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Disaster Preparedness: Current Trends and Future Directions

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Abstract: ***Globally disasters and calamities throw up major challenges for national governments. The major challenge is the protection of life, property, and the vital life-supporting infrastructure necessary for disaster mitigation. Any delay or laxity in disaster relief could escalate the magnitude of distress for the victims. Natural disasters inflict severe damage on almost the entire spectrum of social and natural habitats, ranging from housing and shelter, water, food, health, sanitation, and waste management to information and communication networks, supply of power and energy, and transportation infrastructure. The major challenges faced in all disasters include pre- disaster early warning infrastructure; the supply of food and clean drinking water; health and sanitation; information and communication; power and energy for lighting and cooking; waste collection and disposal, including rapid disposal of dead bodies of humans and animals; disaster-proof housing and shelter; emergency and post- disaster shelters; rescue and relief operations; and transport infrastructure. Though it is not possible to prevent most of the disasters, still their effects can be alleviated or mitigated in magnitude by anticipated preparedness. Advanced disaster management technology could provide a critical support system for disaster management authorities at times of disaster-related crises. Such a technology also provides important inputs for any disaster management plan of action in modern times. Communities and individuals have to be educated on pre-disaster planning and preparedness. Awareness must be created amongst masses, for which first-aid training at grass roots level is essential. There should be a National Disaster Plan that defines the tasks of the communities and local health personnel. The paper examines the evidence for changes in thinking at the government and inter-government level. It also looks at examples of ways in which these policy undertaking are being interpreted and put into practice.***

Keywords: Disaster, Earthquake, Emergency Preparedness, disaster mitigation, climate change, armed conflict, risk management, telemedicine, EMS, terrorist threats, community participation, triage guidelines

1. Introduction

A disaster is a serious disruption in the functioning of a community or society, causing widespread human, material, economic, or environmental losses that exceed the ability of the affected society to cope using its own resources. Disasters come in all shapes and sizes, and have origins that range from natural to artificial (UNISDR, 2009). Natural disasters have been visiting every part of the globe at one time or the other. The world is becoming increasingly vulnerable to natural disasters. From earthquakes to floods and famines, mankind is even more threatened by the forces of nature. Disasters can strike at any time, at any place. Nearly three million people worldwide may have been killed in past 20 years due to natural disasters such as landslides, earthquakes, floods, tsunamis, snow avalanches, cyclones etc. Ninety per cent of the natural disasters and ninety five percent of the total disaster related deaths worldwide occur in developing countries in which India has the second largest share.[1] [Fig. 1]

There is no single measure of a disaster that can capture the full scope of a disaster. A common measure is the number of people killed or affected. The individual will consider the impact on his or her family and livelihood. Disaster managers will assess the speed and success of the disaster response. To think seriously about a disaster means we must consider all affected and their losses both in the immediate and the longer term.[1,2,3]

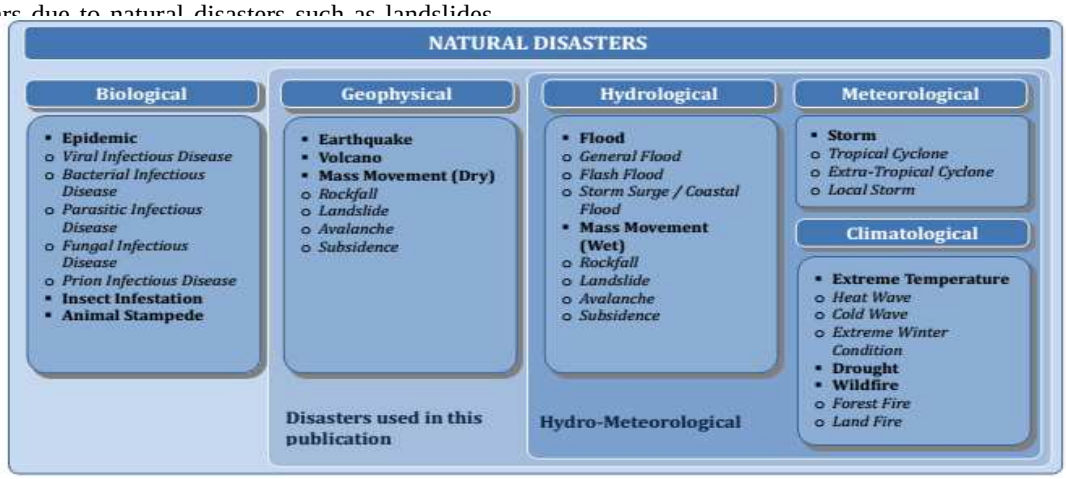


Figure 1: Natural Disasters Classification

2. Himalayan Tragedy

Nepal on 25 April 2015 was rocked by a 7.9 magnitude earthquake, the worst in last 81 years. The quake hit with a devastating force less than 80 miles from the capital Kathmandu causing tremors and damage in various parts of India also. The earthquake destroyed many historical landmarks, including the UNESCO World Heritage temples at Basantapur Durbar Square and the Dharara tower, both in central Kathmandu. The death toll from the devastating earthquake in Nepal has risen to 8,583 as on 17 May, 2015. A Red Cross report put the number of injured at 17,576, adding 6,271 people were still missing following the 7.9 magnitude quake. More than 130,000 houses were reportedly destroyed. Thousands of villages have been devastated, 2,5,00,000 buildings destroyed, with up to 90% of clinics and schools in some districts rendered unusable. [Fig 2] Nearly 60 foreigners had died in the two earthquakes and 112 foreigners were still unaccounted for. The previous deadliest earthquake to strike the country - in 1934 - killed at least 8,519 in Nepal, as well as thousands more in neighboring India.[4,5,6]

For decades, experts have been saying that Nepal is extremely prone to tremors, but the advice was not taken on and little was done to prepare the mountainous country to cope with an earthquake of this magnitude. The Nepalese were not prepared for such a strong earthquake. To being located on colliding tectonic plates, it is Nepal's shoddy infrastructure and poor building standards that made the disaster imminent. Physically and geologically what happened is exactly what experts thought would happen. The disaster in Nepal, therefore, is the result of a shaky foundation: physically, economically, and politically. Meanwhile, radar images from Europe's Sentinel-1a satellite have revealed the aftermath of the Nepal earthquake. The images show that Mount Everest shrank by about one inch due to the land that was shaken in the natural disaster. Further, an area 75 miles (120km) by 30 miles (50km) has lifted up 3.2ft (1 metre) from the ground around the capital, Kathmandu.[7]

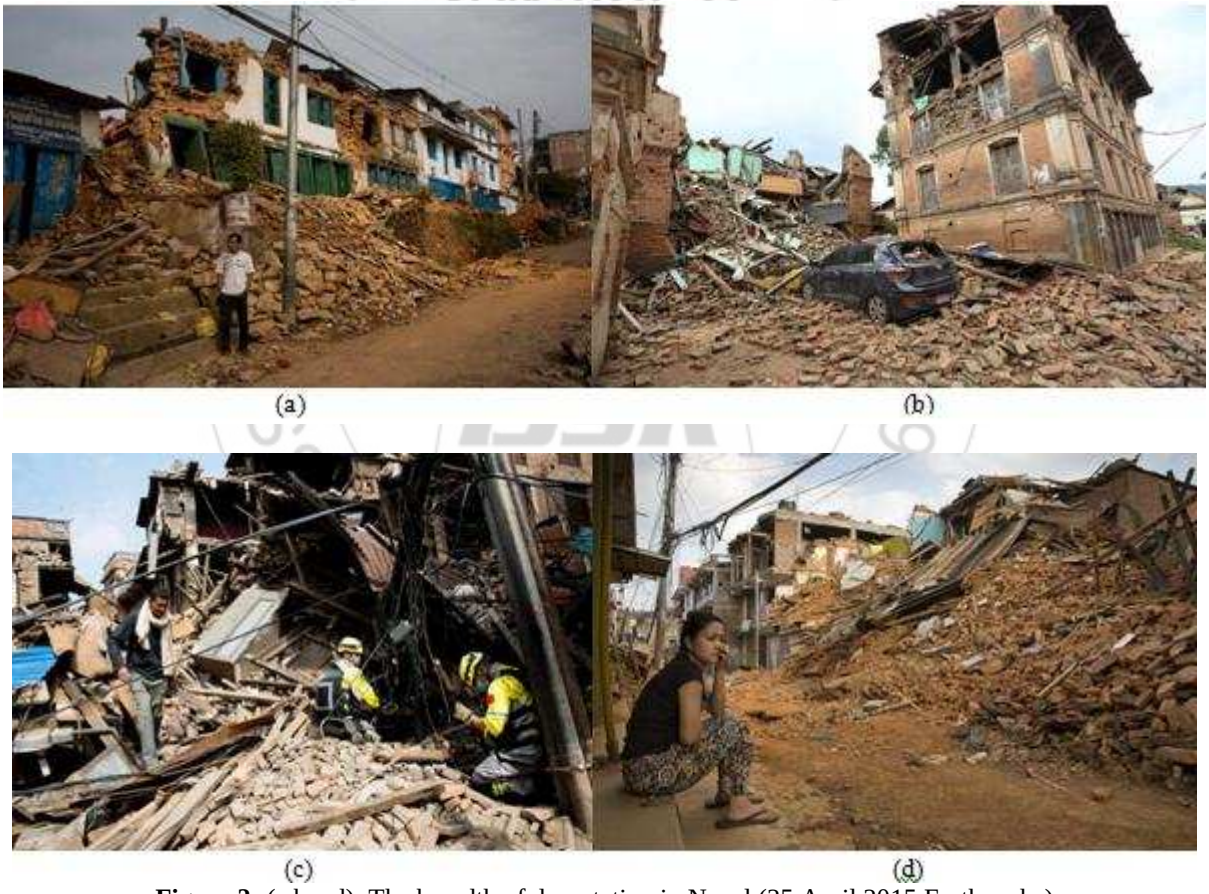


Figure 2: (a,b,c,d): The breadth of devastation in Nepal (25 April 2015 Earthquake)

The powerful earthquake that has led to a humanitarian crisis in Nepal was one that authorities and citizens had long expected. As the country now tries to recover, criticism over the government's lack of preparation has put the spotlight on a state torn by a legacy of civil war, poverty and political gridlock. Political instability has been coupled with years of economic difficulties, resulting in limited work by Nepal on disaster risk reduction.

Preventing an earthquake from becoming a true national disaster is a very expensive proposition. Rich countries can do this; however, Nepal is a very poor country with very weak political leadership. Nepal is categorized as a low-income country by the World Bank. It ranks among the poorer countries in the world, with a GDP of just over 19 billion and a population of 27.8 million. Nepal has abundant hydroelectric capability that is very much underutilized; likewise Nepal has not really made the transition to an industrial or post-industrial country. Nepal had to rely

mostly on agriculture and tourism for income sources, in addition to receiving almost 29 percent of its GDP from remittances by citizens abroad.[8]

The South East Asian Region has been the site of the largest earthquakes in the Himalayas, including a 2005 quake in the Kashmir region and a 1905 earthquake in Kangra, India'[9,10,11]

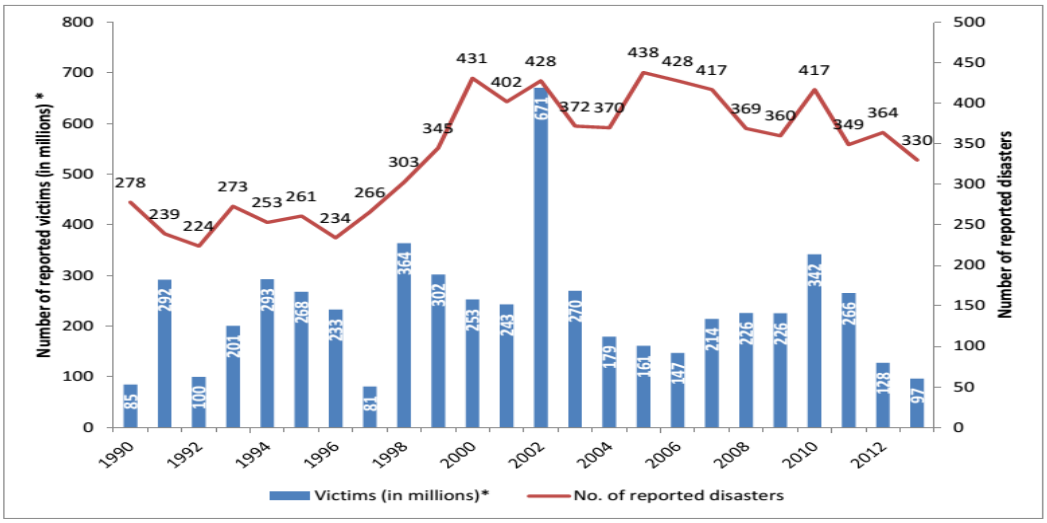
3. Natural Disasters Timeline

Some important and major disasters recorded in recent history include Chillán Earthquake of 1939, Valdivia Earthquake of 1960 (the most powerful earthquake ever recorded, rating 9.5), Hong Kong Flu Pandemic (H3N2) outbreak of 1968, which resulted in nearly 34,000 deaths, Bangladesh Tornado of 1973 (one of the worst tornado tragedies, 681 people were killed) Tabas Earthquake (centered about 600 kilometers southeast of Tehran of Tabas, the death toll was about 15,000), Spitak Earthquake of 1988 (at least 25,000 people killed, 19,000 injured and 500,000 homeless), Bangladesh Cyclone of 1991(at least 138,000 people were killed by the storm), Tropical Storm Thelma 1991(killing nearly 3,000 people), Great Hanshin Earthquake 1995 (more than 5200 deaths), 2001 Gujarat Earthquake (on 26 January 2001, 13,823 deaths), Severe acute respiratory syndrome is a respiratory disease in humans which is caused by the SARS coronavirus (SARS-CoV), Jun 2003 to Aug 2003, Great Sichuan, China, Earthquake of May 12, 2008, and a 7.9-magnitude earthquake (killing more than 70,000).[12]

