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### Effect of Building Type on Risk of Death Following the 1992 Earthquake in Turkey

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**Introduction:** During the earthquake (EQ) that struck Erzinacan, Turkey in March 1992, many mid-rise masonry and concrete buildings (MRB) collapsed. An important reason for the collapse was the frequent use of the first story for commercial stores, causing an open, "soft" story. Engineering reports hypothesized that, in particular, such building collapses were lethal. In view of the increasing use of such buildings in urban areas, a further examination was conducted of the relation between building type and lethality following the EQ.

**Methods:** Geophysical and structural information was gathered from official records, independent engineering reports, and visual inspection. The site of victim deaths was determined from official records. Further information was collected for a sample of deaths through stratified, random interviews of eye witnesses. Of this sample, the subset who died in MRB ( $n = 23$ ) was compared to a randomized control group who survived MRB ( $n = 28$ ) collapse.

**Results:** Though all building types were subjected to similar seismic intensity (Mercalli IX), MRB and one-story adobe structures appeared most vulnerable to collapse. Of the 466 people who died in the city, 456 were indoors with most (418) dying in MRB collapses. Building occupancy rates could not be determined accurately. In this sample, deaths in MRB collapses occurred more likely on the first story ( $p < .02$ ). The study was unable to determine whether the victims' position within the room or his/her behavior influenced outcome.

**Conclusion:** Though fatality rates could not be determined, MRB collapse appears to be associated with an inappropriately high number of fatalities in comparison with other building types. A "soft" first story especially appears to be lethal. Deaths might be prevented by enforcing building codes which should include the design of first stories.

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### Emergency Medical Treatment in the "Billiards Crash" Accident on the Superhighway in Japan

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**Objective:** To investigate controversial points and counter-measures of emergency medical treatment in the large-scale accident on the superhighway in Japan.

**Incident:** The large-scale accident involving as many as 186 vehicles occurred on the superhighway. Two persons died and 108 were injured. Personnel were transported to the scene by helicopter and, for the first time, landed on the superhighway to provide emergency medical assistance.

**Discussion:** Controversial points include: 1) lack of recognition of the importance of emergency medical measures; 2) delay of information to medical institutions; 3) no participation of physicians in the triage process despite the seriousness of the accident; and 4) no cars or helicopters for physicians.

Counter-measures include: 1) creation of emergency manuals to prepare physicians for participation in emergency medical procedures; 2) triage conducted by physicians; 3) cars or helicopters available for physicians; and 4) joint practices involving all concerned parties.

**Conclusions:** Emergency medical treatment, including quick response time, must be planned for by creating manuals and determining practices for disaster prevention in Japan.

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### Cause of Death, Seat Position, and Outcome in Victims of the Clapham Rail Disaster

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**Objective:** To describe the effects of a major rail disaster on the passengers involved in terms of the types of injury, the cause of death, and the influence of seat position on patient outcome.

**Methods:** Retrospective study of the Clapham Rail Disaster with 300 of 1,450 passengers injured and 35 killed. Injury Severity Score categorized injured passengers and Signed Rank testing to establish significance. Use of hospital and post-mortem records in cases of fatality.

**Results:** In most cases (63%), cause of death was due to severe head injury, 26% due to multiple injury, and four deaths were due to traumatic asphyxia, and thus potentially were preventable. Facing travel resulted in more severe injuries, and a seat position on the left also conferred greater risk.

**Discussion:** Injuries among survivors mirrored those of unrestrained vehicle passengers. Therefore, there is an argument for the use of rearward facing seats and lapstraps. Lessons learned in dealing with this accident are of interest to anyone planning for or dealing with major rail and other accidents.

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### Fog-Related Motorway Disasters: An Epidemiologic Study

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**Objective:** This study deals with a group of mass accidents on the A-4 motorway "Serenissima" (from Brescia to Padua, Northern Italy) during foggy conditions. Risk factors, epidemiology, and rescue techniques and troubles were analyzed.

