between the hospitals in the region. About 50% of the severely injured reached the Trauma Centers (there are six in Israel);

3) There was a significant difference between damage caused by explosions in closed areas such as buses or explosions in an open space. In closed spaces, the percentage of fatalities is 40% as opposed to 13% in open spaces; and the percentage of urgent cases is higher, 38% as compared to 24%; and
4) In incidents where more than one explosion occurred, the teams who reached the scene quickly, were greatly endangered — however, the number of casualties per incident in open spaces did not rise significantly.

Keywords: bombings; environment; evacuation; explosions; multi-casualty incidents; teams; terrorists; trauma centers; treatment at scene

G-26
The Nairobi Bombing: The Israeli Medical Team Experience

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On Friday, 07 August 1998, at 10:35 hours local time, a massive bomb blast rocked the American Embassy and its surroundings, in Nairobi, Kenya. The attack killed 213 people and injured more than 4,000 civilians. A rescue team of 180 soldiers was deployed by the Israeli government to assist local authorities in the complicated rescue mission. A medical team of 26 members joined the rescuers.

During the first hours after the bombing, the information received from Nairobi regarding types of injuries was very poor. But, it was obvious that the local medical facilities were intact and functioning. With this assumption in mind, the deployment policy was constructed: The medical team would include various experts to assist at local hospitals and "light" medical equipment to help provide primary medical care to survivors and rescuers at the bombing site. The personnel consisted of: Team Commander and deputy, five general surgeons, three orthopedic surgeons, one neurosurgeon, four anesthesiologists and 11 nurses, paramedics, and medics. The equipment consisted of standard military medical bags, which included appropriate tools for airway management, chest drainage, external hemorrhage control, initial fluid resuscitation, immobilization, and various drugs. Non-standard equipment included: one pulse oximeter in each medical bag, pediatric equipment, a large amount of bicarbonate, type "O" positive blood, and frozen plasma.

Thirty hours after the bombing, the Israeli team arrived in Nairobi. Soon, it became evident that all survivors already were evacuated to local hospitals. At this time, the medical team was split into two components: 1) Medics, paramedics, and one physician remained at the bombing site in case more survivors would be discovered; and 2) All others joined local physicians at Kenyata Medical Center. Israeli anesthesiologists and surgeons, in conjunction with the local teams, performed a total of eight operations.

Important epidemiological information was discovered only after the arrival of the Israeli teams in Nairobi: there were a large number of penetrating eye injuries. If this information had been obtained earlier, ophthalmologic surgeons would have joined the team.

Keywords: bombing; eye injuries; Nairobi; surgery; teams, international; teams, Israeli medical; trauma

Panel Discussion-II

Lessons Learned from the Great Hanshin-Awaji Earthquake

Tuesday, 11 May 8:00–10:00 hours
Chair: *Ernesto Pretto, Kiyoshi Tatemichi*

PN2-1
A Survey of Emergency Medical Requirements following the 1995 Hanshin-Awaji Earthquake: An Overview of Morbidity and Mortality of Hospitalized Patients

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Objective: The objective of this study was to provide an overview of the morbidity and mortality of hospitalized patients during the Hanshin-Awaji earthquake.
Methods: Medical records of 6,107 patients admitted to 95 hospitals (48 affected hospitals within the disaster area and 47 back-up hospitals in the surrounding area) during the initial 15 days after the earthquake were analyzed retrospectively. Patient census data, diagnoses, dispositions, and prognoses were considered.
Results: A total of 2,718 patients (44.5%) with earthquake-related injuries were admitted to the 95 hospitals, including 372 patients (6.1%) with crush syndrome and 2,346 (93.9%) with other injuries. There were 3,389 patients (53.5%) admitted with illnesses. Seventy-five percent of the injured were hospitalized during the first three days. In contrast, the number of patients with illnesses continued to increase over the entire first 15-day period after the earthquake. The mortality rates were 13.4% (50/372), 5.5% (128/2,346), and 10.3% (349/3,389) associated with crush syndrome, other injuries, and illness, respectively. The overall mortality rate was 8.6% (527/6,107 patients). The mortality rate for patients with trauma and crush syndrome was significantly higher in the affected hospitals. Morbidity as well as mortality rates increased with agents for both patients with injuries and patients suffering from illnesses. Out of the 6,107 patients, a total of 2,290 (38%) were transferred to back-up hospitals during the first 15 days following the earthquake, consisting of 187 (50%) with crush syndrome, 702 (26%) of patients with other injuries, and 1,401 (41%) with illness. Of those 2,290 patients, 1,741

(76%) were transferred from affected hospitals to back-up hospitals, while 549 patients (24%) were evacuated directly to the back-up hospitals. The peak in transports came during the first four days. The family car was the most frequently utilized means of transport; ambulances were used in only 26% of cases, and the helicopters were utilized minimally.

