HEALTH AND MEDICAL RESPONSE TO URBAN EARTHQUAKE HAZARDS: CHANGES IN PRACTICE

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Introduction

The significance of earthquake hazard reduction in urban areas has been underscored in recent years with the occurrence of major earthquakes: Mexico City in 1985, Soviet Armenia in 1988, Loma Prieta in 1989, and Luzon, the Philippines, in 1990. This presentation provides an update of the lessons learned from these events and defines the changes that have occurred to date in the knowledge base for health and medical response. Further, it identifies areas where additional research is needed in order to effect preventive measures (mitigation and preparedness) or to ameliorate post-disaster conditions (response and recovery).

Areas in which changes in practice have occurred

Perhaps the major significant change has been the use of epidemiologic research to examine health and medical consequences of disasters. Results of such research have formed the scientific basis for increasingly effective prevention and intervention strategies.

By definition, the epidemiology of natural disasters is the study of the disaster-related deaths, illnesses or injuries in humans and of the factors that affect those deaths, illnesses or injuries. Some of the methods involve a comparison of victims with survivors in order to learn how and where they differed. Risk groups of time/person/place and exposure are identified, the aim being to prevent the occurrence of death, illness or injury. Epidemiologic studies are essential for determining the appropriate relief supplies, equipment, and personnel needed to effectively respond to such situations.

In general, different disasters are accompanied by different health effects as epidemiologic studies have shown. In comparison to other natural disasters, earthquakes bring many deaths, a relatively large number of severe injuries that require medical attention, increased risk of infectious disease found also in other disasters, and less so, the need for food. Population movements are generally rare although may occur in severely affected urban areas.

Earthquake epidemiology, in particular, has been applied to examining the role of the physical setting, occupant behavior, and personal characteristics associated with injuries. Given the wide variance in the magnitude of earthquakes, their locations in urban or rural areas, prevailing building codes, construction design, and so forth, these studies also have yielded a range of results, some of which I share with you.

A population-based cross-sectional study among a sample of damnificados, or affected, in the Mexico City earthquake indicated that injury was more likely to occur inside a structure rather than outside.

Likewise, the possibility of escape was crucial for survival in the Armenia earthquake and depended on the type of building and occupant behavior. These were the results of a case-control study in which cases were identified as persons with hospitalized injuries from neighborhood polyclinics in the city of Kumairy, formerly Leninakan, while controls were non-injured residents from the same neighborhood. The odds ratio of 12.2 indicated that persons who were in a building were twelve times more likely to sustain injury than those who were outside at the time of the earthquake.

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From the same study, in terms of initial reaction and occupant behavior, running out of a building offered a protective factor. Persons who ran out of a building were 4.4 times less likely to be injured than those who remained indoors, as indicated by the odds ratio shown below.

In the Philippine earthquake, the majority of casualties, or 74 percent, were inside a building during the earthquake. This again was a case control study design, with cases and controls similarly distributed inside and outside a structure. Risk factors for being inside a building included building height, type of building material, and floor level that a person was on. Odds ratios indicated the following: 1) Persons inside buildings with seven or more floors were 35 times more likely to be injured than those who weren't; 2) Persons inside buildings constructed of concrete or mixed materials were 3 times more likely to sustain injury than those in wooden buildings; and 3) Persons at middle levels of multistory buildings were twice as likely to be injured than those at the top or bottom levels.

In other areas such as California and Japan, however, students are taught to remain inside a structure and to take cover under desks, as building construction may be sound. Increased knowledge about the impact of structural and nonstructural factors and the reaction of occupants has proved useful in preparing for disasters. Given the differing results, we need to know what actions are appropriate for various urban and rural areas of the world and how those actions vary within a particular urban setting.

Epidemiologic studies can be used to improve disease surveillance after an earthquake. Research has shown that epidemics of infectious disease such as cholera or typhoid generally have not followed earthquakes, nor have diseases been transmitted from decaying corpses to survivors. This has decreased instances of useless immunization campaigns following earthquakes.