**Methods:** All fog-related accidents with 10 vehicles or more, and at least five casualties, were selected in the period ranging from January 1983 through December 1992. Data regarding time and weather, site of the accident, kind of vehicles, casual-

ties, injury severity (by AIS 90), and impact on rescue structures were abstracted.

**Results:** Ten motorways accidents were studied. There were 433 vehicles involved, 156 wounded, and 20 dead motor-vehicle users. These accidents were related mostly to sudden changes in visibility and to variability of light and heavy traffic, and usually were triggered by sudden alterations in traffic flow; it was possible to identify some "black spots" at particular risk.

A motorway disaster frequently is configured with masses of impacted vehicles, separated by a few vehicles that did not crash. The worst consequences to vehicle occupants are often those situated in the middle or in the terminal sub-units of the accident. Therefore, it is difficult for rescue teams to recognize and acquire access to some severe impact zones within the main accident, and the narrow contact of deformed vehicles creates a dangerous situation in case of fire.

**Conclusion:** Motorway "disasters" are rare events (less than 1% of all motorway accidents), but dramatically severe in their economic and human consequences. A correct real-time information system for drivers and a greater distance between vehicles and vehicles in good repair could reduce their prevalence. Moreover, rescue organization must be planned accurately in order to overcome trouble in acquiring access to the scene and in triage of casualties.

### 309 Major Railroad Accidents in Japan in Last 30 Years

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Trains have been accepted by the Japanese as the safest and most reliable means of mass transportation. However, 83 major railroad accidents occurred in the past 30 years, killing 339 and injuring 10,313 people. Causes of these accidents can be classified into several categories: 1) human errors by drivers or conductors; 2) combination of human errors and mechanical troubles; 3) mechanical troubles; 4) obstacles on the tracks; and 5) natural phenomena like floods and landslides.

As to rescue and emergency medical activities, several problems were pointed out repeatedly: 1) lack of command and coordination among the personnel from different organizations; 2) inappropriate triage; and 3) confusion of communications, especially those made by telephone.

Safety measures, such as Automatic Train Control and Automatic Train Stop (ATC/ATS), Obstacle-Detecting Devices, etc., have contributed to reducing railroad accidents. Yet, counter-measures to the problems of rescue and emergency medical activities have made little progress.

### 311 Lesson from the Gulf War

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The Gulf War taught many valuable lessons about disaster planning and war injuries. The time interval between the invasion of Kuwait and the actual war gave sufficient time to revise and rehearse the local disaster plan. The plan was activated by a SCUD attack 500 meters from the hospital, where the American military personnel site was hit. This event demonstrated the disparity between rehearsal and actuality. Problems with the disaster plan, unexpected emergency cases, and the unusual types of injuries incurred are discussed.

**Conclusions:** 1) Disaster plans must be rehearsed frequently without warning; 2) Triage must be a continuous process, with follow-up assessment of the patient's changing condition; and 3) There is a need for constant updating of knowledge regarding the different types of injuries caused by weapons of mass destruction.

### 312 Prehospital Deaths in Three Earthquakes

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**Objective:** To study the causes of death and mechanism of dying among a population of earthquake victims who were observed to have survived the initial impact, but who died prior to definitive treatment.

**Methods:** A retrospective, structured interview format<sup>1</sup> was employed that was aimed at eliciting responses from lay survivors, rescuers, health care providers, and disaster managers concerning first-aid of the critically injured, slowly dying victims they encountered after earthquakes in Armenia (Richter Scale magnitude [R] = 6.8), Costa Rica (R = 7.2), and Turkey (R = 6.8). In each case, a review of a sample of medical records also was conducted. Earthquake related deaths were classified as instant or protracted.

**Results:** The crude death rate (number of deaths/10,000 of total affected population) in these events was 424 in Armenia, four in Costa Rica, and 74 in Turkey. The wide variability in death rate can be explained on the basis of differences in population density, building type, and intensity and location of epicenter relative to population centers. The protracted death rate (number of victims who died slowly/total deaths x 100) was unknown in Armenia, 17% in Costa Rica and 53% in Turkey. The principal cause of death in both groups of victims was crush injury.