicrobial treatment decreased the risk to die (OR 0.41, CI95% 0.2-0.8). CONCLUSIONS: This point prevalent study across Mexican ICUs gives evidence of a high frequency of nosocomial infections, potential risk factors for acquiring infections and mortality. We also provide rates of mortality according to the hierarchy of the systemic inflammatory response syndrome in Latin American ICU's.

DOES TRANSPARENT ADHESIVE DRESSING REDUCE CATHETER-RELATED INFECTION IN REAL LIFE? Starling CEF, Couto BRGM. Felicio Rocho Hosp, Belo Horizonte, Brazil.

INTRODUCTION: In a previous randomized control clinical trial we found a trend favoring the use of transparent adhesive dressing (TAD) in reducing catheter colonization and catheter-related infection (CRI). Now we evaluated the impact of the implementation of TAD as a routine for catheter care in two intensive care units (ICU A and B) on the CRI rates. OBJECTIVE: To evaluate the incidence of CRI in two ICUs after standardization of TAD as a routine for central venous catheter care. METHODOLOGY: A prospective cohort study including all patients submitted to central venous catheterization was conducted to compare CRI rates from period I (Jun 1997 to May 1998), when gauze and tape dressing were used, with period II (Jul 1998 to Jun 1999), when we used just TAD. In Jun 98 the healthcare workers from both units received a practical training about how to use TAD. Data were collected by following NNIS protocols for ICU. RESULTS: Between Jun 97 to Jun 99 3,009 patients were admitted on both ICUs and 1,979 of them were submitted to central line (66%). The monthly average and (standard deviation) of NI data in both periods (I × II) are: patients with central line: ICU A=39 (7) × 36 (4), p=.401; ICU B=46 (7) × 38 (7), p=.008. central line Length of stay (days): ICU A=4.6 (1.6) × 4.4 (0.7), p=.954; ICU B=4.5 (0.7) × 5.2 (1.2), p=.064. Average severity of illness score (ASIS): ICU A=3.1 (0.3) × 3.0 (0.4), p=.641; ICU B=3.3 (0.3) × 3.4 (0.5), p=.643. Central line utilization=central-line days/patient-days: ICU A=0.61 (0.07) × 0.59 (0.08), p=.615; ICU B=0.55 (0.05) × 0.51 (0.10), p=.224. Cardiovascular infection (CVS) rate=CVS/1,000 central-line-days: ICU A=24.9 (19.3) × 18.0 (13.5), p=.321; ICU B=20.5 (14.1) × 16.0 (11.7), p=.597. CONCLUSION: The use of TAD routinely did not change the CRI average rate in both ICUs. Despite a reduction of the number of dressing changes and catheter manipulation, the cost benefit of TAD in developing countries is still an open question.

Dialysis Patients

VASCULAR ACCESS, BLOOD CULTURES, AND BLOODSTREAM INFECTIONS IN HEMODIALYSIS. Alston WK, Goodman DH, Huston CD, Weidner MH, Page SD, Sussman MI, Rimmer JM . Univ of Vermont College of Medicine and Fletcher Allen Health Care, Burlington, VT.

A prospective study was conducted between 11/1/97 and 10/31/98. FAHC provided hemodialysis (HD) to inpatients and at 5 outpatient sites. METHODS: Access for HD patients (pts) was recorded daily and all blood cultures (BCs) were reported weekly. Nurses recorded access, BC indication, and how BC was drawn. Bacteremic pts were reviewed. RESULTS: 282 pts received over 26,000 HD treatments. There were 62,455 access-days: 60% PTFE graft-days, 26% DLC- days (dual-lumen, tunneled, cuffed catheter), and 13% native AV fistula-days (AVF). 135 pts had 628 BCs. BCs were drawn at rates of 17.1 BC/1,000 DLC-days, 5.8 BC/1,000 PTFE-days, and 5.1/1,000 AVF-days (p<.001). Chills best predicted a positive BC: 56/110 BCs (51%) positive vs 114/518 (22%) without (p<.001). 170/628 BCs (27%) were positive: 34% with DLC (5.6 +BC/1,000 DLC-days), 23% with PTFE (1.4 +BC/1,000 PTFE-days), and 10% with AVF (0.5 +BC/1,000 AVF-days) (p=.003). 158/170 BCs (93%) were judged clinically significant. Presumed sources: 95/158 (60%) access-related, 50 (32%) unknown, and 13 (8%) secondary infection. 54/158 (34%) grew S. aureus. Outcomes for 34 pts following initial positive BC during chronic HD via DLC: 5/34 (15%) died, 23 (68%) had DLC removed, 15 (44%) were hospitalized, and 6 (18%) remained bacteremic after one week of antibiotics or relapsed. CONCLUSIONS: Pts with DLCs accounted for 26% of HD access-days, 41% of all BCs drawn, and 54% of all positive BCs. Bacteremias in pts with DLCs result in significant morbidity and mortality.

MICROBIOLOGIC WATER QUALITY OF PROCESSED WATER FROM 19 METRO-ATLANTA HEMODIALYSIS FACILITIES. Arduino MJ, Levi M, Aguero SM, Miller PH, Miller ER. Ctrs for Disease Control and Prevention, Atlanta, GA.

Hemodialysis patients are exposed to up to 225-360 L/week (500 ml/min dialysate flow rate, 2.5-4 hr dialysis session, 3 times a week) in the form of dialysate. The microbial quality of dialysis fluids has been linked to both acute (pyrogenic reactions and bacteremia) and chronic sequelae (chronic inflammatory response syndrome, amyloidosis, carpal tunnel syndrome, etc.) in hemodialysis patients. A microbiologic survey was conducted of 19 metro-Atlanta maintenance hemodialysis facilities during Jan-Mar 1997. Samples of water used to reprocess Hemodialyzers and from selected taps in the water distribution system were collected in sterile endotoxin-free containers and delivered to the laboratory for assay. All water samples were cultured using the recommended Association for the Advancement of Med Instrumentation (AAMI) method (membrane filtration technique, with membrane filters placed on TSA agar and incubated for 48 hr at 36°C) and endotoxin activity was determined using the kinetic turbidimetric Limulus amebocyte lysate test. Colonies were counted and results were compared to several differing limits (<50 CFU/ml, <100 CFU/ml, <200 CFU/ml; <1 EU/ml, <2 EU/ml, <5EU/ml). Overall, 82.6% of samples were within the current AAMI microbiologic standards (<200 CFU/ml) and 91% were below the current limit for endotoxin (<5 EU/ml). Mean colony counts were 20 CFU/ml (range 0-17,000) and mean endotoxin levels were 2.725 EU/ml (range 0-103 EU/ml). Approximately 82% of the samples were found to contain endotoxin activity <2 EU/ml. AAMI is preparing to publish revised standards for water used in hemodialysis applications. These proposed standards address water used to prepare the final dialysate bath and water used in the reprocessing of hemodialyzers. The draft microbiologic standards for water used for hemodialysis are 200 colony forming units (CFU)/ml and 2 endotoxin (EU)/ml with action limits of 50 CFU/ml and 1 EU/ml respectively.

A RANDOMIZED, DOUBLE-BLIND TRIAL COMPARING MINOCYCLINE/EDTA VS HEPARIN AS FLUSH SOLUTIONS FOR HEMODIALYSIS CATHETERS. Bleyer A, Mason L, Raad I, Sherertz R. Wake Forest Univ School of Medicine; MD Anderson Hosp, Houston TX.

We have previously demonstrated that Minocycline/Edta (M) was efficacious at preventing hemodialysis catheters ©-related bloodstream infections in three patients with recurrent infection (CID 25:149,1997). This study compared M vs heparin (H) as flush solutions in central venous C dialysis patients, a high risk group for C-related bloodstream infection. Patients were enrolled within 1 day of C insertion, and randomized in block fashion to receive M or H as a C flush after each dialysis. Each syringe containing flush solution was wrapped in orange plastic to blind the type of solution. Patients were followed for evidence of infection and C thrombosis. During a 14-month period 60 patients were enrolled (M:30,

H:30). The two groups had similar demographics and underlying diseases. Two patients (both H) were excluded from analysis due to their being on antibiotics at the time of enrollment. Five patients withdrew (M: C site itching, alopecia, nausea; H: patient choice, malaise). The average duration of catheterization was as follows: M ±89d, H 65 ±77d. Comparing only those patients whose catheters were not removed due to cessation of renal insufficiency and who completed the study, the average duration of catheterization was 30 ±42d for H (n=14) and 110 ±97d for M (n=19) (p=.003). C in the H group were more likely to be significantly colonized with bacteria than in the M group (69% vs 8%, p=.005). The average time to first thrombosis was 27 ±52d for H (n=13) and 68 ±50 for M (n=14) (p=.049). This preliminary analysis in a small group of patients suggests that M may be a significantly more effective flush solution with a lower risk of infection and thrombosis. Further work is necessary to establish the importance of these observations.

SURVEILLANCE OF HEMODIALYSIS ASSOCIATED BACTEREMIAS: THE EXPERIENCE OF TEN CONNECTICUT HOSPITAL BASED CENTERS. Cooper BW, Dopirak M, Hill C. IC Hemodialysis Surveillance Group. Hartford Hosp, Hartford, CT; Univ. of CT, Farmington, CT. ESRD Network of New England, New Haven, CT; CT Hosp Association, Wallingford, CT.

In hemodialysis (HD) patients, bacteremias are an important source of morbidity and mortality. Although individual HD centers have reported their rates of infection, there are few data comparing rates of bacteremia across multiple centers using standardized surveillance tools and methodology. We developed a multicenter bacteremia surveillance system and report here the initial six-month experience. METHODS: HD and infection control staff at ten hospital based HD centers in Connecticut participated in this effort. A surveillance tool was developed utilizing the Ctrs for Disease Control definition of primary bacteremia. All primary bacteremias occurring in the outpatient HD population were included. Rates of bacteremia were calculated as the number of bacteremias per 1000 dialysis sessions as well as per 100 patient years. All centers utilized active case surveillance by infection control personnel. Infection data were reported to the ESRD Network of New England, which reported coded rates to each center. RESULTS: A total of 103 bacteremias occurred over six months. 33% occurred in patients with fistula/graft access and 67% in patients with central catheter access. Rates per 100 patient years in centers ranged from 0-41.7 with a mean of 18/100 pt. Years. Rates per 1000 dialysis sessions ranged from 0-2.8 with a mean of 1.2/1000 sessions. Coagulase negative Staphylococcus and Staphylococcus aureus accounted for 53.4% and Klebsiella/Enterobacter spp for 11.6% of infections. 52.4% of patients received Vancomycin, 31% received Cefazolin, and 49.5% received aminoglycosides. Our ongoing efforts are an important attempt to establish quality benchmarking for HD associated bacteremia. Data such as these are useful in understanding the epidemiology of primary bacteremias in hemodialysis.

IMPACT OF APPLYING AN ALGORITHM ON THE MANAGEMENT OF FEVER IN PATIENTS RECEIVING HEMODIALYSIS ON RATES OF INFECTION AND COSTS ASSOCIATED WITH CATHETER USE. Mascarenhas LA, Nouér SA,* Vieira PR, Delgado AG, Magalhaes ACG. Univ Hosp, Universidade Federal do Rio de Janeiro, Brazil.

INTRODUCTION: Catheter-related infections account for more than 70% of all infectious complications in patients on hemodialysis. Our hemodialysis center is responsible for patients with acute renal failure coming from the intensive care unit, emergency ward and solid organ transplant unit. There was no standard for the management of catheter-related infections. In May 1998, the infection control service proposed a series of procedures in the hemodialysis unit in order to reduce catheter-related infections, which included: (1) Diagnosis of problems and solutions and (2) Teams training (infection control, handwashing, basic precautions, insertion and manipulation of the catheter). In addition, since Dec 1998, we also applied an algorithm for the management of fever with criteria for removing the device. OBJECTIVE: to assess the impact of these measures in reducing the rates of infection and in the removal of catheters. METHODS: From Jan 1998 to Jun 1999 all patients submitted to hemodialysis who had a central venous catheter were followed. The infection rates were expressed as the number of infectious episodes per patients receiving hemodialysis or per sessions of dialysis performed in each month. We compared the rates of infection before the institution of the procedures (Jan to Apr 1988) to the period after the measures were applied (May 1998 to Jun 1999). RESULTS: 782 patients received 6,997 sessions of hemodialysis. 75 catheter-related infections were diagnosed. The infection rates were 17.7% per patient and 2.17% per session in the first period and 6.9% and 0.75% in the second period (p<.0001 for both comparisons). Between Dec 1998 and Jun 1999, 47 episodes of fever were investigated and in only 26 episodes (44.7%) the catheter was removed. CONCLUSION: Applying the procedures resulted in significant reduction in the rates of infection. In addition, with the use of the algorithm we were able to maintain 44.7% of the catheters in patients with fever.

VANCOMYCIN RESISTANT ENTEROCOCCUS IN DIALYSIS PATIENTS: EVIDENCE OF HOSPITAL ACQUISITION. Steinberg JP,* Howard R, Ho T, Maher M, Hackman B, Jernigan J. Emory Univ School of Medicine, Atlanta, GA; Emory Hosps, Atlanta, GA; School of Public Health, Emory Univ, Atlanta, GA; Emory Hosps, Atlanta, GA.

Dialysis patients are at increased risk for VRE acquisition but it is unclear if VRE transmission occurs primarily in hospitals or outpatient dialysis clinics. During 1997-98, dialysis patients admitted to an urban hospital with a large nephrology service were screened for rectal carriage of VRE within two days of admission. Follow-up cultures were collected during prolonged hospitalizations and a total of 1800 cultures were obtained. Molecular typing of the isolates was done by pulse-field gel electrophoresis (PFGE). During the study period VRE was isolated from 103 of 662 (15.6%) patients whose dialysis clinic could be ascertained. For the nine outpatient clinics from whom >20 patients (range 24-141) were screened, VRE carriage varied from 10% to 23%, but these differences were not statistically significant. To date, PFGE has been done on 50 isolates. There were 3 strains represented by 18, 11 and 4 isolates; all other isolates were unique. Patients carrying the two most common strains received dialysis at 7 and 5 different outpatient clinics, respectively. All three of these strains have been recovered from non-dialysis hospitalized patients. Dialysis patients colonized with VRE (case) were hospitalized for a median of 21 days (range 1-128) during the six month period preceding first VRE isolation compared to a median of 4 days (range 0-26) in non-VRE controls (p<0.001). Case and controls were matched for dialysis clinic and controls had VRE screening within three months of the case-patient's first VRE isolate. We found that VRE colonization in dialysis patients is widespread. These data suggest that dialysis patients are more likely to acquire VRE in the hospital setting and not in the outpatient dialysis clinic.

SURVEILLANCE FOR INFECTIONS IN HEMODIALYSIS OUTPATIENTS: A PILOT STUDY. Tokar JI,* Light P, Armistead N, Parrish J, Miller ER, Gehr T. Ctrs for Disease Control and Prevention, Atlanta, GA; Univ of Maryland, Baltimore, MD; Mid-Atlantic Renal Coalition, Richmond, VA; Virginia Commonwealth Univ, Richmond, VA.

Bacterial and fungal infections, especially those involving the vascular access site, cause considerable morbidity and mortality in hemodialysis patients. Surveillance, with benchmarking of event rates, is well-established in hospitals but not dialysis centers. Therefore, in Oct 1999, CDC initiated surveillance for infections in hemodialysis outpatients. A structured system is used to identify infections: a list is made of all hospital admissions and outpatient starts of an intravenous (IV) antimicrobial, and clinical and laboratory data are recorded for each. We conducted a pilot test of this system during Dec 1997-Jun 1998 at 7 dialysis centers in Richmond, VA, and Baltimore, MD. Overall and center-specific rates of two infections, access-related bacteremia (ARB) and vascular access infection (VAI) were evaluated. Criteria used in definitions were (a) hospitalization or outpatient start of an IV antimicrobial; (b) pus or redness at the vascular access site; and (c) bacteremia without known cause other than the vascular access. ARB were defined as (a) and (c). VAI were defined as (a) and either (b) or (c). A total of 800 patients were followed for 4,056 patient-months (mean 5.1, median 6 months per patient). There were 58 ARB; the ARB rate was 1.5 per 100 patient-months, and varied from 0.3 to 3.3 among the 7 centers. There were 149 VAI; the VAI rate was 3.5 per 100 patient-months, and varied from 1.5 to 5.6 among the 7 centers. Two centers had VAI rates (3.9 and 5.8 per 100 patient-months) above the mean, but ARB rates (0.3 and 0.4 per 100 patient-months) below the mean. At these two centers, blood cultures were performed before only 3.0%-5.9% of IV antimicrobial starts, whereas blood cultures were performed before 8.7%-73.5% of IV antimicrobial starts at the other 5 centers. These data suggest that infections involving the vascular access are common among hemodialysis outpatients, that center-specific rates vary widely, that surveillance for only ARB may significantly undercount infections at some centers, and that both ARB and VAI should be monitored in hemodialysis outpatients.

VANCOMYCIN-RESISTANT ENTEROCOCCI COLONIZATION AT SELECTED OUTPATIENT HEMODIALYSIS CENTERS. Tokars JI,* Gehr T, Parrish J, Qaiyumi S, Light P. Ctrs for Disease Control and Prevention, Atlanta, GA; Virginia Commonwealth Univ, Richmond, VA; Mid-Atlantic Renal Coalition, Richmond, VA; Univ of Maryland, Baltimore, MD.

Vancomycin-resistant enterococci (VRE) are increasingly reported in dialysis patients. To determine the prevalence of and risk factors for VRE, we performed rectal or stool cultures on consenting hemodialysis patients at 7 outpatient hemodialysis centers in Richmond VA and Baltimore MD during Dec 1997-Apr 1998. Consenting patients were recultured during May-Jul 1998 (median 119 days later). Specimens were inoculated onto selective agar with 10 micrograms/ml vancomycin; isolates were tested for vancomycin resistance by disk diffusion using NCCLS standards. We recorded data on demographics; the presence of diabetes, HIV infection, or intravenous drug use (IVDU); vascular access type; albumin concentration; urea reduction ratio (URR; the percent of urea removed during a dialysis session); functional score (1-10 scale with: 1=normal function; 10=disabled, living at home); and inpatient hospital admissions 90 days before culture. Of 800 eligible patients, 346 (43%) were cultured 1 or 2 times. Cultured vs noncultured patients had similar functional score (mean 3.4 vs 3.8, p=.3) and URR (mean 70.5 vs 69.6, p=.1). Of 346 patients, 32 (9.2%) were VRE positive one or more times. Of 132 patients cultured twice, 117 were VRE negative both times, 4 were negative then positive, 8 were positive then negative, and 3 were positive both times. Of 478 cultures, 35 (73%) were positive; the prevalence of positive cultures varied from 4.2% (3/72) to 11.9% (12/101) among the 7 centers. A multivariate model showed that significant (P<.05) independent risk factors for a VRE positive culture were IVDU (odds ratio 6.5), functional score 9-10 (odds ratio 4.2), hospitalization within 90 days of culture (odds ratio 3.4), and lower URR (odds ratio 1.8 per 10% decrease). These findings help identify subgroups of hemodialysis patients at highest risk for VRE. The finding of VRE patients at all 7 centers suggests that VRE colonization may be widespread and therefore that infection control precautions should be used during care of all hemodialysis patients to prevent VRE transmission.

Disinfection

SPORICIDAL ACTIVITY OF ORTHO-PHTHALALDEHYDE AS A FUNCTION OF TEMPERATURE. Chan-Myers HB. Advanced Sterilization Products, Irvine, CA.

Ortho-phthalaldehyde, an aromatic dialdehyde, has emerged as an alternative high level disinfectant to glutaraldehyde (Walsh et al. 1999). To further study the characteristics of ortho-phthalaldehyde, spore suspension tests with 0.3% ortho-phthalaldehyde solution were performed to evaluate the effect of varying temperature on sporicidal activity. The ortho-phthalaldehyde solution was tested against Bacillus subtilis spores (ATCC 19659) at 20, 25, 30 and 35°Celsius. At predetermined timed exposures, aliquots were sampled, neutralized and processed using the membrane filtration methodology. Test results showed that sporicidal activity was observed from all study temperatures evaluated and that the level of activity was directly related to the study temperature. At 35°Celsius, >5-log reduction was observed in 3 hours for the 0.3% ortho-phthalaldehyde solution, whereas at 20°Celsius, a 5-log reduction was observed after 24 hours exposure. In conclusion, the findings of this study demonstrated that the sporicidal activity of ortho-phthalaldehyde is a function of at use temperature.

DO HOSPITAL CLEANING AGENTS AFFECT SPORULATION OF CLOSTRIDIUM DIFFICILE?. Fawley WN, Wilcox MH. Leeds General Infirmary and the Univ of Leeds, Leeds, UK.

Toxigenic Clostridium difficile is the major cause of hospital acquired diarrhoea. A single strain represents approximately 60% of isolates from UK hospitals and 92% of isolates from our own institution. These data suggests that not all C. difficile strains are equally virulent. The presence of organisms in the hospital environment and on the hands of healthcare workers has been repeatedly implicated in the spread of C. difficile infection. Spores produced in vivo are highly resistant to many commonly used cleaning agents, and may persist in the hospital environment for many months. It is possible that endemic strains may display increased levels of spore production, and survive longer in the environment. We report a quantitative method to compare sporulation levels of the endemic clone with other C. difficile strains when cultured in human faeces exposed to hospital cleaning agents. C. difficile strains were cultured for 72 hours in faecal emulsions containing subinhibitory concentrations of 5 cleaning agents, and then samples were spread onto glass slides and Gram stained. Spore counts for the endemic strain (A) were compared with genotypically distinct clinical (B) and environmental (C) isolates. When cultured in detergent-free faecal emulsion, percentage sporulation of strain A was significantly greater than that of strains B and C. All 3 strains showed increased levels of sporulation when cultured in emulsions contain-

ing subinhibitory concentrations of cleaning agent. However, strain A produced significantly more spores than strains B and C when exposed to 3 of the 5 cleaning agents tested. We have demonstrated superior levels of spore production in an endemic C. difficile strain, when grown in faecal matter exposed to hospital cleaning products. We suggest that elevated sporulation capacity, in response to certain environmental stress factors on the hospital ward, may represent a virulence factor associated with the spread and persistence of some strains of C. difficile in the hospital environment.

BACK TO BASICS: A NEW SOURCE OF CONTAMINATION OF ENDOSCOPES. Karanfil LV,* Kress L, Tekle T, Harrington S, Kreska M, Ross T, Hess S, Song X, Perl TM. The Johns Hopkins Hosp, Baltimore, MD.

Endoscopes (scopes) contaminated with bacteria are usually attributed to improper cleaning and disinfection. With the advent of automated scope washers, reports of contamination should have decreased. Periodically at the Johns Hopkins Hospital, the Hospital Epidemiology and Infection Control Department (HEIC) cultures a random sample of scopes. In this procedure culture broth is rinsed through the biopsy channel and cultured for bacteria and mycobacteria. For 6 years of the cultures obtained from scopes grew bacteria. In June of 1999, in both the inpatient (IP) and outpatient scope (OP) suites, 5/13 (39%) of the scope cultures grew Gram negative bacteria. A 2nd set of scope cultures in the IP area still were positive for Pseudomonas aeruginosa with "too numerous to count" (TNC) colonies. Investigations took place in both suites. Cultures of water, hoses, and filters did not yield a source. After observing the scope washing machine in operation in the OP suite, it was found to be leaking water from a fitting which connects tubing to the biopsy channel. The fitting was culture positive for a P. pseudoalcaligenes strain that was a DNA fingerprint match to a scope isolate. In the IP suite, the detergent used for cleaning scopes required dilution with water. Cultures of the detergent, diluted detergent, water and compressed air were all negative. Eventually it was revealed that the detergent bottles in the scope washing machines were never disinfected with a high-level disinfectant as required on a daily basis by the manufacturer. 8/8 (100%) of the detergent bottles grew TNC P. aeruginosa. Representative P. aeruginosa recovered from 2 detergent bottles and one scope were shown to be the same strain by pulsed-field gel electrophoresis. While no infections after scope procedures were reported, an analysis is being performed. Other centers should periodically assess the effectiveness of the high-level disinfection of endoscopes.

ACUTE FEBRILE REACTIONS WITH HYPOTENSION TEMPORALLY ASSOCIATED WITH THE INTRODUCTION OF A CONCENTRATED BIOENZYME PREPARATION IN THE CLEANING AND STERILIZATION PROCESS OF ENDOMYOCARDIAL BIOPTONES. Lee CH, Cheng SM, Humar A, Gardam MA, Daly P, Ross H, Conly JM. Toronto General Hosp, Univ Health Network, Univ of Toronto, Toronto, Ontario; Toronto Western Hosp, Univ Health Network, Toronto, Ontario.

INTRODUCTION: Cardiac transplant patients undergo endomyocardial biopsy (EMB) at 2 sites within our 1000-bed 3-site tertiary care facility. The occurrence of 5 acute febrile reactions post EMB at a single site prompted us to investigate the etiology. CASE DEFINITION: All 5 cases occurred within 24 hours of each other and were characterized by fever > 38°C, rigors, malaise +/- hypotension occurring within 2 hours of EMB done at a single site. INVESTIGATIONS: A review of the medical records of other EMB patients and other cardiac centers across Canada revealed no other cases. Chart review of the 5 affected patients revealed no prior post-EMB fever. Cultures of the drugs and solutions used during EMB and 2 sets of blood cultures from each patient were negative. Examination of the lumen and outer wire of the bioptones with scanning electron microscopy also did not reveal any evidence of a microbial etiology. An extensive review of the EMB instruments, procedures, biological agents and medications used was conducted. We also observed and analyzed the entire cleaning process and the agents used for cleaning/sterilizing the bioptones. Initial cleaning was done by suctioning the bioenzymes (Terg-a-zyme or Enzacare) through the bioptones. The active enzymes in these products arise from Bacillus licheniformis and B. subtilis. Terg-a-zyme was used at both sites until 2 weeks prior to the reactions when the site where the events occurred switched to Enzacare (a liquid enzyme which is more concentrated prior to dilution) with a reduced rinse cycle. Addition of Enzacare into human plasma and assays for anti-endotoxin antibodies was negative. Cytokine assays were unsuccessful due to the highly cytotoxic effect of Enzacare on neutrophils. With removal of Enzacare and a prolongation of the rinse cycle no further cases were noted in the next 6 months. CONCLUSION: Based on our investigations we conclude that the febrile reactions were likely mediated by cytokine release in response to contact between residual proteolytic enzyme moieties from the Enzacare within the bioptone lumen and host inflammatory cells.

RESISTANCE OF SURFACE-ADHERENT BACTERIA TO ULTRAVIOLET IRRADIATION. Lingaas E, Kjaervoll N. Rikshospitalet, Oslo, Norway.

Enterococcus faecalis and Staphylococcus aureus grown overnight in Brain Heart Infusion Broth was spot inoculated onto glass coverslips and left to dry at room temperature. The dried bacteria were then exposed to ultraviolet irradiation at a wavelength of 254 (UVC) and irradiation doses varying from 25 to 100.000 Joules(J)m2. Quantitative cultures were done before and after irradiation and a dose-response relationship was established. Culture was performed in darkness to avoid photoreactvation. Results: With an initial inoculum of 5 × 107, the number of surviving E. faecalis was reduced by approximately 2 log10 up to an UVC dose of 250 Jm2. With increasing irradiation, the dose-response curve gradually leveled off and no further killing was seen at doses above 40.000 Jm2. Despite a dose of 100.000 Jm2, more than 103 bacteria survived. The same phenomenon was observed with S. aureus. The radiation resistance was not influenced by leaving the bacteria dry for 24 hours before irradiation. The resistance was neither reduced by washing the bacteria in fresh broth or heat-inactivated horse serum before drying. However, washing in saline or 2% albumin enhanced initial susceptibility to UVC, with a reduction of 4.5-5 log10 at a dose of 250 Jm2. No further killing was observed, however, when the dose was increased to 1000 Jm2. When E. faecalis initially surviving an UVC dose of 25 000 Jm2 was regrown and reexposed to UVC, no change in resistance was observed, i.e., the same inactivation curve was seen. DISCUSSION: UVC can successfully be used for the killing of bacteria suspended in water and air. The present study, however, shows that bacteria may survive very high doses of UVC when attached to a surface. In particular, extrapolation of data from experiments with UVC doses below 1000 Jm2 may be erroneous.

A COMPARATIVE EVALUATION OF THE RESIDUAL ANTIMICROBIAL ACTIVITY OF DISINFECTANT PRODUCTS. Lisay CM, Brady MJ,* Hale DA, Hamberger JF, Garib S, Manivannan G, Liu F, Yurkovetskiy A, Subramanyam S, Sawan SP. Intelligent Biocides, Tewksbury, MA.

The use of antimicrobial products to disinfect surfaces is standard practice in healthcare settings. The effectiveness of such disinfectants upon product application is well characterized. However, healthcare workers and patients can introduce new contaminants as they come into contact with the disinfected surfaces. If disinfectants deposit an antimicrobial residue that is resistant to removal/inactivation by routine physical wear or water contact, then such products may have significant potential to interrupt disease transmission. This study was designed to characterize the residual antimicrobial effectiveness of disinfectants against typical human pathogens after exposing disinfectant-treated surfaces to water rinsing. Quantitative contact tests were performed involving five alcohol-based disinfectant sprays with varied active ingredients: a biguanide-silver complex (Surfacine™), quaternary ammonium compound(s) (Lysol® and Clorox®), a phenol (Medaphene® Plus) and ethyl alcohol alone (Red Cross®). An aqueous-based hypochlorite solution (1:10 Clorox® Bleach) was also included for comparison. Disinfectants were applied to glazed ceramic tiles, allowed to dry overnight and rinsed with 40°C running tap water for 1 minute at a flow rate of 6L/minute. Tiles were then challenged with Pseudomonas aeruginosa and Staphylococcus aureus for up to 8 hours at 20°C (See TABLE 1). The results show that some new products are able to provide a persistent antimicrobial action that survives water rinsing whereas well known products show no such benefit.

Residual Antimicrobial Activity of Disinfectant Products after 1 Minute Tap Water Rinse

	Log/10 Reduction of Bacteria Relative to Control as a Function of Time									
	Pseudomonas aeruginosa					Staphylococcus aureus				
Disinfectant	0.5 hr	2.0 hr	4.0 hr	6.0 hr	8.0 hr	0.5 hr	2.0 hr	4.0 hr	6.0 hr	8.0 hr
Surfacine\™/	2.2	3.5	4.4*/	4.7*/	4.8	3.3	4.1*/	4.2*/	4.2*/	4.3*/
Clorox\®/	0.2	0.5	0.5	0.5	0.6	0.5	2.2	3.6	3.5	4.3*/
Lysol\®/	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.4	0.0
Medaphene\®/ Plus	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.3	0.1
Red Cross\®/	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0
1:10 Clorox\®/ Bleach	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0

*/ Detection Limit

BACTERIAL GROWTH IDENTIFICATION ON STETHOSCOPES IN INTENSIVE CARE UNITS. Martins APR, Higute SH, Cunha R, Strabelli TMV, Bento CNO, Grimberg M, Uip DE. Heart Institut, Univ School of Med, São Paulo, Brazil; Heart Institut, Univ School of Medicine, São Paulo, Brazil; Clinical Hosp, Univ School of Medicine, São Paulo, Brazil.

Stethoscopes have been pointed as a potential source of infection in hospitals because of their universal use by medical professionals. In this study we surveyed the healthcare team practices used for cleaning stethoscopes at intensive care units and the frequency of its contamination with bacteria and fungi before and after people were informed about alcohol cleaning procedures. There was no routine stethoscope cleaning practices. Forty (40) stethoscopes were analysed in both phases. Coagulase-negative Staphylococcus was the most frequently isolated microorganism. The mean bacterial growth was 47 colony-forming units. Comparing the healthcare workers, nurse's stethoscope presented lesser bacterial counts than those used by doctors and physiotherapists. After the cleaning procedure information, only 05 (12.5%) were negative (P value is 0.55) and 68% remained positive. It is necessary to educate the staff in intensive care units to clean the stethoscope before and after its use between patients.

AN OUTBREAK OF NOSOCOMIAL INFECTION CAUSED BY SERRATIA MARCESCENS DUE TO EXTRINSIC CONTAMINATION OF CHLORHEXIDINE SOAP. Molina-Bustos I, Perez-Miravete A, Avila-Figueroa C. Hosp Infantil de Mexico, Mexico City, Mexico.

The emergence of antiseptic-resistant bacteria is a significant concern because of the limited number of antiseptics that are both effective and relatively free of dermatological reactions. We describe an outbreak of nosocomial infection in 19 patients caused by Serratia marcescens (SM) during Jun-Aug 1999. Patients with a clinical infection and SM isolated from a sterile body site met the case definition. The epidemic curve exhibited a peak during the second week of Aug suggesting a common source. Eight cases had urinary tract infection (7 were associated with urinary catheters), 9 cases had bacteremia, and two cases had peritonitis; 90% of these cases occurred in the surgical intensive care unit. The mortality rate was 37%. Twelve (12) additional patients had bacteriuria with SM but no evidence of infection. A detailed investigation of common sources for transmission of SM was undertaken. The only positive finding was SM cultured from an open chlorhexidine container used for handwashing and disinfection prior to urinary tract catheterization in the surgical intensive care unit. Samples from the container were positive for SM in 2 independent laboratories. Isolates from cases and the chlorhexidine container had the same antibiotic-susceptibility pattern. Antiseptic susceptibility tests and genetic characterization of the bacterial strains involved in the outbreak are currently under investigation. Cultures of unopened chlorhexidine containers were negative. Povidone-iodine was used for handwashing and skin antisepsis and resulted an immediate end of the outbreak. Chemical assays performed on the same antiseptic lot by a reference laboratory reported that the chlorhexidine con-

centration was 3.7%. Our findings suggest that an extrinsic contamination of chlorhexidine was the most likely vehicle for SM transmission during invasive procedures. The emergence of bacterial strains resistant to commonly used antiseptics should be considered in common source outbreaks of nosocomial infections.

ARE DISINFECTANTS ACCURATELY PREPARED FOR USE IN HOSPITAL PATIENT CARE AREAS? Pentella MA, Fisher T, Chandler S, Britt-Ohrmund T, Kwa BH, Yangco BG. Lakeland Regional Med Ctr, Lakeland, FL; College of Public Health, Univ of South Florida, Tampa, FL; Infectious Disease Research Institute, Tampa, FL.

BACKGROUND: Environmental surfaces, although categorized as noncritical, can contribute to secondary transmission of nosocomial pathogens through the contamination of the hands of healthcare workers (HCWs) or medical equipment that come in contact with patients. Disinfectants, when used according to the manufacturer's recommended concentrations (MRC), could kill these organisms. However, it was not known whether HCWs prepared and used disinfectants appropriately. OBJECTIVE: To determine if disinfectants are accurately prepared for use in patient care areas. METHODS: Concentrations of three phenolics in 36 disinfectant carts were measured using the Ultrameter Model 4P (UM4P). After the initial survey, educational intervention and a post-education survey were undertaken. Control dilutions [2.5, 5.0,7.5,10,12.5, and 15 ml (MRC) of disinfectant/gallon of water] were prepared. Conductivity was measured using the UM4P. Environmental surfaces were experimentally inoculated with a clinical isolate of methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus faecium, then cleaned using various concentrations of disinfectants sampled from the patient care areas, and cultured. RESULTS: Initial survey showed that 25/36 (69%) carts contained the appropriate disinfectant but only 5/36 (14%) had the correct concentration. Bacteria survived on surfaces cleaned with all disinfectant concentrations except at the MRC. Post-education survey demonstrated that 31/36 (86%) carts contained the appropriate disinfectant (p=.09) and 16/36 (44%) used the correct concentration (p=.004). CONCLUSIONS: Disinfectants are not always accurately prepared in the hospital. This practice may contribute to the occurrence of nosocomial infections. Conductivity testing is an excellent tool for monitoring accurate disinfectant preparation. Continuing education of HCW on appropriate disinfectant preparation is needed.

EVALUATION OF A NEW SURFACE GERMICIDE (SURFACINE™) WITH ANTIMICROBIAL PERSISTENCE. Rutala WA,* Gergen MF, Weber DJ. Univ of North Carolina (UNC) School of Medicine and UNC Hosps, Chapel Hill, NC.

Contaminated surfaces may play a role in the transmission of certain important nosocomial pathogens such as MRSA, VRE, and C. difficile. Surfacine, a new antimicrobial coating, combines an immobilized polymeric biocide with an insoluble silver salt. The coating is proposed to transfer the active biocide (i.e., silver) on demand directly to a microorganism. To investigate the immediate and persistent antimicrobial activity of this novel compound we treated several surfaces (formica, linoleum, stainless steel) with Surfacine, inoculated the surfaces with VRE, and cultured at various time points. (See table) More prolonged studies were conducted evaluating persistence up to 13 days (surfaces cultured on days 1, 2, 3, 4, 6, 8, 11, and 13). Surfacine-treated formica and stainless steel demonstrated excellent activity up to 13 days (99-100% reduction), and linoleum up to 8 days (88%-100%). Similar results were obtained when the Surfacine treated surface was wiped using a dry cloth with 15 strokes just prior to culture. When surface disinfectants (bleach, phenol, quat) were repeatedly applied to a Surfacine-treated surface some alterations in the persistent antimicrobial effect were observed with the bleach and phenolic. Our data demonstrate excellent persistent antimicrobial activity of Surfacine-treated formica and stainless steel for up to 13 days. Wiping the surface with a dry cloth does not appear to diminish Surfacine effectiveness.

		VRE Counts Per Rodac Plate at Designated Times Following Inoculation					
Surface		**After drying**	**1 hr**	**4 hrs**	**8 hrs**	**24 hrs**	**48 hrs**
Formica	Control	109	126	130	188	100	107
	Treated	2 (98.6%)*	1 (99.6%)	0 (100%)	1 (99.7%)	0 (100%)	0 (100%)
Linoleum	Control	246	261	302	268	239	160
	Treated	1 (99.8%)	1 (99.8%)	1 (99.7%)	5 (98.3%)	1 (99.8%)	0 (100)
Stainless steel	Control	342	378	360	362	266	116
	Treated	0 (100%)	0 (100%)	0 (100%)	1 (99.7%)	1 (99.8%)	0 (100%)

* % reduction [(treated/control) x 100].

Hand Hygiene

IMPACT ON HANDWASHING FREQUENCY OF NURSING WORKLOAD AND WINTER SEASON IN ADULT INTENSIVE CARE UNITS. Bittner MJ, Rich EC, Turner PD, Arnold WH, Lubeley MW. Creighton Univ, Omaha, NE; VA Med Ctr, Omaha, NE.

Because increases in nosocomial infections have occurred when nursing workload has increased, we studied the relationship between handwashing and workload. Because hand irritation may be more common during the dry winter months in the Midwest, we studied whether handwashing decreased in the winter. In a Surgical Intensive Care Unit (SICU) and in a Med Intensive Care Unit (MICU) we recorded patient census and nurse staffing on weekdays May 26, 1998-August 12, 1999. We measured soap and paper towel consumption each day to estimate handwashing episodes with a published regression model. (Clinical Performance and Quality Health Care 1998;4:179) With higher patient:nurse ratio, handwashing frequency was less in both the MICU (Pearson r=0.196, p=0.001) and the SICU (r=0.425, p<0.001). Winter frequency (1.23 episodes per occupied bed per hour, s.d. 0.67) was less than that of other months (1.44, s.d. 0.83); p=0.01. A multivariable linear regression model, with handwashing frequency as the dependent variable, had an r-squared of 0.374. In this model, frequency was less in the winter (B=-0.17, 95% c.l. -0.31 to -0.04) and with a higher patient:nurse ratio (B=-0.59, 95% c.l. -0.73 to -0.45). Higher nursing workload and winter were independent factors diminishing handwashing episodes per occupied ICU bed per hour. Control of nursing workload and hand disinfection methods that reduce skin irritation deserve study as ways to improve handwashing compliance.

EFFECTIVENESS OF SKIN CARE REGIMENS FOR THE PREVENTION OF IRRITANT CONTACT DERMATITIS IN HEALTHCARE SETTINGS. Fendler EF,* Dolan MJ, Barnhart RA, Cartner TJ, Hammond BS, Williams RA. GOJO Industries, Inc., Cuyahoga Falls, OH.

Irritant and allergic contact dermatitis are serious problems in many occupations. Among those with the most severe problems are healthcare professionals. However, very few studies have objectively characterized the extent of irritant contact dermatitis in the medical and healthcare fields. This study was conducted to characterize the extent of contact dermatitis and the effectiveness of intervention with protective moisturizing creams. The skin condition of the subject's hands was evaluated using skin bioengineering techniques and visual observations prior to, during, and after application of a protective moisturizing cream. Both methods of evaluation revealed that the subjects from the healthcare profession have severely damaged skin on their hands. Intervention with the application of a protective cream resulted in improvements in skin hydration, transepidermal water loss, and other measures of skin condition. These results correlated well with those obtained from subject self-evaluation and expert skin evaluation. Bioengineering instrument measurements were more discriminating than visual observations and offer potential useful techniques for early detection of irritant contact dermatitis problems.

EFFECTS OF TOPICAL ALCOHOL GEL USE ON HUMAN SKIN. Fendler EJ, Dolan MJ, Hammond BS, Williams RA.* GOJO Industries, Inc., Cuyahoga Falls, OH.

Although alcohol is known to result in irritant and contact dermatitis, only a limited number of studies of the effects of topical gels have been reported. The dramatic increase in use and concomitant exposure to these products increases the necessity for a comprehensive study. Studies have been performed, using a wide variety of techniques, to evaluate the primary physiological and microbiological effects of topical alcohol gels. A battery of techniques, including skin bioengineering measurements, was used to assess the skin condition, barrier function, and physiological changes in the skin. Antimicrobial studies have shown that the use of alcohol gels resulted in very high reductions in microbial levels on skin within relatively short contact times. The physiological studies demonstrated that topical alcohol gels have shown no potential for eliciting either dermal irritation or sensitization. Bioengineering measurements showed that alcohol and alcohol wipes were detrimental to skin hydration and barrier function, while topical gels resulted in improved both skin hydration and skin moisture capacity. In a clinical use evaluation, an alcohol gel sanitizer was found to be faster to use and cause less irritation than soap and water handwashing.

HIGHER COMPLIANCE AND BETTER SKIN CONDITION RELATED TO INTRODUCTION OF HYGIENIC HAND RUBBING. Girard R, Amazian K, Fabry J. Centre Hospitaler Lyon-Sud Pierre-Benite, France.

OBJECTIVE: To demonstrate that the introduction of Hygienic Hand Rubbing (HHR) by writing of protocols, teaching and equipment of specific devices is related to an increase of hand disinfection compliance and skin condition. DESIGN: Comparative study of two periods before and after introduction of HHR. METHODS: Two similar studies were conducted by an external investigator before and after the introduction of HHR (Sterillium Bode Chemie Germany, Rivadis France) in four care units in a university hospital (between Dec 1998 and Mar 1999). During each study compliance was measured for the group by individual observation during 90 minutes (hand disinfection rate by care, hand disinfection quality rate, adapted to risk level rate). Individual skin condition was evaluated and compared by two methods (clinical score for dryness and irritation, and skin hydration by corneometer). RESULTS: Hand disinfection compliance non significantly increased (from 62.6% to 66.5%). Hand disinfection quality significantly increased (adapted to risk level rate from 66.8% to 84.3% p< 10-6, correct quality rate from 11.1% to 28.9% p < 10-6, good quality and adapted hand disinfection compliance rate from 6.0 to 17.8% p < 10-8). Skin condition was significantly better for clinical score (p< 10-2) and non significantly better for corneometer measuring. CONCLUSION: As some previous studies on this subject, our experience seems to demonstrate that the introduction of HHR (with educational and equipment program) is efficient both for compliance and skin condition.

BASELINE HANDWASHING COMPLIANCE IN A FRENCH UNIV HOSPITAL. Girou E, Oppein F, Cizeau F, Ducellier D, Dupil A, Brun-Buisson C. Hôpital Henri Mondoré Créteil, France.

Before introducing alternative techniques to handwashing, we performed an observational study in 4 voluntary wards of Henri Mondoré hospital (2 intensive care units (ICU) and 2 medical wards (MW)) to measure the baseline level of compliance to handwashing. Opportunities (opp) of washing hands were previously defined and differentiated according to the infectious status of patients (carrier or non-carrier of multiresistant bacteria (MRB)). All categories of personnel were observed, as well as all working shifts. The handwashing technique defined by the use of antiseptic soap when indicated was also observed. Overall, 891 opportunities of handwashing were identified: on average, 15 opp per hour of care in ICU and 13 opp per hour of care in MW. Results on compliance are detailed in the TABLE: *Significant differences between compliance rates in ICU and MW (p<0.0001), and between all patients and MRB patients (p=.005) Compliance did not vary according to working shifts, despite a different number of opportunities: morning, 45% (418 opp); afternoon, 48% (348 opp.); night, 47% (125 opp). Care procedures associated with poor compliance were identified: care between a dirty and a clean body site, 0%; after an interrupted procedure, 20%; care on invasive procedures, 38% (ICU, 50%; MW, 26%). Globally, the technique was appropriate in 73% of handwashings. However, antiseptic soap was used in only 56% of opportunities in MRB patients. These results indicate that during patient care, healthcare workers washed their hands in approximately half of the indicated instances, whatever the infectious status of the patient. Lack of time and poor perception of infectious risk during care seem to be important factors for noncompliance.

Wards	**All patients**	**MRB Patients**
ICU, (n opp.)	53% (477)*	52% (170)
MW, (n opp.)	39% (414)*	66% (29)*
Hospital, (n opp.)	46% (891)	49% (199)

EFFECTIVENESS OF ALCOHOLIC HAND DISINFECTANTS AGAINST ESCHERICHIA COLI AND MICROCOCCUS LUTEUS IN TESTS UNDER PRACTICAL CONDITIONS ACCORDING TO EUROPEAN STANDARD EN 1500. Goroncy-Bermes P, Schuelke and Mayr, Norderstedt, Germany.

PURPOSE: The effectiveness of alcoholic hand disinfectants is evaluated by the European Standard EN 1500. It has been published that E. coli was more suitable as a test organism for this test under practical conditions than other microorganisms. Nevertheless, gram-positive pathogens have become more important during recent years. Therefore, it was the aim of this study to compare the effectiveness of alcoholic hand disinfectants with gram-negative and gram-positive organisms using EN 1500. MATERIAL AND METHODS: Test strains used: M. luteus (ATCC 9341)and E. coli K12 (NCTC 10538). Alcohol-based disinfectants tested: Desderman N and Desmanol (S+M Germany). RESULTS: The results are summarised in Table 1. CONCLUSION: Using E. coli for evaluating the antibacterial activity of alcohol-based hand disinfectants seems to be sufficient.

Effectiveness of two alcohol-based hand disinfectants against *Escherichia coli* and *Micrococcus luteus*

Test organism	Logarithmic Reduction Factors obtained with	
Desderman	N	Desmanol
Micrococcus luteus	3.8	4.5
Escherichia coli	3.7	4.1

EVALUATION OF HAND SKIN CONDITION IN TWO 5-DAY SURGICAL SCRUB/HANDWASHING STUDIES COMPARING A NEW WATERLESS/BRUSHLESS, CHLORHEXIDINE GLUCONATE/ETHANOL-EMOLLIENT ANTISEPTIC PREPARATION AND HIBICLENS® ANTISEPIC/ANTIMICROBIAL SKIN CLEANSER. Grove GL, Zerweck CR, Heilman JM, Pyrek JD. K.G.L. Skin Study Ctr; Broomall, PA 3M HealthCare, St. Paul, MN.

Two randomized, blinded, bilateral comparison studies evaluated skin condition using two antiseptic hand preparation products during 5 days of controlled washing. Trained technicians applied treatments 6 times (scrub study) or 24 times (hand wash study) daily for 5 days to hands of healthy volunteers. Test products were a CHG (chlorhexidine gluconate)/ethanol antiseptic hand preparation in a unique emollient system, for waterless/brushless application; and Hibiclens® (Zeneca) applied with a brush (scrub study) and without a brush (handwash study). An Expert Grader evaluated skin for dryness, erythema, and roughness. Subjects completed a self-assessment questionnaire. Transepidermal water loss (TEWL) was measured by an evaporimeter and an electrical conductance meter was used to measure skin surface hydration levels. Overall, 58 subjects were enrolled. In general, skin treated with the CHG/ethanol-emollient preparation scored significantly ($p<.004$) better on Expert Grader evaluations of dryness and erythema, showed significant improvement in electrical conductance ($p<.003$), and demonstrated less damage (TEWL) than skin treated with Hibiclens® ($p<.002$). Subject self-assessments showed similar results. In conclusion, the CHG/ethanol-emollient preparation was gentler to skin, preventing dry, cracked hands and erythema, thereby helping to maintain the integrity of the stratum corneum.

COMPARISON OF SKIN CONDITION IN A 5-DAY HEALTHCARE PERSONNEL EXAGGERATED HANDWASHING STUDY USING A NEW ETHANOL-EMOLLIENT WATERLESS ANTISEPTIC, PURELL® INSTANT HAND SANITIZER OR WATER. Grove GL, Zerweck CR, Heilman JM. KGL Skin Study Ctr, Broomall, PA; 3M HealthCare, St. Paul, MN.

This randomized, blinded study compared skin condition during five days of bilateral, controlled application. The test product, Avagard™ Instant Hand Antiseptic (product "A", 3M), an ethanol-emollient waterless hand preparation, was tested against Purell® (product "P", GOJO) or plain tap water. Trained technicians applied products (12 applications daily) for five days to hands of healthy subjects. Skin condition was assessed using an Expert Grader evaluation of skin for dryness, erythema, and roughness; a subject self-assessment questionnaire; and an electrical conductance meter measurement of skin surface hydration. Dryness scores progressively increased after additional applications of product P or water but not product A. Of 40 subjects, 12 discontinued due to dryness, erythema, or discomfort (1-product A, 5-product P, and 6-water). The last Expert Grader evaluation of each study day showed product A was significantly ($p<.005$) less drying than either product P or water. Similarly, ratings of erythema and tactile roughness showed product P was significantly more irritating than product A. Subject self-assessment at days 4 and 5 rated product A significantly ($p<.02$) better than product P or water for skin appearance, intactness, moisture, and sensation. Electrical conductance measurements demonstrated that product P or water reduced skin surface hydration while product A increased skin hydration. In conclusion, Avagard™ Instant Hand Antiseptic was less drying and irritating than Purell® or water.

A STUDY ON THE HANDWASHING OF NEONATAL INTENSIVE CARE UNIT NURSES IN A UNIV HOSPITAL IN SEOUL. Jeong IS, Yi YH. Seoul National Univ Hosp, Seoul, Korea.

Handwashing (HW) is an important factor in decreasing nosocomial infections, especially in NICU (neonatal intensive care unit), due to reduced immunity ability, prematurity and various invasive procedures. The purpose of this study was to investigate basic characteristics related to HW by NICU nurses. It was composed of three parts: questionnaire survey ø(general characteristics of HW), questionnaire survey ± (the awareness degree of HW importance) and actual performance. This study was performed for one week from Oct 8 to 14, 1994. The results of this study were as follows: 1. They usually washed their hands 5-10 times (47.0%) during each working hour. The respondents who had different frequency of HW by shift were 47.1%, and 75.0% among these washed hands the most frequently during day shift. According to self evaluation to HW frequency, 64.7% of the respondents said their frequency of HW was inadequate, and the reasons were too busy (47.15), bothering caused by detergent or disinfectant (17.6%), and too far from HW facilities (17.6%). 2. The most common HW agent was soap (88.2%). 52.9% of the subjects showed the adverse effects after HW; rough hand (44.5%), dryness (33.3%). All subjects washed their hands with running water, and 70.6% to wrist. The duration of HW was 5-10 seconds (52.9%), followed by 11-15 seconds (29.5%). 3. 29.4% among subjects had participated in the HW educational program. About 60% responded that they would like to take the course of HW if possible. 4. The important nursing activities(Nas) that need HW were changing or caring ostomy, suctioning, changing IV dressing site. On the other hand, they responded HW was not essential before dealing with omitus, before and after transfering machine, before changing diaper (stool) 5. HW performance was 61.7%. Among seven Nas, suctioning (73.4%) was the highest, the next was dealing with discharge or sampling (71.1%), the lowest was bathing (34.6%). The performance was better after (70.2%) Nas than before (52.5%), and day (63.6%) or evening (68.3%) shift than night (56.7%). With above results, it is needed that the effort to try to level up the percent performance and for this, adequate and good educational prgram should be provided.

ANTIMICROBIAL HAND GEL AS A PRIMARY MEANS OF HAND DISINFECTION: IMPACT ON SELECTED NOSOCOMIAL INFECTIONS. Jones JM,* Newman JL, Hua SY. Regional Med Ctr Bayonet Point, Hudson FL; Johnson and Johnson Med, Arlington TX; Same as author 2.

Background: The transmission of pathogenic microbes on the hands of health care workers is a primary cause of nosocomial infections. Effective hand disinfection is one of the most important measures in preventing these infections. In most institutions hand disinfection has traditionally been achieved with soap and water handwashing despite unacceptably low compliance with this method. In recent years, alternatives to soap and water for routine hand disinfection have been introduced, with alcohol-based products being one of these alternatives. Methods: The study was designed to determine if hospital-wide implementation of an alcohol-based Antimicrobial Hand Gel (AHG) for routine hand disinfection has an impact (positive or negative) on the rates of selected nosocomial infections. The AHG implementation involved the placement of 50 oz wall dispensers or 4 oz bottles of the product (PREVACARE* AHG) in all patient rooms and care areas except surgical scrub areas. Staff and physicians were educated on the proper use of the AHG. Nosocomial infection rates for Methicillin Resistant Staphylococcus Aureus (MRSA), Ventilator-Associated Pneumonia (VAP), and Central Line-Associated Blood Stream Infections (BSI) are being monitored before, during, and after the implementation of the AHG. Standardized surveillance methods and definitions for nosocomial infections were used for 18 months before implementation and during the 6-month study period. Statistical comparisons of these rates are being made to determine if a significant effect occurs. Usage of the AHG is being monitored in individual care areas by inventory management to determine if a correlation can be made between changes in infection rates and level of usage in a given care area. Setting: 256-bed regional hospital with primary services in Cardiology, Oncology, Cardiac, Orthopedic, Neurological, and general surgeries. Results \ Conclusions: The study is ongoing as of this submission. Preliminary results and conclusions based on the first four months of data will be available for presentation at the 4th Decennial Conference.

STERILLIUM RUB VERSUS HIBICLENS FOR THE POSTCONTAMINATION TREATMENT OF HANDS. Kampf G, Rudolf M, Mulberry G. Bode Chemie GmbH and Co., RandD, Hamburg, Germany; Hill Top Research, Miamiville, Ohio, USA.

INTRODUCTION: The post contamination treatment of hands is regarded as essential to break the chain of transmission in the healthcare setting. Various antimicrobial ingredients may be used for that purpose, e.g. ethanol or chlorhexidine. We compared the efficacy of Sterillium rub (ethanol, 80%) with Hibiclens (chlorhexidine, 4%). MATERIAL AND METHODS: The study was carried out according to the tentative final monograph for skin antiseptic products, 1994. Thirty (30) subjects were included. Twenty-four (24) subjects used Sterillium rub, six subjects used Hibiclens. Hands were artificially contaminated with Serratia marcescens and than treated with one of the formulations (11 times, respectively). Sterillium rub (5 ml) was placed onto the palm of one hand and distributed over the entire surface of the hands and lower third of the forearms. Hibiclens was applied according to the label instructions for handwashing. Surviving organisms were recovered by the glove juice method. RESULTS: Sterillium rub revealed a higher mean of log10 reduction at all times (e.g. 3.98 vs 2.21 after wash 1 or 3.60 vs 2.37 after wash 11). Sterillium rub exceeded the proposed performance criteria following the first and tenth hand treatment whereas Hibiclens did not meet the monograph specified criteria following the tenth nor the eleventh treatment. CONCLUSIONS: Sterillium rub is superior in comparison to Hibiclens regarding the bactericidal effect for the post contamination treatment of hands. In the U.S., Hibiclens is regarded as the reference product for the post contamination treatment of hands but in our study did not meet the specified criteria set in the tentative final monograph.

DERMAL TOLERANCE OF STERILLIUM RUB IN THE REPEATED INSULT PATCH TEST. Kampf G, Rudolf M, Shaffer M. BODE Chemie GmbH and Co., RandD, Hamburg, Germany; Clinical Research Laboratories, Piscataway, NJ, USA.

INTRODUCTION: Dermal tolerance of hand disinfectants is very important to achieve compliance by healthcare workers for post-contamination treatment of hands. Hand disinfectants based on ethanol are known to have the potential for skin irritation. We therefore investigated the dermal tolerance of Sterillium rub, which contains special emollients for skin protection. MATERIAL AND METHODS: The repeated insult patch test was carried out with 53 subjects, aged between 20 and 70 who where in general good health and without any skin disease. Aliquots of 0.2 ml were applied to the upper back three times a week (Monday, Wednesday, Friday) for a total of nine applications (semiocclusive). The panelists were instructed to remove the patches after 24 hours. Evaluation of each site was made prior to the application of the next patch for signs of dermal reaction (score: 0 to 4). RESULTS: No scores were observed that were greater than 0 at any time during the study. CONCLUSIONS: Sterillium rub did not demonstrate a potential for dermal irritation or sensitization in the RIPT. From the dermatological point of view, Sterillium rub is very likely to be well tolerated by the healthcare worker for the repeated post contamination treatment of hands.

HANDWASHING-IS IT REALLY NECESSARY ALL THE TIME? Ling ML,* Ching TY, Phoon PC, Leong WS, Seto WH. Singapore General Hosp, Singapore; Queen Mary Hosp, Hong Kong; Department of Microbiology, Queen Mary Hosp, Hong Kong; Quality Improvement, Queen Mary Hosp, Hong Kong.

Current guidelines on handwashing require healthcare workers to wash hands before and after patient contact. We conducted a multinational study to determine the number of patient contacts made by a nurse and therefore, the amount of time spent on handwashing. The study was performed in randomly selected wards of 31 hospitals at Hong Kong and 1 tertiary care hospital at Singapore in 1998-99. A list of 31 patient care activities performed on these patients the previous day was obtained from case notes and nursing

care notes by the infection control nurses. Direct interviews with the patients were also conducted where information required is lacking in the notes. In the data analysis, the patient care activities were further categorized according to the Fulkerson's scale as clean contacts (ranks 1-7) or contaminated/infected contacts (ranks 8-15). A total of 2214 patients from 79 wards in Hong Kong's hospitals and 1050 patients from 33 wards in the Singapore hospital were surveyed. The mean number of clean contacts per 8-hr shift in the Hong Kong study was 15.6 as compared to 18.2 times in the Singapore study, while the mean number of contaminated/infected contacts were 15.3 and 18.2 times, respectively. It is estimated that on the average, a nurse will spend about 85.6 minutes of her 8-hr shift on handwashing if she diligently washes her hands before and after every patient contact. Our study showed that a significant amount of nursing time will be spent on handwashing if a nurse were to attain 100% compliance to current guidelines. This may explain the low compliance with handwashing guidelines seen in the usual healthcare practice. Therefore, a practical and possibly workable way to encourage compliance will be to identify patient contact activities that do not require handwashing.

IMMEDIATE, PERSISTENT AND RESIDUAL ANTIMICROBIAL EFFICIENCY OF SURFACINETM HAND SANITIZER. Manivannan G, Brady MJ,* Cahalan PT, Lisay CM, Hale DA, Hamberger JF, Liu F, Garib S, Subramanyam S. Intelligent Biocides, Tewksbury, MA.

Usage of alcohol-based hand sanitizer formulations as a method to prevent infection has increased significantly in healthcare and personal care arenas. Although most marketed products exhibit initial antimicrobial efficiency, they do not have persistent and residual efficiency. Frequent contact with bacterial contamination warrants the development of new products that demonstrate persistence and residual efficacy over the period of usage. The immediate (reduction of transient/resident microbial flora upon product application), persistent (measure of resident microorganism inhibition for 6 hours after product application) and residual antimicrobial efficacy (reduction of a transient population) of SurfacineTM Hand Sanitizer formulations have been evaluated using pigskin, collagen and human volunteers as representative models. In addition, the residual efficacy has been characterized after exposure to water. Broad-spectrum residual and rinsed residual activity of Surfacine formulations were determined using a pigskin model against the representative potential human pathogens: Pseudomonas aeruginosa, Salmonella choleraesuis, Escherichia coli O157:H7, methicillin-resistant Staphylococcus aureus (MRSA), Shigella flexneri, Listeria monocytogenes, Campylobacter jejuni and multiple-drug-resistant (MDR) Enterococcus faecium (TABLE 1). Comparative performance of similar alcohol based commercial products has also been evaluated. In addition, the safety of Surfacine formulations has also been tested through in vitro and in vivo tests. Obtained results demonstrated that Surfacine has initial, persistent and residual efficacy with no skin irritation or sensitization. [see TABLE]. "Sawan SP"

Residual Antimicrobial Efficacy of Surfacine Hand Sanitizer using pigskin model at 1 hour

	Log/10 Reduction to Control/Baseline	
Organism	**Residual**	**Rinsed Residual**
Pseudomonas aeruginosa	1.6	1.3
Salmonella choleraesuis	2.2	1.1
Escherichia coli	2.7	2.0
Escherichia coli O157:H7	1.9	1.8
Shigella flexneri	1.8	1.7
Listeria monocytogenes	1.9	1.8
Campylobacter jejuni	3.1	1.8
Enterococcus faecium (MDR)	1.9	1.5
Staphylococcus aureus (MRSA)	2.9	2.2

EVALUATION OF A WATERLESS, SCRUBLESS CHLORHEXIDINE GLUCONATE/ETHANOL SURGICAL SCRUB FOR ANTIMICROBIAL EFFICACY. Mulberry G, Snyder A, Heilman J, Pyrek J, Stahl J. Hill Top Research, Inc., Cincinnati, OH.; ViroMed Labs, Inc., Minneapolis, MN; 3M Health Care, St. Paul, MN.

A new waterless surgical hand scrub product containing 1% chlorhexidine gluconate (CHG) and 61% ethyl alcohol in an emollient-rich lotion base provides broad spectrum, rapid and persistent antimicrobial activity. Clinical studies were based on the Tentative Final Monograph for Health Care Antiseptic Drug Products (TFM); Proposed Rule and ASTM E1115-91, Standard Test Method for Evaluation of Surgical Hand Scrub Formulations. Two randomized, blinded well-controlled clinical studies involving over 100 healthy subjects evaluated the antimicrobial effectiveness of the 1% CHG product in producing an immediate and persistent reduction in the normal bacterial flora of the hands. The 1% CHG product was applied without scrubbing or the use of water, while a 4% CHG reference product was applied using scrub brushes in two traditional 3-minute surgical scrubs. Over a 5-day period, each subject performed a series of 11 surgical scrubs using one of the products. After the first treatment on days 1, 2, and 5, surgical gloves were worn for 3 and/or 6 hours. Bacterial samples were taken using the glove juice technique at 1 minute, 3 hours and/or 6 hours after treatment. The immediate bactericidal effect of the 1% CHG product after a single application resulted in a 2.5 log reduction in normal flora. This bactericidal effect persisted throughout the study, and eventually increased to a 3.5 log reduction after the eleventh scrub on day 5. The log reductions of the 1% CHG product proved to be significantly better ($p<.05$) than that of the 4% CHG product at each sampling interval on days 1 and 2, and at the 6 hour sampling on day 5, exceeding the TFM requirements. Use of this new waterless product as a surgical hand scrub lowers bacterial flora on the hands, thereby reducing the risk of cross-infection in the surgical suite.

COMPREHENSIVE EVALUATION OF EFFICACY PARAMETERS FOR A NEW HAND DISINFECTION TECHNOLOGY. Newman JL, Jampani HB, Jones JM. Johnson & Johnson Med, Arlington, TX; Regional Med Center, Bayonet Point, Hudson, FL.

BACKGROUND: In recent years, alcohol-based hand disinfection has been introduced as an alternative to soap and water for healthcare provider hand hygiene. While alcohol-based products are recognized to have excellent spectrum and speed of germicidal activity, the persistent effect of most alcohol-based formulas is limited since they evaporate leaving no chemical residual on the skin. Alcohols without appropriate emollient systems can also have a drying effect on the skin. New technologies have been utilized in the development of an antimicrobial hand gel (AHG) to overcome these limitations. METHODS: The AHG (PREVACARETM Antimicrobial Hand Gel) was evaluated in vitro for its speed of germicidal activity against a wide variety of laboratory strains and clinical isolates. In vivo evaluations of the activity of the AHG were performed by Health Care Personnel Personnel Handwash Test (Serratia marcescens contamination), Surgical Scrub Test and FingerPad Virus Test. Persistence measurements were accomplished through AGAR Patch and CUP Scrub methodology with Staphylococcus aureus as the contaminant. In-use evaluations include hospital-wide application of this formulation as the primary means of hand disinfection. RESULTS AND CONCLUSIONS: A new alcohol-based AHG has been evaluated for spectrum, speed and duration of activity. The data demonstrate continued bactericidal activity against recontamination on the skin for up to 5 hours after application to the skin and suppression of regrowth of resident bacteria for up to six hours under gloves. The use of new formulation technology has provided an alcohol-based AHG with rapid, broad spectrum and persistent antimicrobial activity in a form that helps maintain skin integrity. Alcohol-based hand disinfection utilizing this technology can be a powerful tool for improving compliance with proper hand hygiene in the healthcare setting.

EFFICACY OF TRICLOSAN BASED HANDWASH PRODUCTS AGAINST CLINICAL ISOLATES OF ANTIBIOTIC RESISTANT BACTERIA. Newman JL, Stone P, Gordon MD, Paulson DS, Mitchell JA, Eastman T. Johnson & Johnson Med, Arlington, TX; MDG Consulting, Arlington, TX; Bioscience Laboratories, Inc., Bozeman, MT.

BACKGROUND: Triclosan (TCS) based handwash products are commonly utilized in healthcare settings which are at risk for harboring antibiotic resistant organisms such as vancomycin-resistant enterococci (VRE) and methicillin-resistant Staphylococcus aureus (MRSA). The efficacy of TCS is concentration and formulation dependent. Handwash products have traditionally contained 0.2% to 0.5% TCS. New formulation technology has been used to develop products with higher levels of TCS and enhanced antimicrobial efficacy. Comparative testing performed at the same time under the same conditions is a useful tool for infection control practitioners in evaluating antimicrobial efficacy of products. METHODS: The in vitro bactericidal efficacy of the following formulations was evaluated using a standardized time-kill test method: Antimicrobial Soap (0.2 % TCS), Health Care Personnel Antiseptic Handwash (0.3% TCS), Medicated Lotion Soap (0.5% TCS), and Health Care Personnel Hand Wash (1% TCS). Clinical isolates of VRE and MRSA from eight different sites across the United States, as well as lab strains of these organisms, were used as challenges. Following a contact time of 15 seconds at 30°C, the test samples were carefully neutralized using a validated method. Results and CONCLUSIONS: The test results confirm that the efficacy of TCS based products is highly formulation and concentration dependent. The product containing 1% TCS in an optimized pH-balanced formulation generally provided greater than or equal to 3 log reduction in 15 seconds against both lab strains and isolates of MRSA and VRE; products containing lower levels (0.2-0.5%) of TCS generally provided less than 1 log reduction against the isolates. Previous reports claim that handwash products containing low levels of TCS are efficacious against lab strains and selected clinical isolates of MRSA and VRE. However, a more comprehensive evaluation against clinical isolates from geographically diverse regions has confirmed the superior efficacy of a product with 1% TCS in an optimized, nonalkaline base.

HOSPITAL STUDIES ON PREOPERATIVE HAND DISINFECTION WITH ALCOHOL: RUBBING TIME IS CRUCIAL. Ojajärvi J,* Verkkala K, Eklund A. Nat'l Agency for Medicines, Med Devices Centre, Helsinki, Finland; Helsinki Univ Central Hosp, Helsinki, Finland.

The aim of the study was to investigate the microbiological efficacy of the Finnish routine preoperative hand disinfection practices in hospital conditions. The study was conducted among the open-heart surgeons. In the first phase they washed the hands preoperatively with liquid soap and after drying disinfected them according to the routine manner (short rubbing with alcoholic solution containing 0.5 per cent chlorhexidine in 80 per cent (v/v) ethanol). The samples from the hands were taken after operations by rubbing the fingertips for 1 min against the bottom of two petri dishes containing 10 ml of sample fluid with neutralizers. For two next phases of the study, the preoperative hand washing and disinfection regime was changed. The washing time was shortened, after rinsing the hands were dried with paper towel and then disinfected by rubbing with alcoholic solution so that the skin of the hands was kept wet for 2 and 3 min, consecutively. The results indicated that the routine preoperative practice of alcoholic disinfection yielded unsatisfactory results. In the worst cases the fingertips showed over million colony-forming units of bacteria after the operation, although they preoperatively showed no bacteria. The lengthening of hand disinfection time to 2 min substantially improved the results, but first preoperative rubbing for 3 min gave good and uniform results with all the participants. The surgeons were informed of their results after each phase of the study. They became so convinced of the superiority of the new regime that it was uniformly approved. Based on later uninformed observations, the new regime was found to have been kept. We have later studied various alcoholic products with the same group of surgeons and obtained valuable information on the products. The studies in hospital are difficult, but should be conducted, because they give valuable data on the final efficacy of the disinfectants.

THE INTEGRITY OF LATEX GLOVES IN CLINICAL DENTAL PRACTICE. Pitten FA, Herdemann G, Kramer A. Institute of Hygiene and Environmental Medicine, Univ of Greifswald, Germany.

The aim of the study was to assess the integrity of non-sterile latex gloves (Biogelr Diagnostic (A), Biogelr Dental (B), Gentle Skinr (C) and Manufixr (D)) after clinical use in dentistry. Dentists, assistants, and students were asked to use the gloves 'as usual' and to report the length of time the gloves were worn, perceptible perforations, and if they had carried out a hygienic handrub with an alcoholic hand disinfectant immediately prior to gloving. After use the gloves were collected and examined for perforations using the water inflation test according to the EN 455-1 Standard. Over a 12 month period a total of 847 used gloves was collected and assessed. The mean duration of use for gloves A/B/C/D was 175/112/78/79 min. In spite of these differences favouring gloves C and D, 16 % of glove A, 14 % of glove B, 21 % of glove C, and 29 % of glove D were found to leak. The proportion of

perforated gloves increased if a hygienic handrub using an alcoholic hand disinfectant had been carried out immediately prior to gloving. This correlation was found for gloves A, B and D; for glove B, the correlation was significant. These results indicate striking differences between the quality of medical gloves. As all the gloves comply with the European Regulations in terms of integrity, it is very difficult for the user to distinguish between gloves of superior or inferior quality. In a clinical setting, therefore, it is recommended that the appropriate glove should be determined for each situation. Hands must be thoroughly dry if they are disinfected prior to gloving, since hands being still wet with residues of an alcoholic disinfectant have proven to be a risk factor for glove perforation.

REDUCING THE POSSIBILITY OF HAND CONTAMINATION DURING CASUAL PATIENT CONTACT IN PATIENT CARE. Seto WH, Ching PTY. Queen Mary Hosp, Hong Kong, China.

It is recommended hands are to be washed before and after all patient contacts. This is time consuming as studies have shown that nurses have >30 patient contacts per shift. Half of these are however casual contact activities (CCAs) including temperature/blood pressure measuring, administration of oral medication/IV medication, bed-making and sitting-up of patient. If CCAs are conducted with care, contact with mucous membrane and skin can be avoided. A study, in two phases, was conducted to evaluate the possibility of reducing hand contamination during such activities. PHASE ONE: Fingerprint cultures were obtained from trained ICNs after performing a series of CCAs with care to avoid skin and mucous membrane contact on MRSA patients. As controls, these studies were repeated on the same patients with the ward nurses. For the 153 control CCAs, 54 (35.3%) cultured MRSA on their hands, but there were 21 (13.7%) with <5 colonies MRSA. The ICNs performed 15 CCAs and had 3 (20%) with MRSA and all were <5 colonies (0%), indicating significant improvement. PHASE TWO: Three wards were selected and nurses were educated on how to perform CCAs with care. CCAs are conducted in procedure rounds for each cubicle, some of which are warded with MRSA patients and fingerprint cultures were obtained after these rounds. In the 20 rounds (50% on cubicles with MRSA patients) evaluated, all cultures grew skin flora, 4 grew skin flora with scanty environmental gram-ve (2 Flavobacterium species, 2 Pseudomonas species) and grew MRSA. There were no patients in these wards with infections by these environmental gram-ve organisms. These studies indicated that hand contamination can be significantly reduced when nurses are trained to perform CCAs with care. Further research is in progress to evaluate if such reduction is sufficient to prevent cross infection without handwashing, thus reducing the total time expended for hand hygiene.

DOCTOR, WHY DO YOU WASH YOUR HANDS SO LITTLE? Simon A, Hugonnet S, Perneger T, Sauvan V, Pittet D. Univ of Geneva Hosps, Geneva, Switzerland.

BACKGROUND: Hand hygiene (HH) prevents cross infection in hospitals, and compliance to HH recommendations is often poor among physicians. Several studies conducted by the Infection Control Program from Dec 1994 in Geneva showed that "to be a doctor" was an independent risk factor for non-compliance, and pointed out that interventions to influence HH had measurable effects on all HCWs, except physicians. SETTING: A large teaching hospital in Geneva, Switzerland. OBJECTIVE: To identify risk factor for non-compliance among physicians. DESIGN: Individual observations of physicians in their medical practice by a trained infection control physician. PARTICIPANTS: 163 physicians: internists (20%), surgeons (15%), intensivists (14%), pediatricians (13%), emergency physicians (10%), anesthesiologists (9%), geriatricians (6%). RESULTS: We observed 887 opportunities for HH, distributed in 85 observation periods, totaling 125 hours of observation. Compliance averaged 57%. It varied between physicians, level of activity and level of risk of cross-transmission. The following medical specialties, as compared to internal medicine, were found to be independent risk factor for non-compliance: anesthesiology (OR 13.2, 95%CI (CI) 5.5-31.7), surgery (7.0, CI 3.3-14.7), emergency medicine (4.5, CI 1.8-11.5), geriatric medicine (2.8, CI 1.1-7.2). Procedures with high risk of transmission and situation with higher activity index were associated with non-compliance (1.7, CI 1.1-2.5, and 1.1, CI 1.04-1.17, respectively). On the other hand, the availability of alcohol-based handrub solution predicted compliance (2.0, CI 1.1-3.6), as well as the knowledge of being observed (2.7, CI 1.7-4.3). CONCLUSIONS: Compliance to HH among physicians remained low despite an intensive promotion campaign. These data suggest, first, that wider use of hand disinfection may improve compliance; second, that targeted educational programs, in particular accounting for medical specialties, are needed.

IMPROVING HANDWASHING COMPLIANCE BY CREATING COMPETITION BETWEEN SURGICAL TEAMS. Thompson-Bowers JE, Holmes K, Judd SE, Tasker SA. Naval Med Ctr, San Diego, CA.

Although handwashing is recognized as the single most important measure to prevent the spread of infection, compliance is often poor. We attempted to improve compliance at our 500-bed teaching hospital by generating competition between three general surgery teams. One nurse on the ward secretly observed physicians making rounds and counted the number of handwashing episodes per patient contact. In Dec of 1998, the first unannounced audit was conducted. Handwashing compliance after patient contact for each of the teams was: Team A 14% (2/14), Team B 0% (0/15) and Team C 16% (3/19). In Jan 1999, these results were reported back to each team, The General Surgery Department Head and the Director for Surgical Services. Teams were told that future audits were planned. A second audit in Mar 1999 found handwashing compliance dramatically improved: Team A 60% (6/10), Team B 89% (8/9) and Team C 44% (8/18) ($p<.005$ for Team B, Fisher's exact test). Appropriate positive feedback was given to all of the teams. A third audit was completed in Aug 1999. During this time new house staff had arrived. The results of this audit showed a decrease in compliance, but results were still much better than in our initial observation. The compliance rates in Aug 1999 were: Team A 43% (13/30), Team B 38% (11/29), and Team C 37% (11/30). ANALYSIS: Handwashing compliance increased when feedback was presented to the surgical teams. Feedback was presented in a way to stimulate competition among General Surgery teams.

ELIMINATION AND POST-DISINFECTION TRANSMISSION OF STAPHYLOCOCCUS AUREUS FROM EXPERIMENTALLY CONTAMINATED HANDS. Voss A, Goroncy-Bermes P. St Radboud Univ Hosp, Nijmegen, The Netherlands; Sch lkeandMay, Norderstedt, Germany.

Hands of HCWs still are the major source of transmission for nosocomial pathogens. Next to the ongoing problems with compliance, it is still discussed what kind of hygienic hand product is the most effective one. The aim of this study was to compare the effectiveness of a chlorhexidine-containing scrub (CHX), an alcohol-based hand disinfectant (ALC), and a non-medicated soap (NMS) to reduce S. aureus from artificially contaminated hands of volunteers and to measure the post-disinfection transmission to skin and inanimate surfaces. Based on a newly developed European standard, fingertips of volunteers were inoculated with 10l of a 0.5 McFarland suspension of S. aureus. After a drying period of 1 minute, hands were "washed" with the test-products. This was followed by an attempt to transmit S. aureus to the hands of another volunteer or to a tile. Hands were cultured with the broth-bag method, the tile surface with a Rodac-plate. According to recent literature, steps were undertaken to guarantee sufficient neutralization of chlorhexidine. The average reduction-factor after hand "washing" was 1.93 for ALC, 0.48 for CHX, and 0.36 for NMW, respectively. In general, 4.6%, 48.3% and 47.5% of the initial contamination was recovered from the hands of the receiver in the transmission study after the use of ALC, CHX, and NMS, respectively. The contradicting results regarding the in-vitro effectiveness of CHX reported so far, are probably due to the difficulties to neutralize chlorhexidine. The reduction factors found in the volunteers after disinfection with CHX confirm the conclusions of earlier in-vitro studies, that these scrubs are less effective than ALC. Furthermore, S. aureus was transmitted to skin and inanimate surfaces in an amount corresponding to that remaining on the volunteers' hands after disinfection.

EFFECTS OF HAND LOTIONS AND ALCOHOL SANITIZER ON CHLORHEXIDINE GLUCONATE ANTISEPTIC SKIN CLEANSER. Williams RA, Fendler EJ,* Dolan MJ, Ali Y. GOJO Industries, Inc., Cuyahoga Falls, OH.

Irritant contact dermatitis caused by frequent handwashing and the use of gloves is a common problem among healthcare workers. Skin irritation and dryness can result in lowering compliance with handwashing protocols and other infection control procedures. Both hand lotions and alcohol gel sanitizers have been used to mitigate and improve hand condition. However, the effects of these products on the immediate and residual antimicrobial efficacy of healthcare personnel handwashes and surgical scrubs have received little attention. This study evaluated, in terms of antimicrobial efficacy, the biocompatibility of three types of hand lotions and an alcohol gel hand sanitizer with a 2% chlorhexidine gluconate (CHG) healthcare personnel handwash and surgical scrub. Subjects accepted into the study participated for five days. Baseline values were performed on days 1 and 3 sampling both hands using a glove juice procedure. Subjects were randomly assigned to one of the product use configurations. On the fifth day subjects used the test products as dictated by their assigned product configuration. The glove juice procedure was performed on one hand immediately following product use, and then on the other hand two hours post product usage. Neither the hand lotions nor the alcohol gel hand sanitizer decreased the antimicrobial efficacy of the 2% CHG product when applied before or after a surgical scrub procedure.

Healthcare Personnel

PERCUTANEOUS INJURY REPORTING IN U.S. HOSPITALS, 1998. Alvarado F, Panlilio A, Cardo D, NaSH Surveillance Group. Ctrs for Disease Control and Prevention, Atlanta, GA.

Of all occupational exposures, percutaneous injuries (Pis) pose the greatest risk for transmission of bloodborne pathogens. Health care workers (HCWs) do not report all Pis despite the availability of prophylaxis for some exposures. To determine the level of PI reporting and assess the effect of hospital characteristics and occupation on reporting rates (RRs), we analyzed data from HCW surveys at 12 hospitals participating in the National Surveillance System for Health Care Workers (NaSH) in 1998. In this survey, 14,215 HCWs indicated if they sustained a PI in the last 12 months, how many they reported, and their reason(s) for not reporting. RRs were stratified by hospital size, geographic location, HIV-inpatient days, and occupation. Of 1922 Pis sustained, 800 were reported for an overall RR of 42%. RR varied significantly by region: northeast, 54%; southeast, 38% (range 29-86%; relative risk=1.43; 95% CI 1.28, 1.60; $p<0.01$) and by hospital size: 200-750 beds, 52%; 751-1200 beds, 42% (range 29-86%; relative risk 1.25; 95% CI 1.12, 1.39; $p<0.01$). RRs did not vary with number of HIV-inpatient days per year: 150-700, 53%; 701-8350, 56%. Surgeons' RR was 27% vs. 48% for all other HCWs (range 46-53%; relative risk=0.57; 95% CI 0.49, 0.65; $p<0.01$). The most commonly cited reason for not reporting was an assessment that the injury or the source was low risk (51%). PI reporting appears to be influenced by hospital size, location, and occupation but not HIV prevalence. All hospitals should increase their efforts to facilitate and promote PI reporting.

OCCUPATIONAL BLOOD EXPOSURES AMONG PREGNANT HEALTHCARE WORKERS. Alvarado F, Panlilio A, Cardo D, NaSH Surveillance Group. Ctrs for Disease Control and Prevention, Atlanta, GA.

Women comprise 76% of hospital workers in the U.S., and at least 64% of these women are of child-bearing age. To characterize occupational blood exposures in pregnant health care workers (HCWs), we analyzed data collected from January 1998 to July 1999 by 25 hospitals participating in the National Surveillance System for Health Care Workers. Of 4144 exposures, 2252 (54%) occurred in women 18-45 years of age; 60 (3%) of these HCWs were pregnant. They sustained 45 (75%) percutaneous injuries (Pis), 10 (17%) mucous membrane exposures, four (7%) skin exposures and one (2%) bite. The exposures occurred in all trimesters: first 23 (38%), second 25 (42%), third 10 (17%). Three source patients were HIV-positive and seven were Hepatitis C Virus (HCV) positive. Of thirty HCWs offered HIV postexposure prophylaxis (PEP), 4 accepted; one of three exposed to an HIV-positive source and three exposed to an HIV-negative or unknown source. The other two HCWs who were exposed to an HIV-positive source and did not take PEP sustained mucous membrane and/or skin exposures of short duration. Information on PEP is available for two of four HCWs who initiated a regimen. One, exposed to an unknown source, stopped after 5 days because of side effects. The other, exposed to an HIV-negative source, took PEP for 22 days. Both HCWs took zidovudine, lamivudine, and indinavir. Of the 45 Pis in pregnant HCWs, 25 (56%) were potentially preventable because either the needle use was unnecessary, or there was a needle device with a safety feature or work practice control that could have been used to prevent the injury. Pregnant HCWs sustain occupational blood exposures placing them at risk for infections. Because PEP for HCV is not currently recommended and HIV PEP may have adverse effects on the HCW and/or her fetus, greater emphasis should be placed on preventing these exposures.

RISK ASSESSMENT OF BLOOD EXPOSURE IN INTERVENTIONAL RADIOLOGY WARDS. Baffoy-Fayard N,* Astagneau P, Brucker G. Co-ordinating center for nosocomial infection control (C-CLIN Paris Nord), Paris, France.

In order to determine the risk of blood exposure in interventional radiology, an audit was performed in 11 wards in hospitals of Paris, France, in 1997. Unit organization and

architecture was observed by a hygiene practitioner and a questionnaire was completed for each radiologist on professional experience, radiological procedures, past history of blood exposure and compliance with standard precautions. All intervention rooms were located in a separate unit, but only 3 wards were organized according to standard recommendations for surgical theater. Among 77 radiologists, 50% were unaware of their serologic status for hepatitis C virus, 9% for hepatitis B virus (HBV), 14% for human immunodeficiency virus. At least once per year, 38% reported accidental percutaneous injuries, 37% blood contacts with mucous membrane, and 84% contacts with intact skin. 47% always wore a mask, gloves and goggles. 88% never wore a mask with an eye shield. Only 30% drained their syringes in a security box in order to limit blood splashes. No operator used puncture-proof containers for sharp objects during procedures and 40% always or sometimes recapped needles. In conclusion, the risk of blood exposure was high for radiologists practicing invasive procedures and standard precautions were poorly known and applied. Control efforts should be made to reinforce awareness of medical and technical staff on hygiene precautions in order to reduce transmission of blood-borne viruses in the radiological setting.

HIV TRANSMISSION AFTER AN OCCUPATIONAL EXPOSURE DESPITE POSTEXPOSURE PROPHYLAXIS WITH A COMBINATION DRUG REGIMEN. Beltrami EM, Luo C-C, Dela Torre N, Cardo DM. Ctrs for Disease Control and Prevention, Atlanta, GA.

The U.S. Public Health Service currently recommends combination drug regimens for postexposure prophylaxis (PEP) after certain occupational HIV exposures. Although evidence suggests that PEP may be effective, failures of PEP have been described. We report a case of HIV transmission after occupational exposure despite PEP with a combination drug regimen. A healthcare worker (HCW) was stuck by a needle from a sharps disposal container in the hospital room of an HIV-infected patient. The HCW started PEP with zidovudine and lamivudine within 2 hours of exposure. The PEP regimen was changed to didanosine (ddI), stavudine (d4T), and nevirapine within 8 hours and continued for 4 weeks (the ddI was discontinued after 3 days due to vomiting). The source patient was taking saquinavir and efavirenz at the time of the exposure and had taken ddI, d4T, indinavir, and ritonavir in the past year. The HCW was HIV-indeterminate at baseline (EIA positive, Western blot indeterminate, HIV RNA undetectable [<50 copies/ml]). Six weeks after exposure, the HCW experienced a flu-like illness, rash, and adenopathy and was found to be HIV-positive (EIA positive, Western blot indeterminate, HIV RNA >750,000 copies/ml). The HCW had no other risk factors for HIV infection. DNA sequence analysis in the C2V3 region of the env gene of HIV from HCW and source patient samples collected 90 days after exposure was performed at CDC; the viruses were found to be very closely related (336/342 [98.2%] matched nucleotide base pairs). Further analysis showed that the viruses had identical antiretroviral resistance mutations in the reverse transcriptase gene and no resistance mutations in the protease gene. The transmitted HIV contained two primary genetic mutations associated with resistance to non-nucleoside reverse transcriptase inhibitors. This failure of PEP may have been related to antiretroviral drug resistance and/or other factors. This case highlights the importance of injury prevention to prevent occupational HIV transmission. Any protection afforded by PEP following occupational HIV exposure is not absolute.

UNDER-NOTIFICATION OF OCCUPATIONAL EXPOSURE: ANALYSIS IN THE POSTEXPOSURE PROPHYLAXIS ERA. Brito VC, Feijó R, Orrico G, El Far F, Ferreira DM. Instituto de Infectologia Emílio Ribas, Sao Paulo, SP Brazil.

INTRODUCTION: Healthcare workers (HCWs) are at risk for occupational acquisition of bloodborne pathogens, primarily due to percutaneous exposure to infected blood. Appropriate postexposure prophylaxis-PEP management is considered an important element of workplace safety. It has been estimated that only 10%-60% of percutaneous injuries are reported. OBJECTIVES: To analyze the percutaneous accidents and determine the undernotification rate from Jan to Oct 1999. METHODS: The study was conducted in a referral Brazilian hospital for infectious diseases with 230 beds, 60% of which are set aside for patients with AIDS/HIV. In Oct 1999, during a five-day period, an anonymous and voluntary questionnaire about injuries caused by needles and other sharp instruments in the year of 1999 was offered to HCWs. RESULTS: 492/1038 (47.3%) HCWs answered the questionnaire. 38 (7.7%) referred to have suffered accidents, and the categories most frequently involved were nursing assistants (28, 73.7%), nurses (3, 7.9%) and residents from the first year (R1) (3, 7.9%). Among the R1, the occupational exposure rate was 20% (3/15). In 31 (79.5%) injuries the contaminant fluid was blood, and 26 (66.7%) accidents were caused by needles. The source of 34 (89%) exposures was HIV positive but the serological status for hepatitis B and C remained unknown in 54.1% and 51.4% of the cases, respectively. 29 (74.4%) exposures were reported to the Infection Control Comission. The vaccination against hepatitis B were completed in 324 (65%) of HCWs, and the adequacy were higher among physicians than among the nursing team. CONCLUSIONS: We have found an estimated rate of 9.2 percutaneous injuries/year. 89% from the accidents involved fluid of HIV infected patients. Only 25.6% of the accidents were not reported, probably due to the high amount of accidents with HIV patients and the need to get PEP. The complete schedule for vaccination against hepatitis B among physicians (109/117) was surprisingly higher than among nurses (209/300) (OR: 5.93; CI 95% 2.67<OR<13.73; p<.05).

PREVENTABILITY OF NEEDLESTICK INJURIES TO HEALTHCARE WORKERS IN THE NATIONAL SURVEILLANCE SYSTEM FOR HEALTHCARE WORKER. Campbell SR, Chiarello L, Srivastava P, Cardo D, NaSH Surveillance Group. Ctrs for Disease Control and Prevention, Atlanta, GA.

Needlestick injuries with hollow-bore needles (Nis) represent the most frequently reported type of exposure sustained by health care workers (HCWs) within hospitals participating in the National Surveillance System for Healthcare Workers (NaSH). To determine the proportion of potentially preventable Nis, we analyzed information on Nis reported by 31 NaSH hospitals. Variables assessed included needle type, procedure, and circumstances of injury. Preventability of Nis was defined hierarchically as 1) needle use was unnecessary for the procedure or 2) a "safer" needle device or 3) safer work practice may have been used. Nis were defined as non-preventable if they happened during use in the patient and/or no "safer" needle device was available. Nis that involved a device with a safety feature were assessed independently. From 6/95 to 10/99, 5,548 percutaneous injuries were reported; 3,410 (61%) were Nis. Of the 3,410 Nis, 2,029 (60%) were classified as preventable: in 663 (33%) needle use was unnecessary; 787 (39%) were preventable with a "safer" needle device; and 579 (29%), by a safer work practice. The proportion of preventable Nis varied by hospital (mean=64%, range 48% to 85%). The mean proportions of various preventability categories also varied by hospital. Of the remaining 1181 Nis, 672 (21%) were classified as non-preventable and for 509 Nis, preventability could not be determined based on data provided. An additional 200 Nis involved a "safety" device; in 17 (9%) use of the needle was unnecessary, and for the remaining 183 the Nis most commonly occurred either before activation was appropriate (43%), the user failed to activate the safety feature (22%), or the safety feature failed (3%). Most reported Nis are preventable by eliminating unnecessary needles, implementing devices with safety features, and ensuring compliance with recommended work practices. However, a large proportion of Nis are still considered non-preventable. Methods to prevent these Nis, including the use of devices with safety features that ensure needle protection throughout a procedure, are needed.

HEPATITIS C VIRUS INFECTION AFTER OCCUPATIONAL EXPOSURE. Campbell SR, Srivastava P, Williams I, Alter M, Cardo D, NaSH Surveillance Group. Ctrs for Disease Control and Prevention, Atlanta, GA; many.

Occupational transmission of hepatitis C virus (HCV) is a continuing concern for healthcare workers (HCWs). We describe exposures to HCV sustained by HCWs and infections resulting from those exposures within 24 hospitals participating in the NaSH Surveillance Group. From 6/95 to 2/99, 5,538 exposures to blood/body fluids were reported; 524 (9%) involved a source infected with HCV (154 [29%] were co-infected with human immunodeficiency virus [HIV], 43 [8%] had unknown HIV serostatus). Of 524 exposures to HCV, 435 (83%) involved blood or bloody fluids; 341 were percutaneous and 94 were mucocutaneous exposures. HCW follow-up rates were low: 187 (43%) completed only 3 months of follow-up and 122 (28%) completed 6 months of follow-up. Five HCWs became anti-HCV positive after a percutaneous exposure, and become positive after a mucocutaneous exposure; all five infected HCWs became anti-HCV positive within 6 months of exposure. HCV RNA was detected in all five HCWs; two were tested 4 weeks after exposure and both were HCV RNA positive. ALT elevation was observed in all five HCWs (median peak ALT=870). In four, the elevation was noted at the time of the first positive HCV RNA test, and in one it was noted before a positive test was obtained. Signs/symptoms of acute viral hepatitis were reported for three of the five HCWs. Devices involved in transmission were 4 hollow-bore needles used for venous access and 1 scalpel blade. Four of the five HCWs were exposed to sources co-infected with HIV; all four took two or three HIV post-exposure prophylaxis drugs for 14-28 days. One of the four was HIV positive 13 months after exposure, but was HIV negative at 6 months. HCWs are at risk of acquiring HCV infection after occupational exposure. Exposures to source patients co-infected with HIV and HCV require further study.

COST OF NEEDLESTICK INJURIES IN A UNIV HOSPITAL. Canini SRMS, Machado AA, Castro G, Gir E. Hosp das Clínicas da Faculdade de Medicina de Ribeirao Preto da Universidade de Sao Paulo, Ribeirao Preto, Sao Paulo, Brasil; Faculdade de Medicina de Ribeirao Preto da Universidade de Sao Paulo, Ribeirao Preto, Sao Paulo, Brasil; Escola de Enfermagem de Ribeirao Preto da Universidade de Sao Paulo, Ribeirao Preto, Sao Paulo, Brasil.

OBJECTIVE: To document the cost of accidental needlestick injuries. DESIGN: The study was conducted in a Univ Hosp which has an outpatient clinic specializing in the care and follow-up of health workers (HW) who are victims of cutaneous-mucosal exposure to biological material, and functioning 24 hours/day. The conduct in the case of accidents follows the recommendations of the Ctrs for Disease Control (CDC) and of the Health Ministry of Brazil. We surveyed the notifications of these accidents made at the institutions during the first semester of 1998 and computed the costs of care and follow-up of each HW. SETTING: A 773-bed tertiary-care university hospital in Sao Paulo, Brazil. RESULTS: During the study period, 98 needlestick injuries were recorded, for a total cost of U$ 138,484.00, with U$ 97,191.00 spent for laboratory tests, U$ 30,766.00 with medical and nursing care, and U$ 8,927.00 with medications. The costs involved in lost days of work were not computed, and no seroconversion for HIV or hepatitis B and C virus was detected over a period of 6 months after the accidents. A low rate of compliance with complete follow-up was observed. CONCLUSION: We conclude that the costs could have been much more elevated if all HW had complied with the follow-up recommended by the protocol. The cost of care and follow-up after an accidental occupational injury with biological material proved to be elevated (U$ 1,413.10) and could definitely be minimized with greater investments in financial resources and preventive measures.

HOW HAVE THE NEEDLES BEING DISCHARGED IN A BRAZILIAN HOSPITAL?. Canini SRMS, Silva MHA, Gir E, Souza ACS, Machado AA. Hosp das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo, Ribeirão Preto, São Paulo, Brasil; Escola de Enfermagem de Ribeirão Preto da universidade de São Paulo, Ribeirão Preto, São Paulo, Brasil; Faculdade de Enfermagem Federal de Goiânia, Ribeirão Preto, São Paulo, Brasil; Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo, Ribeirão Preto, São Paulo, Brasil.

The transmission of pathogen carried through blood to the health care workers (HCW) has been a constant worrying. Although the standard precautions (SP) recommend careful handling of needles and not to recap them, we have observed several occupational injuries due to actions contrary to SP. This investigation was carried out in a 730-bed Univ Hosp in the state of Sao Paulo- Brazil, in 1998. The objective was to identify the rate of needle recapping. The containers were randomly selected among the critical and semi critical areas and systematically collected. All the disposable containers were collected before being sealed. Their inside contents were carefully transferred to other containers, as soon as they were identified and analysed. For such procedures, the SP were rigorously used. A nipper type Cheron was also used to avoid the direct handling. In a total of 10 containers, 1066 needles (blood collection, hypodermic, scalp needles) were found inside, being that 681 (63,9%) were recapped and 385 (36,1%) were uncapped. From a total of 627 (74,2%) were away from the syringe and 218(25,6%) were attached to it. These data reveal that the discharge needle actions need to be reevaluated, because the rates of recapping are high and constitute a risk for occupational exposure. These HCW need continuous education and supervision concerning SP and the safety disposable should be implemented in this hospital.

THE APPLICATION OF RAPID TEST FOR HIV AFTER OCCUPATIONAL EXPOSURE: BENEFIT AND LIMITATION. Cardoso FLL, Hosp Univ rio Clementino Fraga Filho, Universidade Federal do Rio de Janeiro, RJ, Brazil.

Objectives: To show the use of the rapid test (RT) for HIV and to discuss the RT benefit and limitation. Method: RT for HIV (Chembio Diagnostic Systems, USA and CQI Med Products, Israel) is used in our hospital since June 1996. The RT is performed by Hosp Infection Control staff (weekdays) and by Infectious Disease specialist on call (weekends and nights). The patient source diagnosis and laboratory exams are systematically checked.

After consent, blood from the patient is collected. The RT result is ready in 5-10 minutes. At least one ELISA is always performed in all patient source. In our institution PEP is in accordance to CDC/USA recommendations. Results: During 3 years, 597 RTs and ELISAs for HIV were performed after occupational exposure. Five hundred and ninety (99%) patients had negative results by both methods. Four patients (0,7%) had positive results by both methods. Two patients had negative ELISA for HIV, but positive RTs (false positive). Only one patient had negative RT for HIV (false negative), but positive ELISA. This serum sample was tested again, one RT from a different batch (CQI) and other RT from a different manufactory (ABBOTT), and both RTs were positive. Discussion: The rapid test and ELISA for HIV were performed in almost 600 patients, considering that 99% were negative by both methods, unnecessary beginning of PEP and emotional stress could be considerably diminished. Four (0,7%) HCWs started PEP in less than 1h after positive RT. Two HCWs suspended PEP after negative ELISA (false positive RT). One patient had a false negative RT, however due to clinical suspicion of HIV infection in this patient, the ELISA was performed in 2h and the HCW started PEP 3h after exposure. The same sample was tested again and both RTs were positive. Our institution is an Univ Hosp with 450 beds. HIV seroprevalence on admission is unknown, however, we can consider that the RT was performed in a low risk population. The RT showed low false positive results (0,33%). Only 5 patients were true HIV positive, a small sample size to conclude about false negative rate. No diagnostic test can assure 100%. The RT has shown to be useful, but there is a question about false negative results. More experience and development of improved RTs are necessary.

EVALUATION HIV-1 OCCUPATIONAL ACCIDENTS AMONG HEALTHCARE WORKERS EMPLOYED BY THE MUNICIPAL HEALTH CARE SYSTEM OF RIBEIRAO PRETO, BRAZIL. Castro G,* Neves FRAL, Lazzarini MPJ, Abduch R, Machado AA, Vilela RD, Soares CSPM. Clinical Hosp of Faculty of Medicine of Ribeirao Preto, Sao Paulo, Brazil; Municipal Department of Health of Ribeirao Preto, Sao Paulo, Brazil; Univ of Sao Paulo, Ribeirao Preto, Sao Paulo, Brazil; Social Service Assistance for the Municipalites of Ribeirao Preto, Sao Paulo, Brazil.

Since the beginning of the acquired immunodeficiency syndrome (AIDS) pandemic there is a concern with the risks of accidental contamination of healthcare workers (HCWs) with the human immunodeficiency virus (HIV). Ribeirao Preto is a city located on the northeast part of Sao Paulo state, Brazil, with an estimated population of 500,000 habitants and about 2,000 HCWs on the municipal healthcare system. The occupational accident cases are attended according to recommendations released by the Ctrs for Disease Control and Prevention (CDC) and the Brazilian Ministry of Health. The aim of this study was the investigation of the risk for accidental contamination with HIV among the HCWs of our municipal healthcare system in order to reinforce the prophylactic measures. Eighty-six (86) cases of occupational accidents were studied from July 1998 to September 1999. Nurse attendants (44%) and dentists (22%) were the professionals who were involved the most on these type of accidents. Percutaneous exposure to needles was the most common accident (93%) found in this study, and hands were the anatomical part most frequently involved (75%). It was possible to ascertain the serological status of the source cases in 76 cases (88%), and the anti-HIV ELISA was positive in 4 of them. Chemoprophylaxis with anti-retrovirals was initiated in 75 HCW (88%) until the serological status of the source patient was known. Forty-six (46) HCWs took zidovudine and lamivudine and in 29 indinavir was associated to the prophylactic regimen. A 30-day regimen of anti-retroviral use was indicated to 14 patients (18%), including 4 where the source patient was HIV-positive and 10 of unknown source. No seroconversion to HIV-positive was observed among the studied HCW. Our study agrees with the literature in the sense that nurse attendants and dentists are among the highest risk groups of HCW for occupational accidents. The need for a 30-day prophylactic regimen on 18% of these accidents, 71% of them originating from unknown sources, reinforces the importance of establishing and educating HCW about preventive measures.

HIV POSTEXPOSURE PROPHYLAXIS IN A TERTIARY BRAZILIAN HOSPITAL. Castro-Neto M, Ribeiro JMVP, Sarquies MGA, Mendonça RC, Murta-Oliveira C, Martin PWL. Mater Dei Hosp, Belo Horizonte, Brazil.

Healthcare workers are exposed to a risk of acquiring many diseases, mainly professionals that handle blood and other body fluids. Among these illnesses transmitted by percutaneous injury (needlestick or cut with a sharp object), the most important are hepatitis and AIDS. Ctrs for Diseases Control and Prevention (CDC) estimated that the risk of acquiring Aids is about 0.4%, 5% for hepatitis C, and 30% for hepatitis B after this kind of injury. Since December 1998, we introduced a postexposure prophylaxis (PEP) protocol for HIV infection with some modifications from the one proposed by the CDC in Mater Dei Hosp, Belo Horizonte (MG), Brazil, a tertiary hospital with 125 beds including various medical specialties and an adult and neonatal intensive care units. In our protocol we evaluate only the kind and time of exposure, without considerations about the source patient, to indicate the PEP. During this period, there were 29 occupational exposures that occurred mainly at intensive care units (8/28%), surgical center (7/24%), and laundry (4/13%). Twenty-seven (27) of these were percutaneous injury and two mucous-membrane exposures. The professionals at higher risk in this study were nurses (18/62.1%), housekeeper (5/17.3%), and laundry (4/13.8%) workers. The body fluids involved were blood (20/68.9%), endotracheal secretion (5/17.3%), liquor (1/3.4%), and in three (10.4%) there wasn't exposure to organic fluids. The majority of these exposures (16/55.2%) were avoidable, being secondary to erroneous procedure (6/20.7%) and inadequate disposal of sharp objects (10/34.5%). Eighteen (18) professionals took antiretroviral drugs, three for 28 days and 25 for a mean of 2.3 days. This study emphasizes the need of continuos training programs focusing on the prophylaxis of blood and body fluid exposures.

PREVENTION OF NEEDLESTICK INJURIES IN HEALTHCARE WORKERS: 27 MONTH EXPERIENCE WITH A RESHEATHABLE "SAFETY" WINGED STEEL NEEDLE USING CDC NASH DATABASE. Chen LBY, Bailey E, Kogan G, Finkelstein LE, Mendelson MH. Mount Sinai Med Center, New York, NY.

Nis from WSNs are considered high-risk for bloodborne pathogen transmission. We evaluated a safety WSN (SafetyLok, BD) at an 1,100-bed hospital, previously reporting a 50% reduction in WSN related Nis by using a safety WSN. Subsequent to this trial the safety WSN was evaluated during a 16 month (6/1/98-9/30/99) post study period (total 27 month experience with this safety device). Nis were tracked using the NaSH exposure form; a survey of sharps disposal boxes was performed to assess usage and activation rates. The non-safety baseline period I (9/1/95-3/31/97) WSN NI rate was 13.41/100,000 WSNs(86 Nis/641,282 WSNs); the study period II (7/1/98-5/31/98) WSN NI rate was 6.87/100,000 WSNs (30 Nis/436,180 safety WSNs); and the post study period III (6/1/98-9/30/99) WSN NI rate was 5.5/100,000 WSNs (39 Nis/710,652 safety WSNs). The post study WSN NI rate was 59% lower than the baseline period ($p<0.01$). Analysis of post-study safety Nis by procedure: 27 percutaneous venous puncture, 8 arterial puncture, 3 to insert a peripheral I.V. line/set up heparin lock, 1 unknown ; 20 occurred during use of item, 13 after use of item before disposal, 5 during or after disposal, 1 before use of item. 23 occurred before mechanism activation was appropriate, the safety mechanism was not activated in 8, 5 occurred during the activation process. A survey of 627 disposed WSNs during period III revealed 627(100%)safety WSNs, activation rate 71%(444/627). In conclusion, the Safety Lok (BD) WSN has remained consistently effective in reducing WSN related Nis for 27 months at our institution. Use of the Safety Lok WSN should prevent bloodborne pathogen transmission to HCWs. Compliance with proper activation procedures needs to be routinely stressed.

VARIATIONS IN NEEDLESTICK INJURIES IN THE NATIONAL SURVEILLANCE SYSTEM FOR HEALTHCARE WORKERS OVER TIME. Chiarello LA, Cardo D. National Surveillance Systems for Healthcare Workers (NaSH) Surveillance Group, Ctrs for Disease Control and Prevention, Atlanta, GA.

Surveillance data on percutaneous injuries (Pis) among healthcare workers (HCWs) are necessary to assess the impact of prevention interventions and identify emerging risks. Data on Pis, including type and purpose of device involved and occupation of injured HCWs, reported from hospitals participating in NaSH were analyzed by year. A total of 5,178 Pis reported from 1/96 through 7/99 (study period) were analyzed, combining data from 1/98 through 7/99. There was no change over time in the distribution of occupations of HCWs sustaining Pis. However, the distribution of device types involved and purposes for which devices were used varied over time. Pis due to winged steel needles (WSN) decreased from 18.2% to 10.5% ($p<.0001$) while Pis due to needles attached to intravenous (IV) tubing increased from 1.7% to 4.5% ($p<.002$) from 1996 to 1999. The proportion of Pis associated with percutaneous blood withdrawal decreased from 22.5% to 16.2% ($p<.0001$). To examine whether the observed variations reflect a changing trend in these types of Pis, we analyzed data from 17 hospitals reporting at least 75 Pis since 1998, since the number of hospitals contributing data to NaSH increased during the period studied from five in 1996 to 31 in 1999. The proportion of injuries attributable to different devices and procedures varied considerably among hospitals. When data from five hospitals participating in NaSH for 2 or more years were analyzed, there was no significant variation over time in the proportion of Pis associated with blood withdrawal, WSNs, or needles attached to IV tubing. Interpretation of aggregated surveillance data on Pis must take into consideration changes in the number and characteristics of institutions contributing data. In addition, each healthcare organization must assess its own surveillance data when setting prevention

POSTEXPOSURE PROPHYLAXIS USE AMONG HEALTHCARE WORKERS WHO WERE EXPOSED TO HIV-NEGATIVE SOURCE PATIENTS. Critchley SE, Srivastava PU, Campbell SR, Cardo DM, The NaSH Surveillance Group. Centers for Disease Control and Prevention, Atlanta, GA.