Improved surveillance of diseases in camps for survivors has heralded the onset of diseases such as measles and in some cases, has enabled public health officials to institute control measures such as prompt immunization campaigns.

Crush syndrome, or crush injuries, or traumatic rhabdomyolysis in medical terms, is the condition that results from the compression of a limb for several hours, as can result from being trapped under rubble. Muscle damage ensues and leads to swelling in the damaged area, hemoconcentration, lowered blood pressure and shock, and the release of products of muscle damage which appear in the urine and may cause kidney failure. Prior to the occurrence of the Armenia earthquake, only a few cases of crush syndrome were described in the literature; the general acceptance was that crush syndrome was not a major medical complication among victims of earthquakes.

The Armenia experience, however, indicated that crush syndrome in fact **did** exist as a significant problem that required medical attention. Crush syndrome comprised 11 percent of all injuries presented to the Ministry of Health two weeks after the earthquake. An estimated 10 percent of the people who were extricated from collapsed structures developed kidney failure, which completely overwhelmed the region's capacity to deliver dialysis, which is relatively high technology care.

Compared to the experience in other earthquakes such as those of Mexico City and Loma Prieta, and other earthquakes in Nicaragua (1972), Guatemala (1976), and El Salvador (1986), where the number of cases with crush syndrome was sparse, the documentation of this condition in Armenia suggested the following: 1) Crush syndrome is more likely to occur in urban areas where medical relief does not or cannot arrive at the extrication site early. On a per capita basis, relatively few cases were seen in Mexico City, where the existing systems for medical care were adequate, unlike those in Armenia; and 2) Crush syndrome rarely occurs in single story structures, where occupants may flee more readily or where rescue is relatively easy to perform. Therefore, crush syndrome would be expected to be seen in urban rather

than in rural areas where single story dwellings are likely to exist.

Prior to Mexico City and Armenia, the location and extrication of victims from modern buildings was not emphasized as a research need. Today, search and rescue (SAR) has emerged as a significant activity because first responders must deal with immediate morbidity and mortality. Successful SAR endeavors consist of rapid location, access, extrication, stabilization, and transportation of victims.

The "golden 24-hour period" has been described for victims of building collapse. This time period implies that the chances of survival are greatest within twenty-four hours after being entrapped.

Observations made after the 1976 Tangshan earthquake in China and the 1980 Campania-Irpinia earthquake in Italy showed that the proportion of people found alive declines rapidly with increasing delay in extrication.

Similarly, the number of live rescues decreased with increasing time, with highest proportions seen less than 18 hours after the earthquake.

If any significant reduction in earthquake mortality is to be achieved, it follows that attention should be given to appropriate SAR action within the first two days after impact.

Clearly, the time factor of prompt rescue is critical for survival. Given that external relief generally does not arrive within 48 hours of an earthquake, efforts in disaster management are presently shifting to prevention and preparedness. Earthquake preparedness and self-reliance in the community are now stressed, particularly the training and education of local volunteers in basic first aid and rescue in earthquake-prone areas.

Studies in SAR also have led to the closer integration of rescue teams with on-site medical personnel. This has resulted in increased chances for survival of entrapped victims who are given immediate medical attention, including receipt of intravenous fluids, stabilization of the neck with cervical collars, and maintenance of patient airways.

The Loma Prieta experience illustrates the process of treating while extricating, as opposed to waiting until the entrapped victim is outside of the collapsed structure.

Finally, the occurrence of recent earthquakes in Mexico City, Armenia, Loma Prieta, and Luzon, the Philippines, has underscored the necessity among governments for disaster preparedness and response. In addition, it has stimulated further interest by academic institutions and, consequently, the importance of earthquakes as a public health problem is now widely recognized.

A number of disaster research centers at universities concentrate on health and medical effects of disasters, among them collaborative centers under the sponsorship of the World Health Organization We also see greater involvement by the public health sector in earthquake mitigation and preparedness. Some examples include: 1) CDC earthquake preparedness collaboration with Central US Earthquake Consortium (CUSEC); and 2) CDC earthquake preparedness planning project with Region IX Public Health Service in San Francisco.

