(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

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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"

patients who could be saved, regardless of whether the core medical institutes are located within or outside the destroyed area. It is very crucial to pick up such red-tagged patients properly and to transport them to the other core medical institutes in intact areas beyond the boundary of local governments.

The medical operations in a disaster are a part of the total disaster plan developed by each Prefectural government. After the Great Hanshin-Awaji earthquake, about 500 hospitals were chosen as core medical institutes for disaster. Each core medical institute must satisfy several requirements: 1) capable to provide advanced medical services for the multiple severely injured patients; 2) capable to function as the headquarters equipped with a medical information system in disaster and emergency situations; 3) facilities to transport patients beyond the border of the local governments, such as dispatched doctors, emergency automobiles, heliport, etc.; and 4) enough personnel to dispatch self-contained medical service teams.

In order to utilize all medical institutions in the damaged area and make them fully functional in a disaster situation, several mutual-aid arrangements for health and medical assistance within a Prefecture or between neighboring Prefectures, or on a nation-wide scale have been established following the Great Hanshin-Awaji earthquake. Every effort has been made to make such mutual-aid arrangements work properly through the use of drills and simulations. Every core hospital and other hospitals have come to prepare their own disaster manual.

In this panel discussion, we will demonstrate the policies and the measures prepared in Osaka Prefecture.

Keywords: core hospitals; disaster; hospitals; mutual-aid; plans; policies; preparedness; transport; triage

PN2-4
Overview of Bio-Psycho-Social Problems after the Hanshin-Awaji Earthquake: Report from Kobe University School of Medicine

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Kobe University School of Medicine is situated at the center of the disaster area where more than 5,500 peoples died in January 1995. Therefore, the affiliated University Hospital played a vital role for medical services for the victims from the beginning of the disaster. Also, the hospital received patients with a variety of stress-related health problems after the Earthquake. At the same time, the Medical School organized systematic research on the various medical and health problems among victims.

Research works carried out at the Kobe University School of Medicine on the Earthquake victims has ranged widely from forensic analysis of the dead, crush syndromes, effects of stress on cardiovascular and digestive systems, psychological problems, care systems for the victims, etc. The research project involved more than 100 doctors and researchers. This paper reviews a wide range of bio-psycho-social impacts of the disaster to the victims, and analyses the longitudinal changes in health problems. Special attention should be directed to the psychological and psychiatric aspects. Also, some medical problems still are continuing even four years after the Earthquake.

Keywords: crush injury; earthquake; forensics; health status; research; residuals; stress

PN2-5
The Hanshin-Awaji Earthquake and Dental Care

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This paper will summarize the dental and oral conditions caused by the Hanshin-Awaji Earthquake, and will describe the damage suffered by dental care facilities and instruments.

Since the Earthquake occurred before dawn, 66.3% of the persons who died in Kobe were crushed by their houses. There were very few cases of maxillofacial trauma; only 28 patients with maxillofacial trauma were examined by personnel from the Departments of Dentistry and Maxillofacial Surgery at seven hospitals in Kobe City. Only four cases of fractures of the jaw were reported.

Dental care facilities in Kobe City also were severely damaged. As of 23 January, one week after the Earthquake, only 183 of the 797 dental care facilities in Kobe City had reopened. The major factors responsible for the delayed resumption of dental-care services were the unavailability of water and gas for one to three months and the high volumes of water required by most dental instruments.

A total of 560 shelters, which housed 210,000 persons who had lost their houses, were established in Kobe at the time of the Hanshin-Awaji Earthquake. Dental care was provided through the joint efforts of the Hyogo Dental Association, Kobe Dental Association, and Hyogo Society of Hospital Dentistry.

Temporary clinics were established at 10 sites in Kobe City, starting on 20 January. A total of 2,344 patients underwent dental examinations. A dental examination bus was used for the temporary clinics. In additions, 18 dental care groups, consisting of volunteers and of health-care staff from schools of dentistry of local universities, visited and treated a total of 1,925 patients at 181 sites.

There were 1,043 cases of pulpitis and dental infections. There were 1,834 cases of caries and periodontitis, and the number of patients examined peaked about 2 weeks after the earthquake. There were 1,108 cases of denture loss or breakage and displacement of prostheses of fillings.