The U.S. Public Health Service recommends the use of antiretroviral drugs after certain occupational exposures to human immunodeficiency virus (HIV). To assess the use of postexposure prophylaxis (PEP) by healthcare workers (HCWs) who were exposed to HIV-negative source patients (SPs), we analyzed data collected on occupational exposures to blood/body fluids reported from 21 National Surveillance System for Healthcare Workers (NaSH) hospitals. From Jun 1995 through Sep 1999, 1142 HCWs from these hospitals initiated PEP following a blood/body fluid exposure. Information on PEP usage was available for 405 HCWs who had an exposure to an HIV-negative SP. The types of exposures sustained by these HCWs were 368 (91%) percutaneous injuries (Pis), 25 (6%) mucous membrane exposures, 9 (2%) skin exposures, and 3 (1%) bites. PEP regimens taken were as follows: a single drug, 35 (9%); 2-drug combinations, 221 (55%); and 3-drug combinations, 149 (37%). Use a of a particular regimen did not vary by the type of exposure. The duration of PEP regimens taken by HCWs ranged from 1-43 days: 291 (72%) for 1-5 days; 72 (18%), 6-10 days; 22 (5%), 11-19 days; and 20 (5%), 20 days. The duration of PEP was not influenced by the type of exposure sustained by HCWs who took PEP <20 days. The only type of exposure sustained by workers who took PEP 20 days were PI (19) or bite (1). Information on symptoms was available for 51 HCWs who took PEP and reported one or more symptoms. The most commonly reported symptoms were fatigue or malaise, 21%; nausea, 20%; emotional distress, 12%; and headache, 9%. These findings suggest that strategies such as use of a rapid HIV antibody assay, SP evaluation for risk of HIV infection, and follow-up counseling could improve the management of exposed HCWs.

OCCUPATIONAL RISK OF H. PYLORI AMONG PERSONNEL SERVING DISABLED PERSONS IN FLANDERS (BELGIUM). De Schryver AA, Van Winckel M, Goossens H, De Backer GG. Univ of Gent, Gent, Belgium; Univ Hosp, Gent, Belgium; Univ of Antwerp, Antwerp, Belgium; Univ of Gent, Belgium.

OBJECTIVES: To determine the prevalence of H. pylori infection in personnel working in institutions for mentally disabled persons and to determine its correlates. METHODS: Staff members of two institutions for mentally disabled persons with a high prevalence of H. pylori in these residents (86% have antibodies against H. pylori) were invited to take part in the study. Infection with H. pylori was diagnosed by presence of antibodies. Prevalence of H. pylori antibodies was compared to a control group, mainly consisting of office workers. RESULTS: In total 603 of 783 staff members of the institutions (77.0%) and 439 persons in the control group participated in the study. Both groups were comparable for "classical" risk factors for H. pylori infection, particularly age, education and social class. Prevalence of H. pylori antibodies in the study population was 40.6% (95%CI 37.3-44.7) compared to 29.2% (95%CI 24.5-33.5)in the control group, difference statistically significant ($p<.001$, 95%CI for difference 0.05 to 0.17). In the study group, prevalence of H. pylori antibodies was dependent on duration of employment ($p<.05$) but not on age ($p=.37$). In personnel having nursing contact with residents, prevalence of antibodies for H. pylori went up from 28% in those working <5 years to 67% in those working >20 years, while such increase was not seen in personnel without nursing contact. Conclusions. Prevalence of H. pylori infection among staff of two institutions for mentally disabled persons is higher than in a group of employed people, with no professional contact with mentally disabled persons. We observed a higher prevalence in staff having close and prolonged contact with residents, an argument in favour of person to person transmission, due to occupational contact.

SUSTAINED DECREASE OF CUTANEOUS EXPOSURES AMONG HEALTHCARE WORKERS. Fahey BJ, Lee LM, Wesley RA, Henderson DK. Natl Institutes of Health, Bethesda, MD.

INTRODUCTION: We previously reported a decrease in cutaneous exposures (CE) in temporal association with implementation of Universal/ Standard Precautions (UP/SP) and the Department of Labor's Bloodborne Pathogens Standard (BPS). UP/SP and BPS entail mandatory yearly training, participation in a hepatitis B vaccination program, provision of personal protective barrier equipment, and ongoing assessment/modification of engineering controls. OBJECTIVE: To determine whether previously reported reductions in self-reported CE have persisted 11 years after UP/SP introduction. METHODS: We conducted a confidential survey of 246 Clinical Ctr nurses for a 12-month period (10/9-09/98). DATA COLLECTED INCLUDED: job category and duties; UP/SP training status; numbers of CE to patients' blood CE; numbers of specific job procedures, and procedure-specific CE. RESULTS: We have observed a 58% reduction in CE to blood since 1986. The most significant decrease occurred in the first year after training; however, rates of CE to blood have continued to decrease over the past 12 years. Mean numbers of self-reported CE by survey year are (TABLE). CONCLUSIONS: Continuing education, attention to work-practices and continuous assessment/modification of engineering controls have been associated with an 11-year sustained decrease of self-reported CE to blood; however, CE to blood still occurs too frequently in our institution.

	Year and UP/SP Implementation Status				
	1986	1988	1992	1994	1998
	1 Year	1 Year	5 Years	7 Years	11 Years
CE Type	Before	After	After	After	After
	Mean # CE	Mean # CE	Mean # CE	Mean # CE	Mean # CE
Blood	35.5	18.1	16.6	15.0	14.8

COST EFFECTIVENESS OF A MANDATORY VARICELLA VACCINATION PROGRAM. Fauerbach LL, Boeff D, Gutekunst RR, Shands JW. Shands Hosp at UF, Gainesville, FL; Univ of Florida, Gainesville, FL.

At Shands Hospital, a tertiary referral transplant center, 26% of exposures to Varicella zoster involved a healthcare worker (HCW) as the index case. In 1996 a voluntary Varicella vaccination program was implemented to reduce this exposure risk. Of 76 susceptibles, 45 were vaccinated between 1996 and 1998 with 31 non-vaccinated HCWs remaining. In Feb, 1998, 4 Varicella exposures occurred. One of these exposures was caused when a susceptible HCW who had not participated in the voluntary program developed Varicella. Over 50 patients, including 5 heart transplant and 2 lung transplant patients, and three susceptible HCWs, were exposed. In addition to the cost for screening potentially susceptible employees, exposure management cost approximately $9,260 due to staff time and the cost of administering Varicella Zoster Immune Globulin to immunosuppressed patients. In contrast, the cost of immunizing the remaining 31 Varicella-susceptible HCWs would be $3,844 ($114 for two vaccine doses + $10 for titer × 31 HCWs). Occupational Health Services (OHS) estimated that 25 new employees each year are Varicella susceptible. Based on the following: (1) Varicella occurring in a normal adult can be a serious debilitating illness; (2) In the immunocompromised patient it can be potentially lethal; (3) Varicella is readily transmitted from HCW to patient and from patient to HCW; (4) The excessive cost and time required for epidemiological post exposure follow up; and (5) The effectiveness of the vaccine in preventing disease: the Infection Control Committee recommended a mandatory vaccination program for susceptible employees. The program has been cost effective and decreased the risk of disease for patients and HCWs. Since implementation of mandatory Varicella vaccination in Jul 1998, no HCWs have developed Varicella or have been off of work due to Varicella exposure. OHS reports 81.3% of HCWs develop a positive titer post immunization.

ADHERENCE OF PROFESSIONALS TO FOLLOW UP TREATMENT AFTER EXPOSURE TO CONTAMINATED MATERIAL IN A BRAZILIAN UNIV HOSPITAL. Figueiredo RM, Garcia MT, Resende MR, Papaiordanou PMO. State Univ of Campinas Hosp, SP, Brazil; State Univ of Campinas - Faculdade de Ciências Médicas.

The number of healthcare workers (HCWs) who suffered accidents with potentially contaminated material and are looking for attendance is increasing. The adherence of these patients, however, to proposed measures has been not satisfactory. 552 HCWs who reported accidents with potentially contaminated material were accompanied in the State Univ of Campinas Hosp between 1997 and 1999. In 65 accidents, the index patients were seropositive for HIV. Of these accidents, 55 were offered antiretroviral postexposure prophylaxis (PPE), but only 24 (46.68%) finished the follow-up. Of the 10 patients who did not use PPE, six (60%) reached the end of the follow up. From a total of 58 accidents related to HCV+ patients, 23 (39.6%) concluded the treatment, as well as six (30%) from 20 with patients HbSAg+. The adherence rate of HCWs who had accidents with materials of unknown sources was 31.3% (27 from 86). The adherence rate within the physician team was 38.4%, the nursing team 40% and the cleaning professionals 32.25%. There were no differences either among the adherence rates of distinct risks (p=.257), or among professional categories (p=.736). Of the HCWs with HIV index patients who did not conclude the follow-up, 55.39% of it was at the first return. The adherence of HCW who suffered accidents with potentially contaminated material is still precarious, even in this well organized and standardized service in southeastern Brazil. Factors such as double work shift, staff substitution, and lessening of the panic produced at the moment of the accident, may contribute to decrease of the rate of the follow-up conclusion. Systems with call for absents and flexible schedules, establishment of relations with the team, and increasing hospital population consciousness, may improve this index.

OCCUPATIONAL EXPOSURE TO POTENTIALLY CONTAMINATED MATERIAL IN A BRAZILIAN UNIVERSITY HOSPITAL. Figueiredo RM,* Resende MR, Garcia MT, Sinkoc VM, Campos EOM, Barbosa SM, Papoiordanou PMO. State Univ of Campinas Hosp, Campinas, Spain State Univ of Campinas - Faculdade de Ciências Médicas.

The description and recommendation of efficient proceedings for occupational infection's prophylaxis moved Brazilian health institutions to organize and to offer services for attending and following professionals who suffered accidents with potentially contaminated material. In the beginning of 1997, the State Univ of Campinas Hosp standardized its attendance carrying out tests and prophylaxis to hepatitis B and AIDS, as well accompanying the patients. In 32 months (Jan 1997 to Aug 1999) 882 accidents were reported, from which 66.9% occurred at the moment of procedure and 33% after the act and up to the discard. Nurse team sustained 41.4% of exposures, 29.9% the physician team, 15.5% the students (nurse and medicine) and 6.4% cleaning professionals. The procedures that generated more accidents were vascular access (30.2%), surgery (12.2%), suturing (5.5%), and finger-stick (7%). About the place, 27.1% of the accidents occurred in intern units, 25% in surgery centers, 16.8% intensive therapy units, and 13.7% in emergency units. The finger was the attacked body part in 67.6%, and blood was the involved material in 82.8% of the exposures. At the accident moment 72.9% of the professionals used protection equipment and only 56.3% respected standard precautions. The accidents were related to HIV+ patients (9.7%), to HCV+ patients (11.3%), to HbSAg+ patients (1.9%), and 16.5% to unknown index patients. Only 62.6% of the professionals showed a complete hepatitis B vaccination schedule. HIV prophylaxis was used in 12.1% of the patients, as well in 2.7% of HBIG patients. All patients with risk exposition were directed to outpatient department follow-up for six months, from which one of them was seroconverted to HCV. Strategies for continuous education about compliance with standard precautions and hepatitis B vaccination were established.

USING NASH (NATIONAL SURVEILLANCE SYSTEM FOR HOSPITAL HEALTHCARE WORKERS) FOR DESIGNING PROGRAMS TO REDUCE PERCUTANEOUS INJURIES IN A UNIV HOSPITAL. Fisher M, Rogers A, Khakoo R, Capodieci J, Sabo L, Buterbaugh A, Horstman P. Robert C. Byrd Health Sciences Center, Morgantown, WV; Ruby Memorial Hosp, Morgantown, WV.

Healthcare workers (HCWs) have an increased risk of exposure to bloodborne pathogens (BBP). Monitoring trends of percutaneous (PI) and other injuries to HCWs is facilitated by a comprehensive computerized program. We have used the software program NaSH developed by the CDC since Jan 1998 to record data on BBP exposures at a Univ hospital (370 beds), associated outpatient facilities, and health sciences center. From Jan through Oct 1999 there were 235 exposures to BBP; 198 PI and 37 non-percutaneous injuries (Non-PI) for a total of 5700 HCWs. The NaSH program allowed us to report data readily to individual units and identify a high risk location (operating room) where 36 (18%) of PI occurred. Further analysis of Pis in the OR during this ten-month period showed that residents had the highest rate of PI with 18 (50%). During the same ten-month period in 1998, the rate of PI for surgical technicians (ST) was 12 (28%). A targeted intervention to reduce the Pis in ST began in Dec 1998. From Jan through Oct 1999, the proportion of Pis in STs dropped from 28% to 11% (p=.12). Further analysis will be performed to determine the proportion of Pis that were potentially preventable among STs in order to determine the effectiveness of the educational intervention. Using NaSH to compare the total number of Pis from the first ten months in 1998 versus 1999, the number of reported Pis in the same day outpatient surgical units increased from 1% to 8% (p<.01). These variations in the number of Pis as demonstrated by NaSH underscore the need for continuous, comprehensive monitoring. Interventional programs are being implemented based on results of NaSH data targeting high-risk groups and locations. We conclude that the NaSH software program provides an efficient tool for tracking Pis in HCWs. Data generated are useful to Employee Health for individual follow-up, finding trends in exposures, and planning specific educational programs that will decrease the risk of exposure to BBP.

MOBILE TEAM FOR HEALTHCARE WORKERS VACCINATION: SEEKING FOR BETTER COVERAGE. Fonseca MO,* Ferreira IG, Oliveira S, Shimbori S, Neves MAC. Emilio Ribas Institute of Infectious Diseases, Sao Paulo, Brazil.

Influenza nosocomial outbreaks brings increased absenteeism, reduced efficiency among healthcare workers (HCWs) and increased mortality, morbidity, and length of stay among patients. The Ctrs for Disease Control and Prevention recommends flu vaccinations for HCWs, but achieving high immunization rates have proven difficult. The Emilio Ribas Institute of Infectious Disease is a tertiary assistance referral and teaching hospital. Of the 230 beds, 60% are dedicated for HIV/AIDS care. In May 1999, a flu vaccine campaign was initiated among the hospital staff. The objective was to evaluate the vaccine coverage of the HCW and to compare two simultaneous methods of a vaccination campaign, a fixed vaccination clinic and a mobile team. There was ample notification of the HCWs regarding the five-day campaign and two methods for vaccination. A mobile vaccination team was sent to all sectors (both involved in direct and indirect patient care) of the hospital during the same period that a fixed central clinic was available. 606/1704 (36%) of hospital workers, 171/266 (64%) of student trainees, and 184/271(68%) of contract workers were vaccinated. The mobile team performed 61% of the vaccinations, significantly more (95% CI 57.5%-63.8%) than half. Of those involved with direct patient care 41% (558/1364) were vaccinated, 30% by the mobile team and 10% by the fixed clinic. The mobile team performed a higher percentage of the vaccinations in this group, 75% (95% CI 71%-78%). Of staff without direct patient care 36% (219/606) were vaccinated, 14% by the mobile team and 22% by the fixed clinic. Of the contract workers (performing direct and indirect patient care) 68% (184/271) were vaccinated, with 30% and 38% by the mobile and fixed teams, respectively. By professional classification 23% of doctors, 41% nurses, 36% nurses assistants, and 64% of those in training were vaccinated. The mobile team gave better coverage for the hospital staff with direct patient care, and covered a significant proportion of others, suggesting that adding the mobile team as strategics would improve the vaccination coverage.

PROSPECTIVE SURVEILLANCE AND RISK ASSESSMENT FOR VARICELLA ZOSTER VIRUS TRANSMISSION FOLLOWING OCCUPATIONAL AND HOUSEHOLD EXPOSURES IN HOSPITAL STAFF. Green K,* Volkening G, Hilborn G, McGeer A. Mount Sinai Hosp, Toronto, ON, Canada; York County Hosp, Newmarket, ON, Canada; Univ of Toronto, Toronto, ON, Canada.

BACKGROUND: Data on frequency of chickenpox following occupational exposures to varicella zoster virus (VZV) and what constitutes 'significant' exposures is limited. However, exposed unvaccinated staff are routinely restricted from work at considerable cost to the healthcare system. The objective of our study was to determine the rate of chickenpox (CPX) in hospital staff following exposures to CPX or shingles and to assess the ability of occupational health personnel to use pre-defined criteria to determine high and low risk exposures. METHODS: 96 hospitals participated. A questionnaire describing demographics, exposure details, serological status, risk assessment and outcome was completed for each VZV susceptible employee at the time of exposure. To determine inter-rater reliability, 3 reviewers blinded to the original risk designation categorized the exposures according to pre-defined criteria. RESULTS: 22/96 (23%) hospitals provided 57 (range 1-14) case reports .15/23 (65%) household exposures and 7/31 (23%) occupational exposures developed CPX. Of the 22 cases who developed CPX, 6 were categorized as low-risk at time of exposure and

7,6,4 were rated low-risk by raters 1,2, and 3 respectively. In those rated low-risk originally or by the 3 raters, 27%,33%,32%, and 20% developed CPX. Overall agreement on risk categories varied, with least agreement between blinded raters and the original assessor (Kappa 0.552,0.652, 0.676). Inter-rater reliability was better between blinded raters (Kappas 0,788, 0.803, 0.832, 0.788). CONCLUSION: Household exposures, which may not be reported, pose the greatest risk for CPX in hospital staff. Our risk assessment tool, while predicting risk to some extent, was not adequate to alter work restriction policies for low risk exposures. Hosp staff should be vaccinated against CPX.

HBV IMMUNIZATION AND POST-IMMUNIZATION SEROLOGY AMONG CANADIAN NURSES, SURGEONS AND DENTISTS. John, MA,* McCarthy, GM, MacDonald, JK, Koval, JJ. London Health Sciences Centre; The Univ of Western Ontario.

To investigate the HBV immunization status of nurses, surgeons and dentists we conducted mailed surveys of stratified random samples of dentists (n=6,444), surgeons (n=4,000) and nurses (n=500) in Canada. Follow-up included two additional mailings of questionnaires to nonrespondents. The adjusted response rates were 66.4% (dentists), 55.6% (surgeons) and 67.1% respectively. Unweighted data were used for descriptive statistics and multiple logistic regression (MLR) analyses. HBV immunization was reported by 78% of nurses, 87% of surgeons, and 90% of dentists (p<.0001). MLR indicated that the best predictors of HBV immunization were age (<30 years, Odds Ratio(OR)=62.9; 30-39 years, OR=9.6; 40-49 years, OR=3.5; 50-59 years, OR= 1.9; reference group= >= 60 years), healthcare worker group (surgeons, OR=2.9; dentists, OR=2.4), and attending continuing education on infection control in the past two years (>5 hours, OR=1.4; 1-5 hours, OR=1.3). Among those who reported HBV immunization, post-immunization serology was reported by 83% of nurses, 87% of surgeons and 70% of dentists (p<.0001): MLR indicated that the best predictors of post-HBV immunization serology were age (<30 years, OR=1.5; 30-39 years, OR=2.6; 40-49 years, OR=1.6; reference group= ≥60 years), healthcare worker group (surgeons, OR=3.6; nurses, OR=1.6), female sex (OR=1.4), and attending continuing education on infection control (>5 hours, OR=1.4; 1-5 hours, OR=1.3). Education interventions are required to improve compliance with HBV immunization (especially for nurses) and post-immunization serology (especially for dentists).

RISK OF EXPOSURE TO BLOODBORNE PATHOGENS BY NEEDLE-STICK AND SHARP INJURIES IN HEALTHCARE WORKERS AT THE JORDAN UNIVERSITY HOSPITAL. Khuri-Bulos N, Abu Khader I, Hatoog R. Jordan Univ Hosp, Amman, Jordan.

OBJECTIVE: To define the risk of exposure to Needle-stick and sharp injuries (NSSI) in Health Care Workers (HCWs) in a tertiary care setting in a developing country. METHOD AND SETTING: Prospective study of NSSI in HCWs between 1996-98 at the Jordan Univ Hosp (JUH), a 500-bed hospital in Amman, Jordan. RESULTS: The risk of NSSI is well defined in developed countries, but this is ill defined in HCWs in developing countries. As part of an ongoing study aimed at defining the risk of exposure of healthcare workers to bloodborne pathogens following NSSI at the JUH, hepatitis B, hepatitis C and HIV status was determined on the source patient. In the 3-year period between 1996-98, 387 NSSI were reported. 142 in 1996, 116 in 1997 and 129 in 1998. Testing for HBV was done in 160 instances. In 34 this was positive for HBsAg (21.2%). HCV was positive in 17/151 (11.2%) and HIV was positive in 5/128 (3.9%). It is noteworthy that compared with previous studies, the rates of these diseases are higher in this study of hospitalized patients than in the general population. In Jordan HBV carrier rate is 5-10%, 2-3% for HCV and <1% for HIV. CONCLUSION: From this preliminary study of NSSI, HCWs in Jordan have a substantial risk of exposure to blood-borne pathogens. Further definition of infectivity has to be documented and every effort at minimizing these events should be adopted.

KNOWLEDGE AND PERFORMANCE OF UNIVERSAL PRECAUTIONS BY NURSING STUDENTS IN KOREA. Kim KM, Kim MA, Chung YS, Kim NC. St. Mary's Hosp, The Catholic Univ.of Korea, Seoul, Korea; Andong Science College, Andong, Korea; The Margaret Pritchard College of Nursing, Chonju, Korea; The Catholic Univ of Korea, Seoul, Korea.

PURPOSE: The purpose of this study was to identify knowledge of universal precautions and its performance in practice. METHODS: The research was conducted from Nov 2-30, 1998. A total 515 student nurses; 249 from a baccalaureate nursing college and 266 from second and third year students of a 3-year community nursing college were surveyed. RESULTS: The average score for universal precautions knowledge was 270.41-_19.43/300 (range 150-300). The results showed that 99.2% of students avoid injury from used needles, 98.6% answered that they always wash their hands if they had contact with the patient's blood and they always dispose of used needles in sharps collectors (97.7%). But 39.2% responsed that they dispose of used needles after recapping them. The average score for universal precautions knowledge of the senior students in the 4-year college was the highest (277.65-_13.99). The average score for the performance of universal precautions knowledge was 53.18-_5.91 (range 14-70). The items: "I cautiously avoid injury from the used needles" (4.92-_0.33), "I always wash my hands if there has been contact with the patient's blood" (4.91-_0.34), and "I always disposed of used needles in the appropriate collector" (4.89-_0.42) showed the highest performance. However "I always dispose of used needles after recapping them" (2.19-_1.39), and "I always use protection goggles when in danger of contamination" (2.19-_1.20) showed low performance level. The highest average score for universal precautions performance was shown among the second year students in 3-year nursing colleges (54.19-_6.92) between the groups. It showed that the level of the universal precautions performance was higher for those who had education on universal precautions prior to performance of the universal precautions than for those without any prior education. The Pearson Correlation Coefficient between the knowledge of universal precautions and performance of universal precautions in practice showed a positive correlation. CONCLUSION: The student in the college of nursing comparatively have higher level of knowledge of Universal precautions, but some of them are misunderstanding in some parts. This study shows that it is essential to educate the students about Universal precautions since it shows that the pre-educated students not only have higher knowledge, but also higher tendency to follow the guides in a more appropriate manner.

PERCUTANEOUS EXPOSURES IN HEALTHCARE WORKERS—THE E.E.E.'S OF REDUCTION. Korn C, Burke R, Garvin G, Sulis C. Boston Med Ctr, Boston, MA.

Boston Med Ctr (BMC) is a 547-bed teaching hospital. Over the past 10 years, several interventions have contributed to a reduction in percutaneous injuries (PI) among healthcare workers (HCW). We report a continued reduction. Key elements of the program include root cause Evaluation of each injury, focused Education, and implementation of Engineering controls. HCW with PI are evaluated and treated by a trained "Needlestick Counselor." Risk reduction strategies are discussed. Aggregate PI data are analyzed by a multidisciplinary team using NaSH (National Surveillance System of Hosp HCW) software to assess trends and focus improvement efforts. Two interventions are described. Between 12/96 and 12/97, 17 physicians reported PI while suturing central lines (17/64 = 27% of all physician PI). A needleless central-line anchoring device was evaluated and purchased. Multidisciplinary inservices and poster presentations were followed by focused hands-on training for users. Over the next 12 months there were only 4 PI while suturing central lines (4/70 = 6%; p = 0.0009). Between 7/98 and 9/98, 8 physicians reported PI associated with high risk procedures in the Emergency Department (ED) (8/30 = 27% of all physician PI). Risk reduction strategies included presentation of ED-specific PI data and review of safe needle practices followed by implementation of focused education and strict supervision of new House Officers (HO) performing invasive procedures. Over the next 3 months there were no PI among ED physicians (0/9 = 0%; p = 0.08). BMC has documented a decrease in targeted PI. The optimal methods to achieve sustained reduction in PI are unknown. We believe prevention is key to long-term reduction. New initiatives planned for the next 12 months include development of a multidisciplinary hands-on skills lab to teach high risk procedures to entry-level HO, standardization of devices and equipment, and ongoing assessment of safer devices.

DETECTION AND PREVENTION OF INFLUENZA IN HEALTHCARE WORKERS. Kuehnert MJ, Bridges CB, Strikas RM, McKibben PS, Campbell SR, Fukuda K, Cardo DM, the NaSH Surveillance Group. Ctrs for Disease Control and Prevention, Atlanta, GA.

Influenza outbreaks in hospitals often affect health care workers (HCWs), and infected HCWs have been implicated as important vectors of influenza transmission to patients. Guidelines for influenza infection control in health care facilities recommend HCW vaccination and outbreak investigation to reduce transmission. To assess influenza vaccination rates, we surveyed 24,736 HCWs from seven hospitals participating in the National Surveillance System for Health Care Workers (NaSH) were surveyed in 1996 or 1997. Overall, 6,903 (27.9%) were vaccinated (range 19.6-44.0%). Physicians or physician assistants were most likely and technicians or clerical staff least likely to be vaccinated (40 vs 22%, p<0.001). To assess institutional practices regarding influenza surveillance, we conducted a survey during a NaSH training course in 1999. Representatives from 34 hospitals located in 20 states and the District of Columbia (mean bed size 433 beds, range 120-1,120) were surveyed. Although 17 (50%) participants reported that rapid diagnostic testing was available at their facility, only 9 (27%) routinely conducted exposure investigations when influenza was suspected; availability of rapid testing was associated with investigation (p=0.05). Reasons given for not conducting investigations included lack of awareness that influenza was a significant problem, lack of expertise for investigation, disease reporting not required, or logistic difficulty (e.g., lack of staff, time, or resources). Few NaSH hospitals surveyed have policies for either surveillance or epidemic control of influenza, and adherence to recommendations for HCW vaccination is poor. Additional guidance and improved dissemination of existing information are needed for effective implementation of influenza prevention measures in acute-care facilities.

RISK OF ACCIDENTS WITH POTENTIALLY CONTAMINATED MATERIAL AMONG HEALTH PROFESSIONALS IN THE CITY OF RIBEIRAO PRETO, SAO PAULO, BRASIL. Machado AA, Lazzarini MPT, Neves FRAL, Bouvet E, Tarantola A, Costa JC. Univ of Sao Paulo, Ribeirao Preto, Sao Paulo, Brasil; Municipal Health Secretariat of Ribeirao Preto, Sao Paulo, Brazil; Groupe d'Etude sur le Risque d'Exposition au Sang (GERES), Paris, France; Faculty of Medicine of Ribeirao Preto, Univ of Sao Paulo, Ribeirao Preto, Sao Paulo, Brazil.

OBJECTIVES: To assess the risk of accidents with potentially contaminated material (APCM) among health professionals (HP) working at primary and tertiary level centers in the city of Ribeirao Preto, Sao Paulo, Brazil. METHODS: Four of 35 primary level Basic Units (BU) and 2 sectors (Surgery and AIDS/Infectious Diseases Unit) of the Univ Hosp (UH), tertiary level, were chosen. HP responded to a questionnaire about APCM. Data were analyzed with EpiInfo 6.0. RESULTS: 161 HP were studied: 86 from BU and 75 from UH. We detected 54 HP (27 from the BU and 27 from the UH) who had suffered some type of APCM, with an overall accident rate of 33.5%. 69.8% were females, aged 20 to 54 years, mean 35 years. Most were nurse technicians, nurses and doctors, respectively representing 49.1%, 18.9% and 18.9% of the HP population who reported an APCM. The risk of accidental exposure to biological material for HP of each category was 38.2% (26/68) for nurse technicians, 50% (5/10) for dentists, 47.6% (10/11) for doctors and 47.6% (10/11) for nurses. With respect to the number of times they suffered an accident, most HP reported only one occasion (84.1%), although some (7 HP, most of them nurse technicians) suffered more than one accident. CONCLUSIONS: Despite the small number of HP who reported an APCM in the present sample, some suffered more than one event and are professionals in high risk areas. Are doctors, nurses and dentists more exposed or less prepared since practically 50% of the HP in these categories are at risk for APCM? The application of universal measures and the acquisition of protective material are not sufficient to guarantee a preventive strategy that includes reflection about changes in behavior and about the causes of accidents.

ALGORITHM FOR STANDARDIZED PPD CONVERSION AND COMPLIANCE RATES FOR INTER-HOSPITAL COMPARISON. Martin DL, Wiggins DL, Gustafson TL. Infection Control and Prevention Analysts, Inc., Austin, TX.

The resurgence of tuberculosis (TB) in the U.S. has greatly increased the risk of transmission to healthcare workers. Although national guidelines and standards require ongoing monitoring of employee exposure with periodic tuberculin skin testing (TST), annual TST conversion rates in published studies vary widely (0.1%-10.0%). Some of the inter-hospital variation is undoubtedly due to different TB transmission risks (differences in patient populations, behavioral or engineering controls), but much of it is artifactual, caused by poor compliance with TST guidelines and/or different methods for calculating TST conversion rates. The calculations appear simple because only four numbers are required. The number who: a) were tested, b) should have been tested, c) converted from negative to positive, and d) were at risk of converting. The compliance rate (%) is ($a/b \times 100$), and the conversion rate (%) is ($c/d \times 100$). In practice, however, correctly categorizing employees is extremely complex. Employee turnover, incomplete or questionable TST histories, booster phenomena, and sampling bias are all confounding factors. We present a computer algorithm that recognizes all possible variations in TST histories, and provides rules for catego-

rizing employees into 9 mutually exclusive groups. From these, reproducible conversion and compliance rates can be calculated. Standardized calculations are essential for meaningful inter-hospital or national benchmark comparisons. This computer algorithm identifies weaknesses in a tuberculin skin-testing program, and calculates accurate, reproducible conversion and compliance rates.

ROLE OF QUALITATIVE HEPATITIS C VIRUS RNA DETECTION BY POLYMERASE CHAIN REACTION IN THE SURVEILLANCE OF HEALTHCARE WORKERS POST-NEEDLESTICK EXPOSURE. McCormick MI, Zink KM, Cox J. VA Med Ctr, Lexington, KY.

The potential for Hepatitis C Virus (HCV) transmission following a needlestick injury is well established. However, the advantage of early diagnosis and its implication for initiation of therapeutic interventions are not clearly defined. In Jan,1998 the HCV polymerase chain reaction (PCR) test was included in our surveillance protocol for healthcare workers (HCW) exposed to a known HCV person. We report our experience with the HCV PCR test to date. Four HCWs had needlestick exposures to patients with HCV. All HCWs were HCV antibody (AB) negative at base line. One refused follow-up. The other three HCWs had positive HCV PCR detected on at least two separate occasions (see table). It is unclear at this time how to interpret the Hepatitis C qualitative PCR positively detected in our HCWs; whether it represents transient viremia with no clinical consequence or self limited illness (as it did in HCW #1) or it warrants prompt therapy to prevent progressive Hepatitis C in the HCW. Prospective cohort studies to establish the advantage of using HCV PCR in this population are needed.

	1st Positive HCV PCR	2nd Positive HCV PCR	1st Negative HCV PCR	Last Follow-up Date	Liver Function Tests	Clinical Symptoms
HCW #1	Week 10	Week 17	Week 20	18 months	Normal	None
HCW #2	Week 19	Week 27	NONE	27 weeks	Normal	None
HCW #3*	Week 4	Week 6	Week 24	24 weeks	Normal	None

*Requested and received three months of Ribavirin and Inteferon Alfa at week 7.

15-YEARS EXPERIENCE WITH HOSPITAL-ACQUIRED BRUCELLOSIS IN A SINGLE INSTITUTION. Memish ZA, Mah MW, Bannatyne RM, Khan MY. King Fahad National Guard Hosp, Riyadh, Saudi Arabia.

Saudi Arabia is highly endemic for brucellosis with more than 8000 cases reported each year, and the prevalence is especially high in the Central Region of the country. During 1998, brucellosis was the number one reportable communicable disease (22.5%) in Saudi Arabian National Guard communities. King Fahad Hosp is the major referral healthcare center for National Guard personnel in the Central Region, and processes 17,500 specimens per year for Brucella diagnostic studies. Between 1983 and 1998, 16 hospital employees, mainly from non-endemic areas of the world, developed brucellosis. Six (6) were from England, 6 from North America, 2 from South Africa, 1 from the Philippines, and 1 from Saudi Arabia. Thirteen (13) were bacteriology technologists, 1 was a nurse, 1 was an obstetrician, and 1 was a pathologist. Each had a clinical syndrome compatible with brucellosis (headache, fever, sweats, and myalgias) plus elevated Brucella serum agglutinin titers of >1:1280. Six (6) patients had positive blood cultures. All patients responded to anti-Brucella therapy. Four (4) patients had relapses, and complications occurred in 4 patients (septic endophlebitis of the leg, infected prosthesis, epididymo-orchitis, and lumbar spondylitis). In all these employees, the infection was associated with processing Brucella species cultures or handling infected body fluids or tissues. Despite the enforcement of stringent infection control measures including the use of a biosafety hood in the laboratory, the problem of nosocomial brucellosis continues due to the large number of infected specimens handled by the laboratory. Major efforts are under way to reduce the endemicity of the disease in the country. It is hoped that control measures in the community as well as in the laboratory will reduce the incidence of this disease among hospital employees.

EVALUATION OF A SAFETY IV CATHETER (INSYTE AUTOGUARD, BECTON DICKINSON) USING THE CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC) NATIONAL SURVEILLANCE SYSTEM FOR HOSPITAL HEALTHCARE WORKERS DATABASE. Mendelson MH, Chen LBY, Finkelstein LE, Bailey E, Kogan G. Mount Sinai Med Center, New York, NY.

A safety IV catheter (Insyte Autoguard, Becton Dickinson) was evaluated at an 1,100 bed Univ affiliated medical center to determine efficacy in reducing needlestick injuries (Nis). A baseline period I (pre-safety trials) from 6/1/93-8/31/96 (27 months) was compared to a study period II (safety IV catheter, two-month training, 2-3/99 and six-month pilot, 4-9/99; 8 months data thus far, study ongoing). The interim between the baseline and study periods was inclusive of an evaluation of Protectiv® Plus Catheter (Johnson and Johnson). Training included model practice insertions for IV catheter users. NI data was analyzed utilizing the National Surveillance System for Hospital Healthcare Workers (NASH) data collection tool and database. A survey of sharps disposal boxes was performed to assess usage and activation rates. An 89% reduction in IV stylet related Nis was demonstrated comparing the baseline period injury rate of 6.6/100,000 IV stylets (56 injuries/848,958 stylets) to the training and pilot periods (8 months) injury rate of 0.7/100,000 IV stylets (1 injury/152,952 safety IV stylets) ($p<0.01$). The period II injury occurred while the stylet was being withdrawn from the patient and the healthcare worker (HCW) failed to activate the safety mechanism. A survey of 495 disposed IV stylets during the pilot period revealed 495 (100%) safety IV stylets with an activation rate of 85% (420/495). In conclusion, the safety IV catheter (Insyte Autoguard) resulted in a marked and significant reduction in IV stylet-related injuries during the training and pilot periods with an overall compliance with activation of 85%. Although the Insyte Autoguard requires activation by the user, the simplicity of the activation process should promote user compliance and therefore reduction in injuries. In that IV stylet-related injuries are high risk (hollow-bore needle, inserted directly into vein or artery), if reduction of injuries continues during the study period, usage of this safety device should result in decreased blood-borne pathogen transmission to HCWs.

EPIDEMIOLOGY OF BLOOD AND BODY FLUID EXPOSURES IN A UNIV HOSPITAL. Parreira F, Halker E, Costa VF, Coutinho AP, Verotti MP, Rego, SM, Marino CGJ, Medeiros EAS. Universidade Federal de Sao Paulo, Sao Paulo, Brazil.

OBJECTIVE: To analyze the incidence of BBF exposures in healthcare workers (HCW), the serologic profile of the patient source and the serologic status of HCW for hepatitis B virus (HBV). METHODS: The Sao Paulo Hosp is a 700-bed-Univ hospital in Brazil. The infection control program provides a 24h service for BBF exposure. The exposed HCW receive orientation and follow-up (0, 30 and 180 days). The HCW were also tested for HIV, HCV and HBV at each visit. When identified the source patients were also tested. The prophylaxis has been indicated based on CDC criteria. RESULTS: From 10/92 to 12/98 1200 exposures were notified. The professional categories involved were: 479 (40%) nurse assistant, 213 (17.8%) housekeepers, 235 (19.6%) physicians, 103 (8.5%) students, 93 (7.8%) nurses, 44 (3.6%) lab technicians and 33 (2.7%) others. 689 (57%) HCW were immunized against VHB at the time of the exposure. There were 1059 (88%) sharp injuries and 127 (11%) mucous membrane/skin exposures. The most frequent sharp injuries occurred during venous catheterization (18%). 888 (74%) HCW were exposed to material contaminated with blood. The source patient was identified in 739 (62%). 127 (17%) of these were HIV positive, 46 (6%) were HbsAg positive and 61 (8%) were HCV positive. One HCW became positive for HBV after exposure. CONCLUSION: We concluded that besides the extensive training in Universal Precautions and educational programs, the frequency of BBF exposures is high and hepatitis B vaccination adhesion among HCW is still very low in this Brazilian hospital. The maintenance of frequent reports and involvement of HCW in educational programs is extremely important for the reduction of BBF.

PROFILE OF OCCUPATIONAL EXPOSURES TO BLOODBORNE PATHOGENS AND EXPERIENCE OF PEP FOR OCCUPATIONAL EXPOSURE TO HIV AMONG HCWS IN RIO DE JANEIRO CITY, BRAZIL-FOLLOW-UP OF 3 YEARS PROGRAM WITH 3,834 EXPOSURES REPORTED. Rapparini CS, Saraceni V, Durovni B, Fonseca AF, Lauria L, Mendes R. STD/AIDS Program, Health Secretariat of Rio de Janeiro, Brazil.

After standardized protocol for post-exposure prophylaxis (PEP) for HIV provided worldwide in June 1996, a surveillance and prevention program for occupational exposure to bloodborne pathogens and a network to provide HIV postexposure prophylaxis (PEP) to healthcare workers (HCWs) in the city of Rio de Janeiro was started in January 1997 by the AIDS Program of the Health Secretariat of RJ city. From Jan 97 to Nov 1999, 3,834 exposures were reported from 275 medical institutions, with an important increase of reports in 1998 and 1999 (~170 exposures reported/month in 1999). The results showed that the majority of exposures: compromised nurses, physicians and housekeepers; occurred during attempts to recap needles, handling surgical material and handling trash; were percutaneous exposures involving blood, with HIV, HBV, HCV unknown source patients. Of 2,824 known source patients, 440 (16%) were known to be HIV-positive at the moment of exposure. 2,342 HCWs initiated antiretroviral prophylaxis, the most common prescribed combination was ZDV/3TC. PEP was initiated for 401 (91.1%) of 440 HCWs exposed to an HIV-positive source patient; for 83 (14.8%) of 559 exposed even to a source known to be HIV-negative at the moment of the exposure; 1,109 (65,0%) of 1,705 exposed to a source patient with an unknown HIV status and 599 (64.4%) of 930 exposed to an unknown source patient. Initiation of antiretroviral therapy occurred within less than 2 hours in 43% of exposures and 85% within 24 hours. No seroconversions for HIV or hepatitis B virus were reported. One seroconversion, not yet confirmed, for hepatitis C virus was reported. Further investigation is ongoing to evaluate the adequacy of serology followup. Most of the exposures were preventable, and educational strategy concerning biosafety needed to be enhanced. This system was an effective program for HCWs to receive PEP showed by the data on the time-lag between exposure and initiation of antiretroviral therapy. The data obtained will be useful planning tool to strategies for the health department.

POOR ACCEPTANCE AND TOLERABILITY OF POST EXPOSURE PROPHYLAXIS FOLLOWING OCCUPATIONAL EXPOSURES AMONG HEALTHCARE WORKERS AT AN URBAN MEDICAL CENTER. Sanchez M, del Rio C, Wittkamp M, Camins B, Larsen N, Gordon W, Hunter M, Blumberg HM. Emory Univ, Atlanta, GA; Emory Univ and Grady Health System, Atlanta, GA; Emory Univ School of Medicine, Atlanta, GA.

Healthcare workers (HCWs) are at risk for occupational exposure to HIV, HCV and HBV. Post-exposure prophylaxis (PEP) with antiretroviral (ARV) agents is thought to reduce the risk of HIV transmission from patients to HCW following occupational exposure. CDC guidelines recommend a 4-week PEP course of ARVs following a significant exposure. However, limited data exists regarding the acceptance and tolerability of HCWs to CDC PEP recommendations. We reviewed records on all reported HCW blood and body fluid exposures during 1997-98 at our institution to describe the epidemiology of these and assess acceptance, tolerability, and completion of PEP by HCWs. 511 HCWs reported exposures to the employee health clinic over the 2-year study period. 368 (72%) were needlestick/sharps injuries and 143 (28%) were splashes/other exposures. Exposed HCWs included 208 (40%) nurses; 110 (21%) house staff; 30 (6%) attending physicians; 18 (3%) medical students; 34 (7%) housekeepers; 21 (4%) clinical laboratory workers; 11 (2%) phlebotomists; and 79 (16%) others. The exposure rate per 100 person-years worked was 14.9 for nurses, 18.8 for house staff, and 5.8 for medical students ($p<.001$). Serological status of known source patients (n=477) was as follows: 82 (18%) were HIV+, 54 (12%) were HCV+ and 15 (3%) were HbsAg +. Overall, 117 (26%) source patients were seropositive for at least one blood borne pathogen (i.e., HIV, HCV and/or HBV). Of the 82 HCWs with exposure to a HIV+ source patient, 60 were offered PEP; 43 (72%) accepted PEP, and 17 (28%) did not. Of those 43 HCWs who initiated PEP, 13 (30%) completed a full 4-week course, 14 (33%) did not return for any follow up after receiving the initial 3 day supply starter pack, and 16 (37%) discontinued PEP due to side effects (which included nausea, fatigue, rash, CNS, and hepatitis). In summary, CDC PEP was poorly tolerated by HCWs with less than one-third completing a full 4-week regimen. Serious side effects were not uncommon. Further efforts at prevention of occupational exposures are warranted given the poor tolerability of current PEP regimens.

SUSTAINED DECREASE IN PERCUTANEOUS INJURIES IN TEMPORAL ASSOCIATION WITH UNIVERSAL/STANDARD PRECAUTIONS AND PERCUTANEOUS INJURY REDUCING STRATEGIES. Schmitt JM, Taylor J, Fahey BJ, Peduzzi T, Henderson DK.* Natl Institutes of Health, Bethesda, MD.

OBJECTIVE: To evaluate whether Universal Precautions/Standard Precautions (UP/SP) and percutaneous injury-reducing strategies introduced (PIRS) in the Clinical Ctr (CC) from 1988-98 were associated with sustained decrease in self-reported percutaneous injuries (PI). METHODS: Interventions by year included: 1987: annual UP/SP training; 1992: protected intravenous (IV) catheter safety device (upgraded 1997); 1992: "needleless" system (ongoing expansion/ incorporation); 1993: "no-rinse" transport tray system for contaminated reusable instruments; 1994: IV piggybacking blunt cannula system; 1994: protected blood transfer system for vacutainer tube and blood culture vials; 1994: self-retracting lancet device; 1995: sharps disposal receptacle design improvement; 1997: chemosafety spill kit; 1997: venous arterial management protection system; and 1998: modification of IV threaded lock cannula. CC and Occupational Med Service data were reviewed for PIRS and staff-self-reported PI. RESULTS: The number of staff self-reporting select PI by year are (TABLE).The decrease in self-reported PI is paralleled by similar decreases in PI as determined by retrospective staff surveys. The decrease remains highly significant irrespective of surrogate denominator (i.e., number of admissions, procedures, blood product transfusions). CONCLUSIONS: Sustained PI reduction occurred in temporal association UP/SP and PIRS. Continuous assessment/modification of PIRS may be critical to maintain PI reduction and improve workplace safety. New strategies are needed to provide additional levels of safety in the workplace.

PI Type	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98
Working with IV	35	24	24	32	25	29	16	9	5	9	12	6	4
Working with disposal bucket	22	28	29	19	15	13	15	6	2	7	3	4	7
Recapping	20	12	15	19	17	11	8	5	3	6	4	3	5
Transferring sharp to bucket	11	10	11	7	2	7	0	4	1	4	0	1	1
Total	88	74	79	77	59	60	39	24	11	26	19	14	17

PREVALENCE OF MEASLES ANTIBODY AMONG YOUNG ADULTS: 1980S VERSUS 1998. Seo SK,* Abdel Malak S, Lim SL, Eagan JA, Sepkowitz KA. Memorial Sloan-Kettering Cancer Ctr, New York, NY.

AIM: Due to concern about sub-optimal vaccine-induced immunity among young adults in the U.S., the Immunization Practices Advisory Committee (ACIP) on Measles Prevention added an additional measles vaccination in 1989 to be given after age 5. To determine the effectiveness of the new vaccination regimen, we determined the seroprevalence of measles antibody among new hospital employees before the new guidelines (1983-88) versus after the guidelines (1998-99). METHODS: All new employees at Memorial Sloan-Kettering Cancer Ctr must demonstrate measles immunity. Of new employees hired from 1983-88, a 90% random sample (N=400) of new employees was selected from the Employee Health Service (EHS) database. Similarly, for 1998 to the present, a 90% random sample (N=1349) was selected. RESULTS: For 1983-88, 96% of new employees demonstrated measles immunity whereas 4% were susceptible. The mean age of those testing immune (36.5 years, 9.0 SD) was not significantly different ($p<0.889$) from those who were susceptible (35.8 years, 7.6 SD). In contrast, only 91% of newly hired workers from 1998 to the present were immune to measles with 8.5% being susceptible. The mean age of those immune to measles (31 years, 8.8 SD) was significantly different ($p<0.00$) from the group lacking measles antibody (27.2 years, 5.3 SD). CONCLUSION: Despite more stringent vaccination recommendations in the 1990s, the prevalence of measles immunity in young adults entering the healthcare workforce is significantly lower than before the 1989 guidelines. Furthermore, younger workers are significantly less likely to be immune to measles. Although employment in a healthcare facility in New York state requires subsequent vaccination of susceptible persons, these data suggest that increasing proportions of young adults remain susceptible to measles.

THE ROLE OF UNDERSTAFFING IN NOSOCOMIAL VIRAL GASTROINTESTINAL INFECTIONS ON A GENERAL PEDIATRICS WARD. Stegenga JM, Bell E, Jabbour R, Goldman C, Matlow A. The Hosp For Sick Children, Toronto, Ontario, Canada.

OBJECTIVE: To examine the relationship between nurse staffing levels and the rate of nosocomial viral gastrointestinal infections (NVGI) in a general pediatrics population. METHODS: This retrospective descriptive study, from Dec 1997 to Mar 1999, examined the effect that monthly nursing hours/patient day and monthly day shift and night shift patient:nurse ratios, extracted from administrative data, had on the monthly NVGI rate. To account for the incubation period of NVGIs, staffing levels in the 72 hour period prior to each infection (pre-infection period, PIP) were compared to those in non-pre-infection periods (NPIP). The NVGI rate over the 72-hour period after any day when the number of nursing hours/patient day was less than 10.5 was compared to the NVGI rate for all other periods, and this rate ratio was determined. RESULTS: Forty-three (43) NVGIs were detected in 37 (1.3%) patients. The monthly NVGI rate was correlated with the monthly night patient:nurse ratio ($r=.56$, $p<.05$) and the monthly day patient:nurse ratio ($r=.50$, $p<.05$). The nursing hours/patient day during the PIP was lower than during the NPIP (12.5 vs .13.0; $p<.05$). There was no difference between the PIP and NPIP day patient:nurse ratio (3.31 vs 3.32), however, there was a significant difference between the PIP and NPIP night patient:nurse ratio (3.26 vs 3.16; $p<.05$). The incidence of NVGI infections in the 72-hour period after any day when the nursing hours/patient day was less than 10.5 was 6.39 infections/1000 patient days, compared with 2.17 infections/1000 patient days in periods with more than 10.5 nursing hours/patient day (rate ratio=2.94, confidence interval: 2.16 to 4.01). CONCLUSION: Nurse understaffing contributed to an increased NVGI rate in our general pediatrics population.

A PROSPECTIVE STUDY OF THE EFFECTIVENESS OF USE OF THE HANDS-FREE TECHNIQUE, A RECOMMENDED WORK PRACTICE. Stringer B, Infante-Rivard C, Hanley J. Univ of British Columbia, Vancouver, BC, Canada; McGill Univ, Montreal, QU, Canada.

CONTEXT: Operating room personnel are at a high risk for transmission of blood-borne pathogens when passing sharp instruments. OBJECTIVES: To evaluate the effectiveness of the hands-free technique, whereby a tray is used for instrument transfers, eliminating simultaneous handling of sharp instruments by two people. DESIGN: A prospective cohort study. SETTING: The main and surgical day care operating rooms at the Providence Med Ctr in Seattle. METHODS: Circulating nurses and other surgical personnel, quantified the proportion of use of the hands-free technique and reported on other risk factors over 6 months during consecutive surgeries. The hands-free technique, considered used when 75% or more of the passes in a surgery were done in this way, was used, in 42% of surgeries. MAIN OUTCOME MEASURE: Percutaneous injuries, contaminations and glove tears during surgery. RESULTS: Of the 70% of eligible surgeries (3,765) included in this study, there was an overall injury, contamination and glove tear rate of 3.9%. In 136 surgeries there were 143 percutaneous injuries (40), contaminations (51) and glove tears (52) reported. In surgeries with greater than 100cc blood loss, use of the hands-free technique was associated with a 59% [OR 0.41 (95% CI 0.23-0.72], reduction of injuries, contaminations and glove tears, while in surgeries with less than 100cc blood loss, that association was not seen [OR 1.00 (95% 0.49-1.98)]. CONCLUSIONS: The use of the hands-free technique during surgery was an effective means of reducing the risk of transmission of blood-borne diseases in the operating room. KEY WORDS: Hands-free technique; injury, contaminations, glove tears, sharps; seroconversion; operating room, surgical personnel.

MULTIPLE BLOOD EXPOSURES AMONG HEALTHCARE WORKERS. Sulis CA, Derridinger O. Boston Univ School of Medicine and Boston Med Center, Boston, MA; Boston Med Center, Boston, MA.

Boston Med Center (BMC) is a 547 bed teaching hospital. Over the past 10 years several interventions have contributed to a reduction in employee (HCW) exposures. HCW may report a single exposure (SE), multiple exposures (ME), or fail to report. Our analysis is described below. Risk-reduction strategies are discussed during evaluation and treatment. Supplemental information is elicited from observational studies and anonymous surveys. NaSH software is used to assess trends and focus interventions. Between 1/97 and 7/99, 327 exposures were reported by 292 HCW. 11% reported ME (27 with 2, 4 with 3). Post exposure prophylaxis (PEP) was initiated for 51% of all HCW. A similar proportion began PEP following exposure to HIV+ source (63% for SE, 60% for ME), 38% declined. Median time between hire and first exposure was shorter for residents with ME (8 months) than for other HCW with ME (44 months). Most frequent cause of exposure was suturing (9), handling equipment/specimens (8), passing equipment (7), and manipulating needles (5). Of 18 exposures observed during 874 procedures, only 1 (6%) was reported. HCW surveys confirmed variable rates of under-reporting, but supplied no clues to a solution. We have failed to ascertain why certain HCW have multiple exposures, or why many HCW fail to report. Optimal strategies to achieve improvement are unknown. New initiatives planned for the next 12 months include development of a multidisciplinary hands-on skills lab to teach high-risk procedures to residents, standardization of equipment, ongoing evaluation of safer devices, and improvement of reporting procedures.

ACCIDENTAL BLOOD EXPOSURE INCIDENCE RATES IN THE NORTHERN FRANCE ABE SURVEILLANCE NETWORK. Tarantola A, Ha C, Astagneau P, Taleb D, Bouvet E, Bruecker G— ABE Network Correspondents . CCLIN Paris-Nord and GERES, Paris, France.

The Northern France Accidental Blood Exposure (ABE) surveillance network is based on healthcare workers' ABE notification to occupational physicians in 54 hospitals. A total of 7,650 ABEs were documented in these centers between Jan. '95 and Dec. '98, 5,632 (74%) of which in the 24 centers which participated all of 4 years. Denominator data collection began in Sept. '99 (e.g., number of admissions, beds, nurses employed or catheters ordered over these 4 years). As of 15 Nov. 1999, approx. 60% of these 24 centers have responded. Based on preliminary data, the notified ABE incidence rate per acute care hospital admission went from 0.36/100 admissions/year [CI 95% 0.34-0.38] in 1995 to 0.27/100 adm./yr. [CI 95% 0.26-0.29] ($p<0.001$). The notified needlestick injury (NSI) incidence rate in nurses (RN) went from 12 NSI/100 RN/yr in 1995 to 9.15 NSI/100 RN/yr in 1998 ($p<0.001$). The notified NSI rate per 100 peripheral catheters ordered was 0.018 NSI/100 cath/yr. In 1996 vs. 0.022 NSI/100 cath/yr in 1998 ($p=0.25$). The NSI rate for vacuum tube blood drawing devices (VT) went from 0.014/100VT/yr in 1995 to 0.0075/100VT/yr in 1998 ($p=0.012$). Although denominator data collection is ongoing, preliminary data suggest a decrease in notified ABE incidence in these centers over 4 years. ABE rates decreased in tasks using vacuum blood drawing systems, often presenting safety features. However, ABE incidence rates associated with peripheral, often non-safety catheters remained stable. Four-year trends will be discussed.

NELFINAVIR IN EXPANDED PEP CAUSING ACUTE CHOLANGITIC HEPATITIS: TWO CASE REPORTS. Trapé M, Barnosky S. Univ of Connecticut School of Medicine, Farmington, CT.

Two healthy healthcare workers received an expanded regimen of Post-Exposure Prophylaxis (PEP) after percutaneous occupational exposure to HIV and developed hepatitis believed to be nelfinavir induced. BACKGROUND: The Ctrs for Disease Control and Prevention (CDC) recommend that healthcare workers (HCW) with high-risk occupational exposure to HIV receive aggressive triple anti-retro viral medication therapy immediately after the exposure. Nelfinavir is a protease inhibitor frequently used in the triple drug regimen due to mild gastrointestinal side effects usually relieved by over-the-counter symptomatic medication. METHOD: The authors completed a retrospective chart review of HCW treated for high-risk HIV exposure during a 12 months period. RESULTS: Fifteen (15) HCWs reported events characterized as high risk HIV exposure and 13 received triple anti-retro viral therapy with a protease inhibitor. Acute hepatitis, with cholangitic features, appeared in two of the four HCW who received nelfinavir. Abrupt onset of nausea/vomiting, fever, chills and abdominal pain, followed by jaundice and hepatomegaly began 15-17 days after initiation of therapy. A full description of the cases, including laboratory data and chronological symptomatology confirmed the diagnosis of acute cholangitic hepatitis. Inflammatory signs and symptoms successfully resolved in both cases when nelfinavir was discontinued. The patients were able to continue taking zidovudine and lamivudine, after a brief pause, despite the clinical picture. Review of the literature failed to show reports of liver toxicity associated with nelfinavir. However, other protease inhibitors (ritonavir, saquinavir and indinavir) have been associated with acute hepatitis. CONCLUSION: When the expanded regimen of PEP, using nelfinavir as a protease inhibitor, is prescribed to HCW, special attention should be paid to liver toxicity, mostly after the 2nd week of therapy.

TESTING THE EFFICACY OF A TUBERCULOSIS CONTROL PROGRAM WITH AN INDEX CASE. Trapé M, MacArthur S, Dupont N, Schenck P. Univ of Connecticut School of Medicine, Farmington, CT; Univ of Connecticut Health Ctr, Farmington, CT.

A patient was hospitalized for 10 days on a general medical ward at a Univ Hosp before displaying signs and symptoms suggestive of tuberculosis. Once active pulmonary tuberculosis (TB) was suspected, the patient was appropriately placed in respiratory isolation within a negative pressure room and healthcare workers (HCWs) immediately implemented all elements of the TB Control Program including use of TB masks. The HCWs had been previously trained and fit tested for TB masks during the annual TB training. There were 178 HCWs identified as having sustained prolonged exposure to the index case before the patient was placed in respiratory isolation. Of the 178, 157 had a negative Tuberculin Skin Test (TST) with Purified Protein Derivative (PPD) by the Mantoux technique before this exposure, and 21 had a past history of a positive TST result. Twelve weeks after the exposure, 124 of the 157 (79%) HCWs exposed were tested with a TST. Three workers had a positive reaction of 5 mm or more with an overall TST conversion rate of 2.4%. The three converters worked on the Medical Ward, Lab Medicine and for an outside HCW agency ("sit care," per diem employee). TST conversion rate among Medical Ward healthcare workers was (1/26) 3.8%. Conversion rate among the Lab Medicine workers was (1/7) 14.3%. The histories of the three TST converters were reviewed in detail. All three had multiple TST tests before the exposure that were read as negative or 0 mm by professional staff at Employee Health Service or elsewhere. These three cases are most likely true conversions. There were no conversions among staff who cared for the patient after the institution of respiratory isolation precautions. CONCLUSION: In a hospital setting, respiratory isolation of the patient in a negative pressure room and respiratory protection of HCWs are effective ways for controlling nosocomial transmission of TB.

USING THE NATIONAL SURVEILLANCE FOR HOSPITAL HEALTHCARE WORKERS TO REDUCE PERCUTANEOUS INJURIES. Trapé M, Schenck P, Warren A. Univ of Connecticut Health Ctr, Farmington, CT.

The National Surveillance for Hospital Health Care Workers (NaSH) data on percutaneous injuries collected over two years was used to improve a health center's infection control program in two ways: (1) improved surveillance with increased reports of injuries; and (2) targeted interventions to reduce injuries. The NaSH surveys over the 1997-98 and 1998-99 supplemented the employee health infection control surveillance program. Reports of percutaneous injuries with blood and body fluid exposure (BBFE) increased from 82/5220 HCW (1.5%) the year before the NaSH, to 155/5305 HCW (2.9%) and 189/5422 HCW (3.4%) during the two years using the NaSH database. The reports likely reflect improved awareness of the importance of evaluation and treatment after an incident rather than increased problem practices. The NaSH data was used to characterize BBFE injuries and identify higher risk groups and activities. NaSH information was reviewed on: occupation of the HCW; where the incident happened; HIV, hepatitis B and C status of the source patient; visible blood on the sharp; how the injury occurred; whether through gloves or other clothing; and depth and body site of injury. Educational programs on available safety devices and protective protocols were disseminated and interactive computer safety training was improved and targeted at higher risk groups. The largest group with BBFE was the resident physicians who comprised 39% of the exposures in 1997-98. Percutaneous injury was reduced by 12% from 60 to 51 in 1998-99. Because residents and students go to various affiliated hospitals, each with unique programs in place, additional educational efforts are planned that will use further analysis of the NaSH data. The challenge is to decrease the total number of BBFE and at the same time to encourage reporting of all possible exposures. Activities planned are: inter-hospital interactive tele-video conferences; training the trainer programs to nursing staff coordinated with infection control staff; health fairs with displays of available safety devices and of the data collected from BBFE over the years.

THE IMPACT OF A RAPID HIV TEST TO LIMIT UNNECESSARY POST EXPOSURE PROPHYLAXIS FOLLOWING OCCUPATIONAL EXPOSURES. Veeder AV, McErlean M, Putnam K, Caldwell WC, Venezia RA. Albany Med Ctr, Albany, NY.

Post exposure prophylaxis (PEP) is recommended for healthcare workers (HCWs) following high risk occupational exposure. Since the toxicity and side effects of PEP are significant, timely HIV results on the source patient are essential to limit days on PEP when the source is HIV negative. In 1999, a rapid HIV test (SUDS®, MUREX) was introduced in an effort to limit unnecessary PEP. Our purpose was to compare the duration and cost of PEP between the Enzyme Immunoassay (EIA) and the HIV rapid test. The average time until results were available in our institution was 4 days for EIA and 1 day for the rapid test. The data on occupational injuries were obtained from the National Surveillance System for Hosp Health Care Workers (NaSH). From Jan 1-Oct 31, 1999, 180 HCWs reported exposures to blood or other body fluids. For the purposes of this study, HCWs were excluded if the source patients were known HIV positive, could not be identified, or consent to test source patients could not be obtained. Forty-two (42) HCWs (23% of all reported exposures) were placed on PEP pending source patient HIV results. The 26 HCWs whose source patients were tested with EIA stayed on PEP a total of 101 days (median 4 days; range 1-8). Eleven (11) stopped PEP prior to HIV results due to side effects. The average cost per HCW, including cost of test and drugs, was $123. The 16 HCWs whose source patients were tested using the rapid test remained on PEP a total of 23 days (median 1 day; range 1-3). Only 2 HCWs stopped PEP in the first 24 hours due to side effects. The average cost of test and drugs per HCW for these patients was $69. Based on 42 HCWs requiring PEP during the first 10 months of 1999, we estimate annual institutional savings of $2,700 if the rapid test is used for all source patients testing.

INFLUENZA VACCINATION OF HEALTHCARE WORKERS IN THE UNITED STATES, 1989-97. Walker FJ,* Singleton JA, Lu PJ, Strikas RA. National Immunization Program, Centers for Disease Control and Prevention, Atlanta, GA.

Healthcare workers (HCWs) have increased risk of occupational exposure to influenza and transmission of the virus to high-risk patients. The Advisory Committee on Immunization Practices recommends annual influenza vaccination (IV) for HCWs attending patients at high risk of complications from influenza (since 1986) or who are at high risk themselves due to age, certain chronic medical conditions or pregnancy. Data from the 1989, '91, '93-95 and '97 National Health Interview Surveys, weighted to reflect the U.S. noninstitutionalized population, were analyzed to determine trends in self-reported IV of HCWs (persons currently employed in healthcare occupations, regardless of setting, or working in hospitals or other healthcare settings, regardless of occupation). Among all HCWs, reported IV in the past 12 months increased from 10.0% (95% confidence interval, 9.1-11.0) in 1989 to 34.0% (31.9-36.2) in 1997. Among other employed persons, reported IV also increased, from 4.6% (4.3-4.8) in 1989 to 17.3% (16.6-17.9) in 1997. In 1997 among HCWs aged 18-64, those with 1 or more high-risk medical conditions (22%) had slightly higher IV levels (37.3%, 32.6-42.0) compared to those with no conditions (32.4%, 29.9-34.9). In 1997, HCWs aged >=65 years were more likely to be vaccinated (57.3%, 44.1-70.4) than HCWs aged 18-64 but not more likely than all persons aged >=65 years (63.2%, 61.9-64.6). In 1997, among HCWs aged 18-64 years, 44.6% (35.5-53.7) currently employed as physicians and other health diagnosing occupations (e.g., dentists, optometrists) reported IV. Health assessment and treating occupations (e.g., R.N.s, pharmacists) and health technologists (e.g., dental hygienists, radiology technicians) had similar IV rates: 34.6% (30.4-38.8) and 31.5% (25.5-37.6), respectively. In 1997 among HCWs aged 18-64, non-Hispanic whites were more likely to report IV (36.3%, 33.7-38.9) than non-Hispanic blacks (20.9%, 16.7-25.1) or Hispanics (26.1%, 20.1-32.1). By 1997, IV coverage for U.S. HCWs had reached half the Healthy People 2000 goal of 60% vaccination for high-risk groups.

IMMUNIZATION OF HEALTHCARE WORKERS: A SURVEY OF HOSPITALS FOR COMPLIANCE WITH CURRENT GUIDELINES. Weber DJ,* Padgett PJ, Hoffmann KK, Rutala WA. Univ of North Carolina School of Medicine and UNC Hosps, Chapel Hill, NC; Univ of North Carolina School of Public Health, Chapel Hill, NC.

The Centers for Disease Control and Prevention (CDC) and other advisory (Advisory Committee on Immunization Practices [ACIP], Healthcare Infection Control Practices Advisory Committee [HICPAC]) and professional organizations (American Academy of Pediatrics, American College of Physicians) have recommended that all healthcare workers (HCWs) should be immune to mumps, measles, rubella and varicella, and that those with potential exposure to blood or blood contaminated fluids be immune to hepatitis B virus (HBV). We assessed compliance with these recommendations by surveying all North Carolina acute care hospitals (N=121) in late 1998. Responding hospitals (N=69, 57.0%) included recommended vaccines in their policies with the following frequencies: diphtheria 75%, hepatitis B 100%, influenza 100%, measles 96%, mumps 94%, rubella 97%, tetanus 96%, and varicella 86%. Employee subgroups were included in the policies covering mumps, measles, rubella, varicella, and hepatitis B as follows: nurses 100%, employees with direct patient contact 100%, employees without direct patient care 73-80% (HBV vaccine 39%), contract workers ~50%, volunteers 40-50%, students 40-45%, EMTs ~30%, and medical staff ~40% (HBV vaccine 60%). Many hospitals only recommended mumps, measles and rubella immunity rather than requiring immunity: immunity was required for all workers by 34-46% of the hospitals and required of some workers by 22-27% of the hospitals. Frequency of noncompliance with current recommendations was as follows: assuring measles immunity for person born before 1957—63%, requiring two doses of live virus measles vaccine—53.3%, obtaining anti-HBs titers following HBV vaccination—50%, evaluating HBV vaccine response using a quantitative test (i.e., anti-HBs greater than or equal to 10 mIU/mL)—52.2%, and provision of a 2nd hepatitis B vaccine series for persons not responding to 3 doses of HBV vaccine—45%. Hospitals should include all HCWs in their immunization policies and incorporate new CDC/ACIP/HICPAC recommendations.

HIV/HBV/HCV

ANTIRETROVIRAL DRUG RESISTANCE IN HIV-INFECTED SOURCE PATIENTS FOR OCCUPATIONAL EXPOSURES TO HEALTHCARE WORKERS. Beltrami EM, Cheingsong R, Respess R, Cardo DM. Occupational HIV Exposure Study Group, Ctrs for Disease Control and Prevention, Atlanta, GA.

Postexposure prophylaxis (PEP) is recommended for certain occupational HIV exposures. Resistance of the source virus to antiretroviral agents, particularly to agents that might be used for PEP, is of concern to those selecting PEP regimens. Failure of PEP to prevent HIV transmission, possibly related to antiretroviral drug resistance, has been reported. To assess the prevalence of HIV antiretroviral resistance-associated mutations, we studied source patients for occupational HIV exposures at seven sites in the United States during 1998-1999. Blood from and data about (e.g., stage of HIV disease, previous antiretroviral drug therapy, and HIV RNA viral load) 52 HIV-infected patients who were source patients for occupational exposures to healthcare workers (HCWs) were collected. Virus from 41 patients was sequenced; virus from 11 patients with an undetectable (i.e., <400 RNA copies/ml) viral load could not be sequenced. Overall, 16 (39%) of the 41 patients had primary mutations associated with resistance to reverse transcriptase inhibitors, and 4 (10%) had primary mutations associated with resistance to protease inhibitors. Eleven of the viruses with primary mutations were phenotyped by recombinant assays; all had phenotypic resistance that matched the genotypic analysis. Of the 41 patients studied, 22 had taken antiretroviral agents in the past year. Twelve (55%) of the 22 drug-treated patients had a primary resistance mutation to at least one drug in their antiretroviral regimen. Three (16%) of the 19 drug-naïve patients had a primary resistance mutation. Of the 16 patients with genotypically resistant virus, 13 (81%) were drug-treated. No cases of HIV transmission were observed among the exposed HCWs. The results demonstrate an emergence of drug-resistant HIV among source patients for occupational HIV exposures. Although the implications of these findings for PEP are uncertain, healthcare providers should use source-patient drug treatment history information when making decisions about PEP.

HEPATITIS C VIRUS TRANSMISSION THROUGH A SPRING-LOADED FINGER-STICK DEVICE. Desenclos JC, Bourdiol-Razès M, Thiers V, Rolin B, Garandeau P, Ducos J, Bréchot C. Institut de Veille Sanitaire, Saint-Maurice, France; Direction Départementale de l'Action Sanitaire et Sociale, Montpellier, France; Centre National de Référence de l'épidémiologie molléculaire des hépatites, Paris, France; Centre Hospier Universitaire,Montpellier, France.

BACKGROUND: The nosocomial transmission of hepatitis C virus (HCV) has been reported.We investigated a cluster of HCV infection among cystic fibrosis and diabetes patients cared for in a specialized unit and identified a spring-loaded finger-stick device as the mode of HCV transmission in the unit. METHOD: Cystic fibrosis patients who had been cared for in the unit before 1995 were tested for anti-HCV antibody. To identify risk factors for HCV infection we reviewed, from the medical record of each patient, the medical procedures and treatments undergone while hospitalized each time. Screening for HCV was proposed by mail to patients with diabetes who had been admitted to the unit. Virus isolates were genotyped and sequenced by molecular methods. RESULTS: Of 57 cystic fibrosis patients (age in 1995: 2 to 28 years) admitted for the first time between 1975 and 1994, 38 (66.7%) were tested and 22 (57.9%) were anti-HCV positive. Eight (50%) of 16 patients with anti-HCV antibody were viraemic. All of 18 (100%) cystic fibrosis patients who had ever undergone self capillary blood glucose monitoring in the unit were anti-HCV positive compared to 4 (20%) of 20 who did not (relative risk [RR]=5.0, 95% confidence interval: 2.1-12.0). Seventy (70, 39.5%) of 177 patients with diabetes admitted to the unit between 1983 and 1992

were screened for anti-HCV, 12 (18.8%) of whom tested positive with three (25%) positive for HCV-RNA. Patients with diabetes had routine capillary blood glucose monitoring while hospitalized. All HCV isolates belonged to the type one subtype b. HCV isolates obtained from patients with cystic fibrosis and diabetes had a high degree of homology. Before 1991, cystic fibrosis and diabetic patients shared, in the unit, the same spring-triggered devices for self capillary blood glucose monitoring by finger puncture without changing the disposable platform after each use. CONCLUSION: As reported earlier for hepatitis B virus, a spring-triggered device for capillary blood glucose monitoring by finger puncture may transmit HCV if the disposable platform is not changed between each use.

COMMERCIALLY ACQUIRED TATTOOS AND ANCILLARY HEALTHCARE JOBS AS POTENTIALLY IMPORTANT SOURCES OF HEPATITIS C INFECTION. Haley RW, Fischer RP. Univ of Texas Southwestern Med Center, Dallas, TX; Dallas Spine Group and Presbyterian Hosp, Dallas, TX.

To assess the relative importance of all risk factors for infection with hepatitis C virus identified in a computer literature search, sero-prevalence and risk factors were measured in 626 consecutive workers from the southwestern U.S. visiting an orthopedic clinic for evaluation or treatment of back pain in 1991 and 1992. Hepatitis C infection was detected by screening with both the first and second generation enzyme-linked immunosorbent assay (EIA) and testing all positives with the recombinant immunoblot assay (RIBA-2). Of 626 workers, 43 (6.9%) were sero-positive for hepatitis C. All risk factor information was elicited in confidential, personal interviews by one of the physician investigators. Stepwise logistic regression analysis identified 4 independent risk factors for hepatitis C infection: injection-drug use (adjusted prevalence odds ratio [OR]=23.0; 95% confidence interval [CI] 7.5-70.6), ancillary healthcare jobs in hospitals held by men (OR=9.6; 95% CI 3.8-24.3), tattoos from commercial tattoo parlors (OR=6.5; 95% CI 2.9-14.8), and drinking 3 or more sixpacks of beer per month (OR=4.0; 95% CI 1.8-8.7). If causal, these 4 factors appear to account for almost three-quarters of hepatitis C infections (population attributable risk percentage, or etiologic fraction), with commercial tattoos accounting for 30%; ancillary healthcare jobs for men, 20%; injection-drug use, 22%; and facilitation by heavy beer drinking, 23%. Transfusions, acupuncture, homosexual or promiscuous sexual activity, vertical or intimate transmission in families, and other modes were not independently associated with hepatitis C infection. Although it is possible that tattooing, ancillary healthcare jobs and beer-drinking are surrogate measures for unacknowledged history of injection drug use, public health action should be reemphasized to curb possible hepatitis C transmission in commercial tattoo parlors and hospitals.

MULTI-CENTER EPIDEMIOLOGICAL STUDY ON HEPATITIS C VIRUS INFECTION IN INTERVENTIONAL RADIOLOGY. Maugat S, Astagneau P,* Brucker G. Co-ordinating Center for Nosocomial Infection Control (C-CLIN Paris Nord), Paris, France.

In order to estimate the prevalence of hepatitis C virus (HCV) infection in hospitalized patients and to identify potential risk factors for nosocomial transmission, a sero-epidemiological study was conducted in six interventional radiology wards. Before the procedure onset, all patients were consecutively tested for HCV antibodies using enzyme-linked immunosorbent assay (ELISA) and HCV viremia was measured in ELISA-positive serums using polymerase chain reaction. All patients were interviewed by a medical investigator on past exposure to intravenous drug use, blood transfusions, diabetes mellitus, alcohol abuse, chronic hemodialysis, organ transplantation, immunodeficiency, surgery, endoscopy, and interventional radiology. Overall, 91 of 944 (9.7%) patients were ELISA-positives for HCV, 10 (11%) of whom were screened during the study, and 82 (90%) had positive viremia. Logistic regression analysis showed that intravenous drug use and history of blood transfusions were the only independent risk factors for HCV infection (odds ratio [CI95%] : 71 [17.7-84.2] and 3.8 [2.0-7.3] respectively). Nosocomial risk factors were primarily related to past history of blood transfusion. These results highlight the potential for HCV transmission in radiology wards where radiologists and environment are usually exposed to contaminated patient blood during invasive procedures. Compliance with standard precautions is crucial in those units.

INVESTIGATION OF POTENTIAL IATROGENIC TRANSMISSION OF HEPATITIS C IN VICTORIA, AUSTRALIA. Trasancos CC, Kainer MA, Kelly HA, Desmond P. Dept of Human Services, Melbourne, Victoria, Australia; Monash Univ, Melbourne, Victoria, Australia; Victorian Infectious Diseases Reference Lab, Melbourne, Victoria, Australia; St Vincent's Hosp, Melbourne, Victoria, Australia.

BACKGROUND: Hepatitis C (HCV) may be transmitted from patient to patient by medical and surgical procedures (e.g., colonoscopy) and from healthcare workers (HCW) to patients (pts). AIM: To determine the level of exposure to multiple medical and surgical procedures in the transmission of HCV in pts with unknown mode of acquisition. SETTING: Referral centre for hepatitis C in a tertiary teaching hospital. SUBJECTS: Australian-born pts persistently HCV antibody positive on at least two second generation commercial assays. METHOD: Retrospective case series. One trained interviewer administered a detailed questionnaire in person or by phone. RESULTS: Of 135 pts, 54 fulfilled all the entry criteria and agreed to participate. 11 refused to participate, 36 were unable to be contacted (2 in prison, 1 dead), 12 were classified as indeterminate or false positives, and in 22 alternate modes of transmission could be assigned, e.g., injecting drug use (IDU), tattoos, blood transfusion prior to 1990 (29% of those contacted). The median age of the 54 (25 males) pts was 41.5 (range 18-60). The median time interval between HCV diagnosis and time of interview was 4.6 years. Fifty-three (53) of the 54 cases had a medical/surgical procedure and/or invasive dental work. Two (2) received RhD immunoglobulin, 44 (82%) had dental extractions, 19 had complex dental work, e.g., root canal, 44 (82%) had an operation requiring general anaesthesia, and 41 had a procedure requiring local anaesthetic. The following endoscopic procedures were reported: gastroscopy (3), colonoscopy (3), laparoscopy (4), arthroscopy (5), and cystoscopy (2). Ear piercing was reported in 40, acupuncture in 19 and electrolysis in 3. Needlestick injuries were reported in 4. Eleven (11) had sex with known IDU or HCV positive partners. A further 12 thought they may have acquired HCV sexually. CONCLUSION: The exposure to medical/surgical procedures is substantial. A case control study is planned to determine whether the level of exposure to these medical procedures is unexpectedly high.

Home Healthcare

ASSESSMENT OF INFECTION CONTROL RESOURCES IN THE HOME CARE SETTING. Manangan LP,* Schantz M, Pearson ML, Greico KE, Taylor J, Eckhardt JN, Banerjee SN, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Missouri Alliance for Home Care, Jefferson City, Missouri; Kimberly-Clark, Roswell, GA.

In the U.S., the delivery of healthcare in the home setting has increased dramatically in recent years. However, little is known about infection control resources in home care. In 1999, we conducted a survey of Missouri Medicare-certified home health agencies through the MAHC and Missouri Dept of Health to describe agency characteristics and assess home care infection control resources and strategies to address antimicrobial resistance. MAHC is a non-profit association that provides home care education, advocacy, and information. Of 188 agencies surveyed, 95 (51%) responded; 43 (45%) were nonprofit, hospital-affiliated; and 47 (50%) were Joint Commission on Accreditation of Health Care Organizations-accredited. In 1998, these agencies provided care to 48,112 patients during 1.6 million home visits (median=225 home visits per week), which were mostly conducted by registered nurses (44%) and home care aides (33%). Patients cared for by Missouri Medicare home health agencies were largely elderly (i.e., >70 years [62%]) and received care for an average of 7-13 days (61%). Most agencies had written infection control policies (90%, [84/93]) and a system for reporting exposures, injuries, or infections in their personnel (95% [86/91]). Of 65/93 (70%) agencies that conducted infection surveillance, 85% had standardized infection definitions and data collection forms and 66% calculated infection rates. Only 54% (51/95) had a designated infection control practitioner and only 9% (8/87) used a computerized database for collating surveillance data. To address antimicrobial resistance, 64% (58/91) had a routine process for checking pathogen antimicrobial susceptibility and 42% (37/89) had strategies (e.g., active monitoring, clinical guidelines) to promote appropriate use of antimicrobials. Most Missouri home health agencies have established infection control and surveillance programs and strategies for combating antimicrobial resistance. However, additional resources are needed to augment and standardize existing programs for home care.

PREVALENCE OF INFECTIONS AMONG PATIENTS IN HOME CARE. Manangan LP,* Schantz M, Pearson ML, Taylor J, Greico KE, Stewart K, Patel S, Mychalak NA, Brown TT, Lenar A, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Missouri Alliance for Home Care (MAHC), Jefferson City, Missouri; Kimberly-Clark, Roswell, GA; CenCtrs for Disease Control and Prevention, Atlanta, GA.

An increasing number of patients are being cared for in the home, yet there are few data on infections in this population. Therefore, we conducted a survey of the prevalence and types of infections among patients of the Missouri Alliance for Home Care (MAHC). MAHC is a non-profit association that provides home care education, advocacy, and information for its members. During June 1-30, 1999, home care nurses in 73 Missouri home care agencies completed questionnaires on 5,148 patients; 793 (16%) patients were reported to have infections. Of these infections, 8% were reported as home-care acquired, 16% as hospital-acquired, and the remainder as community-acquired (41%) or unknown (35%); 90% were treated with antimicrobials, including 4% treated with vancomycin. The most common infection sites were the urinary tract (27%), respiratory tract (24%), skin/soft tissue (24%), surgical site (12%), or bloodstream (2%); 18% of infections occurred at other body sites (e.g., gastrointestinal tract, bone). Invasive medical devices were present in 1,729 (34%) of surveyed patients: 21% had a urethral or suprapubic catheter, 17% a central venous catheter, 14% another device (e.g., wound drainage tube, tracheostomy or nephrostomy tube, or implanted device), 7% a gastrostomy tube, and 1% a mechanical ventilator. Use of a urethral or suprapubic catheter was associated with a higher risk of urinary tract infection (76/297 vs. 138/4637, p=<0.001) and use of a central catheter was associated with a higher risk of bloodstream infection (6/283 vs. 9/4850, p=<0.001), whereas ventilator use (1/10 vs. 186/4951, p=0.33) was not associated with respiratory tract infection. In Missouri home care agencies, an estimated 16% of patients had infections; urinary tract infection was the most common and was associated with the use of an invasive device. Further studies are needed to assess the risk factors for infection among Missouri home care patients and whether infection control resources in these agencies can contribute to a decrease in infections.

MEDICAL DEVICE UTILIZATION IN THE HOME CARE SETTING. Pearson ML,* Banerjee SN. Ctrs for Disease Control and Prevention, Atlanta GA.

BACKGROUND: In hospitals, indwelling medical devices have been associated with an increased risk of nosocomial infection. Little is known about the magnitude of such device utilization in non-hospital settings such as the home. METHODS: To provide national estimates and correlates of device utilization in home care agencies, we analyzed agency and discharge data from the 1996 National Home and Hospice Care Survey conducted by CDC's National Ctr for Health Statistics. Indwelling medical devices were defined as Foley catheters, central venous catheters, peripheral or midline catheters, wound catheters, or ventilators. RESULTS: Among 7.8 million discharges, an estimated 578,677 (7.5%) patients had at least one indwelling medical device: 194,980 (34%) had CVCs; 191,508 (33%) Foley catheters; 197,751 (34%) peripheral or midline catheters; 172,446 (30%) wound catheters; and 39,751 (7%) ventilators. Overall, device utilization was associated with age (i.e., <65 years) (65% vs 37%, p=.06), particularly ages 18-44 years (29% vs 10%, p=.01), male gender (50% vs 35%, p=.05), private insurer payor status (36% vs 15%, p=.07), proprietary agency ownership (52% vs 30%, p=.03), and agency location (outside Northeast) (83% vs 68%, p=.04). However, device utilization was not associated with a greater frequency of nursing, physician, or respiratory therapy provider visits (p=.13). CONCLUSIONS: In U.S. home care agencies, a sizeable number of patients have medical devices that were traditionally confined to acute care settings; vascular catheters were the most commonly used devices. Although these patients are at increased risk for device-associated infection, they received a comparable number of skilled provider visits as did patients without such devices. Enhanced patient educational activities and infection prevention efforts in are needed in the home care setting and should be targeted to these at-risk groups.

HOME CARE IN THE UNITED STATES: A NATIONAL PERSPECTIVE. Pearson ML,* Banrejee SN. Ctrs for Disease Control and Prevention, Atlanta GA.

BACKGROUND: Over the past decade, healthcare delivery has increasingly shifted from hospitals to outpatient settings such as the home. METHODS: To determine the characteristics of home care agencies and patients, we analyzed agency and discharge data from the 1996 National Home and Hospice Care Survey conducted by the Natl Ctr for Health Statistics. RESULTS: During 1996, there were an estimated 11,409 home care agencies and 7.8 million patient discharges, representing 69% and 150% increases respectively since 1992. Home care agencies were largely proprietary (55%) and group-operated (49%); 29% were hospital-operated. Of patients who received home care, 66% were > age 65 years, 64% were female, and 63% were white. The most frequent primary admission diagnoses were cerebrovascular disease or hypertension (7%), congestive heart failure (5%), or femoral frac-

ture (4%). Registered nurses provided 83% of home care visits; home health aides, 26%; licensed practical nurses or nurses aides, 16%; and physicians, 2%. Over 500,000 home care patients had indwelling medical devices. Hospital-operated agencies were more likely than other agencies to be Medicare- (99% vs 94%, p<.001) or Medicaid-certified (98% vs 92%, p<.01) and nonprofit (74% vs 33%, p<.001), but were similar to other agencies in average patient census (141 vs 93, p=.11) and provision of skilled nursing (97% vs 96%) or physician services (21% vs 18%) and high-tech care (e.g., intravenous therapy) (91% vs 87%). CONCLUSIONS: In 1996, nearly 8 million U.S. persons received medical care in the home. Surveillance and infection control programs are needed in home care as in traditional health-care settings.

IC Program Management/Administration—Abstracts in this category appear in Am J Infect Control *February 2000.*

Infection Prevention and Control—Abstracts in this category appear in Am J Infect Control *February 2000.*

Long-Term Care

INFLUENZA AND PNEUMOCOCCAL VACCINATION IN NURSING HOMES, U.S., 1997. Buikema AR, Singleton JA, Sneller V-P, Strikas RA. Natl Immunization Program, Ctrs for Disease Control and Prevention, Atlanta, GA.

Influenza and pneumococcal outbreaks continue to occur among nursing home residents. Data from the 1997 National Nursing Home Survey (NNHS), weighted to reflect the U.S. nursing home population, were analyzed to determine: factors associated with organized programs for influenza vaccination (IV) and pneumococcal vaccination (PPV); resident vaccination status reported by facility staff; and changes from the 1995 NNHS. In 1997, most residents (99%; 98% in 1995) were in the 97% of facilities with organized IV programs; 76% of residents (72% in 1995) were in the 72% of facilities with a PPV program. Facility factors found to increase the likelihood of having an organized PPV program include increased size and presence of an IV program; facilities in the western U.S. were less likely to have PPV programs. In 1997, a high percentage of residents had unknown IV and PPV status (see Table); residents in facilities with organized PPV programs were less likely to have unknown IV or PPV status. IV in the past year was reported for 64% of residents, with only 28% reported to have ever received PPV. Residents in facilities with an organized PPV program were more likely to have reported PPV, as well as known IV and PPV status, than residents in facilities without a program. Among residents with known vaccination status, coverage levels were 82% (CI=80%-83%) for IV and 51% (CI=48%-53%) for PPV. In 1997, IV (but not PPV) coverage among residents of nursing homes may have been near the 80% Healthy People 2000 objective. Further program changes may be needed in many nursing homes to achieve the proposed 90% Healthy People 2010 objective, e.g., yearly IV campaigns, vaccination status assessment on admission, PPV if indicated when status is unknown, standing orders for vaccination, documentation of all vaccinations in the medical record, and annual assessment of vaccination rates.

Effect of Pneumococcal Vaccination Programs on Pneumococcal and Influenza Vaccination Status National Nursing Home Survey, 1995 and 1997

	Pneumococcal Vaccination (PPV)		Influenza Vaccination (IV)	
	% reported as vaccinated (95% CI)	% w/ unknown status (95% CI)	% reported as vaccinated (95% CI)	% w/ unknown status (95% CI)
1997				
Overall	28 (27-30)	44 (42-46)	64 (62-65)	22 (20-24)
w/ PPV program	35 (32-37)	40 (38-42)	65 (63-67)	20 (19-22)
w/out PPV program	11 (9-14)	56 (52-60)	62 (58-65)	25 (22-28)
Odds Ratio*	4.1 (3.1-5.4)	0.5 (0.4-0.6)	1.1 (1.0-1.3)	0.8 (0.6-0.9)
1995				
Overall	24 (22-26)	43 (41-45)	63 (61-64)	21 (20-22)

* Comparing facilities with PPV programs to facilities without PPV programs

ANALYSIS OF ANTIBIOTIC USE IN A LONG-TERM CARE FACILITY: IDENTIFYING OPPORTUNITIES FOR IMPROVEMENT. Coignard B, Trick WE, DeMarais PL, Vernon M, Schwartz D, Wojslaw A, Weinstein RA, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Cook County Bureau of Health Services, Chicago, IL.

Several studies have documented a high prevalence of antibiotic (AB) use in long-term care facility (LTCF) residents; some of this use may be inappropriate and lead to the emergence of resistant pathogens. We conducted a retrospective chart review assessing AB use in an LTCF. We reviewed the clinical course and AB indications for all patients on two wards of this LTCF from June 1998 through May 1999 who received Abs. We defined a course as at least 1 oral or parenteral AB given for a clinical event noted in the patient's chart. Of 232 LTCF patients admitted during the study period, 79 (34%) received 130 AB courses (263 agents and 2,524 AB-days); 51 (39%) courses included at least 2 agents and 197 (75%) agents were prescribed empirically. Median course length was 11 (range 2-155) days. Broad-spectrum Abs accounted for 1,591 (63%) AB-days: fluoroquinolones (31%), b-lactam-inhibitor combinations (18%), third-generation cephalosporins (11%), or imipenem (3%). AB courses were given for 123 presumed infections: urinary tract infection (26%); cellulitis, soft tissue, or wound infection (20%); unexplained febrile episode (20%); respiratory tract infection (19%); or other infection (10%). Before AB therapy, 29% of patients had fever and 21% had an elevated white blood cell count (WBC). Cultures were ordered before AB therapy in 75 (58%) courses; susceptibility results were available for 52 (40%) courses and altered therapy in 15 (29%) of these 52 courses. Physicians in this LTCF often gave broad-spectrum empiric Abs for extended periods; most patients were afebrile and had normal WBCs. Although cultures often were obtained, results usually did not influence therapy. Interventions are needed to guide empiric AB therapy and to improve use of the microbiology laboratory in this LTCF.

AN OUTBREAK OF RHINOVIRUS RESPIRATORY TRACT INFECTION ASSOCIATED WITH SERIOUS COMPLICATIONS AMONG RESIDENTS OF A PEDIATRIC SKILLED NURSING FACILITY. Huskins WC,* Potter-Bynoe G, Spencer S, Erdman D, Sadeghi L, Friedman S, Goldmann DA, McIntosh K. Children's Hosp, Boston, MA; Centers for Disease Control and Prevention, Atlanta, GA.

An outbreak of rhinovirus respiratory tract infection (RTI) occurred among residents and staff of a pediatric skilled nursing facility (SNF). Case definitions were: definite RTI (new onset of 2 of 10 defined respiratory signs/symptoms and new fever >=101°F/38.3°C); LRTI (definite RTI with new chest X-ray finding consistent with pneumonia); probable RTI (respiratory criteria as for definite RTI, but no new fever). Cases were identified among residents by chart review and among staff by a self-administered questionnaire (42% response). Diagnostic studies for respiratory viruses, Mycoplasma, Chlamydia, Legionella, and invasive bacteria were obtained from hospitalized residents and from symptomatic, non-hospitalized residents and staff during 2 surveys. An in-house multiplex reverse transcription polymerase chain reaction (RT-PCR) assay for rhinovirus was performed. Culture for rhinovirus was performed using MRC-5 cells rolled at 33°C. The TABLE shows RTI and complication rates. Cases clustered on 2 of 3 wards and complications clustered in 1 of 6 classrooms. Multivariable models did not identify other significant risk factors for RTI or complications. Rhinovirus RT-PCR was positive in 4 (44%) residents with LRTI, 4 (36%) who were hospitalized, and 1 (17%) who required ICU care. RT-PCR and culture of lung tissue were negative for rhinovirus from one autopsy. Of samples obtained during the first week of illness, 32% were positive by RT-PCR. Cultures grew rhinovirus in 4 (50%) of the RT-PCR positive samples. One resident had a throat swab positive by PCR for Mycoplasma. Specimens were negative for all other respiratory agents tested. The outbreak was terminated by cohorting, use of contact precautions, and cancellation of classes. RTIs caused by rhinoviruses can be associated with serious complications among residents of SNFs.

	Definite or Probable RTI	% of samples + for rhinovirus by RT-PCR (# tested)	% of RTI with complications (#) LRTI	Hospitalized	ICU care	Death
Residents (n=63)	62% (39)	29% (24)	21% (8)	28% (11)	15% (6)	5% (2)
Staff (n=73)	40% (29)	7% (14)	3% (1)	3% (1)	0	0

LOW PREVALENCE OF COLONIZATION WITH METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AND VANCOMYCIN RESISTANT ENTEROCOCCUS IN PATIENTS TRANSFERRED TO AN INTERIM CARE FACILITY. Landolfo P, Thompson G, Wylie JL, Embil JM. Misericordia Health Centre, Winnipeg, Manitoba, Canada; Cadham Provincial Lab, Winnipeg, Manitoba, Canada; Sciences Centre, Winnipeg, Manitoba, Canada.

A hospital (Misericordia Hosp, MH) previously used for acute care was converted to an interim care facility (Misericordia Health Centre, MHC). The function of this facility is to provide interim care for medically stable patients awaiting permanent placement in a long-term care institution. Patients are transferred from any of the six acute care hospitals and long-term care facilities in a city of population 650,000. During the 6 months, (November 15 - June 1, 1999) after the MHC opened, there were 283 patients transferred from 6 acute care hospitals (52, SOGH; 43, HSC; 68, SBGH; 25, GGH; 35, VGH; 34, CGH) and 4 long-term care facilities (17, RV; 7, DL; 1, TV; 1, other). There were 34 additional residents who were long-term patients of the MH and they remained in the facility. During this period, 175 (61.8%) transfers were screened for carriage of MRSA and VRE. Screening consisted of throat and nares swabs for MRSA and rectal swabs were evaluated for the presence of VRE carriage. Of the 175 patients screened, were colonized with MRSA or VRE. Of the residual patients only one was colonized with VRE. For the same period, a review of unique isolates recovered at the Provincial laboratory revealed that there were 7 VRE and 67 MRSA isolates from the province of Manitoba with a population of one million persons. This survey demonstrates the low prevalence of MRSA and VRE colonization of patients transferred from other facilities.

IMPACT OF MULTI-RESISTANT BACTERIA ON THE QUALITY OF LIFE OF OLDER ADULTS IN LONG-TERM CARE FACILITIES. Loeb M, Wodchis W, Stiller A, Smith S, Jubelius R, Molloy W. Hamilton Regional Laboratory Program, McMaster Univ, Hamilton, Ontario, Canada; School of Public Health, Univ of Michigan, Ann Arbor, MI; McMaster Univ, Hamilton, Ontario, Canada; McMaster Univ, Hamilton, Ontario, Canada.

INTRODUCTION: The colonization of older adults in long-term care facilities (LTCFs) with multi-resistant organisms (MROs) is increasingly common. Frequently, this leads to the introduction of infection control precautions which are modified for LTCFs. Very little is known, however, about the impact of such precautions on the quality of life (QOL) of these elderly individuals. OBJECTIVES: To examine the effect of known MRO colonization on the QOL of older adults in LTCFs. METHODS: Adults colonized with either MRSA or VRE for at least two weeks in 7 units providing long-term care (5 nursing home units, 2 chronic care units) were identified. A standardized mini-mental status examination (SMMSE) was conducted for these residents, who were then matched on age, sex, and SMMSE score to noncolonized residents residing on the same unit (1:1 match). Quality of

life was assessed using the following: Geriatric Depression Scale (GDS), the Dysfunctional Behavior Rating Instrument (DRBI), and a care-giver's global assessment of QOL using a 7 point Likert scale (CGA). Differences between colonized and noncolonized residents were assessed using a matched analysis (paired t-test). RESULTS: Fifteen (15) residents (14 colonized with MRSA, 1 with VRE) were compared to 15 noncolonized residents. The median time from identification of the MRO to QOL evaluation was 105 days (range 21 to 280 days). Colonized residents had significantly more major medical diagnoses than controls (3.5 vs 2.2, P=0.02). Cases had a higher mean depression score (GDS 11.3, SD 7.2 vs 7.6 SD 4.8), although the difference between pairs was not significant (P=0.16). No significant difference in DBRI scores was noted between colonized and noncolonized residents (32.7 SD 37 vs 36.9 SD 47.8, P= 0.7). The CGA was, however, lower in residents with MROs than controls (4.4 SD 1.3 vs 5.1 SD 0.7, P=0.04). CONCLUSIONS: Few differences exist between matched colonized and noncolonized residents with respect to QOL indicators. Because few precautions are used in LTCFs, the effect on QOL appears to be minimal.

RECIRCULATING HYDROTHERAPY TUBS, BIOFILM AND WATER QUALITY. Mak AK, Hanna L, Zazulak E. Capital Health Authority, Edmonton, Alberta, Canada; Good Samaritan Society, Edmonton, Alberta, Canada.

In spite of the fact that many disease outbreaks have been traced to equipment utilizing a similar recirculating principle, drain-and-fill recirculating hydrotherapy bathing tubs are commonly used in long-term care facilities (LTCFs). Although the link between contaminated aquatic equipment and infection is an unequivocal foregone conclusion, hydrotherapy-related infection in LTCF has been underdiagnosed and has obscured the risk disposition, resulting in the lack of a comprehensive cleaning/disinfection protocol for hydrotherapy equipment. Biofilm forming on the water/solid interface of recessed plumbing fixtures complicates the situation further as it can render chemical disinfectants less efficacious. It may eventually act as a continuous source of Pseudomonas aeruginosa and other pathogens. To manage the risks, drain-and-fill recirculating hydrotherapy tubs, and including the internal piping, should be properly disinfected after each use. Identification and surveillance of hydrotherapy-related outbreaks are urged. A quality assurance program that assesses the compliance to the cleaning/disinfecting procedure, continuous staff education and possibly bacteriological water sampling are essential to prevent biofilm formation and hence to protect the health of the users. In addition, a reassessment of the benefits of using hydrotherapy tubs is recommended. The information can then be incorporated into comprehensive changes in equipment policy and maintenance protocol.

NURSING HOMES AS A RESERVOIR OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN ITALY. Pan A, Catenazzi P, Carnevale G, Granata L, Seminari E, Ceruti T. Istituti Ospitalieri di Cremona, Italy.

INTRODUCTION: The high prevalence of methicillin-resistance among Staphylococcus aureus in some countries has posed questions about the diffusion of MRSA in the community and the usefulness of screening for this germ upon hospital admission. The high prevalence of methicillin-resistant Staphylococcus aureus (MRSA) in Italy (25-60%) could be associated with high prevalence in the community, particularly in nursing homes, and cost-effectiveness of such a screening is not known. METHODS: One year, laboratory based retrospective analysis of outpatients' specimens. All outpatients with a positive specimen for S.aureus were identified through the hospital information system and data regarding hospital admissions (HA) and residency in nursing homes (NH) were collected. Statistical analysis was performed with epi-info program (ver 6.04). RESULTS: During the period 4/98-3/99, 37,461 microbiological exams were performed, 14,720 (39%) on an outpatient basis. 388 outpatients had 410 specimens (2.3%), positive for S.aureus. Fifty-one patients had 71 (21%) specimens positive for MRSA; of these, 40 (79%) were nursing home residents. Of the 73 nursing home patients with an isolate of S.aureus, 40 (55%) had a methicillin-resistant (MR) isolate. The percentage of MR was higher in nursing home patients than in patients that had a history of hospital admission in the previous 2 years (Odds ratio 9.37, p<0.0001). CONCLUSIONS: Our data show that 1) nursing homes in Italy may serve as a reservoir for MRSA; 2) in Italy isolation of MRSA from specimens of outpatient not residing in nursing homes, or without any admission in the previous 2 years is extremely rare; 3) MRSA screening on hospital admission should include patients residing in nursing homes; 4) implementation of guidelines to control MRSA both in acute care hospitals and in nursing homes/long term care units is advisable.

NOSOCOMIAL INFECTION SURVEILLANCE IN EIGHT LONG TERM-CARE FACILITIES. Sands KE, Peto R, Barsamian N, Gyseck L, Pero S. Beth Israel Deaconess Med Ctr, Boston, MA; MassPRO, Boston, MA; Healthcare Financing Administration, Boston, MA; US Lab, Boston, MA.

There is a need for standardized approaches to nosocomial infection (NI) surveillance in long-term care facilities (LTCFs). As part of an ongoing performance improvement project, selected LTCFs were solicited to participate in a coordinated NI surveillance program. A surveillance tool that captured all antibiotic prescribing for presumed urinary or respiratory NI, plus elements of the CDC and McGeer NI definitions, was implemented. Training and ongoing oversight regarding surveillance and data abstraction was provided. Separately, we retrieved aggregate data on all laboratory and microbiology testing ordered by those facilities outsourcing these services to one vendor (US Lab). NI rates reported here are based on a modification of CDC definitions. From 7/97 to 9/98, 10 LTCFs enrolled and 8 participated for at least 12 months. Aggregate laboratory test data was available for 4 LTCFs. Urinary NI varied from 0.9-3.4 per 1000 pt-days. For the 4 facilities with laboratory data, the rate of urine culturing varied from 3.4-9.2 per 1000 patient days, with the highest and lowest culturing rates matching with the highest and lowest observed urinary NI rates. Respiratory NI rates varied from 0.7-2.0 per 1000 pt-days. Within individual facilities, the seasonal increase in respiratory Nis during Q1 1998 varied from 0%-270%. LTCFs also varied in the fraction of antimicrobials prescribed for events meeting definitional criteria for NI: 40%-90% for presumed urinary NI; 30%-55% for presumed respiratory NI. We conclude that even with labor intensive efforts at standardized surveillance, significant variation in NI rates is observed. Aggregate data on clinical testing, often available from third party vendors in this setting, may correlate with trends in NI occurrence and deserves further evaluation as an adjunct to active surveillance.

EVALUATION OF AN INNOVATIVE RESIDENT INFLUENZA VACCINATION CAMPAIGN IN FIVE LONG-TERM CARE FACILITIES. Schwab, B., Clements, B., Storey, R. Infection Control Consortium, BJC Health System, St. Louis, MO.

PROBLEM: Although vaccine preventable, Influenza A in the elderly continues to be a sourece of morbidity and mortality. Two of five long-term care facilities (LTCF) experienced an Influenza A outbreak during the 1997-98 flu season. The outbreaks resulted in 1 influenza-pneumonia mortality and 3 influenza-related hospitalizations. Vaccination rates among residents prior to the outbreaks were 87% at facility A, 78% at facility B, and only 87% total in all five facilties. After outbreak control and debriefing, an intensive vaccination program was created for the 1998-99 flu season. AIM: The program aimed to improve the resident vaccintion rate at each LTC, thus prevent unnecessary complications from Influenza and avert future Influenza outbreaks. METHODS: We initiated development of the program at monthly Director of Nursing (DON) Council meetings that DONs from each LTCF attend. The program included indentification of a vaccination liaison from each facility, a flow chart of process steps, a timeline of agreed-upon vaccination dates, a 90-minute training session for all liaisons, educational materials for staff and residents, mechanisms for data collection and analysis, and incentives for employee vaccination. After attending the training session, liaisons conduted a two-week influenza educational program at their respective facilities and vaccinatied residents and staff during the agreed-upon dates. RESULTS: All five facilities participated in the vaccination program. 5/5 liaisons attended the training session, conducted the vaccination campaign within the specified timeframe, and submitted vaccination data for analysis and review. The total resident vacciation rate increased from 87% to 95%. 40% (2/5) of LTCF achieved 100% vaccination among residents, most LTCF (4/5) achieved >95% resident vaccination. No further outbreaks were detected and there were no influenza-related deaths or hospitalizations. CONCLUSION: Implementation of an intensive influenza vaccination campaign was effective in averting additional Influenza A outbreaks and positively impacted overall resident vaccination rates. The campaign may also have contributed to reduced influenza-related morbidity. Next steps include: continue to use the program, publish employee and resident vaccination rates in LTCF, strive for 100% compliance in both groups, evaluate/revise program annually.

USING RESOURCE UTILIZATION GROUPS AS A PREDICTOR OF THE INCIDENCE OF HEALTHCARE-ASSOCIATED INFECTION RATES: FINDINGS FROM THE APIC NORTHEASTERN NEW YORK LONG-TERM CARE SURVEILLANCE PROJECT. Steele L, Valentine L, M Therriault, Silver LC. Ctrs for Disease Control and Prevention, Atlanta, GA; Saratoga Hosp and Nursing Home, Saratoga Springs, NY; Our Lady of Mercy Life Ctr, Guilderland NY; APIC Chapter 69, Northeastern New York.

NENY is a demonstration project to develop a surveillance system for healthcare-associated infections and enable benchmarking among long term care (LTC) facilities. Since 1997, 16 upstate New York LTC facilities have conducted surveillance using standardized methods and submitted monthly data to a central registry. In 1998, NENY surveillance added LTC facility case-mix or Resource Utilization Group (RUG II) data. RUG II is a reimbursement structure, derived from the HCFA-mandated Minimum Data Set used to assess LTC residents based on clinical conditions, services needed, and functional status. NENY evaluated 4 RUG II populations—Special Care, Clinically Complex, Behavioral, and Reduced Physical Functioning—which are subdivided into 14 groups with assigned, weighted scores. (RUG II Rehabilitation residents are not included in NENY surveillance). Data from 214 surveillance months (4,059 infections in 43,669 resident months) show strong correlation between healthcare-associated infection rates and RUG II scores (Spearman correlation coefficient 0.82; p-value <.001). Infection rates varied by RUG II populations.

HCFA requires LTC facilities to perform surveillance for infections and encourages development of interventions to prevent infections. Creating valid infection rate benchmarks, adjusted for case mix/severity of illness, is an essential step in this process. Our results show that in upstate NY, RUG II scores strongly correlate with observed incidence of healthcare-associated infections and are a suitable proxy for severity of illness. Evaluation of new HCFA RUG III scores is underway. If these results are generalizable, LTC facilities may be stratified as "high," "moderate," or "low" acuity, based on facility mean RUG score, to promote valid infection rate benchmarking and targeted quality improvement efforts.

RUG II Group	Mean RUG II score	NENY Pooled Mean Infection Rate (per 100 resident months)	Rate Ratio	p-value
Behavioral	0.99	8.4	1	Ref
Reduced Physical Function	1.00	8.5	1.01	0.65
Clinically Complex	1.21	10.1	1.21	<0.001
Special Care	1.63	13.6	1.62	<0.001

PROGRESS IN THE CONTROL OF INFLUENZA AND PNEUMOCOCCAL DISEASE IN CANADIAN LONG TERM CARE FACILITIES: WHERE DO WE STAND?. Stevenson C,* McArthur MA, Zivnickova, H, Abraham E, Naus M, McGeer AJ. Mount Sinai Hosp, Univ of Toronto, Toronto, Ontario, Canada ; Ontario Ministry of Health and Long Term Care.