Finally I would like to address areas for changes in practice which require research:

While few studies have been done to assess the health and medical response, the knowledge base is still lacking. For example, the precise causes of deaths and injuries in building collapse is not well studied. This incomplete data base often results in inappropriate relief services, as well as in inadequate planning for earthquake response.

A study of the details of entrapment, types of injuries and mortality would result in appropriate training for search and rescue, community education, emergency planning, and appropriate rehabilitation programs. The exact nature of immediate medical needs in terms of trauma, injury (fatal or nonfatal), and mortality together with their relationship to structural and demographic factors of the community and the physical circumstances of entrapment would contribute significantly to community education, earthquake planning, response worker training, and appropriate rehabilitation programs.

Earthquake response involves multiple disciplines, but the **integration** of knowledge bases from emergency management, geology, structural engineering, architecture, public health and emergency medicine, among others, is acutely lacking.

A familiar concept in emergency management is the comprehensive emergency management system, which is the conceptual framework for organizing and managing emergency protection efforts. The application of the concept is the integrated emergency management system which refers to the incorporation of all available resources for the full range of emergencies and the full range of issues that relate to emergency management. Likewise, a comprehensive approach should be extended to the research spectrum as well. Efforts are being made in this direction with the establishment of the National Earthquake Hazard Reduction Program under the leadership of the Federal Emergency Management Agency, the U.S. Geological Survey, the National Science Foundation, and the National Institute of Standards and Technology.

Postearthquake research findings have yet to be widely disseminated:

a) Specific guidance protocols that national emergency management agencies such as the Federal Emergency Management Agency's CPG 1-8 and 1-8A are normally provided to state and local governments. However, these protocols do not integrate the knowledge from disaster research for planning, training and education of disaster practitioners. Perhaps researchers also must attempt to disseminate their findings for operational use by appropriate emergency management agencies.

b) Furthermore, epidemiologic information from past disasters traditionally has not been linked to the management decision-making process, nor has it been integrated with training for emergency management. For example, epidemiologic studies regarding valid casualty estimation models, disease control and sanitation after earthquakes, and problems associated with external relief have not been communicated with emergency managers.

In addition, emergency management needs to create an information system for the effective coordination of response and recovery operations. For instance, an inventory of specialized staff, heavy equipment, and medical supplies must be available in order to match needs with requirements given a minimum amount of time. Given this system, the health and medical response to an earthquake can function effectively in light of the constraints that earthquakes impose.

In summary, a deeper understanding of the health and medical effects of earthquakes in urban areas has been realized with the rescue events. An expansion of the present knowledge base and the integration of that information with different disciplines should increase our capacity to respond effectively to the next earthquake.

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ASSESSING THE MENTAL HEALTH OF POST EARTHQUAKE VICTIMS

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The psychological research concerning people's reactions to natural disasters has yielded mixed results Some authors have claimed that disasters produce new mental illnesses, exacerbate old ones, and affect people adversely for long periods of time. Other researchers suggest that after the initial response of anxiety and general numbness people begin to react rationally and cope with their stress. From their point of view victims soon regain their pre-disaster level of mental functioning.

Psychological research on earthquakes is often mingled with investigations about other natural disasters. Earthquakes present their own psychological stressors. They are unexpected and, because of the aftershocks, it is difficult for people to know that the worst is over; instead, they fear more is coming, but they cannot know when or how severe the next tremor might be. On the other hand, hurricanes (typhoons and cyclones), volcanic eruptions, and flooding are generally preceded by warnings and offer time for evacuations. After their onset they leave without lingering. Unlike earthquakes, there is most commonly a low point, a turning moment which allows people to know the worst is over.

The purpose of this presentation is to present a detailed and orderly account of people's emotional reactions to earthquakes. I will show that, in addition to the stress of the earthquake, there are social and cultural variables which contribute to people's reactions. Furthermore, I will demonstrate that the manner in which victims cope influences how relief workers respond, which in turn changes the victims' responses. I will also present several policy recommendations.