Some World's worst earthquakes include: March 11, 2011, nearly 18,900 are killed when a tsunami triggered by a massive magnitude 9.0 undersea quake slams into the northeast coast of Japan, triggering a nuclear crisis at the Fukushima Daiichi atomic plant; October 23, 2011: an earthquake of 7.2 magnitude rocks eastern Turkey, leaving more than 600 dead; January 12, 2010, magnitude 7.0 quake hits Haiti, leaving 300,000 dead; April 14, 2010: a 6.9-magnitude quake hits Yushu county in northwest China's Qinghai province leaving 3,000 people dead; May 12, 2008: a quake measuring 8 hits China's southwest province of Sichuan, leaving more than 87,000 dead; May 27, 2006, a powerful quake in Indonesia's Yogyakarta region kills 6,000 and leaves 1.5 million homeless; October 8, 2005: an earthquake of 7.6 kills more than 75,000 people, the vast majority of them in Pakistan's North West Frontier Province and the Pakistani-administered zone of Kashmir state, some 3.5 million are displaced; March 28, 2005: an earthquake on Indonesia's Nias island of Sumatra leaves 900 dead; December 26, 2004: a massive undersea earthquake off the coast of Sumatra island triggers a tsunami which kills 220,000 in countries around the Indian Ocean, including 168,000 in Indonesia; December 26, 2003: a quake measuring 6.7 hits the Iranian city of Bam, killing at least 31,884 people and injuring 18,000; January 26, 2001: a massive 7.7 earthquake hits the western Indian state of Gujarat, killing 25,000 people and injuring 166,000; September 30, 1993: a 6.3-magnitude quake hits the western Indian state of Maharashtra, killing 7,601; October 20, 1991: a quake measuring 6.6 hits the Himalayan foothills of Uttar Pradesh state in India, killing 768; August 20, 1988: a magnitude 6.8 quake hits eastern Nepal, killing 721 people in Nepal and at least 277 in the neighbouring Indian state of Bihar; July 28, 1976: a magnitude 7.8 quake hits Tangshan, in north China's Hebei province, at least 242,000 people died; January 15, 1934: magnitude 8.1 quake hits eastern Nepal and Bihar state in neighbouring India killing 10,700 people.[12]

In 2013, 330 natural triggered disasters were registered. This was both less than the average annual disaster frequency observed from 2003 to 2012 (388), and represented a decrease in associated human impacts of disasters which were, in 2013, at their lowest level since 16 years. However, natural disasters still killed a significant number of people (21,610) but largely below the annual average between 2003-2012 (106,654) and 96.5 million people became victims worldwide, which was also below the 2003-2012 annual average (216 million). Like the other indicators, economic damages from natural disasters also show, in 2013, a decrease to average levels (2013 US $ 156.7 billion), with estimates placing the costs at US$ 118.6 billion. Over the last decade, China, the United States, Indonesia, the Philippines and India constitute together the top 5 countries that are most frequently hit by natural disasters. In 2013, China experienced its highest number of natural disasters of the last decade. The country was affected by a variety of disaster types, including 17 floods and landslides, 15 storms, 7 earthquakes and one mass movement of geological origin, one drought and one period of extreme temperature. Amongst the top 10 countries in terms of disaster mortality in 2013, five countries are classified as low income or lower-middle income economies. These countries accounted for 88% of global reported disaster mortality in 2013. Two disasters killed more than 1,000 people: the cyclone Haiyan in the Philippines, in November (7,354 deaths) and the monsoonal floods in June in India (6,054 deaths). The low number of reported natural disasters in 2013 (330), when compared to the annual average occurrence from 2003 to 2012 (388), was mostly due to a smaller number of hydrological and climatological disasters (18% and 45% below their 2003-2012 annual average, respectively). Hydrological disasters (159) still had by far the largest share in natural disaster occurrence in 2013 (48.2%), followed by meteorological disasters (106; 32.1%), climatological disasters (33; 10%) and geophysical disasters (32; 9.7%). In 2013, the number of people killed by disasters (21,610) was very far from the 2003-2012 annual average of 106,654 deaths. But this is mainly explained by the impact, on the decade's average, of three years (2004, 2008 and 2010) with more than 200,000 people reported killed and two years (2003 and 2005) with around 100,000 deaths, most of them having been killed by earthquakes. At a more detailed level, it appears that, in 2013, the number of people killed by floods (9,819) was the highest of the decade and the number of those killed by storms (8,583) the second highest. Deaths from floods had the largest share of natural disaster fatalities in 2013, representing 45.4% of global disaster mortality, while deaths from storms accounted for 39.7%. Most disaster victims in 2013 were sourced by cyclone Haiyan which affected 16.1 million people, by cyclone Phailin in India, in October (13.2 million) and by cyclone Utor/Labuyo in China, in August (8 million). Victims from these three cyclones accounted for 38.7 per cent of all natural disaster victims of 2013. Other disasters with severe human impact

were reported in China (one drought with 5 million victims, one flood with 3.5 million and one earthquake with 2.2 million), in the Philippines (one earthquake with 3.2 million victims and one flood with 3.1 million), in Thailand (one flood with 3.5 million victims) and in Zimbabwe (one drought with 2.2 million victims). In 2013, 51% of victims were from storms, 33% from floods, 8% from droughts and 7% from earthquakes. Only three countries accounted of 72.4 per cent of victims: China (28.5%), the Philippines (26.6%) and India (17.3%). Looking at the geographical distribution of disasters, Asia was the continent most often hit by natural disasters in 2013 (40.7%), followed by the Americas (22.2%), Europe (18.3%), Africa (15.7%), and Oceania (3.1%). This regional distribution of disaster occurrence resembles the profile observed from 2003 to 2012. In 2013, disaster occurrence in Asia (156) was similar to its 2003-2012 annual average (155). Inversely, numbers of disasters were below their decade's annual average in Africa (-38.6%), Oceania (-26.2%), the Americas (-19.8%) and Europe (-17.7%).[13] [Fig. 3,4,5,6]



Victims : Sum of deaths and total affected

Figure 3: Trends in occurrence and victims

DEADLIEST RECENT QUAKES

A glance at the world's deadliest earthquakes in the past decade:

Day	Year	Location	Deaths
April 25	2015	Nepal	1,457[1]
Aug. 3	2014	China	700
Sept. 24	2013	Pakistan	825
March 11	2011	Japan	18,000
Feb. 27	2010	Chile	700
Jan. 12	2010	Haiti	316,000
Sept. 30	2009	Indonesia	1,100
May 12	2008	China	90,000
Aug. 15	2007	Peru	500
May 26	2006	Indonesia	5,700
Oct. 8	2005	Pakistan	80,000
March 28	2005	Indonesia	1,300
Dec. 26	2004	Indonesia	230,000

1 – preliminary figure as of 3 p.m. ET Saturday.

SOURCES: USA TODAY research and the U.S. Geological Survey
Frank Pompa, USA TODAY

USA TODAY

Figure 4: Timeline of Natural Disasters

Country	Disaster distribution	No. of deaths	Country	Disaster distribution	Deaths per 100 000
Philippines		7750	St Vincent and the Grenadines		11.89
India		7119	Philippines		7.88
China P Rep		1395	St Lucia		3.29
United Kingdom		772	Solomon Is		1.78
Pakistan		730	Somalia		1.61
Japan		400	Cambodia		1.32
Mexico		223	Bolivia		1.27
United States		212	United Kingdom		1.20
Cambodia		200	Zimbabwe		0.88
Viet Nam		200	South Sudan		0.88

Figure 5: Top 10 countries in terms of disaster mortality in 2013 and distributed by disaster type

Damages (2013 US$ bn)	Africa	Americas	Asia	Europe	Oceania	*Global*
Climatological 2013	0.06	2.64	0.00	0.00	1.19	3.89
Avg. 2003-12	0.05	4.87	3.59	3.76	0.2	12.47
Geophysical 2013	0.00	0.00	9.03	0.00	0.05	9.08
Avg. 2003-12	0.71	4.44	39.67	2.04	2.58	49.45
Hydrological 2013	0.14	9.86	25.97	17.2	0.00	53.17
Avg. 2003-12	0.4	4.2	18.45	3.56	1.31	27.93
Meteorological 2013	0.03	21.83	23.45	5.09	2.02	52.42
Avg. 2003-12	0.08	52.65	9.55	3.75	0.83	66.86
Total 2013	0.23	34.33	58.45	22.29	3.26	118.57
Avg. 2003-12	1.24	66.16	71.26	13.11	4.92	156.71

Figure 6: Natural Disasters: Occurrence & impact

Asia accounted in 2013 for 90.1% of global disaster victims, followed by Africa (5.1%). Compared to their 2003-2012 annual averages, the number of victims in 2013 increased in Asia and Europe, decreased in Africa and the Americas, and remained stable in Oceania. On a more detailed note, hydrological disasters caused, proportionally, more victims in 2013 in Africa, the Americas, Europe and Oceania. Climatological disasters also created more victims in the Americas, Asia and Oceania; meteorological disasters in Asia and Europe and geophysical disasters in Asia. In 2013, the regional distribution of disaster damages kept the main profile observed from 2003 to 2012, with Asia suffering the most damages (49.3% of global disaster damages), followed by the Americas (28.9%), Europe (18.8%), Oceania (2.75%) and Africa (0.2%). Damages were below their annual 2003-2012 average in all continents except Europe. The highest drop occurred in Africa (-80.6%) while the lowering was less sharp in the Americas (-48.1%), Oceania (-33.8%) and in Asia (-18.0%). Inversely, in Europe costs of natural disasters were 69.8% above their decade's annual average. More precisely, costs of climatological disasters were above their 2003-2012 average in Oceania and near their average in Africa. Damages from hydrological disasters were above their decade's average in the Americas, Asia and Europe and damages from meteorological disasters in Asia, Europe and Oceania. Hydrological disasters contributed most to the increased damages in Europe, mainly due to the flood in South and East Germany. In Europe, the increase in damages can largely be attributed to the two earthquakes in Italy. [13] [Fig 7 a,b,c,d]

Figure 7: (a,b,c,d): South Asia Earthquake October 2005

4. Climate Change: A Reality

Extreme weather and climate events, interacting with exposed and vulnerable human and natural systems, can lead to disasters. Weather- and climate-related disasters have social as well as physical dimensions. As a result, changes in the frequency and severity of the physical events affect disaster risk, but so do the spatially diverse and temporally dynamic patterns of exposure and vulnerability. Some types of extreme weather and climate events have increased in

frequency or magnitude, but populations and assets at risk have also increased, with consequences for disaster risk. Opportunities for managing risks of weather- and climate-related disasters exist or can be developed at any scale, local to international. Some strategies for effectively managing risks and adapting to climate change involve adjustments to current activities. Others require transformation or fundamental change.

The deluge (September 2014 floods in Jammu & Kashmir) raises many questions about environmental degradation and climate change. Unplanned growth of cities and towns of Kashmir within and outside the flood basins has to be regulated and no growth is to be allowed within the river basin. Illegal mushrooming of houses within the river basin of Jhelum and Doodganga have been major contributing factors for overflow of river waters. It has obstructed the flow, swelled the river water and pushed the waters over the embankment and also forced the breach. According to WHO, unmitigated climate change will lead to significant increases in illness and death brought on by environmental changes. Climate change is considered the greatest global health threat of the 21st Century. The effects of climate change on health have begun to be well established. Little attention has been paid to the health systems that must adapt to deliver services that can respond to changing disease patterns and health needs of people. Climate change will have far-reaching effects on how we build, organize, and manage health systems as complex institutions. Developed economies have established surveillance and early-warning systems and planning tools, but developing nations lag far behind. To pursue development with concern for the fragile Himalayan environment is essential. Eco-sensitive development is more sustainable and equitable. Taking full advantage of scientific advances particularly in MET Sciences, Information Technology and rebuilding the cities/towns is an inescapable necessity. Community based research is required to measure the morbidity due to psychiatric diseases as a consequence of floods. Similarly the impact of disaster on the mental health of children and young adults should be a priority. Serious efforts are required to make disaster preparedness an important agenda of governance.[13]

5. Early Warning & Disaster Preparedness

In recent years, efforts in disaster management have gained impetus from the unprecedented development in information, communication, and space technologies (ICST), which have wide-ranging applications in disaster preparedness, reduction, mitigation, and management. ICSTs provide vital support for disaster management in many ways: observation, monitoring, data collection, networking, communication, warning dissemination, service delivery mechanisms, GIS databases, expert analysis systems, information resources, etc. ICSTs, especially remote sensing, have successfully been used to minimize the calamitous impact of disasters in all phases of disaster management.[1,2,3]

The widespread and consistent availability of current and accurate data is fundamental to all aspects of disaster risk reduction. For correct decision-making at any stage of natural disasters – from prediction to reconstruction and rehabilitation – a considerable amount of data and information is necessary. The most important procedures relating to information for disasters are monitoring, recording, processing, sharing, and dissemination. A dynamic communication system would serve to integrate many different communication categories such as: data transfer from observatory stations; data exchange among suppliers and users; exchange of information and experience; training and video conferences; and tele-control (commands). Space technology is a crucial component of ICST-enabled disaster management systems because it remains largely unaffected during disasters whereas both information and communication technologies which are based on ground infrastructure are vulnerable to natural disasters.

The wide spectrum of ICSTs used in disaster preparedness, mitigation, and management include: Remote sensing; Geographical Information System (GIS); Global Positioning System (GPS); satellite navigation system; satellite communication; amateur and community radio; television and radio broadcasting; telephone and fax; cellular phones; internet, e-mail; and special software packages, on-line management databases, disaster information networks. Critical applications of ICSTs include the following: to develop and design *early warning systems* which include: understanding and mapping the hazard; monitoring and forecasting impending events; processing and disseminating understandable warnings to administrative authorities and the population, and undertaking appropriate and timely actions in response to the warnings. [1,2,3]

Food Supply, Storage and Safety

Storage, safety, and distribution of food in disaster-prone and disaster-affected areas require a package of best practices, technical know-how, technologies, equipment, and devices. While contamination can occur at any point of the food chain, inadequate washing, handling, and cooking of food just before consumption is still a prime cause of food-borne diseases. Many infections are preventable by observing simple, hygienic rules during food preparation whether in family settings or large food-catering facilities.