OBJECTIVES: To assess influenza (FLU) and pneumococcal (PNE) vaccine use and antiviral prophylaxis in Canadian long term care facilities (LTCFs). DESIGN: Cross-sectional surveys in 1991, 1995, and 1999 of Canadian residential LTCFs with 325 beds. Vaccination (VAC) rates over time were compared in LTCFs responding to all surveys. RESULTS: Response rates were 88% in 1991, 84% in 1995 and 76% (420/550) in 1999. In 1999, 97% of responding LTCFs provided resident FLU VAC rates, 86% staff FLU VAC rates, and 50% resident PNE VAC rates. Mean reported FLU VAC rates in 1998 were 86.7% for residents and 39.9% for staff, significant increases over 1990, when 78.5% of residents were vaccinated and 81% of facilities reported staff VAC rates of <25%. Rates increased in all provinces; differences between provinces persisted. The mean PNE VAC rate among residents was 67%, significantly increased over 1990 and 1995. Higher resident VAC rates were reported from LTCFs with an infection control practitioner (ICP) (P=0.002), and those obtaining consent for VAC on admission (P=0.02). Predictors of higher staff VAC rates included smaller size of facility (P<0.001), and presence of an ICP (P=0.01). Resident VAC rates were not associated

with the frequency of FLU outbreaks. Facilities without FLU outbreaks reported higher staff FLU VAC rates (P=0.05). In the 1998/9 season, 55% of LTCFs with staff FLU VAC rates <25% reported at least one FLU outbreak, compared to 39% with rates of 25-49%, 34% with rates of 50-74% and 27% with rates 375% (P=0.006). LTCFs with ICP were more likely to have a policy on amantadine use (81% vs 52%, P=0.001). Of those LTCFs reporting FLU A outbreaks, 84% prescribed amantadine to residents in 97/8 and 91% in 98/9; and 69% offered amantadine to staff in 97/8 vs 77% in 1998/9 (P=NS). Amantadine was discontinued due to side effects in 2.1% of residents. CONCLUSIONS: VAC rates are increasing but remain suboptimal. Staff VAC reduces the risk of FLU outbreaks. The presence of an ICP is associated with increased VAC rates and antiviral prophylaxis.

COMPARISON OF UNIVERSAL GLOVING TO CONTACT ISOLATION PRECAUTIONS TO PREVENT TRANSMISSION OF MULTIDRUG-RESISTANT BACTERIA IN A LONG-TERM CARE FACILITY. Trick WE, DeMarais PL, Jarvis WR, Tomaska W, Ohlrich S, Hageman J, Rice T, Nathan C, McAllister S, Weinstein RA. Ctrs for Disease Control and Prevention, Atlanta, GA; Cook County Hosp, Chicago, IL.

No national guidelines exist to minimize multidrug-resistant bacteria (MDR-B) transmission in long-term care facilities (LTCFs) and hospital guidelines are difficult to implement. We compared universal gloving (UG) to contact isolation precautions (IP) in two similar sections of a LTCF. We performed admission/discharge swabs and periodic prevalence surveys during Jun 1998-Oct 1999 to detect methicillin-resistant S. aureus (MRSA) [rectum, nares, gastrostomy, wound], vancomycin-resistant enterococci (VRE) [rectum], and extended-spectrum β-lactamase producing K. pneumoniae or E. coli [rectum] colonization. Two consecutive swabs were considered as paired. Paired swab culture results varied by section and pathogen (TABLE). By multivariate analysis, we determined risk factors for colonization. Then, we entered residence on the UG section in all final models. There were no significant differences (p<.05) between the two sections; odds ratios (OR; 95% confidence intervals) for UG resident colonization by each target organism were: MRSA-(OR=.7; [.3-1.4]); VRE-(OR=.5; [.2-1.5]); K. pneumoniae -(OR=.8; [.4-1.6]); E. coli -(OR=1.9; [.9-4.1]). Acquisition of MDR-B occurred at similar rates in the IP and UG residents. UG, which decreases gown use and resident isolation, may be preferable in some LTCFs.

	UG Section		IP Section	
	(-)/(+)	(-)/(-)	(-)/(+)	(-)/(-)
MRSA n=262	12	92	11	85
VRE*	2	100	6	113
| *K. pneumoniae* | *	10	88	15	96
| *E. coli* | *	13	72	9	108

*n=254

STREPTOCOCCUS PYOGENES OUTBREAK IN A LONG TERM CARE FACILITY. Tsivitis M, Cervo F. Long Island State Veterans Home/Med Services, State Univ of Stony Brook, Stony Brook, NY.

An outbreak of Streptococcus pyogenes (STPY) was detected in a 350-bed LTC facility. The outbreak occurred in residents and staff of a 30-bed unit specializing in respiratory care, during an influenza A epidemic. A total of eight residents developed influenza like illness, 3 residents had confirmed Influenza A and 11 developed gastrointestinal symptoms. Four cases of STPY were identified in hospitalized residents, two from blood cultures, with one wound (ear) culture, one sputum and one anterior nares. Screening of remaining residents and 37 employees of the unit revealed one carrier in a nurse aide. Two other employees reported symptoms and tested positive by their personal healthcare provider. The four resident strains were typed by the WHO reference lab as "M1, T1." All infected cases were treated and recultured 48 after completion of therapy with no persistence noted. One month later, recurrence was noted in a resident with a tracheostomy. His antemortem and autopsy testing revealed overwhelming infection with STPY. Rescreening of selected residents and staff identified two resident and one direct care employee carriers of STPY. Additional surveillance cultures of other staff revealed four new cases. Subsequent rescreening of residents identified two new cases who were roommates. A total of 17 cases were identified. All resident strains tested were confirmed as M1 and employee strains were M1, M6 and nontypable. STPY in the setting of an influenza outbreak is associated with severe morbidity and mortality in long-term care residents. Cases were clustered in 5 rooms but were limited to residents and staff of a single unit. Transmission probably occurred via healthcare worker, resident to resident, and possibly through secretion-contaminated surfaces. Control efforts of screening, treatment and education of staff, residents and families appear to have been effective in stopping the outbreak.

PNEUMONIA IN LONG-TERM CARE: A PROSPECTIVE CASE-CONTROL STUDY OF RISK AND IMPACT ON SURVIVAL. Vergis EN, Brennen C, Wagener MW, Muder RR.* VA Pittsburgh Healthcare System and Univ of Pittsburgh School of Medicine, Pittsburgh, PA.

We conducted a case-control study of pneumonia in a long-term care facility in order to determine whether (1) we could identify modifiable risk factors and (2) whether an episode of pneumonia had significant impact on survival extending beyond the acute episode. All patients developing pneumonia from 2 days to 1 year after admission were entered. Controls were matched for admission date, level of nursing care, and level of dependence as assessed by Katz ADL score. Assessed risk factors for pneumonia included demographics, feeding method, medications, restraints, nutritional status, immune status, and comorbid illness as measured by the Charlson Index. Patients were followed for up to two years, or until death or discharge. We identified 104 case-control pairs. Risk factors significantly associated with pneumonia included witnessed aspiration (OR 13.9, 95%CI 1.7-111; p=.013), sedative medication (OR 2.6, 95%CI 1.2-5.4; p=.011), and Charlson comorbidity score (OR 1.2; 95%CI 1.0-1.4; p=.05). Tube feeding was not independently associated with pneumonia (p=.20). Pneumonia mortality was 23% at 14 days. Pneumonia patients had significantly higher mortality than controls at 1 year (74% vs 40%; p=.0001); survival curves did not converge until 2 years. We conclude that, among long-term care patients matched for level of dependency and admission date, an episode of pneumonia is associated with significant excess mortality that persists for up to two years. Two independent risk factors, large volume aspiration and sedation, are potential candidates for invention.

Molecular Epidemiology

METHICILLIN RESISTANT S. EPIDERMIDIS WITH DECREASED SUSCEPTIBILITY TO TEICOPLANIN ISOLATED FROM NEUTROPENIC PATIENTS IN NATIONAL CENTER OF BONE MARROW TRANSPLANTATION IN TUNIS. Ben Hassen A, Greco A, Jouaihia W, Leclrecq R. Natl Ctr of Bone Marrow Transplantation, Tunis; CHU of Caen, France.

Fifty-seven (57) Methicillin resistant S. epidermidis with decreased susceptibility to teicoplanin were obtained from 14 neutropenic patients during a 11-months period (Feb-Dec 1998) from essentially blood cultures (30 strains) and upper respiratory tract specimens (21 strains). The MIC 90 of methicillin, gentamicin, ofloxacin, and teicoplanin were equal to 1024, 1024, 512 and 32 mg/l, respectively. We applied pulsed field gel electrophoresis (PFGE) after SmaI digestion to 21 isolates from 8 patients with multiple isolates. A methicillin and teicoplanin-resistant S. epidermidis isolated at the hospital of Caen was included in the study as a control. The isolates were separated by PFGE into eight groups, from I to VIII. The control strain was classified in group IX. Group I included 14 strains which could be subdivided in 3 sub-types differing by 1 to 3 bands. Seven strains had the pulsotype Ia (5 strains from the transplantation unit and 2 strains from the hematology unit). Two strains isolated in 2 units had the pulsotype Ib. Five strains from transplantation unit (4 strains) and hematology unit (1 strain)had the pulsotype Ic. Each of the other pulsotypes were composed of a single strain. Until recently, infections due to coagulase negative staphylococci have been regarded as endogenous in origin. Our results showing teicoplanin-resistant S. epidermidis with similar pulsotypes isolates into different wards suggested a nosocomial origin for the strains, probably by medical staff transmission since no teicoplanin-resistant S. epidermidis was isolated from environmental samples taken during the same period of time.

STAPHYLOCOCCUS AUREUS ISOLATES FROM PATIENTS AND STAFF AT A VA MEDICAL CENTER: CHARACTERIZATION BY ANTIBIOGRAMS AND MOLECULAR TYPING. Dever LL, Leach TS, Smith SM, Simmons A, Mathema B, Campo ML, Kreiswirth B. VA NJ Health Care System, East Orange, NJ; Public Health Research Institute, New York, NY.

Antibiograms have traditionally been used in attempts to determine the relatedness of Staphylococcus aureus isolates. Molecular typing techniques offer greater discrimination and can provide new insights into the epidemiology of S. aureus, both methicillin-susceptible (MSSA) and resistant (MRSA), within a healthcare facility. METHODS: Nares cultures were obtained from 75 inpatients (IP), 391 outpatients (OP), 50 long-term care facility (NH) residents, and 274 staff (STF) of a VA Med Ctr. S. aureus isolates were characterized by antibiograms (disk diffusion susceptibility to penicillin, oxacillin, clindamycin, erythromycin, levofloxacin, tetracycline, and vancomycin), pulse-field electrophoresis (PFGE) and hybridization of ClaI restriction fragments using mecA and Tn554 probes. RESULTS: S. aureus (57 MRSA, 174 MSSA) was isolated from a total of 230 subjects. There were 15 PFGE types among MSSA strains and 6 among MRSA strains. Nineteen (19) different antibiograms were represented among the isolates. Resistance rates were: 41% (n=94) for erythromycin, 25% (n=58) for levofloxacin, 25% (n=57) for oxacillin, 20% (n=46) for clindamycin, and 9% (n=20) for tetracyline. Eleven percent (11%) of isolates (n=25; 22 from OP and STF) were susceptible to all drugs and included 10 different PFGE types. The most frequently encountered antibiogram (n=100; 92 from STF and OP) was resistance to penicillin only; all 15 PFGE types were represented. The second most frequent antibiogram was resistance to penicillin and erythromycin only (7 PFGE types) The third most frequent antibiogram was resistance to all drugs except tetracycline and vancomycin (3 PFGE types). Many MSSA strains had PFGE patterns that indicated genetic relatedness to MRSA strains however their antibiograms (specifically susceptibility to clindamycin, erythromycin, levofloxacin, and tetracycline) were frequently different. CONCLUSIONS: Antibiograms do not reliably predict relatedness among MRSA and MSSA strains and should not be used alone for epidemiologic studies.

INTERNATIONAL TYPING STUDY OF TOXIN VARIANT STRAINS OF CLOSTRIDIUM DIFFICILE THAT CAUSE NOSOCOMIAL HUMAN DISEASE. Gerding DN, Brazier JS, Delmee M, Avesani V, Sambol S, Merrigan M, Johnson S. VA Chicago HCS - Lakeside Division and Northwestern Univ, Chicago, IL.; Univ Hosp of Wales, Cardiff, Wales; Universite Catholique de Louvain, Brussels, Belgium.

Variant strains of C. difficile that are negative in Toxin A immunoassays and positive in cell cytotoxin assays (ToxA-B+) have been found in Europe and North America. They are thought to be rare and not to cause clinical illness. We compared ToxA-B+ strains in three typing systems, Serogrouping, PCR ribotyping, and restriction endonuclease analysis (REA). Six isolates from Wales, 6 from the U.S., and 11 from Belgium were typed in a blinded fashion. All 6 U.S. isolates (REA types CF1, CF1p, CF2, CF3, CF4) were Serogroup F and PCR type 17. All 7 Serogroup F isolates from Belgium were PCR type 17 and REA type CF1, CF5, or CF6. All 4 Serogroup X isolates from Belgium were PCR type 17 and REA type CG1 or CG3. Serogroup F prototype strain #1470 is PCR type 17 and REA type CF1. Three PCR type 17 isolates from Wales were all REA type CF1. PCR type 47 from Wales was REA type CF1p. PCR type 36 was REA type CY1, and is strain #8864, a unique ToxA-B+ strain with major deletion of the toxin A gene. ToxA-B+ strains were from children in Belgium and disease could not be documented, but isolates from the U.S. (Chicago and Minneapolis) and Wales (United Kingdom, 10 hospitals) were documented to cause nosocomial diarrhea and pseudomembranous colitis. Most C. difficile ToxA-B+ strains typed in this study (serogroup F, PCR type 17, REA group CF) are identical or highly related and a cause of clinical illness in the U.S. and the United Kingdom, suggesting wide distribution of these disease-causing C. difficile strains that are not detected in Toxin A immunoassays.

MOLECULAR EPIDEMIOLOGY OF PNEUMOCYSTIS CARINII USING A PCR-SSCP TYPING METHOD. Hauser PM, Blanc DS, Seggen Manoloff E, Nahimana A, Bille J, Weber R, Francioli P. Univ Hosp, Lausanne, Switzerland; Univ Hosp, Zurich, Switzerland.

Bronchoalveolar lavage specimens of 212 European Pneumocystis carinii pneumonia patients were analyzed using the typing method for P. carinii f. sp. Hominis consisting of PCR-single strand conformation polymorphism analysis of four genomic regions. Twenty-three percent (23%) of the patients were presumably infected with a single Pc. hominis type. The other specimens were infected with two (50%) or more (27%) types. Thirty-five (35) different Pc. hominis types were identified. Their frequency ranged from 0.4% to 10% of the total isolates observed, and up to a maximum of 15% in a given hospital.

The same types were observed in different hospitals at intervals of several years, suggesting their genetic stability and ubiquitousness. There was no significant association between the P.c. hominis type and geographical location, year of collection, gender, age, or HIV status. The diversity of types observed suggested the existence of multiple sources of the infection. No more than three patients infected with the same type were observed in the same hospital within the same 6-month period, suggesting that nosocomial interhuman transmission of the pathogen was only limited, if it did occur at all.

MOLECULAR EPIDEMIOLOGY OF A HUMAN RESPIRATORY SYNCYTIAL VIRUS OUTBREAK IN A CANCER CENTER. Pittarelli, L, Peret, T, Fuss, E, Talley, E, Erdman, D, Lovchik, J, Roghmann, M-C, Meisenberg, B, Hebden, J, Mulligan, M *. Univ of Maryland School of Medicine, Baltimore, MD; Centers for Disease Control and Prevention, Atlanta, GA; Univ of Maryland Med Systems, Baltimore, MD; Veterans Affairs Maryland Health Care System, Baltimore, MD.

Human respiratory syncytial virus (HRSV) is a major cause of serious lower respiratory tract illness in infants, the elderly and the immunocompromised. Two major groups of HRSV (A and B) and multiple strains within these two groups have been identified. An outbreak of 19 cases of infection due to HRSV occurred within 13 days in a cancer center (with diagnosis supported by one or more of 4 diagnostic tests) in 10 healthcare workers (HCW), 6 hospitalized patients with hematological malignancies who had severe disease and 3 bone marrow transplant recipients who were treated as outpatients. Mortality was 50% among inpatients who had pneumonia. Of 37 HCWs tested, 30 returned questionnaires; 27 reported symptoms. Phylogenetic analysis showed that all but one of the 18 HRSV isolates available were genetically related (group A). Those isolates were distributed in 3 clusters of identical sequences plus 2 unique sequences: cluster I (9 subjects); cluster II (4 subjects) and cluster III (2 subjects). All 7 isolates from patients and employees of the cancer center belonged to cluster I. For 11 epidemiologically unrelated patients, 9 had isolates with the other sequences and only 2 had cluster I isolates. Analysis of nursing assignments revealed one individual who had more contact with HRSV positive patients than with HRSV negative patients (p=.06, Wilcoxon ranks test), but this person had no respiratory symptoms. Previously reported clustering of nosocomial infections in this setting has been found to be due to a variety of strains suggesting multiple independent introductions into the population. Our study strongly suggests nosocomial transmission of an HRSV strain and supports the need for precautions within the hospital to protect patients at risk for severe respiratory disease.

MOLECULAR EPIDEMIOLOGY: A COST SAVING MEASURE IN INVESTIGATION OF OUTBREAKS DUE TO VANCOMYCIN RESISTANT ENTEROCOCCI. Roscoe DL, Bryce EA, Porter S. Vancouver Hosp and Health Sciences Ctr, Vancouver, B.C., Canada.

OBJECTIVE: To assess the value of molecular typing in the determination of links between clusters of patients with vancomycin resistant enterococci (VRE). OUTBREAK DESCRIPTION: In a 5-month period, 3 clusters of patients were found to have VRE without clearly identifiable risk factors. Cluster A (3 patients) occurred on a ward where patients known to have VRE had previously been hospitalized, but were not in hospital at the time. Cluster B (4 patients) occurred on this same ward but occurred 4 months later. Cluster C (2 patients) occurred on a hospital ward remote from the other clusters, and these patients had no known contact with other VRE patients. The index case/source for these patients was unclear. Molecular typing was done by pulsed field gel electrophoresis (PFGE) using SmaI and standard methods. RESULTS: PFGE revealed that the VRE isolates from each cluster had unique patterns. Isolates from cluster B (pattern B) revealed a similar pattern to that previously identified from patients isolated on the same ward. One patient in this cluster had been exposed in a previous outbreak on the same ward, but refusal to allow surveillance swabs prevented identification of carrier status. VRE isolates from cluster A (pattern A) and cluster C (pattern C) had new PFGE patterns never before identified in our hospital setting. SUMMARY: PFGE was useful to establish the probable unrelatedness of these three clusters. This information was valuable as a cost and time saving measure. An extensive investigation into the possibility of occult transmission of VRE due to lapses in infection control procedures or environmental contamination was not required.

MOLECULAR FINGERPRINT ANALSYIS OF MRSA ISOLATES AMONG THORACIC SURGERY PATIENTS AT A CANCER HOSPITAL. Seo SK, Eagan JA, Stiles JJ, Kiehn TE, Wall L, Downey R, Sepkowitz KA. Memorial Sloan-Kettering Cancer Center, New York, NY.

BACKGROUND: MRSA is a well-recognized nosocomial pathogen that may cause significant morbidity. Recently, molecular typing has been used in conjunction with routine hospital surveillance to assess for patient-to-patient transmission. We applied this approach to thoracic surgical oncology patients to determine whether a recent increase in cases might be due to intra-institutional spread. METHODS: All MRSA isolates from the thoracic oncology floor at Memorial Sloan-Kettering Cancer Center, a 434-bed tertiary care hospital, from Jun 12, 1999, to Nov 1, 1999, were typed by pulsed-field gel electrophoresis. The floor treats both medical and surgical patients. Routine infection control surveillance data were extracted and analyzed. RESULTS: Sixteen (16) cases (4 bacteremias, 10 respiratory specimens, 2 wounds) were identified. All were surgical cases. Eleven (11, 69%) of 16 were due to a single strain. Importantly, 6 clonal cases (Jul and early Aug) were separated from the 5 remaining ones by a 5-week interval. No clinical or demographic characteristics distinguished those with and without clonal MRSA. All cultures of environmental surfaces and of bronchoscopes were negative. Because of the appearance, disappearance, and reappearance of the clonal strain after a 5-week hiatus, we have cultured the nares of all HCWs, including physicians, nurses, respiratory therapists, physical therapists, and others assigned to the floor (N=200). The isolates of those with MRSA will be typed to determine if any HCWs carry the clonal strain. Since institution of rigorous infection control interventions, no new cases have been seen in 5 weeks. CONCLUSION: Using combined molecular and routine epidemiologic methods, we investigated an increase in MRSA cases among thoracic surgical oncology patients and found 69% with a clonal strain. The appearance, disappearance, and reappearance after 5 weeks of the clonal strain suggest a possible HCW carrier of MRSA. Combined clinical and molecular epidemiologic examination may expedite and focus the investigation of possible nosocomial transmission.

MOLECULAR EPIDEMIOLOGY OF NOSOCOMIAL BLOODSTREAM INFECTIONS INVESTIGATED BY INFREQUENT-RESTRICTION-SITE PCR DIFFERENTIATES EPIDEMIC FROM ENDEMIC NOSOCOMIAL INFECTIONS. Su LH, Wu TL, Chiu YP, Leu HS, Chia JH, Kuo AJ, Sun CF. Chang Gung Memorial Hosp, Taoyuan, Taiwan.

An outbreak of nosocomial infections is usually defined as a statistically significant increase of infection rates beyond normal expectancy in a defined geographic area within a defined time period. However, with a long-term high prevalence of nosocomial infections, it appears difficult to identify or distinguish outbreaks from endemic infections. In our hospital, there are more than 1,500 episodes of nosocomial blood stream infections (BSIs) every year. These resulted in continuously high nosocomial BSI rates, which peaked at 12.3/1000 discharges or 1.31/1000 patient-days of care in 1997. Several bacterial species have been responsible for this high prevalence for more than three years. Among these, Staphylococcus aureus and Acinetobacter baumannii were arbitrarily selected to study the molecular epidemiology of nosocomial BSIs in our hospital. During the observation periods of eight and 11 months, respectively, between 1998 and 1999, 49 S. aureus isolates and 36 A. baumannii isolates, all of nosocomial origins, were collected consecutively and fingerprinted by a molecular typing method, infrequent-restriction-site PCR (IRS-PCR). Of the 11 types obtained from S. aureus, two major types were observed among 16 (32.7%) and 17 (34.7%) isolates, respectively. Furthermore, 26 (86.7%) of the 30 S. aureus isolates collected from pediatric wards and intensive care units (ICUs) were categorized into these two types. It appears that two clones of S. aureus strains were responsible for the comparatively higher (30/49=61.2%) prevalence of nosocomial BSIs associated with S. aureus among the pediatric patients. On the other hand, of the 18 types obtained from A. baumannii, one major type was found among 15 (41.7%) isolates, with 14 of which from surgical ICUs. It is clear that one particular strain of A. baumannii was responsible for the comparatively higher (21/36=58.3%) prevalence of nosocomial BSIs associated with A. baumannii among the surgical patients. Thus epidemic nosocomial BSIs were clearly differentiated from previously assumed endemics. An efficient molecular typing method, such as IRS-PCR, appears to play an important role in making this discrimination.

OUTBREAK OF STAPHYLOCOCCUS AUREUS INFECTIONS IN A CORRECTIONAL FACILITY. Tallent SM, Wenzel RP, Edmond MB. Med College of Virginia, Campus of Virginia Commonwealth Univ, Richmond, VA.

Over a four-month period, 44 cases (approximately 1 case/100 inmates) of staphylococcal furunculosis were detected in a 1700-bed correctional facility. All infecting isolates were found to be susceptible to methicillin. In two cases, deeper soft tissue infections ensued, but there were no cases of bacteremia or metastatic infections. 17 (39%) of the cases occurred in two dormitories (A and B). To assess the prevalence of S. aureus colonization in the inmate population, a point prevalence study of nasal cultures was done in three dormitories—A, B and C (a control dormitory where no cases had been reported). All prison healthcare workers (HCWs) were also cultured. Staphylococcus aureus was isolated from 89 (32%) of the 281 individuals cultured. Colonization rates were as follows: dorm A 27% (29/107), dorm B 35% (41/117), dorm C 30% (13/43), HCWs 43% (6/14). All colonizing strains, as well as three infecting strains that were retrieved, were analyzed by pulsed field gel electrophoresis (PFGE) to determine strain relatedness. One of the infecting strains was genetically indistinguishable (0 band differences) from 3 colonizing strains, closely related (2-3 band differences) to 10 colonizing and 1 infecting strains, and possibly related (4-6 band differences) to 14 colonizing isolates. The third infecting strain was unrelated (>7 band differences). Another strain (including indistinguishable and closely related isolates) was responsible for colonization in 16 (18%) individuals. This strain accounted for 15% of the isolates detected in dorm A, 17% of the isolates from dorm B, 15% of the isolates from dorm C, and also colonized 50% of the HCWs. Numerous interventions were implemented, including treatment of colonized inmates and HCWs with topical mupirocin, and the outbreak was controlled.

MOLECULAR EPIDEMIOLOGIC INVESTIGATIONS OF A NOSOCOMIAL OUTBREAK OF A MULTIRESISTANT CLONE OF ACINETOBACTER BAUMANNII. Wang GCY, Ang A, Wee M, Ling ML.* Tan Tock Seng Hosp, Singapore General Hosp, Singapore.

An outbreak of multiresistant Acinetobacter baumannii occurred initially at a neurosurgical intensive care unit (ICU) at a regional hospital from Feb-Sep 1996 involving 103 patients. Records were available for analysis for 99 patients. 17 of these were infected with the organism and 82 were colonizers. There were 21 deaths, of which 5 were patients infected with the organism. Environmental sampling done then was negative for the organism. The following control measures were carried out initially: cohorting of cases, strict Contact Precautions, cleaning of tap aerators, partial closure of the ICU. The outbreak was successfully controlled only after the ICU and affected wards were completely closed in Mar 1996. Epidemiological typing of bacteria was done using ribotyping and pulsed-field gel electrophoresis (PFGE) to confirm the outbreak strains. 88 of the 99 strains were available for PFGE. These came from 16 infected and 74 colonised patients. Of these, only 1 infected patient showed a different PFGE pattern D in contrast to the rest (A, A1, A2, and A4). Ribotyping done on 15 strains confirmed identical DNA type (R1 or R2) for the outbreak strains. Both PFGE and ribotyping are useful for strain differentiation in epidemiological studies of nosocomial outbreaks due to Acinetobacter baumannii.

MRSA

NASAL MRSA AND SUBSEQUENT INFECTION IN THE SURGICAL INTENSIVE CARE UNIT. Ang BSP, Soon M, Khoo FSH, Chan SP, Wee M. Tan Tock Seng Hosp, Singapore.

Methicillin- resistant Staphylococcus aureus (MRSA) is an important nosocomial pathogen and is endemic in major hospitals in Singapore. A retrospective study was conducted in the Surgical Intensive Care Unit (SICU) from 1st Jan-31st Dec 1997 to determine the relationship between nasal carriage and subsequent infection/colonization. A total of 415 patients were screened for nasal carriage of MRSA within the first 24 hours of admission into the SICU; 28 (6.7%) of the 415 patients had a positive nasal culture for MRSA. Of these 11 (39.3%) subsequently developed MRSA infection at other sites (respiratory, blood and wound), while the other 17 (60.7%) remained free of infection/colonization. In comparison, of the 387 patients who had initial negative nasal cultures, 105 (27.1%) developed subsequent infection/colonization at other sites during their stay in hospital, while the other 282 patients (72.9%) yielded negative MRSA cultures. The study showed that initial nasal screening for MRSA is not related to subsequent infection/colonization at other sites (X2=0.17). Analysis of the risk factors for acquisition of MRSA using Logistic Regression showed that length of stay in the hospital prior to ICU, and length of stay in the ICU to be significant predictors. We concluded that nasal MRSA is not related to subsequent MRSA infection/colonization either in the SICU or during the rest of the hospital stay.

MRSA/MSSA BACTEREMIA: A CASE-CONTROL STUDY. Austin TW, Austin, MA, Coleman, B. London Health Sciences Centre (LHSC), London, Ontario.; LHSC, London, Ontario; Elgin County Health Department, St. Thomas, Ontario.

PURPOSE: To examine the differences between the clinical presentation, management, and outcome of adults, bacteremic with methicillin-resistant Staphylococcus aureus (MRSA) vs methicillin-sensitive Staphylococcus aureus (MSSA), after matching for age, sex and primary diagnoses. METHODOLOGY: We carried out a review of the clinical records and laboratory results of all 78 MRSA and 254 MSSA bacteremic patients managed at our centre between Jan 1, 1994, and Jan l, 1999. Fifty (50) MRSA/MSSA patients were successfully matched and a number of clinical, laboratory, management and outcome variables compared. RESULTS: Univariate analyses revealed A) Duration of hospitalization prior to bacteremia. B) Time to optimal treatment. C) Concomitant polymicrobial bacteremia, to be significantly different between the two populations. The attributable mortality difference was borderline, 36% vs 20% (p 0.1). Those variables with a p value 0.1 were subjected to multiple logistic regression analyses. A), B) and C) remained significant. CONCLUSION: In our matched case-control study of S. aureus bacteremia in a hospitalized population of adults, we found those with MRSA infection were bacteremic later in their hospital stay, were optimally treated sooner, and more often had a polymicrobial blood-stream infection. Although mortality attributable to sepsis was higher in this group, it did not achieve statistical significance.

EPIDEMIOLOGY OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS AND PREVALENCE OF TRUE COMMUNITY-ACQUIRED MRSA IN AN IOWA STATEWIDE SURVEILLANCE NETWORK. Beekmann SE, Diekema DJ, Brueggemann AB, Doern GV, PFaller MA, Jones RN, Herwaldt LA . Univ of Iowa College of Medicine, Iowa City, IA.

An Iowa statewide surveillance system was initiated in 1998 to assess trends in antimicrobial resistance. Quarterly, 15 hospitals submit the first 10 isolates from unique patients (pt) for each of 9 pathogens to a central lab, which performs antimicrobial susceptibility testing. 12/15 infection control practitioners submitted epidemiologic data for 853 S. aureus (SA) isolates: demographics, antibiotic usage, long-term care facility (LTCF) status, and whether the isolate was hospital- (HA) or community-acquired (CA). 26% of SA isolates submitted from 7/98-9/99 were MRSA (range 3-50% by center). Epidemiologic data were available for 293 (34%) isolates, 79 (29%) of which were MRSA. Methicillin resistance was associated with current antibiotic use (p=.01), LTCF residence (p=.005), and designation of the isolate as HA (p=.004). MRSA pt age distribution was bimodal: pt <5yr 7/16 (44%) and >60yr 48/136 (35%). MRSA was most prevalent in hospitals with <200 beds (75% vs 25%, p<.0001) and rural areas (33% vs 22%, p=.0009). Only 20/79 (25%) MRSA isolates with epidemiologic data had <2 co-resistances (co-r) to rifampin, erythromycin, clindamycin, ciprofloxacin, chloramphenicol, tetracycline, or TMP/SMX. MRSA with <2 co-r were most common among pt aged 5-59 yr (p<.0001), who did not reside in a LTCF (p=.0006), were not on antibiotics during the previous month (p=.01), and received outpatient care (p=.01). Only 3 MRSA pts met a stringent definition of CA: outpts who did not reside in a LTCF, had not received antibiotics nor undergone an operative procedure in the previous month. Two of these isolates were resistant only to methicillin, while one was multi-drug resistant. Although MRSA are frequently isolated in small rural hospitals, true CA-MRSA appears to be very uncommon in Iowa.

GENETIC DIVERSITY OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN SWITZERLAND. Blanc D, Pittet D, Ruef C, Widmer A, Mhlemann K, Petignat C, Harbarth S, Auckenthaler R, Bille J, Frei R, Kayser FH, Moreillon P, Francioli P. Centre Hospier Universitaire Vaudois, Lausanne, Switzerland; Hôpitaux Universitaires de GenÊve, Switzerland; Universitätsspital, Zurich, Switzerland; Universitätsspital, Basel, Switzerland; Institut für Medizinische Mikrobiologie, Bern, Switzerland; Institut for Mikrobiologie, Zurich, Switzerland.

OBJECTIVE: To assess the diversity of methicillin-resistant Staphylococcus aureus (MRSA) strains in a country where hospitals have a low MRSA incidence, and which is surrounded by countries where this incidence is usually reported as high. MATERIAL AND METHODS: One-year national survey of MRSA cases (hospitalization of one patient during which MRSA was detected) in Swiss hospitals. Analysis of epidemiological data (questionnaire) and MRSA strains by molecular typing (PFGE). Results. During 1997, 365 cases of MRSA were recorded in 5 Swiss university hospitals and in 40 community hospitals from all over Switzerland. Half of the cases were found in the Geneva area where MRSA was already known to be endemic (48 cases/10,000 admissions/year). The remaining cases (180) were distributed into 43 hospitals (1.6 to 8.2 cases/10,000 admissions for university hospitals and a mean of 6.8 cases/10,000 admissions for community hospitals) throughout the rest of Switzerland. Molecular typing of 291 isolates (one per patient) showed that 62% belong to 4 clones, the remaining 38% of the strains being clustered into 66 PFGE types and accounting for 1 to maximum 3 patients per hospital. Three of the four clones were found to be predominant in Geneva hospitals. The majority of the isolates of these three clones (83%) were found in Geneva, whereas the remaining 17% were spread in 10 other hospitals. In contrast, the fourth clone (85 cases) was spread in 23 hospitals (1 to 16 cases per hospitals). Three of the four clone were found to be related to other European epidemic MRSA clones. CONCLUSION: A high genetic diversity of strains was recorded among the MRSA isolates in Switzerland. However, four clones were predominant in the same geographic area, but with two different characteristics: three clones were largely restricted in one hospital, whereas a fourth clone was spread in 23 hospitals. This add to the complexity of the epidemiological behavior of MRSA.

REEMERGENCE OF GENTAMICIN-SUSCEPTIBLE STRAINS OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN FRANCE: A POPULATION GENETIC STUDY. Blanca DS, Francioli P, Le Coustumier A, Gazagne L, Lecaillon E, Gueudet P, Vandenesch F, Etienne J. Centre Hospier Univ Vaudois, Lausanne, Switzerland; Hôpital Champ le Roi, Neufchateau, France; Centre Hosp Maréchal Joffre, Perpignan, France; Centre Natl de Référence des Toxémies á.Staphylocoques, Lyon, France.

Several reports have described the reemergence and increased incidence of gentamicin susceptible (Gm-S) methicillin-resistant Staphylococcus aureus (MRSA) isolates in France between 1992 and 1996. The aim of the present study was to investigate if this is due to the emergence and rapid spread of an epidemic Gm-S clone or to the loss of Gm resistance factors in the various existing clones of French MRSA. To investigate this hypothesis we used a phylogenetic typing system (multiprimer RAPD) applied to samples of randomly selected Gm-R and Gm-S strains (10 Gm-R strains isolated in 1990, 35 GM-R and 30 Gm-S strains isolated between 1995 and 1998). Most strains were clustered into two discrete taxonomic units (DTUs) of 65 and 7 strains, respectively. Both DTUs comprised GM-S and GM-R strains. The smallest DTU includes 3 Gm-R and 4 Gm-S strains, isolated after 1994. The largest DTU, which was previously shown to include epidemic clone of MRSA from all over Europe, can be subdivided into 3 subclusters. The first subcluster (5 strains) includes only Gm-R strains, all isolated in 1990. The second subcluster (32 strains) also includes Gm-R strains, but isolated both in 1990 (4 strains) and latter (28 strains). The third subcluster (27 strains) includes 24 Gm-S strains and only 3 Gm-R strains, all isolated between 1995 and 1998. These results show that the reemergence of Gm-S MRSA strains in France was mainly due to the spread of one specific clone (the third subcluster). Because this clone belonged to a subcluster of the DTU comprising the Gm-R strains of 1990, it is likely to be due to a Gm-R strain which have lost its resistance factor to gentamicin.

THE COST OF DOING BUSINESS-MANAGING MRSA AND VRE. Bryce EA, Kerschbaumer V Vancouver Hosp and Health Sciences Centre, Vancouver, British Columbia, Canada.

Control of antibiotic resistant organisms (AROs) continues to be a priority in healthcare, but few studies have calculated the direct as well as the indirect costs of managing these organisms in an acute care setting. We determined the costs of controlling cross-transmission as well as the costs of increased stay for Methicillin resistant Staphylococcus aureus (MRSA) and Vancomycin resistant enterococcus (VRE). Expenditures from patient care and service areas were compiled from Jan 1 to Dec 31, 1998, in our 900-bed adult tertiary care hospital. Expenses were categorized as direct (the cost of detecting cases and preventing cross-transmission) or indirect costs (the cost of additional days stay while awaiting placement/transfer as well as additional days stay resulting from infection with MRSA or VRE). There were 296 cases of MRSA and 11 of VRE in 1998. Direct costs of $1,578,000 were spent on detection of cases and prevention of cross-transmission ($4,345 Canadian/MRSA case and $13,545/VRE case-adjusted cost). $1,976,000 ($6,500/case) reflected indirect costs for a total of $3,554,000 managing MRSA ($10,845/case) and VRE ($20,045/case), the majority of funds being redistributed from within the hospital budget. These costs did not reflect productivity loss on nursing care units or pharmacy costs of treating AROs. In addition, approximately 1500 acute bed days were lost due to inability to transfer patients to the appropriate level of care. Institutions may underestimate the costs of managing AROs if only direct costs are calculated. The impact of prolonged length of stay and loss of acute bed days as well as loss of revenue from private rooms should be considered when assessing the fiscal impact of MRSA and VRE.

METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS: EVALUATION OF A 10-YEAR CONTROL PROGRAMME IN A UNIV HOSPITAL. Byl B, Struelens MJ,* Strale H, Deplano A, Rost F. Erasme Univ Hosp, Brussels, Belgium.

OBJECTIVES: To review the impact on MRSA acquisition of successive control interventions during the period 1990-99 in a Univ hospital from a country where MRSA is endemic. RESULTS: In 1989, MRSA emerged from endemic to epidemic pattern in our hospital. Since 1990, a continuous surveillance and control programme involved 6 successive steps. In 1990, patients were screened and those colonized were placed in contact isolation, decolonized with mupirocin (step 1) and later cohorted in an isolation unit (step 2). In addition, personnel were screened and carriers decolonized with nasal mupirocin. This led to significant reduction in incidence from 1.65 to 0.6 case/100 admissions. Screening for nasal carriers and cohorting were discontinued (step 3) for economic reasons. In 1992, the incidence again increased significantly to 0.8 case/100 admissions. In response, handwashing was replaced by use of glove for caring non-intact skin, mucosae or secretions and hand desinfection with 70% isopropanol-0.5% chlorexidine solution in pilot units (step 4) and resulted in a significant decrease of MRSA transmission. This policy was promoted hospital-wide (step 5, 1993) resulting in the lowest incidence in 1994 (0.4 case/100 admissions). In 1995, MRSA incidence increased again due to a new clone spreading in the intensive care units (ICU). From 1996 to 1998, half of all ICU admitted patients received prophylaxis with mupirocin and chlorexidine in a cross over study (step 5). Which showed a 50% reduction of transmission. During this period, a new clone of MRSA with reduced mupirocin susceptibility emerged in the ICU and prophylaxis was stopped. At the end of 1998, the incidence of MRSA colonization ranged from 0.3 to 0.5%. During the whole period, introduction of MRSA colonized patients to the hospital fluctuated from 0.2 to 0.8 case/100 admissions and contributed to local outbreaks due to three different clones. CONCLUSION: These data show that MRSA control interventions were accompanied with reduction and containment of transmission. Continuous introduction of patients colonized with diverse MRSA clones led to repeated outbreaks and required a close monitoring of the local epidemiology backed-up by molecular typing to adapt control measures regularly.

TEA TREE OIL AS AN ALTERNATIVE TOPICAL DECOLONISATION AGENT FOR METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS. Caelli ML, Riley TV, Carson CF, Heller RF. Centre Clinical Epidemiology and Biostatistics, Univ of Newcastle, Callaghan NSW Australia; Univ of Western Australia, Queen Elizabeth II Med Centre, Nedlands, Western Australia; The Univ of Western Australia, Queen Elizabeth II Med Centre, Nedlands, Western Australia.

The carriage and dissemination of methicillin-resistant Staphylococcus aureus (MRSA) by hospital staff and patients is a well recognised risk for nosocomial infections. The emergence of mupirocin-resistant MRSA potentially compromises our ability to eradicate the carrier state and alternative treatment agents have been suggested. A pilot study to evaluate the clinical efficacy of tea tree oil in the eradication of MRSA was undertaken at John Hunter Hosp, Newcastle, NSW, Australia. A total of 30 adult inpatients, either colonised or infected with MRSA, were recruited during the 9-month pilot study during Dec, 1997 and Aug 1998. Participants were randomly allocated to receive either a 5% tea tree oil nasal ointment and a 2% tea tree oil body wash (intervention care [IC]), or mupirocin nasal ointment and triclosan body wash (routine care [RC]), for a minimum of 3 days. Screening for MRSA was undertaken 48 and 96 hours post cessation of topical treatment. The numbers of those infected in each treatment group were similar (6/15 vs 8/15). Infected participants also received IV Vancomycin. 50% (15/30) of participants successfully completed the initial treatment regimen. Five of the IC group were initially cleared of MRSA carriage compared to of the RC group. In this pilot study, a combination of tea tree oil products performed better than mupirocin and triclosan, although the numbers of participants was too small for the difference to be statistically significant. These results do suggest, however, larger studies are warranted.

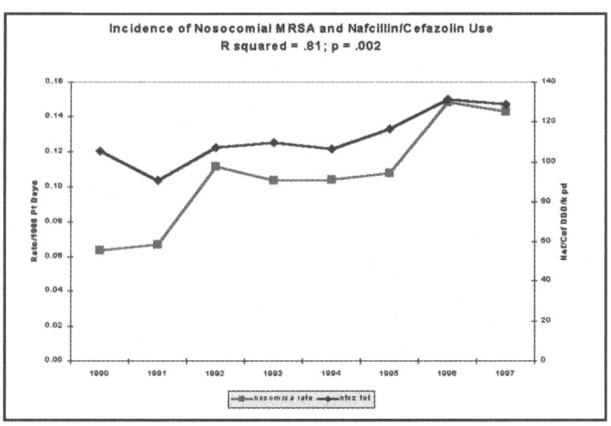
Parameter	RC (n=15)	IC (n=15)
Average age (yrs)	74 (Range: 45-87)	58 (Range: 28-82)
Male	7 (47%)	5 (33%)
Infected	6 (40%)	8 (53%)
Skin isolate	9 (60%)	10 (67%)
Average treatment days	5.6 (Range: 2-14)	10.7 (Range:1-34)
Initially cleared (%)	2 (13%)	5 (33%)
Chronic (%)	8 (53%)	3 (20%)
Incomplete (%)	5 (33%)	7 (47%)

EVALUATION OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS SCREENING PROGRAM IN A TERTIARY PEDIATRIC CENTER. Desmarais N, LeMay M,* Cloutier N, Mimeault C, Boileau G, Perpête C, Laferrière C . Hôpital Ste-Justine CHU mère-enfant, Montréal, Canada; Univ. de Montréal, Montréal, Canada; Hôpital Ste-Justine CHU mère-enfant, Montréal, Canada.

OBJECTIVES: Methicillin resistant Staphylococcus aureus (MRSA) is endemic in several Québec hospitals. We have experienced 5 MRSA outbreaks between 1992 and 1997 at Ste-Justine. Thereafter we initiated a MRSA screening program. We report our evaluation after 2 years of surveillance. METHODS: The program consists of screening all patients requiring admission with a history of prior hospitalization into a MRSA endemic Québec hospital or any hospital outside the province. The identified patient remains isolated until negative culture result. Surveillance cultures are also done on selected babies in newborn intensive care unit (NICU) on a monthly basis. Nasal swabs are done on all screened patients except for newborns who have nasal, ombilic and anal swabs. All specimens are placed into the staphylococcal broth on arrival to the laboratory and subcultured onto oxacillin agar screen at 24 hours of incubation. MRSA suspected stains are confirmed at the Québec Public Health Lab. RESULTS: Of the 708 patients tested, 22 were positive for MRSA. 11/22 were detected on admission through our screening program. of them came from the NICU surveillance program. Of the remaining 11, 6 were identified from laboratory culture results requiring epidemiologic investigations. Those 6 patients were unrelated and led to 5 colonised contact patients. Two of the 6 index cases represented program failure, 3 community acquired MRSA and 1 nosocomial MRSA surgical wound infection. CONCLUSION: Despite MRSA endemicity in surrounding adult hospitals, our program has been successful to prevent most of the potential outbreaks into our 450-bed pediatric hospital.

RELATIONSHIP BETWEEN HOSPITAL ANTIMICROBIAL USE AND NOSOCOMIAL METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS BACTEREMIA. Donegan NE, Pic-Aluas L, Barbaccia J. Washington Hosp Center, Washington, DC.

Infections with methicillin-resistant Staphylococcus aureus (MRSA) are on the rise in most U.S. hospitals, with much of the increase attributed to transmission. However, widespread use of certain antimicrobials may have contributed to the emergence of MRSA. We studied the correlation between the use of antimicrobials with activity against methicillin-sensitive Staphylococcus aureus (MSSA) and nosocomial MRSA bacteremia in our hospital, from 1990 to 1997. The antimicrobial use, calculated in Defined-Daily-Doses (DDD)/1,000 patient-days, included vancomycin, ciprofloxacin, cefazolin, nafcillin, ceftriaxone, ceftazidime, penicillin G, ampicillin, ampicillin-sulbactam, and piperacillin. The annual proportion and incidence of MRSA/1000 patient-days were plotted against antimicrobial use, and linear regression analysis was performed. The proportion of MRSA in nosocomial bacteremic isolates has increased from 20 to 36%, while the incidence increased 2.3-fold from .06 to .14 /1000 patient-days. We found a statistically significant correlation between the use of ciprofloxacin (R2=.63), cefazolin (R2=.57), ceftriaxone (R2=.65), third-generation-cephalosporins (R2=.61), nafcillin and cefazolin combined (R2=.77), and all b-lactams combined (R2=.59), and the proportion and incidence of MRSA bacteremia. Use of antimicrobials with activity against MSSA may select out a few resistant strains present in small numbers in heterogeneous populations. Eradication of MSSA carriage through antimicrobials may render the host more susceptible to subsequent colonization or infection with MRSA.



BED UTILIZATION FOR PATIENTS INFECTED OR COLONIZED WITH METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN A CANADIAN TERTIARY CARE CENTRE. Embil JM, Cooper C, Dyck B, Nicoll D, Olekson K, McLeod J, Nicolle L . Univ of Manitoba, Winnipeg, MB, Canada; Health Sciences Centre, Winnipeg, MB, Canada.

OBJECTIVE: To identify demographic characteristics, and determine hospital bed utilization, for providing care for patients identified as being colonized or infected with MRSA. METHOD: A retrospective chart review of all patients admitted to the Health Sciences Centre, Winnipeg, Manitoba between Jan 1, 1995, and Dec 31, 1998, and who were either colonized or infected with MRSA was performed. Gender, age, place of residence, ethnicity, and number of isolation days was established. Errors in isolation enforcement were identified. RESULTS: 107 patients either colonized or infected with MRSA were identified of which 61.7%, 45.8%, and 63.6% were male, First Nations (FN), and rural dwelling respectively. Of these 108 patients, 66 required isolation during hospital admissions. 3,000 isolation days (950 medical, 1,116 surgical, 344 pediatric, 590 other) were utilized. Because not all isolation rooms are of single occupancy, an additional 1,938 beds were blocked for isolation purposes. Errors in the isolation protocol occurred in 5 (4.6%) admissions during this period. CONCLUSION: A high number of FN individuals, males, and rural residents required isolation for positive MRSA status. Although comprising only 1 in every 1,111 admissions, patients colonized or infected with MRSA lead to additional pressure on hospital bed utilization. Our infection control team effectively identified and isolated patients colonized or infected with MRSA.

COMMUNITY ACQUIRED METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS IN HOSPITALIZED CHILDREN IN SOUTH TEXAS. Fergie J, Purcell K, Wright C. Driscoll Children's Hosp (DCH), Corpus Christi, TX.

The emergence of community acquired MRSA in children with no predisposing risk factors has occurred in the last 3 years at DCH. At the same time, the annual rate of MRSA has increased from a range of 2.9-6.7% per year of all Staphylococcal aureus isolates for 1990-96 to 8.3-11.4% for 1997-99. From Jan 1996 to Sep 1999 a total of 33 hospitalized children (18 boys; 1 month to 17 years) had MRSA isolated. Of these infections, 14 were considered to be community acquired because they did not meet the 1988 CDC criteria for nosocomial infections. Only 1 of these children had an identified risk factor for MRSA (underlying chronic illnesses and recent hospitalization). Soft tissue infections (cellulitis or abscess) accounted for 11 of the 13 cases of the community acquired MRSA in children without risk factors. The other 2 children without risk factors had toxic shock syndrome and pneumonia/empyema with pneumatocele, respectively. Of the community acquired MRSA isolates from children without risk factors, 100% were susceptible to TMP/SMX and clindamycin, 62% to ciprofloxacin, 31% to tetracycline, and 23% to erythromycin. Of the nosocomial acquired MRSA isolates, 84% were susceptible to TMP/SMX, 53% to clindamycin ($p<0.005$), 42% to ciprofloxacin, 95% to tetracycline ($p<0.001$), and 21% to erythromycin. Definitive antibiotic therapy with vancomycin, TMP/SMX, clindamycin, erythromycin, tetracycline, or ciprofloxacin as appropriate by sensitivity was administered to 7 of the 13 children with community acquired MRSA without risk factors. The other children recovered despite inadequate antimicrobial therapy but 4 of these 6 children did require surgical treatment (incision and drainage). The emergence of community acquired MRSA as a cause of common infections may require a change in the initial selection of antibiotics to assure appropriate coverage in severely ill children.

SUSTAINED REDUCTION OF NOSOCOMIAL METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS OCCURRENCES AFTER INTRODUCTION OF A FOCUSED INTERVENTION PROGRAM. Garcia M, Kennedy C, Weinwurm D, Rappoccio M, Burt J, Dedier H, Campbell I, Gardam MA, Conly JM. Toronto General Hosp, Univ Health Network, Toronto, Ontario.

INTRODUCTION: With increasing rates of methicillin-resistant Staphylococcus aureus (MRSA) colonization and infection identified at two sites of Univ Health Network (UHN) since 1996, a series of interventions aimed at decreasing the rates of nosocomial transmission of MRSA were planned and implemented during 1998. METHODS: Occurrences of MRSA are recorded as nosocomial, community, community institution, indeterminate, or unknown according to explicit criteria. Interventions in 1998 included: provision of waterless handwash agents, dedicated use of equipment, use of chlorhexidine bed baths on transfer patients, a poster campaign on general hygiene, information pamphlets, and provision of additional 1.5 Infection Control Practitioners to implement the program and an eight-bedded stepdown unit often used to house chronically ill patients was thoroughly cleaned and converted into two four-bedded rooms. A program of screening high-risk patients on transfer had previously been implemented. RESULTS: The rate of MRSA occurrences varied between 0.3-1.6/1000 admissions up until 1994. The rate of isolation increased to 2.8 and to 8.0/1000 admissions in 1996 and 1998, respectively with stable admission rates during 1998, the rate decreased significantly ($p=.004$) from 9.0 to 6.7/1000 admissions following the intervention period and from 5.1 to 3.2/1000 admissions if only nosocomial occurrences are included, representing a 37% reduction in the number of nosocomial occurrences. This rate has been sustained during the first half of 1999. CONCLUSIONS: The rate of MRSA isolation has decreased significantly since the adoption and implementation of the interventions. It is uncertain if this decrease is the result of natural history of MRSA in our patient population or if it is a result of the interventions, although based on the temporal course and intensity of the interventions, we believe the latter is more likely.

INFLUENCE OF NURSING WORKLOAD ON CROSS TRANSMISSION OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN AN INTENSIVE CARE UNIT. Girou E, Oppein F, Lorthiois S, Cizeau F, Ducellier D, Soubrier N, Brun-Buisson C. Hôpital Henri Mondoré Créteil, France.

The high level of nursing workload inherent in intensive care units has been shown to favor the occurrence of nosocomial infections. However, few studies have documented its influence on transmission rates of multiresistant bacteria. We analyzed data collected daily in a 26-bed medical ICU and related to nursing workload and nosocomial acquisition of methicillin-resistant Staphylococcus aureus (MRSA), including 1) the patient-to-bed ratio (PBR) per area (acute care area, ACA, 13 beds; intermediate care area, ICA, 13 beds), 2) the mean workload score (Omega score, OM), reflecting the daily therapeutic activity and estimated per area and per day, and 3) new cases of MRSA acquired in the ICU. From 06/01/96 to 05/31/98, 2169 patients were admitted in the ICU and 53 patients acquired MRSA during their stay (ACA, 38 patients, and ICA, 15 patients). Mean PBR and OM in the 7 day-period preceding MRSA acquisitions were compared to mean PBR and OM calculated in days not preceding MRSA acquisition: n=number of days These results suggest that nosocomial acquisition of MRSA occurs following periods with higher levels of nursing workload in the ICU. The higher MRSA acquisition rate in the ACA is also reflected by a higher workload score.

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Variables	Before MRSA acquisitions	Outside MRSA acquisitions	p
PBR in ACA, %	81±15 (n=266)	76±16 (n=464)	0.001
PBR in ICA, %	80±15 (n=105)	75±18 (n=625)	0.065
OM in ACA, points	16.2±3.3 (n=266)	15.2±3.8 (n=464)	0.004
OM in ICA, points	8.9±2.1 (n=105)	8.6±2.6 (n=625)	0.066

COMPARISON OF SYSTEMATIC VERSUS SELECTIVE SCREENING FOR METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS CARRIAGE IN A HIGH-RISK DERMATOLOGY WARD. Girou E, Wolkenstein P, Azar J, Cizeau F, Roujeau JC, Brun-Buisson C. Hôpital Henri Mondoré Créteil, France.

To compare 2 strategies for screening methicillin-resistant Staphylococcus aureus (MRSA) carriers in a high-risk dermatology ward: a strategy of systematic screening of all admitted patients versus selective screening of patients at risk, a prospective study was conducted during 2 consecutive periods in a 19-bed inpatient dermatology ward, a referral center for toxic epidermal necrolysis and severe extensive dermatoses. In Period A (8.5 months), only patients at high risk for MRSA carriage (i.e., patients transferred from other wards, and/or with a history of prior hospitalization, and/or presenting chronic wounds or disease with denuded skin) were sampled. In Period B (7.5 months), all admitted patients were systematically screened. End-points were the number of patients having a MRSA-positive screening sample on admission during Period B and having of the risk factors used in Period A, and the rate of imported and acquired MRSA cases. During Period A (n=370 included patients) screening samples were obtained on admission in 30% of patients (77% of the patients at risk) and allowed to detect 25 MRSA carriers. During Period B, 90.5% of the 359 admitted patients were screened and 26 MRSA carriers were detected on admission; all these patients belonged to at least one category at risk for carriage. Overall rates of imported and acquired cases were similar between the 2 periods (6.8% vs 7.2%, and 2.9 vs 2.4%, respectively). These results suggest that a screening strategy targeted to patients at risk of harboring MRSA has similar sensitivity and is more cost-effective than a strategy of systematic screening to identify MRSA carriers on admission.

RISK FACTORS FOR PERSISTENT CARRIAGE OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS. Harbarth SJ, Liassine N, Dharan S, Herrault P, Auckenthaler R, Pittet D. Children's Hosp, Boston, MA; Geneva Univ Hosps.

We have recently conducted a double-blind, placebo-controlled trial [AAC, 6-99] about the efficacy of nasal mupirocin in eradicating carriage of methicillin-resistant Staphylococcus aureus (MRSA) and observed an association (P=.003 by Fisher's exact test) between low-level mupirocin resistance (LMR) and subsequent treatment failure in both study arms. Therefore, we explored further the study cohort (n=102) to assess the clinical significance of LMR (MIC, 8 to 64 mg/L) and to determine independent risk factors associated with persistent MRSA carriage. Examined covariates included patient demographics, underlying conditions, recent antibiotic exposure, previous MRSA history, and type and number of MRSA colonization sites. Crude and adjusted hazard ratios (HR) were estimated using Cox proportional hazards analysis. E-test methodology and genotyping were used to determine MICs of mupirocin and to assess strain relatedness. Among 98 evaluable patients, MRSA eradication was unsuccessful in 77 patients at the end of follow-up (79%). The prevalence of LMR at the end of treatment was 24%; 4 cases acquired LMR during mupirocin therapy. No isolate showed high-level resistance. By univariate analysis, 4 variables were associated with failure (all P<0.1): absence of mupirocin treatment (HR 1.5; CI 1.0-2.3); recent fluoroquinolone therapy (HR 1.6; CI 0.9-2.7); >2 positive body sites (HR 1.8; CI 1.1-2.9); and LMR (HR 1.6; CI 1.0-2.6). After multivariable modeling, the presence of >2 positive body sites (adjusted HR [AHR] 1.7; CI 1.0-2.9; p=.03) and previous receipt of a fluoroquinolone (AHR 1.8; CI 1.0-3.3; p=.05) were independently associated with MRSA persistence, whereas nasal mupirocin tended to confer protection (AHR 0.6; CI 0.4-1.0; p=.07). LMR was observed in 9 genotypically different MRSA strains and was not independently associated with treatment failure (AHR 1.5; CI 0.9-2.5; P=.15). Our findings suggest that multisite MRSA carriage and previous receipt of a fluorochinolone are independent risk factors for persistent MRSA colonization after topical eradication treatment. Further research is needed to assess the clinical significance of LMR at extra-nasal carriage sites.

MULTIRESISTANT MICROORGANISMS FROM FOREIGN HOSPITALS TO THE NETHERLANDS—AN INTERIM ANALYSIS. Kaiser AM, Kruithof GJ, Coppoolse D, Debets-Ossenkopp YJ, Vandenbroucke-Grauls CMJE. Univ Hosp Vrije Universiteit, Amsterdam, The Netherlands; ANWB bv, Den Haag, The Netherlands; SOS International, Amsterdam, The Netherlands..

Methicillin-resistant Staphylococcus aureus (MRSA) is often introduced in the Netherlands with patients who are transferred from foreign hospitals. How often this occurs and whether other multiresistant microorganisms (MRMO) are also introduced is not known. We determined the prevalence of carriage of: MRSA, vancomycin-resistant enterococci (VRE) and gentamicin-resistant Gram negative bacilli (grGNB) in consecutive patients who were transferred to the Netherlands between May 1998 and Jul 1999. During transfer, escort staff obtained swab specimens from nose, throat and rectum and recorded clinical and demographic data. Data were analyzed by logistic regression. We present the results for the first 500 repatriates.The prevalence of MRMO carriage was 19.2% (CI95: 17.8-22.7). Fourteen (14, 2.8%) patients carried MRSA. Carriers were only found in patients who were admitted to a hospital after transfer, and not in patients who were transferred directly to their homes; this indicates that MRSA is acquired by the most critically ill. In the patients transferred to a hospital carriage rate was 5.4%. Risk factors for MRSA carriage were: presence of a urinary catheter (adjusted OR: 8.2; CI95: 1,8-37) and use of multiple antibiotics (adjusted OR: 7.1; CI95: 2.3-21.7). Patients with MRSA stayed significantly longer in a foreign hospital than patients without MRSA (20.5 vs 12.4 days, p < 0.05). VRE were isolated from 17 (3.4%) patients; this is close to the carriage rate of 2-3% found in Dutch outpatients. GrGNB were isolated from 65 (13.0%) patients, and comprised mainly E. coli and Acinetobacter spp. GrGNB were found more frequently in patients that were transferred from countries outside Europe (adjusted OR=3.1; CI95: 1.6-5.7). Our study confirms that approximately 5% of patients admitted to Dutch hospitals from foreign hospitals are colonized with MRSA. In addition it points to the high acquisition rate of g-GNB, while acquisition of VRE does not seem to occur.

PREVALENCE OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS COLONIZATION AMONG RESIDENT-PHYSICIANS AT A TEACHING HOSPITAL USING CONTACT/DROPLET PRECAUTIONS FOR MRSA ISOLATION. Karchmer TB,* Ribadeneyra MG, Durbin LJ, Giannetta E, Farr BM. Univ of Maryland; Univ of Virginia.

Healthcare workers (HCW) with nasal MRSA colonization have rarely been the source for MRSA outbreaks, in part due to a very low prevalence of colonization among HCW. A recent study found that nasal MRSA shedding increased significantly during a common cold and that an isolation mask reduced this shedding by 75% (Sherertz, Ann Intern Med 1996;124:539). A British study reported that 13 of 26 HCW wearing gown and gloves on an MRSA ward became transiently colonized in the nose 32 times during 7 weeks and one required decolonization therapy for persistent colonization, suggesting that MRSA can colonize the unprotected an nose. How much a mask would protect against colonization when working with MRSA patients has not been investigated. In 1996, CDC changed its longstanding recommendation for isolation of MRSA with mask, gown, and gloves to gown and gloves only (Garner, ICHE, 1996;17:53), but recommended using a mask for VRSA the following year (CDC, MMWR 1997;46,626). There is concern that MRSA colonization of HCW may now increase and becomes a more important part of the epidemiology of nosocomial MRSA infections. A teaching hospital in France recently reported that 24 (5%) of 521 HCW under 50 years old were colonized with MRSA (Martin, ICAAC 1999:637). To see whether a similar increase in prevalence had occurred at a hospital continuing to use mask, gown and gloves for MRSA isolation, we cultured medical residents having frequent contact with MRSA patients. During one week medical residents had anterior nasal vestibule cultures performed. S. aureus (SA) was isolated by standard lab technique with methicillin-resistance defined as an oxacillin MIC of > 4 µg/ml. 80 (90%) of 89 residents were cultured. 38 (48%) were found to carry methicillin-sensitive SA. were colonized with MRSA, suggesting a very low prevalence. In the absence of comparative studies, more prevalence surveys among HCW in hospitals using vs not using masks for MRSA isolation would be useful. If a rising prevalence of MRSA colonization among HCW is documented, this could indicate the need for a change in the CDC Isolation Guideline.

CONCOMITANT COLONIZATION/INFECTION WITH METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS AND CLOSTRIDIUM DIFFICILE IN A TERTIARY CARE INSTITUTION. Kennedy C, Rappoccio M, Burt J, Katz K, Gardam MA, Conly JM. Toronto Western Hosp, Univ Health Network, Toronto, Ontario.

INTRODUCTION: Methicillin-resistant Staphylococcus aureus (MRSA) and Clostridium difficile (CD) are pathogens frequently associated with nosocomial transmission which can become endemic within institutions. Although there are multiple common risk factors, little data exists about co-colonization and/or infection with MRSA/CD in the acute care setting prompting a review of this occurrence in our patient population. METHODS: A 3 year retrospective cross-sectional epidemiologic analysis was done in a 1000-bed 3-site tertiary care facility to identify demographic and risk factors and outcome by cross-referencing of Microsoft Access/Excel 97 databases for identification of MRSA colonized/infected and CD toxin positive patients with diarrheal illness. Duplicates were excluded and it was confirmed that the MRSA isolates had been collected during the same hospital admission. RESULTS: Of 377 CD and 805 MRSA + patients, 46 or 12.2% and 5.7%, respectively were found to be co-colonized. Their mean age was 73 +/- 14.8 years, 41% (19) had > 1 prior hospital admissions within 6 months, 72% (33) were medical patients, 50% (23) had an ICU stay prior to the identification of MRSA/CD, 32.6 %(15) were initially transferred from a long term care facility, and the crude mortality rate was 45.6%. The mean length of stay (LOS) prior to CD or MRSA identification was 30.5 and 37d, respectively. There was no difference in the number of infected MRSA patients between the MRSA (38.4%) and MRSA/CD (37%) groups. CD illness antedated MRSA positivity in 58.7% and vice versa in 28% of cases. Excluding those CD + on admission, 81.4% developed CD illness after 2 weeks of hospitalization. CONCLUSIONS: Factors associated with co-colonization with CD and MRSA appear to be advanced age, ICU stay, prolonged LOS, prior admission and transfer from a nursing home. The identification of CD illness prior to MRSA acquisition suggests that prior antibiotic use may be a common risk factor. Patients who are MRSA + with CD illness appear to have a high mortality rate.

STRATEGY OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS SURVEILLANCE AND CONTROL PROGRAM IN A FRENCH TEACHING HOSPITAL: A FIVE-YEAR EXPERIENCE. Lepelletier D, Le Gallou F, André-Richet B, Luce D, Richet H. Institut de Biologie, Centre Hospier Universitaire, Nantes, France.

In Nantes hospital, a MRSA surveillance program (MSP) was implemented in 1993. Five years later, we sought to assess if the initial objectives were reached. A study was performed in 1998 using the guidelines published by the CDC in 1988. We described the MSP and assessed his usefulness, and reviewed the following subjective criteria (simplicity, acceptability), and measurable criteria (sensitivity, positive predictive value, representivity, and timeliness). The MSP was useful, detecting trends: the number of MRSA strains isolated decreased from 414 in 1993 (incidence rate per admissions, 0.78%) to 288 in 1997 (0.49%). In the same period, the implementation of isolation precautions increased: wearing of gloves (50%-93%), gowns (72%-92%), handwashing (72%-90%), private room (60%-75%) and sign on the patient's door (11%-40%). The MSP was also useful, detecting outbreaks, and being used by the nurses to improve prevention. The sensibility and the positive predictive value of the data collected by phone concerning the precautions were high, except for the following data: sign on the patient's door (53%-73%) and wearing of masks (67%-20%). The MSP was reactive because the time lapsed from the date of collection of the specimen to the date of the bacteriological diagnosis, and to the date of the antibiotic prescription did not differ according to the collection dates and the type of sample. The MSP was also simple, acceptable and representative. In conclusion, the strategy used to survey and control MRSA infections was conducted successfully. However, we suggested 5 recommendations to improve the MSP quality: (1) initiate periodic visit in units; (2) appoint an referent in each unit to facilitate the collection of data by phone; (3) inform units receiving MRSA colonized /infected patient from another units where the collection of the specimen was done; (4) list MRSA colonized patients at the admission in the hospital to take isolation precaution rapidly; and (5) broaden the surveillance to other multidrug-resistant organisms to evaluate the flexibility of the MSP.

SURVEILLANCE AND CONTROL OF INFECTIONS CAUSED BY METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN FRENCH HOSPITAL. Lepelletier D, Richet H. Institut de Biologie, Centre Hospier Universitaire, Nantes, France.

MRSA is a leading cause of hospital-acquired infections but few data are available on the methods used by hospitals to monitor and control these infections. Therefore, a survey was performed to assess the way French hospitals conduct surveillance and control infections caused by MRSA and to evaluate the incidence of these infections. A representative sample of 38 French public hospitals was randomly selected in 1996 from 24 different urns in order to take in account the number of beds and the location of the hospitals. Administrative data, surveillance denominators used, anti-microbial resistance rates, and infection control practices were analyzed from 1990-95. The same 38 centers were contacted three years later in 1998 to evaluate if they had modified their surveillance and control methods. French hospitals were late in implementing MRSA surveillance program, since only 5% had such program in 1990 while the median incidence per admission (0.37%) and per patient-days (0.4%) of MRSA infections was already high. Despite the implementation of surveillance programs in 76% of French hospitals in 1995 and 88% in 1998, the MRSA infection rates remained stable from 1990-95 and increased from 1995-98 (TABLE 1). The proportion of French hospitals isolating MRSA colonized/infected patients increased from 87% in 1995 to 92% in 1998, while screening for MRSA colonization remained stable, from 42%-52%. This first national survey showed that French hospitals are probably not prepared to control and prevent MRSA infections, since they seldom use reliable surveillance indicators, and do not systematically implement the infection control measures.

MRSA surveillance indicators used by French hospitals (median values and range)

Indicators	1990	1995	1998
Proportion of MRSA (%)	23 [3-34]	29 [7-47]	34 [12-48]
Incidence per 100 admissions	0.37 [0.1-0.42]	0.40 [0.03-1]	0.60 [0.24-3.9]
Incidence per 1000 patient-days	0.40 [0.08-0.71]	0.30 [0.02-1.3]	0.60 [0.06-4.4]
No of strains isolated	193 [14-442]	235 [6-2310]	278 [30-1968]

PREVALENCE AND RISK FACTORS FOR METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS COLONIZATION IN THE COMMUNITY AMONG PATIENTS ADMITTED TO A PUBLIC URBAN HOSPITAL. Liao M, Larsen NM, Larson JM, Halvosa JS, Chandler, K, Jernigan, JA, Blumberg, HM. Emory Univ, Atlanta, GA; Grady Health System, Atlanta, GA; Emory Univ, and Department of Epidemiology, Grady Health System, Atlanta, GA.

Methicillin-resistant S. aureus (MRSA) is a major cause of nosocomial infections and concerns have recently arisen about the potential for community acquired infections due to MRSA. We investigated the prevalence of and risk factors for MRSA nares colonization in the community among patients being admitted to Grady Memorial Hosp (GMH) and studied the molecular epidemiology of MRSA isolates recovered. Anterior nares cultures were obtained on a total of 630 patients within 48 hours of admission over a 1 month period (Jun 1999) for patients admitted to the Medicine and Surgery services (including ICUs). 42% of patients were female, 58% were male; mean age was 49 (range: 16-93 years): 12% were HIV+, 29% were HIV-, 59% had unknown HIV status. 38 (6%) of 630 patients had a positive nares culture for MRSA, 106 (17%) for methicillin-susceptible S. aureus (MSSA) and 486 (77%) were culture negative. The rate of MRSA colonization was similar throughout all age groups. A higher proportion of those with MRSA colonization had taken an antibiotic within the three months prior to admission (22/38 [58%] vs 179/592 [30%], OR=3.2, 95%CI 1.6-6.2; P<0.001) and had been hospitalized in the prior six months admission (24/38 [63%] vs 226/592 [38%], OR=2.8, 95%CI 1.4-5.5; P=0.003). In multivariate analysis, only prior antibiotic use within three months of admission was associated with increased risk of MRSA colonization admission (OR=2.5, 95%CI 1.1-5.6; P=0.02). Molecular epidemiologic typing studies using pulsed-field gel electrophoresis demonstrated 19 different clones or strains among the 38 MRSA isolates recovered. In summary, prior antibiotic use was associated with an increased risk of MRSA colonization at the time of admission. "Community" MRSA nares colonization was not rare among adult patients admitted to our institution, and rates of colonization did not differ by age, suggesting an increasing prevalence in the community. These findings will impact infection control strategies for the prevention of MRSA transmission within healthcare institutions.

COMPLIANCE WITH MRSA SCREENING. Loo VG, Hebert G. McGill Univ Hosp Centre, Montreal, Canada.

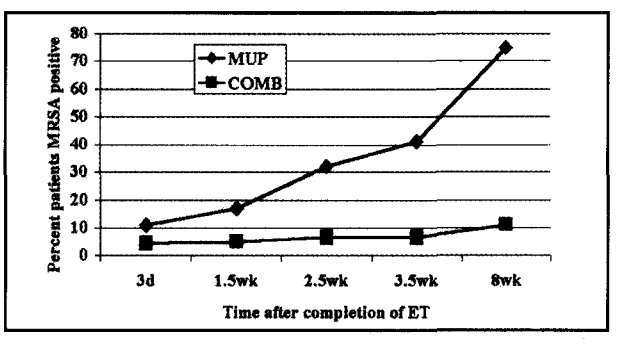
INTRODUCTION: There has been an increase in the rates of methicillin-resistant Staphylococcus aureus (MRSA) in acute care and long term facilities in Canada. To control the transmission of MRSA in our 450-bed tertiary care center in Montreal, patients transferred from other institutions are screened for MRSA upon admission. The objective of this study was to examine the compliance of MRSA screening in these patients. METHODS: A retrospective analysis of admission MRSA screening of all patients transferred from other healthcare facilities was performed over a 10 month period from May 1,1998, to Feb 28,1999. RESULTS: There were 464 patients transferred from other institutions. Of the 464 patients, 318 (68%) were screened for MRSA. CONCLUSIONS: Compliance with MRSA screening was moderate. Mechanisms to facilitate MRSA screening need to be developed.

A TEN-YEAR REVIEW OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN A HONG KONG HOSPITAL. Lyon DJ, Fung KSC, Chan RFY, Ho DYM, Cheng AFB. Prince of Wales Hosp, Hong Kong, China.

The isolation of methicillin resistant Staphylococcus aureus (MRSA) was reviewed for patients admitted to the Prince of Wales Hosp, Hong Kong, during the ten year period 1989-98. The use of an "alert organism" database allowed estimation of new patient episodes of colonization/infection, and new patient episodes of MRSA bacteremia. The infection control procedures implemented to curtail the spread of MRSA were consistent throughout the period. The overall incidence of colonization/infection with MRSA for 1989-98 was 0.47/100 deaths and discharges (DandD), and for bacteremia it was 0.035/100 DandD. The incidence of colonization/infection was highest in 1989 at 0.81/100 DandD, fell to 0.33/100 DandD in 1995, and then rose to 0.53/100 DandD in 1998. The incidence of MRSA bacteremia fell from 0.03/100 DandD in 1989 to 0.02/100 DandD in 1993/94 and then rose to a high of 0.05/100 DandD in 1998. The ratio of colonized/infected patients to bacteraemia patients was 23.3 in 1989 and dropped to a low of 8.2 in 1998. The percentage of patient S. aureus bacteremia episodes which were MRSA was 24% in 1989, dropping to 15% in 1993 before steadily rising to 41% in 1998. For clinical areas, the highest incidence was seen in the burns unit (9.8/100 DandD colonization/infection, 0.39/100 DandD bacteremia), and the intensive care unit (3.8/100 DandD colonization/infection, 0.6/100 DandD bacteremia) and lowest in the ob/gyn unit (0.01/100 DandD colonization/infection, no bacteremias). The falling MRSA incidence during 1989-94 and the subsequent rise during 1995-98, and the relative increase in bacteremia during the study period, is not explained by infection control practices since these were largely unchanged during the period of study. We suggest that changing MRSA strain types and changes in patient profiles and treatment protocols may explain the resurgence of MRSA seen after 1995.

REDUCING THE RESERVOIR OF MRSA: VALUE OF ERADICATION THERAPY IN AN ACUTE CARE HOSPITAL. Majury A,* Wigston C, Green K, Goldman C, Moore C, Mcgeer A. Mount Sinai Hosp, Univ of Toronto, Toronto, ON, Canada.

OBJECTIVE: To assess the value of eradication therapy (ET) for methicillin-resistant Staphylococcus aureus (MRSA) in an acute care hospital. BACKGROUND: MRSA was uncommon in Ontario before 1992, but has increased 20-fold, to 7 patients/1000 admissions. Our hospital's control program (admission and high risk unit prevalence screening, investigation of nosocomial cases, isolation, attempted ET) is associated with an overall MRSA rate <35% of regional mean, and a decreasing nosocomial rate despite increasing MRSA-colonized admissions. However, many patients fail ET, and therapy selects for resistance. We therefore evaluated our use of ET. METHODS: All patients colonized/infected with MRSA are assessed. ET was not attempted if patients were to be discharged or were on palliative care. ET included mupirocin ointment to nares/skin lesions tid plus 2% chlorhexidine for bathing x 7d (MUP). In patients who could tolerate oral therapy rifampin plus TMP-SMX, doxycycline or fucidin (based on susceptibilities) were added (COMB). Follow-up swabs (nares, rectal, skin lesions, previously positive sites) were obtained 3 days after end of therapy, then weekly x 3, then monthly. Swabs were planted on mannitol salt agar with 2 µg/ml oxacillin and processed by standard methodology. One course of ET was evaluated. Relapse/reinfection was assessed by PFGE. Repeat susceptibilites were performed on relapse isolates. RESULTS: MRSA was identified in 135 patients from Jan 98-Sep 99. 86 (69%) received eradication therapy: 51 MUP and 35 COMB. Overall success rates were 88% (52/59) at 2 days post therapy, 85% (44/52), 74% (31/41) and 73% (27/37) 1,2 and 3 weeks later, and 48% (11/23) at 8 weeks. Cumulative risk of relapse for COMB and MUP is shown below. No mupirocin or rifampin resistance was detected in relapse isolates. CONCLUSION: 73% of treated patients remained free of MRSA at 1 month and 48% at 2 months. Patients able to tolerate COMB had significantly higher success rates. Although the risk of resistance is present, ET reduces the reservoir of MRSA significantly and is a useful adjunct to our control program.



EVALUATION OF PREVENTION AND CONTROL MEASURES FOR METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS. Moreira M, Medeiros EAS, Freitas MR,* Rego ST, Santos OP, Tosin I, Sader HS, Wey SB, Amaral JLG. Federal Univ of Sao Paulo, Sao Paulo, SP, Brazil.

OBJECTIVE: To evaluate the efficacy of control measures in the prevention of Methicillin-resistant Staphylococcus aureus (MRSA) infection in an adult intensive care unit. DESIGN: Prospective cohort study. PATIENTS: All patients hospitalized in the unit, according to the methodology of the National Nosocomial Infections Surveillance System (NNISS), from June 1, 1996 to October 31, 1996—control group (CG); from November 1, 1996 to October 31, 1997—intervention group (IG); from November 1, 1997 to June 30, 1998—post-intervention group (PIG). Intervention measures: education programs to all unit staff; early identification of MRSA infected and colonized patients, labeled with an identification tag on their beds, for contact isolation; treatment of nasal carriers, patients, and healthcare workers with mupirocin for five days. The hospital infections were compared between the CG and the PIG. RESULTS: The incidence coefficients of hospital infection per sites (monthly average of 1000 pts/day) in the CG, IG and PIG were respectively: bloodstream infection (BI): 19.3; 20.7; 6.5 (p<0.001); pneumonia: 25.5; 28.6; 14.9 (p=0.006); infection of the urinary tract: 10.6; 17.9; 14.0 (p=0.36). The MRSA global rate of infection was 10.2; 5.1 and 2.5/1,000 patients day (p<0.001), and the BI caused by MRSA were 3.6; 0.9 and 1.8/1000 patients day (p=0.281). Nasal colonization in both IG and PIG was of 30.9% and 22.0% among the hospitalized patients (p=0.06), and 12.7% and 4.6% among the healthcare workers. (p=0.037). In the IG, 76.2% of the patients who had infections caused by MRSA were already nasal carriers of the microorganism, MRSA colonized patients had a risk 7.1 times bigger to develop infection. The average time between colonization and development of the infection was 8 days. The mortality rate in the three periods was, respectively 28.8%; 27.3%; and 21.2% (p<0.001). This study concludes that the intervention measures, have been efficient in the reduction

of incidence of bloodstream infections, pneumonia and hospital infections caused by MRSA and reduced the general mortality rate.

THE IMPACT OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS ON A COUNTRY: CONTINUOUS TOTAL POPULATION SURVEILLANCE. Morgan M, Evans-Williams D, Salmon RL, Hosein IK, Looker DN. Public Health Lab Service (Wales), Cardiff, UK; Communicable Disease Surveillance Centre (Wales), Cardiff, UK; Rhyl Public Health Lab, Ysbyty Glan Clwyd, Rhyl, UK.

Staphylococcus aureus from blood cultures (BC) and cerebrospinal fluid (CSF) detected in medical microbiology laboratories in Wales have been reported electronically since 1993. In 1996 surveillance was expanded to include new methicillin-resistant S. aureus (MRSA) from all clinical sites, associated with colonisation and infection, from hospitals and the community. Risk factors, clinical impact and resistance to 7 antibiotics are collected. Results show that: (1) MRSA has increased substantially. Methicillin resistance in S. aureus from BC or CSF rose from 4%-45%, 1993-99 (provisional). Total MRSA reports also increased, especially 1996-97 (93%). The increase in patients with serious illness from MRSA is from the overall increase in incidence rather than increased strain virulence. (2) Certain groups are especially vulnerable to MRSA. Most reports are from the 65+ age group (1998:3828/5541) and highest incidence is in men aged 75+ (1998 incidence/100,000 population—overall:193; men 75+:1435). Patients with MRSA from BC or CSF are significantly older and more likely to be male than patients with methicillin-sensitive S. aureus (MSSA) (1993-97: mean age (95% CI): MSSA-58 (56-59), MRSA-66 (64-67), p<.001; male sex OR (95% CI)=1.4 (1.1-1.8), p=.003). (3) Most isolates are resistant to 2 antibiotics in addition to methicillin (1998:68%), usually erythromycin and fluoroquinolones. Resistance has remained stable over time, except for falls in resistance to tetracycline (17%-2%) and trimethoprim (36%-10%) between 1996-99 (provisional). Information is returned to Welsh hospitals to aid in local decision- and policy-making.

THE IMPACT OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN WALES: INCIDENCE AND POLICY SURVEYS. Morgan M, Evans-Williams D, Salmon RL, Hosein IK, Looker DN. Public Health Lab Service (Wales), Cardiff, UK; Communicable Disease Surveillance Centre (Wales), Cardiff, UK; Cardiff Public Health Lab, Univ Hosp of Wales, Cardiff, UK; Rhyl Public Health Lab, Ysbyty Glan Clwyd, Rhyl, UK.

To audit the continuous surveillance of new methicillin-resistant Staphylococcus aureus (MRSA) in Wales and to obtain further data, 2 surveys were undertaken. The first was in 1997 and included a survey of MRSA control policies, a two week incidence survey and an outcome survey of patients from the incidence survey. Results showed that the continuous surveillance was broadly accurate, with highest incidence in the elderly, particularly in men, for all MRSA and invasive MRSA. In addition the following information was found: I. Although a large pool of MRSA existed in the community (10% of MRSA was from general practitioners; 15% of hospital patients were positive on admission), the majority had a history of hospitalisation (70% of MRSA hospital patients were hospitalised in the previous year). II. Patients not positive on admission had long hospital stays pre-isolation of MRSA (median: 12 days). III. The severity of MRSA progressed in only 3 patients between the incidence and outcome surveys (3.5 months). IV. Resources devoted to MRSA control were considerable: 72% of patients were isolated for a median of 13 days; 49% received antimicrobials for MRSA control. V. Most patients (67% of those who lived) were discharged positive from hospital. The second survey, comprising a one week incidence survey and a follow up survey of treatment and control measures, was in Jul 1999, following publication of new national guidelines for MRSA control. Results will be compared to the previous survey and to the new national guidelines, to determine whether hospital practice has changed.

EVALUATION OF A PROGRAM FOR SCREENING OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AT ADMISSION IN A PRIVATE TERTIARY CARE HOSPITAL IN RIO DE JANEIRO, BRAZIL. Oliveira MPB, Moura MH, Py L, Amaral M, Azevedo SM, Silva MS, Bozza F, Gudziki R, Sampaio J, Moreira BM. Hosp Espanhol, Rio de Janeiro, Brazil; Univ Fed, Rio de Janeiro, Brazil.

Since the beginning of the 1990s, methicillin resistant Staphylococcus aureus (MRSA) became established as an important nosocomial pathogen at Rio de Janeiro, mainly in the large, university affiliated hospitals. Surveillance programs have helped private and smaller institutions to keep this pathogen under control. However, the admission of patients presenting MRSA colonization poses the risk of developing outbreaks in these hospitals. In the present report, the screening program in a private tertiary care institution was evaluated in a prospective transversal study to determine the risk factors for MRSA carriage at admission. From Dec 1998 to Aug 1999, 308 patients underwent MRSA screening, including 156 (50.6%) with a history of previous hospitalization, 97 (31.5%) directly transferred from another hospital, 34 (11%) with home care, 18 (5.8%) undergoing dialysis, and 3 (1%) with previous MRSA infection. of the patients revealed drug use. Nasal swab specimens, evaluated in all patients, and specimens from any broken skin site were plated on blood agar. Staphylococcus aureus isolates were susceptibility tested by the disk diffusion method according to NCCLS recommendations. The chi-square and two-tailed Fisher's exact test were used to test the associations. The overall carrier rate was 4.5% (14/308), all MRSA patients showing a positive nasal swab specimen. The only risk factor for MRSA (p<.05) was home care (8/34, RR=2.13; CI 95% 1.163.90; p<.0001). However, restricting the screening program to the patients with a history of home care would have not detected 6 (43%) of the MRSA carriers. Among these remaining MRSA patients, 4 were directly transferred from another hospital. The evaluation the subgroup of directly transferred patients (97) revealed that admission for >72h in the previous hospital was associated with MRSA carriage (3/19, RR=12.2; CI 95% 1.34-110.48; p<0.03). MRSA screening of patients under home care and patients transferred after a period of >72h in another hospital is an alternative to optimize the screening program at this hospital.

LOW PREVALENCE OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS NASAL CARRIAGE IN ITALIAN HOSPITAL STAFF. Pan A, Barosi C, Carnevale G, Ceruti T, Crema L, La Russa A, Ferrari L, Dolcetti L, Barosi C, Catenazzi P, Granata L. Istituti Ospitalieri di Cremona, Italy.

INTRODUCTION: Methicillin-resistant Staphylococcus aureus (MRSA) is one of the most common nosocomial pathogens. The incidence of methicillin-resistance in Italy, as well as in other developed countries, is quite high, being reported between 25 and 60%. Although nose carriage among staff is usually low, there are studies reporting high staff nasal contamination. In a program aimed at controlling MRSA spread within our hospital, we performed nasal swab on staff of selected wards. METHODS: In 1997 we started in our hospital a program to control MRSA spread. Within this program staff nasal swabs were taken in 6 selected wards (hematology, nephrology/dialysis, AIDS/infectious diseases, intensive care, and post-intensive rehabilitation, rehabilitation service) to evaluate the prevalence of nasal carriage. Nasal swabs were also performed on staff members during 2 MRSA epidemics, between in Jul 1997 and Oct 1999 in a surgical ward. Nasal swabs were performed through a moisturized sterile swab rotated 10 times in both anterior nares. Results 264 nasal swabs have been performed on 180 healthcare workers and MRSA was isolated in only 4 cases (1.5 %). In 81 healthcare workers (31%) nasal swabs yielded methicillin-sensitive S. aureus. DISCUSSION: Hosp staff was found to have low prevalence of nasal carriage (1.5 %). No correlation between carrier healthcare workers and epidemics was found. The implementation of control measure (isolation of patients, decontamination with mupirocine/chlorexidine of MRSA patients, reinforcement of handwashing) resolved both epidemics. Hosp spread of MRSA occurred during 2 epidemics most probably through staff hands. Performing nasal swabs during MRSA epidemics may prove useless and even deleterious moving attention of the staff from handwashing to nasal carriage and giving a false feeling of low risk of MRSA transmission. Staff nasal swabbing may play a role only in epidemics not controlled with standard approach.

EVALUATION OF ANTIMICROBIAL RESISTANCE IN STAPHYLOCOCCI ISOLATED AT THREE HOSPITALS IN ROMANIA FROM JAN 1 TO AUG 31,1999. Pana M, Ghita M, Silaghi E, Papagheorghe R, Vasile L. Institutul Cantacuzino, Bucharest, Romania; Institutul National de Cardiologie "C.C. Iliescu," Bucharest, Romania; Spitalul Clinic Universitar Coltea, Bucharest, Romania; Spitalul de Ortopedie "Foisor", Bucharest, Romania.

Ninety-five (95) Staphylococcus spp.strains (S.aureus [SA]: N=87, coagulase-negative staphylococci [CNS]: N=8) were isolated at three Romanian hospitals.Those strains were isolated from patients hospitalized in the following services: cardiovascular (surgical wounds: N=43, blood: N=8, prosthesis thrombus: N=5, pericardic fluid: N=2, peritoneal fluid: N=1, drains: N=7, sputum: N=2, and abscess: N=3), digestive surgery and othorhinolaryngology (surgical wounds: N=7, jaw: N=2, frontal sinuses: N=3, eye orbit: N=3, blood: N=1,drains: N=2,and pleural fluid: N=1), orthopedics (surgical wounds: N=2, drains:N=1,and prosthesis:N=2). The antimicrobial susceptibility testing was performed by determining the MICs of the isolates by the agar dilution method.All CNS and 52.1% of SA were resistant to methicillin (MR). Eighty-three percent (83%) of MRSA isolates were resistant to gentamicin, 60.4% were resistant to erythromycin, 75% were resistant to ciprofloxacin, and 12.5% had MIC to vancomycin equal to 4. In conclusion,this study enables to forecast the probable emergence of glycopeptide-intermediary susceptible SA strains in Romania.

MRSA IN BACTEREMIA DETECTED AT TIME OF EMERGENCY CLINIC VISIT. Rezende NA,* Blumberg HM, Metzger BS, Larsen NM, Ray SM, McGowan JE Jr. Federal Univ of Minais Gerais School of Medicine, Belo Horizonte, Brazil; Emory Univ and Grady Memorial Hosp, Atlanta, GA; Rollins School of Public Health of Emory Univ, Atlanta, GA.

CONTEXT: Community-acquired infections due to Methicillin-resistant strains of Staphylococcus aureus (MRSA) have increased. Guidelines now must be developed for empiric treatment and isolation of patients with suspected infection due to these organisms. Characteristics permitting recognition of such strains would aid guideline development. DESIGN: Retrospective review of medical and laboratory records to analyze factors associated with methicillin resistance (MR) in S. aureus strains recovered from blood cultures taken from adult patients at the time of emergency clinic visit. PATIENTS AND SETTING: Consecutive sample of adults seen in the emergency care center of Grady Memorial Hosp, Atlanta, GA, from Jan 1, 1996, to May 31, 1998, whose blood cultures taken within 24 hours yielded Staphylococcus aureus. The relationship of demographic and clinical factors to isolation of resistant strains was assessed. MAIN OUTCOME MEASURE: Multivariate model of factors associated with isolation of resistant strains RESULTS: Isolates of S. aureus from 118 (39.7%) of 297 study patients exhibited MR. Multivariate analysis identified hospitalization in the 6 months preceding admission (OR=4.4, 95% CI=2.0-9.8), receipt of antimicrobials in the past 3 months (OR=5.6, 95% CI=2.6-11.9), presence of indwelling urinary catheter (OR=7.3, CI= 2.5-20.9) and nursing home residence (OR 9.9, 95% CI=3.9-25.6) to be independently associated with MR strains. All but four of the 118 patients with MR strains had at least one of these factors. The likelihood that a blood isolate of S. aureus was MR diminished with the interval since prior hospitalization. CONCLUSION: The factors above should be considered first when making decisions about isolation precautions and empiric antimicrobial therapy with vancomycin for these patients. Similar studies could guide these practices in other centers.

METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS AND INTERNATIONAL TRAVEL-IMPORTED STRAINS AT A SWISS TERTIARY CARE CENTER. Sax H,* Colombo C, Giger H, Ruef C. Univ of Zurich Hosp, Switzerland.

OBJECTIVE: To study the clinical and epidemiological characteristics of patients with methicillin-resistant Staphylococcus aureus (MRSA) at the Univ of Zurich Hospital (UZH) with prior contact to healthcare institutions abroad. METHODS: Descriptive analysis of prospectively registered MRSA cases at a tertiary care hospital in a five-year time period (Oct 1992-Jul 1998). CASE DEFINITION: Persons with in-patient or outpatient treatment abroad within one year prior to hospitalization at UZH and from whom MRSA was isolated at USZ. All strains underwent typing by pulsed field gel electrophoresis. RESULTS: 36 cases of MRSA met the case definition (27% of a total of 131 MRSA cases). Mean age was 42.4 years ±16.9 SD. Patients were transferred form Italy (10), Yugoslavia (7), Greece (4), Egypt and Germany (2 each), Albania, Australia, Brazil, France, Great Britain, Japan, Poland, Singapore, Spain, Thailand, and U.S. (one each). 72% were living in Switzerland. Eight of 36 (22%) were hospitalized in another Swiss institution before being transferred to this hospital. Diagnosis comprised trauma in 26 cases (71%), cardiovascular disease in 3 cases (8%), neurological, gastrointestinal disease in 2 cases (6%) each, and dermatological, respiratory disease, and ear infection in one case (3%) each. MRSA was found because of known colonization, by screening, or accidentally in 3 (8%), 5 (14%), and 28 (78%) cases, respectively. Median latency from admission to detection of MRSA was 1 day (range, 0-47). MRSA infection was found in 15 of 36 cases (44%). Genotypes of all recovered strains proved markedly different from those of endemic strains at UZH. Two secondary cases were noted. CONCLUSIONS: A sizable proportion of all MRSA strains was imported from abroad and was found by chance. The

patients were mostly young, male, and admitted to surgical units and ICU following trauma during international travel. These data help to tailor preventive measures against further intra- and inter-hospital spread.

THE ECONOMIC IMPACT OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN CANADIAN HOSPITALS. Simor AE, Kim T, Oh PI. Sunnybrook and Women's College Health Sciences Centre, Univ. of Toronto, Toronto, ON, Canada.

We determined the economic impact of MRSA by conducting a cost analysis to estimate the attributable cost associated with the management of infected or colonized patients and the cost of surveillance in a tertiary care teaching hospital. In-patients with MRSA between Apr 1996-Mar 1998 were identified. Patient-specific costs were used to determine the attributable cost associated with excess hospitalization and concurrent treatment. Excess hospitalization for infected patients was identified using the Appropriateness Evaluation Protocol, a criterion-based review to assess the need for each day of hospitalization. A total of 20 patients with 21 MRSA infections and 84 colonized patients (with 100 admissions) were identified. This represented a rate of 2.9 MRSA per 1,000 admissions. Eight (38%) infected patients died; in 3, death was attributed to MRSA infection. The total attributable cost to treat MRSA infections was $286,084 (CDN) or $13,623 per admission. The average number of additional hospital days was 13, with 11 admissions having at least one attributable day. The total cost for treatment and isolation of colonized patients was $128,095 (CDN), or $1,363 per admission. The total surveillance cost for MRSA screening was $168,243, or $5.02 for each non-MRSA admission. Therefore, the total cost to our hospital was $580,695 (CDN). We estimated the burden to Canadian hospitals based on 3,167,521 hospital discharges from 1996/1997, and an incidence of 2.12 MRSA per 1,000 admissions (in 1998). Assuming an infection rate of 10-20%, we determined the cost of MRSA in Canadian hospitals to be $24M-$33M (CDN) annually. Our results indicate that there is a substantial impact associated with MRSA in Canadian hospitals. Furthermore, this burden will grow as the incidence of MRSA increases.

ERADICATION OF AN OUTBREAK OF METHICILLIN RESISTANT S. AUREUS IN A NEWBORN INTENSIVE CARE UNIT POSSIBLY MEDIATED BY ISOLETTE FILTERS. Singh F,* Donelan SV, Greene WH, Spitzer ED, Tortora G, Sohl F. State Univ of New York, Stony Brook, NY.

Outbreaks with MRSA continue to present a threat to high risk patients (pts). Endemicity once established, can be difficult to eradicate despite aggressive infection control measures (ICM). We describe an outbreak in our NICU between 12/27/97-5/4/98 that we believe was partly mediated by Iso air filters. The NICU had been free of MRSA for >12 months until 12/97 when a cluster of 3 pts grew MRSA, 2 in one room. One of these remained in NICU on isolation and remote from patient #4 who returned to NICU on 2/27/98 after cardiac surgery. A femoral catheter tip culture was positive (Pos) for MRSA on 3/1/98. Within 2 wks 2 additional MRSA pts were identified. Isolation and cohorting of staff and pts failed to halt the outbreak and environmental and staff cultures failed to identify a common source. A total of 15 (3+12) pts acquired nosocomial MRSA; 6 were colonized in the eye only. Review of Iso cleaning revealed that Iso were cleaned every 7 days and rotated among all pts. However, the filters were changed only once every 3 months, per manufacturer's recommendation. On 4/10 we ordered that all filters be replaced, be sent for bacterial cultures, and that Iso occupied by culture Pos pts be rotated only among the MRSA cohort. One filter was found to be culture Pos. The pt in this Iso had previously been culture negative but became nasal culture Pos on 4/12. This was the last Pos culture. ICM were discontinued on 5/4/98 after 3 wks of negative cultures. Surveillance cultures of nose, groin and eye obtained for two months following cessation of ICM revealed no new pt with Pos cultures. Pulsed-field gel electrophoresis indicated that all MRSA were clonally related. Thus, rotation of Iso only among culture Pos pts until discharge and changing the filters upon discharge, prior to general circulation, halted MRSA, spread. NICU has remained free of MRSA for the past 1½ years.

COMMUNITY VERSUS NOSOCOMIAL ACQUIRED METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AT A UNIVERSITY HOSPITAL IN THE CENTRAL U.S. Suntharam N, Hacek DM, Peterson LR. CDC Prevention Epicenter, Northwestern Univ Med School, Chicago IL.

BACKGROUND: Community-acquired MRSA (CA-MRSA) is potentially a new emerging pathogen, with recent reports coming from the North-Central U.S. and Western Australia. Most of these strains are unique in that they are susceptible to many antimicrobials except β-lactams. We hypothesized screening for clindamycin susceptible MRSA would be a method to detect CA-MRSA. METHODS: We retrospectively reviewed the MRSA isolates during a 20-month study period (Jan 1998 to Sep 1999) that were clindamycin susceptible. Patients were not considered harboring CA-MRSA if they had been admitted to Northwestern Memorial Hosp (NMH) within the preceding two years, or if their isolate had been obtained more than 72 hours after admission. If there was no indication of a prior NMH contact, the chart was reviewed to determine if there had been an admission to an outside facility within two years. RESULTS: We were unable to assess 2 charts. In 1998, there were a total of 1,658 S. aureus isolates with 616 being MRSA. Of these 616 isolates, 80 were clindamycin susceptible recovered from 47 patients, and 14 infections appeared community-acquired. In 1999 (through 8/31), there were 1,159 S. aureus isolates with 455 being MRSA. Of the 445 isolates, 81 were clindamycin susceptible recovered from 34 patients, and 5 appeared community-acquired. The majority of the cases were skin/soft tissue infections. Of these presumed community-acquired isolates, all also were susceptible to gentamicin, 18/19 were susceptible to tetracycline, and 16/19 susceptible to ciprofloxacin. Reviewing patients with multidrug susceptible MRSA may be a useful tool to detect CA-MRSA infection. This screening approach for CA-MRSA indicates that the prevalence of this unique S. aureus is low (~1%) in adults in Chicago.

PREDOMINANCE OF A MULTIDRUG RESISTANT CLONE OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS AT A TERTIARY CARE CENTER OVER A THREE-YEAR PERIOD, 1996-98. Topal JE,* Farrell PA, Callan DA, Bursey BN, Dembry LM. Yale-New Haven Hosp and Yale School of Medicine, New Haven, CT.

The percentage of methicillin resistant Staphylococcus aureus isolates (MRSA) at Yale-New Haven Hosp, a 824-bed tertiary care center, remained below 10% until 1996. From 1996-98, the MRSA rate increased steadily from 10.2% (1996), 16.3% (1997), and to 22.0% (1998) [p< .00001]. Coupled with the increased rate of MRSA, a unique MRSA antibiotic sensitivity pattern appeared in 1996 which displayed resistance to all standard antibiotics except for rifampin, chloramphenicol, and vancomycin (R/C/V). The percentage of MRSA sensitive to only R/C/V increased dramatically from 8.3% in 1996 to 46.9% in 1998 (p<.000001). Fifty-one (51) unique patient MRSA isolates from Sep 1998 were analyzed for strain-relatedness by contour-clamped gel electrophoresis (CHEF). Thirty-seven (37) of the 51 isolates displayed the R/C/V sensitivity pattern. Of the 37 with the R/C/V sensitivity pattern, 35 (94.6%) were the same strain type (strain 1) by CHEF analysis. In the remaining isolates, a second strain type (strain 2) was found in 10 patients. CHEF analysis revealed that strains 1 and 2 accounted for 68.6% and 19.6% of the 51 MRSA isolates. Further investigation revealed that 71.4% of strain 1 isolates were found in surgical service patients and 28.5% of medical service patients. Strain 2 isolated were more prevalent on the medical service (60.0%) than the surgical service (30.0%). Neither strain was confined to a particular patient care unit or specialty service. Not only did MRSA rates increase significantly in this 3-year period, but an extremely multidrug-resistant clone has become one of the two predominant MRSA strains in our institution as revealed by CHEF analysis.

CLINICAL AND MOLECULAR EPIDEMIOLOGY OF MRSA INFECTIONS OVER A 10-YEAR PERIOD. Trilla A, Marco F, Martinez JA, Salles M, Zaragoza M, Horcajada JP, Bayas JM, Soriano E, Jimenez de Anta MT. Hosp Clinic of Barcelona, Barcelona, Spain.

Nosocomial infections due to methicillin-resistant Staphylococcus aureus (MRSA) had been nearly unknown in large Spanish hospitals until 1989. On the third quarter of that year, most hospitals in Spain suffer outbreaks due to MRSA. The Hosp Clínic of Barcelona, a 850-bed public teaching hospital, has experienced one of the largest MRSA outbreaks, fully studied since its beginning. A total of 1,281 infected patients, plus 295 colonized patients and 133 HCW asymptomatic carriers were included in the outbreak. Peak incidence reaches 6.95 cases (infected patients) per 1000 admissions in 1991, declines to its lower level in 1995 (1.51 cases per 1000 admissions) and rises again up to 6.23 cases per 1000 admissions in 1998. Respiratory tract infection was the most common site of infection (28%), followed by bloodstream infection (12%). From 1989 to 1996, a single strain of MRSA (by REAP and DNA typing) was responsible for 95% of all cases. This original strain was multiple resistant, including resistance to aminoglycosides, erythromycin, tetracyclin, and rifampin. Since 1997, a second strain, now resistant to mupirocin (high and low resistance) but sensitive to rifampin was slowly replacing the original strain. At the end of 1998, the second strain fades, and currently, there is a wide variation among different strains. Control measures had included the isolation and cohorting of patients, screening for carriers among HCW, labeling of patient's medical records and many other measures of proved effectiveness. However, until the third quarter of 1999, we have not been able to reduce the endemic rates at our institution. The introduction of MRSA in a new environment offers the opportunity to study its evolution. Renewed efforts and new approaches to its control are clearly needed.

METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS IN AN OUTPATIENT DERMATOLOGY DAY CARE CLINIC. Van Horne E, Barry C, Kotowich L, Sibbald G, Vearncombe M. Sunnybrook & Women's College Health Sciences Centre.

The Dermatology Day Care Clinic (DDC) at Women's College Campus of SWCHSC is a tertiary referral centre for patients with extensive, chronic skin ulcers and wounds. The nature of these lesions, underlying comorbidities and repeated use of antimicrobials puts these patients at risk of acquisition of MRSA. In Jan 1999 an outbreak of MRSA on an inpatient medical unit was linked to a DDC outpatient. An MRSA prevalence screen of all DDC patients was conducted to determine the colonization rate and whether clinic specific risk factors existed. All patients were screened over a 3 week period in Mar 1999: 9 colonized patients were identified. Five were previously known positives whose risk factors were previous admissions to acute care facilities and contact with other MRSA positive patients. Of 4 previously unknown patients one was a nursing home resident, one lived in a retirement home which had no previous residents with MRSA and the remaining 2 lived in their own homes and had not been hospitalized in the previous year. The prevalence rate for the clinic was 11.4%. Typing by pulsed-field gel electrophoresis (PFGE) identified three distinct MRSA strains, A, B and C. Subsequent to the prevalence screening 3 additional cases of MRSA colonization have been identified by clinical isolates. All 3 cases were negative on prevalence screening and were identified by PFGE as being related to strains A and B indicating that transmission had occurred within the clinic. All new clinic patients are now screened for MRSA. Consistent use of Body Substance Precautions was reinforced with clinic staff, management of supplies was improved and waterless hand disinfectants were installed outside each treatment area to facilitate hand hygiene. There has been no further transmission following implementation of these measures.

FLUOROQUINOLONES ENHANCE THE EXPRESSION OF HIGH LEVEL OXACILLIN RESISTANT STAPHYLOCOCCUS AUREUS . Venezia RA, Damaracki BE, Evans AM, Preston KE, Raymo LL, Graffunder EM. Albany Med Center, Albany, NY.

The increase in MRSA has led to therapeutic problems such as the overuse of vancomycin. Albany Med Center is a 650-bed tertiary care center that experienced an increase in the incidence of MRSA. In the past 8 years, the rate of MRSA rose from 0.2 (1991-94) to 0.38 per 1,000 patient days (1995-98; p <0.0001). This change was not due to an increase in nosocomial transmission. It correlated with a continuous rise in fluoroquinolone use from 3.8 to 27.6 defined daily doses per 1,000 patient days (DDD) from 1995 to 1998 for IV and from 24.3 to 51.6 DDD from 1996 to 1998 for PO (r=0.85; p=.03). It was also significant by multiple linear regression analyses (p=.03). To study the effect of fluoroquinolones on the expression of mec encoded oxacillin resistance, 3 clinical strains of S. aureus were analyzed by population analysis profile of heteroresistant cells following exposure to ciprofloxacin. The strains were grown to 109 cfu/ml in tryptic soy (TS) broth. Broths contained either no drug (control) or 1/2 the MIC of ciprofloxacin. Serial dilutions were plated on TS agar with 2% NaCl and oxacillin ranging from 0.5 to 256 Tg/ml. Colonies were counted after 48 h at 37oC. Ciprofloxacin exposure increased the number of colonies that grew on agar containing oxacillin above the MIC. The increase was >200-fold at the higher concentrations of oxacillin when compared to the control. Similar results were observed following levofloxacin and trovafloxacin exposure. No changes in fluoroquinolone susceptibility or in mec negative strains were observed. The fluoroquinolones tested increased the proportion cells that were resistant to clinically significant concentrations of oxacillin. These data support the association of increased fluoroquinolone use and rising MRSA in our patient population in that fluoroquinolones directly enhanced the expression of high level oxacillin resistant S. aureus.

PREVALENCE OF MRSA IN COMMUNITY. Zafar AB, Beidas SO, Sylvester SK, Butler RC. Prince George's Hosp Ctr, Cheverly, MD; Natl Insitutes of Health, Bethesda, MD.

Once considered primarily a nosocomial, MRSA is now frequently acquired in the community and presents an elevated risk of morbidity and mortality. A retrospective review of medical records for patients with positive MRSA was performed at an acute care teaching hospital. There were 746 MRSA patients admitted to the hospital between Jan 95 and Jun 99. Forty-six percent (46%) were community and 54% were nosocomially acquired. Sixty seven percent (67%) were male and 78% were over the age of 50. Twenty-nine percent (29%) were admitted directly from nursing homes. Seventy-one percent (71%) had a history of prior antibiotic use. The most common isolation site was sputum (47%). The most common admitting diagnoses were sepsis or pneumonia with a combined total of 54% of patients in these categories. The most common comorbid factors were diabetes and hypertension with either one of the two being present in 42%. The average length of stay for patients above and below the age of 50 was 23 and 16days, respectively. Eighteen percent (18%) of the community acquired and 40% of the nosocomial patients were admitted to the Critical Care Ctr Males over 50 years, with admission to the Critical Care Ctr, transfer from a nursing home, diabetes and hypertension as comorbid factors, and a longer length of stay were at highest risk for an infection. The relatively high rate of community-acquired MRSA infections, especially from nursing homes, indicates that infection control awareness and education should be instituted outside the hospital.