With a Quick Response Grant from the Natural Hazards Research and Applications Information Center at the University of Colorado, I was able to conduct a participant observational study in Watsonville, California, a small agricultural city of 30,000 people severely affected by the 1989 Loma Prieta earthquake. Within 24 hours after the earthquake, I began to eat, sleep, and talk with evacuees in the various shelters serving Watsonville. Working with local school counselors, I was also able to visit schools and talk to students and teachers. I interviewed victims in their homes and visited migrant farm camps. I also collected archival data, being given access to school records, and to information from a community health agency. I also read newspapers, census reports, and other government documents.

The information from the study revealed a psychological response on the part of the victims and relief workers that occurred in phases. In the immediate hours after the earthquake, most people were very afraid. The earthquake not only came without warning, but it lingered on with severe aftershocks. Many of the residents had been victims of the 1985 Mexico City earthquake, and they remembered that it was the aftershocks that caused so much damage.

Nevertheless, during this first phase, both victims and volunteers showed altruism. Within hours, victims began helping other victims. Further exploration revealed that altruism served an important psychological function: by helping others, the victims coped with the sense of being unjustifiably hurt.

In the second phase, both victims and relief workers reorganized their thinking about the events, either by forgetting what happened, or by distorting their own roles in the series of

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events that followed the earthquake, or more frequently by denying the magnitude of the disaster so they could accept its effects more easily. This presented a variety of problems. In families, parents and children inadvertently colluded to ignore their pain. In schools, counseling of students by teachers ended prematurely.

The victims who used denial to cope with their mental stress often had their symptoms come out in unusual ways, such as one 12-year-old boy whose trouble centered around a toothache, or an 11-year-old child who functioned well until her cat ran away.

In shelters and relief agencies, relief workers who wanted to help victims could not, because victims denied their pain. The victims needed to deny the predicament they were in, and the volunteers needed to have victims in order to be helpful. As a result, there appeared to be an excess of volunteers. This caused considerable frustration among relief workers.

As denial waned, anxiety emerged, turning in the third phase for both victims and volunteers, into anger. Victims were angry for being victimized and unjustly treated by God. Their anger and frustration increased when they had to accept the rules and regulations of the agencies trying to help them. Most victims took out their anger at relief workers, and many relief personnel responded by becoming depressed, burned out, or angry.

Many relief workers who were attacked took out their anger and frustration by responding in kind to the victims, often by exerting their power through a rigid reliance on rules and by the use of arbitrary power. Disputes between victims and relief agencies were common. There were ethnic differences as many of the disputes between victims and officials brought to the surface memories of unfortunate and similar past experiences for the Mexicans and the Mexican-Americans.

Frustration and anger were present in almost all victims. Those victims who had helpful family, community support, who were able to call on religion, or who had good mental health prior to the earthquake were better able to resolve their feelings.

In the first three phases, the psychological needs of victims contributed to the difficulties of volunteers, and the difficulties the volunteers faced heightened the emotional problems of the victims.

A fourth phase, final resolution, is only briefly mentioned because there was not enough time in the field to see it come about, and even now, almost two years after the earthquake, many people have not resolved their losses, both material and psychological.

Several policy recommendations emerged from the study. Even though victim volunteers are not as effective as professionals, victims need the experience of helping others, as it is necessary for their own psychological recovery. Thus, from phase one comes the suggestion that victims should be given a legitimate role in recovery.

In phase two, relief workers need to learn to be aware of denial and its effects on volunteers. Likewise, school officials and others who are dealing with victims need to be aware of the need victims have to use denial, to know when denial becomes counterproductive for victims, and finally to understand how denial on the part of victims affects the psychology of volunteers.

By phase three the frustration of both victims and volunteers came out in conflicts between them, which was further aggravated by past history and bureaucratic rigidity. These emotions can best be reduced by education The suggestions are to provide information about the culture of the community, to have lectures concerning the subtle and strange manifestations of stress symptoms, to teach relief workers about mental status and how to take a mental status exam, and through supervised experience in simulated activities to provide practical experience for relief personnel. These suggestions would go a long way in helping relief workers understand the normal process of psychological recovery.