Under most conditions, the threats posed by polluted water and contaminated food are interrelated and cannot be separated. Therefore, water should be treated as a contaminated food and should be boiled, or otherwise purified, before it is consumed or used as an ingredient in food. Basic precautions, such as those specified in the WHO "*Five Keys for Safer Food*", should be implemented by all food handlers, especially those involved in mass catering: keep clean (prevent growth and spread of dangerous microorganisms), separate raw and cooked food (prevent transfer of microorganisms), cook thoroughly (kill dangerous microorganisms), keep food at safe temperatures (prevent growth of microorganisms) and use safe water and raw materials (prevent contamination). Solar PV and/or mechanical wind pumps may be very effective for longer term solutions, pumping water from the surface or from relatively deep boreholes. For the treatment of non-saline water, solar PV pumping systems can be readily coupled to

suitable membrane filter arrangements (gravity driven), with individual pump and filter units capable of providing up to 10,000 litres of potable water per day – sufficient for 300-500 people. Larger volumes can be delivered by using multiple units. [1,2,3]

Healthcare for Disaster Victims

Modern healthcare management systems and equipment could provide vital support to the medical personnel engaged in post-disaster areas. The technological solutions considered helpful for disaster healthcare managers would include the following: diagnostic equipment; equipment for critical care; equipment for disaster health kits: basic, first-aid items; intravenous (IV) and feeding tube equipment; oxygen and breathing equipment; electrically-powered medical equipment; disaster relief response: robot-assisted medical reach back; telemonitoring; patient tracking systems; pre-hospital management systems; relief medical equipment vans; post-response rehabilitation systems; telemedicine: disease surveillance systems; **w**eb-based telemedicine; personal digital assistants (pocket telemedicine); wearable computing (personal imaging); **a**dvanced sensors and medical monitoring; DICOM network services; and e-Film Video; and advanced systems for disaster medicine and medical relief. [1,2,3]

Relief Medical Equipment Vans

In India, Accident Relief Medical Equipment (ARME) vans and Accident Relief Trains (ART), including a few self-propelled vehicles, are positioned at strategic locations for rushing to an accident site on top priority, along with doctors, paramedical staff, rescue workers, and engineers. The medical team attends to injured passengers, and the seriously wounded are transported to nearby hospitals. ARME vans are equipped with medicines, resuscitation machines, dressings, disposables, etc for use in emergencies and also have an operation theatre with facilities for conducting minor surgeries. [1,2,3]

Tele-medicine

Tele-medicine refers to the utilization of telecommunication technology for medical diagnosis, treatment, and patient care. A telemedicine system is composed of customized medical software integrated with computer hardware, along with medical diagnostic instruments connected to the commercial VSAT (Very Small Aperture Terminal) at each location on fiber optics. Tele-medicine enables a physician or specialist at one site to provide healthcare, diagnose patients, treat and monitor them, give intra-operative assistance, administer therapy, and consult with another physician or paramedical personnel at a remote site, thereby ensuring convenient, site-independent access to expert advice and patient information. Transmission modalities include direct hard-wired connections over standard phone lines and specialized data lines (single/twisted pairs of metallic wires, coaxial lines, fiber optic cable) and "wireless" communications, using infrared, radio, television, microwave, and satellite-based linkages. Improved space- and ground-based technologies now form a communications infrastructure well suited to addressing ongoing disaster management needs. [1,2,3]

The LSTAT is a self-contained, stretcher-type platform designed to aid in field stabilization and transport of severely injured patients. It incorporates a number of on-board devices for ongoing treatment, which include monitors for basic vital signs and blood chemistry; mechanical ventilation and oxygen supplementation for patients requiring endo-tracheal intubation; a self-contained, battery-powered infusion pump to deliver intravenous fluids; and a self-contained, battery-powered suction pump. An automated external defibrillator is also built into each of the LSTAT units. All patient medical data that is monitored by the on-board devices of the LSTAT can be data-linked to the receiving medical facility while the patient is being transported by air or ground ambulance. [1,2,3]

New Technology for Hospital Readiness for Disasters

In the USA emergency medicine specialists from Johns Hopkins have developed a tool to help hospitals prepare for disasters with the potential to overwhelm services. The Electronic Mass Casualty Assessment & Planning Scenarios (EMCAPS) computer program calculates the impact of such crises as a flu epidemic, bioterrorist attack, flood, and plane crash, accounting for such elements as the number of victims, wind direction, available medical resources, bacterial incubation periods, and bomb size. The program depends heavily on population density estimates to derive 'plausible estimates' of what hospitals may expect in the initial minutes or hours of a disaster. [1,2,3]

Sanitation and Waste Management

In the aftermath of disasters, sanitation and waste management are placed next only to food and medical supplies in the list of priorities for the authorities in charge. The maintenance of appropriate sanitary conditions and hygienic waste disposal are critical because these efforts have a direct bearing on the health of disaster victims. If the sanitation and waste management systems and practices are below par, the survivors could be exposed to the danger of infections and diseases. Technologies and methodologies are a critical part of the response strategy that local governments need to have in place for disaster situations. They help to maintain optimum sanitary conditions and to handle large amounts of different kinds of wastes (including hazardous wastes) in an environmentally sound manner.

Disaster-Resistant Housing and Construction

Earthquakes, cyclones, and floods cause extensive damage to buildings, resulting in an overwhelming loss of life and property. Buildings prone to such disasters are the single most important cause of such loss. Therefore, vulnerable houses and other structures made of mud or stone or brick, which are common among the developing countries, must be adequately strengthened to withstand such disasters; and, even more important, existing buildings need to be strengthened or retrofitted to ensure that they are relatively safe. Mitigation measures in the form of retrofitting could significantly reduce the chances of structural damage and

casualty. Disaster-resistant construction and retrofitting technologies are already available in the public and private domains. The technologies range from simple techniques for retrofitting non-engineered buildings to modern and complex civil engineering solutions for constructing engineered building structures and bridges. The technology selected must suit the type of structure, extent of damage, and availability of materials, manpower, funds, etc.

We are not prepared

India is not ready to handle natural disasters. The country has too few support systems and too few medical experts. India, because the Himalayan belt was sitting on a major seismic zone, it was found that around 229 districts, more than a third of the country, falls under seismic zones IV and V, and was just waiting for a quake in the not too distant future. The National Disaster Management Authority (NDMA) has said India is not prepared to face natural disasters. Prevention is better than cure. The world stands united in war against disaster, whether man-made or natural. Knowledge is power. To know what to do at the time of an emergency can be life saving not only for you but also for many others who may need your help. [1,2,3]

Hospital Emergency Preparedness (HDP)

The objective of HDP is to provide policy for response to both internal and external disaster situations that may affect hospital staff, patients, visitors and the community, Identify responsibilities of individuals and departments in the event of a disaster situation and identify Standard Operating Guidelines (SOG's) for emergency activities and responses. Preparing for Mass Casualty Incidents is a daunting task, as unique issues must be considered with each type of event. For example, the systemic stress of a bio-threat is entirely different from that of a chemical disaster. These differences hold challenging implications for the hospital preparedness and training. Hospitals would be among the first institutions to be affected after a disaster, natural or man-made. Because of the heavy demand placed on their services at the time of a disaster, hospitals need to be prepared to handle such an unusual workload. This necessitates a well documented and tested disaster management plan (DMP) to be in place in every hospital. To increase their preparedness for mass casualties, hospitals have to expand their focus to include both internal and community-level planning. The disaster management plan of a hospital should incorporate various issues that address natural disasters; biological, chemical, nuclear-radiological and explosive-incendiary terrorism incidents; collaboration with outside organizations for planning; establishment of alternate care sites; clinician training in the management of exposures to weaponizable infectious diseases, chemicals and nuclear materials; drills on aspects of the response plans; and equipment and bed capacity available at the hospital. The most important external agencies for collaboration would be state and local public health departments, emergency medical services, fire departments and law enforcing agencies. The key hospital personnel should be trained to implement a formal incident command system, which is an organized procedure for managing resources and personnel during an emergency. The hospitals should also have adequate availability of personal protective hazardous materials suits, negative pressure isolation rooms and decontamination showers. [1,2,3]

While responding to a mass casualty event, the goal of the health and medical response is to save as many lives as possible. Rather than doing everything possible to save every life, it will be necessary to allocate limited resources in a modified manner to save as many lives as possible. When a hospital responds to a large number of victims presenting over a short time, often without a prior warning, delivering care to the level of usual hospital standards or benchmarks may not be possible and "altered standards" may have to be acceptable. The "*Altered Standards*" refers to a shift to provide care and allocating scarce equipment, supplies and personnel in a way that saves the largest number of lives in contrast to the traditional focus on saving individuals. For example, it could mean applying principles of field triage to determine who gets what kind of care. It could mean changing infection control standards to permit group isolation rather than single person isolation units. It could mean limiting the use of ventilators to surgical situations. It could mean creating alternate care sites in the waiting area, lobby or corridors which are not designed to provide medical care; minor surgical procedures in victims in these areas could mean altered level of asepsis. It could also mean changing who provides various kinds of care like enhancing the scope of nurses, physician assistants and hospital paramedics. Secondary triage also may be necessary within hospital, as demands on the system grow. Hospital DMP should consider the possibility that a hospital might need to evacuate partially or wholly, quarantine, or divert incoming patients. One of the key components of an effective health and medical care response is ensuring adequate supplies of a broad array of qualified health care providers who are available and willing to serve. Mass casualties will provide more work than any organization itself can address. Coordination is the key and the historic separation is a genuine disadvantage. Several strategies help ensure protection of staff handling disasters e.g. safety measures including personal protective equipment, prophylaxis, training specific for different events, adequate back-up staff for rotation to prevent burnout and fatigue related errors and care of families of staff. [1,2,3]

A wide range of training of hospital staff is needed to ensure an effective health and medical response to a mass casualty event. Preparedness for disasters is a dynamic process. In addition to having a well documented DMP in place, it is prudent to have regular drills to test the hospital's DMP. The hospital preparedness can be enhanced more rapidly if standardized state and national guidelines for model hospital DMP, staff training, disaster drills and accreditation of hospitals based on DMP are developed and widely disseminated.

Pre-Disaster Planning

Pre-disaster planning begins with the identification, understanding and analysis of the natural and other hazards in the area. The analysis will make it possible to establish priorities and to decide on the steps to be taken to reduce the risk. The aim is to reduce vulnerability of people and communities in a territory to damage, injury and loss of life

and property resulting from natural or man-made catastrophes; to prepare for prompt and efficient rescue, care and treatment of victims; to authorize and provide cooperation in disaster prevention, response and recovery; and to provide a disaster management system that embodies all aspects of pre-disaster preparedness and post-disaster response. The system, to be effective, should have legislative authority. Due consideration has to be given to country/region/state (topography, climate, demography, industry, government organization); threat (history, natural events by type, industrial accidents by type, other types like man-made); command and coordination (powers and responsibilities at each level, command authorities and posts, description and role of emergency services); planning groups (arrangements for sectoral planning medical, transport, communication, etc.); emergency operation centres (location, intersectoral communication and liaison) and activation of organization (warning systems, receipt and dissemination of warnings).

Pre-hospital Emergency Care

Efficient system of providing prompt medical care to the injured to save many lives is possible if the rescue team began treatment before the patient reached the hospital. This approach forms the basis of the prehospital emergency care system that has begun to evolve in the USA and elsewhere. Numerous advances in related areas—closed chest cardiac compression, Cardiopulmonary Resuscitation (CPR), Advanced Cardiac Life Support Course (ACLS), Advanced Trauma Life Support Course (ATLS)—made possible the development of prehospital care. Prehospital medical care is administered by many different professionals. The first person to arrive at the scene of the accident (first responder) is often a firefighter or police officer not trained primarily as a health care provider. The health professionals who next arrive at the scene are—ambulance drivers/emergency medical technicians of various types. First responders typically can apply splints and bandages or initiate CPR as indicated. The Emergency Medical Technician (EMT) categories are based on the US Department of Transportation's (DOT) curriculum for Emergency Medical Services personnel, which calls for instruction in rudimentary anatomy, CPR, wound management, extrication of the wounded, and so forth. The evolution of prehospital care as a major area of emergency medicine has led to significant expansion of the scope of emergency nursing. These nurses communicate by radio with paramedics in the field, giving orders for medication and other instructions in accordance with standardized guidelines. The American College of Emergency Physicians has developed a Base Station Physicians course to train emergency physicians in the specifics of prehospital care. The curriculum includes the proper use of radio equipment, the feasibility of various treatment methods outside the hospital, the capabilities of the paramedics (whom the physician will supervise), and administrative structure of Emergency Medical Services (EMS). [1,2,3]

Specialty Centres

It has proved cost-effective to consolidate the treatment of certain medical conditions (e.g., trauma, burns, spinal cord injuries) in specialized centres in the United States. Although patients are often transferred to such centres after initial stabilization measures have been implemented in other hospitals, such patients might be better served if the EMS system were to transport them directly from the field to the appropriate specialty centre where definitive treatment can be undertaken. Delay may be lethal for victims of major trauma. Trauma centres have therefore been the focus of much attention recently. It might seem logical that patients with uncomplicated fractures should be sent to the local level II hospital, whereas critically injured patients should be taken to a level I trauma centre, but a trauma victim with life-threatening tension, pneumothorax or exanguinating haemorrage may not survive prolonged transport to a distant trauma centre. The decision depends on the geographic distribution of the hospital, the experience of medical staffs in treating major trauma, and the condition of the individual patients.

Helicopter Transport

Medical helicopter programmes have now been established in the USA. The major advantage of helicopter transport lies in the fact that total time in the field can be reduced as helicopters can quickly transport specialized teams of physicians and nurses from the hospital directly to the patients in the field. Lifesaving procedures can be performed at the scene that would otherwise be delayed until arrival at the hospital. Helicopter transport provides a smoother ride than surface transport. The main disadvantages of helicopters are expense and safety concerns.

Precaution

During a disaster situation, the first accident occurs at the site of disaster. The second accident occurs on the way (transit) to hospital. It has been seen that lack of basic training and education regarding transportation of casualties leads to unnecessary deaths that could easily be prevented by imparting training to local health personnel, volunteers and the community at large about the transportation of victims. The media has a vital role to play here. Third accident (mishandling by unskilled and negligent hospital staff) can be prevented by having a qualified disaster plan for the hospital.