Neonates/Children

NOSOCOMIAL INFECTIONS CONTROL IN A NEONATAL INTENSIVE CARE UNIT. Castro GH,* Casali A, Casimir L, Andion E, De Sarasqueta PJ, Manterola AC. Hosp de Pediatría J. P. Garrahan, Buenos Aires, Argentina.

Nosocomial Infection (NI), is one of the most important causes of morbidity and mortality in Neonatal Intensive Care Units (NICU). We are a national reference center and our NICU admits newborns (NB) with: cardiovascular and general surgery, prematures and NB with hipoxemic respiratory failure. Bloodstream infections (BSI) associated to central lines (CL) and viral respiratory tract infections (VRI) are the most frequent etiologies of NI. OBJECTIVE: To decrease the CL BSI and VRI with an intervention strategy. MATERIALS AND METHODS: We made a prospective study with 2731 NB in NICU from 1995-98; we followed the NNIS definitions; we analyzed the VRI rate/1000 patients-days (p/d) and the BSI infection rate/1000 CL-days, stratified in NB > and <1500g birth weight. The microbiological documentation was obtained by Maki semiquantitative technique for BSI and by IFI for VRI; the statistical analysis used was EPIINFO 6.04. The general intervention strategies were: Interdisciplinary work, 1/1 nurse-patient relationship for higher risk NB, appointment of an epidemiological nurse; for VRI, respiratory isolation in private rooms and cohortization of NB until discharge; for CL BSI, NB follow-up team. RESULTS: From 1996-98 the CL utilization mean was 52%(>90th percentile of NNIS); the CL BSI mean decrease from 22 to 5 event/1000 p/d (50th percentile-NNIS) (p=.00026), this decrease was more significant in NB<1500g: from 28 to 8 event/1000p/d (25-50th percentile-NNIS); the VRI rates decreased from 38.5 to 3.5 event/1000 p/d rate (p=.00008).The most frequent germs were Coagulase-negative staphylococci for BSI and Adenovirus (1995) and Respiratory sincytial virus (1998) for VRI. CONCLUSION: The implementation of an intervention strategy decreased VRI and CL BSI in a NICU.

INVESTIGTION AND CONTROL OF VANCOMYCIN-RESISTANT ENTEROCOCCUS IN A LEVEL III NEONATAL INTENSIVE CARE UNIT. DeSantis LJ,* Sturm LK, Thirumoorthi MC, Baran J Jr. St. John Hosp and Med Ctr, Detroit, MI; Univ of Michigan Hosps, Ann Arbor, MI.

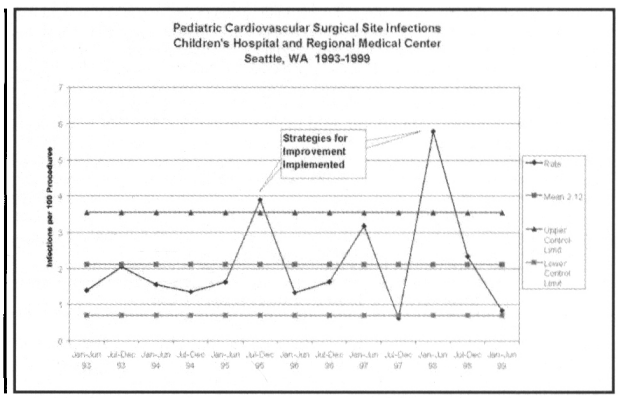
From Aug-Nov 1997, 15 newborns were found colonized or infected with vancomycin-resistant enterococci (VRE). VRE was previously unidentified in this 35-bed community teaching hospital neonatal intensive care unit (NICU). Upon discovery of a second case, a formal investigation began. Practice and environmental issues were identified, and immediate control measures included dedicated-staff case-cohorting; handwashing enforcement and use of PPE; equipment dedication; housekeeping changes; parental education on transmission prevention; and case coding for identification upon readmission. In addition, weekly surveillance stool cultures with pulsed field gel electrophoresis (PFGE) analysis and environmental culturing was performed. Six (6) isolates of E. faecalis and 11 E. faecium were identified. PFGE demonstrated 5 different (>3 bands) strains of E. faecalis and 11 related (1-3 bands) strains of E. faecium. However, 3 temporally related multi-baby clusters were identified with identical PFGE patterns. Only 1/67 environmental cultures grew VRE. By the end of Dec, 13 babies were discharged, 1 died, and 1 remained (isolation was stopped when 3 stool cultures were negative over 3 weeks). Persistent enforcement of basic infection control practices halted this cluster of VRE. Environmental sources played a minor role in this outbreak and PFGE suggested that VRE was introduced from multiple sources with limited nosocomial transmission. It is difficult to prevent hospital introduction of VRE as the community prevalence continues to rise. Infection control should focus on prevention of cross-transmission, community or nosocomial in origin, by emphasizing handwashing, PPE, and environmental cleaning. The NICU continues to be included in the active surveillance plan for the hospital.

HOSPITAL ACQUIRED INFECTIONS IN A PAEDIATRIC HOSPITAL: A SEVEN-YEAR PREVALENCE STUDY. Faoagali JL, Hohrmann R. Royal Brisbane Hosps Campus, Queensland, Australia; Royal Children's Hosp, Queensland, Australia.

The Royal Children's Hospital is the largest paediatric hospital in Queensland, Australia. Primary, secondary, and tertiary care is provided. Hospital-acquired infection prevalence is measured in mid-July (winter) each year. Demographic data collected includes age, gender, postcode, ward, specialty and length of stay as well as surgery this admission, immunosuppression and the presence of a device. The presence of a community acquired or hospital acquired infection (HAI) and its nature, antibiotic use, numbers of antibiotics in use, and the reason(s) for use were determined for each hospitalised patient. Ten volunteer data collectors were recruited and trained each year and data was analysed using EpiInfo 5.1. There were a decreasing number of inpatients each year, (1993,148; 1994, 150; 1995, 155; 1996, 163; 1997, 154; 1998,143; 1999, 121) and a virtually stable HAI rate (11.5%, 13.3% 9.0%, 11.0% 12.3%,) between 1993 and 1997. In 1998 and 1999 the rate halved (4.9%, 5.8%) because MRSA has been controlled. Around one third of all inpatients had community acquired infections on the survey day each year. In 1999 73 of the 99 (73%) non community ward inpatients had been in hospital for less than 7 days and there were no HAIs detected in this group compared with 7/26 (27%) of the patients who had been in hospital for eight or more days. Gastroenteritis, viral respiratory infections and IV line infections occurred most years and, until 1997, MRSA. This data enables the effectiveness of infection control strategies to be monitored and provides overt evidence of its efficacy.

BENCHMARK RATE OF PEDIATRIC CARDIOVASCULAR SURGICAL SITE INFECTIONS: A SEVEN-YEAR EXPERIENCE AT CHILDREN'S HOSPITAL, SEATTLE. Goodrich KM, Rubens CE, Cieri MV, Heath JA. Children Hosp and Regional Med Ctr, Seattle, WA.

BACKGROUND: Surgical site infections (SSI) are a significant cause of excess morbidity and mortality related to surgical procedures. While the incidence of SSI has been well studied in adults, no external benchmark rates exist for the pediatric population. Establishing an internal benchmark was necessary to set a threshold for triggering investigation of suspected outbreaks. OBJECTIVE: To establish a benchmark for nosocomial SSI in pediatric patients undergoing cardiovascular surgery. METHODS: A retrospective cohort study of children undergoing cardiovascular surgery in a free-standing pediatric tertiary care center over a 7-year period was conducted. Clinical and bacteriological information from 1,887 children was analyzed. SSI were defined using Ctrs for Disease Control criteria. RESULTS: Of 1,887 patients, 40 (2.12%) developed cardiovascular SSI (Skin 8, Soft Tissue 19, Organ/Space 13). S. aureus was identified as the pathogen in 25 cases (62.5%). Associated with the 40 infections were 33 events (defined as readmissions or additional procedures). DISCUSSION: 2.12% of study patients developed SSI. These infections did not increase mortality, but readmission and additional procedures were necessary in the majority of cases. Establishing this benchmark enabled infection control practitioners to recognize opportunities for improvement in SSI rates on two occasions, facilitating implementation of process improvement strategies with subsequent decreases in infection rates. CONCLUSIONS: Surveillance of cardiovascular SSI rates allowed the identification of suspected outbreaks and the implementation of interdisciplinary infection control practices that were effective in decreasing the rates of SSI. Benchmark rates of pediatric cardiovascular SSI from multiple centers are needed to define policy/practice changes that will improve the outcome of cardiovascular surgical procedures.



NOSOCOMIAL URINARY TRACT INFECTION IN A PEDIATRIC HOSPITAL: EPIDEMIOLOGY IN THE 1990S. Hanakowski M H, Langley J M IWK Grace Health Centre; Dalhousie Univ and IWK Grace Health Centre.

NUTI is the 3rd most common nosocomial infection (NI) pediatric intensive care units and urethral catheterization (UC) is thought to be the most common risk factor. We reviewed NUTI identified by Infection Control (IC) 1/91-12/97 in our university-affiliated pediatric hospital with 180 beds serving Maritime Canada (pop. 2 million). METHODS: Prospective surveillance was conducted on all wards 8/12 months/year (yr) with regular review of microbiology results. NUTI was defined by laboratory evidence (CDC, 1988) occurring > 48 hours after admission. UC in the previous 7 days was continuous/indwelling (CC) or intermittent (IC). RESULTS: NUTI was the 5th most common NI (134/1380; ~ 10 %) and decreased in frequency over the decade from 0.9 to ~ 0.6 cases/1000 patient days (3.9/1000 patient discharges overall.) Incidence was equal among males (62/134) and females (72/134). Only 56 % of cases had prior UC; 78% CC and 22 % IC. NUTI occurred disproportionately in newborns (17% of NUTI) who comprised 5% of hospitalized children and only 32% had prior CC or IC. Other age distribution of NUTI was >28 days,< 1 yr = 34 %, 5-11yrs = 12%, 11-16 yrs = 11%, 1-3 yrs = 10%, 3-5 yrs = 9%, > 16 yrs = 8%. The most common pathogen was E. coli (28 %; 38/132) followed by Candida species (18%; 24/134), Enterococcus (13%; 18/134), gram-negative nonfermenters (13%; 17/132), Enterobacter (~10%; 13/134), Pseudomonas (9.7%; 13/134) and other (16%; 22/134). Three secondary bacteremias occurred (2.2%). CONCLUSIONS: NUTI poses a less significant burden of illness (incidence, associated morbidity) than other NI in children. If resources do not permit hospital-wide surveillance, children with UC and newborns could be targeted. Fungi are the 2nd most common pathogens in this referral population. Risk factors for NUTI in non-catheterized children remain to be delineated.

NEONATAL NOSOCOMIAL CANDIDA INFECTIONS, REVIEW OF 49 CASES IN 10 YEARS. Kassis I, Makhoul I, Smolkin T, Tamir A, Sujov P. Rambam Med Ctr, Haifa, Israel.

BACKGROUND: Neonatal fungal infections (NFI) are common in neonatal intensive care unit (NICU). Management of NFI is problematic. METHODS: we retrospectively reviewed the charts of 4445 in NICU in the past 10 years, 49 neonates were detected. We compared their data with those of 49 controls without NFI. DETAILS: gestational, perinatal, neonatal course; previous bacterial sepsis; previous antibiotic therapy; laboratory and imaging investigations, site of, and anti-fungal therapy and complications. RESULTS: Incidence range of: 0.4 to 2 cases /1000 live births and 3.8%-12.9% in very low birth weight infants (VLBW). Compared to 1989-92, in 1993-95 the rate of NFI in VLBW neonates increased (3.8-5.6% to 9.6-12.9%)

p<.045), along with an increase of admissions (369-410 to 496-510 admissions/year) (p, .0001). NFI cases had significantly longer hospitalizations, higher rates of mechanical ventilation, umbilical vein catheterization, and previous treatment with amikacin, vancomycin, ceftazidime or imipenim-cilastin. At the onset of NFI 42.8% had Fever (>380 C), 40.9% had normal blood count. Candida (C) albicans was isolated in 42.8%, C. parapsilosis 26.5%, and C. tropicalis 20.4%. In 90% of cases Candida was isolated from blood and in 10% from other sterile sites. Amphotericin B was not stopped due to side effects, and no deaths occurred. CONCLUSIONS: (1) non-albicans Candida is becoming more frequent in NFI's. (2) Mechanical ventilation, umbilical vein catheterization and some antibacterial agents are independent significant risk factors. (3) Fever is a frequent presenting sign. (4) A normal WBC is not reliable. (5) The lack of deaths associated with neonatal candida infections in our NICU is remarkable.

SEPTIC ARTHRITIS AND OSTEOMYELITIS WITH EXTENDED-SPECTRUM KLEBSIELLA PNEUMONIAE IN CHILDREN. Kechrid A, Kaabachi O, Smida M, Thabet L, Ben Ghachem M. Hôpital d'Enfants de Tunis, Tunisie.

Sepic arthritis and osteomyelitis are commonly reported in children. About one hundred cases are reported every year at the orthopaedic unit of the children's hospital of Tunis. Staphylococcus aureus is frequently isolated. But, mutiresistant bacteria are emerging as a new involved pathogen. We reviewed the records of all children with septic arthritis and osteomyelitis followed up at our institution between Sep 1997 to Sep 1999. Extended-spectrum β-lactamase Klebsiella pneumoniae was isolated in five cases. There were 3 female and 2 male. All children were previously hospitalised and had received broad-spectrum antibiotics. Three neonates had developed during intensive care stay arthritis associated to infection of the adjacent bone. In the other case, infection involved both hip and femur of a 14 year old girl with sickle cell disease. In the remaining, septic arthritis developed in an infant hospitalised for pneumonia. All children had surgical drainage and intravenous antibiotics including imipenem and amikacin. They clinically improved within four weeks antibiotics.

MEASURES IMPLEMENTED TO IMPROVE VANCOMYCIN USE IN CHILDRENS HOSPITALS. Keyserling HL, Sinkowitz-Cochran RL, Levine GL, Jones SL, Siegel JD, Jarvis WR, The Pediatric Prevention Network . Emory Univ, Atlanta, GA; Ctrs for Disease Control and Prevention, Atlanta, GA; Natl Assn of Children's Hosps and Related Institutions, Alexandria, VA; Univ of Texas Southwestern Med Ctr, Dallas, TX.

Improving antimicrobial use is a major clinical and public health concern. In particular, the recent emergence of vancomycin resistance in enterococci and Staphylococcus aureus has led to Ctrs for Disease Control and Prevention recommendations to improve vancomycin use. Infection control and pharmacy personnel at children's hospitals have developed and implemented a variety of prevention interventions to improve vancomycin use. To characterize these interventions, we sent a survey to 65 Pediatric Prevention Network (PPN) member hospitals. Fifty-five (55, 85%) responded; 41/55 (75%) PPN respondents reported that they had implemented measures to improve vancomycin use (see Table). Many PPN participants reported implementing >1 measure: 15% of responding hospitals reported 1 measure; 15%, 2 measures; 34%, 3 measures; 19%, 4 measures; 10%, 5 measures; 5%, 6 measures; and 2%, 7 measures. Vancomycin use policies and practices varied widely from hospital to hospital and a variety or combination of interventions may be needed. Studies to evaluate the effectiveness of these measures also are needed so that recommendations can be made of the best methods to improve vancomycin use.

Measures to Improve Vancomycin Use

Practice guidelines	23	56%
Vancomycin use education program	20	49%
Automatic antibiotic stop orders	18	44%
Selected reporting of microbiology data	16	39%
Formulary restrictions	12	29%
Infectious disease approval	12	29%
Pharmacy approval	9	22%
Vancomycin initiation form	4	10%
Vancomycin renewal form	4	10%
Cyclic rotation of selected antibiotics	2	5%

INCIDENCE OF NOSOCOMIAL INFECTIONS IN A PAEDIATRIC POLYVALENT INTENSIVE CARE UNIT. Martin E, Tissot Guerraz F, Gillet Y, Floret D. Herriot Hosp, Lyon, France.

A discontinuous survey of nosocomial infections (IN), has been realized since 1996 in the paediatric intensive care unit, not neonatal (10 beds). Data were collected between Aug, 1998 and Mar, 1999. We have included all the children whose stay was at least 48 hours. Data about 195 children (median age: 2 years) were analyzed. The majority were admitted for medical pathology (72.3%), the others for post-surgery (19.5%) and 8.2 % for traumatology. 23 children were immunodeficients. We found 32 IN (16.4%) for 21 children (10.8%). 5 were immunodeficients and presented 10 IN. The median length of stay was 4 days for children without IN versus 13 days for the others (p<.0005). Methicillin-resistant Staphylococcus aureus is the most frequently detected microorganism, Gram positive microorganisms represent 48.7% and Gram negative 45.9%, Candida 5.4%. Median of the Paediatric Risk Score of Mortality of children with IN and without are 9 versus 5 (p=.004). We compare those data with those of two previous surveys.

Period	September 1997 - February 1998	September 1997 - March 1998	August 1998 - March 1999
Number of children included	119	166	195
% children with mechanical ventilation	64%	54%	53,4%
Number of IN pneumonia	6	4	1
Incidence of pneumonia	5%	2,5%	0,9%
IN pneumonia /1000 days ventilation	10	5	2,58
% children with a urinary catheter	52%	50%	47,4%
Number urinary tract infection UTI	8	9	9
Incidence of UTI	7%	5%	7,6%
UTI/1000 days of urinary catheter	20	16	21,6
Number of primary bloodstream	7	3	8
Incidence of primary bloodstream IN	6%	3%	5,9%
Primary bloodstream /1000 days central lines	17	7	14

NEONATAL BLOODSTREAM INFECTIONS IN VERY LOW BIRTH WEIGHT INFANTS. McDonald JV, Kaempf J, Church NB, Zabari M. Providence St. Vincent Med Center, Portland, OR; Kaiser Permanente NW, Portland, OR; Providence St. Vincent Med Center, Portland, OR; Providence St. Vincent Med Center, Portland, OR.

Providence St. Vincent Med Center (PSVMC) increased nursery acuity to a Level III NICU in Apr 1996 by combining the infants from an HMO medical center that had recently closed with the PSVMC infants. Neonatologists from both the HMO and PSVMC noted increased central line-associated bloodstream infections (22/1000 catheter days) for infants 1-1000 g during the third quarter of 1996. Comparing our data with the NNIS national rate for infants of like size provided comparative data against which to measure change. Meetings were held with nursing, neonatologists, nurse practitioners, pharmacy and infection control to review the literature and establish a plan for decreasing the rate of infection in this high-risk group. The Ten Step Plan was developed to address infection rates. The following procedures were standardized: skin preparation, frequency of line changes, changing the open hub needleless IV system, using a 2% chlorhexidine product, blood culture collections and dressing changes. Review of the plan was done with all staff and teaching was provided by one of the neonatalogists on proper dressing technique and handling of central lines. Data was provided to the NICU quarterly to monitor the change. Infections in the low birthweight population decreased with a mean of 3.74 compared to the NNIS mean of 12.18. This data is confirmed by the Vermont Oxford Network data that also has placed PSVMC as one of a few facilities in their lowest percentile for bloodstream infections. The use of the two databases has continued to reinforce the practice changes that were made to the NICU. The changes created a positive outcome for both the low birthweight infants and for the nursing and medical staff.

PREDICTIVENESS OF SURVEILLANCE FOR NOSOCOMIAL RESPIRATORY SYNCYTIAL VIRUS AND ROTAVIRUS. Mclaws ML, Barratt P, Caelli M, Dalton D. The Univ of New South Wales, Sydney, Australia; Lyell McEwin Health Service, Adelaide, Australia; New Children's Hosp, Sydney, Australia.

Pilot testing of the first standardised seasonally surveillance of nosocomially acquired respiratory syncytial virus (NRSV) and rotavirus (NRV) infection began in Australia in 1999. Surveillance commenced with the first detection of an index case of RSV in patients less than 24 months of age or surgical patients or immunosuppressed, or more than 28 days old for NRV. Surveillance for NRSV continued for 7 days from exposure to an index or NRSV case, or until the case was transferred/discharged. A definite NRSV case developed six or more days post admission or within 48 hours post-discharge. Surveillance for NRV continued after exposure to an index or NRV case for 3 days or until the case was discharged/transferred. A definite NRV case developed more than 72 hours after admission or within 24 hours post-discharge. To test the predictive value of the methodology all admitting and readmitting diagnoses of 'failure to thrive,' 'asthma,' 'sleep apnea,' 'acute bronchiolitis' or 'diarrhea' were examined for missed cases. Of 1498 seasonal admissions 8 patients were readmission with a diagnosis of 'acute bronchiolitis' who were considered missed index RSV cases. These missed index cases resulted in unaccounted RSV susceptible days. No index rotavirus, NRV or NRSV were detected. Lab confirmation date underestimates the at-risk days by 0.8 days for each NRSV and 0.3 days for each NRV. Of the 114 index RSV admissions one third were not confirmed resulting in an over-estimation of at-risk susceptible days.

RISK FACTORS FOR HOSPITAL ACQUIRED INFECTIONS IN NEONATAL INTENSIVE CARE UNITS. Moro ML,* Stolfi I, Carrieri P, Italian Study Group on HAI in NICUs. Istituto Superiore di Sanitá, Roma, Italy; Observatoir Regional de la Santè et INSERM, Marseille, France.

To identify risk factors for hospital acquired infections (HAI), we conducted a two-year multicenter study in 21 neonatal intensive care units (NICU) throughout Italy. Participants consisted of all newborns with a birth weight 1,750 g or suffering from major illnesses, who were followed for the duration of NICU stay. We collected data on demographic/clinical characteristics, severity of illness, care profile, antibiotic treatment, major hospital-acquired infections (CDC criteria), and hospitalization outcome. Hazard rate ratios were estimated using Cox proportional survival model. A total of 2,733 newborns were enrolled (2,799 total admissions). The incidence of major HAIs was 18.9 infected newborns/100 discharges; 24.6 infections/100 discharges; and 7.37 infections/1000 days of stay. Comparing newborns weighing 1,500g to those weighing more, the median incidence of catheter-related bacteremia in CVC-days was 12.6/1000 (range 1.3-39.5) and 9.8/1000 (0.0-52.1/1000), respectively; the incidence of ventilator-related pneumonia in ventilator-days was 3.15/1000 (0.0-34.3/1000) and 5.6/1000 (0.0-39.2/1000). The risk factors for sepsis and pneumonia that were significant (Cox model) only in the 1,500g group were Apgar <7, bronchopneumodysplasia, patent ductus arteriosus, and stay in an NICU with nurse understaffing. For the >1500g group, the only specific risk factor was cerebral hemorrhage. Risk factors common to both groups were mechanical ventilation, CVC, IV lipids, stay in an NICU with a high mean NTISS, and stay in specific NICUs. Factors with no independent association were high FiO2, high base excess, RDS, NEC, IVH, prolonged ROM, intubation and surfactant administration in the delivery room, age at first feeding, high NTISS in the first 24h of stay, and stay in a teaching hospital. This study demonstrates that, in addition to traditional risk factors (i.e., invasive procedures, clinical conditions), understaffing and unnec-

essary interventions increase the risk of HAIs in NICUs, whereas FiO2, base excess, and NTISS upon admission seem to have had no effect.

SURGICAL SITE INFECTIONS POST VENTRICULOPERITONEAL INSERTION IN A PEDIATRIC POPULATION. Olekson K, Embree J, Nicoll D. Health Sciences Centre, Winnipeg, Manitoba, Canada.

OBJECTIVE: To determine the surgical site infection (SSI) rate and infection risk factors following ventriculoperitoneal shunt (VPS) procedures and Salmon-Rickman Reservoir (SRR) insertions in a pediatric tertiary care facility. DESIGN: A retrospective and concurrent chart review of all patients having a VPS or SRR insertion or revision was done. Risk factors analyzed included duration of procedure, pre-operative antimicrobial prophylaxis, ASA score, surgical procedure classification, NNIS score, antimicrobial irrigation of ventriculoperitoneal shunt and hair removal. Evidence of SSI was followed or is being followed for one year post procedure. SETTING: A 125-bed tertiary care pediatric hospital. RESULTS: From Jan 1, 1997, to Jun 30, 1999, 71 patients (38 males, 33 females) underwent 116 VPS procedures or SRR insertions. There were 67 VPS or SRR insertions and 49 VPS revisions performed. Surgical classification of 4 (i.e., dirty procedure) was significantly associated with a higher risk of infection, 50% versus 17.3% (p=.04). Overall, 14 patients accounted for the 20 surgical site infections (SSI) for a SSI rate of 17.2 %. All 20 infections had organisms isolated in the cerebrospinal fluid. S. epidermis (n=10) and coagulase-negative Staphylococci (n=6) were the most predominant organisms. Other organisms included S. aureus (n=4), S. mitis (n=2), E. coli (n=1), and C. albicans (n=1). CONCLUSIONS: A surgical classification of 4 was a significant risk factor for a SSI following VPS and SRR procedures. Six patients had 2 SSIs each following their procedures which accounts for the relatively lower number of patients with SSIs. One-year follow-up in this population may identify further significant risk factors.

OUTBREAK OF NOSOCOMIAL PERTUSSIS IN A MEDICAL CENTER. Patrick M, Curtis M, Goldoft M, Gautom R, Kobayashi J. MultiCare Health System, Tacoma, WA; Washington State Dept of Health, Seattle, WA.

Infants have a high risk of death from infection with Bordetella pertussis. The infection is usually acquired in the community from adults. On Aug 24, 1998, NICU reported pertussis in a five-month-old premature infant that had never left the hospital. Investigation identified a respiratory therapist with pertussis. More than 200 staff and 23 exposed infants were screened and treated with antibiotics. On Sep 26, a second infant was diagnosed with pertussis. Investigation revealed he had been in the NICU in a bed adjacent to (5') the first case. This baby did not receive prophylaxis, as his overlap occurred before onset of symptoms in the first baby. All pediatric staff and volunteers were screened for pertussis and given prophylaxis. Thirty-three (33) employees had a coughing illness, three had PCR-confirmed pertussis. All symptomatic staff were placed on furlough until they had completed five days of antibiotics. Families of 230 potentially exposed pediatric patients were notified, as were the pediatricians and primary care providers in the community. Staff compliance with antibiotics was problematic. Rates of non-compliance were 27% for erythromycin, 10% for Trimethoprim sulfa; and 1% for Azithromycin. In NICU staff, non-compliance resulted in switching to azithromycin. No treated staff developed pertussis, and the outbreak ended.

CONTROL OF EXTENDED SPECTRUM b-LACTAMASE PRODUCING KLEBSIELLA PNEUMONIAE AT A NEONATAL INTENSIVE CARE UNIT IN RIO DE JANEIRO, BRAZIL. Pessoa da Silva CL, Moreira BM, Almeida VC, Sampaio J, Teixeira LM, Lins MCA, Miranda LEV, Gerberding JL. Univ. Federal do Rio de Janeiro, Brazil; Lab. Lamina, Rio de Janeiro, Brazil; Centro de Prematuros do Estado do RJ, Rio de Janeiro, Brazil; Univ. California San Francisco, San Francisco, CA.

After the detection of three cases of extended spectrum b-lactamase producing Klebsiella pneumoniae (ESBLKp) infection at a 26-bed neonatal intensive care unit in Jul 1997, a prospective cohort study was conducted to assess the risk factors for ESBLKp acquisition, from Aug 1997 to May 1999. Screening for ESBLKp colonization was performed by culturing rectal specimens on days 3 and 7 after admission, and once a week thereafter. Control measures included educational activities, contact precautions, 3rd generation cephalosporin use restriction and thorough environmental disinfection. Isolates were identified by biochemical tests and the Vitek system; susceptibility tests were done by the Vitek system. ESBL was detected by the double disk (DD) test. Chromosomal DNA was analyzed by pulsed field gel electrophoresis (PFGE) using XbaI. Pictures were interpreted with the Molecular Analyst Fingerprinting Plus System. The likelihood-ratio chi-square and two-tailed Fisher's exact test were used to test the associations found in the univariable analysis; variables with p<0.25 were then evaluated in a stepwise multivariate model. During the study period 250, newborns (14 cases of infection and 236 colonizations) out of 477 acquired ESBLKp. No cases of infection or colonization were detected since May 1999. PFGE analysis revealed that 19 out of 23 clinical isolates belonged to clonal group A. Among 27 fecal screening specimens, 7 genotypes groups were detected. The risk factors for ESBLKp acquisition were: length of hospital stay ≥7 days (RR=2.33; CI 95% 1.99 2.74; p<0.0001) birth-weight <1501 (RR=1.17; CI 95% 1.09 1.26; p<0.001); antibiotic use (RR=1.54; CI 95% 1.32-1.79; p<0.001); central line use (RR=1.29; CI 95% 1.15-1.45; p<0.001) and artificial ventilation (RR=1.10; CI 95% 1.02-1.19; p=0.015). The only variable independently associated to ESBLKp was length of hospital stay ≥7 days (OR=7.87; CI 95% 4.53 13.66). The infection control measures motivated by the epidemiological and molecular data were effective in controlling the outbreak.

NOSOCOMIAL INFECTIONS AMONG NEONATES IN NEONATAL INTENSIVE CARE UNITIN BRAZIL. Pessoa da Silva CL, Richtmann R, Calil R, Costa MLM, Frota ACC, Takagi NB, Santos RR, Wey SB. Univ Federal do Rio de Janeiro, Brazil; Hosp and Maternity Santa Joana, SP, Brazil; UNICAMP, SP, Brazil; Federal do Rio de Janeiro, Brazil; Univ Federal de Sao Paulo, Brazil.

Neonates are at high risk to acquire nosocomial infections (NI), which result in turn in additional morbidity and mortality. A two-year prospective surveillance of NI in seven NICU was performed. The relationship between NI and death was analyzed. The units are located in three cities, Rio de Janeiro, Sao Paulo and Campinas. The number of beds ranged from five to 55 (total number of beds=150). All neonates admitted were followed up to discharge. The infection control program in these units included surveillance of nosocomial infections, advice on the management of infectious syndromes and training of staff personnel on standard hospital infection control guidelines. The surveillance of NI was performed employing the high-risk nursery surveillance component adapted from the NNIS system. Infections that initiated up to 48 hours of life were categorized as hospital infections of maternal origin. Deaths were considered related to NI if it occurred during an active episode of infection. Among 4,888 newborns, 21.9% had at least one NI. Degrees of infection ranged from 50.6% in the ≤1000 g group to 12.3% in the >2500 g group (p<.01). The overall incidence density was 25.1 NI/1000 patient-days and 26.2% of all NI were maternally acquired. The main sites were bloodstream infection (50.8%) and pneumonia (13.1%). Among these sites, 39.2% and 46.2% were of maternal origin respectively. Gram positive coccus were the main pathogens accounting for 51.3% of all isolates, coagulase negative Staphylococcus ranked in first. Almost 30% of all deaths were considered related to NI. The incidence of central line-associated bloodstream infections (BSI) ranged from 34.9 (< or = 1000g group) to 17.6 BSI/1000 umbilical or central line-days in the >2500 g group. The device utilization (DU) for central lines ranged from 0.11 to 0.25. Rates of ventilator-associated pneumonias per 1000 ventilator-days ranged from 7.8 (< or = 1000g group, DU=0.34) to 8.31 (1000-1500 g group, DU=0.24). COMMENTS: Bloodstream infections were the most frequent nosocomial infections and should be a major focus for prevention measures. In addition, an unexpectedly high proportion of infections were of maternal origin, which may target strategies in perinatal care in Brazil, a country where 60% of deaths among children beyond the first year occur in the neonatal period.

RISK FACTORS FOR NON-COMPLIANCE AND PROMOTION OF HAND HYGIENE IN PEDIATRICS. Posfay Barbe K, Hugonnet S, Pittet D. Geneva Children's Hosp, Univ of Geneva Hosps, Geneva, Switzerland; Univ of Geneva Hosps, Geneva, Switzerland.

BACKGROUND: Hand hygiene (HH) prevents nosocomial infection. The incidence of infectious diseases is high in pediatric hospitals, and proximity of ® dirty ¯ and ® clean ¯ sites a reality, thus facilitating cross-transmission. Compliance to HH in pediatric settings has not been properly assessed. We investigated risk factors (RF) for non-compliance and assessed the impact of a promotion campaign. METHOD: We conducted biannual hospital-wide surveys from 1994 onwards, during which HCWs were observed while providing routine patient care. An ongoing intervention aiming to improve compliance to HH started after baseline survey. Main outcome measure was compliance to HH, whether handwashing or hand disinfection. FINDINGS: We observed 1,909 opportunities for HH distributed in 273 observation periods, totaling 93 hours of observation. Overall compliance to HH was 60%, and was lower in critical (56%) than in non-critical care units (64%, p<.001). It increased from 57 to 75% (p=.032) over the study period. Whereas compliance to handwashing decreased from 50 to 44% (p=.024), that associated with hand disinfection increased from 7.3 to 32% (p<.001). Compliance increased among nurses (p<.001), physicians (p=.055) and other HCW (p=.015), but remained stable among nursing assistants (p=.31). Compliance for low risk activities increased (p=.006) but remained unchanged for high risk activities (p=.9). Independent RF for non-compliance were: be a physician (OR 1.81, p<.001) or other HCW (OR 1.91, p=.008), activities associated with high risk for cross-transmission (OR 2.67, p<.001) and high activity (OR 1.02, p<.001). Even after adjustment for these variables, compliance increased over time (p=.049). CONCLUSION: Our intervention had a marked impact on compliance, attributable to the increased use of hand disinfection. Interestingly, even physicians improved their compliance. However, there is room for improvement, that calls for targeted interventions.

BLOODSTREAM INFECTION IN HIGH RISK NEONATES: A MULTICENTRIC STUDY. Richtmann R, Calil R, Pessoa da Silva CL, Costa MLM, Takagi NB, Frota ANC, Santos RR, Wey SB. Brazil/Santa Joana Hosp and Maternity-Sao Paulo, Brazil; Brazil/UNICAMP-Rio de Janeiro, Brazil; Brazil/ UFRJ-Rio de Janeiro, Brazil; Brazil/ UFRJ- Rio de Janeiro, Brazil; UNIFESP-Sao Paulo, Brazil.

BACKGROUND: According to the NNIS system, bloodstream infection (BSI) in high risk neonates (HRN) is the most important hospital infection (HI) in neonatal intensive care units (NICU). Almost all BSI are catheter vascular central/umbilical (CVC/U) related. OBJECTIVE: To analyze the extent and the etiology of neonatal BSI in three important areas in Brazil. METHODS: Seven NICU from different areas were analyzed in respect to BSI from 01/97 to 12/98. NNIS definitions were used and BSI were classified in three categories: BSI CVC/U -related, early BSI (= or <48 h of life, maternal related) and BSI non CVC/U related. RESULTS: From 4,488 HRN admitted in NICU, 1485 HI were notified (ID= 25.1 NI/1000 patient-days); 50.8% of that were BSI distributed as shown in the TABLE. 38.3% of BSI were microbiological confirmed. The most frequent pathogens were coagulase negative Staphylococcus (20.4%) followed by Enterobacter spp. (18.3%).The positivity of blood culture in the three categories were: BSI CVC/related 64%, early BSI 13.8% and BSI non CVC/U related 45%. Streptococcus agalactae were responsible from 50% of maternal origin BSI; CNS ((20.5%) and Enterobacter spp. (29.6%) were most involved microorganism in BSI CVC/U related and BSI non CVC/U related, respectively. CONCLUSION: In our study BSI is also the most important HI in NICU but the relation with CVC/U is not so important as NNIS suggests. Low positivity of BSI from maternal origin might be explained by two probable reasons: antibiotic use in mothers is extremely common in Brazil; and clinical overdiagnosis of neonatal BSI is surely present in our NICU. The pediatricians, as in other countries, prefer to be safe and when in doubt go to full antibiotic treatment. As expected, early BSI were associated to higher birth weight and real HI (>48 h of life) with lower birth weight.

BSI	<1000 (N)	1001-1500(N)	1501-2500(N)	>2500 (N)	Sum (N)
CVC/U rel	95	52	40	34	221
early	58	59	108	73	296
CVC/U non-rel.	55	94	86	33	238

EFFECT OF USING A NEEDLELESS INTRAVENOUS CONNECTOR, THE CLC2000, ON THE CATHETER-RELATED BLOODSTREAM INFECTION RATE IN A NEONATAL INTENSIVE CARE UNIT. Sabo BE, Topal JE*. Yale-New Haven Hosp, New Haven, CT; Yale-New Haven Hosp and Yale School of Medicine, New Haven, CT.

Yale-New Haven Hosp (YNHH) cares for over 1500 infants annually in its 46 bed neonatal intensive care unit (NICU). A prospective, observational cohort pilot study of a needleless intravenous connector, the CLC2000, used on central venous access devices, was undertaken to determine if the device affected the catheter-related bloodstream infection (CR-BSI) rate. YNHH Hosp Epidemiology performed routine surveillance for CR-BSI using

standard definitions and methods of the National Nosocomial Infection Surveillance System. Upon admission to the NICU, infants were assigned to alternating medical teams (team A and team B). A cross-over design was used to minimize bias in the diagnosis and treatment of CR-BSI. From 11/98 to 1/99, team A patients with a central line were assigned to use the device, and after a one month wash out period, team B patients with a central line used the device from 3/99 to 5/99. A total of 56 infants were assigned to the CLC2000 cohort and 58 infants were assigned to the control cohort. Neither mean and median birth weights nor the distribution of birth weights (<1000 g, 1000-1500 g, 1501-2500 g, and >2500 g) differed significantly between the two groups. Likewise, the number of total parental nutrition days, percentage of patients on antibiotics, the percentage of patients who received vancomycin, and percentage of patients who had blood cultures drawn did not differ significantly. The total number of device-days were similar in both groups and when stratified by birth weight class. A total of 11 CR-BSIs occurred; 5 in the CLC2000 cohort (rate: 5.6/1000 central line days) and 6 in the control group (rate: 6.6/1000 central line days) [p NS]. Ten of the 11 CR-BSIs occurred in the <1000 g birthweight category. The CR-BSI rates in this category were 9.2/1000 central line days and 14.5/1000 central line days for the CLC2000 and control cohorts respectively (p NS). The results of this pilot study of the CLC2000 indicate that this needleless intravenous connector did not increase CR-BSI rates and warrants further study in this high-risk population.

PROPOSED MODEL FOR PEDIATRIC INFECTION CONTROL PROGRAMS. Siegel JD, Bratcher D, Rubens CE, Brady MT, McMahon L, Metcalf PJ, Stover B, 1997 IC Focus Group Affiliation/Org. Univ of Texas Southwestern Med Ctr, Dallas, TX; Univ of Louisville, Louisville, KY; Univ of Washington, Seattle, WA; Ohio State Univ, Columbus, OH; Natl Assn of Children's Hosps and Related Institutions, Alexandria, VA; Children's Med Ctr of Dallas, Dallas, TX; Kosair Children's Hosp, Louisville, KY; Infection Control Focus Group, Alexandria, VA.

To reduce cost and consolidate services, hospital reengineering plans may include downsizing infection control (IC) program (PROG) without appreciation for direct and indirect cost-savings provided by IC. We developed a model for pediatric (PED) IC PROG that is based on the IC needs of children and the current structure of healthcare delivery systems. Unique characteristics of the PED population include: (1) increased prevalence of community-acquired infections, e.g., viruses, resistant S. pneumoniae, MRSA; (2) increased susceptibility to infection due to immaturity of the immune system; (3) interrelationship between behavior and environment that results in increased staffing requirements and facilitates transmission of infection; (4) increased antibiotic use; (5) congregation of large groups of infants and children in off-site medical clinics and day care facilities; (6) prolonged survival of high acuity patients who require complex invasive technological support. The salient components of the proposed model include: (1) decentralization with assumption of responsibility for IC by all healthcare workers; (2) designation of IC nurse liaisons on clinical units; (3) direct reporting of the IC practitioner to a senior patient care services administrator; (4) active participation of the hospital epidemiologist trained in PED infectious diseases; (5)ongoing communication across the continuum of care; (6) access to information systems that link microbiology laboratory, pharmacy, IC data, and patient demographics; (7) active participation in employee health and facilities development/renovation programs. An impact assessment survey distributed to the 19 Natl Assn of Children's Hosps and Related Institutions IC focus group 1997-99 participating hospitals indicated that the model was most beneficial for implementation or expansion of an IC nurse liaison program.

ASSESSMENT OF VANCOMYCIN USE IN PEDIATRICS: THE STRENGTHS OF NEW TECHNOLOGY AND THE WEAKNESSES OF PHARMACY DATA SYSTEMS. Sinkowitz-Cochran RL, Keyserling HL, Stein GP, Levine G, Jarvis WR, The Pediatric Prevention Network. Ctrs for Disease Control and Prevention, Atlanta, GA; Emory Univ, Atlanta, GA; National Association of Children's Hosps and Related Institutions, Alexandria, VA.

Increased use of vancomycin over the past ten years has been associated with the emergence of vancomycin-resistant organisms, such as enterococcus and staphylococcal species. National data on vancomycin use in the pediatric population are lacking. We sought to assess vancomycin use at U.S. children's hospitals and determine the pediatric populations in which vancomycin is administered. A Web-based survey was distributed to 57 member hospitals of the Pediatric Prevention Network. The survey was structured to collect summary statistics on vancomycin use and admissions data by service for 1997 and 1998; 24 hospitals had these data. As of Oct 1999, 15 hospitals completed the survey. Six (40%) hospitals completed the survey on the Internet. Reporting of archived vancomycin use varied: 7 (47%) hospitals reported total doses dispensed from the pharmacy; 1 (7%) reported total doses given to the patient; 2 (13%) reported unit doses dispensed; 2 (13%) reported vials dispensed; and 3 (20%) reported other measures. The distribution of vancomycin use varied by service and year. The majority of vancomycin use for 1997 was on the hematology/oncology (15%), neonatology (14%), neurosurgery (13%), general pediatrics (12%), and cardiothoracic surgery (8%) services. In contrast, the majority of vancomycin use for 1998 was on the neurosurgery (14%), general pediatrics (14%), neonatology (12%), hematology/oncology (11%), and bone marrow transplant (9%) services. A strength of our study was the use of Internet technology which facilitated a more efficient evaluation of vancomycin use (i.e., data were instantly stored and available in a database; basic data entry errors [e.g., non-numeric data] were detected before the data were sent). Our study also illustrates the weaknesses of using current pharmacy databases that are not standardized across hospitals nor systematically validated. Despite these limitations, our data show that the majority of vancomycin use was primarily on subspecialty service patients and education and interventions should focus on these groups.

NOSOCOMIAL OUTBREAK OF MULTIDRUG-RESISTANT SALMONELLA INFANTIS BACTEREMIA IN NEONATES. Toscano CM, Pessoa da Silva CL, Santos AL, Falcao M, Campos E, Amorim E, Solari C, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Univ Federal do Rio de Janeiro, Rio de Janeiro, Brazil; Instituto Municipal da Mulher Fernando Magalhaes, Rio de Janeiro, Brazil; Universidade do Rio de Janeiro, Rio de Janeiro, Brazil.

BACKGROUND: Salmonella infantis (SI) has not been reported previously to cause nosocomial bacteremia. We describe an outbreak of multidrug-resistant SI (MRSI) in a neonatal unit (NU) at Hosp A associated with high mortality and cost. During Jul 98-May 99 (outbreak period), when 163 NU patients had positive cultures for MRSI (136 stool, 27 blood), an investigation was initiated. METHODS: A case-patient was defined as any NU patient with positive MRSI blood culture and clinical infection during the outbreak period. Case-patients, identified by microbiology review, were compared to randomly selected asymptomatic NU patients without bacteremia (controls). Selected environmental cultures were performed. Observational studies were conducted to assess infection control practices (ICP). To evaluate the relationship between staffing and infection rates, monthly nursing-hours/patient-days (NH/PD) ratios were determined. RESULTS: Twenty seven (27) case-patients were identified; 9 (33%) died. A culture prevalence survey revealed 51 MRSI-colonized patients. Case-patients had lower gestational age (32 vs 34 weeks, p=0.003), more intravenous catheter (IVC) manipulations in the 48 hrs before infection (6 vs 0, p=0.01), and were more likely to have an IVC (OR 4.76, p=0.006), or to receive a blood transfusion (OR=21.9, p<0.001). Environmental cultures grew MRSI from multiple sites. The median NH/PD ratio was 8.4. Several breaks in ICP, including inadequate cleaning and handwashing were identified. Hospital stay (38 vs 24 days, p=0.01) and cost (US$2,027 vs 994, p=0.003) were higher in case-patients than in controls. Prompt case identification, cohorting of colonized patients, enhanced staff handwashing, and environmental cleaning terminated the outbreak. CONCLUSIONS: Our results demonstrate that strict adherence to ICP and cohorting were effective in controlling this nosocomial MRSI outbreak. In international settings, attention should be paid to nursery overcrowding and understaffing as they can adversely impact patient morbidity, mortality, and hospital cost.

MATERNAL VARICELLA-ANTIBODY TITER IS THE MAJOR DETERMINANT OF NEONATAL TITER, NOT GESTATIONAL AGE OR BIRTH WEIGHT. Van der Zwet WC, Zaaijer HL, Cranendonk A, Ree EF, Vandenbroucke-Grauls CMJE. Univ Hosp 'Vrije Universiteit', Amsterdam, The Netherlands.

BACKGROUND: Premature neonates <28 weeks of gestational age (g.a.) or <1000 g birth weight (b.w.) are considered at risk for infection with the Varicella-zoster virus (VZV). According to the CDC these neonates should be protected by VZV immunoglobuline (VZIG) i.m. if exposed to VZV. We studied which neonates might be protected naturally by maternal VZV antibodies. METHODS: With a calibrated commercial IgG anti-VZV ELISA (Vidas, BioMerieux) levels of VZV- Ab were determined in postnatal serum samples of 191 premature (appropriate and small for g.a.) and mature neonates (range of b.w.: 600-4800 g; range of g.a.: 25 3/7- 42 3/7 weeks). In 42 of 191 cases a maternal sample was available for quantitative detection of VZV-Ab. In 33 cases follow-up samples of the neonate were available; 13 of these series (comprising 3 or more samples) could be used to calculate the half-life time (T1/2) of neonatal VZV-Ab. RESULTS: The average T1/2 of neonatal VZV-Ab was 21.9 days (range: 14.8-27.8). This T1/2 was used to calculate the theoretical VZV-Ab level at day 0 for each child. The day 0 level was then analyzed for correlation with b.w., g.a. and maternal VZV-Ab levels. Neonatal VZV-Ab levels at birth did not correlate with b.w. or g.a. ($R2 <= 0.01$; $p > 0.1$), but correlated strongly and significantly with maternal VZV-Ab level ($R2=0.79$, $p << 0.001$). When the neonatal/maternal VZV-Ab ratio was used, instead of the absolute neonatal VZV-Ab level, a weak but significant correlation with b.w. and g.a. was found ($R2=0.27$ resp. 0.30; $p < 0.001$). CONCLUSIONS: The half-life time of IgG in neonates is identical to that of adults. The maternal VZV-Ab level, and not b.w. or g.a., determines whether a neonate has protective VZV-Ab levels. Hence the CDC criteria for administration of VZIG to neonates must be reconsidered.

Non-infectious Adverse Events—Abstracts in this category appear in Am J Infect Control *February 2000.*

Other Antimicrobial-Resistant Organisms

ARE WE FACING OUR "LAST STAND"? A NOSOCOMIAL OUTBREAK OF AN ACINETOBACTER SP DEMONSTRATING EXTENSIVE RESISTANCE TO ALL APPROPRIATE LICENSED ANTIBIOTICS. Allworth AM,* Faoagali J, Siebert D, Geary J, Geary A, Woods M, Bodman J, Wyer C. Royal Brisbane Hosp, Brisbane, Queensland, Australia; Royal Brisbane Hosp Campus, Brisbane, Queensland, Australia.

In June 1999, an isolate of Acinetobacter sp. was identified in a patient in the Intensive Care Unit of our hospital that was resistant to all antibiotics routinely tested. This included all extended-spectrum penicillins, cephalosporins, aminoglycosides (gentamicin, tobramycin, and amikacin), as well as aztreonam, carbapenems (imipenem/meropenem), ticarcillin-clavulanate, piperacillin-tazobactam, cotrimoxazole and ciprofloxacin. Subsequently, to date there have been a total of 15 patients found to be colonised with this organism. Further testing of the isolates has indicated variable resistance to netilmicin and ampicillin-sulbactam (not currently licensed in Australia), and suggests possible sensitivity to colistin/polymixin-B. All except one of the patients involved have been accommodated in the Intensive Care Facility and/or the Burns Unit, and all except two were admitted with severe burns. Patients have been both colonised and infected with these organisms, with 3 patients having bacteraemias, which were predominantly cannula-related. The mean time from admission to isolation of the organism in these patients has been 26 days (median and mode 18 days). Examination of isolates utilising pulse field gel electrophoresis has demonstrated this predominant extensively resistant clone, with other clones demonstrating a number of resistance patterns and also demonstrating the potential for transmission in these units. Epidemiological investigations are ongoing, but thus far have failed to reveal a common source or vector. Environmental sampling has revealed significant contamination of the environment with the organism despite routine cleaning procedures. Strict infection control procedures have been instigated and appear to have been at least moderately successful in limiting spread of the organism. The results of ongoing investigations will be presented.

PROJECT SNARE, A COLLABORATIVE STRATEGY FOR COMMUNITY SPECIFIC SURVEILLANCE FOR ANTIBIOTIC RESISTANCE. APIC Dade County. APIC Dade County, Inc., Miami, FL.

OBJECTIVE: Project SNARE-is a community specific, laboratory based surveillance network for assessing and detecting antibiotic resistance and epidemiology of emerging pathogens through the collaborative efforts of infection control practitioners. METHODS: Baseline (1996-97) community specific resistant trends were established by aggregating antibiograms collected from nine area hospitals and two long term care facilities. Data was collected and analyzed for "select" organisms. Applicable results were compared with isolates from sterile sites collected during the initial 14 months of the Florida Sentinel Surveillance for Antibiotic Resistance Project. Antibiograms were again collected in 1998 to document shifting trends and emerging pathogens. Both sets of data were compared with results of the NNIS SAR Jun 1999. RESULTS: Among gram positive isolates from the base-

line study, community specific resistant trend (ORSA-38%, VRE-54, and PRSP-23%) paralleled or exceeded state and national results. Data from sterile sites were ORSA-25%, VRE-3.3% and PRSP-39%. Quinolone resistance among the Enterobacteriaceae ranged from 3% (K. pneumoniae) to 78% (P. stuartii). Quninolone resistance for P. aeruginosa was 28%. Increased resistance (1998) compared with baseline was observed for (ORSA-42%, ORCNS-61%, and PRSP-38%). NNIS resistant data were highest for ORCNS (86% vs 39% vs 63%) and E. cloacae (36% vs 23% vs 29%). CONCLUSIONS: Aggregated laboratory based data may serve as a resource and possible "benchmark" for detecting community specific antibiotic reistance. This is a project of APIC Dade County.

MOLECULAR DIVERSITY AMONG ENTEROBACTER AEROGENES STRAINS PRODUCING EXTENDED SPECTRUM β-LACTAMASES AT A UNIV HOSPITAL. Berrouane Y, Courcol R, Sirot D, Pfaller M, Jones R, Roussel-Delvallez M. Univ Hosp, Lille, France; College of Medicine, Clermont-Ferrand, France; Univ of Iowa College of Medicine, Iowa City, IA.

In our institution, Enterobacter aerogenes (EA) strains producing extended spectrum b-lactamases (ESBL) emerged after 1995. Previously, strains of Klebsiella pneumoniae producing ESBL (KP+) were the most prevalent. However, in 1998, the incidence density rate of non-repeat isolates/1000 patient days was 0.15 for KP+ versus 0.23 for EA producing ESBL (EA+). To further characterize this emergence, we performed molecular typing of 37 EA+ isolates obtained from 28 patients who were hospitalized in intensive care (ICU), surgical, medical, rehabilitation and long term care units. After DNA digestion with XbaI, fragments were separated by pulsed field gel electrophoresis (PFGE). The EA+ isolates belonged to 3 DNA types (A, B, C). Two control isolates exhibited unrelated patterns. Patterns of duplicate isolates from individual patients were identical. Type A was the most prevalent (25 isolates classified into 8 subtypes). Types A and C included isolates from different units whereas the 8 type B isolates were obtained from one ICU. The β-lactamases of 9 isolates were characterized using isoelectric focusing. Three ESBL (TEM-3, TEM-24, and SHV-4) were found, suggesting that each clone had a different plasmid. Heterogeneity among EA strains was further confirmed when six bacteremia isolates were included to the SENTRY program in 1999. Based on ribotypes and ribotype/PFGE composite patterns, the 4 EA+ isolates were considered different. In contrast to the high molecular homogeneity characterizing multi-drug resistant (MDR) Staphylococcus aureus strains, emergence of MDR EA is based on different clones. This indicates that the nosocomial transmission of resistant ESBL organisms originated from different reservoirs among Enterobacteriaceae.

RISK FACTORS FOR AND METHODS TO CONTROL COLONIZATION WITH EXTENDED-SPECTRUM β-LACTAMASE PRODUCING ENTEROBACTERIACEAE. Bisson GP, Lautenbach E, Brennan PJ, Fishman NO. Univ of Pennsylvania Med Center, Philadelphia, PA.

Risk factors for and effective methods to control colonization with extended-spectrum β-lactamase producing enterobacteriaceae (ESBL-EB) remain unclear. We conducted an unmatched case-control study comparing 13 patients with ESBL-EB colonization (ESBL-EBC) to 46 randomly selected non-colonized patients to identify risk factors for ESBL-EBC. The patients with ESBL-EBC were identified during three separate surveys conducted over a 10-month period. Univariate analysis identified duration of hospitalization prior to stool survey (23 vs 8 days, p=.01), total prior antibiotic exposure (23 vs 8 antibiotic-days, p=.02), and admission from another institution (62% vs 26%, p=.02) as risk factors for ESBL-EBC. Multivariable analysis revealed the duration of hospitalization to be the strongest predictor of ESBL-EBC [OR(CI95)/5d=1.29 (1.06,1.57); p=.01]. Of note, presence of malignancy was protective [0.05 (0.01,0.58); p=.02]. of the cases received a late-generation cephalosporin (LGC) in the preceding month, nor were there any associations between the use of specific antibiotics and ESBL-EBC. Colonization rates following formulary changes limiting the use of LGC designed to control an ongoing ESBL-EB outbreak were not significantly lower than rates prior to the intervention [1.43 (0.49,4.17); p=.51]. However, 8 cases (62%) had been admitted from other institutions. In summary, we found that duration of hospitalization is the strongest independent risk factor for ESBL-EBC. The lack of an association between antibiotic use and ESBL-EBC as well as the protective effect of underlying malignancy suggest that the risk factors for infection and colonization may differ substantially. This may explain the failure of formulary interventions to impact upon ESBL-EBC, while this method has been moderately successful in controlling infection. Finally, the large number of patients with ESBL-EBC from other institutions suggests that greater emphasis must be placed on the potential for spread of these organisms between healthcare facilities.

USE OF WHONET SOFTWARE AND ELECTRONIC COMMUNICATION FOR MONITORING ANTIMICROBIAL RESISTANCE: PRELIMINARY RESULTS FROM RUSSIA. Brown SM, O'Brien T, O'Rourke EJ, AIHA WHONET Collaborating Surveillance Group. Harvard Med School, Boston, MA; American International Health Alliance, Washington, DC; and various institutions in Russia.

Antimicrobial resistance is an enormous problem worldwide. Little is known about the state of resistance in the former Soviet Union (FSU). As part of our infection control (IC) initiative, we are installing a translated version of WHONET software in hospitals in the FSU for use in clinical reporting and analysis. Seven sites have been in operation for more than two years and have provided early experience. At those sites, all routine testing and quality control (QC) results are entered into the WHONET files. Data from the most active laboratory provide a preview of resistance at a large, multi-profile hospital in Western Russia. Resistance (%R) rates for Jan 1998-Sep 1999 inclusive: S. aureus: oxacillin 6% (N=665). S. pneumoniae: oxacillin 51% (N=74); erythromycin 27% (N=49); tetracycline 58% (N=48). P. aeruginosa: ceftazidime 19% (N=406); carbenicillin 77% (N=176); gentamicin 67% (N=319); tobramycin 65% (N=317); amikacin 15% (N=405). K. pneumoniae: gentamicin 37% (N=87); tobramycin 43% (N=88); amikacin 13% (N=99); cefotaxime 24% (N=88); ceftazidime 14% (N=98); ciprofloxacin 20% (N=88). E. coli: gentamicin 15% (N=531); tobramycin 20% (N=532); amikacin 12% (N=667); cefotaxime 7% (N=532); ceftazidime 6% (N=665); ciprofloxacin 6% (N=533). Continuing collaborative evaluation of data from all centers, initially via videoconferencing with document-sharing, but increasingly by electronic mail and file transfer (for long-term sustainability), provides the basis for continuous quality improvement, including testing problems, sample selection, interactions with infection control, and dissemination of resistance data to local clinicians. This initiative has provided access to key data previously unavailable for clinical or IC use.

EMERGING INFECTIONS AND THE EPIDEMIOLOGY OF IOWA ORGANISMS: A STATEWIDE ANTIMICROBIAL RESISTANCE SURVEILLANCE PROGRAM. Brueggemann AB, Rhomberg PR, Wingert EM, Huynh HK, Coffman SL, Jones RN, Pfaller MA, Doern GV. Univ of Iowa College of Medicine, Iowa City, IA.

The purpose of this study was to define the prevalence of antimicrobial resistance in the State of Iowa. In what is the first systematic statewide surveillance program of its kind in the U.S., 15 medical centers were chosen based upon geographic location and population distribution. Centers submitted the first ten unique patient isolates of the following species per quarter: E. coli (EC), K. pneumoniae (KPN), E. cloacae (ECLO), P. aeruginosa (PSA), S. aureus (SA), Enterococcus spp. (ENT), S. pneumoniae (SPN), H. influenzae (HFLU) and yeast species (YST, bloodstream only). Selected clinical and demographic data was collected for each isolate. A total of 4,328 isolates were collected from Jul 1, 1998-Jun 30, 1999 and mailed to the Univ. of IA, where isolate identification was verified and reference (NCCLS) broth microdilution susceptibility testing performed. Key resistance ® rates/mechanisms were noted with each isolate: EC (n=606), ampicillin®(32.7%), cefuroxime® (2.1%), ciprofloxacin® (1.0%), ampC® (0.8%), ESBL (0.0%); KPN (n=555), ticarcillin® (72.1%), cefuroxime® (1.8%), ciprofloxacin® (1.4%), ampC® (0.0%), ESBL (0.0%); ECLO (n=406), piperacillin® (12.3%), cefuroxime® (38.4%), ciprofloxacin® (3.4%), ampC® (14.0%); PSA (n=585), piperacillin® (5.6%), ceftazidime® (7.9%), imipenem® (2.7%); SA (n=616), oxacillin® (27.1%), quinupristin/dalfopristin® (0.0%), vancomycin® (0.0%); ENT (n=598), vancomycin® (5.5%), quinupristin/dalfopristin® (78.6%); SPN (n=470), penicillinI+R (36.8%), erythromycin® (28.7%); HFLU (n=403), β-lactamase positive (41.9%); YST (n=89), amphotericinB® (6.7%), fluconazole® (4.5%), itraconazole® (7.9%). Ongoing antimicrobial resistance surveillance in Iowa will provide important data and assist in antimicrobial resistance control efforts.

PILOT SURVEY OF NOSOCOMIAL ACINETOBACTER SPECIES INFECTIONS AT A UNIVERSITY HOSPITAL. deShazo M, Oldenquist G, Shah P, Nolan R.* Univ of Mississippi School of Med, Jackson, MS.

As part of a pilot study investigating the epidemiology of Acinetobacter species at a 650-bed tertiary referral teaching hospital we collected clinical data on 39 patients infected or colonized over a 13-month period. Data collected included demographics, underlying diseases, presence in an intensive care area, use of invasive devices, prior receipt of antibiotics, site of isolations, and outcomes. Mean age of patients was 38 years; 28 (72%) were male. Mean length of stay was 37 days. Mean length of stay prior to first isolation of Acinetobacter was 23 days with mean 10 days antibiotic therapy prior to first isolate. There were 19 isolates from sputum and 5 isolates from blood; 21 (54%) had undergone mechanical ventilation and 24 (71%) were present in an intensive care area prior to isolation; 11 (28%) received steroids and 29 (74%) received H2 antagonists. Mean Apache 2 score at time of first isolation was 12.5. Seven (18%) died. Strain identification via pulsed field gel electrophoresis of banked isolates is in process. Isolation of Acinetobacter sp. occurred predominately in severely ill patients with prolonged hospitalization in intensive care units who received prolonged courses of antibiotics. Based on these findings a case control study focusing on patients in intensive care is planned.

THE EMERGENCE OF STAPHYLOCOCCUS HOMINIS VAR. NOVOBIOSEPTICUS AS A NOSOCOMIAL PATHOGEN. Durra IH, Nahvi MD, Fitzgibbon JE, Dubin DT, John JF. Robert Wood Johnson Med School, New Brunswick, NJ.

Different species of coagulase-negative staphylococci (CNS) continue to emerge as important nosocomial pathogens. Recently, S. hominis was subspeciated into var. hominis hominis (Shh) and var. hominis novobiosepticus (Snb). We first noted Snb as a pathogen in 1994, when it was incorrectly speciated as S. equorum. In 1996, we studied a collection of 200 CNS from central New Jersey; of 5 S. hominis isolates, all were Snb and all were ciprofloxacin resistant, and 1 was additionally trovafloxacin resistant with mutations at gyrA 84 (S84F) and grlA 80 (S80Y) and grlA 84 (D84N) (Antimicrobial Agents and Chemotherapy 1999,43:1631-37). From 1/1998 to 7/1999, we studied the microbiologic traits of 11 strains and clinical characteristics of 14 patients with multiple blood stream isolates of Snb. All 11 strains contained one or more copies of the mecA gene by PCR determination; 8 of 11 grew on novobiocin agar (4 µg/ml), and all 11 were ciprofloxacin resistant. Of 14 patients, 11 (79%) were located in an intensive care unit; 10 patients (71%) had major concurrent infections; 13 (93%) were exposed to at least one antibiotic (range 1-5) prior to the isolation of Snb, including 6 (43%) who received vancomycin; and 11 (79%) had central venous catheters at the time of Snb isolation. The average interval between admission and Snb isolation was 16 days (range 1-30). Four patients (29%) died during the same hospitalization. Three patients (21%) with clinical evidence of catheter-related infection at the time of Snb isolation improved significantly after removal of the catheter. We conclude that Snb is a newly emergent, multiresistant, nosocomial pathogen. Further studies should focus on microbiologic and clinical differences between Snb and Shh, pathogenic mechanisms of Snb and the further expansion of its antimicrobial resistance.

STAPHYLOCOCCU HAEMOLYTICUS, A NEW PROBLEM MICROORGANISM? Faoagali JL, Bodman J, Nuttall NN. Royal Brisbane Hosps Campus, Queensland, Australia.

Staphylococcus haemolyticus is a coagulase negative staphylococcus that is β-haemolytic on horse blood agar, and can be identified by disc sensitivities to colistin, novobiocin and bacitracin and resistance to phosphomycin and desferrioxamine. It is PYR positive and does not produce urease or clumping factor. Three published European studies have shown that this organism causes about 10% of coagulase negative bacteraemias and 9% (9/95) of these isolates had MICs to teicoplanin of equal to or greater than 16 mg/L. Two separate isolates of S haemolyticus with MICs of 256 mg/L to teicoplanin and MICs of 4-6 mg/L to vancomycin were recently isolated here from a central venous catheter tip from and ICU patient and from peritoneal fluid from a patient on CAPD. Both patients had been exposed to vancomycin but not to teicoplanin and a case control study confirmed the association of vancomycin with the isolation of these organisms. No other glycopeptide resistant S haemolyticus isolates have been found subsequently on other patients or in the environment. S. haemolyticus makes up about 10% (20/220 per year) of the coagulase negative staphylococcal isolates from blood cultures here but no glycopeptide resistance has been found in these isolates over the past three years. Ongoing surveillance is essential to monitor the emergence of these resistant strains.

DECREASING THE ANTIMICROBIAL SUSCEPTIBILITY OF NOSOCOMIAL BACTERIA IN RIBEIRAO PRETO, BRAZIL. Fonseca SNS, Kunzle SRM, Candido R, Carloni MC, Lopes D. Hosp Sao Francisco e do Coraçao, Ribeirao Preto, Brazil.

Despite our antibiotic restriction policies, we have noticed the increasing resistance of Enterobacter spp., Pseudomonas spp. And E. coli, the most commonly isolated bacteria in our 180-bed general hospital, to several antibiotics (ab). We studied the susceptibility of these bacteria (colonization and infection) to different ab using the Kirby-Bauer method and reported here the % of susceptibility of these strains to amikacin (amik), ceftazidime (cefz), ciprofloxacin (cip), cefalotin (ceft), imipenem (imp), in 2 periods: Aug 96 to Aug 98 (I) and Sep 98-Aug 99 (II). We also determined the consume (mg/1000 pt-days) of amik, 3rd generation cephalosporins, and cip. The % of susceptibility was compared using the chi-square test, a p< 0,05 was considered significant. Four hundred and eighty-eight (488) strains of Enterobacter spp. (225), Pseudomonas spp. (132) and E. coli (131) were studied. Comparing periods I to II, there was a significant decrease of the susceptibility of Enterobacter spp. Strains to amik (76% to 48%), cefz (71% to 48%) and cip (91% to 50 %). The susceptibility of Pseudomonas spp. Strains to amik (81% to 64%), cefz (81% to 43%), and cip (85% to 57%) also decreased significantly. E. coli strains remained very susceptible to amik, cefz and cip (between 90% to 100% susceptible), but the susceptibility to ceft decreased from 68% to 37%, although not significantly (p=0.08). The susceptibility of these strains of bacteria to Imipenem remained around 95% to 100%. Consume of 3rd generation cephalosporins increased steadily from 46.6 in 1996 to 63.15 (1997), 79.4 (1998) and 116.97 (1999); cip consume fluctuated (16.16 in 1996, 11.87 in 1997, 33.4 in 1998, 15.6 in 1999); and amik consume decreased slightly in the past 2 years (7.97 in 1996, 14.75 in 1997, 5.44 in 1998, 6.99 in 1999). We concluded that we have now very resistant nosocomial bacteria; resistance may be temporally related to increased use of ab, despite our policies of restriction. These policies should continue, but more has to be done to prevent resistance to increase.

PROSPECTIVE SURVEY OF MULTI-RESISTANT BACTERIA IN 1998: A MULTICENTER STUDY IN SOUTH-EAST OF FRANCE. Fosse T, Savey A, Buisson-Touati C, Fabry J. Hôpital Archet2, Nice, France; C. Clin Sud-Est, Lyon, France.

BACKGROUND: Multi-resistant bacteria (MRB) is an increasing therapeutic problem. The France C. Clin Sud-Est (regional coordinating center for South-East of France) surveillance program was established to monitor the incidence of antibiotic resistant bacteria via its regional network. Methods. A 3-month prospective multicenter study was established on the 4th quarter of 1998. A total of 126 centers participated on a voluntary basis. MRB under surveillance were methicillin resistant Staphylococcus aureus (MRSA), ceftazidime resistant Enterobacteriaceae (EB_CF) with or without extended-spectrum β-lactamase (ESBL) and ceftazidime resistant Pseudomonas aeruginosa (PA_CF). Only non-duplicate isolates were reported. Calculated MRB rates were the proportion of resistant bacteria in the species (%R) and the incidence of MRB per 1000 patient-days (IPD). RESULTS: The distribution of resistant organisms was: MRSA (2,368; 52.5%), EB_CF (1,535; 33.7%) and PA_CF (622; 13.8%). Among EB_CF E. aerogenes was more frequently isolated (545) than K. pneumoniae (125). ESBL represented 50% of EB_CF. Overall, urines, respiratory, and wounds represented most of positive samples. The four more represented specialties were medical, surgical, long-term care facilities, and ICU units. MRSA were largely distributed even in small size centers and ward such as pediatrics. Main rates for each MRB in the participating centers were distributed according to 25, 50, and 75 percentiles (see Table). Incidence rates for MRSA, EB_CF and PA_CF increased about proportionally with hospital bed size. Even adjusted by hospital bed size (i.e., >500 bed centers), MRB incidence rate distribution showed a wide dispersion probably in relation with different medical activities. CONCLUSION: An additional study is ongoing to evaluate clinical risk factors associated with intra and inter-hospital MRB dissemination.

	P25 (%R/IPD)	P50 (%R/IPD)	P75 (%R/IPD)	Range (%R/IPD)
MRSA	18.2/0.52	27/0.78	39.8/1.03	0-87.5/0-3.6
EB_CF	1.9/0.18	4.8/0.44	8.2/0.82	0-25/0-5.2
PA_CF	6.9/0.08	13/0.18	18.5/0.34	0-85.7/0-2.18

HANSENULA ANOMALA HOSPITAL INFECTIONS: AN EMERGING PATHOGEN AT BRAZILIAN HOSPITALS?. Freitas AD, Moreira BM, Silva CLP,* Souza PC, Amorim ELT, Leite PC, Nishikawa MM, Marins FM, RM Zancopé-Oliveira, Balassiano BR. Infecçoes Hospares e Assessoria Ltda, Rio de Janeiro, Brasil; Universidade Federal do Rio de Janeiro, RJ, Brasil; Hosp das Clinicas de Niterói, Niterói-RJ, Brasil; Laboratório Dr Sérgio Franco, Rio de Janeiro-RJ, Brasil; Instituto Oswaldo Cruz, Rio de Janeiro-RJ, Brasil.

In the last 45 years, 59 cases of infection by Hansenula spp were reported, 24 of which from one oncological hospital in Rio de Janeiro (Thuler et al, 1997). In the present study, 15 cases of Hansenula anomala (HA) infection in a non-oncological intensive care unit (ICU) in Rio de Janeiro from Jun 1997 to Sep 1998 were identified after the introduction of the VITEK system in the clinical laboratory. A case-control study was conducted to assess the risk factors for HA infection. A case was defined when HA was isolated from peripheral blood specimens or from a central venous catheter (CVC), as part of workup of a febrile episode. In the 2 cases where CVC was the only specimen source of HA, the institution of antifungal therapy and after exclusion of other infections defined HA clinical infection. Three controls were chosen for each case, after matching for gender, age, and length of hospital stay before HA detection. Variables included underlying diseases; associated infections; previous colonization by other fungi; intravenous medications, the APACHE II score at admission, use of antibiotics, antifungal agents, parenteral nutrition, central venous catheter, steroids, previous surgery and cancer. HA identification was confirmed by biochemical characterization (sugar assimilation and fermentation) and strain relatedness was assessed by applying randomly amplified polymorphic DNA (RAPD). Variables were compared using student's t test and the Fisher's exact test (two-tailed). Variables showing a p value <0.25 were entered in a stepwise logistic regression analysis. Of 13 HA isolates obtained from 10 patients, 8 were confirmed as HA, which belonged to six RAPD patterns (I-VI). The inclusion of 2 patients in Pattern I and 2 patients in Pattern IV indicated cross-infection. The only variable independently associated with HA was ventilator-associated pneumonia (p=0.004; OR 14.6; 95% CI 2.3-89.9). The detection of a previously unrecognized pathogen in the ICU indicates the importance of accurate species identification in the setting of hospital infections.

EMERGING OF MULTIPLY RESISTANT ENTEROCOCCI ISOLATED AT THREE HOSPITALS IN ROMANIA, FROM JAN TO AUG 1999. Ghita M, Pana M, Papagheorghe R, Popescu N, Silaghi E, Tudorache D, Andries D. Institutul Cantacuzino, Bucharest, Romania; Spitalul Clinic Universitar Coltea, Bucharest, Romania; Institutul National de Cardiologie "C.C. Iliescu", Bucharest, Romania; Spitalul Clinic Prof. Dr. Th. Burghele, Bucharest, Romania; "Dr. Ion Cantacuzino" Hosp, Bucharest, Romania.

Ninety-six (96) enterococci were isolated at three Romanian hospitals from Jan to Aug 1999.The strains came from patients hospitalized in the following services: digestive surgery (surgical wounds: N=10, bile: N=2, drains: N=6, peritoneal fluid: N=1, faeces: N=1, urine: N=35), cardiovascular (surgical wounds: N=8, blood: N=5, pericardic fluid: N=2, prosthesis: N=1, catheter: N=2, artery: N=1), hemato-oncology(urine: N=20, sputum: N=20).Distribution of Enterococcus spp.strains was the following: E. faecalis (73.9%), E. faecium (21.8%), E. durans (2%), E. avium (1%), E. hirae (1%). The strains were tested to five antibiotics: penicillin (Pc), vancomycin (Va), ciprofloxacin (Cip), gentamicin (Gn), streptomycin (Str).

Resistance (%) of enterococci depending on sample

Sample	Pc	Cip	HLRGn	HLRStr
Blood,pericardic fluid	50.4	70.4	70.4	85
Prosthesis,catheter,artery	50	75	75	75
Bile,drains,peritoneal fluid	22.2	55.5	44.4	44.4
Urine	1.8	12.7	5.4	34.5
Surgical wounds	44.4	50	72.2	83.3
Sputum,faeces	100	33.3	100	100

Pc: penicillin, Cip: ciprofloxacin, HLRGn: high level resistance to gentamicin, HLRStr: high level resistance to streptomycin.
No resistant strain to vancomycin was found.

CHARACTERIZATION OF ROMANIAN ENTEROCOCCUS SPP. ISOLATED BETWEEN 1995-98. Ghita M, Pana M, Papagheorghe R, Popescu N, Tudorache D, Firulescu S. Institutul Cantacuzino, Bucharest, Romania; Institutul Cantacuzino, Bucharest, Romania; Spitalul Clinic Universitar Coltea, Bucharest, Romania; Spitalul Clinic Prof. Dr. Th.Burghele, Bucharest, Romania; Spitalul Clinic de Urgenta, Bucharest, Romania.

One hundred and ninety-eight (198) enterococci were isolated between 1995-98 from different samples at four Romanian hospitals in the following services: digestive surgery, hemato-oncology, intensive care units.The specimens were urine(N=163), surgical wounds (N=9), blood (N=12), CSF (N=2), bile (N=3), drains (N=7), and frontal sinuses (N=2). Distribution of Enterococcus spp.was the folowing: E. faecalis (81%), E. faecium (12%), E. durans (4%), E. avium (2%), and E. hirae (1%). All the strains were β-lactamase negative.The antimicrobial susceptibility testing of the isolates was determined by agar dilution (MICs) and by agar screening to five antibiotics: penicillin (Pc), vancomycin (Va), ciprofloxacin (Cip), gentamicin (Gn), and streptomycin (Str). Resistance of E.faecalis to Cip increased from 9.7% (in 1995) to 12.9% (in 1998), to Gn from 9.7% (1995) to 18.8% (1998), decreased to Str from 59.3% (1995) to 44.4% (1998), and remainded susceptible to Pc and Va. Resistance of E. faecium in 1998 revealed:83.3% to Pc, 77.7% to Cip and Gn, and 55.5% to Str. No resistance to Va was revealed. In conclusion, depending on the resistance achieved by enterococci between 1995-98, the trends of resistance are on the increase for Pc (E. faecium), Cip, Gn, and on the decrease for Str.

TOXIN VARIANT CLOSTRIDIUM DIFFICILE NOT DETECTED BY TOXIN A IMMUNOASSAY CAUSES SERIOUS CLINICAL ILNESS. Johnson S, Kent SA, O'Leary KJ, Merrigan MM, Sambol SP, Peterson LR, Gerding DN. VA Chicago HCS, Chicago, IL; Northwestern Univ Med School, Chicago, IL.

Many clinical laboratories have implemented toxin A immunoassays (ToxA EIA) for Clostridium difficile (CD) testing in place of cell culture assays for cytotoxin because of rapidity and simplicity of the test, and good correlation with cytotoxicity assay results. We report the death of a patient with advanced pseudomembranous colitis who had multiple stool specimens submitted over a 2-month period that tested negative by ToxA EIA, but from which a toxin variant strain of CD was cultured on four occasions. This patient developed chronic diarrhea with abdominal pain, and was eventually treated for inflammatory bowel disease. Autopsy revealed extensive colitis with confluent pseudomembranes. The possibility of CD disease was dismissed premortem based on repeatedly negative ToxA EIA results on stool and the recovered isolates. All four CD isolates were of the identical restriction endonuclease analysis (REA) type, CF4, and were cytotoxin-positive by cell culture assay. Amplification of the toxin A gene in the CF4 isolates by PCR revealed an 1800 bp deletion at the 3' end of the gene when compared to the toxin A gene from standard toxigenic CD strain VPI 10463. Screening an extensive CD strain collection revealed three additional CF4 organisms from patients in two hospitals in Illinois and one in Minnesota. These isolates were not previously recognized as a toxin variant as each hospital laboratory employed cytotoxicity assays. Toxin A variants of CD are present at unknown frequency in U.S. hospitals and can cause serious clinical illness.

PRESENCE OF QUINUPRISTIN/DALFOPRISTIN-RESISTANT ENTEROCOCCUS FAECIUM IN STOOL SPECIMENS FROM HEALTHY PEOPLE AND IN RETAIL CHICKEN PRODUCTS IN THE U.S. Karchmer TB,* MacKinson C, Sullivan M, Johnson S, Park M, Debess E, Sokolow R, Joyce K, Tenover F, Angulo, FJ. Univ of Maryland; Univ of Maryland; MN Dept of Health; GA Div of Public Health; OR Div of Public Health; Foodborne and Diarrheal Diseases Branch, CDC; Hosp Infections Program, CDC; Foodborne and Diarrheal Diseases Branch, CDC.

BACKGROUND: Quinupristin/dalfopristin (Q/D) has recently been approved for treatment of infections due to vancomycin-resistant E. faecium (EF), but is only used

in severely ill hospitalized patients. Since 1974, virginiamycin (V) (a streptogramin related to Q/D) has been used to promote growth in poultry. Studies in Europe showed that use of V in poultry promotes emergence and dissemination of Q/D-resistant EF (Q/DRE) in humans. A prevalence study of Q/DRE in stool specimens from healthy people and in retail chicken products in the U.S. was conducted. METHODS: From 7/98 to 6/99, 4 labs in GA, MD, MN, and OR used enterococci selective media (CAN) and Q/D-resistant selective media (Q/DM) (Ford agar supplemented with arabinose, Q/D and ampicillin) to culture stools and chicken products. Species identification and antimicrobial susceptibility testing by broth microdiluation was conducted at CDC. RESULTS: Using CAN, enterococci were isolated from 278 (68%) of 410 stools. 148 (53%) have been tested. 44 (30%) were EF. 3 (7%) of 44 EF were Q/DRE. Carriage rate of Q/DRE was 1.4%. Using Q/DM, enterococci were isolated from 110 (27%) stools. 38 (35%) have been tested. 28 (74%) were EF. were Q/DRE. Using CAN, enterococci were isolated from 344 (84%) of 410 chickens. 193 (56%) have been tested. 8 (4%) were EF. 6 (75%) of 8 were Q/DRE. Prevalence of Q/DRE using CAN was 3%. Using Q/DM, enterococci were isolated from 327 (80%) of 410 chickens. 209 (64%) have been tested. 171 (82%) were EF. 160 (94%) of 171 were Q/DRE. Prevalence of Q/DRE in chickens using Q/DM was 62%. CONCLUSIONS: We demonstrated community carriage of Q/DRE in healthy humans prior to widespread use of Q/D in hospitals. Such resistance may provide the seeds for Q/DRE infections in hospitalized patients. Continued use of virginiamycin in chickens may compromise the effectiveness of Q/D in humans.

CANDIDAL OSTEOMYELITIS: THE RISING INCIDENCE, RISK FACTORS AND ROLE OF AMPHOTERICIN B LIPID COMPLEX. Knox KL, Lawson W, Friedland J, Holmes A. Hammersmith Hosp, London, UK.

Candidal blood stream infections, particularly those due to fluconazole resistant C. albicans and non-albicans candida are increasing in incidence. Candidal osteomyelitis, previously rarely reported, is emerging as another important candidal hospital acquired infection. It can have insidious onset, presenting months after the initial hospitalisation and little is known about optimal therapy. With chronic antibiotic therapy, immunosuppression, and implantable foreign material the incidence is likely to increase. We report a case series of cases appearing between 4 months to 1 year after the initial admission. Our series also suggests amphotericin B lipid complex may be optimal therapy. CASE 1: A 65-year-old female on prednisolone 5mg/day underwent aortic and mitral valve replacement. Four months postoperatively she developed sternal cellulitis with underlying osteomyelitis. Isolates of P. aeruginosa and C. albicans were treated with ciprofloxacin and fluconazole. After 5 months the wound continued to drain pus and culture revealed fluconazole resistant C. albicans. Amphotericin B lipid complex (ABLC-Abelcet®) at 5mg/kg daily IV resulted in flushing, headache, and shivers. The dose was reduced to 2mg/kg/day. Within 14 days there was dramatic improvement. Treatment was continued for 60 days and the patient is well 2 years later. CASE 2: A 63-year-old man underwent aortic valve replacement. Methicillin resistant S. aureus sternal osteomyelitis was treated with teicoplanin and fusidic acid with only partial resolution despite prolonged antibiotic therapy and surgical debridement. Sixteen months later, further operative cultures grew fluconazole resistant C. albicans. ABLC 2mg/kg/day given for 60 days sterilised and healed the wound and there has been no relapse 18 months later. CASE 3: One year after a total knee replacement, a 69-year-old man developed C. tropicalis infection of his prosthesis. Treatment with ABLC 3mg/kg/day for 21 days was followed with oral fluconazole until surgical revision at 75 days, after which he made an uneventful recovery. Unexpectedly, fluconazole was undetectable on assay of operative bone specimen. These cases demonstrate the natural history of candidal osteomyelitis and a good response to amphotericin B lipid complex. Fluconazole appears to penetrate bone poorly but more data on bone penetration and emergence of resistance are required.

TRANSMISSION OF A HIGHLY RESISTANT PSEUDOMONAS AERUGINOSA IN A MEDICAL INTENSIVE CARE UNIT DESPITE CONTACT PRECAUTIONS. Kressel AB. Univ of Cincinnati College of Medicine, Cincinnati, OH.

On September 1, 1999, an outside hospital transferred a patient to our institution. This patient, who had a history of icthyosiform erythroderma, had been treated for 4 weeks with IV vancomycin at the outside institution and a skilled nursing facility for MRSA endocarditis. On transfer, he was cachectic, had altered mental status, erythroderma with scaling skin lesions, and conjunctivitis with green discharge. Admission cultures of the conjunctivitis grew P. aeruginosa with indeterminate susceptibility to ceftazidime and resistance to all other tested antibiotics. During his hospitalization the patient developed P. aeruginosa bacteremia and pneumonia and grew the highly resistant P. aeruginosa from groin, eye, and respiratory cultures. In addition, a squamous cell cancer of the groin was discovered. He was transferred to the MICU for hypercalcemia and hypernatremia secondary to the cancer. He remained in the MICU September 24-October 12. During the index case's MICU stay his room was adjacent to that of a patient intubated because of cardiomyopathy. This patient's urine and respiratory cultures from October 12 both grew highly resistant P. aeruginosa. of the patient's numerous previous cultures grew P. aeruginosa. PFGE showed that the highly resistant P. aeruginosa from both patients was indistinguishable. In this case transmission of a highly resistant P. aeruginosa occurred despite that fact that the index patient was on Contact Precautions. The index case had severe dermatitis and conjunctivitis, which may have caused increased shedding of the resistant organism. In addition, healthcare workers may not have followed Contact Precautions completely in this very busy MICU. This case demonstrates how resistant organisms can be introduced to a hospital and transmitted to other patients.

CHARACTERIZATION OF STAPHYLOCOCCUS HAEMOLYTICUS ISOLATES BY VANCOMYCIN SUSCEPTIBILITY AND PULSED-FIELD GEL ELECTROPHORESIS PATTERNS. McAllister SK,* Carson LA, Hill BC, Miller JM. Ctrs for Disease Control and Prevention, Atlanta, GA.

Coagulase-negative staphylococci (CNS) are a frequent cause of healthcare-acquired infections and pose a serious health concern because some species of CNS are resistant to multiple antimicrobial agents. S. haemolyticus is among the most frequently isolated CNS causing healthcare-acquired bloodstream infections and was the first staphylococcal species to demonstrate decreased susceptibility to vancomycin (VANC). Thirty-two (32) CNS isolates received by CDC during 1997-99 were identified as S. haemolyticus using standard biochemical tests. The oxacillin and VANC minimum inhibitory concentrations (MICs) of the isolates were determined by broth microdilution and compared with the results obtained by using MicroScan Pos Combo 10 panels and Vitek GPS-SG cards. To assess whether strains showing decreased susceptibility to VANC were clonal, we conducted pulsed-field gel electrophoresis (PFGE) of SmaI digestion products. All 32 strains were resistant to oxacillin in all three test systems. By broth microdilution only 11 of 32 produced intermediate MICs (8 µg/ml) to VANC. In contrast, the Vitek system classified 4 of 32 strains as resistant to VANC (32 µg/ml); only 1 of the 4 was intermediate by broth microdilution. One isolate was intermediate to VANC (8 µg/ml) by both MicroScan and broth microdilution. Analysis of PFGE results showed no evidence of clonality. Among 11 isolates from 7 states with MICs to VANC of 8 µg/ml by broth microdilution tests, nine PFGE patterns were observed. This comparison of conventional and commercial testing systems for antimicrobial susceptibility testing suggests that emerging resistance to VANC among CNS may not adequately be detected and tracked when using commercial automated systems.

SURVEY OF NOSOCOMIAL ENTEROBACTER SPECIES AT A UNIV HOSPITAL. Morris R, Shah P, Nolan R.* Univ of Mississippi School of Medicine, Jackson, MS.

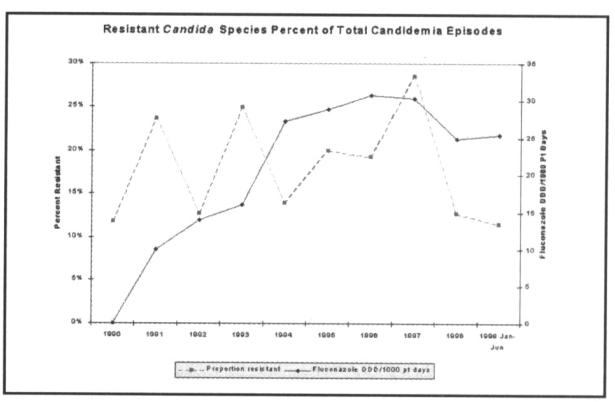
Over a two-year period susceptibility of Enterobacter cloacae to third generation cephalosporins has fallen from near 100% to 75% at our 650-bed tertiary referral teaching hospital. To investigate this we collected data on 87 patients having isolates of Enterobacter species over a ten-month period. Data collected included demographics, prior antibiotic administration, presence in intensive care units, use of invasive devices, underlying diseases and severity of illness. A cohort study was performed comparing 16 patients with isolates of Enterobacter cloacae resistant to ceftazidime to 27 patients with ceftazidime susceptible Enterobacter cloacae. Patients were similar in regard to demographics, underlying illness, duration of intensive care stay, use of invasive devices, and crude mortality. Patients with resistant isolates were more likely to have prior receipt of ceftazidime, vancomycin or clindamycin ($p<.05$). Six of 16 (38%) patients with resistant strains were bacteremic compared to 1 of 27 (4%) with susceptible strains (O.R.=15.6, $p=.007$). Patients with resistant strains had longer duration of hospitalization (36 versus 20 days), longer hospitalization prior to Enterobacter isolation (11 versus 5 days) more antibiotic days (8 versus (1) ($p<.05$) and higher Apache 2 scores (17 versus 14) ($p=.05$). Analysis by pulsed field gel electrophoresis of banked isolates is in process.

A CASE OF STREPTOCOCCUS PNEUMONIAE INFECTION DEVELOPING RESISTANCE TO LEVOFLOXACIN ON THERAPY. Pic-Aluas L, Narayanan S, Croxton M, Levy C. Washington Hosp Ctr, Washington, DC.

The rates of Streptococcus pneumoniae resistant to the newer quinolones remain low, but may increase due to the intense use of these antibiotics for the treatment of respiratory infections. Isolated reports have shown that certain strains of multi-drug resistant S. pneumoniae can also be resistant to the newer quinolones. We present the case of a patient infected with a strain of S. pneumoniae that became resistant to levofloxacin while on therapy. A 44 year-old man with AIDS was admitted to the hospital with pneumonia. He was given pentamidine, steroids and clarythromycin, without improvement. Blood cultures from admission grew S. pneumoniae, resistant to penicillin (MIC 1.5 mcg/ml), erythromycin, and trimethoprim-sulfamethoxazole, intermediate to ceftriaxone (MIC 1.5 mcg/ml), susceptible to chloramphenicol, clindamycin, tetracycline, vancomycin, levofloxacin (by disk-diffusion method). The patient was switched to levofloxacin. However, he remained bacteremic for the next 6 days despite the addition of vancomycin. After being seen by the infectious disease service, a tunneled catheter which had been present on admission for parenteral nutrition was removed, and a chest tube was placed for drainage of a large pleural effusion. Transthoracic and transesophageal echocardiograms were negative for vegetations. The S. pneumoniae isolate from the 5th hospital day was resistant to levofloxacin by disk-diffusion, and was confirmed by Etest, with a MIC of 12 mcg/ml. This result was also confirmed by broth microdilution at the Nosocomial Pathogens Lab Branch of the Ctr for Disease Control and Prevention. The initial isolate was reconfirmed in our laboratory as susceptible to levofloxacin. The patient was treated with vancomycin alone, with clinical improvement and sterilization of the blood cultures. Several factors may have contributed to the development of resistance in this S. pneumoniae isolate: the advanced immunocompromised state of the patient, the presence of an intravenous catheter, and resistance to other antibiotics.

CHANGE IN THE DISTRIBUTION OF CANDIDA SPECIES CAUSING BLOODSTREAM INFECTIONS AFTER DECREASED USE OF FLUCONAZOLE. Pic-Aluas L, Tezky TM, Barbaccia JG, Donegan NE. Washington Hosp Ctr, Washington, DC.

Over the past decade the incidence of bloodstream infections (BSI) with non-albicans species of Candida has increased in most large, tertiary-care medical centers. A case-control study performed at our institution from 1995-98 and presented previously (IDSA '98) suggested that preceding use of fluconazole was a risk factor for candidemia with C. glabrata and C. krusei, species generally considered resistant to this agent. We plotted the hospital-wide use of fluconazole measured in defined daily doses (DDD)/1000 patient days against the proportion of fluconazole-resistant Candida species recovered from blood from



1990 to the first half of 1999. A simple linear regression analysis demonstrated a statistically significant correlation between fluconazole use and the proportion of resistant Candida species, with a p-value of .0005. Results of the case control study had been disseminated to practicing physicians, intensive care unit staff, and members of the Pharmacy and Therapeutics Committee in our institution. Subsequently fluconazole use decreased from a high of 30 defined daily doses (DDD)/1000 patient-days in 1996 to 25 DDD/1000 patient days in 1998 and 1999. The proportion of fluconazole resistant Candida species causing BSI decreased from 30% in 1997 to 10% in 1999. Most of the change was due to a decrease in the proportion of C. glabrata, from 20% before 1997, to 12% of all candidemia episodes in 1999. In addition, no episodes of C. krusei BSI were diagnosed in our institution in the last 2 years. During this time period, the overall rates of Candida BSI have remained stable at .22/1000 patient days. We will prospectively monitor the association between use and resistance as other institutions continue to see an increasing frequency of C. glabrata and other non-albicans species. Future determination of the fluconozole MIC for all Candida isolates will more precisely identify resistance patterns and associations.

FACTORS ASSOCIATED WITH CEFTAZIDIME RESISTANCE IN PSEUDOMONAS AERUGINOSA ISOLATES IN 29 U.S. HOSPITALS. Pryor ER, Fridkin SK, Kleinbaum DG, McGowan JE Jr, Gaynes RP, Phase 2 Project ICARE Hosps. Rollins School of Public Health of Emory Univ, Atlanta, GA; Centers for Disease Control and Prevention, Atlanta, GA.

To determine factors associated with ceftazidime (CTZ) resistance among P. aeruginosa (PA) isolates, we analyzed data from 29 Project ICARE hospitals that reported from non-intensive care unit, inpatient (INP) wards on CTZ susceptibility of clinical PA isolates and use of antimicrobials between Jan 1996 and Oct 1997. Antimicrobial use was expressed as defined daily doses per 1000 patient-days. A multivariate logistic regression model was fit with the proportion of CTZ-resistant PA as the outcome. Several institutional factors were independently important: teaching affiliation of the hospital, CTZ-resistant PA prevalence in intensive care unit areas of the hospital, and presence of an inpatient skilled nursing facility on site. After controlling for these factors, we found several antimicrobial use variables significantly associated with CTZ-resistant PA prevalence in INP wards, and threshold effects, based on quartiles of use, were identified for each drug included in the final model: above first quartile ureido-carboxy-penicillin use (OR=1.79, CI 95%: 1.29-2.49), fourth quartile first generation cephalosporin use (OR=1.70, CI 95%: 1.39-2.08), and above first quartile second generation cephalosporin use (OR=0.58, CI 95%: 0.44-0.75). These results suggest that programs aimed at optimizing use may consider 1) monitoring a threshold level of antimicrobial use, aiming for use reduction below a benchmark value, and 2) including examination of direct and indirect selection pressures of various antimicrobial classes upon the pathogen-antimicrobial combination of interest.

EVALUATION OF ANTIBIOTIC RESISTANT BACTERIA IN HOME KITCHENS AND BATHROOMS. Rutala WA,* Weber DJ, Barbee SL, Gergen MF, Sobsey MD. Univ of North Carolina School of Medicine and UNC Hosps, Chapel Hill, NC.

This study evaluated the prevalence of pathogens in 25 randomly selected homes. Households reported cleaning frequently (1x/week) with a variety of antibacterial products (soaps, surface disinfectants). Sites cultured (N=10) included: kitchen - sink drain, food preparation area (vegetable bin), sponge/dishcloth, cutting board, refrigerator door handle; and, bathroom - sink drain, sink faucet handle, toilet seat, toilet flush handles, and bath drain. Pathogens evaluated for antimicrobial resistance included Klebsiella, E. coli, Enterobacter, P. aeruginosa, S. aureus, and Enterococcus. RESULTS: The overall mean log10 counts (total CFU) for kitchen and bathroom were 4.35 and 4.75, respectively. Gram positive bacteria were more common in the bathroom (4.17) than the kitchen (3.63), while gram-negative bacilli were more common in the kitchen (4.20) than the bathroom (3.76). The sink drain was the most contaminated site, 5.93-6.15-logs. No oxacillin resistant S. aureus strains (N=51 isolates) were found. Four of 58 isolates (6.9%) of Enterococcus (same molecular type from a single home) were resistant to vanco. The susceptibility of enteric bacteria was assessed to cefazolin, cefotaxime, imipenem, amp, pip, cipro, TMP-SMX, gent, tobra, and chloro. All 17 isolates of E. coli were uniformly susceptible with the exception of a single amp resistant isolate (5.8%). The 206 isolates of Klebsiella demonstrated the following frequency of resistance (# homes): cefazolin 8.3% (6), amp 91.7% (20), pip 2.4% (3), TMP-SMX 0.5% (1), and chloro 3.3% (4). The 268 isolates of Enterobacter demonstrated the following frequency of resistance (# homes): cefazolin 33.9% (15), cefotaxime 2.2% (2), imipenen 0.75% (2), amp 81.7% (9), pip 15.7% (8), TMP-SMX 0.37% (1), tobra 0.37% (1), and chloro 2.24% (5). Pseudomonal strains were uniformly susceptible to imipenem, pip, gent, and cipro. One isolate (2.4%) was resistant to tobra. Compared to pathogens causing clinical infections in the ICARE study, pathogens isolated from households are less likely to demonstrate antimicrobial resistance.

A META-ANALYSIS OF RISK FACTORS FOR NOSOCOMIAL INFECTION WITH ANTIMICROBIAL-RESISTANT PATHOGENS, MRSA, VRE, C. DIFFICILE, ESBL-POSITIVE GNB, AND CANDIDA. Safdar N, Maki DG. Univ of Wisconsin Med School, Madison, WI.

The late 20th century has seen a growing crisis in antimicrobial resistance, especially among microorganisms which cause nosocomial infection. We undertook a meta-analysis of risk factors (RFs) for nosocomial infection with MRSA, VRE, C. difficile, ESBL-positive GNB and Candida, restricted to studies which employed multivariate RF analysis, to better understand the commonality of RFs among different resistant organisms. Overall, 56 published studies provided data; unfortunately, most were retrospective and many addressed relatively few potential RFs or did not quantify risk. The analysis, however, showed impressive commonality of risk factors between the groups of multiresistant organisms studied: severity of illness (range of odds ratios [OR]: 1.8-12.53), organ transplantation (OR, 3.8-4.2), chronic renal failure (OR, 1.4-4.4), prolonged LOS (OR, 1.0-3.8), exposure to central venous catheters and other invasive medical devices (OR, 2.7-26.4), and exposure to antimicrobial drugs (OR, 1.8-18.7), especially 3rd-generation cephalosporins, were identified in nearly all studies of specific organisms that examined these RFs individually. This analysis suggests that reduction in the use of antibiotics, especially 3rd-generation cephalosporins, and strategies to prevent cross-infection in the hospital, would likely yield benefit with all types of resistant organisms. Conversely, programs that focus on one organism or one drug are unlikely to succeed. Prospective studies of sufficient size, which address all potential risk factors, especially individual anti-infective agents, and which employ matched controls shown by screening cultures not to be colonized by resistant organisms, would improve our understanding of the epidemiology of antimicrobial resistance in institutions and guide efforts to develop more effective strategies for prevention.

GENOTYPIC AND PHENOTYPIC ANALYSIS OF CLOSTRIDIUM DIFFICILE: CORRELATION WITH ANTIBIOTIC EXPOSURE IN PATIENTS WITH C. DIFFICILE-ASSOCIATED DIARRHEA. Samore MH, Venkataraman L, DeGirolami PC, Merrigan M, Johnson S, Gerding DN, Carmeli Y. Univ of Utah; Beth Israel Deaconess Med Center, Harvard Med School; VA Chicago-Lakeside Division and Northwestern Univ.

C. difficile susceptibility results and DNA types were analyzed in relation to the antibiotic exposures that precipitated C. difficile-associated diarrhea (CDAD). We examined 83 C. difficile isolates recovered from nosocomial CDAD cases diagnosed at a tertiary care hospital between 10/93 and 10/97. MICs were determined by the e-test method using modified-Brucella agar. Isolates were characterized by pulsed field gel electrophoresis (PFGE); restriction endonuclease analysis (REA) was used for PFGE-degrading strains. Antibiotic percent susceptibilities were: clindamycin [clinda] (59%), erythromycin [ery] (65%), trovafloxacin [trova] (63%), ciprofloxacin (0%), ampicillin (100%), piperacillin/tazobactam (100%), cephalothin (49%), ceftriaxone [(73%), metronidazole (100%), and vancomycin (100%). Clinda exposure was strongly associated with clinda resistance (odds ratio 6.3 [2.2-18.4]), confirming results of a previous study of an REA J group strain [Johnson et al., 1999]. For other categories of antibiotic exposure and antibiotic resistance, significant associations were not seen. 87% of trova resistant isolates were also clinda and ery resistant. Overall, 2 strain-types were most common, group 10 (n=11) and group J (n=22); the other 50 isolates were diverse (31 distinct groups). All but 1 of 27 trova/ery/clinda resistant isolates belonged to group 10 (n=8) or J (n=18). These 2 groups were acquired on multiple wards. In conclusion, even prior to use of trova, resistance to trova was part of a multi-resistant C. difficile phenotype that disseminated through the hospital. The reason for the linkage between trova and clinda resistance as well as the precise mechanism by which clinda predisposes to CDAD caused by clinda-resistant strains remain unknown.

CONTINUING INCREASE IN THE PREVALENCE OF PENICILLIN-NONSUSCEPTIBLE STREPTOCOCCUS PNEUMONIAE IN JAPAN. Satake S, Sunakawa K, Hayashi K, Hotta K. Gunma Univ, Maebashi, Japan; Kitasato Univ, Sagamihara, Japan; National Institute of Health of Japan, Tokyo, Japan.

Penicillin-resistant Streptococcus pneumoniae are being encountered more frequently throughout the world and are becoming increasingly more difficult to treat. A nation-wide surveillance in Japan, conducted during a two-week period in the months of Jan and Jul, was begun in 1992. Approximately 500 clinical microbiology laboratories throughout Japan have participated in this survey. The Ministry of Health and Welfare has entrusted the collecting, processing, and publishing of data to the Medical Information System Development Center. The susceptibility testing methods and interpretations were made according to the NCCLS guidelines. The yearly prevalence ratios of penicillin-susceptible S. pneumoniae using the disk diffusion method (oxacillin 1μg) from 1992 to 1995 were 55.2% (n=391), 53.8% (n= 396), 50.9% (n=586) and 42.0% (n=555), respectively. Most of the penicillin MICs of nonsusceptible strains determined by the broth microdilution method were in the intermediate range (0.12-1 (micro)g/ml). The yearly ratios of penicillin-intermediate strains from 1992 to 1995 were 24.4% (n=307), 26.5% (n=219), 36.2% (n=348), and 40.3% (n=377), respectively. Every year, the frequency of penicillin-resistant strains was less than 5%, and the frequency of cefotaxime-resistant strains was less than 1%. Although the changes in isolation frequency for S. pneumoniae from the blood were not observed year by year, the frequency observed in January was significantly higher than that of July (p=0.032). A rapid emergence of penicillin-intermediate S. pneumoniae in Japan, similar to that seen in other regions of the world, has been observed. The penicillin- or cefotaxime-resistant S. pneumoniae, however, has appeared infrequently. There was a significant association between the season and infection or colonization of S. pneumoniae.

CLINICAL RELEVANCE OF ESBETALS ORGANISMS. Scotton PG, Zanatta A, Rigoli R, Vaglia A, Dacomo, Baldassarre P, Berti C, Tessarin M, Ramon R. Treviso Hosp, Treviso, Italy.

Ca' Foncello Hospital is a regional Hosp with 1,100 beds, 1 million population basin and all principal medical and surgical specialties. We checked for ESBetaLs organisms in the last year by microbiologic computerized data. ESBetaLs organisms were detected by the double disk synergy test and the MIC by the Etest strips (AB BIODISK, Solna Sweden). 12 ESBetaLs were detected (3 E. cloacae; 3 P. stuartii; 2 S. maltophilia; 1 C. freundii; 1 A. baumani; 1 K. oxytoca; 1 E. coli) from 11 patients in the following divisions: long-term care unit (4 patients), neurosurgical intensive unit (3 patients), cardiosurgical unit, cardiosurgical intensive unit, geriatric unit and internal medicine unit (1 patient each). 9 patients received antibiotic therapy on the 2 weeks before isolation. The ESBetaLs organism was considered the etiologic agent of clinical disease in 6 cases (3 pneumonia, 2 IVU, 1 pleural empyema) and in the other 6 cases only a colonization agent. 5 of 6 cases, where the ESBetaLs organism was the etiologic agent, resolved with ciprofloxacin (2 cases, both pneumonia), imipenem plus amikacina (1 case, pneumonia), cotrimoxazolo (1 case, IVU) and piperacillin (1 case, IVU). 1 patient died of pleural empyema and sepsis due to ESBetaLs C. freundii and VRE faecium; this patient was transferred from the intensive unit of another hospital. All isolates, except S. maltophilia, remained susceptible to imipenem (MIC<0.75 mg/ml) and to aminoglicosides, except E. cloacae that was susceptible only to amikacin. ESBetaLs organisms had not represented a relevant problem in our hospital last year; this may be due to the restricted extended spectrum cephalosporin use. The areas that need surveillance are the long-term care unit and the neurosurgical intensive unit, besides patients coming from other hospital (intensive unit). In the neurosurgical intensive unit E. cloacae with the same antibiotype had been isolated in 2 patients; this requires a more sophisticated epidemiological investigation.

NOSOCOMIAL CEFTAZIDIME-RESISTANT GRAM-NEGATIVE BACILLI INFECTION/COLONIZATION IN NEONATES. Singh-Naz N, Leger M-M, Patel, K, Campos, JM. Children's National Med Center, George Washington Univ.

BACKGROUND: An increased incidence of nosocomial infection caused by ceftazidime resistant (CR) enteric gram negative bacilli (EGNB) in neonates admitted to the intensive care unit (NICU) led us to initiate surveillance (Mar 1998 through Mar 1999) and assess the risk factors. METHODS: During the surveillance period 542 patients were admitted. All patients were screened for rectal carriage of CR EGNB. Infected patients met the CDC criteria for nosocomial infection. RESULTS: Of the 542 patients, 130 were excluded from the study because 46 had no rectal cultures taken and could not be classified as cases or controls, 30 who were readmitted to the NICU multiple times and were neither colonized nor infected during the study period, and 54 who were admitted with rectal colonization with ceftazidime resistant Gram negative bacilli. Of the 412 study patients, the prevalence of col-

onization was 14%. The incidence of infection among colonized patients was 16% (11 infected/69 patients at risk). There were 11 cases of nosocomial infection, 58 cases of colonization, and 343 controls. Characteristics of infected versus colonized patients were lower birthweight (1022 gms), hospitalization for longer duration (22 days), and longer course of antimicrobial therapy (22 days) ($p<.05$). Specifically, duration of gentamicin (17 days) and vancomycin (17 days) therapy prior to infection was greater than for patients who were colonized ($p<.05$). By multiple logistic regression analysis, colonized neonates with low birthweight, on multiple antimicrobial agents (Odds Ratio 2.25) (specifically gentamicin [Odds Ratio 1.2]) and longer uses of these agents were at higher risk of colonization with CR EGNB. CONCLUSIONS: Very low birthweight neonates with prolonged hospitalization receiving multiple antimicrobial agents (specifically gentamicin) are at higher risk of colonization with CR EGNB. Such colonization of NICU patients poses an infection control risk. Efforts to recognize and institute barrier precautions on colonized patients are prudent.

ANTIMICROBIAL RESISTANCE IN BELGIAN ICUs: TIME TRENDS AND REGIONAL DIFFERENCES. Suetens C,* Carwauw H, Jans B, Leens E, Morales I, Selway P. Scientific Institute of Public Health, Brussels, Belgium.

