Editorial

Earthquake disaster-associated health effects and the need for improved preventive measures.

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During the past 20 years, earthquakes alone have caused more than a million deaths worldwide[1]. Nine countries (Armenia, Chile, China, Guatemala, Iran, Italy, Japan, Peru, and Turkey) account for more than 80% of all fatalities in this century, and almost half of the total numbers of earthquake casualties in the world during this period have occurred in China alone[2].

The recent Nepal earthquake of April 25, 2015 of magnitude 7.8 on the Richter scale had its epicenter in the area near Barpak, a mountain village between the capital, Kathmandu, and the tourist town of Pokhara. The earthquake was followed by many powerful after shocks on the same day and a very powerful one (6.7 on the Richter scale) hit Nepal on the very next day, Sunday April 26.

The earthquakes, which caused extensive damage to buildings and thousands of deaths and injuries were even felt in Pakistan, India and Bangladesh.

In Nepal many historic and recently-built buildings collapsed or were very badly damaged, temples have been ruined, roads destroyed. There were nearly 8,800 deaths and more than 23,000 injured in Nepal and tens of deaths in India & Tibet. The quake was followed by more than 1000 after shocks and another huge earthquake (7.3 on the Richter scale) on May 12.

Despite remarkable scientific progress in seismology and earthquake resistant engineering during the past few years, achieving high standards of safety against earthquakes is a goal that has yet to be achieved in many parts of the world. But in Nepal, due to lack of resources and an unstable political situation, no proper safety measures were established a head of time, resulting in great loss of innocent Nepalese (and foreigners) people's lives and earthquake related injuries and illness.

People's health impact: In most earthquakes disasters, people are killed by mechanical energy as a direct result of being crushed by falling building materials. Deaths resulting from major earthquakes can be instantaneous, rapid, or delayed[3]. Instantaneous death can be due to severe crushing injuries to the head or chest, external or internal hemorrhage or drowning from earthquake-induced tidal waves (tsunamis). Rapid death occurs within minutes or hours and can be due to asphyxia from dust inhalation or chest compression, hypovolemic shock, or environmental exposure (e.g., hypothermia). Delayed death occurs within days and can be due to dehydration, hypothermia, hyperthermia, crush syndrome, wound infections, or postoperative sepsis[4,5]. As with most natural disasters, the majority of people requiring medical assistance following earthquakes have minor lacerations and contusions caused by falling elements, like pieces of masonry, roof tiles and timber beams[6]. The next most frequent reasons for seeking medical attention are simple fractures not requiring operative intervention[7].

Such light injuries usually require only outpatient treatment and tend to be much more common than severe injuries requiring hospitalization. Major injuries requiring hospitalization include skull fractures with intracranial hemorrhage (e.g., subdural hematoma); cervical spine injuries with neurologic impairment; and damage to intrathoracic, intraabdominal, and intrapelvic organs, including pneumothorax, liver lacerations, and ruptured spleen. Most seriously injured people will sustain combination injuries, such as pneumothorax in addition to an extremity fracture. Am-putations and chronic sequelae of orthopedic and neurologic injuries, especially spinal cord injuries, can be expected[8]. Huge amounts of dust are generated when a building is damaged or collapses, and dust clogging the air passages and filling the lungs is a major cause of death for many building-collapse victims[2,9,10]. Fulminant pulmonary edema from dust inhalation may also be a delayed cause of death[11]. Dust has hampered rescue and clean-up operations by causing eye and respiratory-tract irritation. Burn sand smoke inhalation from fires used to be major hazards after an earthquake.

During the urbanization process, cities are laden with chemical and petroleum products that could contribute substantially to the generation of toxic substances following an earthquake[11,12]. Industrial storage facilities for hazardous

materials might explode or leak and damage to a nuclear power plant could lead to widespread contamination by radioactive materials. In a major earthquake, pipelines carrying natural gas, water, and sewage can be expected to be disrupted.

In earthquakes, people over 60 years of age are at increased risk for death and injury and can have a death rate five times higher than that of the rest of the population. Children between 5 and 9years of age, women, and the chronically ill also seem to be at an elevated risk for injury and death[12]. Lack of mobility to flee collapsing structures, inability to withstand trauma, and exacerbation of underlying disease are factors that may contribute to the vulnerability of these groups. Mortality distribution by age will also be affected to a certain degree by the social attitudes and habits of different communities. In general, the morbidity and mortality rates are significantly greater among people who are indoors than among those who are outdoors when the tremor begins [9]. Although the probability of finding live victims diminishes very rapidly with time, entrapped people have survived for many days. People have been rescued alive 5, 10 and even 14 days after an earthquake[13], and these "miracle rescues" are often the result of exceptional circumstances. For example, someone with very light injuries could be trapped in a void deep in the rubble with air and possibly water available.

What efforts need to be taken to improve preventive measures?: Prevention and control efforts need to be multidisciplinary and should include public education programs, as well as better building design and improved quality of construction in those areas most likely to suffer an earthquake[14]. Avoiding unnecessary residential and commercial construction on or near active faults and in areas subject to landslide slope failures, soil liquefaction, and rock falls is technically a secondary prevention measure for earthquakes, but it is a primary prevention measure for earthquake related injuries[15]. Prompt rescue should improve the outcome of victims, and early medical treatment should lessen the sequelae of the primary injuries (e.g., wound complications, chronic neurological disabilities). Provision of adequate food, water, and shelter should especially help people in vulnerable age groups and those with pre-existing diseases. Effective environmental control measures should prevent secondary environmental health problems, such as gas leaks, fallen or loose wires, damaged appliances and pipelines, sewage backup, and water contamination. Public health officials need to establish in advance how the affected areas will be surveyed. Just as speed is required for effective search and extrication, it is also essential for effective emergency medical services, since the greatest demand occurs within the first 24 hours[9].The medical and public health impacts of a severe earthquake may well be compounded by significant damage to medical facilities, hospitals, clinics, and supply stores within the affected area [16].

In the worst-case scenario, a hospital building may itself be damaged by the earthquake, and the hospital staff may have to continue emergency treatment without using the buildings[17]. Hospital emergency plans in earthquake areas should provide for the contingency of evacuating patients from the wards; safely removing critical equipment from operating theaters, radiology departments, and other parts of the hospital; and re-establishing routine patient-care services[18].

In addition, a comprehensive training course conducted in advance is essential for provision of sophisticated medical care to victims in the first hours after a catastrophic earthquake. In such a scenario physicians, nurses, and other health care providers who will encounter situations for which they have not been prepared. Therefore, a thorough training course should be required for all medical facility staff. As outlined in the medical disaster-response model, the subjects covered in the training course would be mass-casualty triage, airway management, use of intravenous fluids, anesthesia and analgesia in the field, crush-injury treatment, and command and control.

Problems and challenges: The first need in earthquake assistance is medical care and medicines for the injured in a situation where all government hospitals in the area have been destroyed. Teams of independent doctors from other parts of the country, along with army medical staff, are providing some basic access in such areas in Nepal. However, some recently created medical camps in different areas, mainly in rural Nepal, seem to have very few or no bandages, gauze or painkillers. There is also a need for basic provisions, including food, water and tents.

Earthquakes will continue to affect human populations into the distant future. With technologic advances, increasingly complex infrastructures, and new building designs, the built environment will evolve over time. Shifts in population locations and characteristics will accompany these environmental changes. Every earthquake is different, as is every population affected. Thus, despite the significant challenges involved, there is a critical need for evidence-based prevention and preparedness efforts to ensure the best possible chances of limiting earthquake related death, injury and destruction in the future.

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