6. Multidisciplinary Approach

Advice from specialist departments like the meteorological service, geophysical observations, the mining department and flood control can be helpful to understand the type of calamity or disaster and the potential damage it can create. The first plan should be based on the country's experience with regard to the type, frequency and extent of death and destruction brought about by the calamity. The second plan may be area specific. Special attention should be given to the strength, size and location of a hospital and its support facilities in countries that have become virtual battle fields due to various reasons. Due consideration has to be given to large spaces to accommodate the injured and large mortuary buildings. In the third plan, consideration has to be given to adaptability of space for easy conversion into temporary havens for disaster victims and provisions of food. A

hospital can be designed to accommodate 100, 75, 50 per cent of estimated disaster victims. Inter-hospital and health facility cooperation in disaster planning and practice can lead to improved rationalization of the use of resources in everyday operation. Every health care facility should have a plan of action for the various emergencies that can affect the facility. Disaster plan should reflect a facilities location from internal or external disasters. As an example, areas subject to frequent wildland fires should involve countermeasures for smoke management and air quality maintenance. [1,2,3]

7. Hospital Categorization

A typical EMS system involves widely dispersed hospitals with differing capabilities. Most EMS systems include paramedic base station hospitals and receiving hospitals. In order to ensure uniform quality control, medical direction of paramedics in a EMS district is usually concentrated in a small number of hospitals known as base stations. Hospitals permitted to receive patients transported and cared for by the EMS system are called receiving hospitals. [1,2,3]
Another system classifies hospitals (by capability) with reference to their internal ability to handle various types of patients. [1,2,3]

a) Horizontal categorization (according to their ability to provide definitive care in emergencies)
- *Class I—hospitals offering comprehensive emergency services; most of them are large academic centres with a full complement of interns and residents*
- *Class II—hospitals offering limited emergency services. Such small hospitals are not appropriate for true emergencies, and ambulances should not take patients there.*

b) Vertical categorization describes a hospital's ability to provide in-depth care for specific types of medical problems beyond the immediate life-threatening stage of illness. Situations requiring in-depth care include burns, spinal cord injuries, poisoning and major trauma.
- *Level I: referral centre able to provide definitive long-term care.*
- *Level I: most full-service hospitals that are able to treat each of the emergencies, but patients with exceptionally severe problems may eventually be transferred to level I centre.*
- *Level III: is able to provide only initial care to patients who would rapidly be transferred to level II or level I facilities.*

An effective response to mass casualty incidents requires meticulous planning before their occurrence. Practice drills should be conducted to test the disaster plan. Mass casualty incidents typically involve only problems of increased numbers of patients; natural disasters disrupt the hospital and the environment as well, and this may overwhelm the best disaster plan. Mutual aid must be involved on a massive scale, often involving a national response. As much planning as possible should be accomplished in advance, to anticipate problems and design countermeasures before the occurrence of a natural disaster.

Disaster Operating Procedures

Under routine procedures, the individual patient receives the highest quality of medical care that the health care facility is capable of providing. In a disaster situation the philosophy changes to that of providing the best available medical care for the greatest number of patients. Austerity of treatment and triage play progressively greater roles as the magnitude of the disaster increases.

Flexibility

The key to effective emergency preparedness planning is flexibility, which is attained by contingency planning (i.e., consideration of all likely possibilities and development of options for action that are maximally effective under each such possibility). The essential element of the disaster plan is that it be functional for any time of day or night, any day of the year. The overall coordination which must be developed and rehearsed regularly is the critical issue. A cohesive community resource working along with the medical/nursing/administrative services of a health care facility can provide all the components required for victims of a disaster.

The Aftermath

As the hours and days go by, the problems change. Sometimes rescue work continues for several days, but soon a number of other problems arise as a result of the disaster. The local health personnel must organize themselves to take on these new problems as part of their activities. Most of these activities require intimate involvement with the community, which can be ensured only by the local personnel organizing their work on the basis of support from volunteers and the persons in charge of the family groupings. All measures must be taken for preventing and alleviating the consequences of disasters.

Japan has demonstrated that the impact of disasters can be lessened by proactive measures. Japan has been subject to a range of disasters but has been able to reduce destruction and loss of life by taking a number of measures and enhancing the level of preparedness. For instance, quite a few projects have been undertaken by the Shizurka prefecture to deal with the Tokai earthquake which is expected to occur in the near future. Japan has offered to share with other countries its wealth of knowledge about disaster mitigation.

Recent Trends

Scientists have developed designs for structures that can withstand different natural disasters such as floods, cyclones and earthquakes. The commonly held view is that earthquakes do not kill people, it is the falling buildings that do this. Hence, any reduction in the loss of life during an earthquake is possible only by encouraging quake resistant structures and buildings in seismically active zones. Around 62 per cent of the housing stock in India is found to be vulnerable to collapse during disasters. Inexpensive retrofitting techniques have been developed to reduce the vulnerability of these buildings. These have to be applied

and the buildings strengthened to withstand disasters. Newly built cyclone shelters proved very useful during the latest cyclone that hit Bangladesh in May 1994. These have a high floor level taking into account the heights that tidal waves reach during storms.[1,2,3]

The Action Plan

Sufficient programmes need to be formulated in disaster-prone countries. Regional and country level strategies are essential. Developing countries need to be helped by international organizations in building their capabilities to cope with disasters. Disaster reduction should be promoted at the macroeconomic and political level. Equally important is to revitalize national committees. Efforts should be made to discourage human settlements in flood-prone zones. Disaster reduction needs financial commitment independent from relief and development. Disaster management should be based on proactive preparedness. It is imperative to accord priority in public policy for disaster reduction measures. Disaster mitigation is cost-effective in that the economic savings from mitigation programme far outweigh the costs. [1,2,3]

The Disaster Cycle

A disaster may occur with or without a warning phase. A response is made following a disaster. The response may be helped substantially by any preparedness actions which were made before the disaster occurred. Relief activities occur during the emergency phase, which follows the impact of the disaster. This phase transitions into the reconstruction (rehabilitation) phase. During this phase, the lessons learned are applied to mitigating or totally preventing the effects of future reoccurrences of this type of disaster and, at the same time, make preparations to respond to this type of disaster, should it return.

The cycle concept conceals the fact that the consequence of disasters may go on well beyond a reconstruction phase. In fragile states, there may be only minimal resources to undertake reconstruction and mitigation, with each disaster further reducing the status of the country's people. Weak efforts at reconstruction and mitigation are easily overwhelmed by subsequent disasters. The cyclic concept often breaks down when thinking about armed conflicts, where there are often false starts toward resolution and reconstruction may break down with a return to the armed conflict. Protracted conflicts create populations for whom abuse and displacement are part of their normal existence.

Disaster impact

Most disasters have sudden impact, though some, such as droughts and famines, are somewhat awkwardly called 'slow onset' disasters. In some cases, there may be warnings, such as weather predictions. Getting these warnings to those at risk is often difficult in developing countries. Even with warnings, there is little many people can do in the absence of disaster preparedness or adequate resources. Certain types of disasters can be predicted. An early warning can be issued, lessening the impact. Tropical storms are in this category, where weather satellites follow and track a disaster's build-up. Populations can be alerted to droughts and the potential for famines through the timely collection and analysis of data.

Response in the emergency phase

Some form of disaster response capacity is present in most countries. This may be organized through a national civil defence or emergency management agency. Military forces may take disaster response responsibilities because of their communication and logistical capacity. The Red Cross and Red Crescent National Societies are chartered in many countries to provide relief in emergencies. Civil society organizations such as nongovernment organizations and those associated with religious groups may be the first responders. In almost all disasters, local communities play the first and often most important role in responding by rescuing those affected, providing first aid and emergency shelter, usually long before outside organizations arrive at the scene. Building a strong volunteer group is an important disaster response asset.

Many international agencies have developed excellent disaster response capacities and they can augment local capacities in disasters. International agencies are often most successful in channeling external resources into the long-term reconstruction work in developing countries.[14]

The number and cost of climate-related disasters has been steadily increasing over the past few decades. Climate change poses an additional challenge, with more intense and frequent extreme events expected. The urgency of climate change and advances in climate science have motivated a shift in the climate science community towards the provision of user-oriented climate services. The potential of recent developments in climate science, including the production of climate forecasts for a few months through to decades into the future, can to be extremely useful for disaster prevention, preparedness and response efforts.

Climate-related disasters are by far the most frequent natural disasters, exacting a heavy toll on people and economies. Their frequency and economic losses have steadily increased over the past few decades, stretching the response capacities of governments and humanitarian organizations. One of the many ways this challenge can be addressed is by making more effective use of the increasing wealth of climate information and tailoring it to the needs of those who could use it, to better predict and prepare for such disasters before they occur.[1]

Globally, climate-related disasters including floods, droughts, cyclones, heat waves and mudslides cause tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year. Losses have risen steadily over the past decades, primarily as a result of an increase in the value of exposed assets in hazard-prone areas. Climate change is expected to exacerbate these rising costs due to a higher expected frequency and intensity of extreme events. In order to help meet these challenges, more investment in disaster risk reduction is needed, including in capacity to anticipate risks well ahead of when a hazard strikes.

Disaster risk managers can use climate information to help characterize risks. The process of integrating climate information into disaster risk management requires the commitment and support of a range of partners who can work together to develop and refine climate-informed decision-support tools, systems and platforms. Information platforms help disaster risk managers quickly and easily identify and monitor risks and vulnerabilities. There is a need of explicitly linking climate information to possible actions, including through the development of thresholds and triggers for action. Integrating climate information across time scales into disaster risk management systems can help reduce risk and improve response.

The world is facing the challenge of rising disaster costs and risks, and needs to be better prepared for what is to come. By working together, climate scientists are better able to meet the needs of disaster risk managers, and disaster risk managers are better able to use climate information for improved disaster risk management. This will allow these groups to be better able to achieve their common goal – saving lives and protecting the livelihoods of vulnerable people. The ultimate goal is to reduce suffering, save lives and protect the livelihoods of vulnerable people.

Reconstruction phase

In developed countries the effects of a disaster may be repaired in a short period of time, though the psychological damage among survivors may persist for years. In developing countries the reconstruction process may take years. Consensus on reconstruction policy may take time to reach, records of property ownership may be lost and official permission delayed. At the household level families may take time to decide whether to return to disaster affected areas or rebuild their lives and houses elsewhere. A rapid early response can demonstrate serious commitment to assist survivors by government, as well as promote an early return to normality which will help health psychological trauma for the disaster.

Mitigation

An improved design should be incorporated into the reconstruction of buildings following an earthquake or a tropical storm. Housing in marginal lands or flood plains which have been destroyed by flooding should not be reconstructed. At a time of heightened awareness following a disaster, attention should turn to other vulnerabilities and mitigation efforts should also be directed toward reducing these additional risks. Disasters expose social vulnerabilities which may predispose populations to other potential disasters: these should be addressed. Efforts at mitigation may overlap with plans to improve preparedness for the next disaster. Mitigation activities and longer term development programmes have very similar goals and can reinforce each other. Making available adequate and affordable insurance helps share risks and mitigates the potential effects on the economic devastation that might arise from future disasters.

Preparation for the next disaster

Some disasters can be prevented entirely. Mudslides can be prevented from happening by controlling deforestation or undertaking engineering works. Loss of life and property can be prevented by enforcing housing codes in disaster-prone areas. This requires resolute governments with strong public support to enforce such restrictions. After every disaster, organizations involved should examine their actions to see what could be done to improve their effectiveness in responding to future disasters. The planning process, the mapping of vulnerabilities and the assessing of the shortfall in existing resources help communities and organizations to prepare. In recent years, an 'all hazard' approach to disaster planning has become popular. The mitigation efforts focus on and provide minimal protection. Preparation is still an important step to reducing the damage of a disaster. Although preparedness often includes stockpiling of emergency supplies, few organizations, other than the military, can afford to do this on a large scale, give the capital costs and the costs of regular rotation of provisions. Building the household's capacity to mitigate the effects of common disasters has been the centre piece of most disaster preparedness programmes. The extent that disasters are managed is known only after an event has been dealt with. But training, practices and drills can give some indication of how well a real disaster could be managed. Insurance, which transfers risks from the individual or business to insurers, is an important manageability tool. Macro forces in an environment.

Armed conflicts as disasters

Of all disasters, the effects of armed conflicts are probably the greatest. Among all disasters, some of the largest public health challenges are those associated with the care of persons displaced by conflict. Refugee crises are generally divided into three phases. The emergency phase usually occurs at the start of a refugee influx and is defined by a death rate twice the baseline crude (all-cause) death rate for that group. At this point, displaced populations are particularly vulnerable to outbreaks of disease, malnutrition and environmental hazards. Putting public health measures into place rapidly to minimize excess mortality is a major challenge in the emergency phase. The post-emergency phase begins when that death rate drops back below twice the normal or background rate. Often, this is considered a maintenance phase as refugees wait for conditions to be right for repatriation. This is a time to build good health knowledge and community practices during the protracted waiting which often occurs.

Prevention of conflict attracts little interest from political leaders and policy makers compared with the time and resources spent on defence and the waging of war. From the public health standpoint, the measures developed in the past decade have dramatically reduced illness and death among the displaced. An important goal is building a culture of awareness that preparation is not only possible, but also will greatly reduce the consequences from disasters in terms of human and economic loss. In these, public health is an important partner with engineers, planners, elected leaders and community organizations. An effective response to

disaster begins with effective planning, but must include many other steps. Each of these steps depends on the strength of other links in the disaster management chain.

Community Participation

Groups at the community or local government level are the groups which actually provide help to affected populations to prepare and respond to emergencies. Where national systems exist, these groups have often not followed up in the development of strong community components. Consequently when disaster strikes, the community response will lack the coordination and the training necessary to provide the life-saving response needed. Organizations with an extensive presence already at the community level are probably in the best position to help communities both prepare for disasters and respond when they occur. The development of community plans based on the participatory appraisal of risks, strengths and vulnerabilities to various hazards offers the best strategy to mitigate disasters at the community level.

Community participation before, during, and after a disaster can greatly reduce the overall mortality as well as improve the use of resources. Whatever the type of disaster, the greatest number of lives can be saved during the first few hours following a disaster before help from the outside arrives which can take several hours or days. The local community must, therefore, be ready to assist since they may only have themselves to rely on. Most health and survival problems can be handled by the community. This is possible if the community is active and sufficiently organized to sustain itself until outside help arrives.

When a population is threatened by a disaster such as flooding, cyclones, tidal waves, volcanic eruptions or open conflict, evacuation may be necessary. It is important that the community takes part in determining its own evacuation routes and plans, its means of transportation, its next destination and how to access basic supplies. Every member of the community should be made familiar with these plans so that evacuating people can go as smoothly as possible. The emotional trauma from disasters can persist for a long time, perhaps even a lifetime. However, returning to normal life as soon as possible helps people to function better than if the return is protracted.[15] If a community is in a state of preparedness before a disaster strikes, this may reduce the impact of the disaster with regard to the number of injuries and deaths, damage to infrastructure, loss of property or livelihood. Most health and survival problems can be handled by the community.