OBJECTIVE: To study time trends and regional differences in antimicrobial resistance patterns in ICU-acquired pneumonia (PN) and bloodstream infections (BSI) in Belgium from Jan 1996 to Jun 1999. METHODS: Antimicrobial resistance (AMR) data reported to the national patient-based surveillance of nosocomial infections in the ICU were analysed for time trends and regional differences. Data from hospitals reporting less than 90% of AMR data were excluded. Differences between the 3 Belgian regions (Flanders (F), Walloon (W) and Brussels (B)) and differences by type of infection were examined. Resistance data were examined for pathogens selected because of their frequency or clinical importance in the Belgian context. RESULTS: Time trends: Methicillin resistance decreased in S. aureus (n=430) from 44.4% in 1996 to 20.3% in 1999 ($p=.008$) but increased from 64% to 81% in S. epidermidis (n=198; $p=.018$). During 1998 and 1999, 2 vancomycin intermediate and 1 vancomycin resistant S. epidermidis were reported. Quinolone resistance in E. coli (n=346) increased from 4.6% in 1996 to 21.3% in 1999. No significant time trends were observed in AMR in P. aeruginosa and E. aerogenes. Regional differences: The southern part of the country showed significantly higher resistance rates for ceftazidim (W24.6%; B9.5%; F12.4%), piperacillin (W27.7%; B19.1%; F27.7%) and imipinem (W8.5%; B4.0%; W16.9%) resistance in P. aeruginosa (n=452), methicillin resistance in S. aureus (W 39.7%; B34.7%; F27.6%), C3 resistance (W82.7%; B55.2%; F51.7%), quinolone resistance (W83.9%; B58.3%; F61.3%) and imipenem resistance (W6.7%; B3.3%; F3.6%; NS) in E. aerogenes (n=173). CONCLUSION: The national decreasing trend in MRSA resistance rate observed in the national surveillance of MRSA was confirmed by the data of the ICU surveillance. The reasons for the generally higher resistance rates in the southern part of the country should be further examined.

DAILY PREVALENCE OF MULTI-DRUG RESISTANT BACTERIA IN A BRAZILIAN UNIV HOSPITAL. Trabasso P,* Tresoldi AT, Dantas SRPE, Padoveze MC, von Nowakonski A. Campinas State Univ, Campinas, Brazil.

INTRODUCTION: Widespread use of antibiotics in hospital setting has resulted in selection of multi-drug resistant (MDR) organisms, increasing morbidity and mortality and high healthcare costs. OBJECTIVE: to assess daily prevalence of MDR bacteria and to evaluate the measures of control adopted. METHODS: A prospective study was performed from Jan 97 to Jul 99; all patients, after 5 days of hospitalization, were searched for MDR bacteria by nasal and oro-pharyngeal swabs. Criteria adopted for MDR were: Staphylococcus aureus resistant to methicillin (MRSA); Acinetobacter baumanii and others Gram negative bacilli resistant to Aminoglycosides (AMG), fluoroquinolones and 3rd generation Cephalosporins (3CEF) and Pseudomonas aeruginosa resistant to AMG and 3CEF. RESULTS: mean of daily prevalence of MDR bacteria was 8.6 cases in 1997, 9.6 cases in 1998, and 9.4 cases until Jul 1999. Most frequent MDR bacteria were MRSA (min=7.3; max=9.4; mean=8.1), A. baumanii (min =6.1; max =7.4; mean =6.8) and P. aeruginosa (min=1.4; max=2.5; mean=1.9). MRSA had a significantly ($p=0.028$) increase in prevalence in 1999. Daily prevalence of MDR A. baumanii and P. aeruginosa did not change throughout the three years. There was a statistically significant increase of Enterobacter cloacae and E. aerogenes from 1997 to 1998 (0.5 to 1.6 for E. cloacae and 0.1 to 0.6 for E. aerogenes, respectively), but both returned to basal levels in 1999 (0.2 and 0.3, respectively). MDR strains of Klebsiella pneumoniae, Serratia marcescens, Escherichia coli, Stenotrophomonas maltophilia and Alcaligenes sp. Were also identified, but with prevalence less than 1.0 each. Until Jun 1999, patients colonized/infected with different MDR strains of Gram negative bacilli did not share same room; this measure, however, didn't show efficiency and was abandoned. CONCLUSION: The acknowledge of distribution of MDR strains in our hospital allowed quickness in control measures, with improvement of assistance and management of hospital beds.

INFECTIONS DUE TO MULTI DRUG RESISTANT BACTERIA IN AN UNIVERSITY HOSPITAL IN BRAZIL. Trabasso P,* Tresoldi AT, Padoveze MC, Dantas SRPE. Campinas State Univ, Campinas, Brazil.

INTRODUCTION: widespread use of antibiotics in hospital setting has resulted in selection of multi drug resistant (MDR) organisms, increasing morbidity and mortality and high health-care costs. OBJECTIVE: To assess annual incidence of MDR bacteria and to evaluate the measures of control adopted. METHODS: A retrospective study (Jan 1994 to Dec 1998) of MDR bacteria isolated from nosocomial infection (NI) in a public, teaching, acute and 3rd level care hospital with 403 beds (36 in intensive care units). Criteria adopted for MDR were: Staphylococcus aureus resistant to methicillin (MRSA); Acinetobacter baumanii and others Gram negative bacilli resistant to aminoglycosides (AMG), fluoroquinolones and 3rd generation cephalosporins (3CEF) and Pseudomonas aeruginosa resistant to AMG and 3CEF. Diagnostic of NI was made according CDC criteria (1988). Bacterial identification, site of isolation, colonization/infection status and origin from hospital or community were analyzed. Patients colonized/infected with MDR organisms were placed in Contact Precautions. RESULTS: MDR bacteria were more frequent in Surgical Intensive Care (13.8%) and Med Intensive Care (13.8%) Units. Overall, MDR bacteria was the etiologic agent of 22.1% to 39.2% (median=29.5%) of NI. The most frequent MDR agents of NI were A. baumanii (median=35.1%) and MRSA (median=33.8%) TABLE 1. Vancomycin Resistant Enterococcus spp. Were not identified. CONCLUSIONS: (1) MRSA and A. baumanii were the most frequent MDR microorganisms in our Institution. (2) Control measures adopted were not sufficient to reduce NI rates due to MDR organisms, showing the necessity of a revision of strategies to reduce cross dissemination.

Relative Frequency of MDR bacteria causing NI, 1994 to 1998.

	1994	1995	1996	1997	1998	Median
A. baumanii	28.6	35.1	37.6	40.4	33.8	35.1
S. aureus	36.2	30.2	39.5	33.8	32.7	33.8
P. aeruginosa	13.3	11.1	10.2	14.7	15.4	13.3
Enterobacter spp.	11.7	14.7	5.1	5.5	12.0	11.7
K. pneumoniae	2.5	4.4	5.7	4.4	1.1	4.4
S. marcescens	4.1	2.2	1.9	0.7	1.9	1.9
Other	3.6	2.2	0.0	0.4	3.0	2.2
TOTAL	100.0	100.0	100.0	100.0	100.0	

Outbreak Investigations

PICHIA ANOMALA FUNGEMIA: AN EXOGENOUS INFECTION?. Aragao PA, Oshiro ICVS, Manrique E, Matsuo LL, Leone C, Branchini MLM, Levin AS . Hosp das Clínicas, Univ of S. Paulo, Brazil.

Fungemia is a growing problem in hospitals and can affect premature newborns, Pichia anomala is a pathogen causing infections mainly in immunocompromised patients and neonates. OBJECTIVE: describe an outbreak of fungemia in the high risk and intensive care units of the Nursery including 4 cases caused by P. anomala. METHODS: From Jan 26 to May 4, 1998, 8 cases of fungemia occurred in newborns in the intensive care and high-risk units. A cohort including all patients admitted to theses units from 8 day before the first case to 2 weeks after the last who had a total time of hospitalization of more than 48 hours. Data were obtained involving birth and maternal factors, invasive procedures, antimicrobials. Preliminary results lead to cultures healthcare workers (hands) and of samples of parenteral nutrition. P. anomala strains were typed using the pulsed-field gel electrophoresis method. RESULTS: The cohort involved 59 newborns. The following factors associated with fungemia were: central venous catheter (RR: 1.6; 95%CI: 1.10-2.32); total parenteral nutrition (RR: 1.47; CI: 1.12-1.92); lipid emulsion (RR: 1.46; CI: 1.07-1.99); previous antibiotic use (RR:1.38; CI: 1.10-1.73); other invasive procedures (RR: 1.38; CI: 1.10-1.73). Prematurity and perinatal asphyxia were not associated with fungemia. There were 4 cases of P. anomala, 3 cases of C. parapsilosis (one associated with P. anomala) and 2 of C. albicans. Only one healthcare worker culture was positive for C. parapsilosis. Parenteral nutrition was negative. All cases were treated with amphotericin B. The 4 patients with P. anomala improved and cultures became negative, 2 also received flucytosine. Parenteral nutrition and lipid emulsion had been inadequately manipulated in the units and many components were added at the bed side. Adequate technique was instituted and the formulation modified. The 4 strains of P. anomala were typed and presented different patterns. CONCLUSIONS: The study showed that the cases of fungemia were associated with CVC, parenteral nutrition and lipid emulsion. Although these are obviously not independent factors, they suggest that the source of fungemia was exogenous related to inadequate manipulation of solutions. Little is known of P. anomala transmission The occurrence of P. anomala with C. parapsilosis known to be exogenous and possibly transmitted by healthcare workers' hands suggests that P. anomala infection may be also exogenous.

AN OUTBREAK OF A CEFOTAXIME, TOBRAMYCINE AND AMIKACIN RESISTANT KLEBSIELLA PNEUMONIAE. Arends JP, Kampinga GA, Gezelle Meerburg G, Postma W, Baas W, Ploeg C vd. Academic Hosp Groningen, Groningen, The Netherlands.

At 14 August 1999, a patient from Warsaw, Poland, was admitted for 6 days to the neurosurgical ward. Because the patient came from a foreign country, he was nursed in a separate room with Contact Precautions. A multiresistant (cefotaxime, tobramycin, gentamicin, amikacin, sulfa, trimethoprim) Klebsiella pneumoniae (MRKLPN) was cultured from a throat and rectal swab. Between 18 and 28 September, 4 patients on the neurosurgical intensive care (NIC) and 2 former NIC patients on another intensive care were found positive. The NIC was closed for new patients. The hands of 10 persons with patient contact were cultured: one nurse was positive. After intensive cleaning, the NIC was reopened at 9 October. Five days later a new patient on the NIC became positive, and the NIC was closed again. Hand cultures of 11 out of 37 persons were positive. Hand hygiene was reinforced, and it was ordered that all patient contact on wards with positive patients should be done with gloves. Thereafter hand cultures of 3 from 52 persons were positive. Screening (rectal and throat swab) on wards were positive patients had been nursed yielded nine other patients, 7 had been nursed on the NIC. Hand cultures from only 2 out of at least 800 persons not working on the NIC were positive. All positive patients were cohorted, with a dictated nursing staff. On 12 November, the NIC was reopened. All MRKLPN had the same DNA fingerprint. They contained three different b-lactamases: SHV-1, TEM-1 and CTX-M-3. The CTX-M-3 β-lactamase, responsible for the cefotaxime resistance, was also found in Escherichia coli, Enterobacter cloacae and Citrobacter freundii. The sequence was identical to the β-lactamase previously described in patients from a hospital in Warsaw, Poland (AAC 1998; 42:827 32). This strain was difficult to eradicate from hands and persisted in two nurses for several days, even after disinfection with isopropanol. Contaminated hands of personnel play an imported role in the spread of this MRKLPN. Strict use of gloves with every patient contact seemed to stop the outbreak.

NOSOCOMIAL LEGIONAIRES' DISEASE CLUSTER: RESULTS AND SOLUTIONS. Arribas JL, Hernández MJ,* Solano VM, Delgado MP, Martínez J, Rueda AJ. Miguel Servet Hosp, Zaragoza, Spain.

Three patients were diagnosed of nosocomial legionaires' disease in Haematologic unit between Sep-Nov 1998. A case was diagnosed with serology test (fourfold increase in titer), and the others with urinary antigen and/or positive culture from respiratory secretions. Two patients received respiratory therapy and they didn't use shower. The third patient didn't use any respiratory therapy, she used shower. All patients died, in two of them Legionella pneumophila (Lp) serogroup 1 was identified. No more cases were diagnosed from 11th Nov 1998. An active surveillance for the disease was initiated; preprinted order forms for cleaning and desinfection devices of respiratory therapy and reminding the use of

sterile water were distributed. The rooms were closed after the third case appeared. At first, environmental samples were obtained by swabbing faucets and shower heads, results were negatives for Legionella. The temperature of hot-water tanks and the water system of hospital was lower than 50°C. Chlorination controls in water distribution systems were in an acceptable level, about 1 ppm. We performed environmental sampling of water samples from hot-water tanks, cooling towers, and water samples from faucets and shower in the rooms. In addition, swabbing samples of faucets and shower heads. Only the water samples of the rooms were positives to Lp serogroups 1, 2, 14. In Dec 1998, we decided to clean all the system of water distribution with a heat-and-flush procedure. After that measure control, it was started a protocol with a heat-and-flush procedure (two times monthly) and surveillance environmental water sampling (two times yearly, at least). The results were the same that in the first sampling. In May 1999, it was installed a metal ionization system. The following environmental water sampling (Aug and Oct) has been negative.

RISK FACTORS FOR COLONIZATION AND INFECTION WITH MULTIRRESISTANT KLEBSIELLA PNEUMONIAE. Asensio A, Oliver A, Gonzalez-Diego P, Baquero F, Ros P, Cobo J, Palacios M, Lasheras MD, Canton R. Clínica Puerta de Hierro, Madrid, Spain.; Hosp Ramon y Cajal, Madrid, Spain.

An observational study was undertaken to describe a nosocomial outbreak caused by multiresistant K. Pneumoniae (MRKP) (third-generation cephalosporin and aminoglycoside-resistant, Klebsiella pneumoniae), the measures implemented for control and to identify the independent risk factors associated with colonization/infection by MRKP. Ten patients in the Paediatric Intensive Care Unit developed colonization or infection with MRKP from Oct 1997 to Apr 1998. Thirty-two (32) patients with MRKP-negative surveillance cultures admitted to the ICU during the outbreak period were selected as controls. Random amplified polymorphic DNA analysis of MRKP isolates revealed that all of them had an indistinguishable pattern. After identification of colonized patients by surveillance cultures, implementation of standard and contact precautions, and decreasing the use of third-generation cephalosporins and aminoglycosides the outbreak was controlled. Rate of 3rd generation cephalosporin and aminoglycoside (gentamycin or tobramycin) use showed a linear decreasing trend during the epidemic period (Chi-square test for trend 56.8 and 15.3 respectively; p values <0.001), as long as the epidemic declined. Age younger than 12 weeks (odds ratio, 13.1; CI95, 1.3-130) and previous treatment with third generation cephalosporins and aminoglycosides (odds ratio, 31.2; CI95, 3.3-298) were independently associated with MRKP colonization/infection by unconditional multiple logistic regression. There is strong evidence that individual exposure to third-generation cephalosporins and aminoglycosides, independently of other clinical determinants, can play a role as risk factor for MRKP acquisition during outbreaks. In addition to standard and contact precautions, the periodical screening of high risk patients during outbreaks, and the adequate use of third-generation cephalosporins and aminoglycosides contribute to the effective prevention and control of these epidemics.

AN ACINETOBACTER OUTBREAK IN THE INTENSIVE CARE UNIT; A "NO SOAP" APPROACH TO OUTBREAK CONTROL. Austin MA, McNabb SA, Peters GT, John MA. London Health Sciences Centre, London, Ontario, Canada.

During 3 weeks in 1998, 8 patients in our Critical Care Trauma Centre (CCTC) were noted to be colonized/infected with an Acinetobacter spp, an unusual isolate in this unit. Pulsed Field Gel Typing (PFGT) revealed all isolates to be a single strain. PFGT of the Acinetobacter spp isolates (7) from the previous 3 months indicated this strain had been present, albeit at a lower level for some time. Two of 40 environmental swabs grew the outbreak strain (sink and respiratory therapist's hands). The 30-bed CCTC is a regional referral trauma centre. A new facility is under construction but the present unit is crowded, with inadequate handwashing facilities. Interventions included: (1) Inservices regarding infection control practices; (2) cohorting of cases, (3) review of clinical practices, (4) providing devoted respiratory therapy equipment. The concurrent presence of methicillin-resistant Staphylococcus aureus (MRSA) in the CCTC made adequate cohorting of patients difficult and despite these efforts, 17 further cases occurred over 3 months. There was a reluctance to improve the existing handwashing facilities, given the planned new unit and so a decision was made to introduce waterless skin cleansers. Following placement of dispensers throughout the unit, the outbreak resolved. Acinetobacter spp has not been isolated from patients in the CCTC for 9 months. Staff reaction to the waterless skin cleanser has been positive. Dermatitis has not been a problem and nosocomial MRSA in the CCTC has decreased.

OUTBREAK INVESTIGATION OF BURKHOLDERIA CEPACIA ASSOCIATED WITH MULTIDOSE INHALATIONAL THERAPY IN AN INTENSIVE CARE UNIT. Babinchak TJ,* Herbert C, Renner C, Slifkin M. Thomas Jefferson Univ, Philadelphia, PA; Allegheny General Hosp, Pittsburgh, PA.

Burkholderia (Pseudomonas) cepacia is a well-characterized pathogen among patients with cystic fibrosis. Outside of this patient population Burkholderia is rarely described. We report an outbreak of Burkholderia cepacia in a non-cystic fibrosis population. Allegheny General Hosp is a 750-bed tertiary-care referral center with 75 intensive care unit beds. From Nov 1997 to Jul 1998, 47 patients were identified with Burkholderia cepacia in respiratory cultures. Patients were predominantly elderly (mean age 65.7), post-cardiothoracic surgery patients (78%), whose only underlying lung disease was chronic obstructive pulmonary disease. Cases were defined as isolation of Burkholderia cepacia from an appropriate respiratory specimen in a febrile patient with evidence of a new or changing infiltrate on chest X-ray or an increase in ventilatory requirements. The outbreak investigation included intensive care unit surveillance of physician, nursing and respiratory therapy practices, evaluation of operating room and pre-hospital practices, surveillance and environmental cultures. Risk factors identified in the acquisition of Burkholderia included poor compliance with barrier precautions and use of multi-dose vials for inhalational therapy. With increased emphasis of barrier precautions and elimination of the use of multi-dose vials for inhalational therapy, Burkholderia cepacia was eliminated from the intensive care units within four months.

CRYPTOSPORIDIOSIS IN A NURSING HOME. Berce I, Fiser J, Frelih T, Princic-Komic D, Kodranov A, Orazem T, Kolman J, Grmek-Kosnik I, Gubina M. Institute of Public Health of Nova Gorica, Nova Gorica, Slovenia; Nursing Home Podbrdo, Nova Gorica, Slovenia; Health Ctr Tolmin, Tolmin, Slovenia; Institute of Public Health of Ljubljana, Ljubljana, Slovenia; Institute of Public Health of Kranj, Kranj, Slovenia; Institute of Microbiology and Immunology of Med Faculty, Ljubljana, Slovenia.

In the period from June 6 to the end of July 1999, an outbreak of diarrhea occurred in a nursing home. Out of 112 elder persons, 29 (26%) had watery diarrhea. Seven of 29 (24%) had also nausea and abdominal pain and 3/29 (10.3%) were vomiting. The mean duration of illness was 4.4 days with a range of 3 to 6 days. Nobody of them was hospitalised. Sixteen samples of faeces of 29 symptomatic persons (ranging from 54 to 92 years, with the median age of 79 years), 14 faeces samples of the asymptomatic elder persons from the same institution and 50 faeces samples of the control group (adult healthy food handlers) were examined for Cryptosporidium oocysts. For the detection of Cryptosporidium oocysts, a modified Ziehl-Neelsen acid-fast staining technique was used. Stool samples were also examined for other enteropathogenic parasites, bacteria, and viruses. Cryptosporidium as a sole microorganism in the 11 of 16 (68.8%) persons with diarrhea did not differ significantly from that found in the 7 of 14 (50%) elder asymptomatic persons ($p < 0.05$). Cryptosporidium alone was significantly more frequently identified in those 7/14 elder asymptomatic persons than in the 3 of 50 (6%) healthy food handlers ($p < 0.005$). The high incidence of Cryptosporidium found in the faeces from the old persons in nursing home suggests an etiology of diarrhea. Danger for spreading of the infection should get more attention in these institutions in Slovenia.

RISK FACTORS FOR ACINETOBACTER BAUMANII BLOODSTREAM INFECTION IN AN SICU. Black CL, Blake W, Halvosa, JS, White N, Blumberg HM, Ray SM. Grady Health System, Atlanta, GA; Emory Univ, Atlanta, GA; Emory Univ, and Department of Epidemiology, Grady Health System, Atlanta, GA.

Over the past decade, Acinetobacter baumanii (Ab) has emerged as an important nosocomial pathogen. In 1998, we noted an increase in Ab infections, including a rise in Ab bloodstream infection (BSI) rate from a baseline rate of 3.1 BSIs/1000 patient days in 1997 to 10.7 BSIs/1000 patient days between Apr-Jun 1998 ($p<0.001$) in our SICU at a public urban hospital. Therefore, we carried out a case-control study in order to identify potential risk factors for Ab infection. A case was defined as any patient in the SICU who had a blood culture positive for Ab between Mar 1998 and Oct 1998. For each case, two controls were selected who had been in the SICU within one week of the respective case, had stayed in the SICU for a minimum of two days, and did not have Ab isolated from any body site. Among the 34 cases, 24 (70.6%) were male, 26 (76.5%) were African-American, the median age was 40 (range 23-82), the median length of stay in the SICU was 10 days (range 3-91), and all cause mortality was 32.4%. Nineteen (19, 55.9%) patients were previously colonized with Ab at another body site before developing bacteremia. Two (6.7%) of the Ab isolates were resistant to imipenem, 1 (3.2%) was resistant to amikacin, and 25 (89.3%) were resistant to gentamicin. Fifteen (15, 79%) of 19 isolates that were available for molecular typing had the same DNA fingerprint. Logistic regression analysis identified APACHE II score upon admission to the SICU >=19 (OR=14.13, 95% CI [2.0-99.7], p=.008) and receipt of hyperalimentation (OR=6.58, 95% CI [1.7-25.6], p=.007) as independent risk factors for Ab BSI. There was also a trend for increased risk of infection with an increasing number of surgical procedures (OR=1.44, 95% CI [0.99-2.1], p=.054). In summary, our study indicated factors associated with severity of illness were associated with an increased risk of developing an Ab BSI in an SICU. Since these factors are nonmodifiable, efforts to prevent the spread of Ab infection should focus on intensified infection control measures including strict adherence to enhanced contact isolation precautions and environmental cleaning.

THERMOMETERS AS VEHICLE OF KLEBSIELLA PNEUMONIAE PRODUCING EXTENDED SPECTRUM BETALACTAMASE. Broek van den PJ, Verbakel-Salomons EMA, Franssen A, Berbée GAM, Bernards AT. Leiden Univ Med Ctr, Leiden, The Netherlands.

In December 1998, for the first time extended spectrum betalactamase (ESBL) producing Klebsiella pneumoniae were isolated from two patients admitted to the pediatric ward of the Leiden Univ Med Ctr. The infection control nurse visited the department and gave instructions for barrier nursing and improvement of general hygiene. In the beginning of February 1999 ESBL producing Klebsiella pneumoniae was isolated from a third child. This finding prompted an investigation. Pharynx and rectum cultures were taken from all children present on the ward. Four children were found to be infected, making a total of seven cases. All cases were babies recently operated for congenital heart malformations. A regular case-control study to look for a source was not possible because only 4 controls could be identified. All routine procedures on the ward were discussed with the staff. This led to a limited number of environmental cultures. The thermometer holder was cultured because the staff mentioned that parents frequently measure body temperature of their children sometimes forgetting to use a protective sheet or to disinfect the thermometer after use. Cultures were taken from the bottom of the holder where some fatty dirt was accumulated. This culture yielded ESBL producing Klebsiella pneumoniae. RAPD typing showed that all isolates were identical, including the thermometer strain and one Klebsiella pneumoniae strain which did not produce ESBL. Apparently this strain had lost the ESBL coding plasmid. All thermometer holders in the hospital were checked, were found to be contaminated. Instructions were given for cleaning and disinfection of thermometers and thermometer holders.

OUTBREAK OF ACINETOBACTER CALCOACETICUS WHOSE SOURCE WAS THE HANDS OF A LABORATORY TECHNICIAN. Castro-Neto M, Sarquis MGA, Ribeiro JMVP, Mendonça RC, Martin PWL, Murta-Oliveira C. Mater Dei Hosp, Belo Horizonte, Brazil.

Mater Dei Hospital in Belo Horizonte, Brazil, is a hosp with 125 beds, with various medical specialties, including two Intensive Care Units (ICU), one neonatal and another adult. In Dec 1998 it was isolated the first strain of Acinetobacter calcoaceticus (AC) in the adult ICU, followed by several others in the next months. All the isolates had the same pattern of antibiogram and biochemical profiles inferred by the bionumber given by the automated identification system Vitek. In Feb 1999 the infection control staff made an epidemiological investigation, including cultures of a number of devices from the ICU, but source identification of the organism was not achieved. Meetings with medical staff, nurses and laboratory and radiology technicians were held; handwashing was emphasized, barrier precautions were installed, but these measures did not diminish the frequency of new cases. The first case in May was identified in the neonatal ICU, and in Jun in other wards. In Jul, when the outbreak totalled 22 cases, the same strain of AC was cultured in one of three blood cultures from a patient recently admitted to the hospital who came from her house, suggesting a collect contamination. A culture of the hands of the worker responsible for this collect was done and revealed a positive result for AC, with the same characteristics as the previous isolates. Cultures of the other laboratory technicians were negative. The worker was laid off his job in Jul and submitted to a decolonization of hands with chlorhexidine; when subsequent hand culture was negative for AC he returned to work. The last positive culture for AC in our hospital dates from 08/07/99; all patients (30) that had an infection by the strain had had contact with the worker mentioned above, previously to his treatment. This outbreak has an unusu-

al and interesting aspect because only one professional was hardly colonized and responsible for the dissemination of a bacterium commonly associated with wet environments.

NOSOCOMIAL BURKHOLDERIA CEPACIA OUTBREAK RELATED TO INTRINSICALLY CONTAMINATED MOUTHWASH. Cook J, Tight RR, Carson PJ, Matthey SG, Carlson LA, Holt SC. MeritCare Health System, Fargo, ND; Ctrs for Disease Control and Prevention, Atlanta, GA.

MeritCare Hosp is a 380-bed tertiary care hospital. Burkholderia cepacia (Bc) was isolated from the sputum of four Intensive Care Unit patients from 1/13 to 1/19/99. Baseline data identified only one respiratory isolate of Bc 11/98. Medical record review identified ventilation and metered dose inhaler Albuterol as the only common factors. There were no new respiratory therapy or nursing practices. Recent product changes included an antimicrobial soap, lotion and a non-alcohol mouthwash. Initial sampling of 12 items including the mouthwash was negative for Bc. Limitations included the small number of items sampled and the time delay from onset of positive cultures to sampling. Another case occurred on 2/9/99; further evaluation at that time was negative. The sixth case was detected 3/3/99 at which time 21 items were immediately sampled from the patient's room. Bc was isolated from the mouthwash. Four lots of the product were cultured in addition to unopened bottles of the suspected lot. Bc was isolated from one lot only. The Food and Drug Administration (FDA), Ctrs for Disease Control and Prevention, State Health Department, and manufacturer were notified. Five additional cases surfaced over the next five days. Pulsed field gel electrophoresis results from the patients and the mouthwash confirmed that the isolates were epidemiologically related. The mouthwash was removed from inventory 3/5/99 and an alcohol-based product was reinstituted. No additional cases occurred. Clinicians identified seven patients as infected and four patients as colonized. The FDA had extensive data demands to document the outbreak and facilitated a national recall of the product which occurred on 4/26. Based on our experience, we recommend that mouthwash that is used for oral cares in ventilated patients contain alcohol.

NOSOCOMIAL PUERPERAL MASTITIS OUTBREAK - COMMON SENSE VS STATISTICAL ANALYSIS. Dziekan G, Daschner FD, Grundmann HJ. Institute of Environmental Medicine and Hosp Epidemiology, Univ Hosp Freiburg, Germany Queen's Med Centre, Nottingham UK.

In a maternity department, 53 (7.2%) mothers who gave birth between Oct 1996 and Oct 1997 developed mastitis three to six weeks after delivery. In all cases Staphylococcus aureus of a single phagetype was isolated. Repetitive screening of personnel identified 7 staff members with S. aureus of the same strain. 6 were only temporarily colonized; one pediatric nurse with neurodermatitis showed the outbreak strain on several skin lesions on 8 different occasions. After removal of the persistently colonized nurse from patient care in Oct 1997, no more mastitis cases occurred. A case-control study was initiated in order to investigate a possible relationship between patient-specific risk factors, the presence of colonized personnel and the development of mastitis. 110 controls were matched to the 53 cases. Neither in the univariate analysis, nor after a stratification for potential confounders could a relationship between mastitis development and a specific exposition be established. On the basis of staff shift plans, a detailed research of possible contacts and contact intensity between patients and staff was carried out. For of the positive staff members could a significant association between presence and the development of mastitis be established. Even after correction for realistic contact rates (nurses/doctors ratio:5/1), no particular staff member was shown to have a significantly higher contact likelihood with cases. An in-depth case-control study couldn't prove an association with the assumed likely cause. Nevertheless, removal of the nurse with persistent skin condition stopped the outbreak and proved the assumed causal link. Reversibility is the strongest proof of causation.

MRSA EPIDEMIC-CASE-CONTROL STUDY TO INVESTIGATE HOSPITAL SPECIFIC RISK FACTORS. Dziekan G, Daschner FD, Grundmann HJ. Univ Hosp Freiburg, Germany Queen's Med Centre, Nottingham, UK.

In early 1996 a hospital-wide MRSA epidemic was recognized in a 900-bed university hospital. In order to investigate hospital-specific transmission routes, a case-control study was carried out. Cases and controls were matched after age (± 10 years), gender, admission date (± 10 days) and department at admission. Data on possibly associated risk factors, among which invasive procedures, intensity of needed care, antibiotic therapy, number of transfers within the hospital, were entered in an EPI Info 6.02 database for further statistical analysis with Stata 5.0. Between 6/1996 and 2/1997, 67 patients with nosocomially acquired MRSA were identified. Molecular typing showed in 96% of cases the prevalence of an identical strain. The average patient days at risk for cases and controls to contract MRSA was 17.3 and 23.7 days respectively (p=.01). 17 case patients (25.4%) showed an MRSA infection. In a univariate analysis a number of factors were associated with the acquisition of the MRSA status. Conditional multivariate regression analysis showed that intensity of care (p=.002), number of transfers (p=.019), quinolone therapy (p=.025) as well as tracheotomy (p=.055) were independently associated with MRSA. Confounding variables and independent risk factors were differentiated in the multivariate analysis. Intensity of care can be considered as a surrogate marker for a number of manipulations which represent the main risk factors for MRSA acquisition. Frequent transfers within the hospital hinder epidemiological analyses and efforts to bring the epidemic under control.

THE ROLE OF PREOPERATIVE ANTIBIOTIC PROPHYLAXIS IN ELECTIVE COSMETIC SURGERY. Fatica CA, Gordon SM, Zins JE. Cleveland Clinic Foundation, Cleveland, OH.

An estimated 2.7 million cosmetic procedures were performed in the United States in 1998, yet the role of preoperative antibiotic prophylaxis for elective cosmetic surgery is not clearly indicated. Routine antibiotic prophylaxis for elective cosmetic procedures was discontinued by a plastic surgeon (Surgeon X) at our institution in an effort to reduce use and cost in Jun, 1999. Subsequently a cluster of four Staphylococcus aureus postoperative surgical site infections (SSI) was identified. We performed a case-control study to identify risk factors for SSI in these patients. All patients undergoing elective cosmetic surgical procedures by Surgeon X during Jun, 1999 who did not develop a SSI were selected as controls. Four (4) cases and 12 controls were included in the study. All of the case-patients were female, the mean age was 65 years, were obese, cigarette smokers, or had underlying illness. The infections occurred in patients undergoing facelift [2], abdominoplasty, and breast reconstruction with implant [1 each]. The only significant risk factor associated with SSI was the mean duration of procedure [5 hours vs 2, p = 0.02]. No common source of infection was identified by review and observation of surgical technique. Pulse-field gel analysis of the S. aureus isolates from the four case-patients and the nares of surgical personnel revealed no common strain. Following the re-institution of preoperative antibiotic prophylaxis with Cefazolin sodium for procedures anticipated to last 2 hours, no additional SSI have been identified (4/29 vs 0/20, p = 0.13). We conclude that targeted antibiotic prophylaxis for elective cosmetic surgery with Cefazolin sodium may be useful in reducing SSI.

AN EPIDEMIC OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN A HEART SURGERY DEPT IN SAXONY, GERMANY, OCTOBER 1998 TO MARCH 1999. Fitzner J, Mueller I, Fellmann G, Sinn G, Hellenbrand W, Ammon A, Petersen L . Robert Koch-Institut, Berlin, Germany; Health Department, Leipzig, Germany; State Lab of Saxony, Germany; Robert Koch-Institut, Berlin, Germany.

BACKGROUND: Oct 1998-Mar 1999, 26 patients with a positive MRSA culture were detected in the department of hospital L, compared to one the previous year. We conducted a case-control study to investigate risk factors for MRSA. METHOD: Cases were patients with a positive MRSA culture who had been admitted to the department from 10 Oct 98 to 12 Mar 99. Controls were randomly chosen from departmental admission lists. Charts were reviewed with a standardized questionnaire. Isolates were typed molecularly. Nasal-swabs from personnel were taken. RESULTS: 26 cases and 54 controls were studied. Cases were older (mean 66.1 vs 60.1 years, p<.03) and were more likely than controls to have had more than one operation (OR=17.1; 95%CI 4.2-66.8), longer intensive care unit (ICU) stays (mean 15 vs 2 days p=<.000005), more days receiving antibiotics (mean 20.5 vs 2.2, p<.0005), trans-esophageal echocardiography (TEE) (OR=3.8; 95%CI 1.2-12.0), and sonography (OR=4.2, 95%CI 1.2-15.1). In a logistic regression model, days in the ICU, age, sonography, TEE and penicillin therapy were risk factors for MRSA. All 21 typed isolates were identical. One staff member from the intermediate care unit was colonized with MRSA. After introduction of cohort isolation, no new patients with the same MRSA type were identified. CONCLUSIONS: The epidemic's length suggested person-to-person transmission. The ICU was the probable transmission location. Measures of underlying disease severity and intensity of treatment increased the probability of there being a case. Colonized personnel were not the source of the outbreak. Strict cohort isolation stopped the epidemic.

A CLUSTER OF NOSOCOMIAL VARICELLA IN A PEDIATRIC INSTITUTION: OPPORTUNITES FOR IMPROVEMENT. Goldman, C, Freeman, R, Streitenberger, L, Scott, L, Monteath, A, Sass-Korstak, C, Matlow, A. Infection Control Department, The Hosp for Sick Children, Toronto, Ontario, Canada.

Patients with suspected or confirmed varicella are admitted into "Airborne Precautions" in negative pressure rooms on one unit, in our 250 bed, tertiary care facility. Between Jun 13 and 25, 1999, three cases of nosocomially acquired varicella were identified in children who had been on this unit, prompting a full investigation that focused on facilities and ventilation, clinical practice and occupational health. Nosocomial varicella (NV) was defined as varicella developing in a patient, family member, healthcare worker (HCW) or other individual, from May 31-Jul 30 and with no other source of exposure identified. A total of 143 patients were identified as exposed during the incubation period and 58% of these families were contacted. One additional patient (8%) and a sibling had NV (1.43% of those contacted). No HCWs were identified as primary sources or as secondarily infected. The operating parameters of the unit's ventilation system did not meet the original design specifications and except for one room, did not comply with current standards. HCW compliance with "Routine Practices" and "Airborne Precautions" as well as with employee communicable disease screening was suboptimal. Ongoing staff education, opimization of enviornmental controls, education and enforcement of infection control practices and compliance with occupational health requirments were key areas identified for improvements. A taskforce developed from the initial outbreak management team is spearheading these initiatives.

AN OUTBREAK OF SERRATIA MARCESCENS IN A CARDIOVASCULAR INTENSIVE CARE UNIT: CONTAMINATED HANDWASHING SINKS AS A RESERVOIR. Gonzalez VR, Hougland PW, Vallejo KR, Price MF, Houston S, LaRocco M, Gentry LO. St. Luke's Episcopal Hosp, Houston, TX.

BACKGROUND: In Nov 1998, a strain of Serratia marcescens (SEM) marked by a unique antimicrobial susceptibility pattern was isolated from the respiratory tract of eight patients in the cardiovascular surgical intensive care unit. During a 6-month period from Oct 26, 1998 through Apr 30, 1999, SEM was isolated from 39 patients. This was a four-fold increase in the frequency of SEM in the intensive care units. METHODS: An outbreak investigation was initiated. A case was defined as a patient with a positive SEM culture that underwent a cardiovascular procedure and/or emergent endotracheal intubation. A case-control study was performed. Demographic and clinical data such as operating room suite, personnel, surgical procedures and respiratory treatments were collected. A representative sample of SEM strains were fingerprinted by the random amplified polymorphic polymerase chain reaction (RAPD-PCR) assay. RESULTS: The lower respiratory tract was the most frequent site of infection and colonization. Results of the case-control (N=53), revealed that a patient's location in a particular zone of the unit (OR 28, p=.0005), treatment by a respiratory therapist (OR 4.02, p=.044), and respiratory treatments with Atro0ent (OR 2, p=.0012) and Mucomist (OR 2.2, p=.028) were significant contributors in the acquisition of SEM. Genotyping of strains by RAPD-PCR revealed that the strains were related but not identical. Cultures were obtained from potential environmental sources including anesthesia and respiratory care equipment, medication solutions, counter tops, sinks, and sink drains. SEM was repeatedly isolated from several handwashing sinks and their associated counters and drains. A biweekly-cleaning schedule of the surgical intensive care unit was initiated, including a thorough surface disinfection of the handwashing sinks and drains. CONCLUSION: SEM was isolated from several highly utilized handwashing sinks in the intensive care unit. Possible transmission of SEM from sinks to the hands of healthcare personnel contributed to its spread in patients and environmental surfaces. Control measures including staff education, identification of the reservoir and subsequent environmental cleaning efforts resulted in the control of this outbreak.

INVESTIGATION AND MANAGEMENT OF AN OUTBREAK OF INVASIVE SURGICAL SITE INFECTIONS WITH ASPERGILLUS FLAVUS. Gordts B, Claeys K, Jannes H, Boelaert J, Van Landuyt H, Heinemann S, Nolard N. AZ Sint Jan, Brugge, Belgium; Institute for Public Health L Pasteur, Brussels, Belgium.

In Apr 1998, A. flavus was recovered from sternal surgical site infections (SSSI) of 2 patients after cardiac surgery (CS). Environmental cultures demonstrated that air and surfaces in the CS rooms were contaminated with A. flavus, but inflowing HEPA-filtered air was sterile. A. flavus was still grown after thorough cleaning and desinfection, and we discovered that the inner compartments of electronic equipment like computer, cell saver and car-

diopulmonary bypass pump contained A. flavus. Dismantling and decontamination eliminated this source of fungi. Further investigation indicated that semirestricted zones adjacent to the CS rooms were massively contaminated with A. flavus. Consequently, the surgical ward (SW) was closed, equipment and ceilings dismantled, and the entire ward cleaned and decontaminated. A task force was established that coordinated the cleaning and reconstruction activities, informed administrators, healthcare workers (HCW), patients and the press. A retrospective case finding study demonstrated SSSI proven or possibly caused by A. flavus in 11 patients who underwent CS between Jan 18 and Apr 17. All were treated with itraconazole, but 3 patients ultimately died. Since no apparent hypothesis could explain the spread of fungi through the SW, we evaluated the current practices and habits in the SW. An action plan was elaborated to change 42 items of behaviour, surgical attire, traffic control and housekeeping that deviated from APIC and CDC recommendations. After implementation of this plan, environmental cultures no longer grew fungi. No case of Aspergillus SSSI occurred in the next year. This epidemic illustrates the complex epidemiology of fungal contamination in a SW. A task force of infection control practitioners, HCWs, administrators, engineers and support services is needed to eradicate the environmental contamination but also to change behaviour of HCWs towards hygiene.

INTERVENTIONAL STRATEGIES USED TO CONTROL A PROLONGED OUTBREAK WITH RESISTANT ACINETOBACTER BAUMANII IN ICU AT A TERTIARY MEDICAL CENTER. Gornick W, Narvaez Y, Cinat M, Ramos S, Martin S, Lekawa M, Thrupp L. UCI Med Ctr.

UCI Medical Center is a 463-bed tertiary teaching hospital with a level I trauma center and a total of 40 ICU beds including trauma, burn surgical and medical. Multi-resistant Acinetobacter baumanii is an increasing nosocomial pathogen. The apparent index patient was transferred to UCIMC in Nov 1996 and had a 53-day LOS. Culture of sputum collected on admission grew A. baumanii resistant to all antibiotics tested except it was susceptible to Polymyxin B, Ampicillin/Sulbactam and intermediate to Imipenem. Because of bed availability, the patient was cared for in BICU, CCU and MICU. A month after admission, apparent transmission had occurred to two patients and continued despite contact precautions and education. Infection (27) and colonization (26) occurred overall in 53 patients over a period of 13 months. During the outbreak period, the average daily census of the ICUs was 89% occupied. Genotyping revealed two closely-related variants of one apparent strain. Suppression of the outbreak required a comprehensive, aggressive control program and included contact precautions, gown, gloves, meticulous handwashing, cleaning of equipment and rooms, point prevalence cultures, staff and physician education, addition of disinfectant wipes and waterless soap, strain typing, patient/family education brochure, sterilization of ventilator temperature probes, cultures of ICU rooms and ventilator equipment, daily cleaning of ventilator and establishing an ICU Acinetobacter cohort by opening a closed unit. Cohorting with ongoing interactive education and enforcement of infection control practices ultimately resulted in eradication of resistant A. baumanii.

SERRATIA LIQUEFACIENS BLOODSTREAM INFECTIONS AND PYROGENIC REACTIONS ASSOCIATED WITH EXTRINSICALLY CONTAMINATED ERYTHROPOETIN. Grohskopf LA,* Roth VR, Feikin D, Hoffman RE, Arduino MJ, Carson LA, Holt SC, Jensen BJ, Tokars JI, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Colorado Dept of Public Health and Environment, Denver, CO.

Between June 30 and August 2, 1999, 12 Serratia liquefaciens bloodstream infections (BSIs) and 6 pyrogenic reactions without BSI occurred at an outpatient hemodialysis center. In our investigation, we defined a case-patient as one who developed fever (greater than or equal to 100°F) or rigors during or within two hours after hemodialysis; a case-session was a session during which the patient met the case-patient definition. We conducted a cohort study of all dialysis sessions that occurred on the same days as case-sessions. Risk factors assessed included: demographic characteristics, underlying disease, vascular access, session date and length, machine, dialyzer reuse number, and parenteral medications. Sessions during which antimicrobials were given were excluded. We analyzed 181 sessions occurring between June 30 and August 10, involving 49 patients. There were 20 case-sessions among 15 patients. Doses of erythropoetin (EPO) received were higher during case- vs. noncase-sessions (median 6500 U vs. 4000 U, p=0.011). The relationship with EPO dose remained after adjustment for age, sex, weight, shift, and hematocrit. Preservative-free EPO vials intended for single use were used on multiple patients. Any remaining EPO was pooled into one vial for later use. Culture of empty post-pooling EPO vials (two lot numbers), pooled EPO, and soap and hand lotion yielded S. liquefaciens. Case-patient, EPO, and soap/lotion isolates were indistinguishable by pulsed-field gel electrophoresis. Following cessation of both pooling EPO and using refillable soap containers, no further cases occurred. Our data document extrinsic contamination of EPO via pooling of residual medication. Multiple entries of single-use vials and medication pooling may cause BSI and should be avoided.

TAP-WATER AS A SOURCE OF AN OUTBREAK OF VENTILATOR-ASSOCIATED PNEUMONIA CAUSED BY ACINETOBACTER BAUMANNII ON A NEUROLOGICAL INTENSIVE CARE UNIT?. Hauer T, Kurajouli S, Dettenkofer M,* Schneider C, Els T, Daschner F, Jonas D. Institute of Environmental Medicine and Hosp Epidemiology, Freiburg, Germany.

Acinetobacter baumannii has increasingly been involved as an agent of hospital outbreaks worldwide. A considerable number of outbreaks due to contaminated medical equipment and materials have also been reported. Tea or other fluids used for mouth hygiene have so far seldom been found as a source of infections caused by Acinetobacter spp. A. baumannii was isolated on our neurological intensive care unit from tracheal secretions in 41/157 patients (26%). Ventilator-associated pneumonia caused by A. baumannii alone or in combination with other pathogens was diagnosed in 22/41 patients (53.6%). Genotyping by RAPD-PCR (randomly amplified polymorphic DNA-PCR) revealed 10 genetically different strains. Six of them were involved in small clusters of patients colonized or infected by one single clone. Species identification by tRNA spacer fingerprinting revealed only 4/10 strains as A. baumannii sensu strictu (other genotypes: 1,3,14). Environmental sampling revealed 2 strains from tap-water and from anti-splash nozzles which were also found in 5 patients. One of the outbreak-strains was also isolated from tea used for mouth care.

List: Risk factors and patient data (n=41)

average length of stay (days)	29.4
ventilated patients (%)	31 (75.6%)
patients with cardiovascular disease (%)	24 (58.5%)
tea used for mouth hygiene (%)	39 (95.1%)
preceding therapy with cephalosporins (%)	31 (75.6%)

Interventions included contact precautions, education, weekly desinfection of anti-splash nozzles and desinfection of tap-water for washing patients with pvp-iodine. A screening of all patients during five weeks conducted later revealed unrecognized colonization in 3/44 patients (skin, throat). Again another strain from tap-water was identical with 2 patient isolates.

CONCLUSIONS: polyclonal acquisition of A. baumannii from tea used for mouth care prepared with insufficiently heated tap-water desinfection of anti-splash nozzles reduced colonization of tap-water with A. baumannii better compliance with hand desinfection resulted in less colonizations/infections.

NEONATAL STAPHYLOCOCCUS AUREUS PUSTULOUS RASH OUTBREAK LINKED BY MOLECULAR TYPING TO COLONIZED HEALTHCARE WORKERS. Hoffmann KK,* Weber DJ, Bost R, Rutala WA. Univ of North Carolina School of Medicine and UNC Hosps, Chapel Hill, NC.

In Aug 1998, a 150-bed naval hospital in eastern North Carolina identified an outbreak in the newborn nursery. Cases were newborn males who had undergone a circumcision procedure and post-discharge required antimicrobial treatment for severe pustulous diaper rash. A total of 36 cases were identified from Aug to Jan 1999. All 17 cases that were cultured grew methicillin-sensitive, erythromycin-resistant Staphylococcus aureus. Extensive environmental culturing of the nursery unit and circumcision procedure equipment did not reveal an inanimate reservoir for the S. aureus. Initial infection control measures (Aug) to review aseptic technique and instrument sterilization procedures were ineffective. In Jan additional control measures included enforcement of glove wearing for all diaper changes and limiting post-circumcision care to one healthcare worker (HCW) per newborn. In Feb all HCWs (MDs, RNs, LPN and corpsmen) were cultured by anterior nasal swabs and hand swab cultures. Fourteen (14) HCWs had positive cultures identified with S. aureus. Pulse field gel electrophoresis (PFGE) was performed on 13 of the 17 case isolates. All 13 case isolates were identical. All 14 HCWs identified with S. aureus were compared to the >13 cases by PFGE, and 3 HCWs (2 RN, 1 LPN) matched identically. One of these HCWs had a chronic cough, and a second had concealed dermatitis. This suggests that these HCWs were disseminators in light of the prolonged nature of the outbreak. Antimicrobial decolonization was instituted for the HCWs and there was one additional case in Mar. In conclusion, HCWs identified by DNA testing may have represented the reservoir of infection in this outbreak.

PSEUDOMONAS AERUGINOSA ENDOPHTHALMITIS OUTBREAK ASSOCIATED WITH A CONTAMINATED PHACOEMULSIFIER. Hoffmann KK,* Weber DJ, Rutala WA, Gergen MF, Weaver LJ. Univ of North Carolina School of Medicine and UNC Hosps, Chapel Hill, NC.

The current risk of endophthalmitis following cataract extraction is ~0.1 to 0.5%. We report here an investigation of an outbreak of post-operative endophthalmitis with P. aeruginosa. Five of eight (60%) patients presented with endophthalmitis within 48-72 post-cataract extraction. All patients had surgery on the same day in the same room by the same surgeon. All infected cases had surgery on the right eye and all noninfected had surgery on the left eye. P. aeruginosa was cultured from the vitreal tap of three patients. Cultures obtained from the anterior chamber only of the other two patients did not yield P. aeruginosa. An extensive evaluation of the environment was performed. Fifty-three (53) cultures were obtained from the following sources: sink drains, sink aerators, potable water, soap dispensers, water pick, phacoemulsifier internal tubing, air pump, all multidose vials (used before, during, and after surgery), unopened irrigating salt solutions, and eye ointments. P. aeruginosa was isolated from phacoemulsifier internal tubing and sink drains. The three patient isolates and the isolate obtained from the phacoemulsifier were identical by pulse field gel electrophoresis and all were different from the strains obtained from the sink drains. This represents the third reported outbreak of P. aeruginosa post-operative endophthalmitis associated with a contaminated phacoemulsifier but the first from this manufacturer. All manufacturer's recommendations regarding the use and reprocessing of the phacoemulsifier were followed. The role of the internal tubing as a potential source of nosocomial infection needs to be further evaluated, and additional recommendations may be required to prevent future outbreaks.

INVESTIGATION OF RELATEDNESS OF PSEUDOMONAS AERUGINOSA POSITIVE CLINICAL AND ENVIRONMENTAL ISOLATES AND THE CLINICAL IMPLICATIONS OF A SUSPECTED OUTBREAK IN A NEONATAL INTENSIVE CARE UNIT. Hood RH, Faoagali JL, Coutler C, Bodman J, Cartwright D. Royal Women's Hosp, Brisbane, Australia; Royal Brisbane Hosp Campus, Brisbane, Australia.

INTRODUCTION: Pseudomonas aeruginosa is not a common neonatal pathogen, but its pathogenicity is well recognised. From Dec 1997 to Jun 1998, five neonates were identified with Pseudomonas aeruginosa bacteraemia, representing a marked increase from previous years. Four babies died as a result of this infection. STUDY OBJECTIVES: (1) To determine if the blood cultures were genetically related, indicating cross-infection. (2) To investigate whether the same strains could be isolated from the nursery environment, indicating a common environmental source. METHOD: The bacterial molecular typing method chosen was pulsed-field gel electrophoresis (PFGE). Neonatal isolates from the period under investigation were analysed. Environmental isolates were also collected and examined. RESULTS: No two babies shared organisms with the same PFGE pattern. Examination of clinical isolates and cultures taken from the environment of one baby were indistinguishable and therefore from the same strain. Two other environmental isolates shared the same PFGE pattern but did not match any clinical isolates. All other environmental isolates were negative for Pseudomonas aeruginosa. CONCLUSION: There was no evidence that this cluster of infections was the result of cross-infection or a common environmental source. However, work practices were reviewed and recommendations made. There have been no further nosocomial neonatal Pseudomonas aeruginosa bacteraemias in the subsequent 18 months.

OUTBREAK INVESTIGATION ON EPIDEMIC KERATOCONJUNCTIVITIS IN A NEONATAL INTENSIVE CARE UNIT. Jeong IS, Ree YH, Oh HS. Clinical Trial Center, Seoul National Univ Hosp, Seoul, Korea; Boramae Hosp, Seoul, Korea; Seoul National Univ Hosp, Seoul, Korea.

BACKGROUND: This report concerned the outbreak investigation of the epidemic keratoconjunctivitis (EKC) which occurred from Apr to May in the neonatal intensive care unit (NICU) of Seoul National Univ Hosp, in Seoul, Korea. METHOD: We defined the cases by the clinical sign and symptoms and investigate the possible causes of this outbreak by cross-sectional analysis. RESULTS: The number of total cases was 18, includeing neonates, healthcare workers. The index case was thought to be infected during a family

visit and the other cases may have been transmitted by contact with nurses who cared for or fed the index patient. There were no statistically significant differences between case and non-case neonates. However, for nurses, the total amount of time worked in the hospital and in the NICU was a significant factor. CONCLUSION: According to our contact precautions, we enforced cohort isolation and emphasized strict handwashing and aseptic technique to the healthcare workers. All of the equipment, especially eye clips used by the cases, was disinfected or sterilized. Fortunately this outbreak was ended approximately one week after it was recognized and the investigation began.

ERADICATION OF AN OUTBREAK STRAIN OF MULTI-RESISTANT ACINETOBACTER BAUMANNII FROM A BURN UNIT. Jones Paul L, Barry C,* Fish J, Smith K, Louie L, Louie M, Simor A, Vearncombe M. Sunnybrook and Women's College Health Sciences Centre, Univ of Toronto, Toronto, Canada.

A. baumannii is an environmental Gram negative bacillus that may become endemic or epidemic in critical care units. It is resistant to drying, surviving on surfaces in the immediate environment of colonized or infected patients allowing contamination of hands and equipment. It may rapidly develop antimicrobial resistance. The burn unit of S&WCHSC is a tertiary regional referral unit with 10 intensive care beds. The index patient was identified after transfer into the unit as colonized with multi-resistant A. baumannii, sensitive only to imipenem. This strain was transmitted to 23 (20%) of 116 acute burn patients over 8 months. Twelve (12, 52%) had infections: 7 bacteremias, 6 pneumonias and 4 wound infections with 2 deaths. Pulsed-field gel electrophoresis typing confirmed all isolates were identical. Investigation of the outbreak indicated transmission was multi-factorial: inconsistent hand hygiene, use of barrier precautions, and concentration of the hospital disinfectant; inadequate cleaning of patient rooms and equipment; contamination of the hydrotherapy room. The burn unit was closed. INTERVENTIONS: improved design of soap and paper towel dispensers, improved access to handwashing sinks, increased use of an alcohol based hand rinse, reinforced use of barrier precautions, movement from clean to colonized patients, improved cleaning of patient care areas and shared equipment, quality control of disinfectant concentration. The burn unit was reopened 1 week later after extensive cleaning and negative environmental cultures. There has been no further transmission of the outbreak strain and no post-cleaning positive environmental cultures. Ongoing surveillance and continued attention to hand hygiene and cleaning are essential to prevent recurrent outbreaks due to this or other antibiotic resistant organisms.

THE ENVIRONMENT AS A RESERVOIR FOR ACINETOBACTER BAUMANII IN A SICU. JS Halvosa, M Cole, CL Black, N White, HM Blumberg, SM Ray. Grady Health Systems, Atlanta, GA.

Acinetobacter baumannii (Ab) is a multiresistant nosocomial pathogen of increasing importance. We investigated an increased rate of nosocomial Ab infections in the SICU. The rate of Ab blood stream infections (BSIs) increased from our baseline of 3.1/1000 patient days (pd) in 1997 to 10.7/1000 pd between Apr-Jun 1998 ($p<0.001$). Outbreak investigation included assessing environmental contamination, performing patient surveillance cultures for Ab every 2 weeks, molecular typing of clinical and environmental isolates, and assessment of adherence to infection control policies. Interventions included implementation of enhanced contact isolation, environmental cleaning protocols, and healthcare worker education. In Jul-Aug. 1998, before implementation of interventions, 38/122 (31%) of the environmental cultures were positive for Ab. Recovery of Ab from the environment was not eliminated but decreased significantly over the next 12 months to <15% by the second quarter 1999 ($p<0.001$). Ab was most commonly recovered in the environment from blood pressure cuffs (42/119 [35.3%]) and bed rails (43/147 [29.3%]). Following infection control interventions, the rate of Ab BSIs decreased significantly from 10.7/1000 pd in Apr-Sep 1998 to 5.4/1000 pd in Oct 1998-Jun 1999 ($p<0.05$). Molecular typing of Ab isolates recovered from surveillance, clinical and environmental cultures revealed that 235/435 (54.0%) had an identical PFGE banding pattern designated AA1. This strain was found in similar proportions from both patient and environmental isolates. In summary, we found the environment to be an important reservoir for Ab, and strains found in the environment were identical to those recovered from patient surveillance and clinical cultures. There appeared to be a temporal relationship between a decrease in environmental recovery of Ab and the rate of Ab BSIs. Nosocomial transmission with this hardy pathogen is challenging to prevent and likely associated with environmental contamination.

EPIDEMIOLOGICAL AND MOLECULAR INVESTIGATION OF A NOSOCOMIAL OUTBREAK OF STERNAL WOUND INFECTIONS. Kainer MA, Pearson SR, Mayall BC. Western Hosp, Melbourne, Australia.

Sternal wound infections are a serious complication of cardiac surgery. They are associated with significant morbidity, mortality (10% to 14%) and financial costs. Over a two-month period there was a significant rise (reaching a peak of 21%) in the number of methicillin-resistant Staphylococcus aureus (MRSA) deep sternal wound infections following cardiac surgery at one institution. A common source for the MRSA was strongly implied on the basis of epidemiological investigations and molecular typing methods. Twenty (20) of 21 MRSA sternal wound isolates (95%) were identical based on SmaI restriction profiles using Pulsed-Field Gel Electrophoresis (PFGE). In thoracic patients (pts) sharing the same ward, 35% of MRSA isolates were of the outbreak type. PFGE of 15 MRSA isolates of non-cardiac pts from the general (medical and surgical) intensive care unit (where all cardiac pts spend the first 12 to 24 hours post surgery), revealed eight strains of MRSA. The outbreak strain was the most common 5/15 (33%). Similarly, the outbreak strain accounted for 35% of MRSA isolates from pts in other areas of the hospital, over the same time period. Prospective pre-operative nose and groin swabs from 33 cardiac pts revealed no MRSA colonization. Of 201 staff members screened for MRSA with nasal swabs, only 2 (1%) were colonised with MRSA; of these were of the outbreak type. Surgical instruments were inspected. The sternal saw and Ankeney sternal retractor are both complicated instruments and very difficult to clean. Debris was evident on hard-to reach places on the saws and retractors. MRSA (of the outbreak type) was isolated from one of the retractors. It remains unclear whether the survival of the MRSA was due to the presence of organic material or autoclave malfunction. Implementation of a number of control measures was associated with termination of the outbreak.

CLUSTER OF INVASIVE INFECTIONS DUE TO NONTOXIGENIC CORYNEBACTERIUM DIPHTHERIAE. Kakis A, Vatan M, Lambert L, McCabe R, Kim C, Wong J, Chandler A, Popovic T. Alameda County Med Ctr, Oakland, CA; Ctrs for Disease Control and Prevention, Atlanta, GA; California State Department of Health Services, Berkeley, CA; Alameda County Public Health Lab, Oakland, CA.

During a 3-month period in 1999, nontoxigenic C. diphtheriae was recovered from the blood (2) and synovial fluid (1) of three patients in California. Identification of the isolates was confirmed by the California Department of Public Health and Ctrs for Disease Control and Prevention. The isolates were negative for toxin by Elek and PCR assays. Ribotyping, which is considered the gold standard for molecular subtyping of C. diphtheriae by the World Health Organization Diphtheriae Reference Ctrs, was performed using BstEII and showed that these 3 isolates were identical. No toxigenic or nontoxigenic C. diphtheriae had been cultured by the ACMC Lab in the previous 20 years. The two patients with C. diphtheriae blood isolates had endocarditis diagnosed during valve replacement surgery for congestive heart failure. One had several probable embolic episodes. The third patient had C. diphtheriae cultured from synovial fluid obtained from an ankle that had recently undergone open reduction internal fixation for fracture. All three patients had poor dental hygiene. Although they all resided in Oakland, of the three patients had known contact among themselves. One of the two patients with endocarditis was likely using illicit narcotics, the other smoked cocaine. The third patient had no known risk factors identified. This cluster of infections suggests that nontoxigenic C. diphtheriae is circulating in Oakand, California, causing infections.

STATE HEALTH DEPT ASSISTANCE IN OUTBREAKS OF NOSOCOMIAL INFECTIONS. Kioski CM, Cage GC, Komatsu KK, Harter G. Arizona Department of Health Services, Phoenix, AZ.

The Arizona Department of Health Services (ADHS) offers assistance to healthcare facilities in epidemiologic investigations, outbreak identification, prevention and control. In addition, the ADHS provides laboratory support using Pulsed-Field Gel Electrophoresis (PFGE) to assist in strain typing. In the past 10 years, 11 nosocomial outbreaks were investigated by the ADHS including one "pseudo" outbreak at a long term care facility. ADHS has provided laboratory support on numerous other clusters. Pathogens associated with outbreaks included Legionella pneumophila serogroup 6, Burkholderia cepacia, Pseudomonas aeruginosa, Mycobacterium fortuitum, Salmonella oranienburg, vancomycin-resistant Enterococcus, and Norwalk virus. P. aeruginosa was the most common pathogen resulting in outbreaks of nosocomial ventilator associated pneumonia, septicemia, ventriculitis, and surgical site infections. Nosocomial pneumonia was the most common site of infection (3 outbreaks) followed by surgical site infection (2 outbreaks) and gastroenteritis (2 outbreaks). Seven outbreaks occurred in hospitals, one in a long term care facility, one in an ambulatory surgical center, and one in an outpatient dialysis unit. Two outbreaks identified a vehicle as a source of infection: water containing L. pneumophila serogroup 6 and alcohol-free mouthwash extrinsically contaminated with B. cepacia. The Centers for Disease Control and Prevention (CDC) provided on-site assistance in two outbreaks. The CDC also provided assistance via telecommunications on 7 of 8 remaining outbreaks.

A CLUSTER OF MYCOBACTERIUM MUCOGENICUM BACTEREMIAS IN BONE MARROW TRANSPLANT PATIENTS: POSSIBLE ASSOCIATION WITH M. MUCOGENICUM IN HOSPITAL WATER SUPPLY. Kline S, Cameron S, Streifel A, Kairis F, Peacock K, Besser J. Fairview-Univ Med Ctr, Minneapolis, MN.; Univ of Minnesota, Minneapolis, MN. ; Minnesota Dept of Health, Minneapolis, MN.

In Aug 1998, there were 4 reported cases of Mycobacterium mucogenicum bacteremia in 35 (11.4%) patients who underwent Bone Marrow Transplant (BMT) in Jul-Aug, 1998 at Fairview-Univ Med. Ctr. There had been one M. mucogenicum bacteremia in the preceding 12 months (of 195 BMTs done, 0.5%). Concern that these patients received a common contaminated product prompted a chart review and case control study. There was no statistically significant difference in the cases and controls in IV products received or procedures performed. Cases were statistically more likely to have ABO incompatibility with their donor than controls (2-sided p-value Fisher's exact = 0.022). Marrow processing procedures were reviewed and no evidence for potential contamination found. Cultures of multiple hospital and clinic water and ice samples for AFB found atypical mycobacterium in several sources. M. mucogenicum was cultured from the BMT Clinic sink tap water, the BMT unit tap and shower water, the hospital hot water source, and the city water supply to the hospital. Quantitative AFB cultures ranged from 0->200 cfu/ml water. Analysis of the first 4 patient isolates showed 3 strains. Two more patients developed M. mucogenicum bacteremia over the next 3 months. A second case control study showed no statistical association between more frequent bathing, neutropenia or steroid use and M. mucogenicum bacteremia. We suspect that the source of the M. mucogenicum outbreak is water contamination of the central venous catheter (CVC) at either the entry site to the chest or the distal connections/caps during bathing. This is the most direct route for M. mucogenicum to enter blood. We recommended that the BMT unit give increased attention to protecting the CVC from water during bathing and that shower heads/hoses be replaced.

EPIDEMIOLOGY AND CONTROL OF A NOSOCOMIAL OUTBREAK OF MULTI-DRUG RESISTANT ACINETOBACTER . Koll B, Raucher B, Friedmann P, Ramnarine J, Woldesenbet E, Vogel R, Motyl M . Beth Israel Med Ctr, New York, NY.

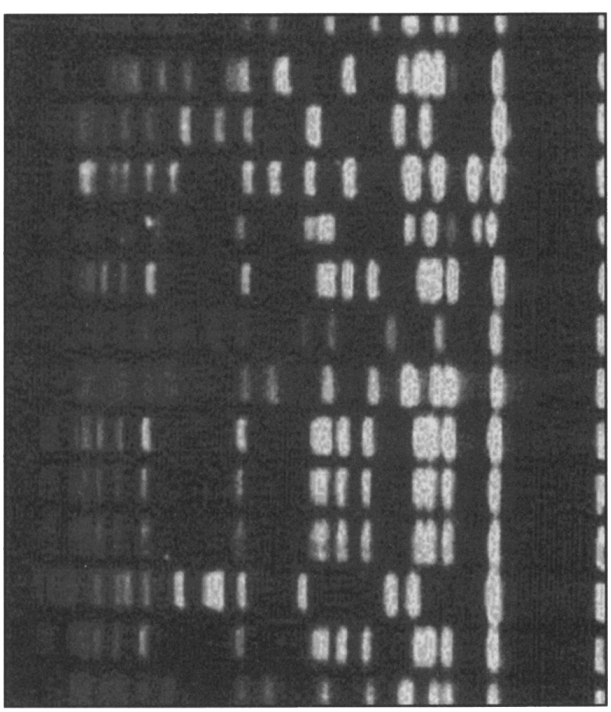
BACKGROUND: Multi-drug resistant Acinetobacter (R-ACIN) sensitive to two or less antibiotics has become a significant nosocomial pathogen. In 1998, our institution noted an increased incidence with clonal transmission of R-ACIN. METHODS: A retrospective case control study was done to determine risk factors for nosocomial acquisition of R-ACIN. Concurrent and prospective surveillance cultures from the environment and non-infected patients on units with R-ACIN were also obtained. Available isolates were sent for molecular typing. RESULTS: Significant risk factors for acquisition of R-ACIN included: hospitalization in an ICU or respiratory step-down unit, use of a central venous or Foley catheter, nasogastric tube or intravenous famotidine, number and duration of antibiotic regimens, and receipt of ticarcillin-clavulanate monotherapy. An association with mechanical ventilation was not seen. Surveillance cultures identified a group of colonized patients and environmental reservoirs. Molecular typing of 57 isolates revealed two predominant patient clones. One of the clones was the main clone from environmental cultures. INTERVENTIONS: All patients with R-ACIN were placed on strict isolation, cohorted with dedicated staff and equipment until discharge; and if readmitted within three months, the same measures were enforced. Patients' rooms were not reused until terminally cleaned and environmental cultures were negative. CONCLUSIONS: The identification of risk factors for nosocomial acquisition of R-ACIN and clonal spread helped develop and allow the implementation of rigid measures that quickly contained this difficult to treat bacteria. Surveillance cultures of patients and the environment were an important adjunct. The continued use of these measures, and intensification of antibiotic utilization control to prevent the development of R-ACIN, are necessary to maintain gains and prevent a recurrence of spread.

AN OUTBREAK OF COAGULASE-NEGATIVE STAPHYLOCOCCAL INFECTIONS FOLLOWING AORTIC VALVE REPLACEMENT. Lark RL, VanderHyde K, Kinney C, Chenoweth C. Univ of Michigan Health System, Ann Arbor, MI.

BACKGROUND: We identified an increased rate of coagulase-negative staphylococcal (CNS) surgical site infections (SSI) in patients s/p Medtronic Freestyle™ aortic root bioprosthesis implantation. METHODS: A retrospective case control study of the cohort of patients undergoing Freestyle™ aortic valve replacement (AVR) from Sep to Dec 1998 was performed to identify risk factors for infection. Med charts, microbiologic data, and infection control records were reviewed. Pulsed-field gel electrophoresis (PFGE) was performed on S. epidermidis isolates from 6 of 7 cases, and also from hand, nares, and nape of neck cultures from selected OR personnel. RESULTS: Seven of 64 patients developed SSI (10.9% vs 1.1% in preceding 8 months), including mediastinitis (2 patients) and endocarditis (5). There were no statistically significant differences between cases and controls with respect to age, sex, underlying illness, preoperative hospitalization, duration of surgery, time of bypass, central venous catheter duration, NNIS index, ASA score, NYHA class, or antibiotic prophylaxis. However, only 3 cases had documentation of vancomycin prophylaxis. Of all staff evaluated, only one surgical resident was significantly associated with infection (OR 7.68, p = 0.02, 95% CI [1.3, 44.1]). PFGE patterns from 4 of 6 cases were identical, and these cases were performed on different days. This surgical resident was the only staff member in the OR for all cases caused by the epidemic strain. This strain of S. epidermidis, however, was not isolated from OR staff. CONCLUSIONS: A surgical resident was highly associated with infection. However, the cause of the outbreak was likely multifactorial. Changes implemented during the investigation included institution of vancomycin prophylaxis and modification of surgical technique which contributed to the resolution of the outbreak.

A NOSOCOMIAL INFECTION OUTBREAK OF METICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN A MATERNITY. Le Coq M, Simon I, Sire C, Tissot-Guerraz F, Fournier L, Aho S, Noblot G, Reverdy ME, Françoise M. Hôpital Edouard Herriot, Lyon, France.

OBJECTIVE: Outbreak investigation to determine origin and transmission mode of pathogenic agent in order to take adequate prevention action. POPULATION: For a 9 weeks, 17 nosocomial infections of SAMR were diagnosed among 195 newborns babies and among 2 adult infections. METHOD: (1) Case report. (2) Space-time epidemiological graph. (3) Strain identification and confirmation by pulsed-field gradient gel electrophoresis of clonal pattern of the strains. (4) Medical and nursing staff microbiological infection survey (nasal and environmental sampling). (5) Risk factors research. RESULTS: We found inadequate medical care and lack of medical procedure. One infected nurse (panaris) was found. All isolated strains have clonal pattern. No risk factor was evident. DISCUSSION: On account of this epidemic, all medical and nursing procedures were brought up to date. The infected nurse was considered as the main reservoir of infection for the first half of the period (8 cases). Despite her eviction, 9 other cases occurred. In fact, during outbreak, each newborn baby (possibly polluted but non infected) could be considered as a reservoir of infection. Environment (including mattress) should also be considered. The outbreak was under control only after closure and extended decontamination of the ward. CONCLUSION: Hand-cross transmission with multiple reservoirs was an hypotheses confirmed by the persistence of outbreak though the main reservoir was excluded and by the absence of established risk factor. Contribution of environment in this outbreak is still on discussion. Pulsed fields gradient gel electrophoresis: illustration of different strains.



Legend:	Well:	Strains:
A	A, H, N	NCTN 8325: reference strain
B	B, C, D	SAMS: sample from staff
C		
D		
E	E	sample from mattress
F	F	SAMR: case n°14
G	G , L	samples from newborns (no clinical signs)
H		
I	I	SAMR: case n°15
J	J	SAMR: case n°16
K	K	SAMR: case n°17
L		
M	M	SAMR: sample from mattress
N		

EVALUATION OF LEGIONELLA ERADICATION MEASURES, INCLUDING COPPER-SILVER IONIZATION SYSTEM, FROM HOSPITAL WATER. LeMay M, Perpête C,* Bernier F, Scrivo C, Cloutier N, Mimeault C, Desmarais N, Dufresne A, Joly J, Lapierre S, Laferrière C. Univ. de Montréal, Montréal, Canada; Hôpital Ste-Justine CHU mère-enfant, Montréal, Canada; Laboratoire de Santé Publique du Québec, Montréal, Canada.

OBJECTIVES: Following 2 cases of pediatric nosocomial Legionnaire's disease, we adopted standard recommendations. A copper-silver ionization system was assessed. The purpose of this report is to describe the microbiologic evaluation following each of the strategies taken. METHODS: Thermal disinfection was done by raising the water temperature above 65°C at the distal outlet for 5 minutes. Samples taken from the hot water recirculation line were plated onto buffered charcoal yeast extract agar supplemented with glycine, vancomycin, and polymyxin B. Specimens were taken in intensive care and transplant units. The copper-silver ionization system (Aqua Resources CTAQ2,5LP) was installed according to the manufacturer's instructions. Copper and silver ion levels were measured by Inductively Coupled Plasma Mass Spectrometry concomitantly to the cultures. RESULTS: Superheating resulted in temporary decrease in the number of positive cultures. Tank cleaning had no effect on culture results. Copper-silver ionization system evaluated over 6-month period failed to eliminate the organism. The silver ion concentration was below 0.001 mg/L in 9 of the 9 specimens tested while the copper ion range between 0.18 to 0.82 mg/L with no relation to the distance between the tested site and the ionizing unit. CONCLUSION: The eradication of Legionella pneumophila in the hot water systems remains a problem. Superheat and flush, hot water tank cleaning, copper-silver ionization have been ineffective at controlling the presence of the organism in hot water recirculation line in a large pediatric university hospital (450 beds). Since the application of primary preventive measures, no new cases have been identified over the last 2 years.

HEALTHCARE-ASSOCIATED OUTBREAKS IN THE 90S: HOSPITAL INFECTIONS PROGRAM, CDC. Lenar AJ,* Manangan LP, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA.

Outbreaks are an uncommon yet important cause of morbidity and mortality. To assess any changes in the types of healthcare-associated outbreaks in the 90s, we reviewed 106 onsite epidemiologic investigations conducted by the Ctrs for Disease Control and Prevention's (CDC) Hosp Infections Program from August 1990 to October 1999. The causes of these outbreaks were bacterial pathogens (55%), fungi (9%), mycobacteria (9%), toxins (7%), viruses (7%), or other causes (14%), including latex (3%). Eighteen (17%) outbreaks were nationwide and/or led to a product recall. There was an increasing number of outbreaks in outpatient settings such as hemodialysis units (15%), long-term care facilities (6%), and home care settings (5%). In the early 90s, most (80%) outbreaks caused by mycobacteria were multidrug-resistant Mycobacterium tuberculosis and later in the 90s, outbreaks involving vancomycin resistance (10%) emerged. In the late 90s, of 49 outbreaks investigated, 15 (31%) were device-related, 12 (24%) product-related, and 4 (8%) procedure-related; 12 (24%) of these outbreaks occurred in intensive care units, 9 (18%) in wards, 8 (16%) in hemodialysis units, 5 (10%) in operating rooms, and 5 (10%) in home care settings. Thirteen (12%) of 106 epidemiologic investigations were in international settings; 62% occurred among newborns, 23% among hemodialysis patients, and 15% among adult hospitalized patients. Our outbreak investigations demonstrate how epidemiologic and laboratory investigations can be combined to identify new pathogens or sources of infections and illustrate the importance of infection control in all segments of the healthcare system for disease prevention.

A PNEUMOCYSTIS CARINII PNEUMONIA OUTBREAK IN A RENAL-TRANSPLANT UNIT. Levin AS, Costa SF, Gobara S, Caiaffa Filho HH, Ianhez LE. Hosp das Clínicas, Univ of Sao Paulo, Brazil.

The transmission of P. carinii has not been well defined. There has been evidence suggesting person to person and nosocomial transmission but these have not been proven. From Dec 1996 to Apr 1997 there were 10 cases of P. carinii pneumonia (PCP) in the renal-transplant unit. OBJECTIVES: evaluate the outbreak of PCP and study factors associated with the infection. METHODS: All patients transplanted from Dec 1995 to Feb 1997 were studied and evaluated as to the presence of confirmed PCP (by direct examination of sputum, PCR or histology of lung biopsy) or suspected PCP (pneumonia without a definite etiology that improved with cotrimoxazol or in patients who died). Chi square for trend was used to evaluate the increase in cases over time. All patients transplanted between Sept 15, 1996 and Feb 28, 1997 were entered into a cohort study to evaluate factors associated with confirmed PCP. RESULTS: There was a significant increase in confirmed and suspected cases as can be seen on Table (p=.02), confirming an outbreak. All PCP patients had received a transplant from 53 to 122 days before PCP, and in 8 it occurred within the first

90 days. Their last previous hospitalization had been for the transplant. Their ages varied from 15 to 55 years (mean: 36.9 SD:13.5) and 50% were male. The immunosuppressive regimen had not been changed for many years. The cohort study involved 42 patients and the only factor associated with PCP was the use of one of the 10 patient rooms (RR:3.00 95%CI: 1.01-8.93). The outbreak was controlled using universal cotrimoxazol prophylaxis during the first 6 months of the transplant. CONCLUSIONS: There was an outbreak of PCP among renal-transplant patients, probably acquired during their hospitalization for transplantation. Results suggest an exogenous source.

Confirmed and suspected cases of PCP among kidney-transplant patients

Transplantation date	Confirmed cases	Suspected cases	Number of transplants
Dec 1995 to Feb 1996	0	1	18
March to May 1996	0	0	15
June to August 1996	1	1	21
Sept to November 1996	4	1	26
Dec 1996 to Feb 1997	6	0	20

OUTBREAK OF NOSOCOMIAL BURKHOLDERIA CEPACIA INFECTION AND COLONIZATION ASSOCIATED WITH INTRINSICALLY CONTAMINATED MOUTHWASH. Matrician LH, Ange GP, Burns SJ, Fanning WL, Kioski C, Cage GD, Komatsu KK. Scottsdale Healthcare, Scottsdale, AZ; Arizona Department of Health Services, Phoenix, AZ.

From Aug 1996 through Jun 1998, 69 patients at two Arizona hospitals had nosocomial respiratory tract cultures positive for Burkholderia cepacia (B. cepacia). Review of hospital laboratory records for the previous 31 months revealed only one nosocomial respiratory culture positive for B. cepacia. An investigation was performed to identify the source of this outbreak. A case-patient was defined as having a nosocomial respiratory culture positive for B. cepacia, between Aug 1, 1996-Jun 8, 1998. All case-patients had been mechanically ventilated while in the intensive care units (ICU). Of the 69 case-patients 33 (48%) were identified as having nosocomial pneumonia based on Centers for Disease Control and Prevention (CDC) definitions, whereas 36 case-patients had respiratory tract colonization only. Pulse Field Gel Electrophoresis (PFGE) showed the same strain (Type A) at both hospitals. The outbreak investigation focused on respiratory therapy treatments, ventilators, pulmonary medications, environmental cultures, and common source personnel, all with negative results. Oral care included swabbing of the mouth with alcohol-free mouthwash. Alcohol-free mouthwash bottles, both opened and unopened, from both hospitals were cultured by the CDC and grew B. cepacia with the same PFGE type (Type A). The outbreak investigation led to a national Food and Drug Administration (FDA) recall of the alcohol-free mouthwash product. Alcohol-free mouthwashes have been manufactured to provide an alternative for patients with sensitive mucous membranes due to radiation, chemotherapy or disease. Unfortunately the FDA has found contamination in several alcohol-free mouthwash products. Based upon this information and evidence from our outbreak investigation we recommend that hospitals and other healthcare facilities discontinue use of alcohol-free mouthwash products for ventilated or immunocompromised patients. The authors acknowledge the assistance of Stacy Holt with the CDC, National Center for Infectious Diseases, Hosp Infections Laboratory.

OUTBREAK OF PSEUDOMONAS AERUGINOSA STERNAL WOUND INFECTIONS TRACED TO A SCRUB NURSE WITH ONYCHOLYSIS. McNeil SA, Nordstrom-Lerner L, Malani PN, Kauffman CA. Univ of Michigan and VA Med Ctr, Ann Arbor, MI.

Over a 3-month period in 1999, 8 of 61 (13%) patients undergoing median sternotomy developed serious infections with P. aeruginosa - mediastinitis (3), deep sternal wound infection (2), prosthetic valve endocarditis (1) and vein harvest site infection (2). Investigation demonstrated identical antibiograms, and pulsed-field gel electrophoresis confirmed that 6 of 7 isolates tested were the same strain. Investigation of the environment revealed biofilm formation on the tubing and growth of P. aeruginosa from the water and a valve in the heater-cooler component of the cardiopulmonary bypass machine. Hand cultures of personnel identified one nurse, who had assisted in 7 of 8 infected cases, from whom the same strain of P. aeruginosa was isolated on multiple occasions. Subsequent investigation found that the nurse wore nail polish to cover severe onycholysis of the right thumb and that the subungual region of this nail, but not the rest of the hand, grew many colonies of P. aeruginosa. Culture of liquid soap and a synthetic loofah sponge used by the nurse in her home shower yielded P. aeruginosa, as did a pocket-sized container of Vaseline which she frequently used to moisten her lips while at work. The nurse was reassigned to areas outside of the OR, and the nail was surgically removed. Culture of the nail bed after nail removal failed to yield P. aeruginosa. No further P. aeruginosa infections have occurred since her removal from the OR.

SPREADING OF STAPHYLOCOCCUS AUREUS (SA) BETWEEN HEMODIALYSIS PATIENTS CARRYING A CENTRAL VENOUS CATHETER, STAFF AND HOSPITAL ENVIRONMENT. Meunier O, Petitjean P, Hernandez C, de Almeida N, Kunz K, Hannedouche T, Bientz M*. Institut d'Hygiène, Hôpitaux Universitaires de Strasbourg, France; Service de Néphrologie et d'Hémodialyse, Hôpitaux Universitaires de Strasbourg, France; Institut d'Hygiène, Hôpitaux Universitaires de Stasbourg, France.

BACKGROUND: Incidence of Sa infections in hemodialysis patients (HD-P) is estimated to be 0.93 per 100 patient months. In our dialysis centre 5 cases of severe Sa infection occurred in HD-P carrying a central venous catheter, within one month. We tested the hypothesis of an epidemia and searched for a potential environment or human reservoir of the responsible Sa stem. METHODS: Besides the blood cultures and catheter site swabs in HD-P, we studied bacterial specimens of the environment by means of a nasal mucosa swab in our HD-P, medical, and para-medical staff of our unit. The genotyping of Sa stems was done by pulsed field electrophoresis (restriction enzyme Sma1) which allowed us to separate different stems of Sa, each of which was assigned with alphabetic letter (A,B,C). RESULTS: Three different clones (A,B,C) were identified in our HD-P. This implies that there was no epidemia, but rather an emergence of cases, forming 2 groups where one clone was present in two patients each (clone A and C). From the 115 surfaces samples taken, Sa was present in 25. 12 stems were studied by pulsed field electrophoresis. There was no unique environmental source responsible for the spreading of colonies, yet one of the stems isolated in HD-P was widely present in the environment (clone C, isolated at 7 occasions). 14 of the 32 nurses in our unit were carriers of nasal Sa. There was no evidence for a unique human source causing infection, but quite few members of our staff hosting identical stems: Amongst the various clones clone C was present in 3 nurses. CONCLUSION: The identification of different Sa stems by pulsed field electrophoresis shows important spreading of stems between staff, from staff towards patients, and from patients and/or staff towards the environment.

AN EPIDEMIC OF STERNAL WOUND INFECTION AFTER OPEN HEART SURGERY. Moehlemann K,* Wengi S, Althaus U, Tueber MG. Institute of Med Microbiology, Univ of Berne, Berne, Switzerland; Univ Hosp, Univ of Berne, Berne Switzerland.

Sternal wound infection (SWI) is a serious complication of cardiac surgery involving median sternotomy and is observed at a frequency of 0.4 to 5%. In our unit, SWI occurs at an endemic rate of approximately 5 cases per year (2% of interventions). In summer 1998, we observed a sudden increase in the number of SWI after open heart surgery for coronary bypass and valve replacement. Between July and September 1998, 13 patients were diagnosed with this complication. An outbreak investigation was conducted. The analysis yielded several intriguing characteristics of this epidemic. SWI during the epidemic period were more often due to a variety of gram-negative bacteria (mainly enterobacteriaceae and Pseudomonas aeruginosa) and enterococci (66% of cases) as compared to the pre-epidemic period, when staphylococci prevailed (61%) (p=0.05). Patients with SWI during the outbreak had surgery significantly more often in the afternoon as compared to patients without an infectious complication (93.7% versus 49%; p=0.001). A comparison of the average number of personnel per surgery during the epidemic and the analogous time period in the previous year showed an increased workload during summer 1998. Based on these results, we hypothesized that hygiene failures during surgery provoked by a high work load was responsible for this outbreak of SWI. Eight hygiene measures were implemented in the operating theatre, where upon the rate of SWI returned to baseline. Thus, this epidemic of SWI was characterised by an unusual predominance of gram-negative rods, and understaffing was probably a main risk factor. Continued surveillance of SWI rates will be necessary.

EPIDEMIOLOGY OF NOSOCOMIAL OUTBREAKS: 14-YEARS' EXPERIENCE AT A TERTIARY CARE CENTER. Ostrosky-Zeichner L, B ez-Martínez R, Rangel-Frausto MS, Ponce de León-Rosales S.* Natl Institute of Nutrition, Mexico City, Mexico.

BACKGROUND: Nosocomial outbreaks are a source of morbidity and mortality, as well as cost generators for both patients and hospitals. Outbreaks are potentially preventable. METHODS: Information on nosocomial outbreaks from 1985-98 was collected from the archives of the Hosp Epidemiology Division at a tertiary care center in Mexico City. Epidemiological description of their incidence, temporal distribution, infection type, in-hospital location, microbiology, risk factors and mortality was carried out. RESULTS: Data on 12 outbreaks were found for the period. Overall mortality was 25.8% and a third of them occurred in the intensive care unit. Nearly 75% of outbreaks occurred in the second semester of the year. Half of the outbreaks were of pneumonia. Microbiology records show that 58.3% the outbreaks were caused by Pseudomonas aeruginosa. Incidence was 2.68 outbreaks per 10,000 discharges, comprising 1.56% of nosocomial infections. Incidence in the intensive care unit was 10-fold higher. CONCLUSIONS: A higher incidence than previously reported was found. Most outbreaks occur in the intensive care unit and the second semester of the year, are related to the lower respiratory tract and are caused by gram negative organisms. Nosocomial outbreaks are a relevant problem.

AN EPIDEMIC OF SERRATIA MARCESCENS SEPSIS DUE TO CONTAMINATED MULTIDOSE VIALS. Pan A, Carnevale G, Ceruti T, Crema L, Dolcetti L, La Russa A. Istituti Ospitalieri di Cremona, Italy.

INTRODUCTION: Serratia marcescens and contaminated multidose vials have been frequently associated with nosocomial epidemics. During the month of Apr 1999, 5 patients admitted to a surgery unit developed sepsis after starting total parenteral nutrition (TPN). An epidemic investigation was therefore started to identify the source. METHODS: An epidemic task group was organized and the following actions taken: 1) surveillance to identify new cases; 2) a case control study of the infected patients; 3) a retrospective analysis of the clinical charts in the previous 3 weeks; 4) extensive microbiological sampling; and 5) a review of the unit practices. RESULTS: The day following the first 5 cases another patient developed sepsis during a dextrose infusion; no new case was identified prospectively thereafter. S. marcescens was isolated from blood culture or TPN solution in 5 of the 6 patients. of the microbiological samples yielded S. marcescens; the drug vials used during the days of the sepsis had already been thrown away and therefore were not cultivated. The case-control study identified TPN solution and i.v. insulin therapy as two possible risk factors for the epidemic (p<0.001). A sepsis due to S. marcescens was identified in the same ward 8 days before. The insulin vials were not always correctly preserved in the refrigerator. DISCUSSION: Although no source of the epidemic was clearly identified, we suppose that this series of events took place: 1) Contamination of the staff hands with S. marcescens. 2) Improper handwashing. 3) Contamination of multidose vials (insulin). 4) Infusion of the contaminated solution in highly growth prone medium (TPN, dextrose). The actions taken were: isolation of infected patients, ward sanitation, reinforcement of hospital guidelines, implementation of a project to improve hand-washing compliance, correct use and conservation of multidose vials, isolation of patients with nosocomial pathogens, identification of S. marcescens as a alert organism.

AN EPIDEMIC OF CORYNEBACTERIUM AQUATICUM IN PATIENTS ON PERITONEAL DIALYSIS. Pan A, Ghiringhelli P, Ceruti T, La Russa A, Dolcetti L, Catenazzi P. Istituti Ospitalieri di Cremona, Italy.

INTRODUCTION: Despite being a bacterium frequently found on the skin and in the environment, Corybacterium spp. Has rarely been associated with catheter infection in patients on peritoneal dialysis. We describe a cluster of 2 cases of Corynebacterium aquaticum peritonitis seen at our institution in 2 patients on peritoneal dialysis. METHODS: An epidemic group was formed and an investigation was carried out. Clinical charts of the patients were retrospectively reviewed, a prospective analysis was organized and an environment control was performed. RESULTS: The patients were on home peritoneal dialysis and were seen at the hospital for con-

trol every month. Patient 1 was diagnosed as C. aquaticum peritonitis and treated on an outpatient basis, and was seen in one single occasion while patient 2 was admitted to the unit for other problems. Patient 2 developed peritonits 10 days after the patient 1 was seen in the unit. There were other 32 patients seen during the period of hospitalization of patient 2, in the service that did not develop any infection. All the water taps of the unit were controlled, as well as disinfectants and dialysis solutions, and all the samples were negative. No new case was prospectively identified. The 2 patients were successfully treated. Handwashing technique resulted generally well applied in the service. DISCUSSION: C. aquaticum is a contaminant of water, and contamination of water taps is relatively common. It is possible that patient 1 was contaminated at home through tap water. We did not isolate the germ from any environmental hospital source; we suppose that the germ was transmitted between the 2 patients via staff hands. This cluster poses the question about the indication for hand disinfection and not handwashing during manipulation of peritoneal catheters.

INVESTIGATION OF SALMONELLA SEROTYPE WORTHINGTON CAUSING CELLULITIS, SEPSIS, AND DEATH IN A NEONATAL INTENSIVE CARE UNIT, INDONESIA, 1999. Parvez FM, Roeshadi D, Irmawati L, Sidharta Y, Rosenthal SR, Padmidewi M, Irawan E, Angsar D, Holt SC, Puhr ND, Arduino MJ, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Dr Soetomo Hosp, Surabaya, Indonesia; World Health Organization, Jakarta, Indonesia; Balai Laboratorium Kesehatan, Surabaya, Indonesia.

Salmonella serotype Worthington has been implicated in many neonatal intensive care unit (NICU) outbreaks in developing countries. From 7/1/98-3/23/99 (study period), 60 NICU patients at Dr. Soetomo Hosp (DSH), Indonesia, experienced rapidly progressive perianal cellulitis, sepsis, and death. Despite initial control measures, 24 (40%) of 60 infants died and an investigation was initiated. We defined a case-infant as any DSH NICU infant who developed perianal cellulitis and suspected sepsis (i.e., temperature <36.5 °C or >38 °C, apnea, bradycardia, feeding intolerance, or diarrhea) during the study period. To determine risk factors for infection, we compared 60 case-infants to 120 controls. In addition, observational studies were done to assess healthcare worker (HCW) infection control practices. A prospective cohort study was initiated to determine the prevalence and etiology of bloodstream infections (BSI) in suspected case-infants. Univariate analysis revealed that case-infants were more likely than controls to be premature (OR=12.1, p<.001), have birthweight <2500 grams (OR=6.5, p<.001), a history of perinatal asphyxia (OR=6.1, p<.001), delivery by a community midwife (OR=6.4, p<.001) or cesarean section (OR=4.8, p<.001), or have lower median 5-minute Apgar scores (8 vs 9, p<.001). Nurse-to-patient ratio was 1:10-1:20. HCWs inconsistently performed handwashing, complied with universal precautions, or adhered to aseptic technique during patient care. BSI pathogens included non-typhi Salmonella spp. (50%); serotyping of the first 13 available case-infant isolates revealed Salmonella serotype Worthington, suggesting nosocomial transmission. Reinforcement of basic infection control practices (i.e., handwashing, cohorting) resulted in termination of the outbreak. Our data suggest that (1) person-to-person transmission of S. worthington occurred in the DSH NICU resulting in neonatal cellulitis and sepsis with a high fatality rate; (2) severely ill infants were at increased risk for infection; and (3) delivery practices may increase infection risk.

SERIOUS PROBLEMS WITH A MULITRESISTANT PSEUDOMONAS AERUGINOSA STRAIN AT A GERMAN UNIVERSITY HOSPITAL. Pitten FA, Panzig B, Schroeder G, Tietze K, Kramer A. Institute of Hygiene and Environmental Medicine, Univ of Greifswald, Germany; Centre for Neurological Rehabilitation, Greifswald, Germany.

We report a large nosocomial outbreak of a multiresistant P. aeruginosa strain at a German Univ Hosp. During 15 months 80 patients became infected by P. aeruginosa which was isolated from tracheal secretions, blood, urine, venous catheters, ascites, and several specimens taken from surface wounds. Most patients had undergone invasive treatment (surgery, cancer therapy) previously. Assignment to a specific serotype was not achieved due to non-agglutinability of the strains. The genetic relationship of the isolates was investigated by Pulse Field Gel Electrophoresis. The isolates were resistant to the β-lactames including the carbapenems and aztreonam, to aminoglycosides and to quinolones. There was no in-vitro activity except from polymyxin B. Extensive environmental sampling was carried out to identify contaminated or colonized medical devices, surfaces or media (water, food). Samples were taken from doctors and nursing staff and various treatment procedures were observed for several weeks. The handling of respirators, resuscitation tubes, urine bottles, and bedpans resulted in a contamination of the patients' environment, although most devices were cleaned and disinfected automatically. Several wash basins at the intensive care unit were colonized, but of the drinking water samples showed any growth of P. aeruginosa. We recommended strict glove usage and application of alcoholic hand disinfectants immediately after discharging the gloves. The chain of infections ceased after strict cohort isolation and a consequent hygienic regimen had been implemented. The analysis of this outbreak emphasizes the outstanding relevance of basic hygienic rules.

AN OUTBREAK OF CRANIOTOMY POST-SURGICAL INFECTIONS ASSOCIATED WITH MULTIPLE ENVIRONMENTAL FACTORS IN THE OPERATING SUITE. Pokrywka MF, Knabe SL, Muto CA. UPMC Health System, Pittsburgh, PA; Univ of Pittsburgh School of Medicine, Pittsburgh, PA.

Epidural and subdural infections following craniotomy are serious surgical complications requiring re-exploration and debridement of the operative site. They are often associated with a poor outcome (J Infect 1986; 12:105). From Apr 9, to Aug 26, 1999, a significant increase in post-surgical infections was noted in patients who had undergone craniotomies (6.5/100 craniotomy cases vs. 1.2/100, p=.0000037). The infections occurred in 20 patients having cranial nerve decompression, aneurysm clipping, or tumor resection performed by one of five different neurosurgeons. All patients required re-exploration of the surgical site and drainage with or without removal of cranioplasties and bone flaps. The time intervals to re-exploration of the surgical sites ranged from 3 to 77 days. Pathogens recovered from surgical specimens included E. coli (1), Enterobacter cloacae (1), E. aerogenes (1), Pseudomonas aeruginosa (1), Staphylococcus epidermidis (5), S. aureus (3), Propionibacterium acnes (6), and no pathogen (2). An investigation into the cases revealed that the operating room (OR) was functioning under considerable environmental stress due to decreased air exchanges, increased traffic, and flies which were observed in the OR and found to be breeding in the locker room drains. The use of a new fibrin glue product that required several steps for reconstitution and application was also temporally associated with four of the infections. The outbreak ceased after the flies were eradicated, other environmental issues were addressed, and the use of the fibrin glue product was temporarily suspended. Chart review to assess host and other surgical risk factors and recommendations for additional preventative measures are underway.

INVESTIGATION OF PSEUDOMONAS AERUGINOSA BLOODSTREAM INFECTIONS IN A BURN UNIT: UTILITY OF MOLECULAR TYPING. Ray SM, Weaver C, Halvosa JS, White N, Blumberg HM. Emory Univ School of Medicine, Atlanta, GA; Grady Health System, Atlanta, GA.

Pseudomonas aeruginosa (Pa) is an important nosocomial pathogen. We investigated a marked increase in Pa bloodstream infections (BSIs) in our Burn ICU (BICU). Our investigation included chart reviews, review of blood culture collection technique, observation of HCW practices, surveillance cultures of BICU and hydrotherapy room, and pulsed-field gel electrophoresis (PFGE) of Pa isolates. Eight BICU patients had documented Pa BSIs in Apr 1999 for a rate of 53.3 episodes/1000 pd compared to 6.3 episodes/1000 pd for all of 1998 (p<0.001). Five of 8 patients had polymicrobial BSIs and the Pa antibiograms demonstrated different patterns of multi-drug resistance. Initial findings included a change in blood culture practice (collected routinely at the time of central line change every 4 days), observed lapses in HCW adherence to contact isolation, and recovery of Pa from showerheads and water in the hydrotherapy room. Comparison between Apr 1999 and the 1998 year revealed no change in blood culture collection rate (15.5 vs 13.6 sets/100 pd, p=.5) but a significant increase in the percent of positive cultures (69.6% vs 41.3%, p=.05). Interventions included staff education, cohorting of patients with Pa, cleaning of hydrotherapy shower heads, and discontinuation of "surveillance" blood cultures. PFGE demonstrated 3 different strains of Pa (A, B, and C) among the 8 patients. Pattern A was recovered from 4 patients, of whom had been to hydrotherapy; pattern B was recovered from 2 patients who had been to hydrotherapy with a matching Pa isolate recovered from hydrotherapy showerheads; and pattern C was recovered from 1 patient. Pa isolates recovered from hydrotherapy room water demonstrated 9 unique PFGE patterns. In summary, the outbreak of Pa BSIs was the result of multiple factors including HCW lapses in contact isolation precautions, contaminated hydrotherapy equipment, and possibly the use of "surveillance" blood cultures. Use of PFGE was critical in determining that there was not a point source outbreak. Molecular epidemiology is an essential part of a modern infection control program.

KLEBSIELLA PNEUMONIAE BLOODSTREAM INFECTIONS IN A HIGH-RISK NURSERY IN CALI, COLOMBIA. Richards C, Alonso-Echanove J, Caicedo Y, Jarvis W. Ctrs for Disease Control and Prevention, Atlanta, GA; Hosp Universitario Del Valle, Cali, Colombia.

Klebsiella pneumoniae (KP) is an important cause of bloodstream infection (BSI) in the high-risk nursery (HRN). From February 6 to March 8, 1999, ten HRN patients at Hosp Universitario Del Valle had KP-BSIs. To determine risk factors for KP-BSI, we conducted a retrospective cohort study of HRN patients. A case-patient was defined as any HUV-HRN patient with symptomatic KP-BSI from February 6 to March 8, 1999. We also conducted a prevalence study of KP colonization and an observation study of healthcare worker (HCW) compliance with infection control practices (ICP). After the prevalence survey, we instituted cohorting of neonates positive for KP. Of 105 patients in the cohort study, ten had KP-BSI. Overall, case-patients had lower gestational age (median: 29.5 vs. 35 weeks, p=0.001) and birthweight (median: 1292 vs. 2216 gms, p=0.002), more intravenous (IV) injections (20 vs. 12 per day, p=0.0002) and were more likely to have blood transfusions (32% vs. 1%, p=0.001). In logistic regression analysis, IV injections (odds ratio [OR] 1.2 per injection, 95% Confidence interval [CI] 1.02-1.5) and blood transfusion (OR 3.1, 95% CI 1.4-9.7) remained significantly associated with KP-BSI. In the prevalence study, 65% (19/41) of patients were colonized with KP. Cohorting of colonized patients reduced colonization to 12%. HCWs had suboptimal handwashing compliance (76%) and glove use (85%) and failed to use aseptic technique during IV injections (0%). In this HRN with a large reservoir of KP colonization, suboptimal ICP during IV injections coupled with more IV injections and blood transfusions among case-patients was probably responsible for this outbreak of BSI. Cohorting of KP-colonized neonates reduced the prevalence of KP colonization and infection.

DETECTION AND CONTROL OF ENTEROBACTER SAKAZAKII SEPSIS OUTBREAK IN FOUR HOSPITALS IN RIO DE JANEIRO, BRAZIL. Santos M, Pessoa da Silva CL, Sampaio J, Marangoni DV, Pinto M, Moreira BM. Hosp de Cardiologia de Laranjeiras, Rio de Janeiro, Brazil; Univ Fed. Do Rio de Janeiro, Brazil; Lab Lamina, Rio de Janeiro, Brazil.

Enterobacter sakazakii (Es) has been rarely reported as a human pathogen associated to infant powdered formula. In the present report an Es sepsis outbreak involving four intensive care units (one for adults-AICU, one pediatric-PICU and two for neonates-NICU) in four private hospitals is described. During a three-week period (from Sep 26 to Oct 16, 1998) seven episodes of Es sepsis were detected: two in the AICU, one in the PICU, and four in the NICU. One of the neonates presented two episodes of Es sepsis. A study of cases was performed including chart review for all intravenous (IV) medications administered in the 12 hours previous to Es sepsis. A case of Es sepsis was defined as a patient presenting clinical symptoms of infection and the isolation of Es in a peripheral blood culture. Isolates were identified by biochemical tests and the Vitek system; susceptibility tests were performed using the Vitek system. All cases were administered IV solutions (parenteral nutrition for the infant and neonates and a solution of ringer lactate containing 5% albumin for adults) prepared in the same outsourced service. The outbreak was controlled after the interruption of the production of the solutions. Es was isolated from unused bags containing each of the two solutions. Cultures of unused empty bags were negative. The environmental surveillance cultures performed in the outsourced service revealed Es in the sponge used for external cleaning of IV solution vials. Neonatal and infant cases presented an uneventful evolution after prompt empirical antimicrobial treatment was started with regimen including a third generation cephalosporin. The two adults died right after Es isolation, before any therapy could be instituted. The prompt recognition of a rare Enterobacter species in blood cultures in different hospitals motivated a study of cases which pointed out to a possible common source leading to the immediate interruption of the outbreak.

OUTBREAK OF INFLUENZA AMONG VACCINATED RESIDENTS IN A NURSING HOME. Sartor C, Levy PY, Fournier PE, Fenollar F, Simon S, Berger P, Chambourlier S, La Scola B, De Lamballerie X, Jamali I, Raoult D. Assistance Publique Hôpitaux de Marseille, France; Laboratoire de Bacteriologie-Virologie, Assistance Publique Hopitaux de Marseille, France.

BACKGROUND: On Feb 4, 1998, an investigation was initiated following the occurrence of a cluster of pneumonia among the residents and the staff of a nursing home. METHODS: A prospective cohorte study and a microbiological investigation were per-

formed. Nasopharyngeal and blood samples were obtained from exposed residents and staff members. The presence of influenza A virus was researched by direct immunofluorescence and viral culture on MDCK cells. A certain case was defined as any person with a positive culture or antigens for influenza virus and a probable case as any person with an influenza like illness during the study period. RESULTS: The residents in the nursing home were from 53 to 102 years old (median, 81 years). From Jan 15 through Feb 4, 1998, 37 persons (42%) among the 88 residents and 13 persons (34%) among the 38 staff members acquired influenza. The complications were one hospitalization (1.1%) and 3 deaths (3.4%). Four certain cases were reported among the residents. The index case was a caregiver. An influenza virus close to the A/Sydney/5/97(H3N2) strain was identified and was not included in the influenza vaccine of the year. The influenza vaccination rate among the residents was 91% (64/70). of the staff members was vaccinated for influenza virus. The vaccinal efficacy was estimated to -27% [95%CI=(-213)-60]. Among the residents, 16% (7/45) had an influenza antibody titer >40. CONCLUSION: This study showed that an influenza outbreak could occur in a nursing home despite influenza vaccination of the residents. This result particularly underlined that influenza vaccination of the staff and droplet isolation measures are essential to prevent influenza transmission.

OUTBREAK OF NOSOCOMIAL INFLUENZA IN AN INTERNAL MEDECINE UNIT: IMPACT ON CARE MANAGEMENT. Sartor C, Zandotti C, Jacomo V, Simon S, Atlan-Gepner C, Raoult D, Sambuc R, Drancourt M. Assistance Publique Hôpitaux de Marseille, France.

BACKGROUND: On Mar 5t, 1999, we initiated an epidemiological study to investigate a cluster of pneumonia among the hospitalized patients and the staff members of an internal medecine unit. METHODS: A prospective cohorte study and a microbiological investigation were performed. Nasopharyngeal samples were obtained from exposed patients and staff members. The presence of influenza A virus was researched by direct immunofluorescence and viral culture on MDCK cells. A certain case was defined as any person with a positive culture or antigens for influenza virus and a probable case as any person with an influenza like illness during the study period. RESULTS: From Feb 28 through Mar 5, 1999, 23 hospitalized patients and 22 staff members were present in the unit. The patients were from 18 to 86 years old (median, 58 years). The A/Sydney/5/97(H3N2) influenza virus was identified in 3 cases. The attack rate of influenza infections was 43% (10/23) among the patients and 18% (4/22) among the staff members. The index case was a patient who shared his room with the second case. The vaccination rate for influenza virus was 43% (10/23) among the patients and 32% (7/22) among the staff members. The vaccinal efficacy was estimated to 60% [95%CI=13-123]. In relation to this outbreak, 14 sick leave days were observed among the staff members. Moreover, 8 programmed admissions were postponed and all the admissions from the emergency unit were refused during one week. CONCLUSION: This outbreak underlined the vital importance of droplet isolation measures to prevent nosocomial transmission of influenza. Influenza vaccination for healthcare workers is essential to descrease exposure of patients to infection and to limit disruption in units.

A PSEUDOEPIDEMIC OF MYCOBACTERIUM AVIUM COMPLEX PNEUMONIA CAUSED BY CONTAMINATION OF POTABLE WATER. St. John, KH, Axelrod, P, Turcios, R, Travaline, J, DeVastey, J, Truant, A. Temple Univ Hosp, Philadelphia, PA; Temple Univ, Philadelphia, PA; Temple Univ School of Medicine, Philadelphia, PA.

In the time period between Oct 1998 and Sep 1999 there was a dramatic increase in the rate of Mycobacterium avium-intracellulare (MAI) growth from bronchoscopic specimens; the mean average monthly isolation rate was 2.9/100 procedures from 6-9/98 compared to 14.1/100 from 10/98-9/99. Of procedures yielding positive cultures, 71% were bronchoalveolar lavage, 33% were biopsies, and 8% were bronchial brushings. Among samples with positive cultures, AFB smears showed few organisms in 3%; rare, 5%, and , 92%. 35% of case patients were transplant recipients (26% lung; 2% heart-lung, 4% heart, 3% marrow); 2% of pts were HIV infected. The vast majority of cases had pulmonary infiltrates; it was difficult to exclude MAI pneumonia in many. Bronchoscopies from cases were done by 12 pulmonary attending M.D.s, and 11 pulmonary fellows; 67% were done in a procedure suite and 33% in an ICU. Case pts were hospitalized on 20 hospital units. It was not possible to determine which scopes were used in pts with procedures out of the bronch. Suite; in the suite most were done using 2 scopes, but this reflected the pattern of use. AFB cultures of fluids used during bronch. Procedures and cleaning were sterile. However, 14/21 cultures of potable water from multiple locations, including the sink used to rinse scopes after disinfection, grew MAI. Both hot and cold water grew MAI as did water in a 110 degree F hot water heater; 3 cultures of water from a 130 degree F heater were sterile. When sterile water was substituted for tap water for terminal rinsing, MAI rates did not improve; when tap water was totally eliminated, rates appeared to drop (cultures still in progress). When MAI contaminates potable water, scope rinsing can create a pseudoepidemic.