Conclusion: In the initial 15-day period following the earthquake, there was an unprecedented number of patients suffering from trauma, and they converged upon the *affected* hospitals. Subsequently, an increased incidence of illness was observed. The existing emergency medical services system was not adequate for this urban earthquake. From our vantagepoint, we are keenly aware of the need for improved communications between hospitals, a well-equipped patient transport system, and a well-coordinated disaster response mechanism.

Keywords: ambulances; automobiles; crush syndrome; disaster; demography; distribution of patients; emergency medical services (EMS); Hanshin-Awaji earthquake; helicopters; hospitals; illnesses; injuries; morbidity; mortality; transfers; trauma

PN2-2

Complex Systems in Crisis: The Great Hanshin Earthquake, 17 January, 1995

Louise K. Comfort
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Sudden disaster creates an enormous disruption for the interdependent systems of services — communications, transportation, electrical, water, gas distribution, and sewage disposal — essential to response operations in a technically advanced society. Disaster environments are dynamic, and require a different mode of organization, information processing, and leadership skills than are the traditional forms of management and control. The problem is how to increase the capacity of interdependent organizations to anticipate risk and demonstrate resilience in response to threat.

This problem intensifies for public organizations that interact with private and non-profit organizations to protect a community at risk from natural or technological disaster. Organizational performance repeatedly declines in environments of increasing complexity, and previous efforts to address this problem have considered it essentially insoluble. Increases in organized complexity require significant increases in information flow, communication, and coordination in order to integrate multiple levels of operation and diverse requirements for decision into a coherent program of action. Yet, human decision makers have limited cognitive capacity. In rapidly changing environments, they often are unable to process the amount and range of information required to make timely, informed decisions essential for adequate coordination among the multiple components of the response system. Accordingly, organized performance in complex environments has been viewed as necessarily limited by human information processing capacity.

Advances in information technology and telecommunications allow means to overcome the long-observed decrease in organizational performance in complex environments. Technical capacity to order, store, retrieve, analyze, and disseminate information to multiple users simultaneously creates the potential for innovative approaches to collective learning and self organization. These means extend information processing capacity beyond the limits of single individuals, and provide decision support to multiple managers addressing the same problem at different locations at the same time. Linking organizational capacity for mobilizing the resources of a community to appropriate uses of information technology creates a "sociotechnical system" in which technical capacity to exchange timely, accurate information among multiple participants increases organizational capacity to solve shared problems that require action at local, regional, and national levels.

This paper will present the concept of self organization in the mitigation of risk and mobilization of response to disaster. This concept depends upon the design and implementation of a socio-technical system that integrates the technical capacity of information technology with organizational design and communication processes among major actors in a community response system. This paper will present findings from a field study of the Great Hanshin Earthquake of 17 January 1995 that shows the consequences of a major earthquake in a metropolitan area of 6 million people. Such an event disrupts the performance of the basic response systems of the community, including the capacity for medical response. This paper will identify possible ways to improve inter-organizational and inter-jurisdictional performance in risk reduction and response to disaster, focusing on medical response, through the appropriate design and application of information technology.

Keywords: earthquake; Great Hanshin earthquake; information systems; mitigation, risk, systems; technology

PN2-3

Disaster Preparedness in Osaka: A Role and Relationship of the Core Medical Institutes in a Disaster

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When a great earthquake strikes Osaka Prefecture, the number of injured and deceased will be several times those that occurred in the Great Hanshin-Awaji Earthquake because Osaka is one of the most overpopulated areas in Japan.

Medical actions should be divided into two categories: 1) those in the affected area; and 2) those in the non-affected areas. Both those injured victims triaged as well as those needing treatment for mild injuries must receive care at the core medical institutes with in the damaged area. However, it is most important for the core disaster hospital to take care of the "red-tagged"