Risk Governance

In terms of its relation to the dynamic development of social systems, the disaster risk management (DRM) community faces increasing complexity and decreasing predictability with new and emerging threats in a risky world. Complexity will result in more incidents, new and unexpected threats, more information to analyze with possibly less time to process it, new players and participants, increasingly sophisticated technologies and exceedingly high public expectations. Increasing complexity also implies increasing uncertainties about what is likely to happen, what will be its potential consequences and therefore in assessing risk. There are two main types of uncertainty, one arising from lack of knowledge and the other reflecting pure chance or random sampling. In terms of looking into the future, lack of knowledge can supposedly be minimized to a certain extent while there will always be a remaining factor of pure chance. Communication on multiple levels is considered a key activity in the forward-looking approaches and enables collective interpretation and sense making of available distributed information which eventually leads to improved public risk perception. It will likely play an increasingly important role in enhancing situational awareness and therefore reducing risks and vulnerabilities in a risk governance context through integrated contribution of information from different sources.[16] [Fig. 8]

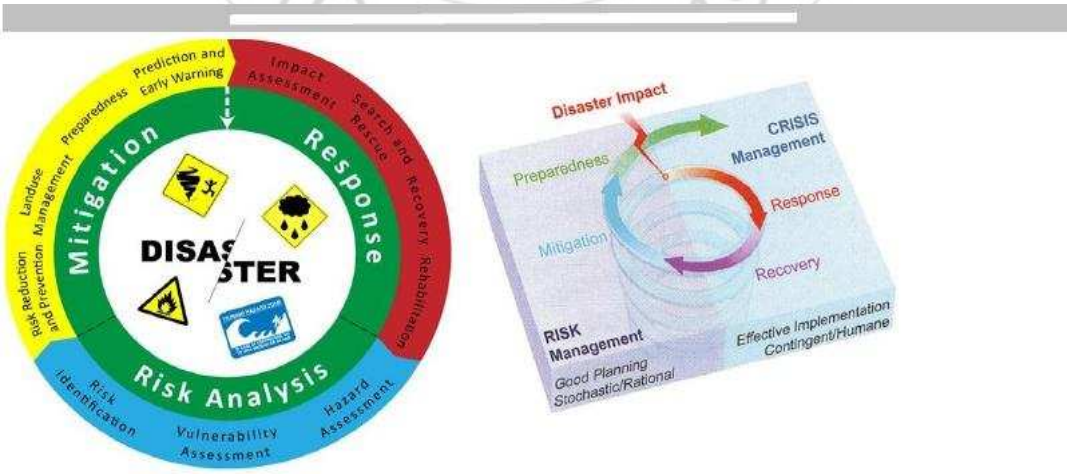


Figure 8: Components of Risk Management

Modern societies and their environments have become increasingly complex and decreasingly predictable, being shaped not only by physical, economic and technological-oriented risk drivers but also by social concerns and growing population pressure and the resulting tendency to place developments in increasingly vulnerable settings. Forward-looking activities and effective participative inter-communication enable gaining more knowledge about things to come and provide the ability to build up a clearer common vision of future conditions and needs to all

involved stakeholders. Such activities are particularly relevant in this long-term risk reduction context. With the aim of moving from a rather reactive towards a proactive and anticipatory adaptation approach based on some assessment of future conditions, the need for multi-perspective risk governance for disaster risk management that integrates forward-looking activities more comprehensively is essential.[16]

Rapid innovations in technology are transforming media and communication, altering how people interact with each other and relate to society and institutions. The pace of technological change—from biotechnology and nanotechnology to information and communication technology—is accelerating and affecting nearly every facet of life. Smart phones, high-speed internet, and "cloud" computing, to name only a few examples, are transforming how people do business, communicate, and carry out essential services such as health care. Technological innovation and the public's evolving expectations of government are fundamentally altering how individuals interact with society—leading to a redefinition of community. The explosion of social media and personal communications technology will continue to increase real-time access and delivery of information. Public access to "raw" data sources, such as Data.gov, expands the possibilities of how existing information can be used, and increases expectations of government transparency.

Essential Capabilities in 2030

There are new models for conducting emergency surge operations that take into account that there are far fewer redundancies in the nation's total national response and recovery assets. The emergency management community has improved technological capabilities. Among them are risk-management and risk assessment tools that account for dynamic changes in hazard risks, such as climate change on flooding levels, and that anticipate interrelated and cascading effects of simultaneous multiple disasters and/or complex events. An important feature of this is continual and sophisticated environmental scanning to understand the consequences of new and unfamiliar risks. Unmanned Aerial Vehicles (UAVs) and robots provide powerful search and rescue capabilities. Pandemic sensors offer early warning of disease outbreaks. The emergency management community enjoys collaborative relationships with the technology community and even influences the development of emergency management applications. To make all this possible, coordination among emergency managers and a common set of standards to maximize interoperability and asset sharing has been incorporated into normal operations.[17]

8. Risk Management Practices for Cultural Heritage Sites

A review of disaster risk management activities of international heritage conservation groups reveals that organizations tend to focus their efforts on one of the three disaster phases: advance planning, emergency response, or post-disaster recovery. The reasons for this are directly related to the types of resources the agency or organization can commit to these activities: professional expertise, technical support, funding, local networks, or some combination of these. The most effective form of risk mitigation at any heritage site, however, is the inclusion of risk management procedures into general site management operations; regular maintenance and monitoring alone can substantially minimize damage and loss in unavoidable natural

Disaster prevention can be thought of as taking measures to reduce overall vulnerability to natural hazards. These include measures taken to detect, contain, or forestall events or circumstances that, if left unchecked, could result in a disaster. As it is often impossible to completely avoid losses, disaster risk managers also try to mitigate adverse impacts by updating buildings and/or building codes, improving environmental policy, and increasing public awareness of potential vulnerabilities.

Preparedness includes those strategies, activities, and actions taken before hazard events occur in order to lay the groundwork for effective response. Once disaster occurs, the focus changes to response and includes the mobilization of emergency services during or after a disaster situation to reduce impacts on the population. Recovery involves the restoration (or improvement, in some cases) of the facilities, livelihoods, and living conditions of disaster-affected communities. This includes repairing or upgrading physical infrastructure, ensuring appropriate social services, and the provision of food and other resources. Recovery describes rehabilitation and reconstruction activities that save lives, address immediate needs, restore normal activities, and reduce future disaster risk. [Fig.9,10]

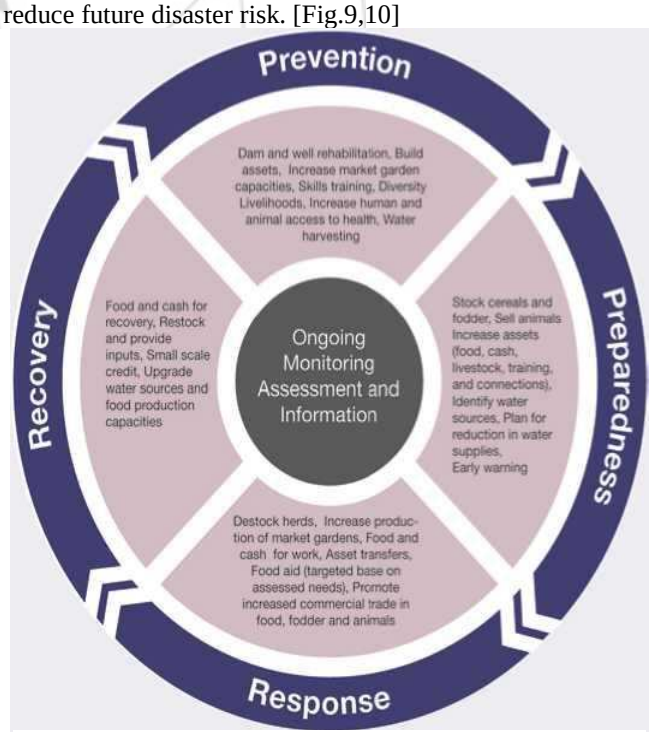


Figure 9: The disaster risk management cycle in the Sahel, where frequent droughts lead to famine and food insecurity (adapted from Kelly and Khinmaun, 2007).

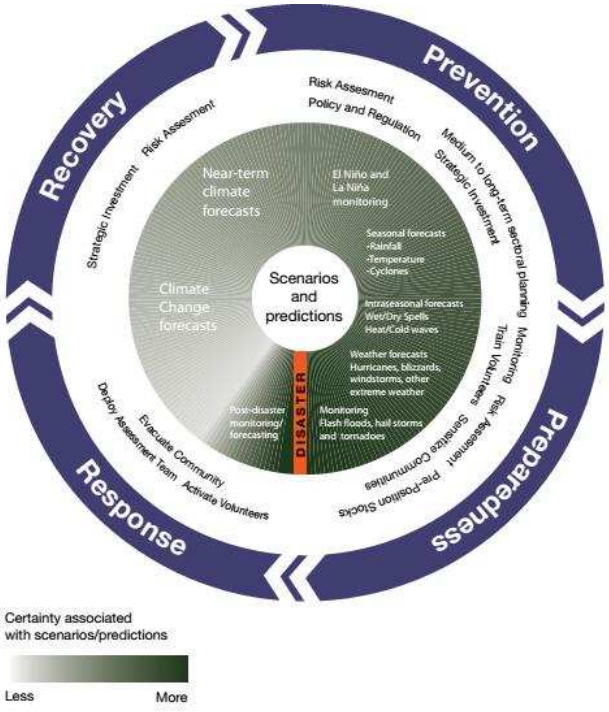


Figure 10: Incorporating climate information into the disaster risk management cycle illustrates the kinds of information that can inform specific decisions (adapted from Kelly and Khinmaun, 2007).

9. Persons with Special Needs

The challenges faced by people with disabilities in disaster-threat situations have been made clear through disaster situations. Specific problems with warning transmission and receipt, transportation, evacuation, shelter, and long-term recovery have been documented through research studies. The response encompasses: *The Life Cycle of Comprehensive Emergency Management:* four main phases of emergency management activity - preparedness, response, recovery, and mitigation; *Emergency Managers and Voluntary Organizations* - strategies to build capacities and leverage resources for people with disabilities in harm's way, and *Promising Practices* - identifies promising initiatives, reveals trends in policy and practice, and provides a comprehensive set of interventions. Preparedness efforts including education and training, planning, designing warning systems, and evacuation protocols, is the area where most work has been conducted. Still, many emergency managers and people with disabilities remain unprepared for a disaster, in part because of the extra burden placed on minimal staff or the already difficult circumstances of many people with disabilities.[18]

10. Towards Safer India

Natural disasters have been visiting every part of the globe at one time or the other. The world is becoming increasingly vulnerable to natural disasters. From earthquakes to floods and famines, mankind is even more threatened. India, a country with diverse hypsographic and climatological conditions, 70 per cent of the cultivable land is prone to drought, 60 per cent of the land area is prone to Earthquake, 12 per cent to Floods, 8 per cent to Cyclones, 85 per cent of the land area is vulnerable to number of natural hazards and 22 States are categorized as multi hazards States. Tens of thousands of people are affected by these natural disasters. No State, no Government can meet the challenges alone. The Governments' effort have to be strengthened by communities themselves getting involved in the emergency response system and being aware of the do's and don'ts to be prepared for any eventuality. The stock-taking found the Japan earthquake and tsunami a wakeup call for India, because the Himalayan belt was sitting on a major seismic zone. It was found that around 229 districts, more than a third of the country, falls under seismic zones IV and V, and was just waiting for a quake in the not too distant future. Even major cities like Guwahati, Srinagar, New Delhi, Chandigarh, Mumbai, Kolkata and Chennai fall under high seismic zones.

The Indian sub continent is highly prone to natural disasters. Floods, droughts, cyclones and earthquakes are a recurrent phenomenon. As per the latest seismic zoning map brought out by the Bureau of Indian Standards (BIS) over 65% of the country is prone to earthquakes of intensity MSK VII or more. Some of the most intense earthquakes of the world have occurred in India, but fortunately, none of these have occurred in any of the major cities. India has highly populous cities including the national capital of New Delhi, located in zones of high seismic risk. Typically, the majority of the constructions in these cities are not earthquake resistant. It is most important in the medium and long term to formulate strategies to reduce the vulnerability to and losses arising from a possible earthquake striking one of these cities. Frequent disasters lead to erosion of development gains and restricted options for the disaster victims. Physical safety especially that of the vulnerable groups is routinely threatened by hazards. Disasters such as the Gujarat Earthquake have very clearly illustrated that we need mitigation, preparedness and response plans so that the threat to human life and property is minimized.

Guwahati and Srinagar fall in what is called "very severe intensity zone", or zone V, the highest-risk earthquake zone. Eight cities, including Delhi, fall in the "severe intensity zone" or zone IV, according to a seismic zoning map issued by the Bureau of Indian Standards and quoted in this National Disaster Management report. The other 30 cities fall in the "moderate intensity zone", or zone III. Figures 11,12,13 show India's 38 earthquake-prone cities:

LIST OF 38 CITES WITH OVER HALF A MILLION POPULATION IN SEISMIC ZONES III, IV AND V

Sl. NO.	State	Name of City	District	Zone
1	Uttaranchal	Dehradun	Dehradun	IV
2	Delhi	Delhi	New Delhi	IV
3	Gujarat	Jamnagar	Jamnagar	IV
4	Gujarat	Rajkot	Rajkot	III
5	Gujarat	Bhavnagar	Bhavnagar	III
6	Gujarat	Surat	Surat	III
7	Maharashtra	Greater Mumbai	Mumbai	III
8	Maharashtra	Bhiwandi	Thane	III
9	Maharashtra	Nashik	Nashik	III
10	Maharashtra	Pune	Pune	III
11	Orissa	Bhubaneswar	Khurda	III
12	Orissa	Cuttack	Cuttack	III
13	Tamil Nadu	Chennai	Chennai	III
14	Bihar	Patna	Patna	IV
15	West Bengal	Asansol	Bardhaman	III
16	Assam	Guwahati	Kamrup	V
17	Gujarat	Vadodara	Vadodara	III
18	Gujarat	Ahmedabad	Ahmedabad	III
19	Tamil Nadu	Coimbatore	Coimbatore	III
20	Uttar Pradesh	Agra	Agra	III
21	Uttar Pradesh	Varanasi	Varanasi	III
22	Uttar Pradesh	Bareilly	Bareilly	III
23	Uttar Pradesh	Meerut	Meerut	IV
24	Uttar Pradesh	Lucknow	Lucknow	III
25	Uttar Pradesh	Kanpur	Kanpur Nagar	III
26	West Bengal	Kolkata	Kolkata	III
27	Jammu & Kashmir	Srinagar	Srinagar	V
28	Jammu & Kashmir	Jammu	Jammu	IV
29	Madhya Pradesh	Indore	Indore	III
30	Madhya Pradesh	Jabalpur	Jabalpur	III
31	Punjab	Amritsar	Amritsar	IV
32	Punjab	Jalandhar	Jalandhar	IV
33	Andhra Pradesh	Vijayawada	Krishna	III
34	Jharkhand	Dhanbad	Dhanbad	III
35	Karnataka	Mangalore	South Canara	III
36	Kerala	Kochi	Ernakulam	III
37	Kerala	Kozhikode	Kozhikode	III
38	Kerala	Trivandrum	Trivandrum	III