NOSOCOMIAL OUTBREAK OF INFLUENZA A ASSOCIATED WITH LOW VACCINE COVERAGE IN HEALTHCARE WORKERS, NEW YORK, 1999. Uyeki TM,* Kitsutani PD, Mehrotra A, Ackelsberg JA, Bridges CB, Fukuda K. Centers for Disease Control and Prevention, Atlanta, GA; Centers for Disease Control and Prevention, Atlanta, GA; New York State Department of Health, Albany, NY.

BACKGROUND: Guidelines to control influenza outbreaks in nursing homes are well established and include influenza vaccination, antiviral prophylaxis and treatment, droplet precautions, isolation and cohorting of affected patients. To assess the impact of these measures in a hospital setting, we investigated a nosocomial influenza outbreak among patients at a 279-bed acute care facility. METHODS: We conducted retrospective medical chart review and active prospective surveillance of patients on 4 hospital units to identify cases of influenza-like illness (ILI) [temperature greater than or equal to 100.0 degrees F, and cough or sore throat] and viral culture-confirmed influenza A. Cases were classified as either nosocomial (symptom onset greater than or equal to 72 hours after admission) or community-acquired (symptom onset <72 hours after admission). We also surveyed employees about influenza vaccination and antiviral medication use. RESULTS: Ten nosocomial influenza cases and 38 nosocomial ILI cases were identified among patients and were clustered in mid-Jan 1999. The rate of nosocomial influenza and ILI cases decreased from 93 to 35 per 10,000 patient-days after outbreak interventions were implemented (62% decrease); community influenza and ILI cases decreased from 131 to 75 per 10,000 patient-days in the same period (43% decrease). Influenza vaccine coverage in healthcare workers was 11.5% before the outbreak. Antiviral prophylaxis was started by 44% of unvaccinated employees, but 40% discontinued prophylaxis. CONCLUSIONS: Despite continued admissions of community-acquired influenza cases, control measures appeared to reduce nosocomial cases. Staff acceptance of vaccination and antiviral prophylaxis was limited. Low influenza vaccine coverage in healthcare workers may have contributed to this nosocomial outbreak.

INFECTIOUS DISEASE EXPOSURE EVALUATION AT A UNIVERSITY HOSPITAL, 1994-98. Weber DJ,* Rutala WA, Kanoy C, Consoli S. Univ of North Carolina (UNC) School of Medicine and UNC Hosps, Chapel Hill, NC; Univ of North Carolina (UNC) Hosps, Chapel Hill, NC.

Evaluation of possible infectious disease exposures is an important function of infection control units. Such evaluations assure that infected patients are placed on appropriate isolation, infected employees are restricted or furloughed from work and offered appropriate therapy, and exposed employees are offered appropriate prophylaxis. We analyzed all infectious disease exposure evaluations performed at our hospital over a 5-year time period. UNC Hosps is a 650-bed tertiary care academic facility. Exposures were considered true exposures if the source patient was infected with a communicable pathogen, inadequate isolation occurred, transmission was possible, and nonimmune persons were exposed. Overall, 353 evaluations were performed; 233 (66.0%) represented true exposures. The source of true exposures was a patient 88.0%, an employee 8.6%, or a visitor 3.4%. Persons exposed included employees 92.7%, patients 23.6%, and visitors 0.9%. Sites of the exposures included the emergency ward 35.2%, inpatients units 64.8%, outpatient units 23.2%, and specialty clinics 10.3%. Specific exposures are displayed below. {See TABLE} In conclusion, infectious disease exposures are common with Varicella zoster and TB being the most common. The index case is almost always a patient but employees are most commonly exposed.

Infectious Disease Evaluations (True Exposures) at Indicated Time

Infection	1994-98	1994	1995	1996	1997	1998
Varicella	93 (63)	25 (22)	26 (21)	11 (6)	15 (4)	16 (10)
Zoster	91 (50)	12 (12)	22 (18)	23 (9)	13 (5)	21 (6)
Tuberculosis	81 (55)	15 (12)	21 (12)	19 (14)	13 (10)	13 (7)
Pertussis	32 (25)	8 (7)	8 (7)	3 (3)	6 (3)	7 (5)
Meningococcus	17 (9)	1 (1)	1 (0)	6 (1)	6 (5)	3 (2)
Ectoparasites	14 (13)	2 (2)	5 (5)	2 (2)	3 (3)	4 (3)
Miscellaneous	23 (16)	7 (6)	5 (2)	2 (2)	3 (2)	6 (4)
TOTAL	353 (233)	70 (62)	88 (65)	66 (37)	59 (32)	70 (37)

CONTROL OF INFLUENZA A ON A BONE MARROW TRANSPLANT UNIT. Weinstock DM, Eagan J, Abdel Malak S, Kiehn T, Sepkowitz KA. Memorial Sloan-Kettering Cancer Ctr, New York, NY.

INTRODUCTION: Immunocompromised patients are at risk for significant morbidity and mortality from influenza. In Jan, 1998 an outbreak of influenza A occurred on our bone marrow transplant (BMT) unit. Aggressive infection control measures were instituted for the 1998-99 influenza season. We report the results of this program. METHODS: MSKCC is a 434-bed cancer hospital in New York City. The adult BMT unit is a 30-bed ward with both allogeneic and autologous BMT patients. Nosocomially-acquired influenza was defined as an influenza-like illness with onset 48 hours or more after hospital admission, accompanied by a positive enzyme immunoassay or viral culture. RESULTS: From Jan 24-30, 1998, seven cases of nosocomially-acquired influenza were diagnosed on the BMT unit. The outbreak was controlled by: (a) immediate isolation of any admission with a compatible syndrome, pending culture results; (b) strict isolation (single room, gown, gloves, mask) of all patients; (c) restriction of visitors; (d) administration of rimantadine prophylaxis for all patients (n=27) and HCWs (n=191) on the unit. An enhanced influenza control program was implemented during the 1998-99 season focusing on HCW education, vaccination of patients and HCWs, and early identification/isolation of cases. All BMT patients were placed on respiratory precautions during the 1998-99 influenza season. Between the 1997-98 and 1998-99 seasons, vaccination among HCWs and patients at our institution increased by 34.2% and 17.2%, respectively. Over the same period, nosocomial cases of influenza per 10,000 patient days decreased 72.1%, from 2.62 to 0.73. The same program was implemented for the 1999-2000 season and results will be shown. CONCLUSION: Nosocomial influenza was effectively controlled by several means including a vigorous vaccine campaign, early patient isolation, and close cooperation with the microbiology lab to facilitate rapid diagnosis. Similar to nosocomial control of TB, control of influenza requires immediate isolation of any potential patient, pending microbiologic diagnosis.

NOSOCOMIAL SPREAD OF NORWEGIAN SCABIES. Zafar AB, Beidas SO, Sylvester LK, Butler RC. Prince George's Hosp Ctr, Cheverly, MD; Natl Insitutes of Health, Bethesda, MD.

A cluster of scabies developed in seven healthcare workers (HCW) exposed to a single index case in a 450- bed acute care hospital in Maryland in 1998. Prior to this cluster there had been no recognized nosocomial scabies infections for over 10 years. Norwegian scabies was diagnosed clinically for each HCW. In all cases the implicated HCW presented with an interdigital pruritic eruption within days after coming in contact with the index patient who had similar clinical features. The index case, was a terminal AIDS patient admitted with dementia, hyperkeratotic skin lesions and respiratory distress. The patient was not on isolation for the first 24 hours of admission. All these cases of scabies were clustered over a four week period in Sep 1998 and involved HCW in the same unit as the patient. Infection control measures instituted included isolation policy enforcement and aggressive surveillance activity. Seven HCW were treated for scabies and 11 other HCW were given prophylaxis. These measures were effective in eliminating further nosocomial scabies. The hospital has remained free of nosocomial scabies since then. Since Sep 1998 there have been 11 patients admitted with scabies who also had a diagnosis of AIDS. A multidisciplinary approach involving many departments significantly contributed to the continuing success in prevention of nosocomial spread of scabies.

Outcomes Assessment—Abstracts in this category appear in* Am J Infect Control *February 2000.

Performance Measurement—Abstracts in this category appear in* Am J Infect Control *February 2000.

Pneumonia

RISK FACTORS FOR VENTILATOR-ASSOCIATED PNEUMONIA: PRELIMINARY ANALYSIS OF THE DETAILED INTENSIVE CARE UNIT SURVEILLANCE COMPONENT STUDY. Alonso-Echanove J, Edwards J, Richards M, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA; Univ of Melbourne, Melbourne, Australia.

To identify potential risk factors for ventilator-associated pneumonia (VAP), we analyzed data from the DISC study, a prospective, multicenter, cohort surveillance in eight adult general medical and/or surgical ICUs. DISC collects information daily on 65 potential intrinsic and extrinsic risk factors for the entire ICU admission on patients admitted >24 hours. From Nov 1997 to Aug 1999, 8,298 patient-admissions contributed 57,393 patient-days and 392 pneumonias. Of the 392, 317 (81%) were VAP (rate 8.2/1000 ventilator-days). In preliminary multivariate analysis, controlling for ICU stay, the following factors were significantly associated with an increased risk for VAP (p value <0.01): mechanical-ventilation (MV)-days (odds ratio [OR] per day=1.2; 95% confidence interval [CI]=1.1-1.3); MV 34 days (OR=1.6; CI=1.2-2.1); being unarousable (or paralyzed) for 90% to 100% of the ICU stay (OR=2.0; CI=1.5-2.7); nasogastric tube (NGT) exposure (OR=1.9; CI=1.4-2.6); chest tube (CT) exposure (OR=1.8; CI=1.3-2.5); intracranial monitor (ICM) exposure (OR=2.2; CI=1.3-3.6); receipt of gastric pH-raising agents (OR=1.5; CI=1.1-2.1); and male gender (OR=1.7; CI=1.4-2.2). Our results suggest that there is a complex relationship between the intrinsic and extrinsic risk factors associated with VAP. For ventilator exposure, the risk for VAP steadily increased daily but there was an additional increase in the risk when MV was maintained 34 days. The main intrinsic risk factor for VAP was being unarousable most of the ICU stay. Among extrinsic factors, exposure to gastric pH-raising agents or several devices (NGT, CT, ICM) were independent risk factors. Finally, male gender may be a surrogate for certain patient population and requires further analysis.

AN EVALUATION OF PROPOSED CDC DIAGNOSTIC CRITERIA FOR NOSOCOMIAL PNEUMONIA. Calfee DP, Farr BM. Univ of Virginia Health System, Charlottesville, VA.

BACKGROUND: The Univ. of Virginia Hosp is a 600 bed teaching facility where hospital-wide surveillance for nosocomial infections (NI) is performed using CDC guidelines. This study compared the performance of current and proposed CDC diagnostic criteria for nosocomial pneumonia (PNX). METHODS: Cases of nosocomial pneumonia diagnosed between 1/97 and 11/98 on four adult intensive care units were reviewed; 157 of 163 identified cases (96.3%) were evaluable. For each case, the reviewer determined which of the current and proposed CDC revised criteria were met. Under the proposed guideline, a physician's diagnosis alone would be insufficient for reporting PNX. RESULTS: All 157 cases had been reported using the current CDC guidelines for diagnosing PNX. 81 cases (51.6%) were reported based solely on the diagnosis of PNX by the treating physician, which is allowed under current guidelines. 34 cases (21.6%) met at least one of the proposed revised CDC diagnostic criteria for PNX. 7 of these 34 cases (20.1%) had been reported by physician's diagnosis alone under the current criteria. Using the proposed guidelines, the rate of PNX among these four units would have been 1.2 per 1,000 patient care days (PCD) as compared to 5.81 per 1,000 PCD using the current criteria. CONCLUSIONS: There was a 79.3% relative reduction in the rate of PNX using the proposed revised CDC diagnostic criteria. This was due to elimination of physician diagnosis as sufficient justification for reporting PNX and to the requirement of quantitative cultures in the PNEU-5 category, a procedure not yet routinely performed at this facility.

DO PHYSICIAN WEANING PRACTICES IMPACT ON VENTILATOR-ASSOCIATED PNEUMONIA RATES?. Clarvit JA,* Fleming J, Lumish RM. Mercy Hosp, Pittsburgh, PA.

BACKGROUND: Mercy Hospital is a trauma I facility with 2 adult intensive care units. They include a medical/surgical trauma unit (TLC) and a medical/surgical cardiovascular unit (HVC). Ventilator-associated pneumonia (VAP) rates in both units have remained consistently beyond the National Nosocomial Infection Surveillance 90th percentile range. Two physician groups are primarily responsible for ventilator management. Despite attention brought to the rates by Infection Control, the situation remained an ongoing problem. This precipitated an in-depth review of all ventilator patients. METHOD: A prospective study was conducted Feb through May of 1999 to identify factors that contributed to the increased VAP rates. RESULTS: The VAP rate for the study stayed consistent with previous rates. Prolonged length of stay (LOS) and the number of days on the ventilator (DOV) were the most significant risk factors in both units in the VAP population. The mean LOS was 33.3 days (p=.000025). The mean DOV was 30.2 days (p=.000035). Other significant risk factors were (1) tracheostomy, (2) nasogastric tube, (3) length of time until tracheostomy was performed and (4) the use of a paralytic agent. Our study also included a review of ventilator management. Each of the two physician groups rotates weekly through the TLC and HVC, leading to an inconsistent weaning approach.

VENTILATOR-ASSOCIATED PNEUMONIA RATES BEFORE AND AFTER ALTERATION OF VENTILATOR'S CIRCUITS-CHANGING PERIOD. Dantas SRPE, Trabasso P, Padoveze MC, Tresoldi AT. Campinas State Univ, Campinas, Brazil.

INTRODUCTION: Ventilator-associated pneumonia (VAP) represents at least 30% of nosocomial infection and is associated with high morbidity and high healthcare costs. OBJECTIVE: To compare VAP rates before and after modification of circuits-changing period. METHODS: prospective study comparing VAP rates from Jan 94 to Aug 98 and from Sep 98 to Aug 99 when ventilators circuits-changing period was altered from 72h to 7 days in a medical-surgical intensive care unit (MSICU), a pediatric intensive care unit (PICU) and a medical intensive care unit (MICU) of a teaching, acute, 3rd level care hospital. Diagnostic of VAP, patients-day, ventilator-day, ventilator utilization ratio and VAP rate were made according National Nosocomial Infection Surveillance (NNIS) System (1991). NNIS System Report (1998) was used as reference for comparative values. Results: 22,664 patients-day using 12,123 ventilators-day were enrolled until Aug 98 and 8,565 patients-day using 3,895 ventilators-day were enrolled from Sep 98 to Aug 99. In these periods, ventilator utilization ratio were respectively 0.73 and 0.74 (both above percentile 90%) in MSICU, 0.69 (above percentile 90%) and 0.49 (in the median) in PICU and 0.43 and 0.42 in MICU (both in the median). In the studied periods, VAP rate decreased from 21.43 to 12.43 (p=0.000) in MSICU and from 12.81 to 7.64 (p=0.000) in MICU but increased from 2.13 to 2.86 (p=0.026) in PICU. MSICU VAP rates diminished from above percentile 90% to percentile 75% during studied time, while MICU rates changed from percentile 75% to median in same period. PICU rates stayed in median values in both periods. CONCLUSION: (1) There were no statistically significant changes in ventilator utilization ratios between evaluated periods among studied units. (2) There were statistically significant decrease in VAP rates in MSICU and MICU after alteration of ventilators-circuits changing periods. (3) Despite a significantly increase of VAP rate in PICU, this unit's rates remains in the median. (4) There was an improvement of assistance after modification of circuits-changing period.

RISK FACTORS FOR EARLY- AND LATE-ONSET VENTILATOR-ASSOCIATED PNEUMONIA IN PROSPECTIVELY STUDIED PATIENTS IN A SURGICAL INTENSIVE CARE UNIT. Haley RW, Hawkins K, Moody B, Gander R, Southern PM Jr., Uchal L, Joy K, Christensen L, Minei JP. Departments of Internal Medicine and Surgery, Univ of Texas Southwestern Med Center, Dallas, TX; Parkland Memorial Hosp, Dallas, TX.

To search for new hypotheses about the etiology and pathogenesis of ventilator-associated pneumonia (VAP) we conducted a prospective cohort study in 255 consecutive ventilated patients admitted to Parkland Memorial Hosp's surgical intensive care unit (SICU) for at least 48 hours. Extensive clinical data were recorded each day on a form by surgeons (MD), nurses, respiratory therapists, pharmacists, and infection control staff, continually monitored to ensure complete recording. Transtracheal aspirate (TTA) and bronchoalveolar lavage (BAL) cultures were performed when clinically indicated. For this epidemiologic analysis we used the modified Johanson definition of VAP, which required simultaneous occurrence of an infiltrate on chest X-ray, purulent sputum, abnormal temperature (>38.5 or <36°C) and leukocytosis. Since the distribution of VAP cases by SICU day of onset showed a bimodal pattern separated at the fifth SICU day, we defined early onset VAP as a case with onset on SICU days 3-5 (13 cases) and late onset VAP as a case with onset between days 6 and 20 (18 cases). In a Cox proportional hazards stepwise regression analysis (requiring p<.01 for significance), early VAP was independently associated with a positive culture for Pseudomonas aeruginosa (risk ratio 6.6, 95% CI 1.8-24.9), dichotomous skin assessment score (risk ratio 5.1, 95% CI 1.5-17.0), and more frequent change of central venous catheters (ratio 3.9, 95% CI 1.8-8.2, per catheter change). In contrast, late VAP was independently associated with the severity (Abbreviated Injury Score >2) of traumatic chest injury (risk ratio 6.0, 95% CI 2.1-17.0) and the duration of neuromuscular blockade therapy (coded in 1 day increments from 0 to 6+ days) in the SICU (risk ratio 1.3, 95% CI 1.05-1.6, per day of therapy). We found no association with smoking, mental status, Injury Severity or APACHE scores, body mass index, age, serum albumin, number/duration of operations, emergent operation, blood loss, shock, transfusion, wound class, ASA score, observed aspiration, oral care, antacid or H2 blocker or sucralfate therapy, antibiotic choice, steroid or narcotic use, nasogastric tube, ventilator settings, type of ventilator, breathing circuit changes, nebulized medications, inadvertent extubations or other pathogens.

ASSOCIATION BETWEEN MONOCHLORAMINE USE BY MUNICIPAL WATER TREATMENT PLANTS AND NOSOCOMIAL LEGIONNAIRES' DISEASE. Heffelfinger JD, Fridkin SK, Kool JL, Fraser V, Carpenter J, Hageman JC, Zell ER, Kupronis B, Whitney CG. Ctrs for Disease Control and Prevention, Atlanta, GA; National Institute for Public Health and the Environment, Bilthoven, The Netherlands; Washington Univ School of Medicine, St. Louis, MO.

A recent case-control study found that institutions that had reported outbreaks of nosocomial Legionnaires' disease (NLD) were less likely to be supplied by water systems that used monochloramine as a disinfection method than institutions without reported outbreaks. Because the potentially protective effect of monochloramine is a novel finding, further study is needed to confirm the finding. We surveyed Society for Healthcare Epidemiology of America (SHEA) members representing 459 hospitals. The survey addressed hospital features, occurrence of NLD, source of the hospital water supply, and methods of disinfection used by the local water treatment plant and by the hospital. Completed surveys were returned for 166 (36%) hospitals. Responding hospitals were similar to non-responding hospitals with respect to census, metropolitan size, academic affiliation, and presence of oncology or transplant services. Thirty-three (20%) reported one or more cases of NLD between 1994 and 1998 and 23 (14%) reported an outbreak of NLD between 1989 and 1998. Hosps reporting NLD had more intensive care unit beds (median 36 vs. 26, p=.03), and a higher census (median 340 vs. 226.5, p=.05), and were more likely to have a transplant program (relative risk [RR] 1.6, 95% confidence interval [CI] 1.2-2.3), to perform surveillance for NLD (RR 1.4, CI 1.1-1.7), and to use additional water treatment (RR 4.6, CI 2.2-9.6) than were hospitals without NLD cases. Hosps supplied by water plants using monochloramine were less likely to have NLD cases (RR.36, CI.18-.72) and outbreaks of NLD (RR.32, CI.13-.77) than were hospitals supplied with water with free chlorine residual disinfectant. This study confirms the previous investigation suggesting that disinfection of potable water with monochloramine reduces the risk of NLD.

SUCCESS OF AN INTERVENTION PROGRAM FOR THE CONTROL OF NOSOCOMIAL PNEUMONIA IN A TERTIARY CARE HOSPITAL. Higuera-Iglesias AL, Chavez de la Peña ME, Rangel-Frausto MS, Ponce de León-Rosales S. Natl Institute of Nutrition, Mexico City, Mexico.

BACKGROUND: despite the use of wide spectrum antibiotics, nosocomial pneumonias (NP) remain an important cause of morbidity and mortality. At our hospital the overall NP rate is 1.4/100 admissions and 10/100 admissions in the ICU. OBJECTIVE: To evaluate the results of an intervention program for the prevention of NP in a tertiary care hospital. METHODS: The intervention program consisted of two phases: (1) Diagnosis and evaluation: analysis of NP trends between 1991 and 1998; identification of risk factors associated with NP through case-control studies; evaluation of the awareness of preventive measures amongst hospital employees; performance of a shadow study to determine ICU patients' positions while in bed; (2) Design of specific measures according to the results of phase 1: intensification of continued personnel education; review of all processes involved in the care of mechanical ventilation systems; reinforcement of the surveillance system, flu vaccination for all personnel, patients and their families and other specific preventive measures. RESULTS: The study was carried out for 13 months (7 months

before and 6 months after the intervention). Before the intervention the average NP rate was 2.68/100 admissions and after the program this rate was reduced to 0.94/100 admissions. This constitutes a 65% reduction throughout the hospital and a 45% reduction in the ICU. The average NP rate per 1000 ventilator days was 37.1/100 admissions in the pre-intervention period and was reduced by 34% to 24.53/100 admissions. A 39% reduction in anomalous patient position (Fowler œ30o). After this program, inpatients had 35% less risk of acquiring a NP (95% CI, 0.2-0.6 SD, p<.5). CONCLUSION: A successful NP intervention program can achieve important reductions in the incidence of this infection (65%) and the associated risk (35%). Such a program should be tailored to the local needs and requires a collaborative and multidisciplinary effort.

CLASSIFICATION OF PNEUMONIA IN BELGIAN ICUS ACCORDING TO THE AMERICAN THORACIC SOCIETY APPROACH TO INITIAL MANAGEMENT OF HOSPITAL-ACQUIRED PNEUMONIA. Leens E, Suetens C, Ilunga J, Jans B, Carsauw H, Morales I, Selway P. Scientific Institute of Public Health, Brussels, Belgium: Clinique Ste-Elisabeth, Brussels, Belgium.

OBJECTIVE: To evaluate the ability of the American Thoracic Association (ATS) classification of hospital-acquired pneumonia (PN)1 to discriminate pathogens in PN reported in the Belgian national surveillance of ICU-acquired PN from Jan 1996 to Jun 1999. METHODS: PN were classified in 3 groups according to the definition of the ATS which relies on disease severity, the presence of risk factors and time of onset of PN. Each group has a list of likely pathogens that leads to the initial antimicrobial regimen. The list of pathogens in each group as presented by ATS was compared with the microorganisms found in Belgian ICU patients. RESULTS: A total of 2,963 PN episodes were included in the analysis. According to the ATS algorithm, 366 PN episodes (12.4%) were classified in the first group (patients without risk factors who present a mild-to-moderate PN with onset any time or a severe PN of early onset), 716 (24.2%) in the second group (patients presenting risk factors with a mild-to-moderate PN occurring any time) and 1881 (63.5%) in the third group (patients with severe PN either of early onset with risk factors or of late onset). The organisms isolated in the different groups are presented in TABLE 1. CONCLUSION: Although important deviations from the ATS "likely" pathogens appeared in our data (e.g., P. aeruginosa in group 1), the variation of the spectrum of organisms was generally similar to the ATS lists.

1 American Thoracic Society. Hosp-Acquired pneumonia in adults: diagnosis, assessment of severity, initial antimicrobial therapy and preventive strategies. A consensus statement. Am J Respir Crit Care Med 1996; 153: 1711-25.

Organisms (%) isolated in PN classified in 3 groups according to the definition of the ATS

Organisms	Group1	Group2	Group3	p-value
Enteric gram-negative bacili	28.9	39.1	37.5	<0.001
H. influenzae	10.7	4.8	5.7	<0.001
S. aureus (MRSA%)	11.5 (35)	11.6 (45)	14.7 (37)	0.023
S. pneumoniae	8.8	3.2	2.9	<0.001
Anaerobes	0.0	0.0	0.2	NS
P. aeruginosa	10.9	15.2	15.7	0.025
Acinetobacter species	1.7	2.1	2.2	NS
Other*	27.5	23.9	21.1	<0.001

* not specified by ATS (e.g. fungi)

DIAGNOSTIC PROCEDURES FOR VENTILATOR-ASSOCIATED PNEUMONIA: A META-ANALYTIC APPROACH. Michaud S,* Suzuki S, Harbarth S. Faculté de Médecine, Univ de Sherbrooke, Québec, Canada; Harvard School of Public Health, Boston, MA; Children's Hosp, Harvard Med School, Boston, MA.

Controversy persists among infection control and critical care physicians about how to accurately diagnose and survey ventilator-associated pneumonia (VAP). This study sought to systematically evaluate the performance of 7 diagnostic procedures for VAP in mechanically ventilated (MV), non-immunocompromised, adult patients: regular protected specimen brush (PSB), telescoping plugged catheter (TPC-PSB), bronchoalveolar lavage (BAL), quantitative cultures of endotracheal aspirates (EA), protected BAL (PBAL), protected mini-BAL (MBAL), and blind TPC (BTPC). Computerized literature search of MEDLINE (English, French and German languages; 1966-99) and manual scanning of retrieved articles were performed. Study exclusion criteria were: non-MV patients, lack of information on the sensitivity and specificity of the tests, use of TPC-PSB or BAL results as the only VAP definition criterion, and community-acquired pneumonia. Pooled estimates of sensitivity and specificity were calculated for each test. The performance of TPC-PSB, BAL, and EA, was expressed by Q* values estimated from summary receiver-operating characteristic curves, using random-effects models. Subgroup analyses and meta-regressions were also performed. Our results suggest that TPC-PSB is the most accurate diagnostic test for VAP, followed by BAL and EA. More studies are needed to evaluate the performance of PBAL, MBAL, and BTPC. Although methodologic limitations hamper drawing strong conclusions from this analysis, our findings may be useful for future studies about the prevention, early diagnosis and targeted therapy of VAP.

Test (threshold in cfu/ml)	Sensitivity (95% CI)	Specificity (95% CI)	Q* (95% CI)	Studies (n)	Episodes (n)
TPC-PSB (10^3)	70% (66-74)	94% (91-96)	0.91† (0.88-0.94)	23	1008
BAL (10^4)	65% (61-70)	81% (77-85)	0.82† (0.74-0.89)	17	793
EA (10^5)	66% (60-73)	72% (63-80)	0.71 (0.69-0.73)	7	308
PSB (10^3)	70% (60-79)	91% (86-96)	-	2	206
BTPC (10^3)	61% (53-69)	95% (88-100)	-	3	180
PBAL (10^4)	65% (54-76)	88% (82-95)	-	3	155
MBAL (10^3)	72% (62-83)	81% (72-90)	-	3	145

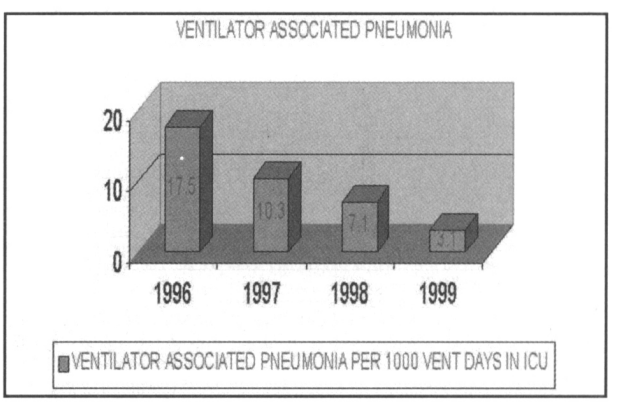
† Adjusted for the population studied and patient inclusion criteria.

CLINICAL SIGNIFICANCE OF CANDIDA ISOLATES IN ICU-ACQUIRED PNEUMONIA. Morales I, Suetens C, Jans B, Carsauw H, Leens E, Selway P. Scientific Institute of Public Health, Brussels, Belgium.

OBJECTIVE: To determine outcome and risk factors of pneumonia with documented isolation of Candida sp. In Belgian ICUs. METHODS: 2,929 pneumonias (PN) reported by Belgian ICUs participating to the national surveillance of ICU-acquired infections from Jan 1996 to Jun 1999 were reviewed. Candida pneumonia (CPN) were classified in pneumonia with isolation of Candida alone (SCPN) and in association with other micro-organisms (MCPN). Both groups were compared to other pneumonia with regard to clinical outcome (death in the ICU) and risk factors. RESULTS: On a total of 2,929 pneumonias, 281 (9.6%) Candida sp. Were isolated. Of those, 77.4% were Candida albicans. Candida pneumonia (CPN) was more likely to be associated with other micro-organisms: 56.2 % versus 21.1 % in other PN (p<.001). Case fatality was 35.8% in SCPN and 42.1% in MCPN, compared to 24.9% and 27.2% in PN without Candida. The difference remained significant after adjustment for LOS before the onset of infection and SAPS II score. The average LOS in survivors after infection was 12.1 days in SCPN and 9.4 days in MCPN and did not differ significantly from other PN. Risk factors associated with CPN were infection at admission in the ICU (ORSCPN 1.67; 1.13-2.46; ORMCPN 2.35; 1.59-3.46), presence of metatastic cancer or hematologic malignancy (ORSCPN 2.04; 1.03-3.96; ORMCPN 2.16; 1.05-4.40) and female gender (ORSCPN 1.66; 1.13-2.44; ORMCPN 2.25; 1.37-3.73). In MCPN two additional factors were identified: age 3-60 years (OR 2.25; 1.37-3.73) and use of therapeutic antibiotics prior to ICU admission (2.63; 1.71-4.04). CONCLUSIONS: Although Candida sp. Are seldom considered as important pathogens in nosocomial pneumonia, they were frequently reported in ICU-acquired PN in the Belgian national surveillance and were associated with a high mortality.

REDUCTION IN VENTILATOR ASSOCIATED PNEUMONIA AND HOSPITAL COSTS IN A COMMUNITY HOSPITAL. O'Connor MA, Batchik J, Morse AB, Dempsey E. Dominican Hosp, Santa Cruz, CA.

Dominican Hosp, a CHW affiliate, is a 222-bed acute care hospital located in Santa Cruz, California, with a 16-bed Med-Surgical Intensive Care Unit (ICU). Infection rates using device-day denominators were instituted in 1996. The Ventilator-Associated Pneumonia (VAP) rate of 17.5/1000 ventilator days was significantly higher than the NNIS mean of 11.5. It was also noted that ventilator usage and reintubation rates were higher than predicted using APACHE III system. A multidisciplinary Process Improvement Team (PIT) was formed to develop and implement strategies to reduce these rates. In 1997, Heat Moisture Exchange (HME) was introduced. In 1998, a ventilator management program was implemented. This included instituting new sedation and weaning protocols, conducting family conferences, performing naso-jejunostomy feedings and elevating the head of the bed to minimize aspiration, extending the time between ventilator circuit changes and in-line suction catheter changes. The VAP rate has decreased to 3.1% (see graph). The cost of a VAP was calculated using total hospital costs for all patients on ventilators. Of the 1,112 ventilated patients there were 37 VAPs in 36 patients (3.3%). The mean total cost is $71,000. Over the last 3 years, the cost savings associated with reducing VAP is estimated to exceed 1 million dollars (see table).



Reduction in Ventilator-associated Pneumonia and Hospital Costs in a Community Hospital

	Ventilated Patients	Patient with VAP
Number of Patients	1112	36
Mean Days on Ventilator	3.5	22.1
Mean ICU Days	5.9	27.7
Mean Hospital LOS (days)	11.2	34.3
Mean Total Cost of Hospitalization	$30,494	$101,608

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NOSOCOMIAL PNEUMONIA IN A CANCER CENTER IN MEXICO. A 12-MONTH EXPERIENCE. Vilar-Compte D, Castillo-Mancilla JR, Roldan-Marin R, De la Rosa M, Sandoval S, Gordillo P, García B, Volkow P. Instituto Nacional de Cancerologia, México City, México; Universidad Nacional Autónoma de México.

The INCan is a referral cancer center for adult patients. Nosocomial Pneumonia (NP) is the third most frequent nosocomial infection at the INCan. Since 1993 an increasing rate of NP was observed; by 1996 the NP rate had doubled. In 1998 a case-control analysis was done to evaluate the NP rate per hospital ward, the risk factors and the associated mortality. METHODS: From 1/1/98 to 12/31/98 all patients with NP according to the CDC modified criteria were included. For each case, two controls were matched. The variables analyzed were: age >60 years, smoking, alcoholism, COPD, Glasgow score at diagnosis, hospital length of stay, neutropenia, thoracic and abdominal surgery, antacid treatment, previous broad spectrum antibiotics (PBSA), steroids, ventilatory support, tracheotomy, nebulizers, nasogastric tube, and bronchoscopy. All patients were followed daily until discharge; to evaluate the patient outcome a full chart review was done 2 weeks after dismissal. A case control analysis was done using univariate and multivariate analysis. Results: 53 cases and 106 controls were included. The NP rate was 0.66 per 100 hospital discharged patients (HDP). The HDP rate per hospital ward was: 7.7, 6.5, 0.16, 0.34 and 0.28 for ICU, bone-marrow transplant unit, radiation-oncology, surgical and hematology-oncology wards respectively. The risk factors associated after the logistic regression analysis were: age >60 years (OR= 3.1 95% CI=1.2-8.4), ventilatory support (OR=2.9 95% CI=1.1-7.4), nebulizers (OR= 6.4 95% CI=2.4-17) and PBSA (OR= 3.04 95% CI=1.1-8.7). The most frequently isolated microorganisms were: Candida sp. 22 (34%), Enterobacteria 11 (17%), Streptococcus sp. 9 (14%) and Pseudomona sp. 5 (7.69%).Twenty-one (39.6%) cases died, in 13 (62%), the NP contributed directly to death. *CONCLUSIONS: All* the associated risk factors, except *BANM* are similar to those previously reported. The increase on NP since 1993 correlates with the opening of the pulmonary therapy department. Candida sp. Was the most frequently isolated microorganism, which in part explains the seriousness of the episodes seen and the type of pts treated in our institution.

Quality Improvement—Abstracts in this category appear in* Am J Infect Control February *2000.

SSI

IMPACT OF SURGICAL SITE INFECTIONS ON MORBIDITY AND MORTALITY IN SURGERY PATIENTS: RESULTS FROM THE 1997-99 INCISO NETWORK. Astagneau P,* Golliot F, Brucker G. Co-ordinating center for nosocomial infection control (C-CLIN Paris Nord), Paris, France.

Since 1997, a surgical site infections (SSI) surveillance network (INCISO) have been implemented in volunteer general surgical units in the Northern France area. Three months a year, data were consecutively collected in all surgery patients on peri-operative factors in order to assess the NNIS index. All patients included were traced for their outcome during 30 days after surgery. SSI was defined based on three levels according to CDC definition. Death attributable to SSI was mentioned according to physician decision. Over the 1997-99 surveillance periods, 1,372 of 41,816 (3.3%) patients developed SSI within 30 days after surgery, including 78% within the first two weeks and 43% after discharge, 28% were readmitted before the 30th day and 22% required reoperation. 34% of SSI were deep or organ-site infections. Mean extra-hospital stay attributable to SSI was 8.2 days. Crude mortality rate was 1.4%, and case-fatality rate 2.3%. Of the 59 SSI-associated deaths, 53% were deep or organ-site infections and 12% were directly attributable to SSI. As SSI incidence increased with the NNIS index from 1.8% to 22.9%, crude mortality increased from 0.3 to 21%. These results demonstrate that SSI have a significant impact on morbidity in surgical patients. NNIS index is a predictor of crude mortality that could be used as a prognostic index in surgical wards.

THE INFLUENCE OF "BARRIER" QUALITY SURGICAL GOWNS AND DRAPES ON SURGICAL SITE INFECTIONS. Belkin NL, Retired, Clearwater, FL.

The new Guidelines for the Prevention of Surgical Site Infections (SSI) issued by the Ctrs for Disease Control and Prevention (CDC) state that "there are limited data that can be used to understand the relationship of gown or drape characteristics with SSI risk" and that "the wide variation in the products and study design make interpretation of the literature difficult." Fiscal conditions in our nation's healthcare delivery system mandate that the cost-effectiveness of a product be predicated on its influence on the outcome of the procedure. One of those products is "barrier" quality surgical gowns and drapes. This session will review all of the relevant literature and then consider whether their influence on SSI is predicated on what has been described as "anecdotal experience and commercial interests or conclusive clinical studies."

RISK FACTORS FOR SURGICAL SITE INFECTION AFTER 1,3-BIS (2-CHLOROETHYL)-1-NITROSUREA (BCNU) GLIADEL™ WAFER IMPLANTATION FOR GLIOBLASTOMA. Bertin ML, Mani A, Barnett G, Gordon S. Cleveland Clinic Foundation, Cleveland, OH.

BACKGROUND: Implantable biodegradable polymer Gliadel™ wafers (GW) are a novel method of providing interstitial BCNU chemotherapy directly to the resected tumor bed of malignant brain tumors. The dura is closed in a water tight fashion to prevent leakage of BCNU, the majority of which is slowly released over a few weeks. GW have been used by neurosurgeons at the Cleveland Clinic Foundation (CCF) since 1997. Routine surveillance identified two patients in 1999 with surgical site infection (SSI), prompting an epidemiological investigation to determine the incidence and risk factors for SSI. Methods: A case patient was defined as any patient undergoing a craniotomy with GW insertion from 1/1/97-6/3/99 with a SSI (as defined by the CDC). Control patients were any GW patient without a SSI during the same time period. Med records were retrospectively reviewed for a variety of patient characteristics and operative information. RESULTS: A total of 31 GW procedures were performed during the study period. 28 charts were available for review and included in the study. 75 % of surgeries were performed by a single surgeon. The rate of SSI was 14% (4/28). Mean onset time was 19 days (range: 3-38). Pathogens were P. aeruginosa [2], S. epidermidis and no pathogen identified [1 each]. The only significant risk factor associated with SSI was the use of a GoreTex® (changed because brand name) graft for a water tight dural closure (0/24 [0 %] controls vs 2/4 [50 %] cases p=.01). Cadaver dural allografts are now the CCF neurosurgeons' preference for obtaining a water tight seal. Conclusion: The CCF rate of SSI in GW patients was 14%. P. aeruginosa was the pathogen associated with 50 % of infected cases. Use of GoreTex® (changed because brand name) graft was significantly associated with an increased risk of infection. Implantable wafers demonstrate how new technologies may impact infection risks.

RISK FACTORS FOR EARLY-ONSET PROSTHETIC VALVE ENDOCARDITIS DUE TO COAGULASE-NEGATIVE STAPHYLOCOCCUS. Chemaly RF,* Inamdar RR, Serkey JM, Gordon SM. The Cleveland Clinic Foundation, Cleveland, OH.

BACKGROUND: The most common pathogen causing early-onset (<12 months after valve implantation) prosthetic valve endocarditis (EO-PVE) among patients at the Cleveland Clinic Foundation (CCF) is coagulase-negative staphylococcus (CNS). We conducted a case-control study to identify risk factors associated with CNS EO-PVE. METHODS: PVE was defined by the criteria proposed by Von Reyn for definite endocarditis. A case-patient was defined as anyone undergoing a valve replacement at CCF between 1992-95 with EO-PVE due to CNS. Controls were selected among patients undergoing valve replacement surgery without EO-PVE during the same time period as case-patients. RESULTS: Twenty-seven (27) case-patients and 75 control-patients were included in the study. The mean age of case-patients was 64 years and the mean interval to the onset of EO-PVE was 83 days (range: 3-240 d). The most common sign at the onset of PVE was fever (82%) and 81% had echocardiographic findings of PVE (vegetations and/or an annular abscess). The aortic position was the most common site and bioprosthetic valves were the most common type infected. Ninety-three percent (93%, 25 pts) underwent surgical treatment of PVE and death was attributed to PVE in 22% (6 pts). When compared with control-patients, case-patients were significantly more likely to have had a history of a stroke (6/27 vs 5/75; P<0.02), cardiac arrhythmias (6/27 vs 0/75; P<0.001) and prior infective endocarditis (6/27 vs 6/75; P<0.05) and more likely to have renal failure (4/27 vs 0/75; P<0.001), respiratory problems (4/27 vs 3/75; P<0.05) and bacteremia (2/27 vs 0/75; P<0.01) postoperatively. CONCLUSION: We conclude that several host and post operative factors may be associated with an increased risk of CNS EO-PVE among patients undergoing valve replacement at our institution.

A COLLABORATIVE APPROACH TO IMPROVE SURGICAL SITE INFECTION RATES. Clarvit JA,* Fleming J, Lumish RM. Mercy Hosp, Pittsburgh, PA.

BACKGROUND: Mercy Hosp of Pittsburgh, a tertiary care facility, performs on average 750 Coronary Artery Bypass Graft (CABG) procedures annually. Nosocomial surgical site infection (SSI) surveillance is done utilizing the National Nosocomial Infection Surveillance criteria. Overall infection rates traditionally ranged from 2.6 to 3.3%. An increased trend in SSI's was noted in the first half of 1998 with a rate of 6.6%. Of the infections identified, 50% were deep sternal wounds. METHOD: An epidemiological investigation was initiated, looking at all facets of care during hospitalization. This included a Case Control Study. RESULTS: The most significant variable identified was the use of Bone wax as a hemostatic agent during surgery (p=.059). Diabetic patients accounted for 57% of the SSI's identified. Variables that reflected glucose management did show a higher Odds Ratio. The increased flow of Operating Room (OR) traffic was also identified as a change in practice. Pre-operative skin cleansing documentation was inconsistent, and xistent in the "To Be Admitted" (TBA) population. CONCLUSIONS: Multiple variables appear to have contributed to the increase in SSI's in the CABG population. Using a collaborative approach, Infection Control, Cardiac surgeons and Heart Institute Management implemented action plans. They included: (1) Elimination of the use of Bone wax; (2) mandatory use of the existing Insulin Protocol with tighter glucose control; (3) control of OR room traffic in flow and number; and (4) uniform documentation of the pre-operative skin cleansing, including TBA patients. Once staff members were alerted to the problem and action plans implemented, SSI rates decreased to 2.9%.

RISK FACTORS FOR SURGICAL SITE INFECTION FOLLOWING CRANIOTOMY OPERATION REPORTED TO THE NATIONAL NOSOCOMIAL INFECTIONS SURVEILLANCE SYSTEM. Emori TG, Edwards JR, Horan TC, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA.

The National Nosocomial Infections Surveillance (NNIS) system's surgical site infection (SSI) index, which consists of wound class, American Society of Anesthesiologist's (ASA) score, and duration of surgery, is useful for predicting SSI following most operative procedures, but does not adequately predict SSI risk following craniotomy operations. To determine risk factors for SSI after craniotomy, the NNIS system in 1994 introduced a supplemental protocol for collecting data on additional risk factors that were identified through a review of the literature, i.e., pressure monitoring device, chemotherapy, radiation therapy, steroid therapy, antibiotic prophylaxis, antibiotic agent, and antibiotic therapy for infection at another site. Risk factors that are collected on all surgical patients in the NNIS system were used in this analysis, e.g., gender, age, trauma, wound class, ASA score, duration of operation, emergency, general anesthesia, and multiple operations through the same incision. During 1994 and 1999, 18 NNIS hospitals used the supplemental protocol to collect risk factor data in 2,782 craniotomy operations. They reported 53 SSIs following these operations, yielding an overall SSI rate of 1.9%. The distribution of the specific sites of the 53 SSIs were intracranial (11%), meningitis (43%), skin (25%), and soft tissue (21%). Based on stepwise logistic regression modeling, a patient with multiple operations through the same craniotomy incision is at greater risk of developing an SSI (OR=2.4, 95% CI=1.2-4.5, p=0.009). When the analysis was limited to the 29 deep SSIs (intracranial and meningitis), multiple operations (OR=2.7, 95% CI=1.1-6.2, p=0.02) and antibiotic therapy for an infection at another site (OR=2.5, 95% CI=1.1-5.3, p=0.02) were significant. While more data are needed to confirm these elements in a craniotomy-specific SSI risk index, these results suggest that performing multiple procedures through the same incision during craniotomy places the patient at higher risk for an SSI.

REDUCING SURGICAL SITE INFECTION RATES IN CARDIAC SURGERY IN AN ISRAELI HOSPITAL. Finkelstein R, Rabino G, Mashiach T, Bar-El Y, Adler Z, Hashman N, Milo S . Rambam Med Ctr, Haifa, Israel.

OBJECTIVE: to evaluate the efficacy of an infection control program in reducing surgical site infections (SSI) in cardiac surgery. DESIGN: prospective cohort study. SETTING: 860-bed tertiary-care university hospital in Haifa, Israel. PATIENTS: adults undergoing cardiac surgery requiring sternotomy. MAJOR INNOVATIVE INTERVENTIONS: prospective surveillance, periodic reporting of SSI rates, instructional talks, regular visits by the infection control nurse and infection diseases consultant, screening and treatment for S. aureus nasal carriers among personnel, presurgical shower and prophylaxis in the holding area METHODS AND DEFINITIONS: those recommended by the National Nosocomial

Infection Surveillance (NNIS). SYSTEM RESULTS: 882 procedures were evaluated. From Jan 1997-Jun 1999, a reduction in infection rates was observed in almost all considered parameters: I) in coronary artery bypass graft surgery (CABG) with chest and leg incisions SSI rates decreased from 7.1%-3.8% among patients defined as risk category (RC)-1 and from 22.2%-9.5% for those in RC-2; II) in cardiac surgery other than CABG SSI rates decreased from 6.1%-3.4% in RC 0-1 and 11%-0 in RC-2; III) the rate of superficial incisional infections in patients defined as RC-1 was reduced from 4.3%-2.4%, that of deep infections (RC-2) decreased from 4.3%-1.7% while organ/space infections were reduced from 2.2%-0.8% for RC-1 and from 7.1%-0 for RC-2. CONCLUSIONS: comprehensive ICPs can significantly reduce SSI rates in cardiac surgery even in institutions with limited resources.

INFECTION RATES IN ELECTIVE CESAREAN SECTION IN A BRAZILIAN HOSPITAL. Fonseca SNS, Menegucci MC, Ferriani LA. Maternidade Sinh Junqueira, Ribeirao Preto, SP, Brazil.

Brazil has one of the highest rates of elective cesarean sections (C-section) of the world; in certain maternities the C-section rate can be as high as 85%. For this reason, infection rates (IR) associated with this procedure may not be the same as the ones reported by the National Nosocomial Infection Surveillance (NNIS) study, which is a well-recognized reference for IR around the world. In 1997, we established a post-discharge surveillance in our 80-bed maternity that has a C-section rate over 80%. Five days a week, the infection control nurse phoned a convenience sample of patients discharged 2 weeks before and asked infection-related questions. The Ctrs for Disease Control and Prevention definitions for surgical site infection (SSI) and endometritis were used. From Aug 1997 to Aug 1999, 2,766 women were submitted to gynecologic surgery and 6,766 delivered, 5,508 (81.4%) by C-section. Three thousand seven hundred and sixty-five (3,765, 39.5%) of the patients were contacted; 53 SSI were detected, 20 in C-section patients (rate=0.36%). There was only 1 case of endometritis detected. All SSI cases were detected after discharge; there were no deaths. The pooled mean SSI rate for risk zero C-section by NNIS study is 3.37%. We concluded that we have a much lower SSI rate than the mean NNIS rate, probably because the classic risk factors for endometritis and SSI are not present in our population submitted to so many elective C-sections. Because Brazil is so peculiar in that enormous C-section rate, Brazilian rates should be compared to data such as ours in order to understand better the epidemiology of C-section associated SSI. Maternities, with the same characteristics as ours, reporting SSI rates higher than ours should be alert to the possibility of having an ongoing undetected infection control problem.

EPIDEMIOLOGY AND MICROBIOLOGY OF SAPHENOUS VEIN DONOR SITE INFECTIONS FOLLOWING CORONARY ARTERY BYPASS GRAFT SURGERY. Garcia M, Collins S, Burt J, Conly JM. Toronto General Hosp, Univ Health Network, Toronto, Ontario.

BACKGROUND: Saphenous vein donor site infection (SVDSI) after coronary artery bypass graft surgery (CABG) can be associated with increased costs and prolonged hospital stay. We have followed SVDSI for the past 9 years in a 1000-bed 3-site tertiary care teaching facility. The purpose of our study is to provide the descriptive epidemiology and microbiology of SVDSI following CABG at an urban tertiary referral center. METHODS: All patients undergoing cardiovascular surgery from Apr 01, 1990, to Mar 31, 1999, were included for analysis. SVDSI were identified according to a modified Centers for Disease Control classification of SSI. Patients were evaluated prospectively for the presence of infections from the time they had surgery until discharge. There was no active post-discharge surveillance. The microbiology of SVDSI was obtained from the hospital laboratory information system (Ulticare) reports. RESULTS: There were a total of 19,482 cardiovascular operations of which 13, 067 were CABG surgery. During this period there were a total of 837 (4.3%) SSI with 343 (2.6%) SVDSI representing 41% of the total. Of the 343 SVDI, 15 (4.4%) developed more than one donor site infection. In total, 762 organisms were isolated from SVDSI with 2 or more isolates present in 34%. Gram positive cocci (coagulase negative staphylococci, enterococci and S. aureus) accounted for 55% of the isolates with gram negative bacilli (mainly Escherichia coli and Pseudomonas aeruginosa) accounting for 38%. For 36 (10.5%) SVDSI either no pathogens were isolated or no cultures were obtained The frequency of methicillin-resistant S. aureus isolation from SVDSI was 0.5%. The distribution of pathogens by year has not changed over the 9 year period of analysis. CONCLUSION: Gram positive organisms alone or as part of a polymicrobial flora remain responsible for the majority of SVDSIs with no significant changes noted over 9 years. A better understanding of trends and etiology of SVDSI will lead to more timely and appropriate therapeutic management of donor site infections.

RISK FACTORS FOR ENDOMETRITIS AFTER CESAREAN SECTION: RESULTS OF A 5-YEAR MULTICENTER STUDY. Horan TC, Edwards JR, Culver DH, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA.

To identify risk factors for endometritis after cesarean section (CSEC) so that infection prevention strategies can be developed, we conducted a prospective study in 71 National Nosocomial Infections Surveillance system (NNIS) hospitals from May 1994-June 1999 using NNIS definitions of endometritis. Potential risk factors assessed were age, wound class, American Society of Anesthesiologist's (ASA) score, duration of operation, emergently performed CSEC, trauma, use of general anesthesia, whether multiple procedures were done through the operative incision, pregnancy body mass index (PBMI=[wt-15]/ht in kgm2), level of prenatal care, presence of labor and membrane rupture and their durations, estimated blood loss (EBL), and antimicrobial prophylaxis, including agent, dose, and route. Among 41,710 CSEC operations, 1,277 endometritis surgical site infections were reported for a rate of 3.06%. Results of stepwise multiple logistic regression analyses suggested that 7 factors were independently important in predicting the risk of endometritis. Age was the most important factor and the risk decreased with age (p<0.0001), with most of the risk attributable to teenagers. The risk increased as the duration of operation in minutes increased (p<0.0001). The risk of endometritis was significant if labor was present (OR=1.638, 95% CI=1.443-1.862, p<0.0001). The risk increased as EBL increased in two distinct levels: EBL=601-900 ml (OR=1.432, 95% CI=1.252-1.639, p<0.0001) and EBL>900 ml (OR=2.265, 95% CI=1.942-2.641, p<0.0001). If the operation was performed emergently, the risk also increased (OR=1.256, 95% CI=1.113-1.418, p<0.0001). Two other factors-ASA score >2 and PBMI 19 (i.e., being underweight)-influenced the risk of endometritis, but less so than those already mentioned (p 0.03). The model suggests a complex relationship between these 7 factors and post-CSEC endometritis and underscores the importance of age, especially teenage, presence of labor, duration of operation, EBL, and emergently performed CSEC in predicting endometritis risk.

RISK FACTORS FOR INCISIONAL SURGICAL SITE INFECTION AFTER CESAREAN SECTION: RESULTS OF A 5-YEAR MULTICENTER STUDY. Horan TC, Edwards JR, Culver DH, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA.

To identify risk factors for incisional surgical site infection (ISSI) after cesarean section (CSEC) so that infection prevention strategies can be developed, we conducted a prospective study in 71 National Nosocomial Infections Surveillance system (NNIS) hospitals from May 1994-June 1999 using NNIS definitions of ISSI. Potential risk factors assessed were age, wound class, American Society of Anesthesiologist's (ASA) score, duration of operation, emergently performed CSEC, trauma, use of general anesthesia, whether multiple procedures were done through the operative incision, pregnancy body mass index (PBMI=[wt-15]/ht in kgm2), level of prenatal care, presence of labor and membrane rupture and their durations, estimated blood loss (EBL), and antimicrobial prophylaxis, including agent, dose, and route. Among 41,710 CSEC operations, 585 ISSIs were reported for a rate of 1.4%. Results of stepwise multiple logistic regression analyses suggested that 6 factors were independently important in predicting ISSI risk. The risk increased linearly as PBMI increased (p<0.0001). If the duration of labor after hospital admission or the duration of ruptured membranes was >6 hours, the ISSI risk increased (OR=1.566, 95% CI=1.323-1.852). When the ASA score was >2, the risk was significant (OR=1.669, 95% CI=1.321-2.086). When the wound class was contaminated or dirty, the risk was significantly higher (OR=1.817, 95% CI=1.136-2.760). The risk decreased with age (p=0.0058), with most of the risk attributable to teenagers. The risk increased as the duration of operation in minutes increased (p=0.0143). The model suggests a complex relationship between these 6 factors and post-CSEC ISSI and underscores the importance of increasing body mass, duration of labor or rupture, comorbid conditions, degree of contamination of the wound, younger age at CSEC, and duration of operation in predicting ISSI risk.

RAPID CONVERSION OF A TUBERCULIN SKIN TEST. Joffe AM,* Chang E. Univ of Alberta, Edmonton, Alberta, Canada.

INTRODUCTION: Timing of tuberculin skin test (TST) conversion following tuberculosis (TB) exposure is uncertain. We report a tuberculin skin test conversion occurring exactly 3 weeks following exposure. CASE DESCRIPTION: A 71-year-old man was admitted to the Neurosurgical Intensive Care Unit (ICU) with blunt head trauma. Intubation and ventilation were not required. Single view erect chest X-ray (CXR) on admission revealed apical consolodative changes of uncertain duration. CXR several days later confirmed cavitary apical pulmonary disease on the left side, nodular densities in the right apex and patchy bilateral densities in both lower lung fields. Sputum smears for acid fast bacilli (AFB) were negative but moderate numbers were seen on direct smear of bronchoalveolar lavage specimens. No respiratory isolation was instituted over the first week in hospital. 90 possible contacts were identified: 21 close contacts; 27 casual contacts; and 35 of uncertain risk. 5 individuals were deemed to have not had contact and 2 were lost to follow-up. Follow-up TSTs are pending for most contacts. Rapid Tuberculin Skin Test Conversion: A 28-year-old resident was deemed to have close contact, having admitted the source patient to the ICU. This individual had 5 negative TSTs over the previous 6 years, most recently on 8/3/99. Exposure occurred on 29/9/99. A TST performed on 21/7/99 revealed 20 mm induration on 23/7/99. The negative TST 3-4 months previously and low risk clinical activity between Mar and Jun 1999 strongly suggest that TST conversion occurred within 3 weeks of exposure to this patient with cavitary pulmonary TB. Isoniazid prophylaxis has been initiated. CONCLUSIONS: TST skin test conversion within three weeks of exposure has been documented in one healthcare worker. This suggests that TST conversion may occur more rapidly than is often appreciated and has implications for follow-up and baseline TSTs following exposure to infectious source patients.

SURGICAL SITE INFECTIONS FOLLOWING CAESAREAN SECTION: 3 YEARS OF POST-DISCHARGE SURVEILLANCE. Joffe AM,* Herrick T, Melnyk MP, Koluk J, Demianczuk NN, Okun N, Mayes D, Golosinski A. Royal Alexandra Hosp, Capital Health, Univ of Alberta, Edmonton, Alberta, Canada; Royal Alexandra Hosp, Edmonton, Alberta, Canada; Royal Alexandra Hosp, Capital Health, Univ of Alberta, Edmonton, Alberta, Canada.

OBJECTIVE: To determine surgical site infection (SSI) rates and risk factors in patients undergoing caesarean sections (CS) using post discharge telephone surveillance. METHODS: From 02/96 to 03/99 patients were contacted one month following CS and a surveillance questionnaire based on CDC definitions for SSI was conducted. Charts of those who laboured prior to emergency CS (ECS) were reviewed for the following risk factors (RF): antibiotic use in labour, no. of vaginal exams, duration of membrane rupture, obesity, maternal age, diabetes, smoking, ASA class, estimated blood loss, duration of surgery, primary vs repeat, and fever in labour. RESULTS: A total of 2830 CS were performed during the study period and 1858 (66%) were successfully contacted and interviewed by telephone. The infection rate by risk category was 7.8% (193/2481) for NNIS Risk Score 0 and 10% (34/340) for NNIS Risk Score 1. ECS accounted for 66% (1856) of the CS performed. Of those patients undergoing term ECS between 09/96 and 01/99, 815 were contacted and their charts were reviewed for RF. SSI prophylaxis was received by 40% of ECS patients. SSI was diagnosed in 72/819 (8.8%). Only obesity [OR 1.06 (95% C.I. 1.03-1.10 p=.05)] and antibiotic use [OR 0.21 (95% C.I. 0.07-0.64 p=.05)] were significantly associated with SSI. CONCLUSIONS: We found an 8.0% overall SSI rate for CS using post-discharge surveillance. This may be an underestimate as follow-up was possible for only 66% of cases. Our rates are statistically greater than NNIS means of 3.36% for low risk (z= 3.21, p=<.000671) and 4.45% for moderate risk (z= 1.98, p= 0.023783) likely reflecting differences in surveillance methodology. And possibly underuse of antimicrobial prophylaxis. Obesity is associated with increased risk of SSI following ECS while prophylactic antibiotic use is protective.

IMPACT OF ENDOSCOPIC SAPHENOUS VEIN HARVEST ON POST-OPERATIVE CORONARY ARTERY BYPASS GRAFT LEG WOUND INFECTIONS. Judd SE, Thompson-Bowers JE, Tasker SA. Naval Med Ctr, San Diego, CA.

BACKGROUND: Infections at the saphenous graft harvest site following coronary artery bypass graft (CABG) surgery are detrimental to the patient's overall quality of life and contribute to rising hospital costs. Endoscopic vein harvesting is a procedure which reduces the length of the leg incision, minimizes trauma to tissues, and decreases frequency of complications. METHODS: We have prospectively followed all CABG patients from the operating room until 30 days post procedure since Jan 1998 as part of our hospital's surveillance program. All patients are risk stratified by wound class, ASA score, and length of surgery. Each patient's inpatient record is reviewed daily and the outpatient record is reviewed after the 30th post operative day. In Oct 1998 the harvest vein procedure was changed to an endo-

scopic method. We compared our wound infection rates before and after this procedural change. RESULTS: From Jan to Jun 1998, a total of 100 CABG procedures were performed. Thirteen (13) infections were noted for a surgical site infection (SSI) rate of 13%. From Jan to Jun 1999, 58 CABG procedures were performed. Three infections were noted for a rate of 5.17% (X2 p=.12 odds ratio 0.36 [0.08-1.47]) CONCLUSION: Although not reaching statistical significance, institution of endoscopic vein harvesting for CABG was associated with a marked decrease in saphenous vein harvest site infections.

ADMISSION MEDICATIONS PREDICT SURGICAL SITE INFECTION. Kaye KS, Sands K, Chan KA, Fishman P, Platt R. Beth Israel Deaconess Med Ctr, Boston, MA and the Eastern Massachusetts CDC Prevention Epicenter; Brigham and Women's Hosp, Harvard Pilgrim Health Care, Harvard Med School, Boston, MA; Group Health Cooperative of Puget Sound, Seattle, WA.

INTRODUCTION: The current NNIS risk index uses an ASA (anesthesia risk) score of ≥3 as a measure of patient comorbidity indicative of an increased risk of SSI. The Chronic Disease Score (CDS) measures health status as a function of age, gender and prevalent chronic diseases, which are inferred from the dispensing of any of 28 categories of prescription drugs during the preceding 6 months. The CDS predicts hospitalization, mortality and health care utilization, and we have shown that a score ≥5,000 predicts SSI (SHEA meeting, 4/99, abstract 23). We hypothesized that a CDS based on admission medications (A-CDS) would also predict SSI. METHODS: From 191 total cases with SSI and 378 uninfected controls, procedures with admission and surgery on the same day were excluded, leaving 51 cases and 67 controls. A-CDS scores were compared to the other measures. Bootstrap methods were used to identify the best A-CDS breakpoint. RESULTS: The median A-CDS for cases was 2218 (IQR 1285-4818) and for controls was 1,285 (IQR 1209-2729) (p=.008, Wilcoxon). The A-CDS was correlated with the 6 month CDS (6-CDS) (p<0.001, r=0.45) and with the ASA score (p=0.02, r=0.22). A-CDS ≥4,500, 6-CDS ≥5,000 and ASA ≥3 were all associated with SSI; the association was strongest for A-CDS (for A-CDS, OR=6.8, p=.0003 Fisher's Exact; for 6-CDS, OR=2.2, p=.05; for ASA, OR=3.5, p=.007) (see Table). Logistic regression controlling for anesthesia type, emergent nature of surgery, sex, age, procedure duration and wound class showed A-CDS to be a stronger predictor of SSI than 6-CDS and ASA (for A-CDS, OR=7.6, p=.0008; for 6-CDS, OR=2.0, p=.13; for ASA, OR=3.2, p=.03). ASA did not significantly improve the model already containing A-CDS. CONCLUSION: Among the minority of patients hospitalized before the day of surgery, the A-CDS was a much stronger, but less sensitive, predictor of SSI than either the 6-CDS or the ASA score. Further study is needed to elucidate the relationships between these measures and to determine if it will be worthwhile to collect medication information on the day of admission to enhance risk stratification.

Number (row percent) of cases and controls in each group

	A-CDS <4500	A-CDS >4500	6-CDS <5000	6-CDS >5000	ASA <3	ASA >3
SSI cases	33 (65)	18 (35)	29 (57)	22 (43)	8 (17)	39 (83)
Controls	62 (93)	5 (7)	50 (75)	17 (25)	26 (42)	36 (58)

REALITIES OF DATA MANAGEMENT FOR STUDIES OF SSI. Lemke JH, Saha C, Yankey J, Perl T, Herwaldt L. Univ of Iowa, Iowa City, IA; Department of Biostatistics, Univ of Iowa, Iowa City, IA; John Hopkins Univ, Baltimore, MD.

Trying to evaluate SSI infections following over 170,000 surgeries at the Univ of Iowa Hosps and Clinics from Jul 1, 1983, through Jun 30, 1998, we have experienced a wide variety of data management challenges. We take this opportunity to recognize how changes in technology, changes in policy and definitions, changes in data quality and quantity, changes in patient case mix, changes in hospital staff, and the arrival of new pathogens have created difficulties with data management for SSI surveillance and analyses. There are additional difficulties arising from patient profiles, which include surgeries with multiple sites, multiple surgeries, multiple infections per site, and tracking discharged patients and readmissions, whether or not they are due to infections. In addition, data must be matched from multiple records. We highlight how to prioritize data matching and editing options, the need to track changes in hospital policies and staff, how to deal with multiple records, and the need to monitor trends and events. All of these issues must be dealt with in order to address the overall objective to minimize infection rates.

SIMULTANEOUS ANALYSIS OF CONFLICTING FACTORS INFLUENCING COSTS OF SSI. Lemke JH, Yankey J, Saha C, Perl T, Herwaldt L. Univ of Iowa, Iowa City, IA; John Hopkins Univ, Baltimore, MD.

When estimating costs due to SSI, one cannot directly compare healthcare costs for those with and without infections. If one models time to discharge, then a SSI is a time-dependent covariate. If one models time to SSI, then discharge is a time-dependent covariate with both the chance of infection changing along with the likelihood of detection changing with the aggressiveness of surveillance. In addition, costs of readmission must be included recognizing whether or not they are attributed to SSIs. Finally, deaths cannot be simply discarded, since the saving of a life can dramatically increase one's healthcare costs. Using SSIs following 14 years of CABGs, we simultaneously evaluate the effects of these conflicting factors on length of stay and cost by conditioning on daily transitions.

NOSOCOMIAL INFECTIONS ASSOCIATED WITH LEFT VENTRICULAR ASSIST DEVICES. Malani PN, Dyke DB, Pagani FD, Chenoweth CE. Univ of Michigan Health System, Ann Arbor, MI.

BACKGROUND: Left ventricular assist devices (LVADs) serve as a successful bridge to heart transplant in patients with cardiogenic shock. Infection remains a serious complication of these devices. METHODS: We performed a cohort study to assess infections among patients undergoing LVAD placement between Oct 1996 and May 1999. Cases were identified through microbiological data and medical records using CDC definitions for nosocomial infections. RESULTS: Thirty-six (36) LVADs were implanted in 35 patients with a mean device usage of 73 ± 60 d, (total 2565 days). Thirty-eight (38) infections were identified in 23 patients (14.8/1000 device days). Infections included 7 pneumonias (2.7/1000 device days), 6 venous infections (2.3/1000 device days), 2 bloodstream infections (0.8/1000 device days), 3 urinary tract infections, and 2 miscellaneous infections. Fifteen (15) patients developed 18 surgical site infections (SSI), (9 drive line infections, 4 sternal wound infections, 5 LVAD pocket or device infections). Overall SSI rates were 41.7/100 LVAD implantations (5.8/1000 device days). On average, SSIs developed 32.2 days post LVAD placement (range 14-47 d). Two patients with SSIs developed mediastinitis treated with antibiotics, surgical debridement, device removal and transplant. Other SSIs were superficial and treated with antibiotics and local wound care. Overall antibiotic use was extensive; vancomycin was given an average of 41 ± 34 days (range 2 168 d). A trend toward antibiotic resistant organisms was noted. CONCLUSIONS: SSIs were the most frequent infectious complication of LVAD insertion. Infection control measures and appropriate antibiotic use will be important for the prevention of future infections.

INCREASED INCIDENCE OF POST-CRANIOTOMY INFECTIONS FOLLOWING GLIADEL WAFER PLACEMENT. McGovern PC, Lautenbach E, Brennan PJ, Fishman NO. Univ of Pennsylvania Med Center, Philadelphia, PA.

Gliadel (registered trademark) wafers are dime sized discs containing a biodegradable polymer and carmustine; they have been approved for the treatment of recurrent glioblastoma multiforme (GBM) in which surgery is indicated. The wafers are placed locally in the tumor bed and release carmustine following hydrolysis of the wafer. The principle advantages of the Gliadel wafers are their lack of systemic toxicity and increased central nervous system concentration of the chemotherapeutic agent; however, localized edema and inflammation occur following placement. We report a series of 26 patients who received Gliadel wafers at our institution. Nine patients (35%) had post-craniotomy wound infections including cellulitis, osteomyelitis, meningitis, and epidural, subdural, or brain abscesses. In three cases, treatment involved removal of the Gliadel wafer remnants. Infecting organisms included staphylococcal species, streptococcal species, Propionibacterium acnes, and Candida parapsilosis. The background infection rate for all craniotomies at our institution is approximately 2%. Published rates of wound infections at other institutions following repeat operation for recurrent gliomas are as high as 11%. Gliadel wafers represent a new delivery system for the treatment of GBM; however, they provide only a modest survival benefit and the post-craniotomy infection rate may be higher than previously reported. The cost-effectiveness of this new treatment should be evaluated in light of these findings.

DIFFERENCES BETWEEN INPATIENT AND AMBULATORY SURGICAL SITE INFECTION RATES ARE NOT EXPLAINED BY RISK-ADJUSTMENT. Miller KA, Martin DL Infection Control and Prevention Analysts, Inc., Austin, TX.

Surgical site infections (SSI) account for about 24% of all nosocomial infections, and surveillance and feedback of SSI rates is essential to prevention efforts. However, the rapid increase in ambulatory surgery (and corresponding decline in inpatient surgery) has complicated the interpretation of SSI rates for both inpatient and ambulatory surgical centers. The AICE National Database Initiative has used National Nosocomial Infection Survey (NNIS) definitions and protocols to collect SSI data from 39 U.S. hospitals since 1996. SSI rates are adjusted for patient-level risk factors using the NNIS risk index, and then a standardized infection ratio (SIR) is computed for each hospital (observed/expected infections). For this study all procedures were categorized as (1) inpatient, (2) ambulatory, or (3) a mixture of the two. The mean SIR for hospitals reporting only inpatient surgery (79,165 procedures) was 0.984, and for the mixed group (115,340 procedures) was 0.898. However, the mean SIR for ambulatory surgery (16,425 procedures) was only 0.344. Published NNIS benchmarks exclude ambulatory procedures, and our risk-adjusted rates for inpatient procedures were quite comparable to NNIS. However, the risk-adjusted rates we observed for ambulatory procedures were significantly lower than NNIS (p=.017 by ANOVA). This study identifies large differences between the SSI rates following inpatient and ambulatory surgery that are not eliminated by adjustment using current risk indexes. We conclude that there is a need for further study of these differences, and for national benchmarks that are stratified by location of surgery.

USING SURVEILLANCE DATA TO DIRECT INFECTION CONTROL EFFORTS TO REDUCE SURGICAL SITE INFECTIONS FOLLOWING CLEAN ABDOMINAL OPERATIONS IN JAPAN. Morikane K, Nishioka M, Tanimura K, Noguchi H, Konishi T, Kobayashi H. NTT EC Kanto Med Ctr, Tokyo, Japan.

In 1998, we instituted a surveillance program in our 404-bed general medical-surgical hospital in Japan to identify surgical site infections (SSI). In this paper, we are reporting on SSIs following clean and clean-contaminated abdominal operations and the effect of interventions we initiated to reduce the number of SSIs. The NNIS surgical patient surveillance component protocol was used for collecting to collect the data, and SSI was defined according to the NNIS criteria. The operations included cholecystectomy, 30%; gastric surgery, 25%; colon surgery, 25%; and others (20%). In the first four months of surveillance, between Nov 1998 and Feb 1999, we identified 15 SSIs in 134 patients, with clean or clean-contaminated abdominal surgery, resulting in an 11.2% SSI rate. We instituted several procedures that have been previously reported to reduce the SSI rate, including preoperative and intraoperative prophylactic antibiotics and suturing one more layers at the closure of the abdominal wall in order to minimize the dead space between the skin and the peritoneum. In the ensuing seven months, the overall SSI rate did not change; 10.1% (27) of 266 patients developed a SSI. However, when we examined the specific sites of SSI, 10 of the 27 SSIs (37%) in the second period were superficial incisional compared to 10 of the 15 SSIs (67%) in the first four-month time period. Organ/space SSIs, on the other hand, increased and these were mainly due to intraabdominal abscess caused by anastomotic leakage. The decrease in superficial incisional SSI, although not significant (p=.08, Fisher's exact test), suggests the need for additional data, which we are collecting, to determine if the interventions were effective in reducing this type of SSI. In conclusion, we were able to use SSI surveillance data in a Japanese general hospital to affect change in surgical practice and to document a decrease in the superficial incisional SSI rate.

RISK FACTORS FOR SURGICAL SITE INFECTION AFTER PEDIATRIC CARDIAC SURGERY. Parvez FM, Edwards JR, Gaynes RP, NNIS System. Ctrs for Disease Control and Prevention, Atlanta, GA.

To identify risk factors for surgical site infections (SSI) after pediatric (age <18 years) cardiac surgery, we reviewed surveillance data from the surgical component of the National Nosocomial Infections Surveillance system (NNIS). During January 1992 - January 1998, 36 hospitals reported data from 4,555 pediatric cardiac surgeries. Of these surgeries, 880 (19.3%) were performed in patients age <1 month (AGE1); 649 (14.2%) in age 2-6 months (AGE2); 426 (9.4%) in age 7-11 months (AGE3); 922 (20%) in age 12-24 months (AGE4); and 1,678 (37%) in age > 24 months (AGE5). Among these surgeries, 108 SSI were reported.

Specific infection sites included incisional-skin (n=54; 50%); deep incisional-soft tissue (n=29; 27%); mediastinum (n=12; 11%); and endocardium (n=7; 7%). Preliminary multivariate analysis identified 3 independent categories of risk factors for SSI. Duration of surgery (DUR) was associated with a stepwise increase in SSI risk occurring at 2 distinct DUR levels: DUR=200-300 minutes (OR=1.99, 95% CI=1.2-3.3, p<.01) and DUR= >300 minutes (OR=3.98, 95% CI=2.5-6.5, p<.001). Age groups AGE1 (OR=3.33, 95% CI=2.1-5.4, p<.001), AGE2 (OR=3.0, 95% CI =1.7-5.1, p<.001), and AGE3 (OR=2.13, 95% CI= 1.0-4.1, p<.03), and emergently performed operations (OR=2.1, 95% CI=1.0-3.9, p<.03) were also significant. These results suggest that in pediatric cardiac surgery, DUR, patient age, in particular, infants <1 month, and emergently performed cardiac surgeries are important in predicting SSI risk. These factors may prove useful for risk adjustment in future surveillance and for identification of SSI prevention interventions.

USING A SYSTEM-WIDE CARDIAC SURGERY RISK ASSESSMENT PROGRAM FOR LOCAL ANALYSIS OF SURGICAL SITE INFECTION PREDICTORS. Pear SM, Williamson TH, Brown CR, Sethi GK. Southern Arizona Veterans Affairs Health Care System, Tucson, AZ; Univ of Arizona, Tucson, AZ.

In 1997 a significant increase in Coronary Artery Bypass Graft (CABG) surgical site infections (SSI) was noted and persisted for two years at one of the 42 Veterans Affairs Med Ctrs which perform cardiac surgery (CS). Review of patient-specific characteristics, of surgery-related processes, and numerous discussions with the surgical team did not reverse this pattern. To address this situation, data collected by a VA system-wide Cardiac Surgery Risk Assessment Program, established in 1987 for centralized analysis, made possible the following case-control analysis of our local problem. Infected patients (n=60 cases) were matched 1:2 with controls for date and type of cardiac surgery, and univariate analysis was conducted on 41 other variables. Infected patients had more diabetes, peripheral vascular disease, low cardiac output, prolonged ventilatory support, and longer operative time. Interestingly, the annual mean operative time for all CABG surgeries from 1995 through 1998 had increased: 227, 236, 281, and 300 minutes, respectively (t-test p<.001). Patients with operative times exceeding 300 minutes were more likely to develop low cardiac output >6 hours (OR=3.7, p<.01), or be on a ventilator >48 hours (OR=8.8, p<.05). However, logistic regression analysis supported prolonged operative time, prolonged low cardiac output, and prolonged ventilator time also as independent factors (as well as diabetes) associated with CABG SSI. In the six months since the study findings were reported to the cardiothoracic team, the mean operative time has decreased to 265 minutes (p<.001) and CS SSI rate has decreased 36%. Our experience calls attention to the value of system-wide databases as a resource for controlling local epidemics. It also demonstrates that sub-analyses such as this may be implemented centrally to detect and perhaps even anticipate SSI epidemics in the future.

EFFICACY OF UNINTENTIONAL NON-SELECTIVE ANTIBIOTIC PROPHYLAXIS IN CESAREAN SECTION. Pyper AM, Oni G, Mah MW, Memish ZA. King Fahad National Guard Hosp, Riyadh, Saudi Arabia.

INTRODUCTION: A prospective study of post-Cesarean Section (CS) surgical site infection (SSI) was conducted at a 540 bed hospital serving a Bedouin population with an average of 550 births/month of which 11% are CS. Surgical antibiotic prophylaxis was given only to high risk women (ruptured membranes > 6 hours, prolonged or febrile labor, "stat" CS) immediately after cord clamping. METHODS: U.S. Ctrs for Disease Control definitions were used, and National Nosocomial Infection Surveillance (NNIS) System risk-adjusted infection rates generated. Case-finding was based on review of inpatient and outpatient records. Independence of risks was assessed by logistic regression. RESULTS: 735 CS were studied from Sep 1998 to Jul 1999, and 73% were emergency procedures despite a 95% rate of antenatal care. The overall SSI rate was 3.1% (95% CI=2.0% to 4.7%). The rate for NNIS-risk-category 0 was 1.4% (95% CI=0.5% to 3.5%; n=350) and for category 1 was 4.6% (95% CI=2.8% to 7.5%; n=366). Significant univariate risks for occurrence of SSI were emergency CS (P=0.04), absence of intraoperative antibiotics (P=0.02), and duration of surgery (P=0.02). However, in the multivariate analysis, the only independent risks were duration of surgery (OR=1.01; P=0.04) and absence of intraoperative antibiotics (OR=3.0; 95% CI=1.1 to 7.8; P=0.03). CONCLUSION: Because of an unexpectedly high incidence of emergency CS at our institution, surgical antibiotic prophylaxis was given to the majority of patients despite a policy of selective administration. This practice was associated with a NNIS-risk-category 1 infection rate that was lower than the corresponding NNIS pooled rate of 3.4% for 1986-98. But only 67% of emergency CS received antibiotic prophylaxis and a policy of prophylaxis for all CS cases might increase the number of patients receiving it. The reasons for the high incidence of emergency CS need to be explored.

SURGICAL SITE INFECTIONS FOLLOWING CHOLECYSTECTOMY IN THE UNITED STATES-THE IMPACT OF LAPAROSCOPY. Richards C, Gaynes RP, Edwards J, Culver D. Ctrs for Disease Control and Prevention, Atlanta, GA.

Since its introduction in the 1980s, laparoscopy has replaced the open cholecystectomy as the preferred technique most cholecystectomies performed in the U.S. Little is known about the impact of laparoscopy on surgical site infections (SSI) following cholecystectomy. We analyzed data from the National Nosocomial Infections Surveillance (NNIS) system from 1992 to 1997 to determine risk factors for SSI following inpatient cholecystectomy. For 42,734 cholecystectomies reported to NNIS, the overall surgical site infection rate was 1.05 per 100 operations. In univariate analysis, the SSI rate was lower for laparoscopic cholecystectomy compared to the open technique (0.64 vs. 1.77 per 100 operations, p value=0.001). The SSI rate was higher for males (1.78 vs. 0.76, p=0.001); American Society of Anesthesiology (ASA) score of >3 (1.84 vs. 0.70, p=0.001); surgical wound class of "contaminated" or "dirty" (2.23 vs. 0.96, p=0.001); emergency procedures (2.08 vs. 0.93, p=0.001); multiple procedures through the same incision (3.15 vs. 0.81, p=0.001); surgeries longer than 2 hours (2.18 vs. 0.78, p=0.001); and patients age 65 and older (1.62 vs. 0.80, p=0.001). In logistic regression analysis, each of these factors remained independently important. Even after adjusting for sex, ASA score, emergency surgery, multiple procedures through the same incision and age, laparoscopy remained associated with significantly lower risk for SSI than did the open technique (OR 0.63, 95% CI 0.51-0.78, p value =0.001). CONCLUSIONS: The overall rate of SSI is significantly lower when using the laparoscopic technique, even after adjusting for other known risk factors.

RISK FACTORS FOR SURGICAL SITE INFECTION FOLLOWING SPINAL FUSION SURGERY IN THE UNITED STATES. Richards C, Gaynes RP, Horan T, Edwards J, Culver D. Ctrs for Disease Control and Prevention, Atlanta GA.

Approximately 100,000 spinal fusion procedures are performed in the U.S. each year. Surgical site infections (SSI) are potentially devastating complications of spinal fusion procedures. In order to determine risk factors for SSI following spinal fusion, we analyzed data from the National Nosocomial Infections Surveillance (NNIS) system from 1994 to 1999. Of 14,793 spinal fusion operations reported to NNIS, 363 (2.5%) had an associated SSI. In univariate analysis, the SSI rate was significantly higher with an American Society of Anesthesiology (ASA) classification score of >3 (4.4 vs. 1.8, p value=0.001), operations lasting >4 hours (4.4 vs. 1.8, p=0.001), diabetes mellitus (6.4 vs. 2.3, p value= 0.001), and posterior surgical approach (4.0 vs. 0.8, p value=0.001). No significant difference was seen for surgical wound class, the use of prophylactic antibiotics, presence of a drain postoperatively, or gender. Several factors, such as antimicrobial treatment, operations with an implant, or patients receiving corticosteroids, that were associated with higher SSI rates on univariate analysis did not remain significant on logistic regression analysis. In a logistic regression model, diabetes mellitus (Odds ratio [OR] 2.2, 95% Confidence interval [CI] 1.4-3.3), ASA score >3 (OR 2.0, 95% CI 1.6-2.4), operation duration >4 hours (OR 1.5, 95% CI 1.2-1.9), and posterior surgical approach (OR 4.3, 95% CI 3.2-5.9) remained significantly associated with the risk for SSI. CONCLUSIONS: Patients with diabetes mellitus, ASA scores >3, operations lasting >4 hours, or who have posterior surgical approach have significantly higher risk for SSI following spinal fusion surgery.

INFECTIONS OF PROSTHETIC URINARY SPHINCTER: OCCURRENCE, CHARACTERISTICS AND RISK FACTORS. Sahajian F, Gelet A, Long D, Dubernard JM, Fabry J. E. Herriot Hosp, Lyon, France.

BACKGROUND: Since 1972, prosthetic urinary sphincters (PUS) have been successfully implanted in adults with sphincter failure. Previous studies provide estimates (1-12%) of infectious or mechanical complications that usually require reintervention. OBJECTIVES: To assess the rate and determinants of periprosthetic surgical site infection (PSSI). METHODS: We reviewed the records of 90 consecutive patients undergoing implantation (85) or reimplantation (106) of a PUS over 12 years, by a single team at Edouard Herriot Hosp (Lyon, France). Mean follow-up was 65 months (range 12 -156 months). A PSSI was defined either as pus on Gram strain or positive culture from the periprosthetic space. Antibioprophylaxis has been administered perioperatively in 130 interventions. Data analyses used EpiInfo, and SPSS software for logistical regression. RESULTS: In 191 interventions, PSSI occurred in 24 (12.6 %), with an associated erosion in 8. Rates decreased from 17.4 % in 1986-90 to 9.7 % in 1995-98. Only 21 % of the PSSI appeared in the 1st month after implantation, and 41.5 % after 6 months, the mean delay being 10.7 months. Staphylococcus spp., either aureus or epidermidis, was the more frequently isolated organism (41.7 %) followed by Enterobacter spp. Several factors were univariately associated with an higher rate of PSSI: male sex, reintervention, short delay since previous procedure, scrotal or perineal access, shorter duration of intervention, longer duration of stay and of antibiotics administration. After logistic regression, the risk of PSSI was found to be increased only in the following situations: male sex, reintervention, longer duration of hosp. stay (>3 weeks) and shorter delay since a previous urological procedure. CONCLUSION: Despite a high level of precautions which could explain the reduction in rate, PSSI with or without erosion still remains a real problem when the length of follow-up is long enough. Reinforced preparation protocol should be envisaged for the group of patients with the higher risk of infection.

PREVALENCE OF SURGICAL SITE INFECTIONS AT A LARGE TERTIARY CARE HOSPITAL, HO CHI MINH CITY, VIETNAM, 1999. Sohn AH, Parvez FM, Vu TT, Hai HH, Bich NN, Thu LTA, Hoa LT, Thanh NH, Archibald LK, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Cho-Ray Hosp, Ho Chi Minh City, Vietnam.

Surgical site infections (SSIs) are a major cause of morbidity and mortality worldwide. In many developing countries, SSIs are felt to be a major cause of nosocomial infection, yet their prevalence and risk factors have not been determined. On 8/25/99, we conducted an SSI point prevalence survey at Cho-Ray Hosp (CRH), a 1,500-inpatient facility. We included all CRH patients on 12 surgical and 2 intensive care units and reviewed medical records for surgical procedure(s), antimicrobial (AMBL) use, and evidence of SSI based on defined criteria. Of 395 surgical patients, 276 (70%) were male; median age was 37 (range: <1-90) years. Sixty-one (61, 15.4%) patients had an SSI, of which 25 (41%) had blood and/or surgical site cultures performed; 21 patients had positive cultures with 26 isolates. The most common pathogens were Pseudomonas aeruginosa (n=7; 33%), Escherichia coli (n=5; 24%), or Enterobacter spp. (n=4; 19%). When we compared patients with or without SSI, SSI risk factors included trauma (OR 3.47, CI 1.88-6.41; p<.0001), emergency surgery (OR 2.22, CI 1.23-4.02; p=.004), or dirty wounds (OR 6.78, CI 3.49-13.22; p<.0001). Overall, 201 (51%) patients received non-prophylactic AMBLs before surgery and 394 (99.7%) received AMBLs after surgery. Our data show that (1) SSIs are a major problem at CRH; (2) cultures are infrequently obtained on SSI patients; (3) predominant SSI pathogens are gram-negative bacteria; and (4) perioperative AMBL use is inconsistent with published guidelines. Our data suggest that cultures should be obtained on SSI patients to guide therapy and that SSI prevention interventions, including appropriate AMBL use in surgical patients, are needed.

CARDIAC BYPASS SURGERY: INTERVENTION TO DECREASE SURGICAL SITE INFECTIONS. Squier C, Miller T, DiLucia B, Bechtold C, Hardesty R, Muder RR. VA Pittsburgh Healthcare System, Pittsburgh, PA.

Surgical site infection (SSI) following cardiac bypass surgery results in extended hospitalization, additional operations, and extensive costs. In one study, the increase in cost of hospitalization related to deep sternal infection was $52,245 with the length of stay increased by 21.6 days. Between Jul 1997 and Jun 1998, 152 cardiac bypass procedures were performed at the VA Pittsburgh Healthcare System; 14/152 (9.2%) resulted in SSI; 7/152 (4.6%) were sternal wound infections and 4/152 (2.6%) resulted in deep sternal infections requiring 19 surgical interventions for 4 patients. Cardiac bypass SSI resulted in approximately 372 extra days of hospitalization. Review of these cases identified no trends in microorganisms or surgeon specific data. To decrease the incidence of SSI post-cardiac bypass surgery, standards of practice were evaluated and 3 major changes were implemented. A physician's assistant who does not participate in the cardiac bypass graft procedure was hired to harvest saphenous veins. Duraprep was implemented as the intra-operative prep. Pre- and postoperative wound care standards were developed and implemented. The same time period during the following year was used to evaluate the effect of changes in practice. Between Jul 1998-Jun 1999, the overall SSI rate was 7/168 (4.2%). No superficial sternal SSI were identified and 3/176 (1.8%) patients developed deep sternal SSI. These 3 patients required 7 surgical interventions for sternal repair and 159 additional days of hos-

pitalization. The implemented changes resulted in a greater than 50% reduction in overall SSI, sternal infection and surgical intervention post infection. We estimate a reduction of ICU bed days and 15 operative procedures in one year as a result of the intervention.

SURGICAL SITE INFECTION SURVEILLANCE FOR SAME-DAY SURGERY HERNIORRHAPHIES. Topal JE,* Reagan-Cirincione PA, Guidetti GB, Veiga FA, Kunze KB, Mazon DA, Hierholzer WJ . Yale School of Medicine and Yale New-Haven Hosp, New Haven, CT.

Yale-New Haven Hospital is a 824-bed tertiary care center with 21,000 surgeries/year. Post-discharge surveillance (PDS) has been used at YNHH for surgical site infection (SSI) surveillance in cardiothoracic, large bowel gastrointestinal, and neurosurgical shunt surgical procedures. In Sep 1997, this methodology was extended to herniorrhaphies. Standard definitions of SSI per published CDC criteria were used. Thirty (30) days following the herniorrhaphy, surveillance forms were sent to the attending surgeon for completion. If a patient was readmitted or hospitalized at day 30, Hosp Epid reviewed the medical record for the presence/absence of an SSI. A total of 519 herniorrhaphies were performed through May 1999; 255 pediatric and 264 adult patients. Same-day ambulatory surgeries accounted for 419 (77.6%) of all herniorrhaphies. Of the 471 responses (a return rate of 92.9%), 10 SSIs were identified for an overall SSI rate of 2.1%. All SSIs were identified through ambulatory and post discharge surveillance. The SSI rate for the same-day ambulatory herniorrhaphies was significantly lower at 1.0% when compared to the SSI rate of inpatient herniorrhaphies at 5.2% (p=0.009). The pediatric and adult SSI rates were similar at 1.6% and 2.3%, respectively (p NS). Applying the PDS methodology to a surgical procedure performed on an ambulatory basis worked well to identify SSIs. Our results suggest that targeted surveillance for inpatient herniorrhaphies may be warranted based on the elevated SSI rate above.

SURVEILLANCE OF SURGICAL SITE INFECTION IN ENGLAND: THE VALUE OF A NATIONAL SCHEME. Wilson J,* Ward V, Coello R, Charlett A, Sedgwick J, Pearson A. PHLS Central Public Health Lab, London, UK.

The surveillance of surgical site infection (SSI) as part of the English Nosocomial Infection National Surveillance Scheme began in 1997. The surveillance is targeted at 12 categories of surgical procedures and data are collected according to a defined protocol. Participation in the Scheme is both voluntary and confidential. So far, 96 hospitals have taken part, representing 44% of all acute hospitals in England. In the first two years of surveillance, data have been collected on more than 27,000 operations. 93% of these were in 6 categories: abdominal hysterectomy (3,738), coronary artery bypass graft (4,895), hip prosthesis (8,628), knee prosthesis (4,624), large bowel surgery (2,808), and vascular surgery (1,527). The majority of SSIs (71%) were superficial. Stratification of data by the National Nosocomial Infections Surveillance system risk index showed a significant linear trend associated with increasing risk index group in abdominal hysterectomy, coronary artery by-pass graft, large bowel and vascular surgery. The incidence of SSI varied considerably between hospitals within a category of surgery. The widest variation occurred within large bowel and vascular surgery (standardised rates ranged from 2.3 to 26 and 2.5 to 24 per 100 operations, respectively). Hosps with an incidence of SSI above the 90th percentile are advised to discuss the results with surgeons to agree what action should be taken. There is evidence that some hospitals participating in the Scheme achieved a reduction in the incidence of SSI, although further work on factors which may have contributed to the reduction are required.

Sterilization

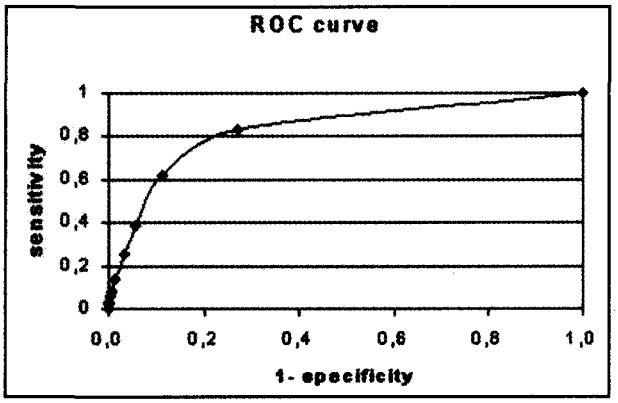
REUSE OF SINGLE USE DEVICES IN VICTORIAN PUBLIC HOSPITALS. Kainer MA, Aberline M, McCrorie ML. Western Hosp, Melbourne, Australia; Monash Med Centre, Melbourne, Australia; Sterilizing Research and Advisory Council of Australia, Victoria, Australia.

OBJECTIVE: To examine the policies governing the reprocessing of items labeled "single use" in light of the Report of the National Health and Medical Research Council (NHMRC) Expert Panel on the Reuse of Med Devices Labeled as Single Use (1996). METHOD: In 1997, infection control practitioners contracted to the Dept of Human Services, Victoria, conducted on site hospital visits and reviewed available documentation. RESULTS: In 55% of major metropolitan teaching hospitals, critical items (in contact with sterile sites) that were labeled "single use" were not reprocessed. Not all hospitals had a written policy for the reuse of items labeled "single use." Written policies were also limited in their comprehensiveness, many of them failing to describe procedures of use, maximum usage, marking, and tracking methods. There was little evidence that reused devices labeled "single use" are coded and documented in patient case notes. In most hospitals, patients were not informed that a device used for a procedure and labeled as a single-use device was reprocessed with the intention of being reused on another patient. CONCLUSION: Many of the draft recommendations of the NHMRC Report are currently not being addressed in hospital facilities. The Australian Health Ministers Advisory Council has commissioned work (still in progress) on the following issues in relation to the reuse of cardiac electrophysiology catheters: (1) research on the transmissibility of viral and bacterial agents; (2) the development of the parameters of the quality assurance program of the reprocessing system and (3) the development of a standard patient consent and patient information form.

Surveillance

APPROACH TO A PREDICTIVE MODEL OF NOSOCOMIAL INFECTION. Arevalo JM, Baquedano FJ, Sampedro J, Barbero I. Hosp Txagorritxu, UPV/EHU School of Medicine, Vitoria, Spain; UPV/EHU School of Medicine, Vitoria, Spain.

BACKGROUND: The application of models of multivariate logistic regression to estimate the relationship between nosocomial infection (NI) and different independent variables is a commonly used technique. Material and METHODS: We have used the original information of 3481 patients included in nine consecutive prevalence studies performed in our hospital (a 500-bed acute-care one.). The methodology for data collection and the criteria for the diagnosis of NI are those expressed on the EPINE (Nosocomial Infections Prevalence Study in Spain) project. With the use of the software SPSS we have created a model of logistic regression to determine the individual likelihood to have or not NI, according to the personal profile, starting from 27 independent variables: hospital service, length of stay (from admission date to moment of study), intrinsic and extrinsic risk factors, surgical operations performed, baseline risk, and diagnosis. The equation provides a continuous p probability distribution of acquiring the NI in opposition to the real values of dependent



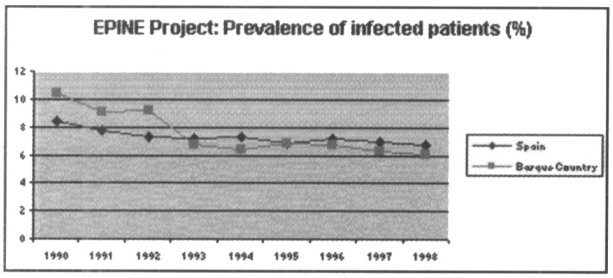
variable (Infected or Non-infected), being able to determine different decision cut-points between zero and one, observing the model output for each one. RESULTS: The risk factors remaining in the model are expressed in TABLE 1. The area below the ROC curve (graph 1) shows a global efficiency of the model of 0.82. The cut-point 0.12 (maximum curvature) offers the best balance between sensitivity (78.53%) and specificity (78.93%). CONCLUSIONS: The global predictability of the model can be considered adequate. However, due to the lack of sensivity, other models should be found to achieve a better reliability.

	B	Wald	sig.	OR	95%	CI
Medical Services	1*					
Surgical Services	-0.5012	9.0207	0.0027	0.6058	0.4368	0.8402
Intensive Care Units	1.0020	8.4744	0.0036	2.7237	1.3873	5.3475
Pediatrics	-0.3812	1.9632	0.1612	0.6830	0.4007	1.1643
Gynaecology & Obstetrics	-0.0081	0.0013	0.9715	0.9919	0.6348	1.5499
0-1 days length of stay				1*		
2-3 days length of stay	-2.2070	37.6737	0.0000	0.1100	0.0544	0.2226
4-5 days length of stay	-0.6898	8.8643	0.0029	0.5017	0.3186	0.7900
6-7 days length of stay	-0.1336	0.4289	0.5125	0.8749	0.5866	1.3050
8-9 days length of stay	0.2593	1.5199	0.2176	1.2960	0.8581	1.9575
10-14 days length of stay	0.7509	21.1882	0.0000	2.1189	1.5391	2.9171
15-24 days length of stay	1.3004	63.1033	0.0000	3.6708	2.6633	5.0594
25-49 days length of stay	1.7928	110.6491	0.0000	6.0062	4.3009	8.3878
>=50 days length of stay	2.1583	97.3597	0.0000	8.6564	5.6387	13.2892
Neoplasia	-0.4183	5.3920	0.0202	0.6582	0.4624	0.9368
Open Urinary System	1.2353	9.3981	0.0022	3.4394	1.5611	7.5775
Closed Urinary System	0.4173	5.0027	0.0253	1.5179	1.0529	2.1881
Peripheral Catheter	0.3857	7.0882	0.0078	1.4706	1.1070	1.9537
Central Catheter	0.9440	14.1119	0.0002	2.5702	1.5706	4.2062
Cen. Cath. periph. Insertion	0.7861	4.4287	0.0353	2.1948	1.0555	4.5638
Surgery	0.8857	19.3773	0.0000	2.4247	1.6345	3.5968
Mild Baseline Risk				1*		
Moderate Baseline Risk	-0.1243	1.7771	0.1825	0.8831	0.7357	1.0601
Severe Baseline Risk	0.3943	12.5919	0.0004	1.4833	1.1931	1.8442
Constant	-2.6599	238.7717	0.0000			

Note: 1* reference category
-2 Log Likelihood: 1687.591
c2= 598.444
p=0.000

ACTIVITIES AND PROSPECTS ON NOSOCOMIAL INFECTION SURVEILLANCE AND CONTROL IN BASQUE COUNTRY HOSPITALS (SPAIN). Arevalo JM, INOZ working group. Osakidetza/Basque Country Health Service, Spain.

BACKGROUND: The Hosp Infection Surveillance and Control Committee (INOZ) was set up in the Basque Country (a region in the North of Spain) in 1990, with the target to encourage the development of surveillance and control programs. Nowadays, it involves representatives from 16 Hosps with 4,600 beds which assist 2,098,000 people. The aim of this paper is to show the current results achieved and the prospects on the surveillance and control in preventing nosocomial infections (NI) in the future. METHODS: The INOZ Committee carried out the first follow-up survey on NI in acute-care Hosps in 1990. Since then, these hospitals have yearly participated in the EPINE project (Nosocomial Infections Prevalence Study in Spain). In 1.998 the INOZ Committee suggested that all hospitals should carry out a follow-up survey on S.S.I. surveillance of 3 specific surgical proce-



dures, critical units and others according to hospital size. Some current guidelines on Hosp Hygiene procedures have been published and computer tools have been designed. RESULTS: Some of our studies are summarized in the TABLE and GRAPH. In the field of prevention and control new guidelines about cleaning, disinfection, sterilization and preoperative procedures have been carried out. A new preventive plan for the maintenance and disinfection of water supplies, air-conditioning systems and medical devices has been designed. Programs to minimize microbiological risks while building repairs take place have been implemented. Criteria for the purchase of medical devices have been defined. Also new rules have been set for isolation according to CDC. Lately an alert system has been designed in case of NI outbreaks or resistant organisms appearance. In addition, a continuous training program for healthcare workers is being carried out. CONCLUSIONS: In the last years NI rates have been decreasing. Every hospital has a NI surveillance and control team. The objectives in the near future are to continue with these activities and to perform a new plan on the use of antibiotics.

Follow-up studies (1998)

Acute-care hospitals	Surgical Site Infection (SSI) %	Cumulative Incidence CI 95%
Hip substitution	2.13	1.33-2.97
Abdominal hysterectomy	3.73	2.27-5.19
Elective colon surgery	25.29	22.07-28.21
Long-term hospitals	**N.I. Incidence Rate %**	
All localizations	3.91	

SURVEILLANCE OF ENTEROBACTERICEAE PRODUCING EXTENDED SPECTRUM BETA-LACTAMASES AT CHARLES NICOLLE HOSPITAL - TUNIS (1993-99). Ben Redjeb S, Boutiba I, Smaoui H, Ghozzi R, Kamoun A. Hôpital Charles Nicolle, Tunis, Tunisia.

Infections caused by Enterobacteriaceae producing extended spectrum β-lactamases (ESBLs) have become a major public health problem worldwide with major implication in the treatment of nosocomial infections. To evaluate the extent of this type of resistance at Charles Nicolle hospital and to improve the control of these infections, a surveillance program was carried out. We report the incidence of ESBLs among Enterobacteriaceae isolated from patients hospitalized from Jan 1993 to Sep 1999. All isolates were identified by Api system 20E and their antimicrobial susceptibility tested by disc diffusion test. Quality control was performed with Escherichia coli ATCC 25922 and ESBLs were detected by double disc synergy test. From 1993-98, the incidence of Enterobacteriaceae producing ESBLs ranged from 3%-5.5% and reached 11% during the first nine months of 1999. This increase was ascribed to the occurrence of outbreaks in the surgery and pediatrics wards. ESBLs were observed mainly among Klebsiella pneumoniae (58%) followed by E. coli (13%), Proteus mirabilis (11%), Enterobacter spp (5%). 55.5% were recovered from urine, 15.5% from pus and 13.2% from blood. 28% were isolated in the pediatrics ward. All strains showed simultaneous resistance to gentamicin (78%), tobramycin (77%), amikacin (47%), trimethoprim-sulfamethoxazole (37%) and ofloxacin (23%). No strains were resistant to imipenem. Our results show that ESBLs have widely disseminated and spread to different species of Enterobacteriaceae. These strains have become endemic in some wards and caused outbreaks in the surgery and pediatrics wards because of a poor observance of infection control procedures. To contain the spread of this resistance, the implementation of infection control measures and the rational use of antibiotics are of paramount importance.

NOSOCOMIAL INFECTION SURVEILLANCE INITIATIVES IN NEW ZEALAND. Bennett SN. Wellington, New Zealand.

BACKGROUND: In 1984 New Zealand state sector reforms introduced population-based funding formulas for allocating resources to healthcare. By 1994 Regional Health Authorities (RHAs) controlled personal health funding. Public health funding was provided by a Public Health Commission and later the Ministry of Health (MoH) while the Crown Company Monitoring Advisory Unit (CCMAU) audited public hospital performance. By 1999 the Health Funding Authority had replaced the RHAs, the MoH had decided that hospital-acquired infections (HAIs) were a personal not public health issue, and CCMAU was requiring that public hospitals report numbers of HAIs. Key surveillance initiatives. This paper describes the six HAI surveillance initiatives introduced in the past eight years. With one exception, each evolved as an outcome of its predecessor. Two died at the proposal stage and one has just been introduced. Of the remainder, one failed from lack of support, one collects data but does not analyse it or provide feedback, and one is under development. SUMMARY: Changing attitudes towards HAIs have shaped each initiative, and changing government interests have limited what each initiative achieved. No single initiative has yet proved completely successful. Review of the initiatives shows several recurring themes, including: confusion as to who is responsible for HAI-related issues; disagreement as to whether HAIs are a public or personal health issue, or a local or national issue; lack of MoH support; and emphasis on cost. The November 1999 election may lead to government restructuring and changes that could impact on existing and future HAI initiatives.

WHICH BACTERIA ARE SUITABLE ORGANISMS TO DETECT TRANSMISSION EVENTS IN STANDARD CLINICAL WARDS. Broek PJ van den, Loef K, Altenburg K, Brussee J, Reyden T van der, Bernards AT, Arends S, Dijkshoorn L. Leiden Univ Med Ctr, Leiden, The Netherlands.

Infection control measures as for example formulated in Standard Precautions are aimed to prevent transmission of micro-organisms and by doing so exogenous nosocomial infections. To assess the validity of this type of precautions one can take the number of infections as an endpoint. This approach has several drawbacks: discrimination between endogenous and exogenous infections is often difficult and on standard wards the number of nosocomial infections is rather low making comparisons statistically cumbersome. The alternative should be to measure transmission events. We performed a pilot study on an internal medicine ward to find out which bacterial species could be used to monitor transmissions. From 17 patients cultures were taken (nose, pharynx, sternal skin, perineum, and rectum) within 24 hours of admission and after a stay of 5 to 7 days. Bacteria were isolated using standard bacteriological techniques. A total of 24 species and genera were identified of 4 main categories: enterobacteriaceae, enterococci, Staphylococcus aureus, and non-fermenting Gram-negative bacteria. The Gram negative bacteria were characterized by RAPD PCR analysis. Among the 208 E. coli isolates 57 RAPD types were identified. Of three strains transmission between two patients was shown. For Klebsiella spp., (12 isolates), Proteus spp. (15 isolates), and Pseudomonas spp. (15 isolates) 9, 5 and 7 RAPD types were identified respectively, without evidence for transmission. The results of this study show that E. coli is a good candidate for monitoring transmission events in a standard clinical ward.

STREPTOCOCCUS PNEUMONIAE BACTEREMIA IN AN ERA OF PENICILLIN RESISTANCE. Castillo EM, Rickman LS,* Brodine SK, Ledbetter EK, Kelly C. San Diego State Univ/ Univ of California, San Diego, CA; Univ of California, San Diego School of Medicine, San Diego, CA; Graduate School of Public Health, San Diego State Univ, San Diego, CA; Naval Station, San Diego, CA; San Diego State Univ, San Diego, CA.

BACKGROUND: The proportion of penicillin-nonsusceptible Streptococcus pneumoniae isolates and associated risk factors vary by geographic area in the United States. We conducted a retrospective study to determine the extent of penicillin-nonsusceptible S. pneumoniae bacteremia and associated risk factors in a tertiary care medical center in San Diego. METHODS: Patients with S. pneumoniae bacteremia at the Univ of California, San Diego Med Ctr from Sep 15, 1991 through Jul 31, 1998 were identified by hospital-based computerized microbiology records. Hosp records included demographic information, patient data, and antibiotic prescription records for patients with bacteremia due to S. pneumoniae. Univariate and multivariate analyses were used to determine risk factors for penicillin nonsusceptible S. pneumoniae bacteremia. RESULTS: Of 281 isolates of S. pneumoniae identified, 192 (68%) were from hospitalized patients. After controlling for other factors, patients from 1-5 years of age (p=.01; OR=3.96; 95% CI, 1.50 to 10.44), 6-18 years of age (p=.04; OR=6.42; 95% CI, 1.13 to 36.51), and HIV seropositive patients (p=.002; OR=5.12; 95% CI, 1.83 to 14.32) were more likely to have penicillin-nonsusceptible S. pneumoniae bacteremia. There was a significant increasing trend of penicillin-nonsusceptible S. pneumoniae bacteremia from 14% in 1991 to 42% in 1998 (p=.001; OR=1.42; 95% CI, 1.16 to 1.73); this included only 2 isolates that were highly resistant to penicillin. There was no increase in mortality in patients who had penicillin-nonsusceptible S. pneumoniae burden. CONCLUSION: With the increase in S. pneumoniae resistance to penicillin, it is important to continue surveillance of infections caused by S. pneumoniae. Hosp-based studies are useful for tracking epidemiologically important pathogens.

