ABC of conflict and disaster
Natural disasters

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This is the second in a series of 12 articles

Disasters are commonly divided into "natural" and "man made," but such distinctions are generally artificial. All disasters are fundamentally human made, a function of where and how people choose or are forced to live. The trigger may be a natural phenomenon such as an earthquake, but its impact is governed by the prior vulnerability of the affected community.

Poverty is the single most important factor in determining vulnerability: poor countries have weak infrastructure, and poor people cannot afford to move to safer places. Whatever the disaster, the main threat to health often comes from the mass movement of people away from the scene and into inadequate temporary facilities.

International medical aid

Local medical services may be disrupted and require international help, not only in dealing with the effects of the disaster but also to maintain routine health facilities for unrelated conditions. An often overlooked aspect of medical need is the rehabilitation of those disabled by the disaster. Help in this regard can be provided in a planned and measured fashion and is often required for years.

The effectiveness of international surgical teams is limited by the delay in getting to a disaster area. However, outside medical and surgical help may be needed in the post-emergency phase. International aid can help national and local authorities to restore routine medical and surgical facilities overwhelmed by the disaster and may support later specialist elective services.

Survivors with crush injury invariably stimulate requests for international aid in the use of dialysis. This is a complex issue raising difficult questions about sustainability and appropriate use of limited resources. As with much aid in complex circumstances, this is best negotiated with guidance from international aid organisations and agencies such as the International Society of Nephrologists.

Types of disaster

Earthquakes

Movements of the Earth's crust create tremors below ground every day; fortunately the vast majority are out at sea. The point nearest to the surface is the epicentre and marks the site where the quake is strongest. Force is measured on the Richter scale—a logarithmic scale, so that a force 7 quake is 10 times stronger than force 6 and 100 times stronger than force 5. When earthquakes occur near to or on land, the major danger is from building collapse. Survivability is not always related to building height. Falling debris and entrapment pose the greatest risks.

Search and rescue

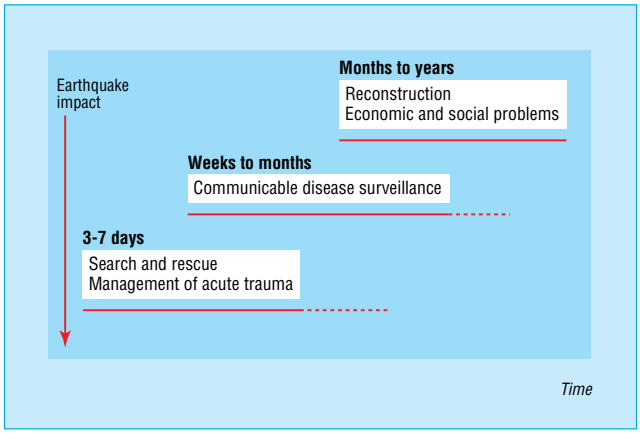
Most successful rescues take place within the first 24 hours. Most lives are saved by the immediate actions of survivors. Local authorities implement the second phase, when a more coordinated response is established with local rescue teams joining the survivors. In the third phase more intensive and focused efforts are supplemented with extra help from other areas. The fourth and final phase involves the provision of specialist aid for rescuing people deeply entrapped.

Most search and rescue is done by survivors, not external teams

Importance of socioeconomic factors in effects of disaster

Characteristics and effects of earthquake	San Fernando, California, 1971	Managua, Nicaragua, 1972
Magnitude (Richter scale)	6.6	5.6
Duration of strong shaking (seconds)	10	5-10
Population of affected area	7 000 000	420 000
No of deaths	60	4 000-6 000
No of people injured	2 540	20 000
No of houses destroyed or unsafe	915	50 000

Adapted from Seaman J. *Epidemiology of natural disasters.* Basel: Karger, 1984



Timing of health needs after earthquake

Buildings and injury from earthquake

- Multistorey framed construction leaves cavities in a "lean to" or "tent" collapse where minimally injured survivors may be found
- Medium and low rise buildings of brick or local materials collapse into rubble with little or no room for survivors.
- Residential property is more fully occupied at night, when earthquakes can be more deadly

Risks associated with entrapment after an earthquake

- Lack of oxygen
- Hypothermia
- Gas leak
- Smoke
- Water penetration
- Electrocution

Up to three times as many people are injured as are killed, presenting an enormous burden to local medical facilities. The combination of injury and entrapment places a limit on survival. Major head and chest injuries are usually fatal. Peripheral limb injuries are the commonest surgical problems, and the effects of crush injury are the most complex.

The greatest effects of earthquakes will be non-medical, with the loss of communication, transport, and power. Water supplies can be disrupted but are rarely contaminated. Fear of the unburied dead as a reservoir for disease is unfounded.

Tsunami (tidal wave)

Earthquakes occurring at sea may produce seismic waves; as these Tsunami approach land and enter shallower water, they slow and the energy transfers into a wall of water. Buildings are destroyed by the initial impact, and by the drag of water returning to the sea eroding foundations. Further danger comes from residual flooding and floating debris. Most deaths are due to drowning, and, unlike in earthquakes, the dead outnumber the injured. This was vividly shown by the tsunami in the Indian Ocean on 26 December 2004.

Landslides

Heavy storms can destabilise rock and soil, particularly in areas of deforestation (a human made rather than natural phenomenon). Mudflows can follow tsunami, floods, and occasionally earthquakes. Extricating victims from the compressive effect of the mud can be difficult, and the weight of the mud can produce crush injury and crush syndrome. Intravenous fluid loading before, during, and after rescue may protect against a catastrophic fall in blood pressure that can follow sudden release after prolonged entrapment.