♣ As per the Vulnerability Atlas prepared by Building Materials Promotion and Technology Council (BMTPC), Government of India, UNDP and MHA, IS 1893 (Part 1) : 2002 Map of Seismic Zones of India and other factors

Figure 11: List of cities in Siesmic zones III,IV,V

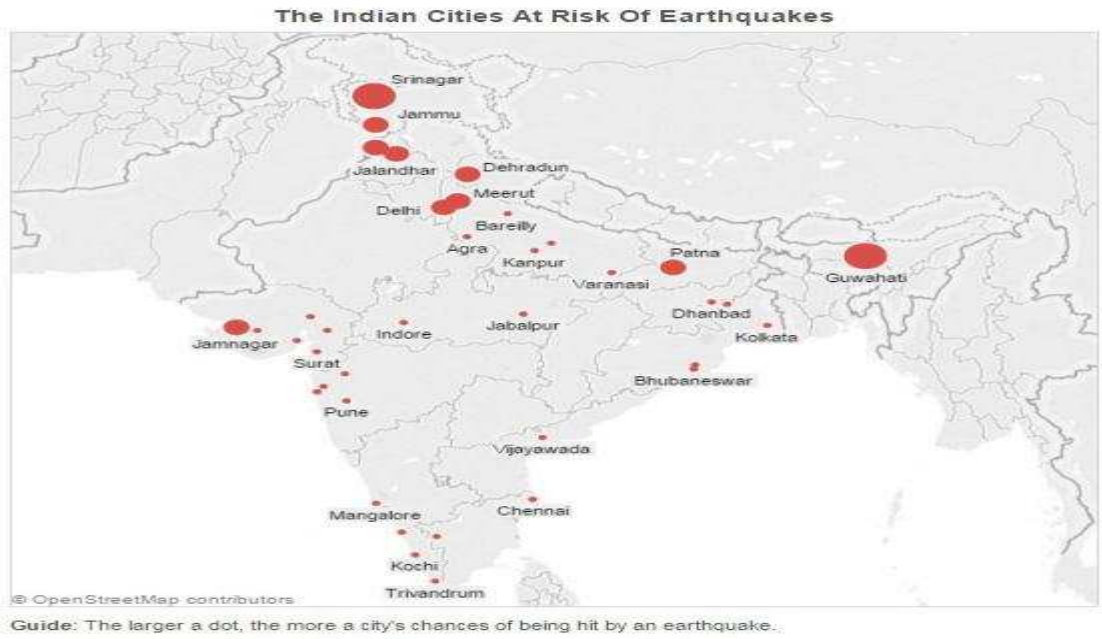


Figure 12: Indian cities at risk of earthquake

Gujarat and Uttar Pradesh appear to be the most vulnerable states, with six cities each in earthquake- prone zones. Both the states have one city each under zone IV and five cities marked under zone III. Maharashtra is next with four cities in zone III. The Bureau of Indian Standards [IS-1893 – part – 1: 2002], based on scientific inputs from a number of agencies, including earthquake data supplied by Indian Meteorological Department (IMD), has grouped India into four seismic zones, II, III, IV and V.[19,20] The Modified Mercalli (MM) intensity scale, which measures the impact of earthquakes on the surface of the earth, is broadly associated with India's earthquake zones, as follows:

Intensity Of Earthquakes In Different Zones		
Seismic Zone	Intensity on Modified Mercalli scale	% Of Total Area
Zone II (Low intensity zone)	VI (or less)	43
Zone III (Moderate intensity zone)	VII	27
Zone IV (Severe intensity zone)	VIII	18
Zone V (Very severe intensity zone)	IX (and above)	12

Source: Indian Meteorological Department

Figure 13: Intensity of earthquake in different zones

11. Emergency Medical Services

Currently, India does not have a centralized body which provides guidelines for training and operation of Emergency

Medical Services (EMS). Emergency Medical Services are fragmented and not accessible throughout the country. Most people do not know the number to call in case of an emergency; services such as Dial 108/102/1298 Ambulances, Centralized Accident and Trauma Service (CATS), and private ambulance models exist with wide variability in their dispatch and transport capabilities. Variability also exists in EMS education standards with the recent establishment of courses like Emergency Medical Technician-Basic/Advanced, Paramedic, Prehospital Trauma Technician, Diploma Trauma Technician, and Postgraduate Diploma in EMS. [21] EMS is provided by a variety of individuals, using a variety of methods. To some extent, these are determined by country and locale, with each individual country having its own 'approach' to how EMS should be provided, and by whom. In some parts of Europe, for example, legislation insists that efforts at providing Advanced Life Support (ALS) services must be physician-led, while others permit some elements of that skill set to specially trained nurses, but have no paramedics. Elsewhere, as in North America, the UK and Australia, ALS services are performed by paramedics, but rarely with the type of direct "hands-on" physician leadership seen in Europe. The goal of emergency medical services is to either provide treatment to those in need of urgent medical care, with the goal of satisfactorily treating the malady, or arranging for timely removal of the patient to the next point of definitive care. [21]

In India, EMS is a relatively new concept, where the most dominant model is the EMRI (Emergency Management and Research Institute) services. The central government support to this scheme is mainly in the form of capital expenditure (capex) support. Operating expenditure (opex) is borne by the states, with the central support being progressively reduced from 60% of opex to begin with, to zero by the third year of operations. Emergency Referral Transportation System (ERTS), mostly through EMRI in PPP mode. Generally, hospital infrastructure, especially in public hospitals, for treating and managing medical emergencies need further strengthening.

While designing an EMS, the essential decision in pre-hospital care is whether the patient should be immediately taken to the hospital, or advanced care resources are taken to the patient where they lie. The "scoop and run" approach is exemplified by the MEDEVAC aero-medical evacuation helicopter, whereas the "stay and play" is exemplified by the French and Belgian SMUR emergency mobile resuscitation unit. The strategy developed for pre-hospital trauma care in North America is based on the Golden Hour theory, i.e., that a trauma victim's best chance for survival is in an operating room, with the goal of having the patient in surgery within an hour of the traumatic event. This appears to be true in cases of internal bleeding, especially penetrating trauma such as gunshot or stab wounds. Thus, minimal time is spent providing pre-hospital care (spine immobilization; "ABCs", i.e. ensure airway, breathing and circulation; external bleeding control; endotracheal intubation) and the victim is transported as fast as possible to a trauma centre.[21]

Existing fleet of ambulances (government owned and private) may be integrated with the EMS. Government owned ambulances, especially at secondary and tertiary level hospitals may be converted to Advanced Life Support (ALS) standard, exclusively for inter-institution transfers. There is also a scope to integrate such emergency transportation services within the framework of RSBY (or other such schemes), to establish links with identified hospitals to provide emergency care and also for payments (RSBY already has provisions for reimbursement for transportation).[21]

In India, EMS is a relatively new concept, where the most dominant model is the EMRI services. States like Madhya Pradesh and West Bengal had opted for basic transportation services (without stabilization care) in the PPP mode through multiple agencies (mostly NGOs) contracted at district/block level. The central government support to these schemes is mainly in the form of capital expenditure (capex) support. Operating expenditure (opex) is borne by the states, with the central support being progressively reduced from 60% of opex to begin with, to zero by the 3rd year of operations Various studies, including a review of EMRI by the health ministry found the following gaps in the existing EMS in India: Hospital infrastructure, especially in public hospitals, for treating and managing medical emergencies need further strengthening; Lack of training and training infrastructure for training health staff (public or private) and other stakeholders in medical emergency management/first aid; Fleet of existing government owned ambulances not liked with the new ERTS schemes (in terms of operational linkages and standardization across fleet); Legal framework defining and regulating roles and liabilities of various stakeholders (like ambulance operators, emergency technicians, treating hospitals and staff, etc.) needs further clarity/transparency, standardization and enforcement across the states.

The EMS for India would necessitate focusing on the following components, as a necessary part of the system: Ambulance – operations and maintenance; Call Centre – for ambulance dispatch and control; Empanelled health facilities/hospitals – ensuring quality of care; Information System and Knowledge Management – using multi-media and multi-channel data management; Training – for emergency case management on-site, in-transit, and in hospitals; Health Education – among general public; Legal framework – to define roles and liabilities of various stakeholders and Governance – for transparency and regulation.

Operating cost, at current level of operations and prices, is approximately 15,00,000 to 17,00,000 INR per ambulance per year. The currently estimated 1,700 crores INR required per year for a projected fleet of 10,000 ambulances needed nationwide (accounting for around one ambulance per 100,000 population) could finally be two to three times this amount. In a scenario where the commitment to raise health care expenditure to 3 percent of the GDP is adhered to, this 1700 to 3000 crores INR commitment would help reach this goal.[21]

The EMS would also need to have linkages with existing ambulance fleet of the states and also with schemes like RSBY. The existing fleet of government owned ambulances,

especially at secondary and tertiary level hospitals may be converted to Advanced Life Support (ALS) standard, exclusively for inter-institution transfers. Integration of EMS would also be needed within the framework of RSBY (or other such schemes), to establish links with identified hospitals to provide emergency care and also for payments (RSBY already has provisions for reimbursement for transportation).[21]

Most developed countries now provide a government funded emergency medical service, which can be run on a national level, as is the case in the United Kingdom, where a national network of ambulance trusts operate an emergency service, paid for through central taxation, and available to anyone in need; or can be run on a more regional model, as is the case in the United States, where individual authorities have the responsibility for providing these services.

Various countries have its own 'approach' to how EMS should be provided, and by whom. In some parts of Europe, for example, legislation insists that efforts at providing Advanced Life Support (ALS) services must be physician-led, while others permit some elements of that skill set to specially trained nurses, but have no paramedics. Elsewhere, as in North America, the UK and Australia, ALS services are performed by paramedics, but rarely with the type of direct "hands-on" physician leadership seen in Europe. Increasingly, particularly in the UK and in South Africa, the role is being provided by specially-trained paramedics who are independent practitioners in their own right.

The levels of service available will fall into one of three categories; Basic Life Support (BLS), Advanced Life Support (ALS), and in some jurisdictions, a Intermediate Life Support (ILS), which is essentially a BLS provider with a moderately expanded skill set, may be present, but this level rarely functions independently, and where it is present may replace BLS in the emergency part of the service. When this occurs, any remaining staff at the BLS level is usually relegated to the non-emergency transportation function.

While designing an Emergency Medical Service, the essential decision in pre-hospital care is whether the patient should be immediately taken to the hospital, or advanced care resources are taken to the patient where they lie.

The "scoop and run" approach is exemplified by the MEDEVAC aero-medical evacuation helicopter, whereas the "stay and play" is exemplified by the French and Belgian SMUR emergency mobile resuscitation unit. The strategy developed for pre-hospital trauma care in North America is based on the Golden Hour theory, i.e., that a trauma victim's best chance for survival is in an operating room, with the goal of having the patient in surgery within an hour of the traumatic event. This appears to be true in cases of internal bleeding, especially penetrating trauma such as gunshot or stab wounds. Thus, minimal time is spent providing pre-hospital care (spine immobilization; "ABCs", i.e. ensure airway, breathing and circulation; external bleeding control; endotracheal intubation) and the victim is transported as fast as possible to a trauma centre.[21,22]

The aim in "Scoop and Run" treatment is generally to transport the patient within ten minutes of arrival, hence the birth of the phrase, "the platinum ten minutes" (in addition to the "golden hour"), now commonly used in EMT training programs. The "Scoop and Run" is a method developed to deal with trauma, rather than strictly medical situations (e.g. cardiac or respiratory emergencies), however, this may be changing. Increasingly, research into the management of S-T segment elevation myocardial infarctions (STEMI) occurring outside of the hospital, or even inside community hospitals without their own PCI labs, suggests that time to treatment is a clinically significant factor in heart attacks, and that trauma patients may not be the only patients for whom 'load and go' is clinically appropriate. In such conditions, the gold standard is the door to balloon time. The longer the time interval, the greater is the damage to the myocardium, and poorer is the long-term prognosis for the patient. Current research in Canada has suggested that "door to balloon" times are significantly lower when appropriate patients are identified by paramedics in the field, instead of the emergency room, and then transported directly to a waiting PCI lab. The STEMI program has reduced STEMI deaths in the Ottawa region by 50 per cent. In a related program in Toronto, EMS has begun to use a procedure of 'rescuing' STEMI patients from the Emergency Rooms of hospitals without PCI labs, and transporting them, on an emergency basis, to waiting PCI labs in other hospitals. [21,22, 23,24,25,26,27]

EMS can generally be placed into one of two categories; one physician-led and the other paramedic-led with accompanying physician oversight. ***The Franco-German model*** is physician-led, with doctors responding directly to all major emergencies requiring more than simple first aid. In some cases in this model, such as France, paramedics do not exist at all. The team's physicians and in some cases, nurses, provide all medical interventions for the patient, and non-medical members of the team simply provide the driving and heavy lifting services. In other applications of this model, as in Germany, a paramedic is present, but is sharply restricted in terms of scope of practice; often not permitted to perform Advanced Life Support (ALS) procedures unless the physician is physically present, or in cases of immediate life-threat. Ambulances in this model tend to be better equipped with more advanced medical devices, in essence, bringing the emergency department to the patient. High-speed transport to hospitals is considered, in most cases, to be unnecessarily unsafe, and the preference is to remain and provide definitive care to the patient until they are medically stable, and then accomplish transport.

The second model, ***the Anglo-American model***, utilizes trained technicians/paramedics, to staff ambulances. In this model it is rare to find a physician actually working in the pre-hospital setting. More typically, they provide medical oversight for the work of emergency medical technicians and paramedics, which may be accomplished off-line (using protocols or 'standing orders'), or on-line medical control (technician in contact with the physician, usually over mobile- phone). Patients may be treated at the scene up to the level of the technician's skill set, and then transported to hospital, but in many cases, the limited skill set of the technician and the needs of the patient will result in the rapid

and timely transport of the patient to a hospital, at which point definitive care will begin.

The most widespread Emergency Response Model in India is the **"*108*"**. Emergency Service managed by ***EMRI*** (Emergency Management and Research Institute) across ten states. EMRI began operations in Andhra Pradesh on April 2, 2005 with a fleet of 30 ambulances across 50 towns of the state. It is responsible for handling medical, police and fire emergencies through the 108 Emergency Service. Presently EMRI has its operations in 10 states: Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, Goa, Madhya Pradesh, Rajasthan, Assam, Meghalaya, and Uttarkhand.