A HOSPITAL COMPUTER BASED SYSTEM TO FACILITATE THE SURVEILLANCE OF NOSOCOMIAL INFECTIONS. Chalfine A, Cauët D, Lin W, Gonot J, Kitzis MD, Blériot JP, Carlet J Hôpital Saint Joseph, Paris, France; EpiConcept, Paris, France.

Hospital-based surveillance of nosocomial infections has been recognised as a powerful tool in the reduction of such infections, and this is now mandatory in France. Traditional methods of surveillance such as patient chart review are very resource intensive. Here, we discuss the development and implementation of NosoCom by the Hygiene Unit of a French hospital. NosoCom is an intra-net system designed for improving the efficiency of infection surveillance and feedback of results to the medical staff. First, it links existing administrative, clinical and microbiological computer databases to facilitate the timely detection and monitoring of suspected cases. The clinical databases utilize established classifications for coding of diagnoses, procedures and risk factors. Second, NosoCom aggregates in a single database, microbiological information on suspected nosocomial infections, demographic and clinical data, invasive procedures and other pertinent risk factors of the hospital population under surveillance. Third, NosoCom automates the analysis and feedback of incidence rates through templates and pre-defined calculations. Key infections monitored include: pneumonia, urinary tract infections, catheter infections, bacteremia, and surgical site infections. The basic surveillance protocol involves the daily electronic retrieval of positive microbiological results from the laboratory. A validation form is generated for each suspected case of infection, and this is relayed to the physician for confirmation of the case as well as indication if the infection is nosocomial, and if it is an incident or prevalent case (elimination of duplicates). The results are entered and stored in the database. By using existing databases, NosoCom eliminates the need for data reentry, a process that is time-consuming and a potential source for errors. NosoCom also ensures consistency through routine updates from original data sources. It also counterbalances insufficient resources of infection control staff.

A 7-YEAR, HOSPITAL-WIDE SURVEILLANCE PROGRAM FOR NOSOCOMIAL ACQUISITION OF MULTIRESISTANT BACTERIA AS AN INDICATOR OF QUALITY OF CARE AND PREVENTION PROGRAMS. Chalfine A, Gonot J, Loyer D, Goldstein F, N'Guyen JC, Carlet J. Hôpital Saint Joseph, Paris, France.

BACKGROUND: Resistance to antibiotics is a growing worldwide problem. The incidence of acquired multiresistant bacteria (MRB) per patient admissions can be an interesting quality indicator of the prevention programs, i.e. the compliance for preventive measures and antibiotic policies. METHOD: The Hôpital St. Joseph is a 450 bed multidisciplinary institution with 13,000 admissions per year. A hospital-wide ongoing prevention program started in 1992 for nosocomial acquisition (more than 48 hours after admission). Surveillance included the following MRB: methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum β-lactamase in Klebsiella pneumoniae (K.ESBL), other ESBL

(O.ESBL), inducible cephaloporinase Enterobacteriaceae (ICB), Pseudomonas aeruginosa (PA), Acinetobacter baumannii (AB). A daily surveillance was done by the infection control nurse in collaboration with the micobiological laboratory. Besides surveillance, several prevention measures were implemented: (1) daily telephone alert to the wards as soon as a case was identified, (2) adequate isolation precautions, (3) sign placed on the patient's door, (4) and more recently (1997), control of antibiotic prescriptions. RESULTS: For MRSA and K.ESBL, a diminution of the incidence was persistently and significantly observed over years (TABLE 1). This trend was not observed for other O.ESBL, ICB and AB. CONCLUSION: Mechanisms for the acquisition of MRB in the hospital vary according to the microorganisms. If prevention measures, in particular isolation procedures, can reduce transmission of MRSA and K.ESBL, an active control of antibiotic policies is needed to be effective on O.ESBL, ICB and AB.

MRB Incidences per 100 admissions from 1992-1998

	1992	1993	1994	1995	1996	1997	1998
SARM	1.02	1.23	0.96	0.78	0.69	0.8	0.64
K.ESBL	0.11	0.34	0.13	0.08	0.11	0.03	0.06
PA	-	-	-	0.82	0.84	0.6	0.67
O.ESBL	0.1	0.11	0.05	0.07	0.11	0.07	0.12
ICB	-	-	-	0.46	0.55	0.54	0.59
AB	-	-	-	0.1	0.11	0.11	0.23

USING STATISTICAL PROCESS CONTROL CHARTS TO SUMMARIZE AN EPIDEMIOLOGICAL SITUATION. Couto BRGM, Starling CEF. Felicio Rocho Hosp, Brazil.

INTRODUCTION: Feed backing data to healthcare workers is a well known key element for reducing nosocomial infection (NI). Summarizing statistical and epidemiological data in a friendly way is a big challenge for hospital epidemiologists. OBJECTIVE: To present a method for automatic analysis of statistical process control (SPC) charts that summarizes an epidemiological situation. METHODOLOGY: For each nosocomial data under analysis we a) construct an SPC table, defining the maximum rates expected for the n months of the period; b) calculate pAbove, i.e., the percentage of months with a rate above the maximum expected; c) if pAbove <10% then we define a situation under Control (approx. 1 outbreak/year); if pAbove >=10% then uncontrolled; d) analyze the time trend of the ND which gives us three tendencies: stability or tendency to decrease or to increase. This combination (pAbove + time trend) generates 6 possible epidemiological situations: 1=controlled and with a tendency to decrease; 2=controlled and stabilized; 3=tendency of strong decrease, generating an excess of months out of control; 4=with mild tendency of increase in the incidence of ND; 5=uncontrolled and with tendency of increase in the incidence; 6=stabilized, but exhibiting excess of months out of control. RESULTS: As an example of this methodology we present the epidemiological situation of NI caused by MRSA after 36 surveillance months in our hospital: general ICU (pAbove=13%): stabilized, but exhibiting an excess of month out of control; cardiovascular ICU (pAbove=0%): controlled and stabilized at 0.3 NI/1000 patients/day; 2nd floor (pAbove=8%): controlled and stabilized at 0.1 NI/1000 patients/day; Pediatric (pAbove=0%): controlled and with tendency to decrease. CONCLUSION: This methodology is an important tool to improve our ability in communicating key information to healthcare workers.

EMPLOYING STATISTICAL PROCESS CONTROL CHARTS AS AN ADJUNCT TO CATHETER RELATED BLOOD STREAM INFECTION SURVEILLANCE IN THE ITU. Curran ET, Booth M, Benneyan J, Weinhardt B, Hood J. Glasgow Royal Infirmary, Scotland, UK; Northeastern Univ Boston, MA.

Following instigation of a surveillance programme (CR-BSI) rates have fallen from a high of 7.1 per 1000 days in 1997 to 0.6 per 1000 in 1999 (Jan-Sep). However contaminated cultures, i.e., skin organisms isolated from patients' blood, not subsequently isolated from the same catheter on repeat cultures and not associated with clinical signs of sepsis, continued to be a problem. This was possibly caused by poor aseptic technique when taking blood cultures. These cultures were taken by junior medical staff who rotate into the unit for 6-8 weeks. Contaminated cultures can result in the removal of the line and the change of appropriate to inappropriate antibiotics. The number of contaminated blood cultures as a proportion of the total number of blood cultures taken is now fed back in the form of a statistical process control chart. These charts require no additional data collection and provide an easy surveillance method for detecting process changes. Since feedback began the process of taking blood cultures has been "in-control," indicating no statistical evidence of changes in the contamination rate over this time period. CONCLUSION: Statistical process control charts can provide a useful adjunct to the standard CR-BSI surveillance programme.

LACK OF BENCHMARK MRSA AND VRE INCIDENCE RATES: A POSSIBLE SOLUTION. DeVries MM, Oda GV, Valdon CA, Higby LA, Von Husen M, Loutit JS. Veterans Affairs Palo Alto Health Care System, Palo Alto, CA.

There is significant variation in the literature among methods used to determine MRSA and VRE incidence rates. To allow comparison of incidence rates of resistant organisms between hospitals, a standardized definition is needed. We propose the consistent use of a simple surveillance definition that can be easily applied in any clinical setting and allows for possible development of benchmark rates. Key considerations for development of our surveillance definition included ease of data retrieval and interpretation of findings with an emphasis on clinically significant isolates. This necessitates an electronically based data retrieval system. We developed the following definition. An isolate is considered nosocomial if: (1) Positive blood/urine culture greater than 2 days after admission AND no previous isolates within the last month OR (2) Positive blood/urine culture greater than 2 days after admission AND patient had previous isolate from any site within the last month AND that isolate was cultured greater than 2 days after an admission. Repeat isolates are not counted unless all the above criteria are fulfilled and it has been greater than three months since the patient's last positive culture. This definition has been used in our institution for over five years and has allowed us to continually assess our incidence of these organisms. Its ease of use and consistency would make this a valuable tool, if adopted by other institutions, to provide a means for inter-hospital comparisons.

NOSOCOMIAL INFECTIONS IN A NEUROLOGY INTENSIVE CARE UNIT. Ebner W, Dettenkofer M,* Babikir R, Hauer T, Els T, Loecking CH, Pelz K, Daschner FD. Univ Hosp of Freiburg, Germany.

In order to identify overall and site-specific nosocomial infection (NI) rates in patients receiving neurological intensive care therapy, a prospective study was started in February 1997, in the ten-bed Neurology ICU (NICU) of our hospital. Case records were reviewed twice a week, all microbiology reports were reviewed and ward staff was consulted. NI were defined according to the CDC-criteria and were categorized into specific infection sites. Within 30 months 505 patients with a total of 4,873 patient days were investigated; 122 NI were identified in 96 patients (74 patients with one, 18 with two and 4 with three infections). For site specific incidence rates and incidence densities (NI/1000 days at risk) see table. A moderate to high overall incidence (24.2/100 patients) and a moderate incidence density (25.0/1000 patient days) of NI could be documented in the NICU setting. As yet there are no NNIS-data concerning NI in NICUs. However, compared to data reported by the NNIS concerning medical ICUs the device-associated infection rates were in the upper (pneumonia, UTI) as well as in the lower range (BSI). 14.7% of isolated pathogens were A. baumannii, 12.9% S. aureus, 10.0% E. coli, 7.1% Bacteroides spp., 7.1% CNS, 7.1% Enterobacter spp., 6.5% Klebsiella spp., 5.9% enterococci and 5.9% streptococci. In 8 cases of NI (6 pneumonias and 2 meningitis) no pathogen could be isolated. The high rate of A. baumannii and the high incidence density of pneumonia was due to an outbreak of nosocomial pneumonia with A. baumannii, followed by a high endemic rate of this germ in the ICU.

Type of NI	No.	NI/100 patients	NI/1000 days at risk[X]	X
Bloodstream Infection	7	1.4	1.9	central line-associated BSIs/1000 central line-days
Pneumonia	59*	11.7	20.4	ventilator-ass. pneumonias/1000 ventilator-days
Urinary Tract Infection	44**	8.7	10.0	urinary catheter-ass. UTIs/1000 urinary catheter-days
Meningitis	2	0.4	0.4	NI/1000 patient days
Ventriculitis	4	0.8	0.8	NI/1000 patient days
Others (SSI, CAI, diarrh.)	6	1.2	1.2	NI/1000 patient days

* 22 pneumonias were device-associated
**42 UTIs were device-associated

COMPLIANCE WITH HAND HYGIENE RULES IN 8 GERMAN INTENSIVE CARE UNITS. Eckmanns T, Rath A, Br„uer H, Daschner F, R den H, Gastmeier P. Institute of Hygiene, Free Univ Berlin, Germany; Inst. For Environmental Medicine and Hosp Epidemiology, Uni. Freiburg, Germany.

INTRODUCTION: Handwashing, or hand disinfection, is believed to be the most important means of preventing nosocomial infections but is nevertheless the most violated of all infection control procedures. METHODS: We conducted an observation study on 8 ICUs. An independent medical student observed the compliance of hand hygiene in the ICUs on 2 occasions over a period of 2 years for 2 days 4 hours in the morning and 4 in the afternoon. The prime necessity for hand disinfection was with handling ventilation devices, intravascular catheters, urinary catheters and dressings. Hand disinfection, the using and disinfecting of gloves were considered as correct procedures. A ratio number of observed hand disinfection divided by number of infection relevant cases of handling was calculated in order to describe the compliance with hand disinfection guidelines. In addition a patient/personal-ratio (PPR) was calculated in order to take account of under staffing. RESULTS: A total of 2,170 infection-relevant handlings were observed (between 58 and 195 in the 8 ICUs). The compliance ranged from 27.4 to 79.8% (mean 61.7%). The PPR ranged from 0.84 to 1.54 (mean 1.2). We compared the compliance with the PPR. In all ICUs together there was a decrease of compliance relative to a decrease of the PPR. But in 6 of the 8 single ICUs the compliance did not change in relation to a better PPR. DISCUSSION: In this study the compliance is more of a constant factor in the single ICU than relating to the PPR. There are different possible interpretations for this result. If there are more staff the additional persons are often untrained students. If one person looks after more than one patient this person is naturally more aware of hand disinfection than somebody who is dealing with just one patient.

INCIDENCE AND TRANSMISSION OF ACINETOBACTER BAUMANNII HAEMOLYTICUS IN A NYC TEACHING HOSPITAL: 1998-99. Finkelstein LE, Petrec C, Kogan G, Moore A, Zhang D, Mendelson MH. Mount Sinai Med Center, New York, NY.

Acinetobacter baumannii haemolyticus is emerging as a significant nosocomial pathogen, primarily seen in patients who are in critical care units and or on mechanical ventilation. An increase in the number of multiresistant Acinetobacter baumannii haemolyticus (MDR; resistant to imipenem (I) and tobramycin (Tob) or amikacin (Ami))and an extended cephalosporin) has recently been reported. We report the results of prospective surveillance of nosocomial Acinetobacter haemolyticus isolates at the Mount Sinai Med Center, an 1,100 bed (incl. 78 critical care beds) acute care teaching facility located in NYC. From 1/98-9/99 there were a total of 278 patients identified with nosocomial Acinetobacter baumannii haemolyticus isolates; 19 of 278 (7%) were MDR. Site distribution of 19 MDR isolates: 12 (63%) respiratory, 1 (5%) blood, 4 (21%) wound/body fluid, 2 (11%) catheter tip. From 9/98-6/99 biotyping was performed on 21 (3 MDR, 18 non MDR) isolates: 9, respiratory; 3, wound; 2, catheter tip; 5, blood; and 2, urine. Pulse field gel electrophoresis (PFGE) revealed 5 distinct types, 1 related type, and 6 indeterminate types. PFGE typing showed specificity and

relatedness in 2 specialty areas: Cardiac Surgery, Cardiac Surgical ICU/Step-down (Adult and Peds)/Adult Surgical ward, 7/7 Types A/A1, 2/7 MDR. Neurosurgery: Neuroscience ICU, 2/2 Type E, 0 MDR. In conclusion, typing of Acinetobacter baumannii haemolyticus in 1998-99 in Cardiac Surgery showed evidence of low level but continued horizontal transmission with a preponderance of non-MDR isolates during the evaluation period.

DEVELOPMENT OF A NATION-WIDE SURVEILLANCE SYSTEM FOR NOSOCOMIAL INFECTIONS IN NEONATAL INTENSIVE CARE UNITS IN GERMANY. Fitzner J, Gastmeier P, Hamouda O, Roden H, Neonatal Nosocomial Infection Study Group. Robert Koch-Institut, Berlin, Germany; Free Univ of Berlin, Berlin, Germany.

Neonates with low birth weight (BW) are at high risk of NI. In May 1999, a nation-wide NI surveillance system for neonates was begun in order to compare and evaluate infection control measures among clinics. 14 NICU reported data on the number of patient-days (pd) for patients with birth weight (BW) <1000 g and 1000-1500 g and, for these patients, the number of days of central venous catheter (CVC) and nasal continuous positive air pressure (NCPAP) use and days of intubation. A trained nurse reported all NI of sepsis, pneumonia or necrotizing enterocolitis (NEC) among these patients using modified CDC definitions. Data from May 99 to Aug 99 representing 38 unit-months were collected and analysed A total of 4,365 pd among patients with a BW <1000 and 3,413 pd among those with a BW 1000-1500 were recorded. The pooled mean CVC usage rates (CVC-days/100 pd) were 17.1 (range 0-97) and 13.9 (0-36) for those with BW <1000 and 1000-1500, respectively. The number of intubation-days/100 pd were 18.0 (0-100) and 13.9 (0-25.2), and the NCPAP usage rates were 21.6 (0-62.5) and 7.9 (0-40.6) for these two groups respectively. The device usage rate varied widely among the units; however, compared to data from the American NNIS (National Nosocomial Infections Surveillance), the German NICU have a lower overall device usage rate. Varying clinic structures between the USA and Germany might explain this. These data indicate that national data are required to effectively compare and evaluate national and local infection control measures.

INFECTIOUS AND NON-INFECTIOUS COMPLICATIONS OF INDWELLING CENTRAL VENOUS CATHETERS IN PEDIATRIC PATIENTS. Foca MD, San Gabriel P, Pimentel M, Saiman L. Columbia Univ, New York, NY.

Infectious and non-infectious complications of indwelling central venous catheters (CVCs) have been reported, but not extensively studied in pediatrics. We performed a prospective, hospital-wide cohort study of complications associated with CVCs (e.g., Broviac or Portacath catheters) in a Univ affiliated, tertiary care pediatric hospital. From Oct 1998 to Sep 1999, 174 CVCs were placed in 141 patients, mean age 6.1 years (range 1 day to 19.75 years). Only 36.9% were oncology patients, and the remainder were on the cardiology (15.6%), gastroenterology (9.2%), liver transplant (7.1%), infectious diseases (5.0%), and other services (26.2%). Thirty (30) non-infectious complications were elicited by telephone interviews with parents, including 8 accidental removals, 15 mechanical difficulties (e.g., dislodged, extruded cuff) and 6 occlusions, representing 1.74 non-infectious complications per 1000 catheter-days. Infectious complications were more common; there were 57 episodes of catheter-associated infections in 36 patients, and 4 secondary blood stream infections. Thus, the rate of catheter infections was 3.27 per 1000 catheter-days. Sixteen (16) episodes were polymicrobial. Compared with gram positive cocci (n=48 episodes) or fungi (n=7 episodes), gram negative rods (n=34 episodes) were very common causes of catheter-related infections, suggesting that gut translocation of enteric pathogens was an important cause of CVC infections. Active surveillance of computerized laboratory results from enrolled patients was compared with electronic reports of positive blood cultures from Med Informatics compendiums. These strategies were not 100% congruent, but proved 95% complementary. Forty percent (40%) of catheter-related infections were diagnosed >48 hours after hospitalizations, and an additional 23% of infections were preceded by a hospitalization within one month. Thus, nosocomial infections cannot be easily distinguished from community acquired infections in this group of seriously ill, immunocompromised pediatric patients. Supported by Pfizer, Inc.

APPLYING PRINCIPLES OF THE SENIC STUDY: RESULTS OF A 9-YEAR PROSPECTIVE NOSOCOMIAL INFECTION SURVEILLANCE PROGRAM. Frenette CH, Delorme M, Lecorre I. Charles Lemoyne Hosp, Sherbrooke Univ, Montreal, Canada.

In 1990 a general prospective surveillance program for nosocomial infections (NI) was implemented in a 500 bed community hospital. A dedicated hospital epidemiologist was designated and a surgical site infection (SSI) rate reporting system was introduced. In 1998 infection control (IC) resources were increased.We report the results of nine-year surveillance for NI. IC practitioner conducted surveillance for NI by visiting acute care wards twice a week. Positive microbiology reports, cardex clues, and headnurse interviews were used to identify patients with potential NI and confirmed according to CDC criteria. Over these years, among others, specific prevention programs were introduced concerning SSI, urinary tract infections, catheter associated bacteremias, intensive care infections and Clostridium diffficile associated diarrhea. From 1990 to 1999 we identified 5,562 NI with an incidence rate of 5.2/1000 patient-days (PD). From 1990 to 1994 the incidence rate decreased from 5.9 to 4.5/1000 PD. In 1994-96 the hospital became a major trauma center affiliated with Univ, intensive care beds were doubled and ambulatory care was developed. From 1995 to 1999 the incidence rates increased to 5.8/1000 PD. Over the 9 years, rates for urinary tract infections decreased by 28% and SSI by 35%. Peripheral intravenous infection decreased 42% and rates for catheter associated bacteremias went from 3.4 to 1.0/1000 catheter-days (-70%). However pneumonia increased from 0.82 to 1.16/1000 PD and Clostridium difficile associated diarrhea increased more than tenfold. Twelve (12) outbreaks were identified and accounted for 5% of NI. We conclude that prospective general surveillance of NI is useful and essential to identify significant IC problems in an institution, monitor trends in NI, target interventions and monitor their efficacy.

RATES OF NOSOCOMIAL BLOODSTREAM INFECTION: VARIATION BY HOSPITAL CHARACTERISTICS AND INFECTION CONTROL RESOURCES. Frenette CH,* Moore DL, Meunier L, Delorme M, Tremblay C, St-Antoine P, Miller M, D'halewyn MA, Weiss K, Hebert G, Gourdeau M. Le groupe de Surveillance Provinciale des Infections Nosocomiales (SPIN), Quebec, Canada.

During a 12 week period in 1998, prospective surveillance of nosocomial bloodstream infections (BSI) was performed in 30 acute care hospitals of the province of Québec. A questionnaire was sent to each participating hospital to collect information on total hospital patient-days and discharges, intensive care unit (ICU) patient-days and discharges, hospital size, Univ affiliation, medical and surgical subspecialties offered and infection control practitioner (ICP) resources. Infection rates per 1000 patient-days (IR) were calculated for the total hospital and for ICU. IR were analysed by univariate and multivariate analysis using Poisson's regression model. ICP resources were calculated as the ratio of full time equivalent ICP per 250 beds. There were 437 BSI in hospitalised patients, with a mean IR of 0.67 BSI for hospitals. For ICU, the mean rate was four times higher (2.74). The total hospital rate was higher in Univ hospital centers (0.85) than in Univ-affiliated hospitals (0.69) or in non-Univ hospitals (0.28). The rate increased with the number of subspecialties offered, from 0.1 for to 1.3 for 6 or more subspecialties ($p < 0,01$). There was no correlation with hospital size. 20 hospitals had less than 0.8 ICP and 10 hospitals had more than 0.8 ICP per 250 beds. Those with more than 0.8 ICP per 250 beds had a 19% lower total hospital IR and a 39% lower ICU IR ($p< 0,05$). We conclude that rates of BSI vary greatly and are higher in Univ hospitals and in those with larger numbers of subspecialties. The differences observed indicate varying needs for infection control resources and suggest that a higher number of ICP per 250 beds may result in a lower rate of BSI, particularly in ICU.

PREVALENCE OF NOSOCOMIAL INFECTIONS IN FRANCE: RESULTS OF THE 1996 NATION-WIDE SURVEY. Gachie JP, Astagneau P, Savey A, Parneix P, Branger B, Gayet S, Lepoutre A, Dumartin C, Carlet J. Co-ordinating center for nosocomial infection control, Bordeaux, France; Co-ordinating center for nosocomial infection control, Paris, France; Co-ordinating center for nosocomial infection control, Lyon, France; Co-ordinating center for nosocomial infection control, Rennes, France; Co-ordinating center for nosocomial infection control, Strasbourg, France; National committee for nosocomial infection control, France.

In order to estimate the prevalence of nosocomial infections (NI) and to increase awareness on hygiene practices for healthcare personnel, all volunteer hospitals were requested to participate to a national point-prevalence survey supported by the Ministry of Health between May and June, 1996. In each ward, data were collected in all patients by trained infection control nurses and practitioners using standard questionnaire. Items included NI clinical and microbiological characteristics, surgical history for the past 30 days and indwelling urinary catheter within 7 days before study. Of the 236,334 inpatients in 830 participating hospitals, 6.7% presented with at least one NI acquired in the hospitals and 1.3% with NI acquired in another hospital. NI prevalence was highest in intensive care (22%) and middle-term facilities (9.3%) and lowest in pediatric (0.7%) and psychiatric (0.3%) facilities and varied dramatically according to size and type of hospital. Urinary (36%), lower respiratory tract (13%), surgical site (11%) and skin/soft tissue (11%) infections were the most frequent NI sites. Post-operative patients and patients with indwelling urinary catheters, accounting for 18% and 9.6%of the overall population respectively, were high risk groups for NI. Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa were the three major microorganisms responsible for NI. Prevalence of methicillin-resistant S. aureus was 0.8% and accounted for 66% of all S. aureus strains. This first national prevalence survey bears witness to the sustained efforts for combating NI in healthcare settings and reflects the impact of the national policy which has been implemented over the past ten years in France.

COMPARISON OF DEVICE ASSOCIATED INFECTIONS RATES: UNIT-BASED AND PATIENT-BASED METHODS. Gastmeier P, Braeuer H, Daschner F, Rüden H. Institute for Hygiene, Free Univ of Berlin, Germany; Inst. for Environmental Medicine and Hosp Epidemiology, Univ Hosp Freiburg, Germany.

BACKGROUND: To save surveillance time the National Nosocomial Infection Surveillance (NNIS)-System method requires a unit based recording of device days. Therefore it is not possible to distinguish between individual device days before and after the onset of nosocomial infections (NI). OBJECTIVE: To determine the difference between both methods. METHOD: The data of a prospective patient based surveillance of NI in intensive care and surgical units in 8 medium-sized hospitals over a period of 6 months were used here. 10,999 newly admitted patients were observed during the observation period, and device associated infection rates-using (1) all device-days, and (2) only those days before the onset of NI-calculated and compared. RESULTS: A total of 13,860 urinary catheter days, 8,762 central venous catheter (CVC) days and 1,746 ventilator days were recorded. The patient based calculated catheter-associated urinary tract infection (CAUTI) rate was 11.7, the CVC-associated bloodstream infection (BSI) rate 1.4 and the ventilator associated pneumonia (VAP) rate 29.0 (per 1000 device days). The unit-based data were 11.1 for CAUTI, 1.4 for CVC-BSI, and 22.3 for VAP (per 1000 device days). Thus, device associated infection rates were almost identical for CAUTI (RR 0.99; CI95 0.76-1.19) and CVC-BSI (RR 0.95; CI95 0.45-2.21)-whether unit or patient based. The VAP rate was lower when measured by the unit-based method (RR 0.77 CI95 0.49-1.20), this difference, however, was not significant. CONCLUSIONS: Although recording by a patient-based method is the accurate method, the benefits of time saving using the unit-based method for routine surveillance outweighs its limitations and hardly influences device-associated infection rates.

SURVEILLANCE IN ICUS: STRATIFICATION OF DEVICE ASSOCIATED NOSOCOMIAL INFECTION RATES ACCORDING TO THE MEAN LENGTH OF STAY IN THE ICU?. Gastmeier P, Sohr D, Geffers C, Nassauer A, Daschner F, Rüden H. Institute for Hygiene, Free Univ. Berlin, Germany; Institute for Hygiene, Free Univ of Berlin, Germany; Robert Koch-Inst. Berlin, Germany; Inst. for Environmental Medicine and Hosp Epidemiology, Univ. Hosp Freiburg, Germany.

BACKGROUND: The German nosocomial infection surveillance system (KISS) for ICU patients using the NNIS method has had quite good resonance in Germany. Meanwhile 113 ICUs distributed all over the country participate and more than 100,000 patients have been observed. However, often the ICU doctors wish to distinguish between those ICUs with a short mean length of stay (MLS) and those with longer periods. OBJECTIVE: To investigate whether a stratification of device-associated nosocomial infection (DANI) rates according to the MLS is useful. METHOD: The KISS data of 74 ICUs participating for at least 6 months were the ones considered for this analysis. DANI rates for the individual ICUs were plotted against the MLS in the ICUs and Spearman Correlation Coefficients (SCC) were determined. RESULTS: The MLS in the various ICUs was 4.5 days (range 1.6-9.0 days). The mean duration of device use was 3.5 days for urinary catheters, 1.7 days for central venous catheters (CVC) and 10.5 days for ventilation. The mean DANI rates were 11.2 for ventilator associated pneumonia (VAP), 1.8 for CVC-associated bloodstream infections (BSI) and 4.0 for catheter associated urinary tract infections (CAUTI). No correlation between DANI rates and MLS was found for CVC-BSI (SCC=.19; p=.10) and VAP (SCC=.14; p=.24). A significant correlation was assessed for CAUTI (SCC=.33; p= 0.004). The incidence of CAUTI was 0.63 per 1000 catheter days higher for each extra day in the ICU.

CONCLUSIONS: Our data confirms the relation of UTI and duration of stay under conditions of the high catheter utilization rate found in most of the ICUs (mean: 80.8%), however this data does not justify demands by the ICUs for stratification of DANI rates for VAP and BSI according to MLS.

INFORMATION FROM HOSPITALS ON CASES OF OUTLIER POSITIONS IN THEIR ICUS ACCORDING TO THE DATA FROM THE GERMAN NOSOCOMIAL INFECTIONS SURVEILLANCE SYSTEM. Gastmeier P, Sohr D, Geffers C, Nassauer A, Daschner F, Rüden H. Institute for Hygiene, Free Univ of Berlin, Germany; Robert Koch-Inst, Berlin, Germany; Inst for Environmental Univ Hosp Freiburg, Germany.

BACKGROUND: In 1997 the German nosocomial infection surveillance system (KISS) for ICUs was introduced using the NNIS method. Meanwhile 113 ICUs participate continuously, twice a year receiving data from all the other ICUs on device associated infection rates, so as to be able to judge their own positions, in comparison to each other. Objective: To get an overview of the information from the infection control personnel (ICP) of hospitals together with an outlier position for their ICU. METHOD: All ICUs participating for at least 12 months were included. As an outlier position all device-associated infection rates for pneumonia, bloodstream infections and urinary tract infections below the 25th percentile (positive outlier position=POP) or above the 75th percentile (negative outlier position=NOP) were considered. The ICP were asked by questionnaire if the outlier position was due to diagnostic differences, patient mix, infection control management or if they had other explanations to offer. RESULTS: The explanations for POP in 14 ICUs were somewhat underreported nosocomial infections (NI) in hospitals with a low rate of microbiology monitoring (50%), low severity of illness in their patient group (29%) and good infection control management (7%). For the remaining 14% no explanation was proffered. In the explanations for NOP in 22 ICUs accuracy of diagnosing NI (43%), followed by severity of illness of patients (36%) and infection control problems (21%) was in general high. CONCLUSIONS: The ICP of the hospitals take care to relate outlier positions to the infection control management. They are aware of the problems in diagnosing NI and of considering patient mix by the surveillance method.

THE EFFECT OF POST-DISCHARGE SURVEILLANCE IN THE DUTCH NATIONAL SURGICAL SITE INFECTION SURVEILLANCE SYSTEM. Geubbels ELPE,* van Dieten HEM, Mintjes-de Groot AJ, van den Berg JM, de Boer AS. Nat'l Institute of Public Health and the Environment, Bilthoven, The Netherlands; Dutch Institute for Healthcare Improvement CBO, Utrecht, The Netherlands.

BACKGROUND: One of the objectives of our surveillance system is to collect comparable data on the incidence of surgical site infections (SSI) and related factors on hospital and national level. We expect the data to be influenced by whether hospitals conduct active post-discharge surveillance (PDS). OBJECTIVE: To study the effect of post-discharge surveillance on the identification of surgical site infections. METHODS: Data on 43,131 surgical procedures resulting in 1,479 SSIs were reported by 56 hospitals in the period Jun 1996 until Jun 1998. The analysis on the effect of PDS focused on two procedures, mastectomies (n=1,157) and replacements of the femur head (n=1,157), using the Chi-square test and a multivariate logistic regression model. RESULTS: With PDS significantly more SSIs after mastectomies were found (11.0%) then without (4.0%; p<.001), but this was not the case for replacement of the femur head (8.5% versus 6.0%). After multivariate adjustment for other covariates it was found that for both procedures about two times more SSIs were found with PDS then without (Ors 95% CI) for mastectomies 2.2 (1.2-4.0) and for replacements of the femur head 1.8 (1.1-2.9)). CONCLUSION: Incidence figures for SSI are influenced by PDS. If PDS is not taken into account, reference figures for SSI can be severely biased, as well as conclusions drawn from them by individual hospitals.

INCISO NETWORK: A FRENCH SURVEILLANCE SYSTEM FOR SURGICAL SITE INFECTIONS IN GENERAL SURGERY. Golliot F, Astagneau P, Brucker G. Coordinating Center for Nosocomial Infection Control (C-CLIN Paris Nord), Paris, France.

Over the last decade, surveillance of surgical site infections (SSI) has been considered as one of the tools for evaluating hospital quality of care, especially for low-risk patients. Since 1997, the INCISO surveillance network has been initiated with volunteer general surgical wards throughout Northern France. Based on a yearly 3-month surveillance period, the aims of INCISO were to detect over-risk wards and to evaluate temporal trends for SSI incidence. In each ward, 200 surgery patients had to be included and traced for 30 days following surgery, including after discharge. For each patient, perioperative risk factors were collected and SSI definition was standardized according to CDC criteria. Each ward was given an EPI-INFO-based program to compare local data to the overall data network. Overall data were restored to wards at the end of each surveillance period using a management report including quality of follow-up, characteristics of surgery, and distribution of wards according to NNIS(0)-SSI incidence. In a random sample of 15 wards, quality of surveillance practices was assessed according to standardized guidelines. Over 1997-99, participation to the study increased from 15 to 185 wards, including 1288 to 24,022 patients respectively. The NISS(0)-adjusted SSI incidence decreased from 3.5% to 1.6%. In 1999, 25% of the wards had a NNIS(0)-adjusted SSI incidence greater than 2.4%. INCISO network is a promising tool to evaluate the trend and the magnitude of SSI risk which should be adjusted for accurate case-mix.

TRENDS IN NOSOCOMIAL PNEUMONIAS WITH CONCURRENT BACTEREMIAS: THE EMERGENCE OF ACINETOBACTER BAUMANII. Gordon SM, Fatica CA, Arroliga AC. Cleveland Clinic Foundation, Cleveland, OH.

Acinetobacter baumanii are ubiquitous aerobic gram-negative coccobacilli resistant to many antibiotics which reportedly cause 3%-5% of nosocomial pneumonias (NP) in NNIS hospitals. We retrospectively reviewed all cases of NP (using CDC definitions) with concurrent bacteremias from 1994-98 at the Cleveland Clinic. A total of 313 episodes of NP with bacteremia were identified accounting for 62% of all NP and 12% of all nosocomial bloodstream infections during the five year study period. 73% were acquired in intensive care units where patients were usually mechanically ventilated. 75% (235 episodes) were due to gram-negative bacilli and 23% (72 episodes) due to gram-positive cocci. The most common pathogens causing NP with bacteremias were Acinetobacter baumanii (25%), Pseudomonas aeruginosa (24%), S. aureus (19%), Klebsiella sp. (8%) and Serratia sp. (8%). The mean onset from admission to onset of Acinetobacter NP with bacteremia was 28 days and 87% of these episodes had Acinetobacter isolated from a respiratory source. We conclude that at our hospital Acinetobacter is a major pathogen in ventilator-associated nosocomial pneumonias associated with bacteremia.

NOSOHUSIAL INFECTION: A DECADE OF SURVEILLANCE FOR COMPLICATIONS OF HOME INTRAVENOUS THERAPY. Graham DR, Molnar VL Springfield Clinic, Springfield IL.

Home IV Therapy (HIVT), a $5 billion U.S. industry, has few guidelines for monitoring. We describe a 10-year prospective surveillance system for bacteremias acquired at home (nosohusial) among 3,627 patients treated by 2 large community teaching hospital home care programs for 211,475 catheter days. The most common diagnoses were cancer/chronic pain (20.4%) and osteomyelitis (18.4%). Only 5% had AIDS. Mean age was 44.8 y. Mean duration of therapy was 58.3 d. The risk of nosohusial bacteremia was 4.2% (7.4/10,000 d): double lumen Broviacs (36.4/10,000 d), epidural catheters (24), double lumen Groshongs (14.5), peripherally inserted central catheters (PICC -2.9), peripheral (0), or subcutaneous infusions (0). One (1.6%) of 61 antenatal patients developed bacteremia. Causes of the 156 nosohusial bacteremias included coagulase-negative Staphylococcus (54.5%), S. aureus (13.5%), alpha Streptococcus (6.4%). Mean catheter age at symptom onset was 143 d. Patients with catheter-related bacteremias were ill a mean of 31 d. Treatment was antimicrobials alone (96), catheter removal alone (6), both (54). Multiple septic episodes occurred in 27 patients. After an episode treated without line removal, the risk of a second was 22%. After a second, the risk of a third was 50%. After a third, the risk of a fourth was 100%. Thirteen (13, 0.4%) persons died unexpectedly after treatment at home from 3 to 308 d (mean 79); causes were catheter sepsis (5), sudden cardiopulmonary event (5), insulin overdose (1), unknown (3). One hospital simultaneously compared systems of prospective and retrospective surveillance; the latter detected 70% of nosohusial bacteremias. HIVT is generally safe, but has quantifiable risks; regular monitoring is required to assure quality. Retrospective surveillance may be cost effective. PICCs are alternatives to tunneled catheters for many patients. Recurrent sepsis warrants catheter removal.

HOW MANY MONTHS BEFORE RISK-ADJUSTED CONTROL CHARTS ARE USEFUL IN INFECTION CONTROL?. Gustafson TL, Martin DL Infection Control and Prevention Analysts Inc., Austin, TX.

A major obstacle to the acceptance of control charts in infection control is the theoretical requirement for 25 "baseline" data points (two years of monthly infection rates!) before any expected mean or control limits can be drawn. We studied the "real-time" value of these charts for hospitals reporting risk-stratified infections to the AICE National Database. Between 1996 and 1998, 51 hospitals reported data for at least 12 months, 43 hospitals for 13-24 months, and 16 hospitals reported data for more than 24 months. Raw and risk-adjusted rates for each hospital were calculated monthly for 28 different control charts. Risk adjustment was performed using the Standardized Infection Ratio (SIR). "Flags" of suspiciously high or low monthly SIR's were investigated by each hospital's infection control staff and classified as (a) preventable, (b) non-preventable, or (c) background. "Real-time" charts were drawn by recalculating means and limits every month, and by calculating limits both including and excluding data points due to preventable causes. During the first 12 months of data collection and charting, no control chart identified real infection control problems any better than chance. However, during the second 12 months of charting, 16 charts performed better than chance, with the mXmR-Chart based on the median range performing the best (ROC area=.725, p=.0006). During the third 12 months of data collection, all 28 charts performed better than chance, but now the mXmR-Chart based on the mean range performed the best (ROC area=.826, p <.000001). Because control charts perform best when preventable IC problems are excluded from subsequent limit calculations, specific rules were developed for identifying and investigating "flags" efficiently. This study in 51 U.S. hospitals suggests that control charts based on SIR's have practical value as soon as 12 months of data have been collected, and provides evidence that mXmR-Charts are valuable and statistically robust tools for infection control.

COMPUTER ASSISTED SURVEILLANCE FOR DETECTING OUTBREAKS OF NOSOCOMIAL INFECTIONS. Hacek DM, Cordell R, Noskin GA, Peterson LR. Prevention Epicenter, Northwestern Memorial Hosp, Chicago, IL; Ctrs for Disease Control and Prevention, Atlanta, GA; Prevention Epicenter, Northwestern Univ Med School, Chicago, IL.

Computerized monitoring of hospital pathogens using microbiological data could enhance infection control efforts by rapidly detecting potential outbreaks from existing information. We assessed two approaches using the monthly number of laboratory isolates for each of 23 bacteria between 1991 and 1998. Initially, a plot for each organism from 1997-99 was prepared, and if more than twice the yearly mean was seen in a given month, this signaled that an infection control investigation should be performed. Nine signaled organisms in 4 months were investigated, and proved to be an outbreak. Thus, a second method was investigated using two-factor analysis of variance (ANOVA) to determine significant differences between month- and year-specific means, dividing data into low and high incidence periods for each pathogen. We determined overall and low/high incidence upper boundaries (UB), defined as the mean plus two standard deviations. A suspected outbreak (SO) was any month when the isolates for a given pathogen exceeded its UB. We identified 60 SOs in the 1,932 pathogen-months of data (8 SOs/year), and retrospectively compared the SOs to those identified through traditional infection control surveillance. Eight Sos occurred in one unit, and the ANOVA method potentially detected 3 clonal outbreaks, missed 2 others, correctly did not recognize a non-clonal increase of infection, and signaled 2 SOs that were not real. ANOVA also identified 5 SOs from other areas between Jan-May 1999. Of the 5, one SO matched an outbreak, and the other 4 were not real. Our results suggest computer analysis of laboratory data can be a useful adjunct to other surveillance methods, however, false positive and negative signals occur using the best tested approach.

INCIDENCE OF NOSOCOMIAL INFECTION IN AN INTENSIVE CARE UNIT: A FIVE-YEAR EPIDEMIOLOGICAL STUDY APPLYING 1,260 PATIENTS. Haond C, Mohamedi I, Duperret S, Bui-Xuan B, Vedrinne JM, Reverdy ME, Tissot Guerraz F, Bouletreau P. Hôpital Edouard Herriot, Lyon, France.

OBJECTIVE: Analysis of incidence of nosocomial infection in an intensive care unit. Method and population: Prospective study of incidence of nosocomial infection among 1,260 patients admitted for 3 48 hours, from the 1st of Jan 1994 to the 31st of Dec 1998, in an intensive care unit in Edouard Herriot Hosp (Lyon, France). RESULTS: 29.4 nosocomial infections/1000 days/patient; 12.7 urinary tract infections/1000 days/indwelling urinary catheter; 16.5 respiratory tract infections/1000 days/artificial ventilation; 4.5 bacteremia/1000 days/patient; 3.1 intra-vascular canula colonization/1000 days/catheter. CONCLUSION: It is important to appreciate level of nosocomial infection in our hospital, and it seems to us a factor to evaluate the protocol and to improve quality of nursing.

SECULAR TRENDS AND ANTIMICROBIAL RESISTANCE AMONG PATHOGENS CAUSING NOSOCOMIAL INFECTIONS IN A TEACHING HOSPITAL IN TAIWAN. Hsueh PR, Sun CC, Chen ML, Chang YY, Yang LS, Chang SC, Ho SW, Lee CY, WC Hsieh, KT Luh. Natl Taiwan Univ Hosp (NTUH), Taipei, Taiwan.

The distribution of pathogens causing nosocomial infections changes with time. From 1981-98, a hospital-wide nosocomial surveillance data were analyzed. Overall, the top six pathogens causing nosocomial infections are Candida spp., Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Enterobacter spp, and Klebsiella pneumoniae. The upsurges of Candida species and some emerging antimicrobial resistant pathogens, particularly, oxacillin-resistant S. aureus (MRSA), vancomycin-resistant enterococci (VRE), extended-spectrum b-lactamases (ESBLs)-producing Enterobacteriaceae, carbapenem-resistant Acinetobacter baumannii, and multidrug-resistant Pseudomonas aeruginosa, were remarkable. [See table]

Major antimicrobial resistant pathogens causing all nosocomial infections and nosocomial bloodstream infections (BTI)

	% of resistance (all/ICUs/non-ICUs)					
Resistant	**1981-1986**		**1987-1992**		**1993-1998**	
bacteria	**All**	**BTI**	**All**	**BTI**	**All**	**BTI**
MRSA	20.2/	4.3/	31.4/	23.9/	64.8/	58.9/
	27.8/	12.5/	58.5/	43.8/	86.9/	84.6/
	19.5	2.6	26.6	18.7	56.7	48.3
MRCoNS	72.2/	55.0/	74.0/	71.9/	79.0/	79.7/
	88.2/	66.7/	83.9/	84.0/	88.7/	88.0/
	70.8	52.9	71.5	64.7	75.1	76.0
PCN-R |enterococci|	5.9/	6.8/	20.7/	29.7/	19.5/	24.9/
	6.8/	0.0/	30.0/	25.0/	22.6/	24.4/
	5.8	9.3	19.6	33.3	18.7	25.3
GM-R |enterococci|	-	-	71.0/	61.1/	61.5/	53.4/
			71.4/	55.9/	67.2/	60.9/
			70.9	65.8	60.0	49.4
CTX-R |E. coli|	1.6/	0.0/	2.8/	1.5/	6.8/	6.1/
	0.0/	0.0/	8.6/	14.3/	13.1/	17.1/
	1.7	0.0	2.5	0.8	6.2	5.1
CTX-R |K. pneumoniae|	4.9/	4.0/	7.4/	14.6/	22.8/	25.8/
	8.8/	7.1/	16.9/	16.7/	50.5/	51.1/
	3.9	2.8	5.6	14.3	15.6	18.3
CTX-R |Enterobacter| spp.	35.8/	48.5/	49.7/	49.2/	57.6/	55.2/
	52.4/	75.0/	55.7/	73.3/	67.0/	65.5/
	32.4	40.0	47/7	35.8	53.6	58.7
CAZ-R |P. aeruginosa|	24.2/	25.0/	16.1/	16.4/	10.2/	9.6/
	20.0/	0.0/	24.3/	27.1/	16.9/	18.4/
	25.0	25.0	12.1	10.5	7.8	5.4

NOSOCOMIAL INFECTION SURVEILLANCE SYSTEMS OF INTENSIVE CARE UNITS IN TAIWAN. Ing-Tiau Kuo B, Lin M-Y. Taipei Veterans General Hosp, Taipei, Taiwan.

Nosocomial Infection Surveillance Systems of the United States (NISS), sponsored by CDC, was a milestone in nosocomial infection surveillance history. This system offered an objective data for hospital infection surveillance comparison. Taiwan has developed a similar surveillance system of intensive care units as Nosocomial Infection Surveillance Systems in Taiwan (NISS-T) since 1994. Hospitals in Taiwan were voluntary to join the NISS-T when they meet its requirements. The requirements to join NISS-T include support personnel who have attend the NISS-T training course, a microcomputer compatible with NISS-T software, and approval from hospital administrator. Data analysis mimics the methods used in NISS. From Apr 1994 to Dec 1998, 107 hospitals have submitted data to NNIS-T. A total of 2,933 months of data from 92 hospitals were available for analysis. This included 13,145 nosocomial infections that occurred in 129,473 patients over 848,149 patient-days, which has an average length of stay ranged from 0-126.71 days (median 10.35). The median of the overall nosocomial infection patient was 9,57 infections per 100 patients or 14.72 case per 1000 patient-days. Device utilization rate, device-associated infection rate stratified by types of ICUs, and comparison between NISS-T and NISS will be presented. The importance of nosocomial surveillance system cannot be over-emphasized. The NISS-T has moved NISS system to Taiwan. Further studies of adjustment may be needed before meaningful intra-hospital and inter-hospital comparison of nosocomial infection rates can be applied.

EFFECT OF STAFFING PATTERNS ON THE INCIDENCE OF NOSOCOMIAL INFECTIONS IN AN INTENSIVE CARE UNIT. Jacobs SL, Colodny SM, Massella JL. St. Clair Hosp, Pittsburgh, PA.

Routine Intensive Care Unit (ICU) nosocomial infection (NI) surveillance for the months of November and December 1997 showed a higher than anticipated NI rate. Pneumonia was the most common NI. Review of surveillance data for this time period identified several clusters of Nis by onset date. Causative associations were sought including staffing levels for both nursing and respiratory therapy. There was a linear association between decreasing nursing hours per patient day (HPPD) and increasing NI rate. Additionally there was an association between NI rate and the prior prevalence of float nursing staff. Full data for respiratory therapy staffing was not available. Subsequent interventions with the cooperation of nursing management included: 1) hiring additional ICU-trained nurses, 2) decreasing utilization of float nurses, and 3) educational updates for ICU staff concerning epidemiology and prevention of pneumonia. Comparison data for the period of November and December 1998 were obtained. Results: 1) 77% reduction in the use of float staff, 2) 100% reduction in the incidences where float staff exceeded ICU staff, 3) 41% reduction in NI rate, 4) 71% reduction in nosocomial pneumonia rate, and 5) elimination of the clusters of Nis around difficult staffing periods (i.e., holidays). Although the reduction in NI rate did not achieve statistical significance (p=0.1029), it did clearly represent a favorable trend and reinforced our belief that staffing levels and degree of training are associated with the development of a NI.

FEMORAL VEIN CATHETERIZATION: INDICATIONS AND COMPLICATIONS AT A COUNTY MEDICAL CENTER. Kakis A,* Vatan M, McCabe R. Alameda County Med Ctr, Oakland, CA.

Femoral vein catheterization (FVC) for venous access is used frequently at Alameda Cty Med Ctr as an alternative to the subclavian and internal jugular sites. We determined to evaluate the indications, frequency, duration, and complications of FVC in the ICU by concurrent review of clinical practice using predetermined criteria. A pilot study done to determine indications for FVC found that 7 (22%) of 32 had indications for FVC (rather than subclavian or internal jugular) documented; the 7 included 5 with head/neck trauma and 2 with unsuccessful catheterization attempts at other sites. Interview of staff yielded indications in 23 (92%) of the 25 remaining patients. In the prospective study of 94 FVCs, 12 (13%) had indications documented (9 head/neck trauma, 3 with head/neck tumors). Interview of staff yielded indications of 77 (94%) of 82. Complications included line infection (3), thrombosis (1), local bleeding (2), and hematoma following arterial puncture (1). During the same period in the ICU, the Blood Stream Infection rate for central venous catheterization was 5.2 compared to 10.0 for FVC. Larger control studies may be needed to determine if other complications including line infection occur more often with FVC.

DEVICE-ASSOCIATED, DEVICE-DAY INFECTION RATES IN AN ISRAELI NEUROSURGICAL INTENSIVE CARE UNIT. Kassis I, Rabino G, Oren I, Bar-Levi Y, Finkelstein R. Rambam Med Ctr, Haifa, Israel.

OBJECTIVE: To evaluate NI rates in our neurosurgical intensive care unit (NSICU) and compare them with those reported by the National Nosocomial Infections Surveillance (NNIS) System. METHODS: Data collection and analysis were performed according to the methods and definitions used by the NNIS System. In a similar manner, we also evaluated the rate of ventricular catheter (VC)-associated infections (ventriculitis/meningitis) as a new and specific component for NSICUs. RESULTS: During an 11-month period we evaluated 183 patients. There were 27.9 ventilator (V)-associated pneumonias per 1000 ventilation-days, 31.6 bloodstream infections per 1000 central line (CL)-days, 24.9 urinary tract infections per 1000 urinary catheter (UC)-days and 10.8 episodes of ventriculitis/meningitis per 1000 VC-days. The device utilization ratios for V, CL, UC and VC were 0.58. 0.57, 0.92 and 0.18 respectively. Major isolated pathogens are summarized in the following table: TABLE

CONCLUSIONS: NI rates in our NSICU are significantly higher than those reported by the NNIS and this may be due to an excess of device utilization (close or > the 90th percentile reported by NNIS). Our findings deserve further investigation, including comparison with other Israeli NSICUs.

	Pneumonia (44)	**BSI (37)**	**UTI (46)**	**Ventriculitis (18)**
Pathogens	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**
P. aeruginosa	10 (23)	3 (8)	4 (9)	1 (5.5)
Klebsiella sp	9 (20)	4 (11)	12 (26)	8 (44)
E. coli	4 (9)	0	6	(13) 0
E. cloacae	6 (14)	4 (11)	1 (2)	0
A. baumanni	4 (9)	2 (5)	1 (2)	4 (44)
S. aureus	6 (14)	3 (8)	1 (2)	0
CNS*	0	12 (32)	1 (2)	1 (5.5)
Enterococci	0	4 (11)	3 (6.5)	0
Candida spp.	0	0	14 (30)	0

*CNS: coagulase-negative staphylococci

DETECTION AND COST COMPARISON OF MULTI-FACETED (MF-SS) VERSUS CLOSTRIDIUM DIFFICILE FOCUSED SURVEILLANCE STRATEGIES FOR IDENTIFICATION OF VANCOMYCIN RESISTANT ENTEROCOCCUS COLONIZATION. Katz KC, Gardam MA, Burt J, Conly JM. Univ Health Network, Univ of Toronto, Toronto, Ontario.

BACKGROUND: The optimal extent, timing and cost-effectiveness of surveillance screening (SS) for the detection of vancomycin resistant enterococci (VRE) colonized patients is unknown and will vary according to the prevalence of VRE. Given a low prevalence of VRE in our centre, we compared 2 SS to detect VRE colonized patients. METHODS: A retrospective analysis of the detection rate and costs for the 2 SS was conducted in a 1000-bed 3-site hospital over 39 months. MF-SS consisting of rectal swabs (RS) performed intermittently on "high- and low-risk wards"; transfers from high-prevalence centres; admissions to wards with VRE cases; screening of diarrheal stools submitted for C. difficile testing and all clinical enterococcal isolates was compared with a Clostridium difficile focused CD-SS consisting of screening only CD samples; wards with new cases identified by CD testing; and clinical enterococcal isolates. RESULTS: Of 66 VRE cases identified, 29 (43.9%) were

from RS; 28 (42.4%) from CD; and 9 (13.6%) from clinical specimens. Of 3,660 RS, 2,993 were random ward screens (2,763 on high-risk [renal, ICUs, transplantation, medical] and 897 on low-risk wards [others]) and 667 focused screens. The CD-SS identified 72.7% (48) of the VRE cases. Screening wards with a new case of VRE detected on a CD specimen was more likely to identify a new VRE case than random screens(11/667 vs 18/1993, p=.01). The incidence density of VRE case finding was higher for CD samples (23/100,000 patient-days [pd]) vs random RS (3.6/100,000 pd), p<0.001; RS done on high risk (5.6/100 000 pd) vs low risk wards (2.5/100 000 pd), p=.04; and CD samples vs RS done on high-risk wards, p<0.001.The CD-SS would have cost $CAN 60,668 (37.2%) less than the MF-SS. CONCLUSION: Adoption of a focused VRE SS would detect the majority of VRE cases in our centre, provide significant cost savings and detect VRE-colonized patients with diarrhea who are more likely to spread VRE into the environment and to other patients.

EFFECTIVENESS OF INFECTION CONTROL PROGRAM TO PREVENT NOSOCOMIAL CENTRAL VENOUS CATHETER-RELATED INFECTION IN A TERTIARY CARE HOSPITAL, KOREA. Kim OG, Yoon SW, Lee JH, Lee NY, Kim SM, Peck KR, Song JH . Samsung Med Ctr, Sungkyunkwan Univ, Seoul, Korea.

Central Venous Catheter (CVC)-related infection is the major cause of nosocomial bacteremia and results in high morbidity and mortality. To determine the risk factors of nosocomial CVC-related infection and evaluate the effectiveness of the infection control program, a prospective surveillance and active interventional activities were performed in a 1,200-bed tertiary care hospital in Seoul, Korea. Interventional activities included the revision and enforcement of CVC management guidelines, education of all healthcare workers, evaluation of infection rates and continuous feedback to all departments by the infection control team. A total of 299 consecutive patients who had CVCs from Apr to Nov, 1998 were analyzed for the effectiveness of interventional activities. Baseline infection rate was 9.3/1000 CVC-days before the interventions. After the intervention, 15.1% of patients with CVCs had CVC-related infection with a rate of 6.1/1000 CVC-days (34 % reduction). Coagulase-negative Staphylococcus was the most common pathogen (34.8%) followed by Staphylococcus aureus (19.6%), Candida sp (8.7%). Statistically significant risk factors for CVC-related infection were long-term catheter use (O.R 2.84, 95% CI 1.47 to 5.49) and use of multilumen catheters (O.R 3.69, 95% CI 1.87 to 7.27). The study confirms the effectiveness of an intensive infection control program to decrease the incidence of CVC-related infections. Continuous surveillance and interventional activities should be implemented on a routine basis.

TEN YEARS OF PREVENTION AND CONTROL OF LEGIONELLA AT NANTES TEACHING HOSPITAL. Le Gallou F, Luce D, Richet H. Institut de Biologie, Centre Hospier Universitaire, Nantes, France.

The CDC guideline for prevention of legionnaires' disease, published in 1994, does not recommend to routinely culture water for Legionella sp, in absence of cases of infection. In contrast a recent official French guideline (Dec 1998) recommends to sample at least annually water tanks and selected outlets in every healthcare facility. Since 1988, chlorination of the hot water system and environmental survey for Legionella sp have been performed at Nantes Teaching Hosp. From 1993-98, 4 outbreaks of nosocomial legionellosis (NL) have occurred: (1) in Nov 1993, a man hospitalized in Internal Medicine unit had NL related to the use of a refrigerating fountain; (2) in Mar 1996, a woman hospitalized in the Hematology unit had NL related to a recent previous stay in another ward of the hospital; (3) in Sep and Oct 1997, two solid organ transplanted patients receiving cyclosporin and corticotherapy had NL related to a deficiency in the continuous chlorination system; and (4) in Jul 1998, NL was strongly suspected in two patients attending the hematology outpatient clinic and related to particularities in the water lines in this unit. These outbreaks' investigations contributed to modify both our disinfection system and our environmental survey strategy. On the other hand, routine sampling of the water distribution system enabled us to detect several technical problems related to the water chlorination system and, therefore, may have prevented additional cases of NL. Our experience suggests that beside environmental investigation related to NL cases as recommended by the CDC, the regular environmental sampling (including a selection of distal sites according to the patients status and the type of the water distribution system) may be useful for the prevention of NL, even in the hospitals where a permanent water disinfection system has been implemented.

ROTATION OF SURVEILLANCE OF NOSOCOMIAL INFECTIONS AND ESTABLISHMENT OF INFECTION CONTROL GUIDELINES. Lemmen SW, Zolldann D, Luetticken R. Univ Hosp RWTH Aachen, Germany.

In clinical practice, scientific evidence in infection control is often ignored or difficult to implement and hygiene rituals are continued to be followed. Within an evidence-based infection control program, a quarterly rotating surveillance program for nosocomial infections was implemented on four intensive care units of a German university hospital. For the first time the unit-specific nosocomial infection situation was made transparent to the clinical staff by interpretive feedback of the surveillance data. This led to an increased awareness towards infection control and a critical reflection of the hygiene practices. After the first surveillance period the hygiene practices of each intensive care unit were revised and modified CDC/HICPAC guidelines for the prevention of nosocomial infections were adopted and established in cooperation with the medical and nursing staff. In conclusion, the awareness and compliance with hospital hygiene and infection control practices could be improved in a non-directive way.

COMPUTER-ASSISTED SURVEILLANCE OF NOSOCOMIAL INFECTIONS IN THE INTENSIVE CARE UNIT: ALTERNATIVE TO TRADITIONAL SURVEILLANCE. Lin W, Chalfine A, Misset B, Paoli B, Kitzis MD, Guerrier ML, Gonot J, Cauët D, Carlet J. Hôpital Saint Joseph, Paris, France ; EpiConcept, Paris, France.

BACKGROUND: The surveillance of nosocomial infections (NI) is resource intensive and time-consuming in the absence of a centralized information system. The Hygiene Unit implemented a computer-based surveillance system (NosoCom) integrating existing databases to replace traditional methods of monitoring NI. METHOD: All patients admitted into the intensive care unit (ICU) between 1 Jun and 15 Oct 1999 were included in the study. Urinary tract infections, pneumonia, bacteremia, and catheter associated infections were monitored. Positive microbiological results were electronically transferred daily from the laboratory NetLab system to the NosoCom server; suspected cases of Nis were identified using predetermined microbiological criteria (e.g. urine: >105 cfu/ml). In the study method, a list of suspected cases was provided weekly to ICU staff for validation. They must indicate yes/no to two questions: Is this an infection? Is it a NI? During this period, two infection control physicians monitored ICU patients prospectively through bedside visits and total chart review (reference method). We evaluated the sensitivity of the study method compared to the reference method. RESULTS: 141 patients were admitted during the study period. The reference method identified 21 cases of nosocomial infections; the study method identified 18. This gave a sensitivity of 85.7%. The study method missed three Nis (all from the same patient) whose microbiological results were not initially transmitted by NetLab. The results were transferred later during a routine update. This was likely due to a technical disruption in the data transfer process that was limited to this specific patient. CONCLUSION: The results from this study show that a semi-automated computer system can be effectively used for the surveillance of nosocomial infections in the ICU. The sensitivity of the system can be further increased by improving the electronic procedure for data transfer. This system is a promising alternative to the traditional surveillance program.

USE OF MATHEMATICAL MODELS TO PREDICT AND MEASURE THE RESPONSE OF BACTERIAL POPULATIONS TO INTERVENTIONS FOR THE CONTROL OF RESISTANCE. Lipsitch M, Bergstrom CT, Levin BR. Harvard School of Public Health, Boston, MA; Emory Univ, Atlanta, GA.

A simple mathematical model of bacterial transmission within a hospital was used to study the effects of measures to control nosocomial transmission of bacteria and reduce antimicrobial resistance in nosocomial pathogens. The model predicts that: (1) Use of an antibiotic for which resistance is not yet present in a hospital will be positively associated at the individual level (odds ratio) with carriage of bacteria resistant to other antibiotics, but negatively associated at the population level (prevalence). Thus inferences from individual risk factors can yield misleading conclusions about the effect of antibiotic use on resistance to another antibiotic. (2) Non-specific interventions that reduce transmission of all bacteria within a hospital will disproportionately reduce the prevalence of colonization with resistant bacteria. (3) Changes in the prevalence of resistance following a successful intervention will occur on a time scale of weeks to months, considerably faster than in community-acquired infections. Moreover, resistance can decline rapidly in a hospital even if it does not carry a fitness cost. The predictions of the model are compared with those of other models and with published data. The implications for resistance control, antimicrobial cycling programs, and the design of studies of nosocomial infections are discussed, along with the limitations and assumptions of the model.

NOSOCOMIAL INFECTION SURVEILLANCE IN A SPANISH SURGICAL INTENSIVE CARE UNIT: 1995-98, A TIME-TREND ANALYSIS. Lizan-Garcia M, Peyro R, Crespo MD, Tortola C, Garijo LL. Hosp General de Albacete, Spain.

OBJECTIVE: To establish the occurrence, distribution, risk factors and secular time-trend of Nosocomial Infections (NI) in a Surgical ICU. To establish a threshold value for detecting an increase in the expected number of NI cases. PATIENTS AND METHODS: In May 1995 a Nosocomial Infection Surveillance System was set up in the Surgical ICU of our hospital. Information on potential intrinsic and extrinsic risk factors was collected daily for all ICU patients with stay ≥48 hours by a nurse trained in hospital epidemiology. Definitions and criteria for infections complied with those of the CDC and the NNIS. Monthly, site-specific infection rates were calculated by using as denominator the total number of patients at risk, total patients-day, total indwelling urinary catheter-days, total central line-days, and total mechanical ventilator-days. Using Poisson Probability Distribution we calculated the estimated number of cases for each month and, when the observed number was above the expected number a review of techniques and procedures was carried to detect any deviation or violation of protocol. If it was deemed necessary an investigation was initiated, and the results were included in the monthly report sent to ICU physicians and head nurse. The monthly incidence-density rates were processed in a database and a secular Poisson regression trend analysis was performed. RESULTS: A total of 574 patients were followed in the 1995-98 period. The average urinary catheter-associated UTI rate was 8 × 1000 catheter-days. The ventilator-associated pneumonia was 13 × 1000 ventilator-days. The central line-associated BSI was 17 × 1000 central line-days. There was no change in the ITU trend during the 1995 98 period, although for BSI and pneumonia there was a decreasing trend in the number of infected patients. DISCUSSION: An intimate knowledge of the specific patterns of disease occurrence within our surgical UCI is required for the proper application of the investigation criteria, and for the identification of change in the risk of acquiring NI over spans of time. Selected control measures may be initiated as soon as any increase in the number of NI cases is detected.

VARIATION IN INFECTION- AND ANTIBIOTIC CONTROL PRACTICES AMONG EIGHT NEW YORK CITY HOSPITALS. Lutwick SM, Currie BP NYC Partnership Policy Ctr, New York, NY; Montefiore Med Ctr New York, NY.

INTRODUCTION: In NYC, a collaborative study is under way to examine local trends in multiple antibiotic-resistant organisms (MRO) and develop evidence-based interventions for MRO control. The project includes developing a shared database (microbiology, demographic, pharmacy data) to look at prevalence of MROs, and correlate patterns with antibiotic usage data. Infection- and antibiotic control practice variation was evaluated to generate hypotheses for testing. METHODS: In 1998, a self-reporting survey was sent to the task force members to assess variation in infection- and antibiotic control practice. RESULTS: 5 (68%) programs have MD directors. F/T ICPs ranged from 3 to 7. All sites have targeted surveillance. 50% are part of NNIS. Alerts to identify patients with MROs are used at 50% of sites. 68% had an automated system for tracking surveillance data. 38% defined resistant gram negatives (MRGN) as "sensitive to 2 or less drugs" and included them in surveillance program. 68% adopted standard precautions. 68% of the sites had a 24-hour approval system; 3 sites allowed staff other than ID to do approvals. 38% had no computerized support. 68% had vancomycin restrictions. 2 sites had prophylaxis guidelines. CONCLUSIONS: In spite of IC consensus statements on management of MROs, individual program interpretation of those guidelines is highly variable. Similar differences occur in antibiotic control programs with respect to formulary structure and approval process. Understanding the effect of these variations on the prevalence of MRO will be key to developing evidence-based interventions.

TUBERCULOSIS SURVEILLANCE AMONG HEALTH WORKERS IN A UNIVERSITY HOSPITAL. Machado AA, M Peinado, Figueiredo JFC, Martinez R. Univ of São Paulo, Ribeirão Preto, São Paulo, Brasil.

OBJECTIVES: to evaluate the previous exposure of health workers (HW) to tuberculosis (TB), their risk to contract the disease by being exposed to individuals with this infection, and to propose prophylactic and/or therapeutic measures. METHODS: HW working in an AIDS/Infectious Diseases Unit of a Univ Hosp gave their consent to respond to a

questionnaire with data concerning a personal history of TB, a history of TB in their families or among their contacts, previous care provided to patients with TB, and past use of BCG. A complete clinical examination, a tuberculin test and a chest X-ray were performed annually. RESULTS: a total of 83 HW were evaluated, 19 of them nurses (N), 45 nursing attendants (NA), and 19 administrators (A). Only one NA reported a personal history of TB, but 30 reported cases among relatives or contacts in the past (7-N, 18-NA, 5-A). 94.7% of the N, 57.7% of the NA and 10.5% of the A had provided care for patients with TB. A previous use of BCG was reported by 18 N, 35 NA and 17 A. Thirty (30) HW did not perform the tuberculin test (10-N, 14-NA, 6-A). Among the remaining subjects, the reading was negative in 13 (1-N; 7-NA; 5-A), the result was 5 mm in 8 (1-N, 5-NA, 2 -A) and > 10 mm in 30 (7-N, 20-NA, 3-A). A chest X-ray was obtained in 66 HW and was considered normal in 62, while 2 subjects showed lesions suggestive of residual TB and 2 showed alterations not related to TB. No case of active TB has been detected thus far among these HW. CONCLUSION: the percentage of susceptibility to TB in the places evaluated can be considered high since 21/83 (25.3%) HW presented a tuberculin test *5 mm despite the previous use of BCG. The fact that some HW did not undergo certain exams included in the protocol indicates the need for increased awareness about the importance of TB as a professional disease and about the value of surveillance measures for its control.

NOSOCOMIAL INFECTION COMPARISON RATES BY LENGTH OF STAY AND SEVERITY PATIENTS IN 2 PEDIATRIC INTENSIVE CARE UNITS. Manterola A,* Andión E, Bologna R, Battistezza J, Carbonaro M. Hosp Juan Garrahan, Buenos Aires, Argentina.

INTRODUCTION: the Nosocomial Infection (NI) evaluation in pediatric intensive care units (PICU) recommended by NNIS, employs infection rate by 1000 patient days, adjusted by patients severity average (ASIS) and length of stay average (ALOS). MATERIAL AND METHODS: since 1995 the Garrahan Hosp (GH) employed the NNIS system in the PICU A and B, aimed at knowing the evolution of global infection rates and the associated invasive procedures rates. Since 1997 we have incorporated the computing program SACIH. The data gathered were introduced in the SACIH and we obtained the infection rates by patients at risk, by patient days and by device days. The infection rates were adjusted by ASIS and ALOS. The statistical analysis of the data was carried out by EPIINFO 6.04. The PICU A and B admit a great number of chronically ill children. In 1998 we introduced a change in the adjustment: that the maximum time of stay be 90 days; after 90 days the patient was considered a new patient. RESULTS: The infection rates without adjustment and adjusted by ASIS presented the same variations. In 1997 and 1998, in the PICU A: correlation coefficient (CC): r = 0.98 (r2 = 0.96; 95% confidence limits (CL) = 0.92-0.98); in the PICU B, CC: r = 0.25 (r2 = 0.91, CL = 0.80-0.96). The rates adjusted by ALOS produced very important differences and the correlation is poor. In 1997 and 1998, PICU A: CC: r = 0.51 (r2 = 0.26,CL = -0.16-0.60); PICU B: CC: r = 0.27 (r2 = 0.07; CL = -0.53-0.61). The differences do not allow a good NI control because the ups and downs of the curves are veiled by the adjustment by ALOS. CONCLUSIONS: In one PICU with similar ASIS, the adjustment by ASIS did not offer advantage in relation to the infection rates without adjustment (this could happen when the ASIS is employed for comparison with other PICU with different ASIS). The adjustments by ALOS have shown great differences and it is not useful.

A TEN-YEAR NOSOCOMIAL INFECTION PREVALENCE STUDY, 1985-98. Martin E, Tissot Guerraz F Herriot Hosp, Lyon, France.

There are two methods for nosocomial infection (NI) survey: the first one is the incidence survey, the results of which are given with accuracy, this type of survey is planned in high risk units such as intensive care units, surgery, and haematology wards. This method is not available on all units of the hospital. The second method is the prevalence survey which allows an inventory of features, but it isn't representative of the whole year. Nevertheless, the method can be used in all units as a teaching method. Our methods of data collecting for the prevalence survey have varied, only a little, since 1985, and most of results are comparable. We have compared our prevalence results according to the units : intensive care, surgery, gynaecology-obstetrical, surgery specialties.

Year	1985	1989	1990	1991	1992	1993	1994	1995	1996	1998
Number of beds	1475	1319	1256	1246	1222	1190	1157	1155	1055	1055
Number of hospitalized	1289	1154	1055	1053	1002	900	873	969	878	725
Bed-occupation ratio	87%	91%	84%	84%	82%	75%	75%	84%	83%	69%
Hospitalized ± 48 hours		883*	807	762	733	614	669	713		514
Number of NI	145	87	95	70	84	43	63	65	73	53
Nb NI/ Nb hospitalized	11,	7,	9,	6,	8,	4,	7,	6,	8,	7,
	3%	5%	1%	6%	3%	7%	2%	7%	3%	3%
Nb NI/ Nb hospitalized		9,	11,	9,	11,	7%	9,	9,		10,
± 48h		9%*	8%	2%	4%		4%	1%		3%
Number patients with NI (p.NI)	111	77	77	61	78	39	59	51	58	37
p.NI / nb hospitalized	8,	6,	7,	5,	7,	4,	6,	5,	6,	5,
	6%	7%	3%	8%	8%	3%	7%	2%	6%	1%
p.NI / Nb hospitalized		8,	9,	8%	10,	6,	8,	7,		7,
± 48h		7%	5%		6%	4%	8%	2%		1%

* in 1989, we have included patients who staid at least 24 hours and not 48 hours.

EPIDEMIOLOGY OF NOSOCOMIAL VIRAL GASTROINTESTINAL INFECTION IN A CHILDREN'S HOSPITAL. Matlow AG, Bell EP, Wray R, Streitenberger L, Freeman R, Goldman C, Stegenga J, Petric M. Infection Prevention and Control Programme, The Hosp for Sick Children, Toronto, Ontario, Canada.

OBJECTIVE: Torovirus is a recently described agent of viral gastrointestinal infection (VGI). The purpose of this study is to describe the epidemiology of nosocomially acquired viral gastrointestinal infection (NVGI) in a pediatric institution. METHODS: NVGI was defined by NNIS criteria, and cases were identified prospectively by ward and laboratory based surveillance. Stools were examined and viral pathogens identified by electron microscopy. Cases from Jan 1998 through Aug 1999 were reviewed. Individual patients were included only once. RESULTS: Three hundred and fifty-two (352) cases of NVGI were identified to give an infection rate of 1.43 per 100 admits. Torovirus accounted for 83.0%, rotavirus 11.1%, Norwalk 2.3%, astrovirus 1.7%, adenovirus 1.1%, picornaparvovirus 0.6%, and coronavirus 0.3%. Torovirus was the sole agent of NVGI in Jul and Aug of both years and predominated in all other months. Rotavirus activity was present mainly in the winter/spring months. The prevalence of rotavirus versus torovirus infection was significantly higher in the general pediatrics population than in patients in the intensive care units or on the hematology/oncology/transplant wards. Patients acquired non-torovirus viral gastroenteritis more commonly on the general pediatrics ward than on the haem/oncology/transplant ward or the pediatric/neonatal intensive care units. CONCLUSION: Torovirus has emerged as the major cause of NVGI in our institution. The routine use of electron microscopy has clarified the etiological agent in many cases of gastroenteritis which might otherwise not have been captured by current NNIS definitions.

SYSTEMATIZING ICU SURVEILLANCE IN A HOSPITAL NETWORK SYTEM. McKinley LL, Johnson CC, Moriarty HJ, Short TH. Philadelphia VA Med Ctr, Philadelphia, PA; Villanova Univ, Villanova, PA.

Infection control surveillance is not performed using standardized methodology within the Department of Veterans Affairs (VA) health system; therefore, interhospital comparisons are of limited value. In addition, many smaller VA hospitals do not meet entry criteria nor have the resources to participate in national surveillance projects, such as the CDC National Nosocomial Surveillance System (NNIS). To facilitate standardization of surveillance within a VA hospital network, a study was designed to use one central coordination site to collect and analyze data for other network hospitals. The purpose of this study was to: (1) provide network hospitals with a systematized data management system for ICU surveillance and (2) to compare ICU nosocomial infection rates in hospitals that receive comparative data feedback to those that do not receive the comparative data. VISN 4 is a VA healthcare network of ten hospitals in the mid-Atlantic region of the United States. Among VISN 4 hospitals, only the Philadelphia VA Med Ctr (PVAMC) has been a NNIS participant. In this study, PVAMC serves as the central coordination site where surveillance data is analyzed according to NNIS criteria and reported back to the sites. The eight participating hospitals in the study were randomized into one of two groups. The experimental group (N=4 hospitals) receives risk adjusted infection rates with national comparative data and the control group (N=4 hospitals) receives only the risk adjusted infection rates without the comparative data. Data has been submitted and analyzed monthly since Jan 1, 1999. The implementation of this system within the hospital network will be described. The study may serve as an infection control surveillance model for both VA and non-VA hospital networks.

PAPERLESS SURVEILLANCE IN AUSTRALIA. McLaws M-L, Whitby M NSW Hosp Infection Surveillance Unit, Univ of New South Wales; Princess Alexandra Hosp.

Surveillance of nosocomial infection in Australia has been an uncoordinated time-consuming activity with few hospitals routinely collecting data. In the past various definitions have been applied and rates are disseminated to few clinicians and are often of historical interest only. New South Wales has 40% of all public hospital in Australia and was the first state to introduce standardised surveillance in Jun 1998 with the Hosp Infection Surveillance System (HISS) program. The HISS program aimed to streamline surveillance using only sentinel patient groups and sentinel microorganisms and have infection control practitioners collect data using a handheld computer at the patient's bedside. Electronic downloading of data has enabled reports to be disseminated in real time. HISS member hospital may collect data for intravascular line-related bacteraemia (IVDRB) and/or surgical site infection (SSI) using CDC definitions on their selected sentinel patient group, and pediatric patients are followed for respiratory syncytial virus or rotavirus. All member hospitals are required to collect data on all newly acquired infections with a multiple resistant microorganism or microorganisms of interest as their hospital's sentinel organism. The software for the handheld computer, written in Microsoft ACCESS, has allowed hospitals to collect over 150,000 data fields in the first 10 months of the program. Preliminary aggregated rates for some sentinel surgical procedures include coronary artery bypass surgery (1.8%, 95%CI 0.7%-3.9%), LSCS (3.3%, 95%CI 1.4%-6.8%), colorectal (7.7%, 95%CI 3.4%-14.7%) with 75th percentile for duration of surgery and patient demographics. Central line infection is estimated at 4.7 per 1000 line days (2.2-8.6) and 99% of all sentinel organisms were MRSA.

SURVEILLANCE AND ADVERSE OUTCOMES ASSOCIATED WITH REFRACTIVE SURGERY. Miller D, Newton J. Bascom Palmer Eye Institute, Miami, FL.

PURPOSE: To highlight potential adverse outcomes and identify potential risk factors associated with refractive surgeries. METHODS: A retrospective review of 2,341 refractive surgery procedures performed at our institute between Jan 1998 and Apr 1999. Data was collected from Refractory Center log books, patient registration data and microbiology reports. Patient population was defined by age, sex, indication for procedure, and type of procedure. We also visited our refractive center and reviewed policies and procedures and observed practices. RESULTS: 51% of patients were <40 years of age. Of this group, 1% were less than 20 years old. 54% (1255) were female annd 46% (1086) male. Admitting diagnosis included: Myopia (77%), myopia and astigmatism (13%), and others (10%). Surgical procedures included lasik (80%), PRK (13%), AK (0.6%), PTK (1%) and repeat surgeries-enhancements (5%). Adverse outcomes included enhancements (50/1000 patients) and infections (BPEI-1.3/1000 surgeries and referral-1.3/1000 surgeries). Age group at highest risk for repeat surgery were patients over 40 (p=<0.0001). Spectrum of organisms recovered from Microbiology: M. chelonae-2, P. acnes, S. aureus, and Bacillus species, 1 sterile infiltrate. There were no uniform observed practices between surgeons. Adverse outcomes in refractive surgery are small. There is a need for surveillance to establish a infection control standard.

A NEEDS ASSESSMENT SURVEY OF HOSPITAL EPIDEMIOLOGIC AND INFECTION CONTROL ACTIVITIES IN INTERNATIONAL SETTINGS. Mohammed MJ, Richet HM, Archibald LK, HIP Global Working Group. Ctrs for Disease Control and Prevention, Atlanta, GA.

Despite an abundance of information, hospital-acquired infections (HAI) remain a problem worldwide. To prioritize strategies for the prevention and control of HAI across the

globe, we conducted a needs assessment survey of healthcare facilities (HCF) that participate in the International Networks for the Study and Prevention of Emerging Antimicrobial Resistance (INSPEAR), and the External Quality Assurance Scheme for antimicrobial susceptibility testing (supported by the Ctrs for Disease Control and Prevention and the World Health Organization). A questionnaire on use of infection control guidelines, and surveillance methods for HAI and antimicrobial resistance (AR) was administered to 67 HCF from 39 countries: 56 (84%) were teaching HCF, 20 (30%) were from developed countries (DC), and 47 (70%) from lesser developed countries (LDC). Surveillance activities varied (DC vs LDC): hospital-wide surveillance (HWS) for HAI (90% vs 68%); laboratory surveillance for HAI (80% vs. 66%); HWS for AR (75% vs 77%); laboratory surveillance for AR (95% vs 83%); intensive care unit (ICU) HAI surveillance (75% vs 74%). The most common HAI sites in DC vs LDC HCF were urinary tract (21% vs 32%), surgical wound (9% vs 21%), gastrointestinal tract (2% vs 15%), and bloodstream (4% vs 11%). Infection control guidelines were more commonly used in DC vs LDC HCF: handwashing (100% vs 72%); isolation precautions (100% vs 66%); and disinfection and sterilization (100% vs 89%). Hospital epidemiologists or at least one infection control nurse was more common in DC institutions (100% vs 62%). Thirty percent (30%) DC and 49% LDC HCF had no infection control training or education programs. The most common reason for inadequate infection control was lack of personnel in DC and LDC HCF, and lack of finances in LDC HCF. In conclusion, training and education in hospital epidemiology should be a priority for both DC and LDC HCF. In addition, resources for HAI surveillance and prevention in HCF might be better targeted in high-risk areas for HAI, such as the ICU and surgical wards.

SURVEILLANCE OF NOSOCOMIAL BLOODSTREAM INFECTIONS IN QUEBEC: INFECTIONS IN PEDIATRIC PATIENTS. Moore DL,* Frenette CH, Meunier L, Delorme M, Tremblay C, St-Antoine P, Miller M, D'halewyn MA, Weiss K, Hebert G, Gourdeau M. Le groupe de Surveillance Provinciale des Infections Nosocomiales (SPIN), Quebec, Canada.

During a 12 week period in 1998, prospective surveillance of nosocomial bloodstream infections (BSI) was carried out in 30 acute care hospitals in the province of Québec. Of a total of 502 BSI, 52 (10.4%) were in patients less than 18 years of age. 21 BSI occurred in neonatal intensive care units. 17 were related to intravascular catheters (IV), 15 of which were used for parenteral nutrition (PN). Mean birth weight was 1477 g and mean age at infection was 1.7 months. Coagulase negative staphylococcus (CONS) was the organism isolated most frequently. Sepic shock occurred in 2 patients and respiratory distress syndrome in 1. There was 1 infection-related death. There were 31 BSI in other pediatric patients. 21 were IV-related. Mean age was 76 months and infection occurred at a mean of 39 days after admission. Fifteen (15) infections occurred in haematology-oncology patients and 13 patients received PN. CONS was the most frequent isolate. Complications included septic shock (5) and disseminated intravascular coagulation, endocarditis, septic emboli, enterocolitis and adult respiratory distress syndrome (1 each). There was 1 death, indirectly related to BSI. In comparison with adults, a higher percentage of pediatric patients developed BSI while in intensive care units; the proportion of BSI related to IV was higher and there were fewer secondary BSI. Children had been hospitalized for a longer time when BSI developed. A higher proportion of children were cancer patients, fewer were general surgery patients, and more received PN. S. aureus was the most frequent isolate from adults. In conclusion, IV use was the major risk factor in pediatric BSI. Nosocomial BSI in pediatric patients differed from those in adults, and different strategies for surveillance and prevention may be indicated.

HOSPITAL OUTBREAK SURVEILLANCE IN WALES. Morgan M, Evans-Williams D, Salmon RL, Hosein IK, Looker DN. Public Health Lab Service (Wales), Cardiff, UK; Communicable Disease Surveillance Centre (Wales), Cardiff, UK; Cardiff Public Health Lab, Univ Hosp of Wales, Cardiff, UK; Rhyl Public Health Lab, Ysbyty Glan Clwyd, Rhyl, UK.

Since 1997 surveillance of hospital outbreaks has been carried out in Wales. Infection control teams (ICT) complete a monthly questionnaire on all outbreaks that have occurred. A nil return is completed if no outbreaks have occurred. An outbreak is defined by the local infection control doctor. A quarterly report is returned to all participating sites. Results from 1997-98 and provisional data from 1999 showed broadly similar results. Forty-nine (49) outbreaks occurred in 1997, affecting 431 patients and 204 staff. There were 41 outbreaks in 1998, affecting 473 patients and 240 staff. Provisional results for 1999 show 21 outbreaks, affecting 214 patients and 146 staff. The majority of outbreaks in 1997-98 occurred in acute rather than community hospitals. Data consistently showed that viral gastroenteritis (of known and unknown aetiological agent) was the most common type of hospital outbreak in Wales (1997: 57%; 1998: 61%; 1999 (provisional): 71%), particularly in the winter months. In 1998, 76% of patients and 92% of staff involved in hospital outbreaks, were involved in viral gastroenteritis outbreaks. Data collected provides a resource for the ICT in Wales, to learn from the experiences of other teams in controlling outbreaks.

INITIATION OF NATION-WIDE NOSOCOMIAL INFECTION SURVEILLANCE IN JAPAN. Morikane K, Nishioka M, Konishi T, Ohkubo T, Kusachi N, Umeta S, Nagai I, Kohno K, Kobayashi H. NTT EC Kanto Med Ctr, Tokyo, Japan; NTT WC Tokai Hosp, Aichi, Japan; Toho Univ, Tokyo, Japan; Seirei Hamamatsu Hosp, Shizuoka, Japan; Kinan Hosp, Wakayama, Japan; Fukuoka Univ, Fukuoka, Japan.

Nosocomial infection surveillance has been performed for over twenty years using National Nosocomial Infection Surveillance (NNIS) system in the United States, and a huge size of data have been collected. However, in Japan we have no such systems/data thus far. Those data are necessary for us to evaluate the quality of the care in each hospital with regard to nosocomial infection. We therefore initiated nation-wide nosocomial infection surveillance in Japan, with the assistance of Ministry of Health and Welfare of Japan and CDC. We established the Japanese Nosocomial Infection Surveillance (JNIS) system based on NNIS system. The initial surveillance in JNIS was focused mainly on surgical site infections (SSIs) because of our interest in SSIs as well as the cost-effectiveness of SSI surveillance. Six institutes participated in this study. The preliminary data collected in these several months showed the SSI rate of 9.6% in the general surgery (87/907), which was much higher than that in the data of NNIS system, and also the SSI rate in each institute was similar. One reason for our high SSI rate seemed to be attributed to the inadequate timing of (i.e., non-preoperative) administration of prophylactic antibiotics, which is not uncommon in Japan. We also found that significant portion of SSIs occurred in the late phase of postoperative wound surveillance, that is, two to three weeks postoperatively. These SSIs could be omitted in the data from NNIS system, because in the U.S. patients are discharged from the hospital in the early postoperative stage and often never visit the hospital in which they had operations. In this point of view our data may be more accurate than the data from NNIS system. In conclusion, we established JNIS system according to NNIS system, surveyed mainly SSIs, and obtained unique results different from data in NNIS system.

REDUCING FALSE-POSITIVES IN SURVEILLANCE FOR INFREQUENT EVENTS. Muhlbaier LH, Wilson SJ, Sexton DJ, Kirkland KB, Milano CA, Smith PK. Duke Univ Med Ctr, Durham, NC; Dartmouth-Hitchcock Med Ctr, Hanover, NH; Dept of Surgery, Univ Med Ctr, Durham, NC.

Detecting a true outbreak of infections such as postoperative mediastinitis is difficult because apparent clusters of cases can be statistically insignificant during short time intervals. Thus, a better statistical method is needed to detect true outbreaks in a timely manner. For example, conventional control charting for process control (the "c-chart") is inappropriate for some relatively infrequent (e.g., <2%) events such as post-operative mediastinitis. The c-chart assumes the data arise from a Poisson distribution. To the extent that the data are not Poisson, the 3s limit is inaccurate. For some data, a geometric distribution is more appropriate (a "g-chart"). We show a reduction of "alarms" for apparent high rates (outbreaks) of mediastinitis from 40 (for c-charting) to 3 (for g-charting) during a 5.5-year time interval that included over 5,500 coronary artery bypass graft operations. We present methods to test the appropriateness of the distribution and the generation the g-chart. The g-chart method results in more appropriate surveillance, fewer false-positives, and a clinically useful definition of an outbreak.

METHODOLOGIES USED IN SURVEILLANCE OF SURGICAL WOUND INFECTIONS AND BACTEREAMIA IN AUSTRALIAN HOSPITALS. Murphy CL,* McLaws M-L New South Wales Department of Health, North Sydney, NSW, Australia; New South Wales Hosp, Univ of New South Wales, Kensington, NSW, Australia.

BACKGROUND: The prevalence of nosocomial infection in Australian hospitals is estimated to be between 5.5%-6.3%. Since 1989, infection control practitioners (ICPs) in hospitals accredited by the Australian Council on Health Care Standards (ACHS) have been encouraged to collect nosocomial infection data according to ACHS methodology. METHOD: In 1996 we surveyed members of the Australian Infection Control Association (AICA) to examine the time spent on surveillance, the practice of surveillance of all hospital infections (hospital wide surveillance), case finding methods, case definitions and reporting routinely used by ICPs in acute hospitals. We also examined the ICP's education and experience in infection control (IC). RESULTS: The survey was completed and returned by 65% (644/993) of AICA members. Of those completing the survey, 47.8% (308/644; CI95% 43.9%-51.7%) met the criteria for inclusion as they coordinated an IC program in an acute care or surgical hospital and performed surveillance for either SWI, IVDRB or non-IVDRB. Of those ICPs who reported their facility's accreditation status, 93.5% participated in ACHS system. Most (97.6%) ICPs had completed hospital-based general registered nurse training. Only 1.9% (6/308) of ICPs reported completion of continuing education relating to hospital epidemiology. The number of years of IC experience ranged from zero to 35 years, with a median of four years. ICPs spent a substantial proportion of their total weekly IC time on surveillance irrespective of ACHS accreditation; 19.5 hours in ACHS hospitals and 15.6 hours in non-ACHS hospitals (p=.33). Over three-quarters (76.0%) of ICPs performed hospital wide surveillance. The case finding methods, definitions of infections and reporting formats varied greatly. The definition most commonly applied by ICPs (6.8%; CI95% 4.1%-10.4%) to define surgical wound infection (SWI) was infection within 30 days after the operative procedure, plus purulent drainage, plus isolation of organisms from a culture from the incision site plus diagnosis by a medical officer. A five-item definition of a patient being asymptomatic, plus afebrile on admission, plus infection occurring at least 48 hours after admission, plus the patient having a fever of >38°C plus a recognised culture from one or more bottles was used by 15.7% (CI95% 11.3%-21.0%) of ICPs to define a case of bacteremia. CONCLUSION: Surveillance is the core business of Australian ICPs and consumes a substantial proportion of their time. The importance of surveillance, the epidemiologic limitations of the current ACHS system and the non-standard methods we report indicate that improved methodology is required for case finding and reporting of nosocomial infections. Australian ICPs should complete training in the principles of surveillance and epidemiology. With this training, ICPs can work collaboratively with other healthcare professionals to develop epidemiologically sound, local, nosocomial surveillance systems and to lobby for a voluntary, national, standardised, risk-adjusted system of targeted nosocomial surveillance.

RISK FACTORS ASSOCIATED WITH THE ACQUISITION OF BURKHOLDERIA (FORMERLY PSEUDOMONAS) CEPACIA AMONG CYSTIC FIBROSIS PATIENTS. Mychalak NA,* Manangan LP, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta GA.

Colonization or infection with Burkholderia cepacia (Bc) has been shown to increase morbidity and mortality among cystic fibrosis (CF) patients. To determine risk factors for acquiring Bc among CF patients, the Ctrs for Disease Control and Prevention (CDC) in collaboration with 20 CF centers in the United States and Canada conducted surveillance of Bc colonization or infection among CF patients from April 1986 to March 1989. A 2:1 matched case-control study was conducted; case-patients were defined as those diagnosed as colonized or infected with Bc for the first time. Controls were those who were not colonized or infected with Bc. Controls (N=274) were matched to cases (N=137) on age and severity of underlying CF. For each case or control, a questionnaire was completed semiannually by collaborating institutional investigator(s) for the duration of the study. Of 411 patients enrolled, 229 (56%) had 'mild' CF, 114 (28%) had 'moderate' CF, and 68 (16%) had 'advanced' CF. A univariate analysis showed that hospitalization for exacerbation of pulmonary infections (Odds Ratio [OR]=2.34, Confidence Interval [CI]=1.51-3.62), attendance at a CF summer camp (OR=1.76, CI=1.02-3.02), or direct contact with Bc-colonized CF patients other than at a CF summer camp or at home (OR=2.09, CI=1.20-3.63) was significantly associated with Bc colonization or infection. Conversely, cleaning and drying home-used nebulizers in between uses was associated with a decreased risk of acquiring Bc by CF patients (OR=0.30, CI=0.13-0.71). Of 410 followed-up patients, 31 (7.6%) died and Bc colonization or infection was found to be a strong risk factor for death (OR=4.82, CI=2.33-9.96). Hospization for pulmonary exacerbations, attendance at a CF summer camp, or direct contact with Bc-colonized patients increased the risk of acquiring Bc among patients with CF. Increased attention to infection control practices may reduce this risk.

A PRELIMINARY STUDY ON JAPANESE NOSOCOMIAL INFECTION SURVEILLANCE USING A LOGISTIC REGRESSION ANALYSIS. Nishioka M, Morikane K, Tanimura H, Konishi T, Kobayashi H, Kobayashi Y. Tokyo, Faculty of Medicine, Tokyo Univ, Tokyo, Japan; Kanto Med Ctr, Tokyo, Japan.

The National Nosocomial Infection Surveillance (NNIS) surgical site infection (SSI) Risk Index of the Ctrs for Disease Control and Prevention (CDC) is used as the standard method for categorizing SSI rates. Few hospitals in Japan are conducting SSI surveillance, and there have been thus far no studies to assess the NNIS SSI Risk Index using Japanese patients. We evaluated the NNIS SSI Risk Index using multivariate analysis. Data were collected prospectively, as a part of Japanese Nosocomial Infection Surveillance (JNIS), on all 338 cases in which abdominal surgical procedures were performed from Nov 1998 to Jul 1999 at a 404-bed general medical-surgical hospital in Tokyo. All cases were followed for 30 days after surgery to observe for SSI. CDC's SSI criteria were used. A logistic regression analysis was performed to control age, sex, and procedures used. Forty-five (45, 13.3%) out of the 338 cases developed SSIs. The SSI rate was 2.2% for cholecystectomy, 19.4% for colon surgery, and 17.8% for others. Univariate analysis showed that each variable age, sex, procedure, and the three factors of the NNIS SSI Risk Index (operation time, wound classification, and the American Society of Anesthesiologists physical status) were associated with developing SSI. In the logistic regression analysis, statistically significant variables were wound classification of class 3 or 4 versus class 1 or 2 (OR: 5.82, 95% CI: 1.99-17.00, p=0.001) and colon surgery versus cholecystectomy (OR: 9.67, 95% CI: 1.63-57.51, p=0.013). Our data suggests that the most important risk factor for developing an SSI following abdominal operation might be contaminated or dirty wound. This study will be extended to involve other hospitals in Japan.

RISK OF VENOUS ACCESS DEVICE RELATED INFECTIONS AMONG HIV SEROPOSITIVE PATIENTS. O'Daniels CM, Larsen NM, Washington CH, Rimland D, Jarvis WR, Manangan LP, del Rio C, Blumberg HM, Abrams C. Emory Univ, Atlanta, GA; Centers for Disease Control and Prevention, Atlanta, GA; Emory Univ and Grady Health System, Atlanta, GA.

Long-term venous access devices (VADs) are commonly required among patients with chronic disease including HIV infection. We assessed rates of and risk factors for VAD-related infections among HIV-seropositive patients who receive care at an urban public hospital clinic. During the study period from Jan 1998 to Oct 1999, 59 patients had 82 VADs placed (64 PICC lines, 17 PAS-Ports and 1 Vas-Cath). Median age was 35 (range 23-66 years) and 76% were male. 74% of patients were African-American, 24% were white, and 2% were Hispanic. Median CD4 count was 23/mm3 (range: 0-395) and the median viral load was 170,320 (range: <400 to >750,000/ml). 13 (22%) of 59 patients developed 21 device related infections for a rate of 3.7 per 1000 VAD days including 14 VAD associated bacteremias; 5 episodes in which the catheter was removed for suspected infection and catheter tip was culture positive but blood cultures were negative; and 2 local infections at the catheter site. Mean and median time to infection after VAD placement was 104.4 days and 34 days, respectively (range: 6-387 days). Distribution of organisms recovered from blood and VAD cultures was as follows: 9 S. aureus (6 MSSA and 3 MRSA), 7 coagulase negative Staphylococcus, 2 E. faecalis, 2 P. aeruginosa, 1 S. pneumoniae, 1 E. coli, and 1 Acinetobacter baumanii. The overall mortality rate for the cohort was 3.6/1000 VAD days. In both univariate analysis (p=.01) and multivariate analysis (p=.02), a higher viral load was significantly associated with increased risk of VAD-associated infection. In summary, in the era of HAART, we continue to see HIV-seropositive patients with low CD4 counts who required a VAD. VAD-associated infections: were predominantly due to gram-positive pathogens; occurred at a relatively high rate affecting approximately one-fourth of those who required a VAD; and were more likely to occur among those patients with a higher viral load.

NOSOCOMIAL INFECTIONS AMONG HIV AND NON-HIV PATIENTS IN A BRAZILIAN INFECTIOUS DISEASES UNIT. Padoveze MC,* Branchini MLM, Travasso P. Universidade Estadual de Campinas, Campinas, Brazil.

OBJECTIVE: to compare the incidence of nosocomial infections (NI) among HIV-positive and non-HIV inpatients from an infectious diseases ward. METHODS: patients admitted to the infectious diseases (ID) ward of the Clinics Hosp of Universidade Estadual de Campinas were prospectively followed from February 1998 to October 1999. NI were defined by the infection control nurse using current Ctrs for Disease Control and Prevention (CDC) criteria. RESULTS: A total of 56 NI occurred in 43 patients, with an overall incidence of 5.90 per 1000 patient days. Thirty-six (36) NI were diagnosed in 29 HIV patients (4413 patient days) and 20 NI were diagnosed in 14 patients (5080 patient days). Central venous and urinary catheter utilization was significantly higher among HIV patients than non-HIV patients. There was no difference between ventilator use in both patient groups. The median time of hospitalization until NI were diagnosed was lower in HIV patients than in non-HIV patients (15 and 24.5 days, respectively). Overall distribution by infection site was 44.63% for bloodstream infections (BSI); 17.86% for urinary tract infections; 14.26% for vascular infections; 10.71% for pneumonia; and 12.5% for all other sites. Overall HIV-infected patients were at overall higher risk of acquiring a BSI than non-HIV patients, including those without any type of vascular access. However, analyzing only patients with central venous catheter, there was no difference in BSI incidence (p=0.24) between HIV and non-HIV subjects. Gram-positive microorganisms were more likely to occur in HIV-positive group. Staphylococcus aureus was the most important pathogen in HIV-patient (38.46%), and 93.33% of them were methicillin-resistant. It is important to notice that the infection control committee had identified, since 1992, this ID ward as having an endemic incidence of methicillin resistance. CONCLUSIONS: The HIV-patients had higher NI rates than patients with other non-HIV infection diseases. They were more likely to have BSI infections and staphylococcal infections than non-HIV infected patients.

ESTIMATE OF THE ANNUAL NUMBER OF PERCUTANEOUS INJURIES IN U.S. HEALTHCARE WORKERS. Panlilio AL, Cardo DM, Campbell S, Srivastava PU, Jagger J, Orelien JG, Cohn RD, NaSH Surveillance Group, EPINet Data Sharing Network. Centers for Disease Control and Prevention, Atlanta, GA; Univ of Virginia, Charlottesville, VA; Analytical Sciences, Inc., Durham, NC.

Needlestick and other percutaneous injuries (Pis) pose the greatest risk of occupational transmission of bloodborne viruses to healthcare workers (HCWs). The annual number of Pis sustained by U.S. HCWs has been estimated using a variety of methods and has ranged from 100,000 to 1,000,000. To construct a single representative result, we estimated the total number of Pis by combining data collected in 1997 and 1998 at 15 National Surveillance System for Health Care Workers (NaSH) and 45 Exposure Prevention Information Network (EPINet) hospitals. The combined data were used as a sample of all U.S. hospitals and adjusted for underreporting. Since the number of Pis has been correlated with various measures of hospital size, the estimate of the number of Pis nationwide was weighted to reflect the number of admissions in all U.S. hospitals relative to those in NaSH and EPINet. The estimated number of Pis sustained annually by hospital-based HCWs was 384,325, with a 95% confidence interval from 311,091 to 463,922. The number of Pis sustained by HCWs outside of the hospital setting was not estimated. Our estimate, based on combined NaSH and EPINet data, may be more widely generalizable than those based on either system alone due to the improved heterogeneity of the hospitals represented. NaSH hospitals tend to be larger than average and are more likely to be found in the Northeast. EPINet hospitals tend to be smaller than NaSH hospitals and are clustered in the West Coast and southeastern U.S. Although our estimate is smaller than some previously published estimates of Pis in HCWs, its magnitude remains a concern and emphasizes the urgent need to implement prevention strategies. In addition, improved surveillance is needed to monitor injury trends among HCWs in all healthcare settings and to evaluate the impact of prevention interventions.

DECREASING THE RISK OF NOSOCOMIAL INFECTIONS: SECULAR TRENDS OF A CONTROL PROGRAM IN MEXICO CITY. Ponce de León-Rosales S,* Rangel-Frausto MS, Huertas-Jiménez M, B ez-Martínez R, Romero-Oliveros C. Natl Institute of Nutrition, Mexico City, Mexico.

OBJECTIVE: Evaluate the trends in nosocomial infections (NI) at a third level hospital, and to measure the impact in mortality and length of hospital stay. DESIGN: A descriptive retrospective study. METHODS: We analyzed the Hosp Epidemiology Division NI data base from 1991-96. Recorded data included: NI rates, site of NI, distribution, and length of stay. Severity of illness was evaluated according to the McCabe and Jackson scale. The study period was divided in three: before remodeling (1991-93), during remodeling (1994-95) and after remodeling (1996). Comparisons were made between the period before remodeling against after remodeling. Sensitivity and Specificity of the surveillance were also evaluated during the period and found to be excellent 93.8 and 98.7 respectively. RESULTS: The mean NI rate was of 8.6 by 100 discharges, a 20% reduction (p<.01) between periods. The intensive care unit was the hospital area with the highest infection rate (26.9/100 discharges), followed by general hospital wards (4 beds/room): 9.47 and private rooms 7.5. Urinary tract infections were the most frequent site of infection (26.6%), followed by surgical wound (24.4%), pneumonia (12.1%) and primary bacteremia (9.5%). During the study periods: urinary tract infections and primary bacteremias decreased significantly (p<.05 and p<.001 respectively), while surgical wound infections and pneumonia increased (p<.005 and <0.001 respectively). Associated mortality decreased in 36% (p<0.001). The length of stay also decreased by 42.8 %. There were no differences in the severity of illness along this period. CONCLUSIONS: Since the establishment of the nosocomial infections surveillance and control program at the INNSZ in 1985, nosocomial infection rates and associated mortality have decreased (56% and 36% respectively). These changes are due to the establishment of the program and the decrease of length of stay and does not seems to be related to the age or to the severity of illness of the patients that attended the Institute during the studied period.

OCCUPATIONAL RISK FOR HEALTHCARE WORKERS: RATES OF EXPOSURE BY JOB CATEGORY AND AREA. Puro V, De Carli G, Petrosillo N, Ippolito G,* SIROH Group. IRCCS "L. Spallanzani", Rome, Italy.

OBJECTIVES: To study the risk of occupational exposures among healthcare workers (HCW) by job category and area. SETTING: 18 Italian acute-care, urban hospitals including infectious disease units, 7 of which are teaching hospitals METHODS: To participate in the study, the presence of an employee health team is required to interview the exposed HCW about circumstances of the exposure, to offer appropriate follow-up, and to record the exposure details in a standard form. Yearly, each hospital is required to provide denominators of resources and activities of the hospital including full time equivalent positions by job category and area. Rates were calculated for those job categories and areas for which both numerator (i.e., occupational exposures) and denominator (i.e., the number of person-years of work) were available. RESULTS: A total of 10,988 percutaneous and 3,361 mucocutaneous exposures were reported. The highest rate of percutaneous exposure was observed among nurses working in general surgery (11%), followed by those working in general medicine (10.6%). The lowest rates were observed among general medicine (1.7%), and laboratory (1%) physicians. The highest rate of mucocutaneous exposure was observed among midwifes (5.34%), followed by dialysis nurses (4.74%). The lowest rate was observed among medicine physicians (0.4%). Infectious diseases nurses have a cumulative 11.31% risk of percutaneous and mucocutaneous exposures. CONCLUSIONS: The risk of exposures relates mostly with the number of procedures performed by job category, and to the type and complexity of care provided in different areas. Cumulatively, risk of exposure by percutaneous and mucocutaneous route is higher in surgical specialties, followed by ICU and dialysis, regardless of job category. Some factors may influence HCW in reporting their exposures: in particular, the rate observed in infectious diseases personnel could be ascribed to a higher awareness for reporting.all exposures, while underreporting of low risk exposures could underestimate the actual exposure rate in other areas.

MULTICENTER NOSOCOMIAL INFECTIONS SURVEILLANCE SYSTEM IN INTENSIVE CARE UNITS IN ARGENTINA: A PILOT STUDY. Quirós RE, Del Castillo M, Efron E, Durlach R, Almada G, Bonafine N, Maimone S, Giuffre C, Laugas S. VEHA group.

BACKGROUND: Nosocomial infections (NI) continue to be an important problem related with in-patient care, especially in intensive care units (ICUs). One of the initial steps in order to control these events is to have precise information through the development of an appropriate surveillance system. OBJECTIVE: To determine the incidence of device-associated (DA) NI in ICUs and to evaluate the impact of interventions implemented in order to have a more effective control. DESIGN AND SETTINGS: Multicenter concurrent surveillance study conducted from Jan 1995 to Jul 1999. In that period, five tertiary care hospitals reported data from their adults medical-surgical ICUs for a median of 42 months (range=14-49). MEASUREMENTS: Data were prospectively collected according to the National Nosocomial Infection Surveillance (NNIS) system protocol, by using a modification of NI definitions from the Ctrs for Disease Control and Prevention. Only those DA infections were registered (e.g., ventilator-associated pneumonia [VAP], urinary catheter-associated urinary tract infections [UTI], and central line-associated bloodstream infections [BSI]). INTERVENTIONS: Based on the epidemiological data, different interventions were implemented in order to reduce the NI rates (e.g., improvement in the handwashing techniques, modifications in the routinely change of the breathing circuits, improvements in the intravascular-catheter site care, etc). RESULTS: During the study period a total of 39,621 patient-days with 762 device-associated NI were registered (20.93 VAP/1000 ventilator-days, 9.40 UTI/1000 urinary catheter-days, and 8.15 BSI/1000 central line-days). Nosocomial pathogens more frequently found related with site-specific infections were Acinetobacter spp (22%) and Pseudomonas aeruginosa (21%) for VAP, Escherichia coli (29%) for UTI, and Staphylococcus aureus (38%) for BSI. While the resistance to ciprofloxacin represented 77% for Acinetobacter

spp, the methicillin resistance was detected in 60% of the S. aureus isolates. The implementation of those control measures allowed to achieve significant reductions (between 6 and 15 episodes/1000 device-days) in 8 of 15 NI rates, with no changes in four and increases in three. CONCLUSIONS: This is the first large study in our country with the use of the NNIS methodology which permitted to obtain a more systematic and reliable results for further comparisons and to start implementing actions referred to this information.

INNOVATIVE MONITORING TOOLS FOR CONCURRENT SURVEILLANCE OF NOSOCOMIAL INFECTION RATES: EXPECTANT SURVEILLANCE AND LINEAR TREND ANALYSIS OF CHARACTERISTICS MEANS CHARTS. Quirós RE, Del Castillo M, Efron E, Durlach R, Bonafine N, Alamada G, Maimone S, Laugas S, Giuffre C. VEHA group, Buenos Aires, Argentina.