Floods

Although the immediate impact on survivors is likely to be injury and the death of relatives, damage to crops, housing, and infrastructure can conspire to precipitate acute food shortages and homelessness. Water supplies may be contaminated with sewage, leading to disease.

Volcanic eruptions

Because volcanic ash eventually provides highly fertile soil, areas vulnerable to volcanic activity are often well populated. There is a greater risk from injury from falling rocks than there is from burns, but homelessness, both temporary and permanent, poses the biggest threat to health. Special threats to life include ash falls, pyroclastic flows (horizontal blasts of gas containing ash and larger fragments in suspension), mud flows, tsunami, and volcanic earthquake.

Hot volcanic ash in the air can produce inhalational burns, but only superficial burns to the upper airways will be survived. Respiratory effects of ash include excessive mucus production with obstructive mucus plugs, acute respiratory distress syndrome, asphyxia, exacerbation of asthma, and silicosis. Toxic gases may be emitted, and poisoning from carbon monoxide, hydrofluoric acid, and sulphur dioxide can occur.

Tropical storms

Convention dictates that tropical storms in the Indian Ocean are called cyclones, those in the north Atlantic, Caribbean, and south Pacific are called hurricanes, and those in the north and west Pacific are called typhoons. They occur as humid air twists upwards from warm sea water into cooler air above. Over the sea, air may move at speeds of more than 300 kph, twisting anticlockwise in the northern hemisphere and clockwise in the southern. Flying debris causes injury, and secondary flooding may occur.

Aftermath of the 1988 Armenian earthquake. The unburied dead pose little or no risk to the living

Crush injury and crush syndrome

Crush injury	Crush syndrome
• Skin necrosis	• Rhabdomyolysis
• Rhabdomyolysis	• Renal failure
• Bony injury	• Hyperkalaemia

Volcanic eruption, Cape Verde. The eruption itself caused few deaths and injuries, but a cholera outbreak followed the mass evacuation of local people to tented accommodation

Dangers from volcanic eruptions

Lava flows
- Destroy everything in their path
- Risk of secondary fires
- Move slowly and predictably
- Limited direct risk to life

Pyroclastic flows
- Horizontal blasts of gas containing ash and larger fragments in suspension
- Material can be 1000°C
- Move at several hundred kph
- Speed and unpredictability of movement pose a considerable risk to life

Mudflows
- Occur when heavy rain emulsifies ash and loose volcanic material
- The mud, with a consistency of wet concrete, can reach speeds >100 kph flowing downhill

Famine

Famine may complicate all "natural" and human made disasters, and socioeconomic and political issues lie at the roots of cause and prevention. Trigger levels for urgent humanitarian intervention include a rise in crude mortality to 1 in 10 000 a day, pronounced wasting (loss of >15% of normal body weight), and food energy supplies of <1500 kcal (6.3 MJ) a day.

An adequate response requires planning and coordination at national and international levels. Famine, like other "natural disasters," leads to the mass movement of people. It is a cause or consequence of other humanitarian crises including complex emergencies—where conflict compounds humanitarian needs and responses.

Children are among the most vulnerable during famine

Case study

Hurricane Andrew and health coordination

Three days after Hurricane Andrew struck south Florida in August 1992, epidemiologists performed a rapid needs assessment using a modified cluster sampling method. Firstly, clusters were systematically selected from a heavily damaged area by using a grid laid over aerial photographs. Survey teams interviewed seven occupied households in each selected cluster. Surveys of the same area and of a less severely affected area were conducted seven and 10 days later, respectively.

Initial results, available within 24 hours of starting the survey, found few injured residents but many households without working telephones or electricity. Relief workers were then able to focus on providing primary care and preventive services rather than diverting resources towards unnecessary mass casualty services. This represented the first use of cluster surveys to obtain population based data after a natural disaster (previously they had been used in refugee camps to assess nutritional and health status).

Medical services were severely affected: acute care facilities and community health centres were closed, and doctors' offices destroyed. State and federal public health officials, the American Red Cross, and the military established temporary medical facilities. Within four weeks after the hurricane, officials established disease surveillance facilities at civilian and military centres providing free care and at emergency departments in and around the disaster area. Public health workers reviewed medical logbooks and patient records daily, and recorded the number of patient visits using simple diagnostic categories (such as diarrhoea, cough, rash).

This surveillance allowed the health status of the affected population to be characterised and the effectiveness of emergency public health measures to be evaluated. Surveillance information was particularly useful in refuting rumours about epidemics, so avoiding widespread use of typhoid vaccine, and in showing that large numbers of volunteer healthcare providers were not needed.

Although the surveillance achieved its objectives, there were several problems. Data from the civilian and military systems had to be analysed separately because different case definitions and data collection methods were used. There was no baseline information available to determine whether health events were occurring more frequently than expected. Also, rates of illness and injury could not be determined for civilians because the size of the population at risk was unknown.

Although proportional morbidity (number of visits for each cause divided by the total number of visits) can be easily obtained, it is often difficult to interpret. An increase in one category (such as respiratory illness) may result from a decline in another category (such as injuries) rather than from a true increase in the incidence of respiratory illness.

Hurricane Andrew, one of the most destructive hurricanes in US history, inflicted widespread damage

Further reading

- International Society of Nephrology (ISN). www.isn-online.org/site/cms/
- cyberNephrology (National Kidney Foundation). www.cybernephrology.org/

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The ABC of conflict and disaster is edited by Anthony D Redmond; Peter F Mahoney, honorary senior lecturer, Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, Birmingham; James M Ryan, Leonard Cheshire professor, University College London, London, and international professor of surgery, Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD USA; and Cara Macnab, research fellow, Leonard Cheshire Centre of Conflict Recovery, University College London, London. The series will be published as a book in the autumn.

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