The "108 Ambulance Service" is a Public Private Partnership model between state governments and EMRI and the service provides complete pre-hospital emergency care from event occurrence to evacuation to an appropriate hospital. The concept of "108 Ambulance" aims at reaching the patients/sites within 20 minutes in urban areas and 40 minutes in rural areas and that the aim is to shit the patient to the nearest hospital within 20 minutes after reaching him/her. The emergency transportation is conducted in a state-of-the-art ambulance, which is provided free. The transportation is coordinated by a state-of-art emergency call response centre, which is operational 24-hours a day, 7-days a week. In addition, the call to the number 108 is a toll free service accessible from landline or mobile. The ambulances have been designed with a uniquely Indian perspective and it includes space for the patient, paramedic in the back and also bench seat for family members. EMRI ambulance fleet includes Basic Life Support ambulances (BLS), Advanced Life Support ambulances (ALS). The ALS ambulances are available with cardiac monitor and defibrillator in addition to the basic provisions of a BLS ambulance. The Emergency Response System (ERS) implemented by EMRI also includes trained human resources form the call centre staff to support staff in ambulances. Each ambulance has three pilots (drivers) and three EMTs who work in pairs of two for every 12 hour shift with a break every fourth day. For every 15 ambulances there is one operation executive and one fleet executive. Above them there is one district manager and one administrative officer, for every district. One of the key functions that EMRI performs is to recruit private hospitals who would participate in the ERS and this would imply cashless service for the first 24-hours till the patient is stabilized. The financing of EMRI in the initial years including capital or operational from the central government expenditure routed through the NRHM flexible pool. The government provided 100 per cent capital expenditure for procurement of ambulances and infrastructure and also provided 95% of operating expenses. The rest five per cent contribution comes from the private partner EMRI as their share in the PPP initiative. [21,22, 23,24,25,26,27]

Janani Express Scheme (non-EMS, merely transportation model)

The Janani Express scheme launched by the Department of Health and Family Welfare, Government of Madhya Pradesh (MP), on August 15, 2006 as a strong and innovative measure aimed at addressing the delay factor affecting MMR and the IMR, as envisioned by the National Rural Health Mission. The understanding behind it was that MP is not only the largest state in terms of area but also dominated by tribal areas with poor connectivity and inaccessibility to the cities/towns. The Janani Express scheme is a Public Private Partnership model, where the contract is signed between the Government (at the district/block level) and the private vehicle provider who is generally a local transporter. The Janani Express is basically a vehicle (four wheeler – Jeep/Tata Sumo/Mahindra) hired locally for a period of one year, to ensure provisioning of 24-hours transport availability at the field level (Block level) in order to bring the pregnant women to the health institutions. Transport is made available in the area served by a government hospital, CHC, and PHC. The Rogi Kalyan Samitis (RKS) of the concerned health facility plays a vital role in all issues related to the contracted vehicle and all reimbursements and the monitoring and control of the scheme is with the respective RKS. There is also the provision of performance based incentives to the transport agency.[21,22, 23,24,25,26,27]

Bihar Model: "102" and "1911" (mix of EM and basic transportation model)

The ambulances and respective hospitals are connected through a toll free number –"102". In addition to this, doctors are also empanelled, who would provide services on conference call and also would visit the patients who needed immediate doctor's assistance (using another toll free number – "1911"). The calls can be transferred from 102 to 1911. Details of the empanelled ambulances and hospitals are provided to the control room operated by IT managers who would contact the ambulance at the time of emergency. The State Health Society of Bihar (SHSB) under NRHM is the nodal agency for 102 control room. The SHS, along with District Health Society (DHS) has district wise empanelled list of ambulances (who are functional at that point of time) with their driver contact details and also enrolled ambulances from interested not-for-profit NGOs. The onus of maintenance and management of ambulances is with the respective owners. The ambulance operators charged user fees for the services provided, which ranged from 75 to 200 INR per 10 kilometers, (in respective areas/districts). The amount collected through government ambulances is pooled into the RKS fund of the monitors the management of the control room and also performs the regulatory role.[21,22, 23,24,25,26,27]

West Bengal Ambulance PPP Model (non-EMS, merely transportation model)

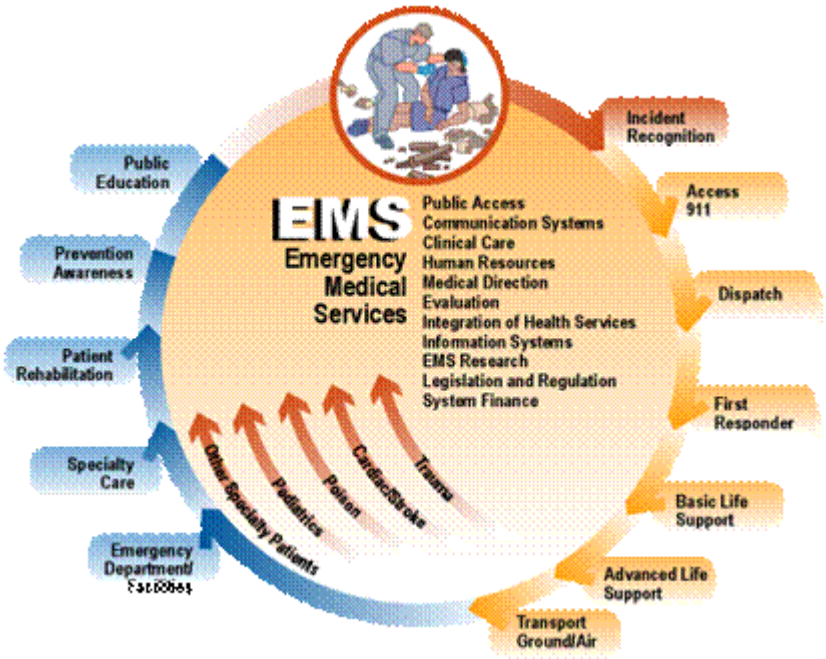
Another model of emergency transport is contracting out of the management and operation of Ambulance services to various NGOs/CBO's/Trusts under PPP arrangement in West Bengal. In this PPP model the state government procured and equipped ambulances and handed them over to selected NGOs, keeping the ownership with itself. This was facilitated by entering into agreements with various NGOs/CBO"s/Trusts by the respective District Health & Family Welfare Samiti (DHFWS) for a five-year period. These NGOs then operate the ambulance in the designated area on a user-fee basis. The DHFWS fixes the user charges and these can be retained by the NGO"s for meeting the recurring expenditure. The monitoring of the program is done by Block Health and Family Welfare Samitis (BHFWS). [21,22, 23,24,25,26,27]

Referral Transport System in Haryana (trauma/highway ambulance)

To reduce the maternal and neonatal deaths, the Government of Haryana has launched a unique scheme to provide referral transport service branded as "Haryana Swasthya Vahan Sewa No.102" on 14th November 2009. All the 21 districts of Haryana are covered under the scheme. The scheme offers transportation from the site of accident or home or any other place to nearest appropriate Medical Facility in case of medical need, and transportation from a Medical Facility to a higher medical facility. Free transportation Services are provided to pregnant women, victims of road side accident, patients belonging to BPL or notified slums, post natal cases in case of emergency (till 6 weeks after delivery), neonates in case of emergency (till 14 days after birth), freedom fighters and ex-defence personnel. For all other categories of patients, user-fees are charged which amounts to 7INR/per kilometer. The scheme is run by the government in collaboration with District Red Cross Societies and toll free telephone number "102" installed at each district control room for easy access to the public. There exists a 24x7 Control Room in each district hospital, for receiving the calls and monitoring of ambulances through GIS/GPS. There is common pooling of ambulances belonging to the Health Department as well as those owned or operated by the District Red Cross Societies. The operating cost for ambulances run by District Red Cross Society is reimbursed to them by the government.[22, 23,24,25,26,27]

12. Components of EMS

There are certain core elements in an EMS like the ambulance operations, call centre, and the treating hospitals/health facilities. These work in an environment that includes elements like information system, health education and training, legal environment and governance system. [Fig 13]



Source: Jones & Bartlett Learning, LLC

Figure 14: Components of EMS

The core elements of ambulance transporting the patients to the hospitals, coordinated by the call centre, would be linked in real-time through information system, using multi-mode and multi-channel media. This needs to be supported by well trained healthcare providers, both the in ambulance as well as in the hospitals, and also by aware members of the public (on the road, in workplaces, at home – made aware through targeted health education). For overall transparency in operations and fairness in service provision, an overarching legal and governance framework would be needed.

Call centre have to coordinate using interactive GIS software, integrated with ambulances and empanelled facilities/hospitals. Hospitals to be informed beforehand on type of cases, requirement for blood, etc. Public Emergency Management agencies like Police and Fire Service, also need to be integrated in the real-time information system for guidance, monitoring and other necessary actions.[22, 23,24,25,26,27]

The EMS may be managed and supervised at the state level by a State EM Trust, which may include representation from government agencies (health, police, fire, etc.) and other stakeholders (ambulance operators, private hospitals, insurance companies, civil society organizations, etc.); under the chairmanship of an appropriate authority (Health Secretary or the Chief Secretary). The National EMS Trust may be federation of State EMS Trusts under the chairmanship of an appropriate authority like the Health Secretary. The Trust may overlook the functioning of the EMS at state level, including procurement, tendering process, empanelment and accreditation processes, review of O&M, Quality, Health Education and Training. [22,23,24,25,26,27]

Strategic Trends in Disaster Risk Management

The disaster risk assessment requires calculations to be made of the likelihood. Analysis and management tools are required to manage these risks in all their aspects: hazard potential, exposure, capacities and vulnerabilities, and impact. A number of key trends have appeared. The trends in crisis response include: Governments are giving a higher priority to improving their own performance in managing national emergencies by shifting the emphasis from reactive crisis response to proactive risk management; improving coordination and accountability within and between government and its agencies; looking ahead and systematically assessing the risks, and their impacts, against a wide range of criteria; using national risk assessment to gain consensus on the priorities and as an evidence base for investment decisions on capabilities; exploiting advances in technology, in particular to enhance early warning of hazards; communicating risks and collaborating with a wider range of stakeholders in the private and voluntary sectors and civil society. Emergency response is being localized, with local government taking on an increased burden of responsibility for routine emergencies and for the initial response to national disasters. Governments are working with national infrastructure providers to improve the robustness and recuperative qualities of transport and communication networks, and distribution systems for energy and other services essential to human welfare. Some are beginning to assess the long-term risk trends to provide strategic early warning of changes in national risk profiles to ensure that resilience considerations can be build into national infrastructure, building, and environmental and social programmes for the long term. At the local level, and particularly in cities, the trend is to reduce vulnerability in the short term by upgrading local infrastructure where possible, and by promoting business continuity and community resilience schemes. A long term focus on preventing risk accumulation will require public and private investments facilitated by improved communication of risk data and education in risk reduction, and by risk-informed building regulation and urban planning systems.

Disaster risk management means considering the possibility of: risk termination (i.e. stopping doing the things, like building in a flood plain, that give rise to the risk), risk prevention (not usually available in the case of natural hazards except where it involves 'last-ditch' preventive actions designed to reduce vulnerability and mitigate the harm done, like dismountable flood barriers; or longer term risk reduction activity such as reducing carbon emissions), detection (provision of early warning alerts as well as detection of a latent hazard), protection, preparedness, crisis response, and risk transfer (i.e. insurance). It also means considering the impacts on all the 'objects of value' to a nation including not only lives and the health of the population, but livelihoods and the economy, the maintenance of essential services, and 'non-material' impacts on a nation's culture, political system and public confidence. The main trends associated with a resilience approach are: a short-term component (termed Resilience Performance), encompassing response and recovery, in which management of crises is strengthened by shifting the focus to the pre-event phases (risk identification, assessment, and mitigation through proactive preparedness and protective measures), and by: strengthening coordination of Government planning and response; use of risk assessment to build capability and capacity for response; enhanced ability to detect and provide early warning of disasters; growth of regional collaboration among countries in the group; decentralising emergency response, and re-balancing responsibilities for risk management accordingly and increased use of catastrophe insurance. A short- to medium-term component to build the resilient qualities (Resilient Characteristics) of some or all of a nation's economy, environment, infrastructure, and social and governance systems in the face of foreseeable and persistent risks of disaster or disruption is important.[28,29]

Trends in Hospital Disaster Plan

Disasters in the communities come in all the shapes and sizes. Hospitals would be among the first institutions to be affected after a disaster, natural or man-made. Because of the heavy demand placed on their services at the time of a disaster, hospitals need to be prepared to handle such an unusual workload. This necessitates a well documented and tested disaster management plan (DMP) to be in place in every hospital. To increase their preparedness for mass casualties, hospitals have to expand their focus to include both internal and community-level planning. The disaster management plan of a hospital should incorporate various issues that address natural disasters; biological, chemical, nuclear-radiological and explosive-incendiary terrorism incidents; collaboration with outside organizations for planning; establishment of alternate care sites; clinician training in the management of exposures to weaponizable infectious diseases, chemicals and nuclear materials; drills on aspects of the response plans; and equipment and bed capacity available at the hospital. The most important external agencies for collaboration would be state and local public health departments, emergency medical services, fire departments and law enforcing agencies. The key hospital personnel should be trained to implement a formal incident command system, which is an organized procedure for managing resources and personnel during an emergency. The hospitals should also have adequate availability of personal protective hazardous materials suits, negative pressure isolation rooms and decontamination showers. While responding to a mass casualty event, the goal of the hospital and health care response is to save as many lives as possible. Rather than doing everything possible to save every life, it will be necessary to allocate limited resources in a modified manner to save as many lives as possible. One of the key components of an effective response is ensuring adequate supplies of a broad array of qualified health care providers who are available and willing to serve. This could mean re-allocating non emergency and non-clinical doctors to emergency area of the hospital and recruiting retired or unemployed providers for temporary service. Coordination is the key. A wide range of training of hospital staff is needed to ensure an effective health and medical response to a mass casualty event. Preparedness for disasters is a dynamic process. In addition to having a well documented DMP in place, it is prudent to have regular drills to test the hospital's DMP.

Future Directions in Emergency Management

There are many factors that will affect the direction of emergency management that include global challenges, global opportunities, national challenges, national opportunities, professional challenges, and professional opportunities. There are many significant global challenges facing emergency managers. Five of these are global climate change, increasing population and population density, increasing resource scarcities, rising income inequality, and increasing risk aversion. Emergency managers are also faced with exciting opportunities including increased scientific understanding of the hazards and societal responses, as well as revolutionary technologies.