Statistical Process Control (SPC) charts are chronological graphs analyzing data based on statistical theory which are easy to use and interpret. However there are two limitations for concurrent monitoring of nosocomial infection (NI) rates, which should be taken into account. First, in order to determine if an outbreak occurred, the data must be evaluated at the end of the month before making a decision. Secondly, as the processes (e.g., varying behaviors, time of the day, case mix, etc.) continuously change it could be difficult to evaluate which is the real trend of an indicator. In an effort to control for these limitations, we have developed two innovative tools. For the first limitation stated above, we developed a graphic model based on expectant surveillance (ES) relating patient-days of exposure and specific NI rates. The upper limits are calculated using the historical data (characteristic mean as baseline). The data are collected in weekly bases, and the NI rate obtained is plotted on a graph. By using prediction rules, an outbreak can be suspected before the end of the month. For the second limitation, we have constructed a graphic model, which plots the updated means for each month, excluding outbreaks (characteristic means), and a trend line as an overall tendency of the process. In order to test these models, we reviewed data relating to device-associated infections, for 189 months obtained from the ICU databases of five facilities between Jan 1995 and Jul 1999. Using 37% of our sample, we developed the prediction rules of our model. The gold standard used was only one of the out-of-control signals based on the traditional SPC charts (one point falling above upper 3 SD control limit). While evaluating the model related to the initial subset of data, the operative characteristics were: sensitivity=100%, specificity = 91.6%, likelihood ratio (LR) + =11.9, LR - =0.0, and overall accuracy=91.7%; in the validation data set the difference in the performance was less than 1%. For those ICUs with at least 36 months of follow-up, the second model allowed us to identify 8 significant reductions, 3 increases, and 1 no-change in the trend of NI rates. These powerful tools may be used to improve the control of NI rates by summing additional data in order to make more appropriate decisions based on time. Finally, these tools should be used as a complement to those presently used.

NOSOCOMIAL BACTEREMIA AT A CANCER CENTER. A FIVE-YEAR EXPERIENCE. Sandoval S, Vilar-Compte D, Gordillo P, De la Rosa M, Garcia B, Volkow P. Instituto Nacional de Cancerología, México.

The extended use of central venous lines is one of the main factors for developing NB. Quantifying the occurrence of catheter-related nosocomial bacteremia (CRNB) offers the unique possibility to evaluate the handling of central lines within the hospital and to establish preventive policies. There is an intravenous therapy team (IVTT) at our hospital working since 1987, using a protocol of maximum barrier for the care of all central lines within the hospital. Thus we have proposed a classification of NB, separating CRNB from primary NB. CRNB is described as a patient with a central venous catheter in place and no source of sepsis and at least two of the following criteria: A) positive blood culture obtained through the catheter and peripheral puncture with the same microorganism; B) same pathogens isolated from blood and catheter tip culture; C) sepsis refractory to antimicrobial therapy; D) improvement with catheter removal; and E) sepsis remission with specific antimicrobial therapy and negative blood cultures obtained through the catheter. RESULTS: During the study period 4,247 patients had blood-cultures drawn (11.3% of all hospital admissions). 437 NB were identify in 368 patients; 304 (69.5%) were primary NB, 76 (17.4%) were secondary NB, and 57 (13.04%) CRNB. NB incidence rate per 100 admissions was 1.16; primary NB 0.8, secondary NB 0.2, and CRNB 0.15. The most common pathogens isolated from each type of bacteremia were: E. coli 58 (17.1%), E. cloacae 32 (9.5%) and S. epidermidis 32 (9.5%) for primary NB, E. coli 17 (19.5%), P. aeruginosa 12 (13.8%) and E. clocae 8 (8.2%) for secondary NB and S. epidermidis 14 (22.6%), S. aureus 6 (9.7%) and C. tropicalis 4 (6.4%) for CRNB. Eighty-nine (24.2%) patients died. Infection contributed to death in 51 (57.3%), in 28/58 (48.3%) in patients with primary NB, in 17/24 (71%) patients with secondary NB, and 6/7 (85.6%) with CRNB. The main type on NB was primary probably related to the type of patients attended in this hospital. The frequency of NB is in the lower level reported in literature.

INTERHOSPITAL DIFFERENCES IN NOSOCOMIAL INFECTION RATES-THE SECOND SWISS NOSOCOMIAL INFECTION PREVALENCE STUDY. Sax H.* fSwissNOSO network, Univ of Geneva Hosps, Switzerland.

BACKGROUND: Nosocomial infection (NI) prevalence was assessed in 4 Swiss hospitals for the first time in 1996 (Pittet, ICHE 1999;20:37). We repeated the survey in 1999 including additional hospitals and investigated the possible relation between NI rates and infection control (IC) programs and hospital characteristics. METHODS: A period-prevalence study conducted in Apr 1999 including the 5 teaching and 13 additional representative Swiss hospitals. Hospitals were classified according to their size: <200 beds (9); 200-500 beds (4); >500 beds (5) and further characterized using a microbiology diagnostic index, average length of stay (LOS) at time of study, and IC program characteristics. All adult acute care wards were included except dermatology, ophthalmology, ENT, gynecology-obstetrics, bone marrow transplant, and burn units. Nis were defined according to Ctrs for Disease Control and Prevention (CDC) criteria. Variables used for case-mix adjustment included LOS, admission diagnosis, co-morbidities (Charlson and MacCabe indexes), exposure to antimicrobials, invasive devices, and procedures. Data collection was standardized and completed by local IC personnel trained and coached by experienced IC staff, before and during the study. Extensive data check was performed. RESULTS: Overall, out of 4,077 patients, 424 had at least one NI (prevalence 10.4%) and 464 infections were reported (infection ratio, 1/1.1). NI prevalence varied significantly by hospital size (<200 beds: 7.6% [CI95 6.1-9.5]; 200-500 beds: 11.3% [CI95 9.5-13.3]; >500 beds: 11.3% [CI95 10.0-12.8]; p=0.0043). Evidence for the possible impact of case mix, IC and hospital characteristics on NI rates will be presented. CONCLUSIONS: We found significantly higher unadjusted NI prevalence rates in large and medium size compared to small hospitals. Case-mix adjustment using different confounding variables is necessary before conducting comparison of infection rates.

CONTROL OF NOSOCOMIAL LEGIONELLOSIS: TAILORING THE CONTROL METHOD TO THE FACILITY. Sellick JA. SUNY at Buffalo, Buffalo General Hosp./KALEIDA Health and VA Western New York Healthcare System at Buffalo, Buffalo, NY.

The best method for control of nosocomial (N) legionellosis is controversial but local experience argues for flexibility. Buffalo General Hosp (BGH) is a tertiary-care teaching hospital; the current patient care building opened in 1986 and utilizes a tankless instantaneous water heater (IWH). State guidelines mandate that hot water at the tap be less than 120°F. A case of N Legionella pneumophila (Lp) serogroup (sg) 3 pneumonia occurred in 6/90; a superheat/flush was performed but three additional cases occurred by 7/93. Lp strains were genetically identical by pulsed field gel electrophoresis to water system isolates and there were no opportunities for airborne exposure to Lp. The health dept. allowed water temperature to be raised to 132°F and there have been no further N Lp cases identified. Surveillance cultures in the areas served by the IWH have remained negative. The Buffalo VAMC was built in 1949; there is a hot water tank and pipes are heavily scaled. N Lp sg 1 cases were identified in 1984 and several attempts at control using superheat/flush were unsuccessful. An average of 4.0 (SD=2.3, range 0 8) cases/yr occurred 1984 95. In 2/96, a silver/copper ionization system (Tarn-PureT, LiquiTech Inc., Burr Ridge, IL) was installed. Ion levels are monitored and electrodes serviced according to company recommendations. All environmental surveillance cultures except one (single colony, 7/96) have been negative and no N Lp cases have been identified since installation. Local experience shows that eradication of Lp from potable water eliminated N legionellosis. Superheat/flush does not provide long term control but elevated hot water temperature may be useful in a newer, tankless system. Silver/copper ionization appears to be effective in an older system.

INTRODUCTION OF INTENSIVE CARE ANTIMICROBIAL RESISTANCE EPIDEMIOLOGY BASED SURVEILLANCE TO A REGIONAL GENERAL INTENSIVE CARE UNIT IN THE UNITED KINGDOM. Smyth ETM, Webb CH, Barr JG, Lowry K, O'Hare J, McIlvenny G. The Royal Hosps, Belfast, Northern Ireland.

In the UK there has been great concern expressed regarding the general increase in antimicrobial resistance. Since we already employed the National Nosocomial Infections Surveillance (NNIS) System intensive care unit (ICU) component in our 14-bed regional general ICU, we decided to pilot the Project ICARE (Intensive Care Antimicrobial Resistance Epidemiology) Phase 2 methodology to assist in the monitoring of antimicrobial use and resistance over a 12-month period. Project ICARE was developed by CDC's Hosp Infections Program, in cooperation with the Rollins School of Public Health at Emory Univ, Atlanta, Georgia, USA. There are no established accepted UK national criteria for nosocomial infection (NI) or antimicrobial resistance surveillance. In the UK, comparison between data published by different bodies is therefore impossible. National Nosocomial Infections Surveillance System scoring criteria were used to enable comparison with NNIS data from medical/surgical ICUs. Automated data entry of completed NI questionnaires was employed (Formic Ltd., London UK). The Pharmacy Department supplied data on the use of antimicrobial agents over the study period. Antimicrobial use was expressed as multiples of the defined daily dose (DDD) per 1000 patient-days for that particular agent. Device utilization ratios were all above the 90th percentile for a medical/surgical ICU (based on NNIS semi-annual report from Oct 1986-Apr 1997). There were 111 infections during 4,402 patient days giving an overall infection rate of 25.2 per 1000 patient days. Average length of stay was 8.9 days. Infection rates per 1000 device days were; urinary tract (catheter associated) 5.1 (50th-75th percentile); bloodstream (central line associated) 9.0 (>90th percentile); and ventilator-associated pneumonia 13.3 (50th-75th percentile). There were marked differences in the use of antimicrobials when compared with published ICARE data.

DATA COLLECTION WITH A PALM COMPUTING PLATFORM AND STATISTICAL ANALYSIS USING CONTROL CHART METHODS. Stackelroth JL, Sartor AL, Curtis MD, Morton AP, Whitby M. Princess Alexandra Hosp, Brisbane, Australia.

Surveillance of healthcare acquired infection forms one of the cornerstones of modern infection control practice. It is however time consuming and labor intensive. In Australia it has traditionally been performed with manual collection of data on paper forms followed by manual data entry into one of a number of databases. We have recently developed a specialised tool for the collection, organisation and structured analysis of healthcare acquired infection surveillance data. Infection Control Assessment Technology (ICAT) consists of a Palm device with a data collection program that synchronises with a Microsoft Access 97 customised relational database. This has resulted in user customised data collection and report format, internal quality assurance, ability to interface with patient management information systems, appropriate data analysis with significance testing and confidence intervals for rates and proportions, and automatic implementation of control charts. Reducing healthcare acquired infections depends on improving infection control systems and processes. Data are collected and analysed to gauge the response to process changes and the result of the analysis are then fed back to effect further improvement. Infection data must be collected and analysed to establish baseline rates and to detect increases in baseline rates. Control charts are a very useful method for summarizing such data sequentially. Excessive infections may be due to special cause or common cause problems. Each tends to produce a different pattern and different control chart methods are more efficient for each type of problem. For common cause problems the cumulative sum (CUSUM) and Exponentially Weighted Moving Average (EWMA) charts are more efficient. For special cause problems, the standard Shewhart control chart for proportion or count data and the Bourke's interval method chart is preferred. Each control chart method is described and illustrated with infection control data.

SURGICAL SITE INFECTION RATES BY OPERATIVE AND RISK INDEX CATEGORY IN BRAZILIAN HOSPITALS. Starling CEF, Couto BRGM, Pedigone MC, Gomes L, Jaciara M. Vera Cruz, Felicio Rocho and Baleia Hosps, Belo Horizonte, Brazil; Santa Casa de Franca, Franca, Brazil; Getulio Vargas Hosp, Manaus, Brazil; Casa de Caridade Manoel Moreira, Brazil.

OBJECTIVE: In this study we calculate Surgical Site Infection (SSI) rates to be used in interhospital comparisons in Brazilian hospitals. METHODS: Analysis of NI data obtained by applying the surgical patient surveillance component of the National Nosocomial Infection Surveillance (NNIS) system. This is a multicenter volunteer study enrolling 7 hospitals from 3 Brazilian regions, with data from Jan/97 to Oct/99. The patients were stratified by the NNIS operative and risk index category. RESULTS: We analyzed 22 NNIS operative categories totaling 26,056 procedures with 633 SSIs (2.4%). The SSI rate by NNIS risk index was: index 0=164/15,600=1.1%; index 1=295/8,383=3.5%; index 2=135/1,841=7.3%; index 3=39/232=16.8% ($p < 0.001$). The SSI rates were calculated by oper-

ative and risk index category (R0, R1, R2 and R3). The results for the most frequent procedures are as follows: Vascular surgery: R0=7/1,709=0.4%; R1=30/967=3.1%; R2=23/240=9.6%; R3=not available (NA). Colon surgery: R0=4/796=0.5%; R1=28/848=3.3%; R2=24/195=12.3%; R3=8/37=21.6%. Herniorrhaphy: R0=10/2879=0.3%; R1=9/457=2.0%; R2,R3=4/72=5.6%. Mastectomy =R0,R1=7/986=0.7%; R2,R3 =2/25=8.0%. Open reduction of fracture: R0=30/1,458=2.1%; R1=27/625=4.3%; R2,R3=2/118=1.7%. Cholecystectomy: R0=5/386=1.3%; R1=8/243=3.3%; R2=4/75=5.3%; R3=2/16=12.5%. Craniotomy: R0=12/457=2.6%; R1,R2,R3=45/734=6.1%. Cardiac surgery: R0=0/149=0.0%; R1=16/362=4.4%; R2,R3=21/243=8.6%. Prostatectomy: R0=2/148=1.4%; R1=6/285=2.1%; R2,R3=3/171=1.8%. CONCLUSION: The SSI rates identified in this study are an important tool for interhospital comparison in Brazilian hospitals. The rates will probably change with the inclusion of other hospitals in future analysis.

BENCHMARKS FOR NOSOCOMIAL INFECTION IN MEDICAL AND SURGICAL INTENSIVE CARE UNITS IN BRAZIL. Starling CEF, Couto BRGM, Pedigone MC, Gomes L, Mattos E, Maio C, Laura M. Felicio Rocho Hosp, Belo Horizonte, Brazil; Sao Francisco de Assis Hosp, Belo Horizonte, Brazil; Santa Casa de Franca, Franca, Brazil; Getúlio Vargas Hosp, Manuas, Brazil; Santa Casa de Londrina, Londrina, Brazil; Hosp Universit rio de Londrina, Londrina, Brazil; Mae de Deus Hosp, Porto Alegre, Brazil.

OBJECTIVE: In this study we proposed benchmarks for nosocomial infection (NI) data to be used in interhospital comparisons of medical and surgical intensive care units (ICUs) from Brazilian hospitals. METHODS: Analysis of NI data obtained by applying the adult and pediatric ICU surveillance component of the NNIS system. This is a multicenter volunteer study enrolling 9 ICUs from 5 Brazilian regions, with data from Jan/96 to Oct/99. We calculated ALOS=average length of stay (days); ASIS=average severity of illness score; CLU=central line utilization=central line-days/patient-days * 100; UCU=urinary catheter utilization=urinary catheter-days / patient-days * 100; VU=ventilator utilization=ventilator-days/patient-days * 100; catheter-associated urinary tract infection rate (UTI/1,000 urinary catheter-days); central line-associated cardiovascular infection rate (CVS/1,000 central line-days); central line-associated bloodstream infection rate (BSI/1,000 central line-days); ventilator-associated pneumonia rate (PNEU/1,000 ventilator-days). Benchmarks [min; max] were defined as the 10th and 90th percentiles, respectively. RESULTS: 1,995 Nis were reported; 43% pneumonia, 17% UTI, 9% CVS, 6% BSI, 6% skin and soft tissue, 4% eye, ear, nose, and throat infection, 3% gastrointestinal and 11% other infections. Benchmarks proposed: ALOS=[4; 15]; ASIS=[3.0; 3.5]; CLU=[31; 63]; UCU=[38; 67]; VU=[31; 80]; UTI=[4.0; 12.6]; CVS=[1.7; 16.8]; BSI=[0.0; 2.4]; PNEU=[3.6; 39.4]. CONCLUSION: The proposed benchmarks for ICUs can be used for interhospital comparison in Brazil, although the limits will probably be changed with inclusion of others ICUs in future analysis.

MULTICENTER STUDY OF THE DEFINITIONS OF NOSOCOMIAL INFECTIONS. Starling CEF, Couto BRGM, Pinheiro SMC. Felicio Rocho, Sao Francisco de Assis, Vera Cruz Hosps, Belo Horizonte, Brazil; Felicio Rocho Hosp, Belo Horizonte, Brazil.

INTRODUCTION: In 1991, we started to apply the National Nosocomial Infection Surveillance (NNIS) system proposed by the Centers for Disease Control and Prevention (CDC) in three Brazilian hospitals. Data collection was made prospectively according to the NNIS protocol, using nosocomial infection (NI) definitions of the CDC (1988/92). In the followings years the infection surveillance and control team (about 20 people) went to other hospitals and now these people work in 10 hospitals in the metropolitan area of Belo Horizonte, Brazil. Despite all training about NI diagnosis and the fact that we have weekly meetings and extensive discussions on NI case definitions, we never evaluated the accuracy of our NI diagnoses process. OBJECTIVE: To analyze the performance of an infection control team in diagnosing NI. To calculate sensitivity (Se) and specificity (Sp) for each professional and to determine the predictive value of a NI positive diagnosis (PV+) and the predictive value of a NI negative result (PV-) according to some NI prevalence. METHODS: We used 35 case studies produced by the Association for Professional in Infection Control (APIC) research committee. An answer sheet sent us by the CDC hospital infection program was our gold standard. Besides the Se, Sp, PV+ and PV- results, we calculated the accuracy (Ac) in diagnosing NI (including the major NI site) according to the gold standard. For the PVs we used an NI prevalence of 5%. RESULTS: 15 people participated in this phase of the study. The maximum and minum results were: Se (%)=65 to 91; sp (%)=33 to 83; Ac (%)=57 to 86; PV(+)=5 to 22%; PV(-)=95 to 99%. CONCLUSION: All nurses who have surveillance as their main activity had a very good performance in diagnosing NI, except one nurse who is out of work more than a year. We do recommend this kind of evaluation to all people who work with NI at least once a year.

CENTRAL VENOUS CATHETER INFECTION RATES IN A PEDIATRIC CANCER POPULATION. Stone S, Abdel Malak S, LaQuaglia M, Boulad F, San Miguel L, Eagan J, Sepkowitz KA. Memorial Sloan-Kettering Cancer Center, New York, NY.

OBJECTIVES: Numerous studies have defined rates and risks for central venous catheter (CVC) complications in adults. Few studies have focused on the pediatric population. We therefore sought to determine the incidence and associated risk factors of CVC complications in a pediatric cancer population. METHODS: As part of the MSKCC CDC EpiCenter program, a 1-year prospective study of complications (infection, malfunction, clot) in pediatric CVCs was initiated Jul 1, 1998 (n=195). Patients were identified via communication with surgery (MLQ). Catheter placement was verified by surgery and radiology reports using the MSKCC computerized database (Disease Management System, or DMS). All patients and their families were interviewed by an infection control practitioner (ICP) to determine method of catheter care. Additional variables, including demographic information, type and stage of disease, device history, current oncologic treatment, microbiology and lab data were gathered by the ICP and via the MSKCC Clinical Research Database (CRDB). For the analysis, patients were grouped into three broad disease categories (solid, liquid, or other tumors). RESULTS: From Jul 1, 1998, to Jun 30, 1999, 195 catheters were placed into 165 patients (145 Broviac-Hickmans and 50 implantable ports) comprising 34,551 catheter days (as of Nov 1, 1999); 66 catheters (33.8%) were removed due to infectious or mechanical complications. Incidence of infections was twice as great in patients with a Broviac-Hickman vs implantable ports (2.79/1000 vs 1.33/1000). CONCLUSIONS: Children with cancer have central venous catheter complication rates similar to adults with cancer. The ongoing study will allow identification of specific associations that carry a higher complication rate. This hopefully will lead to the development of effective interventions.

ELECTRONIC CHART REVIEW AS AN AID TO POST DISCHARGE SURGICAL SITE SURVEILLANCE: INCREASED CASE FINDING. Sturm L, Friedman C, Chenoweth C. Univ of Michigan Hosps and Health Centers, Ann Arbor, MI.

BACKGROUND: Various methodologies are used to increase surgical wound infection (SSI) case finding for discharged surgical patients, including surgeon or patient questionnaire, antibiotic usage, telephone interviews, and outpatient electronic chart review. At the Univ of Michigan Hosps and Health Centers there has been increased use of an electronic medical record. Since orthopedic surgeons dictate all outpatient visits to the patient's electronic record, total knee arthroplasties (TKA) were chosen to determine if use of the electronic record increased case finding. METHODS: All patients who underwent a TKA during the study period (1996-98) were followed prospectively using the NNIS definitions. Traditional surveillance methods (culture reports, readmissions, etc.) were used to ascertain infections. In addition, each patient's post discharge outpatient clinic chart was reviewed electronically for one year postoperatively. RESULTS: From 1996-98, 417 procedures were performed. Twenty two TKA infections were identified postoperatively, resulting in an average wound infection rate of 5.3 (risk indices 0-2). If electronic chart review had not been used, the rate would have been 1.7% (p=.004). The comparative NNIS rate is 0.9-2.0. The use of the electronic chart review post discharge surveillance revealed 15/22 (68%) of the infections that would not have otherwise been identified using traditional surveillance methods. CONCLUSION: The post discharge electronic chart review enhanced case finding significantly, resulting in a more accurate infection rate. However, awareness should be given to the institutions' surveillance methodology and intensity when comparing to published rates.

EPIDEMIOLOGIC PROFILE OF NOSOCOMIAL INFECTIONS IN MEXICO. Tapia-Conyer R, Alvarez-Lucas C, Rangel-Frausto MS,* Ponce de León-Rosales S, Kuri-Morales P, Montiel-Perdomo J, Gómez-Valdés H. General Management of Epidemiology, Mexico City; Mexico National Institute of Nutrition, Mexico City, Mexico.

BACKGROUND: So far, Mexico's nosocomial infection (NI) profile has been largely inferred from isolated reports. In order to obtain a more accurate perspective of this problem, a nationwide hospital surveillance net was recently created. OBJECTIVES: To determine the Mexican NI epidemiologic profile. METHODS: A multicentric study was carried out from Jan. '97-Jul '98 which included 77 secondary and tertiary care centers. Standardization of operative definitions, surveillance, data gathering and notification were carried out. Information was analyzed by sex, age, geographic area, infection site, microorganism, hospital type, mortality and lethality. RESULTS: A total of 17,865 cases of NI were identified, with incidence rates of 1.7 patients and 2.1 events/100 admissions. These rates were highest in Mexico City with a 4.4/100 admissions rate. The most frequent infection sites were pneumonia and UTI with 3.1 and 2.9/1000 admissions rates, respectively. Of these, pneumonias were associated with greater mortality, followed by UTI and wound infections. Lethality varied from 13.0 in pediatric hospitals to 18.6 in hospitals with 100 or more beds; it was greatest in the North with 16.8%, followed by the central states with 15.8%. The most frequently isolated germs were P. aeruginosa and K. pneumoniae as cause of pneumonia and E. coli and Candida as causes of UTI. The services with higher risk of NI were Internal Medicine (IM) and General Surgery (GS) with 3.3 and 2.1/100 admissions, respectively. Associated mortality was 11.1, 5.4 and 3.4/100 admissions for IM, Pediatrics and GS, respectively. CONCLUSIONS: 1) The magnitude of the NI problem is evidenced by its high lethality and excess hospital stay; 2) most NI can be related to specific interventions; 3) this is the first study to show the national epidemiologic NI profile in Mexico and their potential impact on healthcare indicators and costs.

ASPERGILLUS IN HOSPITALIZED PATIENTS. Taylor GD, Buchanan-Chell M,* Kirkland T, McKenzie M, Wiens R. Univ of Alberta Hosp, Edmonton, Alberta, Canada.

OBJECTIVE: Aspergillus can cause invasive infection in immunocompromised patients producing significant morbidity and mortality. We have collected prospective data on Aspergillus in hospitalized patients since 1993 to detect nosocomial acquisition of invasive aspergillosis (IA). METHOD: Cases were detected by monitoring laboratory isolates, and defined as patients from whom Aspergillus species was grown in culture while in our hospital between May 1993 and Dec 1998. IA was defined as a case with clinical evidence of infection and histologic or radiographic evidence of organ system involvement. Pathology reports and Health Records discharge diagnoses were retrospectively reviewed to determine whether these sources would improve IA case finding. RESULT: There were 215 Aspergillus cases. Range by calendar month was 10-26, no seasonal variation. Range by year was 12-54, no trend in frequency. Speciation was performed in 204. A. fumigatus accounted for 51.5% of all cases, A. versicolor 12.3%. In IA cases, 60% were A. fumigatus and 15% A. flavus. There were 25 episodes of IA all in immunocompromised patients (17 pulmonary disease, 3 sinusitis, 5 multiple sites); 5 cases diagnosed at autopsy; 9 (36%) were nosocomial. The underlying cause of immunocompromise was hematologic disease (15), solid organ transplantation (5) and other conditions (5). IA developed in 0.5% of solid organ transplant recipients (5/936). Most IA cases (84%) were detected by microbiology lab report. 11 different antifungal therapy combinations were given to 23 IA patients. The IA hospital mortality rate was 60%; 80% in cases with multiorgan infection. CONCLUSION: IA is a rare condition in our hospital population but has very high mortality. The wide range of antifungal therapies given to our patients suggests is considered satisfactory. IA case finding by infection control programs is efficiently carried out by monitoring of laboratory isolates.

A NETWORK FOR SURVEILLANCE OF NOSOCOMIAL INFECTION IN MATERNITY WARDS. Tissot Guerraz F, Girard R, Haond C, Vanhems P, Pinzaru G, Ronnaux-Baron AS. Hôpital Edouard Herriot, Lyon, France.

OBJECTIVE: Collect of information concerning nosocomial infections. METHODS: We have created in 1995 a network including 25 to 32 voluntary maternity wards, from South-East France. Each maternity ward has to collect all the items concerning nosocomial infections during, at least, 4 months. Results: 32 maternity wards have participated totaling 13 539 vaginal deliveries and 2,950 caesarian sections. The incidence of nosocomial infections (NI) for vaginal deliveries is 1.9 %, (endometritis 32%, UTI 28%, episiotomy infection10%). The incidence of NI in caesarian sections is 7.9% (UTI 33%, SWI 29%, endometritis 12%.

Risk factors correlated with nosocomial infections after caesarean section (multivaried analysis)

Risk factors	N (%)	Adjusted odd-ratio	IC 95 %	p
Hyperthermia	99 (3,4 %)	2,1	1,2 - 3,9	0,02
Emergency caesarean section	1207 (41,7 %)	1,5	1,1 - 2,0	0,003
No antibioprophylaxy	1097 (37,6 %)	1,8	1,4 - 4,4	0,0001

EPIDEMIOLOGIC EVIDENCE OF INTERHOSPITAL TRANSMISSION OF IMIPENEM-RESISTANT ACINETOBACTER SPP. INFECTIONS. Toscano CM, Fridkin SK, Edwards JR, Jarvis WR, Gaynes RP. Ctrs for Disease Control and Prevention, Atlanta, GA.

To determine if imipenem resistance among Acinetobacter spp. (AS) is increasing, we reviewed National Nosocomial Infections Surveillance (NNIS) system data for 1989-99. Overall, 389 (8.9%) of 4,352 AS isolates were reported as resistant to imipenem. Since 329 (84.6%) of these imipenem-resistant AS (IRA) were from infections in intensive care unit (ICU) patients, we focused our analyses on NNIS ICU component data. Of 2,909 AS isolates from ICU patients, 248 (8.5%) were IRA. The percentage of AS isolates that were IRA increased from 4.7% (during 1989-91) to 11.9% (1998-99) (p<0.001). Of the 244 NNIS hospitals reporting ICU component AS infections, one (Hosp A) accounted for 108 (43.5%) of all IRA isolates. ICUs in hospitals located 20 miles from Hosp A (Area B; 22 hospitals) reported a greater proportion of IRA than did ICUs in hospitals located >20 miles from Hosp A (Area C; 221 hospitals) (15.7% vs 2.9%, p<0.001). In a logistic regression analysis, we demonstrated that during 1989-91 AS isolates from Hosp A were significantly more likely than isolates from any other hospital to be IRA (Odds ratio (OR)=3.7, p<0.001). In addition there was a stepwise increase in the likelihood of being an IRA during 1992-97 (OR=3.5, p<0.001) and 1998-99 (OR=11.0, p<0.001) in Hosp A. A similar but smaller increase occurred in Area B during 1992-97 (OR=4.3, p<0.001) and 1998-99 (OR 14.1, p<0.001). Our data suggest that interhospital transmission of IRA isolates may be occurring from Hosp A to hospitals located in Area B. Potential transfer of antimicrobial-resistant pathogens among hospitals in a community should be taken into account when attempting to control transmission of these antimicrobial-resistant pathogens.

TEN YEARS OF NOSOCOMIAL INFECTION CONTROL WITH GLOBAL SURVEILLANCE AT A BRAZILIAN UNIVERSITY HOSPITAL. Trabasso P,* Tresoldi AT, Branchini MLM, Dantas SRPE, Padoveze MC, Reginato L, von Nowakonski A. Nosocomial Infection Control Committee, Campinas State Univ, Campinas, Brazil.

OBJECTIVE: To assess data from global surveillance of nosocomial infection (NI). METHODS: Descriptive study of surveillance of NI performed in a teaching, 403 beds, acute, 3rd care hospital, with Global Surveillance of NI from 1987 to 1997. RESULTS: The global incidence mean of NI was 9.6%, with a increase to 12.98% in 1992, when Methicillin-resistant Staphylococcus aureus (MRSA) was introduced into surgical units and rapidly spread. After controlling this outbreak, annual incidence of NI returned to basal values (mean=8.2%). NI were more common in Bone Marrow Transplant (BMT, 43.6%) ward; Med-surgical Intensive Care Unit (MSICU, 30.5%); Pediatric Intensive Care Unit (PICU, 26.3%); Med Intensive Care Unit (16.8%), Trauma Unit (16.6%) and Surgical Intensive Care Unit (SICU, 14.6%). Vascular Surgery, Infectious Disease, Nephrology, Neurology and Urology showed risk varying from 6.9% to 9.8% and were classified as mild risk. Gastroenterology (3.2%), Lung Diseases (1.7%), Oncology (1.6%), Cardiology (1.5%), and Endocrinology (1.3%) were classified as low risk. Surgical wound infection (SWI, 21.1%) and ventilator-associated pneumonia (VAP, 20.1%) were the most frequent NI, followed by urinary tract Infection (UTI, 17.3%) and blood stream infection (BSI, 11.9%). Acinetobacter baumanii caused 29.3% of NI in MSICU and 28.8% in SICU, while S. aureus caused 27.8% of NI in PICU and S. epidermidis 16.2% of NI in BMT. Escherichia coli (16.2%), Pseudomonas aeruginosa (14.5%) and Klebsiella pneumoniae (10.3%) were de most frequent pathogens for UTI. Enterococcus faecalis (13.2%), Enterobacter cloacae (13.2%), P. aeruginosa (12.3%) and A. baumanii (12.3%) were the most important pathogens for SWI. Only 7.4% of VAP had etiologic agent in our series (A. baumanii, 21.7%; P. aeruginosa, 17.4%). Despite the difficulty that global surveillance has to compare data from different settings, it was important to knowledge of characteristics of our hospital and contributed to change surveillance methods to prevalence for low risk wards and to the methodology by components in high risk units.

IMPLEMENTATION OF NOSOCOMIAL INFECTION SURVEILLANCE BY METHODOLOGY OF COMPONENTS AT A BRAZILIAN UNIV HOSPITAL. Trabasso P,* Tresoldi AT, Dantas SRPE, Padoveze MC. Nosocomial Infection Control Committee, Campinas State Univ, Campinas, Brazil.

OBJECTIVE: To assess data from surveillance in our hospital and to compare with National Nosocomial Infection Surveillance (NNIS) System. METHODS: the methodology was implemented in Jan 94 in medical intensive care unit (MICU, 18 beds), pediatric intensive care unit (PICU, 10 beds) and med-surgical intensive care unit (MSICU, 8 beds) of a teaching, acute and 3rd level care hospital. Diagnostic of nosocomial infection (NI), patients-day, device-day, device utilization ratio and device-associated infection rates were made according NNIS System. NNIS System Report (1998) was used as reference for comparative values. Results: There were *11,828 patients-day in MICU, 13,253 patients-day in PICU* and 6,148 patients-day in MSICU. Urinary Catheter (UC) utilization mean was in percentile 10% in MICU (0.43), in the median in PICU (0.25) and outlier in MSICU (0.94). Central Line (CL) utilization mean was in the median in MICU (0.39), in percentile 90% in PICU (0.62) and outlier in MSICU (1.14). Ventilator utilization mean was in percentile 10% in MICU (0.22), in percentile 90% in PICU (0.65) and outlier in MSICU (0.73). UC-associated Urinary Tract Infection (UTI) rate was in percentile 75% in MICU, outlier in PICU and in percentile 25% in MSICU. CL-associated Blood Infection (CLAB) rate was in percentile 25% in MICU, in percentile 75% in PICU and outlier in MSICU. Ventilator-associated pneumonia (VAP) rate was in percentile 90% in MICU, in the median in PICU and outlier in MSICU (TABLE 1). There were no changes in ratios and rates throughout the years. CONCLUSION: It is necessary an improvement of NI control measures in MSICU, since almost all its indicators are around percentiles 90% or even outliers. Despite its VAP rate under the median, PICU needs an improvement of UTI control measures. Methodology by components is an helpful way to compare data from different hospitals.

Device-associated infection rates

	UC-Days	UC-associated UTI rate	CL-Days	CLAB rate	Ventilator-Days	VAP rate
MSICU	5,771	3.0	7,024	9.2	4,489	18.0
PICU	3,241	14.4	8,350	11.1	7,819	2.1
MICU	5,192	9.5	4,604	3.7	2,796	14.8

TRENDS IN PRIMARY BLOODSTREAM INFECTIONS ASSOCIATED WITH CANDIDA SPP IN THE US. Trick WE, Fridkin SK, Edwards JR, Gaynes RP. NNIS System, Ctrs for Disease Control and Prevention, Atlanta GA.

Candida spp (C spp) are the fourth most common cause of nosocomial bloodstream infection (BSI). We evaluated BSI associated with any C spp reported to the NNIS system during 1989-99. Regardless of patient age, most (70%) BSI with C spp reported to the NNIS system occurred in an intensive care unit (ICU) or high risk nursery (HRN). Of all C spp BSIs in which the species was reported, C. albicans (CA) (54%) was most common, followed by C. parapsilosis (CP) (18%), C. tropicalis (CT) (9.8%), C. glabrata (CG) (9.6%), C. krusei (CK) (1.7%). A higher proportion of CP was reported among neonates (age <30 days) compared to adults (>16 years) (36% vs 13%; p<.01). Incidence was determined by pooling C spp BSIs and central line-days (CL-days) for each year and each hospital with a HRN or ICU reporting. In HRNs, the overall incidence of BSI with C spp remained stable from 1989-99 (4.7 per 1000 CL-days). However, there was a significant decrease in the rate of BSI with C spp among newborns under 1.5Kg (9.3-7.0 per 1000 CL-days; r=-.9, p=.002). In adult ICUs, the incidence of BSI with C spp decreased from 5.4-3.9 BSI per 1000 CL-days from 1989-99 (r=-.68, p<.001) despite increased BSI with CG (0.1 to 0.4 BSI per 1000 CL-days; r=.8, p=.002); the incidence of BSI with other non-albicans C spp did not significantly change over time. However, the incidence of BSI with C spp varied significantly by type of ICU (p<.001). Controlling for type of ICU, CA BSI significantly decreased about 5% per year (p<.001). In adult ICUs in the NNIS system, the incidence of C spp BSIs per 1000 CL-days is decreasing. This drop is due to decreased rates in CA BSI, whereas CG BSI is becoming more frequent. In HRNs, incidence of C spp BSI has decreased only in neonates <1.5 kg. Although CP BSI is very common in HRN, the incidence of non-albicans C spp has remained stable over time.

PREVALENCE OF NOSOCOMIAL INFECTIONS IN SPAIN (EPINE STUDY, 1990-98). Vaque J, Rossello J, Trilla A, Arribas JL, Caballero JG, EPINE Working Group. EPINE Working Group, Barcelona, Spain.

A serial prevalence survey of nosocomial infections (EPINE study) has been conducted yearly in Spanish hospitals since 1990. On a voluntary basis, acute care hospitals (<50 beds) are eligible for the study. In 1990, a total of 123 hospitals joined the study, and in 1998 the number rose to 224 (80% of all hospitals). A core sample of 50 hospitals participated in all studies. The aim of the EPINE study is to provide all participating centers with a common set of definitions and methods to collect data across the country. Data are gathered at each institution by the Infection Control Team in May, double-checked, validated and submitted to a central data processing unit for analysis. RESULTS: Overall prevalence rate of patients with nosocomial infections was 7% in the last four years. There has been a significant decrease from the initial 8.4% rate (test for trend, p<.001). The prevalence rate of UTI and SSI has decreased over time, and the prevalence rate for LRI and BSI has increased (test for trend, p<.001). Prevalence rate of nosocomial infections increased over time in the UCI's. Mean age of admitted patients also increased, together with the proportion of patients with intrinsic and extrinsic risk factors. Of note, the proportion of patients with either a very short or very long ALOS increased, with a likely effect in lowering the nosocomial infection rate. The prevalence of antimicrobial agents use increased from 33.8% in 1990 to 36.6% in 1998 (test for trend, p<.001). In summary, the EPINE study has proved to be an important tool for fostering Infection Control practice in Spain, and it is unique also as the largest and longest serial prevalence survey conducted in Europe. The prevalence rate of nosocomial infections seems to have reached a steady state in Spain, and therefore new reinforcement of infection control measures is needed.

HIGH COMPLICATION RATES AMONG CANCER PATIENTS WITH PERIPHERALLY INSERTED CENTRAL CATHETERS. Walshe LJ, Abdel Malak S, Velazquez I, Eagan J, Sepkowitz KA. Department of Nursing, Memorial Sloan-Kettering Cancer Center, New York, NY.

BACKGROUND: The increase toward briefer hospitalizations has lead to more intravenous therapies being delivered in the outpatient setting, often by use of PICCs. More than 250 MSKCC patients receive PICCs annually, yet we knew little of the rates or risks for complication. Because patients with PICCs often receive treatment as outpatients, we needed to develop new methods of infection control surveillance for the outpatient domain. DESIGN AND OBJECTIVES: One-year prospective observational study to determine the incidence and risk factors of PICC-related complications. METHODS: All PICCs inserted in adult patients at MSKCC, a 434-bed tertiary care cancer center in New York City, were identified and followed prospectively. Data was collected using three standardized data collection forms: insertion form, inpatient follow-up and care form, and outpatient follow-up and care form. RESULTS: 291 PICCs were inserted into 257 patients during the study period for a total of 11,013 catheter days (median 16 days, range 0-322 days). 76 home-care companies, representing 140 separate units, were contacted to follow-up patients with a PICC. 92 PICCs (31.6%) were removed due to complications, a rate of 8.35/1,000 catheter days. 48.9% of complications were infection-related (45 PICCs, 4.08/1,000). Other complications were due to leakage/broken catheters (14 PICCs, 1.73/1,000), accidental removal/malfunction (19 PICCs, 1.73/1,000) and sluggish/occlusion/thrombosis (14 PICCs, 1.27/1,000). In univariate analysis PICC-related complications occurred more frequently among patients whose PICCs were inserted by the IV team compared to interventional radiology staff, 41.5% vs 24.2%, p<0.002. CONCLUSIONS: Complications occur frequently among cancer patients with PICCs. Incidence of compli-

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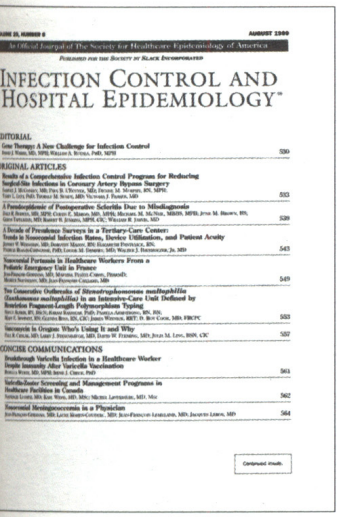
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cations varied significantly by unit inserting the PICC. Follow-up of patients and further analysis of this prospective study is ongoing.

RELATIVE FREQUENCY OF NOSOCOMIAL PATHOGENS AT A UNIVERSITY HOSPITAL, 1980-98. Weber DJ,* Rutala WA, Brown V, Samsa GP. Univ of North Carolina School of Medicine and UNC Hosps, Chapel Hill, NC; Duke Univ, Durham, NC.

Surveillance of nosocomial infection pathogens may reveal long term secular trends in the relative importance of different pathogens. National surveillance data is available from the National Nosocomial Infections Surveillance (NNIS) system. Data collected by NNIS strictly is not comparable from year to year because it does not represent a random selection of U.S. hospitals and the same facilities are not represented in different years. Univ of North Carolina Hospitals has conducted total facilities wide surveillance using slightly modified CDC criteria for more than 20 years. We report here the relative frequency of nosocomial pathogens isolated from 1980 through 1998 (will be update by meeting to 1999). table Gram positive pathogens have dramatically increased in frequency over the last 19 years. Candida/yeast increased from 1980-84 to 1985-89 and maintained this elevated level.

Pathogen*	1980-98	1980-84	1985-89	1990-94	1995-98	Change†
S. aureus	14.5%	11.7%	12.7%	16.1%	18.6%	59.0%
E. coli	11.4%	12.5%	11.2%	11.3%	9.4%	-24.8%
Candida/yeast	10.0%	7.6%	10.6%	11.1%	11.0%	44.7%
P. aeruginosa	9.4%	9.4%	9.5%	10.0%	8.8%	-6.4%
Coag neg Staph	8.8%	6.9%	7.6%	8.1%	12.4%	79.7%
Enterococcus sp.	8.0%	8.2%	6.8%	7.9%	8.8%	7.3%
Klebsiella sp.	6.9%	7.3%	7.7%	6.0%	6.3%	-13.7%
Enterobacter sp.	6.2%	6.8%	7.0%	6.3%	4.7%	-30.9%

* All other pathogens <3.8%; † Percent change from 1980-84 to 1995-98

IMPLICATIONS OF A NOVEL APPROACH TO SURVEILLANCE FOR MEDIASTINITIS AFTER CARDIAC SURGERY. Wilson SJ,* Kirkland KB, Muhlbaier LH, Milano CA, Smith PK, Sexton DJ. Duke Univ Med Center, Durham, NC; Dartmouth-Hitchcock Med Center, Hanover, NH.

BACKGROUND: Mediastinitis is a rare but devastating complication of cardiac surgery. The etiology of post-operative mediastinitis is multifactorial. Increased endemic rates and epidemics may be secondary to patient-related risk factors, procedure-related risk factors, or both. Innovative surveillance methods are necessary to quickly and accurately detect statistically significant increases in the incidence of mediastinitis so that infection control efforts can be initiated to understand and terminate the causes. OBJECTIVE: To describe the preliminary findings using a novel surveillance system for post-operative mediastinitis. SETTING: Academic, tertiary-care medical center. DESIGN: Prospective cohort study utilizing control charting based on geometric probability distribution (g-charting), a quick and accurate method to detect statistically significant differences in the occurrence of rare events. PATIENTS: Using g-charting we identified two groups of patients: (1) those who underwent cardiac surgery during periods when mediastinitis rates were statistically high, and (2) those who underwent surgery during periods when mediastinitis rates were statistically low. MEASUREMENTS: Nineteen (19) patient-related variables including known risk factors for mediastinitis. RESULTS: Of 5,538 consecutive patients having coronary artery bypass, there were 293 patients who underwent surgery during the high-rate periods and 817 patients who underwent surgery during the low-rate periods. There were no significant differences in patient-related risk factors for mediastinitis between these two groups. CONCLUSIONS: G-charting provides a quick and accurate method for detecting statistically significant increases in the incidence of post-operative mediastinitis. Preliminary findings utilizing this technique at our institution suggest that procedure-related risk factors are more important than patient-related risk factors during epidemic periods.

NOSOCOMIAL INFECTIONS IN A CANADIAN PAEDIATRIC INTENSIVE CARE UNIT. Wray R, Cox P, Bell E, Matlow AG. The Hosp for Sick Children, Toronto, Ontario, Canada.

BACKGROUND: A recent report from the National Nosocomial Infections Surveillance Systems suggested that the pattern of nosocomial infections (NI) in PICU's may differ from adult ICUs. In this study we report the pattern of NI in a large Canadian pedicatric intensive care unit (PICU). Rates and patterns of NI in our PICU were established through continuous prospective surveillance conducted by qualified infection control personnel following CDC definitions. The distribution of infections recorded between Jan 1997 and May 1999, categorized by age groups is outlined below. RESULTS: A total of 232 infections were reported in 4071 PICU patients (5.7NI/100 admissions). As in the NNIS series, we found that BSI were the most common NI overall in our PICU. Despite small numbers, the distribution of infection site was similar to the NNIS data with the exception of higher rates of GI in our two younger age groups as compared to NNIS results (14% vs 4% and 27% vs 5%). The most frequently reported pathogen in these patients was Torovirus (81%). CONCLUSION: BSIs constitute the majority of NI in our PICU. Continued enforcement of the intravascular guidelines is required to reduce their frequency. Strategies are also required to prevent the transmission of agents of viral gastroenteritis in infants and toddlers. Efforts to minimize contact transmission of viral gastroenteritis agents should also impact favorably on the transmission of ARO's.

	<=2 mos (N=85)	>2mos - <=5yrs (N=110)	>5yrs - <=12 yrs (N=18)	>12yrs (N=19)
BSI	31%	23%	44%	38%
PNE	7%	9%	11%	5%
LRI	4%	11%	6%	5%
SSI	25%	10%	0	5%
GI	14%	27%	0	0
UTI	11%	12%	28%	26%

EFFICIENT IDENTIFICATION OF POSTPARTUM INFECTIONS OCCURRING AFTER DISCHARGE. Yokoe DS,* Christiansen C, Sands K, Platt R. Brigham and Women's Hosp, Harvard Med School, Boston, MA; Harvard Pilgrim Health Care, Boston, MA; Beth Israel Deaconess Med Ctr, Boston, MA.

OBJECTIVE: Develop an efficient method to identify postpartum infections occurring after discharge, using routinely collected automated data. Background: We previously reported a 6.0% infection risk following 2,826 consecutive deliveries (2,301 vaginal, 525 cesarean) from 1/93 through 6/95 among HMO members. Infections were identified by screening automated ambulatory medical records, hospital and emergency room claims, and pharmacy records for 90 diagnostic, testing, treatment, or pharmacy dispensing codes suggestive of postpartum infection during the 30 days after delivery. Fourteen percent (14%) of deliveries had at least one of these codes (PV pos 40%). Ninety-four percent (94%) of infections occurred after discharge. Full text record reviews to confirm infection status were performed for a weighted sample of cases. METHODS: Logistic regression was used to select predictors of infection, based on predictive performance and stability of the regression coefficient estimates using 1,000 bootstrap samples of two-thirds of the data from 332 reviewed records. Overall test performance was extrapolated to the entire cohort. RESULTS: Important predictors were rehospitalization, cesarean delivery, antistaphylococcal antibiotics, diagnosis codes for mastitis, endometritis and wound infection, and blood and wound microbiology cultures. A cutoff probability of infection >.20 yielded an expected sensitivity of 87% (95% confidence interval 74%, 94%), specificity of 97% (94%, 98%) and positive predictive value (PPV) of 54% (36%, 70%). For a cutoff probability of >.40, the sensitivity was 77% (64%, 87%), specificity 99% (98%, 99%) and the PPV was 68% (56%, 80%). CONCLUSIONS: Automated information routinely collected by HMOs and insurers allows efficient identification of women who are very likely to have postpartum infections that are not detected by conventional surveillance. This information can support surveillance programs, either by guiding selective record review, or possibly as a surrogate outcome measure.

ENHANCED METHODS FOR INPATIENT SURVEILLANCE OF SURGICAL SITE INFECTIONS FOLLOWING CESAREAN DELIVERY. Yokoe DS.* Channing Lab, Boston, MA

OBJECTIVE: Compare the accuracy of quantitative antibiotic exposure thresholds and/or ICD-9 diagnosis codes to prospective National Nosocomial Infection Surveillance system (NNIS) surveillance to identify surgical site infections (SSI) after cesarean delivery. METHODS: This was a prospective cohort study of 2,774 consecutive cesarean deliveries occurring from 4/98 to 12/98 in 5 hospitals. Prospective SSI surveillance was performed using NNIS methods and definitions. Retrospective medical record review was performed to obtain information required for NNIS risk index classification, ICD-9 diagnosis codes and inpatient antibiotic exposure. We reassessed the NNIS SSI classification of patients with an ICD-9 code suggestive of infection or with at least 2 days of antibiotics after the first postoperative day or any antibiotic during a readmission within 30 days of discharge. RESULTS: These are interim results based on 1,648 cesarean deliveries that have been fully reviewed at this time. A total of 66 SSIs (4% SSI rate) were confirmed (3.0% for risk index=0, 6.5% for risk index=1). The performance of these methods is shown below. [See TABLE] The performance of antibiotic exposure thresholds for detecting SSIs was homogeneous across hospitals (homogeneity of odds ratios p=.5). CONCLUSIONS: Based on these interim results, conventional NNIS surveillance failed to detect 2/3 of SSIs following cesarean delivery. Focused surveillance among the 8% who received a threshold amount of antibiotic identified nearly 3 times as many SSIs as conventional NNIS methods. In many hospitals, this method requires less effort. In some settings, antibiotic exposure itself may be an outcome worth monitoring.

	Cesarean Deliveries		
Surveillance Method	Sensitivity	Specificity	Pos Pred Value
Conventional NNIS surveillance	21/66 (32%)	1,582/1,582 (100%)	21/21 (100%)
Antibiotic threshold	59/66 (89%)	1,511/1,582 (96%)	59/130 (45%)
ICD-9 diagnosis code	31/66 (47%)	1,560/1,582 (99%)	31/53 (58%)
Antibiotic threshold and/or ICD-9 code	64/66 (97%)	1,502/1,582 (95%)	64/144 (44%)

POINT PREVALENCE SURVEY OF NOSOCOMIAL PATHOGENS AT A TERTIARY CARE CENTER. Zembower T, Stosor V, Noskin GA, Hacek D, Lee C, Cordell R, Lee J, Slom T, Peterson LR. CDC Prevention Epicenter, Northwestern Univ, Chicago, IL; Molecular Epidemiology Lab, Northwestern Memorial Hosp, Chicago, IL Ctrs for Disease Control and Prevention, Atlanta, GA.

A point prevalence survey (PPS) to determine rates of colonization with vancomycin-resistant enterococci (VRE), multidrug-resistant gram-negative bacilli (MDR-GNB), C. difficile (C diff) and methicillin-resistant S. aureus (MRSA) was conducted on 293 (96%) of 305 inpatients (pts) at NMH in April 1999. Colonization rates were as follows: 8.8% of pts were colonized with VRE, 4.5% with MDR-GNB, 2.7% with MRSA, and 0.7% with C diff. Surveillance for VRE and MDR-GNB is performed weekly on high-risk units; however, during the PPS, only 29% of VRE-colonized and 23% of MDR-GNB-colonized pts were located on units that are routinely screened. Half of the VRE-colonized pts were not previously known to be carriers. A risk factor analysis revealed that colonization with MRSA (p<.001), VRE (p<.001), or MDR-GNB (p<.001) was associated with transfer from another healthcare facil-

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ity. Molecular strain typing performed on the VRE isolates revealed 11 distinct genotypes and 5 nosocomial clusters. The different clusters consisted of 7, 4, 3, 2, and 2 pts. The genotypes were compared to >1500 archived VRE strain types collected at NMH. Of the 11 strain types detected, 5 were endemic to NMH, 1 was a recently emerging genotype, and 5 strain types were newly detected. 3 of the 5 newly discovered strain types were recovered in pts transferred from another healthcare facility. In conclusion, pts transferred from outside healthcare facilities are a reservoir for these pathogens and a source for the introduction of new VRE strain types at our medical center. Furthermore, the existing surveillance program for VRE and MDR-GNB needs to be reexamined and possibly broadened to include additional patient populations not currently screened.

Tuberculosis

INCREASED EFFICIENCY IN THE EVALUATION OF PATIENTS AFTER THE IMPLEMENTATION OF A DEDICATED RESPIRATORY ISOLATION UNIT. Black CL, Parrott, PL, White N, Ray SM, Blumberg HM. Grady Health System, Atlanta, GA; Emory Univ, and Department of Epidemiology, Grady Health System, Atlanta, GA.

Tuberculosis (TB) remains a serious problem in the inner city. We have previously demonstrated the efficacy of our infection control program in preventing nosocomial transmission of TB, but these effective policies result in over-isolation of patients. We investigated the impact of a dedicated respiratory isolation (RI) unit in improving the efficiency of "ruling out" patients for TB who are admitted to RI. In late May 1999, a 26-room dedicated RI unit was opened. Prior to this, RI rooms were located on multiple floors of the hospital. Data regarding length of stay, laboratory results, and relevant demographic information were collected on all patients placed in RI during respective two-month periods before and after the opening of the unit. Of these 528 patient admissions (n=296 in the period before the unit was opened and n=237 following the opening of the RI unit), 72.3% were male, 86.5% were black, 69.5% were HIV positive (median CD4=39/mm3), and the median age was 41 (range: 18-94). Fifty-six (11%) patients placed in RI were diagnosed with culture confirmed or clinical TB. There were no significant differences in these factors among patients isolated before and after the opening of the RI unit. Patients were "ruled out" for TB by having 3 negative AFB smears and no clinical diagnosis of TB. The mean isolation time to "rule out" TB in patients decreased significantly from 5.6 days (median=5 days; range 1-35 days) prior to opening of the unit to 4.4 days (median=4 days; range 1-24 days) following the opening of the unit ($p<0.001$). If these data are extrapolated to 1 year, the number of total RI days following the opening of the RI unit will be reduced by 1440 days, resulting in potentially significant cost savings to our institution. Since these data were collected during the first 2 months after the opening of the unit, it is likely that the efficiency in "ruling out" patients can be increased even further. In summary, our findings suggest that the use of a dedicated RI unit resulted in more efficient use of RI rooms and a potential financial savings in addition to increased patient and staff satisfaction.

EFFICACY, EFFICIENCY, AND IMPACT OF A TB RESPIRATORY ISOLATION POLICY AT AN INNER-CITY MEDICAL CENTER. Blumberg HM, Buckley AE, Lonsway D, White N, Parrott P, Ray SM. Emory Univ, Atlanta, GA; Grady Health System, Atlanta, GA.

High rates of TB in the U.S. are often reported from urban areas. We assessed the efficacy and impact of a TB respiratory isolation (RI) policy at an inner-city hospital in a high endemic area. In 1997, a total of 1,543 patients were admitted to RI at Grady Memorial Hosp (GMH). This represented 5.4% of all adult admissions (n=28,542) to GMH during 1997 and 12.8% of patients (n=12,008) admitted to Medicine-Surgery wards (where negative pressure RI rooms were located). 74% of patients admitted to RI were male; mean age was 42 years. 689 (44.7%) patients admitted to RI were HIV seropositive (median CD4=55/mm3), 381 (24.7%) were HIV seronegative, and 473 (30.6%) had an unknown HIV status. 162 (10.5%) of 1,543 patients admitted to RI were diagnosed with TB (137 [8.9%] were cultured-confirmed and 25 [1.7%] had a clinical diagnosis). A higher proportion of HIV seronegative patients admitted to RI were found to have TB compared to HIV seropositive patients (96/381 [25.2%] vs 48/689 [7.0%], OR=4.51, 95% CI=3.1-6.7, p<.001). 7 patients subsequently diagnosed with TB in 1997 were not placed in RI on admission; therefore, 162 (96%) of 169 patients admitted to GMH and diagnosed with TB were appropriately placed in RI on admission. TST conversion rates among healthcare workers (HCWs) was 0.25% (13/5279) from Jan-June 1997 and 0.10% (5/4893) in Jul-Dec 1997. The positive predictive value of an AFB smear positive respiratory specimen for M. TB was 49% (109/224) and was significantly higher among HIV seronegative patients than HIV seropositive patients (70/90 [78%] vs 26/110 [24%], OR=11.3, 95% CI 5.6-23.3, p<.001). In summary, the RI policy had a major impact upon care at an urban hospital. More than 5% of all adult admissions and >10% of those admitted to medicine/surgery required isolation per the RI policy. The policy was extremely effective in detecting patients subsequently diagnosed with TB (>95% of patients were appropriately isolated) and associated with a low HCW TST conversion rate but resulted in over-isolation as only 1 in 10 placed in RI were subsequently found to have TB disease.

TUBERCULIN SKIN TEST CONVERSIONS AMONG HEALTHCARE WORKERS, U.S. Curtis AB, Cardo D, McCray E, Pratt R, Onorato IM, NaSH Surveillance Group. Centers for Disease Control and Prevention, Atlanta, GA.

INTRODUCTION: Routine tuberculin skin testings (TSTs) are recommended for many HCWs. The National Surveillance System for Health Care Workers (NaSH) was implemented to track exposures to and infection with several infectious agents including TB. Through this system, incidence of infection with M. tuberculosis in HCWs can be estimated and factors associated with TST conversions can be assessed. METHODS: Data on HCWs enrolled at 9 hospitals in Florida (FL), Illinois (IL), Kansas (KS), Massachusetts (MA), and New York (NY) from 6/95-3/99 were analyzed. TST conversions were defined as >10 mm increase in TST induration. Multivariate Poisson regression was used to calculate adjusted rate ratios (RR) and 95% confidence intervals (CI). RESULTS: Twenty-nine (29) conversions occurred among the 12,084 HCWs enrolled in the system. The overall conversion rate was 2.3 per 1000 person-years. The greatest number of conversions occurred at the two hospitals in FL and IL with conversion rates of 12.7 and 10.6 per 1000 person-years, respectively. Factors associated with conversions differed between FL and IL and the other seven sites. In IL and FL, the strongest factor associated with conversion was birth outside the U.S. (adjusted RR 5.2, CI=1.3-20.6). In contrast, for the other sites, being an ancillary worker/technician (adjusted RR 7.7, CI=1.9-31.7) was most strongly associated with conversion. CONCLUSION: This study shows low TST conversion rates in HCWs and suggests that non-occupational exposure to M. tuberculosis may be a significant source of infection.

SIX-YEAR REVIEW OF EMPLOYEE TUBERCULIN SKIN TEST CONVERSION EVENT RATES IN THE DEPARTMENT OF VETERANS AFFAIRS. Danko LH, Roselle GA, Kralovic SM, Simbartl LA. DVA HQ, Wash, DC, VAMC Cinti, OH; DVA HQ, Wash, DC, VAMC, Cinti, OH, Univ of Cinti Coll of Med, Cinti, OH.

Although reported cases of active M. tuberculosis (Mtb) disease in the Veterans Health Administration (VHA) Department of Veteran Affairs declined since 1993, healthcare workers (HCWs) continue to be at risk for occupationally acquired Mtb infection. Hence, surveillance and assessment of Mtb infection in HCWs is part of an effective TB control program. From fiscal year (FY) 93-FY98, VHA requested data from 172 medical facilities/clinics on number of employees/volunteers (EV) covered in facility's Tuberculin Skin Test (TST) program, number of EV in TST program who are TST current, and TST Conversion Event Rates (CER). In FY93, 94, 95, 96, 97, and 98 respectively 191,358; 201,264; 204,765; 181,624; 179,476; and 176,898 EV were reported in the TST component of the TB control program. Nationwide, percent of EV reported current with TST was 68.2 in FY93, 64.9 in FY94, 71.1 in FY95, 75.1 in FY96, 71.5 in FY97, and 77.3 in FY98. Nationally TST CER of 1.92% in FY93, 1.97% in FY94, 1.09% in FY95, 1.18% in FY96, 1.10% in FY97, and 0.73% in FY98 were reported. CER decrease over time was significant (Kruskal-Wallis, $p<0.0001$). Each FY there was a positive correlation between number of Mtb cases and CER, p-values ranging from 0.03 to 0.0008 (Spearman correlation). VHA data suggest improved TST program compliance. Nationally, VHA TST CER are low. Even though technical and reliability issues can result in false positive TST, the positive correlation between Mtb cases and CER suggests HCWs continue to be at risk for Mtb infection. HCW TST programs remain important.

VALUE OF POSITIVE BACILOSCOPY IN THE PREDICTION OF TUBERCULOSIS. Feijó R, Orrico G, Abreu ES, Souza SA, Souza I, Hadad DJ, Ramalho MR. Instituto de Infectologia Emilio Ribas, State Secretary of Health, Sao Paulo, SP, Brazil; Instituto Adolpho Lutz, State Secretary of Health, Sao Paulo, SP, Brazil.

INTRODUCTION: Tuberculosis represents a great challenge for the public health system, especially in underdeveloped countries. In Brazil, its incidence rate is 51.7/100,000 inhabitants. In Sao Paulo, 18,000 new cases are diagnosed each year and the co-infection tuberculosis/AIDS reaches 15-19%. The Emilio Ribas Institute, located at Sao Paulo City, is a national infectious diseases referral teaching center with 230 beds. In 1998, 554 new cases of tuberculosis were diagnosed. Taking into account that tuberculosis is transmited through respiratory route, the early diagnosis and isolation of the positive AFB-sputum smear patient are considered essential to reduce the risk of transmission in the hospital setting. OBJECTIVE: To determine the predictive value of positive baciloscopy of sputum for the diagnosis of tuberculosis in a national infectious diseases referral center. METHODS: The results of all positive acid-fast bacilli (AFB) sputum smears and their respective cultures were retrospectively analysed between 07/98 and 06/99. RESULTS: 219 positive sputum smears, collected of 140 patients, were analysed. 12 cultures were contaminated and were discharged. Pulmonary tuberculosis was diagnosed for 103 patients (74% from those who were AFB positive). Six (6%) patients had positive sputum smears and culture positive for M. kansasii. Among the culture results of the 207 positive sputa, mycobacteria were isolated of 167: Mycobacterium tuberculosis (Mt) strains were isolated from 160 (96%) specimens and M. kansasii from 7 (4%). Forty (40, 19%) specimens resulted negative. The positive sputum smears were stratified according to the Mycobacterium load: Mt were isolated in 95% of the 1+ sputum smears, 93% of the 2+, 100% of the 3+, and 95% of the 4+. CONCLUSIONS: Mycobacteria were isolated of positive sputum smears in 73% of the specimens. Among the positive cultures, Mt strains were isolated of 96% of them. This study strongly supports the necessity of respiratory isolation for those patients with positive AFB sputum smears, even for those with only 1+.

THE EFFECT OF BACILLUS CALMETTE-GUERIN (BCG) VACCINE ON TUBERCULIN SKIN TESTS AMONG MEDICAL AND NURSING STUDENTS, SAO PAULO, BRAZIL, 1997-99. Laserson KF, Medeiros EAS, Soares MCS, Homenko AS, Garrett DO, Roth VR, Jarvis WR, Binkin NJ. Centers for Disease Control and Prevention, Atlanta, GA; Universidade Federal de Sao Paulo, Sao Paulo, Brazil; Division of TB Elimination, Centers for Disease Control and Prevention, Atlanta, GA.

BCG vaccination is associated with positive tuberculin skin tests (TST); however, the duration of BCG-induced TST reactivity varies. Thus, the usefulness of TST to measure tuberculosis (TB) infection in BCG-vaccinated individuals is often questioned. We evaluated the effect of BCG on TST reactivity among TST-negative first year medical and nursing students who received BCG vaccine at birth and upon entry to medical/nursing school. A longitudinal analysis of TST reactivity was conducted among these students from 1997-99 to examine the duration of TST reactivity after BCG re-vaccination and determine whether the frequency of TST influences reactivity. The study population consisted of all re-vaccinated first year medical and nursing students at the Escola Paulista de Medicina with a positive two-step TST (defined as >= 10 mm induration) within 5 months of re-vaccination. One-half of the study population was randomly selected to receive a one-step TST 1 and 2 years after initial TST; the other 1/2 received a one-step TST after 2 years only. Each year, a questionnaire was administered to assess factors associated with TST reactivity. The study population comprised 102 students, of which 49 (48%) received one-step TST after 1 and 2 years, and 53 (52%) after 2 years only. Of 45/49 with available data after 1 year, 19 (42%) had reverted to TST negative (< 10 mm) and 26 (58%) remained positive. TST performed after 2 years among the 19 with a negative TST demonstrated that of 12 with available data, 6 (50%) remained negative and six were again positive; Among the 26 with a positive TST at one year, 14 of 19 (74%) with available data remained positive and 5 (26%) had reverted to negative. Of the 30/53 with available data who received TST after 2 years only, 10 (33%) reverted to TST negative, and 20 (67%) remained positive. These data suggest that greater than 1/3 of TST reactivity may wane in a BCG-vaccinated adult population after one to two years. Frequency of TST does not appear to modify the effect of BCG on TST reactivity. TST remains useful to measure TB infection, even among BCG-vaccinated populations.

SELECTIVE PRE-EMPLOYMENT TWO-STEP SKIN TESTING IN FOREIGN-BORN AND/OR BACILLE CALMETTE-GUERIN VACCINATED HEALTHCARE WORKERS AND ITS EFFECT ON SKIN TEST CONVERTERS. Madison LK, Alexis U, Gordon SM. The Cleveland Clinic Foundation, Cleveland, OH.; Morehouse School of Medicine, Atlanta, GA.

The Cleveland Clinic Foundation is a 994-bed tertiary care center hosting large numbers of foreign nationals who receive their medical training. We began selective two-step pre-employment PPD skin testing in Sep 1997 for all foreign-born healthcare workers

(HCWs) and/or all HCWs who had received Bacille Calmette-Guerin (BCG) vaccination in an effort to reduce the number of false-positive tuberculin skin test (TST) converters in our institution. HCWs routinely undergo a pre-employment single-step TST utilizing a single Mantoux PPD skin test. A TST converter was defined as any HCW with >10 mm increase in induration of the PPD response (if younger than 35 yrs), or >15mm (if older than 35 yrs). TST converters among HCWs were identified through a computerized Occupational Health database. The medical records of all HCWs with TST conversions were reviewed and attempts were made to interview them by telephone. Between 1996 and 1998 the overall TST conversion rate among HCWs at our institution was 0.3% (96 converters/28,861 annual TST's). The incidence of TST conversions was significantly higher during the 20-month period prior to implementation of the selective two-step TST policy when compared to the 15 month period afterwards (0.5% [84 TST converters/16,282 annual HCW TST] vs 0.1% [12/12,579], p<0.001). HCWs with TST conversions prior to implementation of selective two-step TST policy were younger (34 yrs vs 42 yrs, p<0.01) and more likely to be foreign-born and/or received BCG (51% vs 25%, p=.09) than those after implementation of the policy. The mean number of cases of pulmonary TB diagnosed at our institution during the study period was 9.3 (range: 8-11 cases). We conclude that implementation of a selective two-step pre-employment skin test policy for foreign-born HCWs and/or those HCWs who had received BCG reduced the number of false-positive TST converters in our institution.

COMPARATIVE CLINICAL TRIAL IN 3,031 HEALTHCARE WORKERS OF THE TWO COMMERCIAL TUBERCULIN ANTIGENS AVAILABLE IN THE U.S., APPLISOL® AND TUBERSOL®. Maki DG, Hla KM, Ircink FG. Univ of Wisconsin Med School, Madison, WI.

Tuberculin testing is fundamental to U.S. TB control strategies, providing the mechanism for identifying persons with M tuberculosis infection, especially newly acquired infections (tuberculin conversions), permitting targeted chemoprophylaxis to reduce the risk of reactive symptomatic infection. CDC, ATS and JCAHO all recommend annual testing of HCWs and high-risk patients. Two commercial tuberculin antigens are available at the present time in the U.S., Applisol® (Parke-Davis) and Tubersol® (Connaught). Limited data are available on the relative efficacy of these two products for detection of M. tuberculosis infection. A prolonged and heavy exposure of hundreds of HCWs to a house officer with far advanced cavitary pulmonary tuberculosis in our Univ Hosp provided a unique opportunity to test the two commercial antigens head-to-head. Over one year, 3,031 HCWs, including 302 exposed to the infected house officer, were tested using both antigens, one on each arm, in the standard 5-TU Mantoux intradermal test; 95 percent of skin tests were read by one of the co-investigators. The comparison shows that Applisol® is far more sensitive for the detection of M tuberculosis infection (sensitivity >5 mm, 90.0 vs 61.2%; >10 mm, 77.5 vs 45.5%, both P<0.001) and suggests comparable specificity (>5 mm, 94.2 vs 98.8%; >10 mm, 97.7 vs 99.0%). These data indicate that Applisol® is a superior antigen for detection of M. tuberculosis infection by standard Mantoux tuberculin testing.

	% PPD + >5mm/>10mm	
	Applisol	**Tubersol**
Overall (3,013)	11.5 / 7.5	6.3 / 4.1
Exposed (502)	12.5 / 9.6	6.0 / 3.2
Likely true PPD + (209)	90.0 / 77.5	61.2 / 45.5
Likely true PPD − (2,807)	5.8 / 2.3	2.2 / 1.0
Definite conversion by one or both (171)	88.3 / 75.8	51.6 / 36.7
X-ray evidence old TB (31)	90.3 / 77.4	54.8 / 45.2

CONTACT INVESTIGATION FOLLOWING EXPOSURE TO AN EMPLOYEE WITH MULTI-DRUG-RESISTANT TUBERCULOSIS AT A TRANSPLANT CENTER. Muto CA, Posey K, Pokrywka MF, Krystofiak S, Pasculle AW, McMahon D. Univ of Pittsburgh School of Medicine, Pittsburgh, PA; UPMC Health System, Pittsburgh, PA.

On Jun 2, 1999, the local health department notified our hospital that an employee had been diagnosed with active pulmonary tuberculosis (TB) by his primary care physician (PCP). The employee had been symptomatic for approximately nine weeks before diagnosis. His primary job responsibility was technical maintenance necessitating contact primarily with heart and lung transplant patients and patients on artificial heart-assist devices. A contact investigation was initiated on 3 cardiothoracic patient units and 1 privately owned, offsite housing facility for patients and their families. Over 400 patients, 349 employees, 38 physicians, 34 volunteers and 199 family members were considered potentially exposed. All patients, along with their attending physicians and identified PCPs, guests of the housing facility and employees on the affected patient units were notified by letter of the possible exposure. The immune status of all patients was evaluated to determine appropriate recommendations for follow-up. Tuberculin skin testing (Mantoux) and/or chest X-ray was recommended for all immunocompetent patients. Transplant patients were to receive prophylactic antibiotic treatment for one year postexposure. The choice of drugs for antibiotic therapy in transplant recipients was confounded by the identification of the isolate as a multi-drug-resistant strain. Patients are currently being treated with a combination of pyrazinamide and levofloxacin. To date, no secondary cases of TB have been identified. Skin testing conversion data is being compiled along with outcomes of long-term prophylactic antibiotic therapy for transplant recipients exposed to a multi-drug-resistant TB strain.

TUBERCULOSIS MANAGEMENT IN A BRAZILIAN COMMUNITY HOSPITAL. Oliveira TC. National Research Council, Brazilian Government.

Early diagnosis and treatment are the basis for TB prevention and control. In the small community hospitals from undeveloped countries, the low grade of TB suspicion by physicians, delays time to start appropriate TB treatment and increase the risks of TB transmission in these facilities. OBJECTIVE: To describe TB management in a community Brazilian hospital, regarding time from suspicion until treatment of persons who may have active pulmonary TB. DESIGN: All adults included in the definition of probable active TB admitted in 1997 were under surveillance. Healthcare workers (HCWs) were evaluated by a questionnaire survey. SETTING: A 118-bed community hospital located in Mogi-Mirim, Sao Paulo State, Brazil. RESULTS: 17 patients were included in the case definition of probable active pulmonary TB; 11 were admitted in the isolation rooms. All had thoracic X-rays ordered, five were positive for TB. Acid-fast bacilli (AFB) were ordered for only 7 patients, six of them were positive. Mean time from admission until treatment was 3.2 days. Three patients needed to be referred to Public Health Department (PHD) to start appropriate treatment. For 6 patients admitted in the internal medicine wards (IMW), 5 had X-rays ordered and 1 was positive. AFB was ordered for this patient and it was positive. The time from admission to treatment was 24 days. The patient needed to be referred to PHD in order to start TB therapy. Alcoholism history, HIV known status and isolation room admission were associated with higher suspicion for TB active disease (P<0.005). Regarding the 280 HCWs, no TB screening program was developed in the studied facility. Less than 10% had been submitted to PPD test and related to be negative. CONCLUSIONS: It was found a high risk degree of TB transmission in the IMW associated to low grade of HCW TB screening and the long time from admission to diagnosis and treatment. To have appropriate drugs for TB available in the hospital can reduce the time of infectiousness, decreasing risk for TB dissemination in the hospital and the community.

LOW UTILITY OF HEALTHCARE WORKER TUBERCULOSIS EXPOSURE INVESTIGATIONS AT AN URBAN MEDICAL CENTER. Parrott P, White N, Larsen NM, Ray SM, Blumberg HM. Grady Health System, Atlanta, GA; Emory Univ, Atlanta, GA.

A hierarchy of TB infection control measures are recommended to prevent nosocomial transmission. CDC guidelines recommend post-exposure surveillance for healthcare workers (HCWs) who are inadvertently exposed to potentially infectious patients with TB. We evaluated the efficacy of this HCW postexposure surveillance in 1997-98 at our inner-city hospital which cared for 325 different patients with TB disease. HCW exposure episodes were defined as exposure to a patient subsequently found to have AFB smear positive pulmonary TB who was not isolated upon admission (inpatient exposure) or similar patients seen in outpatient clinics who were not isolated or did not have a mask placed. During the 2-year period, there were 22 exposure episodes (10 inpatient exposures with a range of 1-9 days [median 2 days] and 12 exclusively outpatient exposures with a range of 1-17 hours [median 3 hours]). A total of 398 HCWs were potentially exposed; 99 (25%) were previously tuberculin skin test (TST) positive. Baseline (shortly after the exposure) and follow up TSTs (>12 weeks postexposure) were recommend on the remaining 299 susceptible (previously TST negative) HCWs; of 233 susceptible HCWs still working at the institution at >12 weeks postexposure had a TST conversion. During the study period, TSTs were mandatory for all HCWs on an every 6-month basis unless there was documentation of a previously positive TST. Six-month HCW TST conversion rates were 13/5279 (0.25%) Jan-Jun 1997; 5/4,893 (0.1%) Jul-Dec 1997; 4/4,670 (0.1%) Jan-Jun 1998; and 8/4,363 (0.2%) Jul-Dec 1998, but of those who converted could be linked to an exposure episode. SUMMARY: TB exposure episodes at our institution were brief, and no HCW TST conversions were documented from these exposures. These exposure investigations were extremely time consuming and postexposure testing of HCWs at 12 weeks did not prove to be of benefit at an institution with an effective TB infection control program and mandatory biannual HCW TSTs.

THE 9-YEAR EVOLUTION OF A CONTINUOUS, QUALITY-MANAGED TUBERCULOSIS SCREENING AND TREATMENT PROGRAM AT A VA DOMICILIARY. Potts D. VA Domiciliary, White City, OR.

The continued growth of the HIV epidemic and emergence of multi-drug resistant Mycobacterium Tuberculosis, has once again brought the importance of screening for TB in high-risk populations to the forefront of the infection control literature. The VA Domiciliary, White City, Oregon, is a 918-bed, 403-person staffed Drug/Alcohol and Rehabilitation facility. Housing such programs as Homeless Veterans, creates a high risk screening, diagnostic, treatment and followup program. This program meets VA, CDC, and OSHA requirements and has systematically screened close to 12,000 patients in the past 9 years. Specific step-by-step flow charts, policies and procedures, AFB smear and recovery rates, INH treatment protocols will be offered. The success of this program is based on two very opposite approaches: a decentralized screening process with followup in a highly structured, computerized data base assisted, centralized clinic. continuous quality management/improvement programs, teamed with well established infection control programs, can create TB screening, diagnostic, treatment and followup for high risk populations, that can become institutional role models for cost effective, low risk and high quality patient care.

INFECTION CONTROL PARAMETERS IN THE MANAGEMENT OF INFECTIOUS TUBERCULOSIS AT A BRAZILIAN HOSPITAL. Resende MR, Sinkoc VM, Papaiordanou PMO. Campinas State Univ Hosp, Campinas, Brazil.

OBJECTIVE: to evaluate infection control parameters in the management of infectious tuberculosis patients. DESIGN: inpatients (new cases) with positive acid-fast bacilli (AFB) sputum, admitted from Jan 1997 through Sept 1999, were included in the study. The following parameters were evaluated: interval between admission and AFB sputum collection (INTERVAL1); interval between admission and initiation of airborne isolation (INTERVAL2); interval between AFB sputum collection and TB treatment (INTERVAL3). SETTING: a tertiary-level hospital with 400 beds for acute care. RESULTS: 260 new cases (82 inpatients) with positive AFB sputum were reported of the period. Of inpatients, 63 cases were included in the study. The HIV association occurred in 31.7%. Other underlying diseases were present in 13 (20.6%) cases. Forty (63.5%) patients were admitted by emergency room (ER), with median of permanency in the area of 21 hours. Three wards (infectious diseases, lung diseases and internal medicine) took 69.8% of all hospitalizations. Suspicion of TB was present on admission in 42 (66.7%) patients. The INTERVAL1 exceeded 12 hours in 27.5% (11/40) cases admitted by ER and 30.4% (7/23) admitted directly in wards (p=0.803). Patients with and without HIV infection showed similar INTERVAL1 (p=0.09). Delayed isolation measured by INTERVAL2 occurred in 31 (49.2%) cases. Thirteen patients were never isolated (9 in ER and 4 in wards). The delay of isolation was related to the absence of TB in admission diagnoses (p<0.000) and lower bacilli load (p=0.032). HIV infection (p=0.530), hospitalization ward (p=0.284) and underlying diseases (p=0.541) were not associated with delay of isolation. The median number of days of isolation was 8 days (sum=484). The sum of days without isolation was 164 days. Only 15.9% cases showed INTERVAL3 superior to 24 hours. CONCLUSIONS: the delay of isolation observed in many cases, shows the necessity of education staff towards a higher index of suspicion for TB and establishing the rapid triage of these potentially infectious patients from ER to isolation areas.

TUBERCULOSIS CONTACT INVESTIGATIONS IN SEVEN NASH HOSPITALS. Robertson PR, McCray E, Panlilio AL, Cardo DM, Srivastava PU, NaSH Surveillance Group. Centers for Disease Control and Prevention, Atlanta, GA; Division of TB Elimination, Centers for Disease Control and Prevention, Atlanta, GA.

Despite heightened awareness of tuberculosis (TB), exposures of healthcare workers (HCWs) and patients continue to occur. To characterize TB contact investigations (Cis), we analyzed information from the National Surveillance System for Health Care Workers (NaSH). From Feb 1996 to Jun 1999, seven NaSH hospitals reported 34 Cis (1-10 per hospital). The median duration of exposure was 4 days (range 1-163 days). The mean number of HCWs exposed per CI was 29 (range 2-197); one CI also involved 54 patients. All sources of exposure were infectious TB patients. The sites of infection in the source patients were pulmonary in 30 (88%); larynx and skin in one each (6%); and missing in two (6%). Of those with test results available, 84% (27/32) had positive sputum smears for acid-fast bacilli; 97% (31/32), positive cultures for Mycobacterium tuberculosis; and 13% (4/32), drug-resistant TB (streptomycin [2], isoniazid [1], and ethambutol [1]). Reasons for exposures were reported for 23 Cis; 16 occurred because patients with TB were asymptomatic or had symptoms that were unrecognized or not recorded and seven occurred because either TB isolation was not ordered or respiratory protection was not used properly. Among 253 HCWs tested following exposure, 105 (42%) received a single (follow-up) tuberculin skin test (TST), 71 (28%) received a baseline and follow-up TST, 77 (30%) received a TST less than 12 weeks after the reported exposure date. In addition, 30 patients with exposures had results reported for two TSTs. TST conversions were documented for two HCWs, and one patient with baseline and follow-up TSTs. Both HCWs were offered preventive therapy; one accepted, and the other declined. As TB admissions fall, nosocomial exposures to and transmissions of TB still occur, highlighting the importance of rapid identification, isolation, diagnostic evaluation, and treatment of persons likely to have TB.

BOOSTER TUBERCULIN SKIN TEST RESPONSES AMONG HEALTHCARE WORKERS IN BRAZIL. Roth VR,* Garret DO, Goncalves MLC, Didier ME, Medeiros EAS, Kritski AL, Starling CEF, Laserson K, Binkin N, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Hosp Univ. Clementino Fraga Filho da Univ. Federal do Rio de Janeiro, Rio de Janeiro, Brazil; Hosp Julia Kubitschek, Belo Horizonte, Brazil; Univ. Federal de Sao Paulo, Sao Paulo, Brazil.

Routine tuberculin skin test (TST) screening of healthcare workers (HCWs) for Mycobacterium tuberculosis (MTB) infection is currently recommended in the U.S. However, in international settings, such as Brazil, with a high prevalence of MTB and high rates of Bacillus of Calmette and Guérin (BCG) vaccination, an enhancement or booster effect of TST due to remote exposure may be misinterpreted as TST conversion due to new infection. To assess rates and predictive factors for boosting, 5TU Purified Protein Derivative was applied to 3,847 HCWs from Sao Paulo (SP), Rio de Janeiro (RJ), and Belo Horizonte (BH), Brazil using the Mantoux method. HCWs with a negative TST (i.e., <10 mm induration) were retested 7-21 days later. Boosting was defined as an increase in induration of >= 6mm compared to baseline, from <10mm to ≥10mm. Of 2,024 initially negative HCWs, 1,804 (89%) were retested; 349 (19%) had boosted reactions. Predictive factors for boosting were the presence of a BCG scar (22% vs 14%; OR=1.6; p<0.001), working in a hospital in SP or BH vs. RJ (22% vs 14%; OR=2.1; p<0.001; and 22% vs 14%; OR=2.0; p<0.001, respectively), a history of MTB contact (21% vs 16%; OR=1.3; p=0.02), and working in patient areas vs. administrative areas (21% vs 14%; OR=1.6; p<0.01). There was no association with age, gender, or education. In a multivariate model, the presence of a BCG scar, hospital of employment, and working in patient care areas were independent predictors. These results demonstrate a higher frequency of boosting in HCWs with previous BCG vaccination and prior clinical MTB exposure and support the necessity of two-step testing to establish baseline HCW TST status.

A PROSPECTIVE MULTI-SITE STUDY OF TUBERCULIN SKIN TEST CONVERSION RATES AMONG HEALTHCARE WORKERS IN BRAZIL. Roth VR,* Garrett DO, Didier ME, Goncalves MLC, Starling CEF, Kritski AL, Medeiros EAS, Laserson K, Binkin N, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Hosp Julia Kubitschek, Belo Horizonte, Brazil; Hosp Univ. Clementino Fraga Filho da Univ. Federal do Rio de Janeiro, Rio de Janeiro, Brazil; Univ. Federal de Sao Paulo, Sao Paulo, Brazil.

Mycobacterium tuberculosis (MTB) is a well-recognized occupational risk to healthcare workers (HCWs). However, the magnitude of this risk to HCWs in Brazil, where MTB is highly prevalent and infection control measures are often inadequate, is unknown. To assess this risk, HCWs in 3 Brazilian hospitals completed an exposure questionnaire and two-step tuberculin skin test (TST). A follow-up questionnaire and TST were administered 6 months later to baseline-negative HCWs (i.e., TST <10 mm induration). TST conversion was defined as *15 mm increase in induration compared to baseline. At baseline, 1,309 (36%) of 3,847 HCWs had a negative two-step TST; 73% (956/1309) were re-tested 6 months later. The overall TST conversion rate was 4.2/1,000 HCW months. There was an increased risk for TST conversion among HCWs with a history of MTB contact in the preceding 6 months (5.1% vs 0.9%; RR=5.9; p<0.01), working in patient care areas vs. ancillary or administrative areas (3.7% vs 1.0%; RR=3.8; p<0.01), employed as a nurse (4.7% vs 1.5%; RR=3.1; p<0.01), or working in Hosp Julia Kubitschek (4.4% vs 1.9%; RR=2.3; p=0.03). These risk factors remained significant after adjusting for age, gender, level of education, and the presence of a Bacillus of Calmette and Guérin scar. These results indicate an important occupational risk for nosocomial MTB acquisition in these Brazilian hospitals and highlight the need for improved MTB control interventions. Economically feasible infection control measures to reduce this risk are being implemented and will be prospectively evaluated by following trends in TST conversion rates.

THE ROCHE AMPLICOR™ POLYMERASE CHAIN REACTION SYSTEM IS USEFUL IN THE EVALUATION OF PATIENTS WITH ABNORMAL CHEST X-RAYS WHO ARE SMEAR-NEGATIVE YEARS AFTER TREATMENT FOR PULMONARY TUBERCULOSIS. Tambyah PA, Gough A, Lim TK, Yogananthan S, Yong MY, Reuben M, Kumarasinghe G. Natl Univ Hosp, Singapore; Singapore Anti-Tuberculosis Association, Singapore.

Pulmonary tuberculosis (PTB) remains a major cause of mortality and morbidity worldwide. Both endogenous reactivation and exogenous reinfection can lead to active PTB in individuals who have previously been treated. The early diagnosis of active disease in these patients is often hampered by negative acid-fast sputum smears and "stable abnormal" chest X-rays (CXR). The Roche Amplicor™ polymerase chain reaction system (PCR) has been recently licensed by the FDA, but only for use in the diagnosis of PTB in smear positive sputum specimens. The aim of this study was to determine if PCR could detect active PTB in smear negative individuals with abnormal chest X-rays years after completing treatment in an area of intermediate endemicity for PTB. We studied a cohort of 82 individuals with sequential CXRs, sputum acid-fast smears and cultures and sputum specimens for PCR testing. All 82 had completed therapy for PTB 20.6 ±15.4 years ago and were acid-fast smear negative. All CXRs were abnormal; 57% had unilateral apical infiltrates, 19% had old cavitary disease. Three individuals had positive PCRs for Mycobacterium tuberculosis; of these, 2 were culture negative and had no clinical evidence of active pulmonary tuberculosis and were determined to be false positives. The remaining individual did have a positive culture and evidence of active tuberculosis requiring therapy. of the PCR negative individuals had culture or clinical evidence of active PTB. Overall, for patients with treated PTB who are AFB smear-negative individuals, PCR has a sensitivity of 100% and a specificity of 98%; its positive predictive value is 33% and its negative predictive value is 100%. The Roche Amplicor™ polymerase chain reaction system may be a useful adjunct in the evaluation of smear negative individuals with previously treated PTB and abnormal CXRs. A larger study is warranted to determine its wider clinical application in this setting.

THE ROCHE AMPLICORTM POLYMERASE CHAIN REACTION SYSTEM IS USEFUL IN THE EVALUATION OF PATIENTS WITH ABNORMAL CHEST X-RAYS WHO ARE SMEAR-NEGATIVE YEARS AFTER TREATMENT FOR PULMONARY TUBERCULOSIS. Tambyah PA, Gough A, Lim TK, Yoganathan S, Yong MY, Reuben M, Kumarasinghe G. National Univ Hosp, Singapore; Singapore Anti-Tuberculosis Association, Singapore.

Pulmonary tuberculosis (PTB) remains a major cause of mortality and morbidity worldwide. Both endogenous reactivation and exogenous reinfection can lead to active PTB in individuals who have previously been treated. The early diagnosis of active disease in these patients is often hampered by negative acid-fast sputum smears and "stable abnormal" chest X-rays (CXR). The Roche AmplicorTM polymerase chain reaction system (PCR) has been recently licensed by the FDA, but only for use in the diagnosis of PTB in smear positive sputum specimens. The aim of this study was to determine if PCR could detect active PTB in smear negative individuals with abnormal chest X-rays years after completing treatment in an area of intermediate endemicity for PTB. We studied a cohort of 82 individuals with sequential CXRs, sputum acid-fast smears and cultures and sputum specimens for PCR testing. All 82 had completed therapy for PTB 20.6 ±15.4 years ago and were acid-fast smear negative. All CXRs were abnormal; 57% had unilateral apical infiltrates, 19% had old cavitary disease. 3 individuals had positive PCRs for Mycobacterium tuberculosis; of these, 2 were culture negative and had no clinical evidence of active pulmonary tuberculosis and were determined to be false positives. The remaining individual did have a positive culture and evidence of active tuberculosis requiring therapy. of the PCR negative individuals had culture or clinical evidence of active PTB. Overall, for patients with treated PTB who are AFB smear-negative individuals, PCR has a sensitivity of 100% and a specificity of 98%; its positive predictive value is 33% and its negative predictive value is 100%. The Roche AmplicorTM polymerase chain reaction system may be a useful adjunct in the evaluation of smear negative individuals with previously treated PTB and abnormal CXRs. A larger study is warranted to determine its wider clinical application in this setting.

PREVALENCE OF MYCOBACTERIUM TUBERCULOSIS INFECTION AMONG HEALTHCARE STUDENTS IN ABIDJAN, COTE D'IVOIRE. Toscano CM, Kassim S, Kone M, Delafosse J, Roels T, Wiktor SZ, Binkin N, Jarvis WR. Ctrs for Disease Control and Prevention, Atlanta, GA; Projet Retro-CI, Abidjan, Côte d'Ivoire; Institut National de Formation des Agents de Santé, Abidjan, Côte d'Ivoire.

Few studies have assessed tuberculin skin test (TST) positivity rates and risks for nosocomial infection with M. tuberculosis in healthcare students (HCS). We conducted a cross-sectional two-step TST and risk assessment survey in HCS of the national training center for healthcare students (INFAS) in Abidjan, Côte d'Ivoire. INFAS has six different training programs; HCS within each of these programs have different exposures to tuberculosis (TB) patients during their 3-year training period. HCS with a TST 15 mm or any TB symptom were referred for a chest X-ray. Of 1094 HCS, 927 (84.7%) agreed to participate in the study. Of these, 909 (98.1%) were tested and 111 (12.2%) were lost to follow-up. Of the 927 HCS who completed the questionnaire, 20 (2.2%) reported a history of TB; median age was 26 years (range 20-42), and 552 (59.5%) were male. of the 176 HCS who had a chest X-ray had radiological symptoms compatible with active TB. Of the 798 HCS who had a two-step TST, 659 (82.6%) HCS had a positive TST (induration of 10 mm). TST positivity rates were significantly higher in male HCS (86.9% vs 76.8%, p<0.001) and in HCS aged >22 years (629/747 vs 30/51, p<0.001). Of the 927 HCS, 370 (40.1%) reported community exposure to TB patients, and the median time from the last known exposure was 3 years. TST positivity was associated with the presence of Bacillus of Calmette and Guérin (BCG) scars (1 scar: OR=3.1, p<0.001; 2 scars: OR=5.7, p<0.001). Boosting (defined as a 2nd step TST of 10 mm) occurred in 124/318 (42.1%) HCS who received the 2nd step TST. Boosting was more likely to occur if the HCS had one BCG scar (OR=1.9, p=0.02), or 2 BCG scars (OR=3.04, p<0.01). No differences in TST positivity rates were observed between the different training programs or by year of training (1st 83.7%, 2nd 78.8%, 3rd 85.7%; p=0.1). High TST positivity rate was observed in HCS in a setting where community exposure to M. tuberculosis is common, and universal childhood BCG vaccination is performed routinely. In this population, the usefulness of TST to assess risk of nosocomial M. tuberculosis infection may be limited.

DEVELOPMENT OF A HOSPITAL TUBERCULOSIS PREVENTION POLICY IN AN ENDEMIC AREA. WH Seto, PTY Ching, NC Tsang. Hong Kong Hosp Authority.

Tuberculosis (TB) is endemic in Hong Kong with an incidence of 1/1000 for the last decade, but Multiple Drug Resistance remains at <2%. A policy for TB control is developed which is less rigorous then the CDCs' recommendations, including: (1) Respirators (N95) are only reserved for high risk procedures like intubation and bronchoscopy of possible TB patients. (2) Fit-testing is not performed but sessions demonstrating use of N95 are conducted. (3) Adopting a prioritization system in isolation in contrast to one isolation procedure for all, due to limited supply of -ve pressure isolation rooms. (4) No annual PPD surveys are conducted as BCG is given at birth. Efficacy of prevention is obtained from two main sources. Firstly, cases of TB in HCWs are reported in all hospitals and the Occupation and Safety Ordinance make this mandatory in 1997. TB incidence in HCW from 7 hospitals with >20,000 staffs shows that it ranges from 0.38-0.84/1000 from 1994-98. Secondly surveillance for TB patients in two large hospitals in the last 4 years failed to demonstrate the occurrence of unusual clusters. The criteria for a workable hospital TB preventive program in an endemic area of the developing world will be discussed.

FALSE POSITIVE HEALTHCARE WORKER TUBERCULIN SKIN TEST CONVERSIONS ASSOCIATED WITH A PARTICULAR BRAND A PPD REAGENT. White N, Gordon W, Hunter M, Parrott P, Ray SM, Blumberg HM. Grady Health System, Atlanta, GA; Emory Univ Atlanta, GA.

Tuberculin skin testing is a recommend component of a TB infection control program. At our institution which cares for >150 patients with active disease per year in a high incidence area, tuberculin skin tests (TSTs) are mandatory for all health care workers (HCWs) every 6 months. We investigated a marked increase in TST conversions among HCWs at the Grady Health System (GHS) which occurred beginning in mid-Sep 1999. HCW TSTs are performed in the GHS Employee Health Clinic (EHC) using the Mantoux method (with 5 TU of PPD reagent). Two-step testing is required for all new HCWs. A positive TST is defined as induration of ≥10 mm. All TSTs are read at 48 to 72 hours after placement by EHC staff; self reading is not permitted. Baseline 6 month TST HCW conversion rates were as follows: 4 of 4,670 tested (0.09%) in Jan-Jun 1998, 8/4363 (0.2%) from Jul-Dec 1998, and 5/4,358 (0.1%) from Jan-Jun 1999. Between 9/15/99 and 10/15/99, there were 11 HCWs with a new TST conversion among 914 tested (1.2%), a significant increase compared to the previous 1.5 years (P<.001). These 11 HCWs had a variety of different job descriptions (housekeeping, nursing, dietary, counselor) and worked in different hospital areas. All 11 HCWs had a negative CXR. Our investigation indicated that the GHS pharmacy had switched from Tubersol® (Connaught, Swiftwater, PA) which had been used exclusively for the prior 6 years to Aplisol (Parkdale, Rochester MN) in Jul 1999. Beginning on Sep 22, 1999, the EHC stopped using Tubersol® and began using Aplisol PPD reagent (lot #01739P and 00159P). All 11 HCWs who tested positive with Aplisol were retested using Tubersol® PPD; all had a negative repeat TST (10 with 0mm induration and 1 with 3mm induration). An additional 3 HCWs who had a positive baseline TST with Aplisol had a positive repeat TST with Tubersol®. In summary, we demonstrated false positive HCW TSTs associated with the introduction and use of Aplisol PPD reagent. Our experience indicates the limitations of the TST and that there may not be equivalency between different PPD products.

UTI

EFFECT OF A NITROFURAZONE-IMPREGNATED URINARY CATHETER ON THE INCIDENCE OF CATHETER-ASSOCIATED UTI IN BURN PATIENTS. Leclair JM, Cycan KA, Munster AM, Neste CM, Murphy PA. Johns Hopkins Bayview Med Ctr, Baltimore MD; Baltimore Regional Burn Ctr and the Johns Hopkins Univ School of Medicine, Baltimore, MD.

BACKGROUND: Patients hospitalized in Burn ICUs are at higher risk of catheter-associated UTI (CAUTI) than patients in any other type of ICU, as reported by the National Nosocomial Infections Surveillance (NNIS) system. Heavy colonization of burn wound surfaces in close proximity to the catheter-urethral junction may make CAUTI in burn patients difficult to prevent using conventional methods. Because secondary bacteremia occurs in 0.5-4% of patients with CAUTI, and bacteremia significantly increases mortality in burn patients, it is imperative to minimize the incidence of CAUTI in the burn center surveillance in conjunction with NNIS in a regional burn center showed a baseline CAUTI incidence of 19.4/1000 catheter days. Reeducation of staff in catheter insertion and management techniques as recommended by the CDC resulted in only a marginal decrease in the incidence of CAUTI. Intervention: In Dec 1998 a nitrofurazone-impregnated catheter was introduced into the burn center. Surveillance for CAUTI using the same NNIS definitions and methods as in the baseline period was performed. RESULTS: The device was used in 22 burn patients for periods ranging from 3-60 days, for a total of 406 catheter days. Two CAUTIs occurred for an incidence of 4.9/1000 catheter days. Both infections were caused by Candida albicans. CONCLUSION: The nitrofurazone-impregnated catheter was effective in reducing the incidence of catheter-associated urinary tract infection in a regional Burn ICU. Use of these catheters may have an important role in minimizing the risk of CAUTI in burn patients.

RISK FACTORS FOR CATHETER-ASSOCIATED URINARY TRACT INFECTION: A PROSPECTIVE STUDY SHOWING THE MINIMAL EFFECTS OF CATHETER CARE VIOLATIONS ON THE RISK OF CAUTI. Maki DG, Knasinski V, Tambyah PA. Univ of Wisconsin Med School, Madison, WI.

Catheter-associated urinary tract infection (CAUTI) is the most frequent nosocomial infection and comprises the largest reservoir of antibiotic-resistant pathogens in healthcare institutions. The effect of compliance with catheter care on the risk of CAUTI has not been adequately examined. We prospectively studied risk factors for CAUTI in 850 newly-catheterized patients in a Univ hospital; each patient was seen daily by research nurses, a urine culture was obtained and specific aspects of catheter care were scored quantitatively: integrity of closed drainage, position of the catheter, collection tubing and bag, and protection of the drainage port. Data bearing on the risk of CAUTI, including age, gender, urologic disease, implanted stents, co-morbidities, APACHE II score, immunosuppressant therapy, ambulatory status, ICU care, surgery, antimicrobial therapy, uses of the catheter and catheter-care scores, were recorded. CAUTI was defined as new bacteriuria or candiduria > 103 CFU/mL. Risk factors for CAUTI were identified by stepwise logistic regression and Cox proportional hazard modeling. Overall, 158 (18.6 percent) of the patients developed CAUTI during the study. Only seven factors were independently predictive of increased risk: extended catheterization (OR 5.2, P<0.001), female gender (OR 3.7, P<0.001), a urologic stent (OR 2.5, P<0.008), other active infections (OR 2.4, P<0.001), malnutrition (OR 2.4, P<0.001), insulin-requiring diabetes (OR 2.2, P<0.002), and drainage tube position (OR 2.1, P<0.03); antimicrobial therapy (OR 0.1, P<0.001) conferred protection against CAUTI. The only catheter-care violation predictive of an increased risk of CAUTI was the drainage tube sagging below the level of the collection bag. These data indicate that we are at the point of diminishing returns with regard to what further can be achieved with compliance in catheter care and point up the importance of novel technology designed for prevention of CAUTI, a goal coming to fruition with catheters manufactured with antinfective surfaces.

IMPACT OF NOSOCOMIAL INFECTIONS ON MORBIDITY, MORTALITY, COSTS AND DIAGNOSTIC AND THERAPEUTIC PROCEDURES: A NESTED CASE-CONTROL COHORT STUDY. Sánchez-Velázquez LD, Rangel-Frausto MS,* Domínguez-Cherit G, Ponce de León-Rosales S. National Institute of Cancerology, Mexico City, Mexico.

BACKGROUND: Nosocomial infections (NI) increase morbidity, mortality, therapeutic and diagnostic procedures and, consequently, they also increase costs. OBJECTIVE: To document the effect of NI on incidence and duration of organ failures, mortality, use of therapeutic and diagnostic procedures and on hospitalization costs. METHODS: A case-control study was carried out on a cohort of ICU patients. NI in the ICU were defined as those detected 48h after admission to the unit or within 48h after release. Case-control pairing was carried out with the following criteria: ICU stay before the onset of NI (±5 days), Apache II score (±4 points), age (±5 years). Statistical analysis was carried out with Student's t test for paired samples and with McNemar's c2 with Yate's adjustment. RESULTS: Fifty-three (53) cases with a 100% pairing controls were identified. Average hospital stay for cases was 26 ±12 vs 16 ±12 for controls, average ICU stay was 17 ±9 for cases vs 9 ±6 for controls (p<0.001). The number and duration of organ failures were statistically different between cases and controls. The number and duration of diagnostic and therapeutic procedures as well as the associated costs also differed (p<0.05). No difference in mortality was found. CONCLUSIONS: NI in the ICU increase hospital stay, ICU stay, incidence and duration of organ failures, need for diagnostic and therapeutic procedures, and hospitalization costs. The present study could not detect a statistical difference in mortality.

A STUDY OF THE FORMATION OF CRYSTALLINE PROTEUS MIRABILIS BIOFILM ON URETHRAL CATHETERS. Stickler DJ, Morris NS, Hughes G. Cardiff Univ, Cardiff, Wales, UK.

Catheter encrustation and blockage is a common complication in the care of the many patients undergoing long-term indwelling bladder catheterisation. The problem is caused by the formation of crystalline biofilms of Proteus mirabilis on the catheter surfaces. The bacterial urease produces alkaline conditions under which crystals of urinary calcium and magnesium phosphates form and become trapped in the biofilm. In this study we have examined the formation of these encrustations on four different types of catheter, in a simple physical model of the catheterised bladder. Artificial urine was supplied to the model at 0.5 ml/min. The bladder was inoculated with P. mirabilis NSM6, a clinical strain that had been isolated from an encrusted catheter. The models were operated until the catheters blocked. The mean times to blockage recorded from five replicated experiments were 24 h for hydrogel-coated latex catheters, 21.6 h for silver-coated latex catheters, 46 h for all-silicone catheters and 56.2 h for nitrofurazone-coated silicone catheters. In each case, scanning electron microscopy confirmed the blockage of the catheter lumen by crystalline biofilm. Examination of catheters removed from models after 1, 4, 6, 18 and 24 h incubation revealed that biofilm formation starts on the rough uneven surfaces around the eye-holes and then spreads down the catheter lumen. It is also clear that the incorporation of antibacterials such as silver and nitrofurazone into catheter materials does not prevent the formation of catheter-blocking crystalline biofilms.

VISA-GISA

IDENTIFICATION AND MANAGEMENT OF A PATIENT WITH VANCOMYCIN INTERMEDIATE STAPHYLOCCOCUS AUREUS. Chou T, Carey R, Larson R, O'Keefe P. Loyola Univ Med Ctr, Maywood, IL.

In Apr 1999, LUMC reported the fourth confirmed VISA case in the United States. A 63-year-old woman with endstage renal disease on hemodialysis was admitted with Methicillin resistant S. aureus (MRSA) bacteremia. On hospital day 14, S. aureus isolated from her blood showed a minimum inhibitory concentration (MIC) to vancomycin of 4 g/ml by Vitek, 6 by E test, and 8 by broth dilution. Pulse field gel electrophoresis performed by the Ctrs for Disease Control and Prevention (CDC) of the initial MRSA and VISA isolates showed a pattern of identity. Management of the patient was in accordance with CDC guidelines (MMWR 1997;46:626-635). Upon isolating the VISA strain, the Clinical Microbiology Lab immediately notified CDC, Infection Control personnel, the chairman of the Infection Control Committee, and the patient's physician. The patient was isolated in a private room on contact precautions (gown, glove, mask, antimicrobial handwashing agent). Individuals having contact with the patient were limited to designated hospital personnel and immediate family members. On each shift, one nurse was assigned only to the VISA patient. Infection control personnel provided on-site education programs, monitored compliance with isolation precautions, notified the local health department, and performed surveillance cultures on 181 healthcare workers and family members. All surveillance cultures were negative for VISA and cost nearly $3,000. Further analysis of costs to manage the case is being made.

COMPARISON OF PULSED-FIELD GEL ELECTROPHORESIS FINGERPRINTS OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS ISOLATES WITH VARYING SUSCEPTIBILITIES TO VANCOMYCIN. Steward CD,* Carson LA, Hill BC, Tenover FC. Ctrs for Disease Control and Prevention, Atlanta, GA.

Most isolates of methicillin-resistant S. aureus (MRSA) have susceptible vancomycin (VANC) MICs of ≤1 µg/ml. Since 1997, several countries have reported MRSA with decreased susceptibility to VANC (MICs ≥4 µg/ml). Globally, MRSA isolates have descended from 3 ancestor clones; however, there is sufficient diversity among pulsed-field gel electrophoresis (PFGE) fingerprints to provide adequate discrimination of strains to track the spread of resistant strains over time. To investigate whether certain MRSA strains are more likely to develop decreased susceptibility to VANC over all other MRSA strains, we analyzed PFGE fingerprints of SmaI-digested restriction fragments of 36 unique MRSA isolates with varying broth microdilution VANC MICs. These isolates included three MRSA strains from the United States (U.S.) and 15 European epidemic MRSA (EMRSA) strains with VANC MICs ranging from ≤0.25 to 2 µg/ml. The PFGE patterns were compared to 13 patterns from MRSA with VANC MICs of 4 µg/ml from France, Scotland, and the U.S., and five MRSA with VANC MICs of 8 µg/ml from Japan and the U.S. Gel analysis was performed using Advanced Quantifier 1-D Match software. The computer-generated dendrogram, calculated from Dice coefficients, showed two main groups of isolates. Group 1 (80% similarity) contained EMRSA 3 (the Pediatric Clone), 8 MRSA with VANC MICs of 4 µg/ml from the U.S., and five MRSA with VANC MICs of 8 µg/ml from the U.S. and Japan. Group 2 (75% similarity) contained 12 other EMRSA strains and the MRSA strain from France and Scotland. The dendrogram showed only 68% similarity between Groups 1 and 2. Outside of the two groups, two other U.S. MRSA strains with VANC MICs of 4 µg/ml were 97% similar to each other, but only 59% similar to Groups 1 and 2. The two remaining EMRSA strains were different from each other and all the MRSA with VANC MICs of ≥4 µg/ml. In summary, all four U.S. MRSA strains with VANC MICs of 8 µg/ml more closely resembled the EMRSA 3 strain than any of the other EMRSA strains. This suggests that changes leading to decreased susceptibility to VANC are occurring primarily within one cluster of U.S. MRSA strains.

VRE—Abstracts in this category appear in* Am J Infect Control *February 2000.