2005, is irrelevant to field situations and will force the manufacturers of disinfectants to overformulate or use more potentially toxic ingredients because of the challenging virucidal hierarchy of naked viruses (nonenveloped vertebrate viruses or bacteriophages).

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Staphylococcus aureus: What Are the Levels of Contamination of Common-Access Environmental Surfaces?

TO THE EDITOR—Outbreaks of community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) infection have increased public concern about the risks of infection, especially from contamination of the environment.[1] MRSA can survive on plastic surfaces[2] and stainless steel.[3] Clusters of community-associated MRSA infection in athletes indicated that transmission occurred through the use of shared items rather than through physical contact.[4] Tabloid press reports of sampling of public area surfaces may lack validity, as further investigation has questioned their methodology and interpretation.[5]

S. aureus, which is carried by approximately 25% of humans, may be transferred to the fingers by nose picking or touching the nasal area. Although nasal MRSA colonization rates remain low in Hong Kong,[6] there is concern about environmental reservoirs of the organism. We investigated levels of *S. aureus* contamination and characterized isolates from commonly contacted surfaces.

Over a 5-week period, 100 samples were collected on the same weekday from a range of publicly accessed surfaces in a densely populated area of Hong Kong, with each of the 25 sites being sampled 4 times daily. Temperature and humidity were also recorded. The sampling sites were chosen as a convenience sample within walking distance of an underground railway station. Samples were collected by swabbing the entire surface of a keyboard or elevator button or a 2.5 cm^2 area of larger surfaces with a saline-moistened transport swab. Swab samples were cultured within 2 hours of collection on blood agar, mannitol salt agar, and oxacillin-resistant screening agar and then enriched in brain-heart infusion broth (all media; Oxoid). Colonies with staphylococcal morphology were characterized as *S. aureus* by use of the Staphaurex test (Murex Biotech). All blue-pigmented colonies on oxacillin-resistant screening agar were Gram stained, and positive cocci were subcultured to blood agar and further identified. Brain-heart infusion broth was subcultured after 24 h on blood agar and oxacillin-resistant screening agar, and any growth was identified as mentioned above. *S. aureus* isolates were tested for susceptibility to a range of antibiotics. The presence of the *mec*A gene and the genes for enterotoxins *(sea–sef)*, exfoliative toxin *(eta* and *etb)*, and toxic shock syndrome toxin *(tsst-1)* were determined by means of multiplex polymerase chain reaction.[7] Isolation rates were compared over time with the χ^2 test, and correlation with temperature and humidity was determined with the Pearson correlation test.

Of a total of 500 samples, 56 (11.2%) yielded *S. aureus.* No culture-positive samples were obtained from public telephones, but other sites were frequently contaminated (Table).

TABLE. Rates of Isolation of *Staphylococcus aureus* from Publicly Accessible Sites in Hong Kong

Site sampled	Proportion (%) of samples positive for *S. aureus*
Automated teller machine	19/160 (11.9)
Drink vending machine	3/20 (15)
Ticket vending machine	9/60 (15)
Escalator belt	6/60 (10)
Game center console	1/10 (10)
Public telephone	0/20 (0)
Public toilet door plate	7/60 (11.7)
Elevator button	5/60 (8.3)
Travel card add-value machine	2/20 (10)
Door access keypad	4/30 (13.3)

Though organisms were most frequently recovered from samples collected between 4 and 6 PM, this finding did not reach statistical significance ($P = .93$). The percentage of samples that were culture-positive each week varied from 8% to 15%, but this variation did not reach significance ($P = .42$). Daily mean temperature varied from 14.4°C to 25°C, and humidity from 45% to 75%. There was a correlation between an increased rate of isolation of *S. aureus* and both increasing temperature ($P = .618$) and increasing humidity ($P = .545$), but this correlation did not not reach statistical significance ($P = .266$ and $P = .342$, respectively).

All 61 *S. aureus* isolates were susceptible to imipenem, vancomycin, gentamicin, and cefoxitin. Rates of resistance to penicillin (78%), tetracycline (23%), erythromycin (14%), ciprofloxacin (3%), chloramphenicol (3%), and fusidic acid (16%) were similar to those recently reported for nasal *S. aureus* isolates.[6] Although several isolates grew on oxacillin-resistant screening agar, none were resistant to cefoxitin, and results of polymerase chain reaction for *mec*A was negative for these isolates.

Twelve isolates (21.4%) harbored enterotoxin A *(sea)*, 2 (2.6%) enterotoxin B *(seb)*, and 8 (14.3%) *tsst-1*. Three isolates harbored both *sea* and *tsst-1*, and another harbored both *sea* and *seb*. No carriage of other enterotoxins or exfoliative toxins was detected.

Although community-associated MRSA infection is reported in Hong Kong, the absence of methicillin-resistant isolates among those we recovered was not remarkable, because colonization levels are less than 1.0% in the community.[6] However, 11% of samples yielded *S. aureus;* therefore, should colonization levels increase, it can be expected that such isolates would include some MRSA strains.

With few exceptions, isolation rates for particular types of sites were similar to the overall isolation rate. Apparent cleanliness of public telephones may reflect limited use due to the ubiquity of cellular phones. In a study of recovery methods, the use of contact agars to collect samples was demonstrated to increase the rate of isolation from contaminated surfaces.[8] However, there would have been difficulties in using contact agar to collect samples in crowded public areas and from irregular surfaces. Direct inoculation of swabs, as used in our study, is more sensitive than use of pour plates.[8] In addition, our use of enrichment media increased the isolation rate. Oxacillin-resistant screening agar as a selective medium lacked specificity for MRSA, because organisms that grew on this medium were not confirmed to be MRSA on further testing. The lack of specificity of oxacillin-resistant screening agar has been previously reported,[5] and it should be replaced by other MRSA-selective media in future studies.

Time of day did not affect the isolation rate, but the area sampled is busy at all times. Although *S. aureus* can withstand drying, a higher isolation rate was correlated with increasing humidity levels. This may be related to an increased rate of hand carriage rather than an increased environmental survival rate, and further work is needed to determine these relationships.

Most materials used in publicly accessible sites do not appear to have properties that allow for the adherence and survival of staphylococci and other potentially pathogenic organisms. Recent work has shown that both plastics and stainless steel can be modified to reduce the bacterial survival rate,[3-4] and the timely introduction of these materials into publicly accessible sites may help prevent transmission in the community. There is a need to reinforce the importance of handwashing and to encourage regular use of alcohol-based hand rubs[9] after contact with publicly accessible sites, both to prevent transmission and to reduce risks of food poisoning, because almost a quarter of the isolates we recovered in this study carried genes for enterotoxin production. In addition, measures to improve hygiene at publicly accessile sites should be monitored.

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