There is an increasing awareness at all levels of society of the connection between the ecological health of systems and the occurrence of disasters, both natural and technological.

There have been major advances in integrated detection, forecast, and warning systems, and the future seems bright for continued advances in this area. Sensing and recording devices include detection systems for hurricanes, flash floods, tsunamis volcanic eruptions, and hazmat (especially the release of toxic chemical, biological, or radiological agents). Other devices include satellite and aerial remote sensing, geographical positioning (GPS) systems, portable weather stations, scanners, and digital cameras. Communications devices include cellular and satellite telephones, pagers, fax machines, and personal computers that are connected through systems such as satellite dishes and local and wide area network connections. Radio continues to be a mainstay of emergency communications, but there is increasing attention to problems of interoperability. Emergency managers also are using specific software for hazard analysis such as GIS (Environmental Systems Research Institute, 2000), CAMEO (National Safety Council, 1995), ALOHA (FEMA, no date, a), and HAZUS (National Institute for Building Sciences, 1998). Although it is clear that these technologies will receive increasing utilization, research will be needed to examine the rate at which these other technologies are being adopted and the factors affecting their adoption. Many of the technologies that support emergency response also support disaster recovery, especially in the short term recovery phase. The increasing availability of cellular telephones, GPS devices, and powerful computers (both notebook and pocket sized) facilitates rapid and definitive disaster assessment. This is especially advantageous in retrieving the locations of critical facilities (schools, hospitals, nursing homes), hazardous facilities, infrastructure (bridges and viaducts), and historic buildings from databases. In addition, damage assessors can enter their findings directly into those databases (bypassing paper forms) and use wireless capabilities to transmit each day's disaster assessments back to the EOC.

Terrorist Threats

Most terrorist threats involve familiar hazard agents such as explosive and flammable materials; toxic chemicals have been used much less frequently and radiological and biological agents have so far remained a potential threat. Regardless of the specific hazard agent used, terrorist attacks will initiate the familiar agent generated demands for emergency assessment, hazard operations, and population protection. The methods of emergency assessment will differ from those involved in natural hazards because threat detection and emergency classification, hazard and environmental monitoring, population monitoring and assessment, and damage assessment differ by hazard agent. However, the types of hazard agents used by terrorists might not differ from those that can be released accidentally from fixed site facilities and transportation of hazardous materials. Terrorists can use indigenous materials—those already available locally. That is, future attacks might involve hazardous materials facilities (e.g., chemical or nuclear plants) or transportation routes (e.g., trucks or railcars carrying hazardous materials through densely populated areas). Methods of population protection will also continue to involve protective action selection and population warning, protective action implementation, impact zone access control and security, reception and care of victims, search and rescue, emergency medical care and morgues, and hazard exposure control.

Terrorist threats could pose some significant new challenges. Exotic chemicals such as sarin gas, "dirty bombs" (explosive devices designed to disperse radioactive materials that contaminate victims), and biohazards (e.g., exotic diseases such as Ebola virus) exhibit some behaviors that are unfamiliar to local emergency responders (e.g., contagion rather than contamination).These will require new biohazard-specific emergency response procedures, even though the general processes of emergency assessment, hazard operations, and population protection defined in local EOPs will remain the same. Similarly, all terrorist threats initiate response generated demands that are the same as for more familiar natural and technological hazards. These include agency notification and mobilization, internal direction and control, external coordination, public information, administrative and logistic support, and documentation. Consequently, emergency managers must link preparedness for each hazard agent into existing emergency management networks. They must anticipate potential hazard impacts on risk area population segments and assess their capabilities for self protection. Household emergency preparedness for terrorist threats will depend upon the basic awareness of hazard agents and feasible protective actions, hazard intrusiveness (frequency of thought, discussion, and information receipt), beliefs about hazards (severity, duration, certainty, immediacy), and beliefs about hazard adjustments (efficacy in protecting persons and property, utility for other purposes, cost, safety, time and effort, equipment and skill, and cooperation from others). Emergency managers must work with public health agencies to establish methods of emergency response coordination. Local emergency response organizations need to be trained and equipped for biohazard-specific methods of emergency assessment, hazard operations, and population protection. Extensive drills and exercises are needed to determine if biohazard contagion could create emergency response challenges even more complex than those of hazardous materials contamination. There are two important professional challenges confronting emergency managers in the coming years. These are linkage of emergency

management with new professions and linkage of emergency management practitioners with academic disciplines.

CDC Field Triage Guideline Recommendations

The Guidelines[30] apply to "routine" daily triage of injured patients. [Fig.15]

Step One: *Physiologic Criteria* is intended to allow for rapid identification of critically injured patients by assessing level of consciousness (Glasgow Coma Scale [GCS]) and measuring vital signs (systolic blood pressure [SBP] and respiratory rate). Transport patient to a facility that provides the highest level of care within the defined trauma system if any of the following are identified:

- Glasgow Coma Scale <13, or
- SBP of <90 mmHg, or
- Respiratory rate of <10 or >29 breaths per minute (<20 in infant aged <1 year), or need for ventilatory support.

The need for ventilatory support (including both bag-mask ventilation and intubation) has been added to "respiratory rate of <10 or >29 breaths per minute (<20 in an infant aged <1 year).

Step Two: Anatomic Criteria

Certain patients, on initial presentation to EMS providers, have normal physiology but have an anatomic injury that might require the highest level of care within the defined trauma system. Transport the patient to a facility that provides the highest level of care within the defined trauma system if any of the following are identified:

- all penetrating injuries to head, neck, torso, and extremities proximal to elbow or knee;
- chest wall instability or deformity (e.g. flail chest);
- two or more proximal long-bone fractures;
- crushed, degloved, mangled, or pulseless extremity;
- amputation proximal to wrist or ankle;
- pelvic fractures;
- open or depressed skull fractures; or
- paralysis.

Patients with pelvic fractures should receive rapid and specialized care because of the possibility of internal hemorrhage and other associated injuries.

Step Three: Mechanism of Injury

An injured patient who does not meet Step One or Step Two criteria should be evaluated in terms of mechanism of injury (MOI) to determine if the injury might be severe but occult. Evaluation of MOI will help to determine if the patient should be transported to a trauma center. Although different outcomes have been used, recent studies have demonstrated the usefulness of MOI for field triage decisions. Transport the patient to a trauma center if any of the following are identified:

a) falls

- adults: >20 feet (one story = 10 feet)
- children: >10 feet or two to three times the height of the child

b) high-risk auto crash

- intrusion, including roof: >12 inches occupant site; >18 inches any site
- ejection (partial or complete) from automobile
- death in same passenger compartment
- vehicle telemetry data consistent with a high risk for injury;

c) automobile versus pedestrian/bicyclist thrown, run over, or with significant (>20 mph) impact; or

d) motorcycle crash >20 mph

Step Four: Special Considerations

EMS personnel must determine whether persons who have not met physiologic, anatomic, or mechanism steps have underlying conditions or comorbid factors that place them at higher risk of injury or that aid in identifying the seriously injured patient. Persons who meet Step Four criteria might require trauma center care. Transport patient to a trauma center or hospital capable of timely and thorough evaluation and initial management of potentially serious injuries for patients who meet the following criteria:

a) older adults

- risk for injury/death increases after age 55 years — SBP <110 might represent shock after age 65 years
- low impact mechanisms (e.g., ground-level falls) might result in severe injury

b) children should be triaged preferentially to pediatric capable trauma centers

c) anticoagulants and bleeding disorders

- patients with head injury are at high risk for rapid deterioration
- burns without other trauma mechanism: triage to burn facility
- with trauma mechanism: triage to trauma center

d) pregnancy >20 weeks

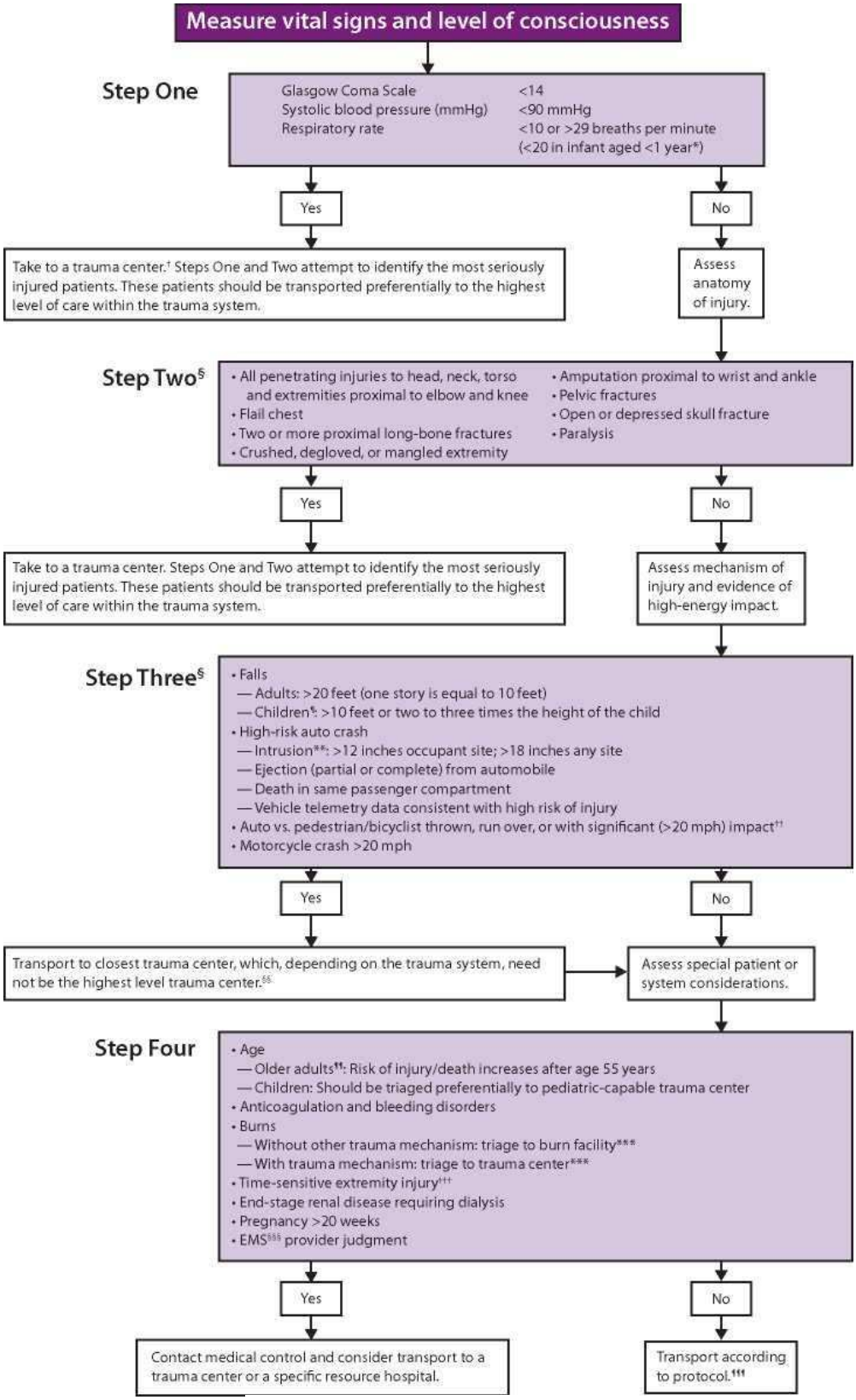


Figure 15: Field triage decision scheme

13. Disaster Prevention

Reducing the impact of disasters requires a complex mix of technical and social endeavors, and no single prescription or discipline can provide all the answers. Indeed, disaster researchers have frequently expressed concerns that technology not be viewed as a panacea. Disaster prevention can be thought of as taking measures to reduce overall vulnerability to natural hazards. These include measures taken to detect, contain, or forestall events or circumstances that, if left unchecked, could result in a disaster. Another essential part of the disaster risk management cycle is preparedness, which is also an effort to reduce vulnerability, though recognizing that impacts cannot be prevented entirely. Preparedness includes those strategies, activities, and actions taken before hazard events occur in order to lay

the groundwork for effective response. Once a disaster has occurred the focus changes to response which includes the mobilization of emergency services during or after a disaster situation. Recovery involves the restoration of the facilities, livelihoods, and living conditions of disaster-affected communities. This includes repairing or upgrading physical infrastructure, ensuring appropriate social services, and the provision of food and other resources. Recovery describes rehabilitation and reconstruction activities that save lives, address immediate needs, restore normal activities, and reduce future disaster risk. [1,2,3]

These have greatly advanced knowledge on effective approaches to mitigate the effects of disasters and support communities in coping with disaster consequences. The focus should be on building national and community resilience to disasters. Three strategic goals include the introduction of disaster risk reduction into planning for sustaining development at national and local levels; development and strengthening of institutions, mechanisms and capacities to build resilience to hazards; systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes.

14. Looking to the Past to Understand the Future

Disasters cut across many boundaries, including organizational, political, geographic, professional, topical and sociological. A comprehensive disaster management system must allow access to many different kinds of information at multiple levels at many points of time. The disaster information infrastructure encompasses three subsystems: knowledge infrastructure, interconnectivity infrastructure and integration infrastructure. Knowledge infrastructure involves observation techniques for data collection and visualization, information analysis, event forecasting, knowledge modeling and information management. Interconnectivity subsystem relates to the mode of communication employed to retrieve and distribute data and dissemination of information products. Integration infrastructure addresses the operational system, standards and protocols, procedures for evaluation of quality and reliability and training of key personal. [1,2,3]

15. Conclusion

The world will not look the same as it does today. Shifting demographics and the rate of technological innovation will challenge the way we plan and communicate with the public. More frequent and more intense storms will present operational challenges and complexities. Any of these issues alone would challenge some current emergency management policies and procedures. Forces of change produce a difficult, highly uncertain future, the complexity of which will test the ability of the emergency management community to execute our mission. Exploring the nature of such future challenges can help us take actions to improve resilience and adaptability. Rapid advancement of technology could be deployed in efficiently tackling the challenges emerging from disasters, minimizing the impact of disasters in terms of reducing the magnitude of death and casualties, improving the health and sanitary conditions of the affected population, rehabilitation of the victims, etc. Specific technological solutions can be utilized in all the phases of disaster management, namely, disaster preparedness, disaster reduction, disaster mitigation, and post- disaster rehabilitation. There is a need for the application of modern technologies in disaster management, wherever and whenever possible. Many frontier areas such as space technology, modern information and communication systems, renewable energy, advanced medical diagnostics, and remotely operated robotic systems for rescue and relief operations; find useful applications in disaster management efforts.

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