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Disaster Epidemiology - Introduction

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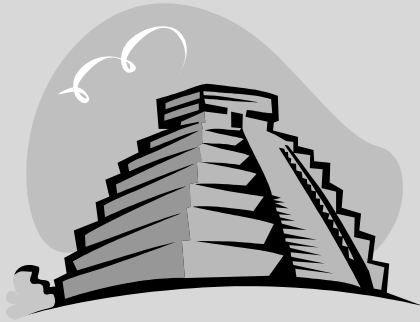
Disasters

Fatalism vs. Preparedness

Are Disasters Inevitable? In many areas, disasters are accepted as a feature of life. In the opinion of many individuals, there is little that one can do to prevent a disaster. It is an “act of god”.

This viewpoint is antagonistic to public health professionals who are busy at work on plans for dealing with disasters and reducing their impact. One thing that we have learned from the many disasters that preceded us, is that the impact of most disasters can be reduced with proper planning and intervention before the event occurs.

Historically



- Catastrophes and religion
- Catastrophes and mythology
 - Atlantis
- Folklore
 - Pompeii

The fatalistic notion of disasters probably arises from the manner in which disasters have been portrayed throughout history. Foremost, disasters have commonly been linked to religion. A popular perception today is that disasters represent an “Act of God”. Historically, this notion has strong ties to religious teaching. The flood of 40 days and 40 nights (Noah’s Ark) is one example. Another example was the view of many cultures (e.g. Incan, Mayan) that volcanoes represented the power of the gods. Several individuals were sacrificed into volcanoes as an offering of gifts to the gods.

The catastrophic nature of disasters has also led to the evolution of disasters as a part of folklore and mythology. We all have been taught about the destruction of Pompeii in 79AD by a volcano. The myth surrounding the underwater community of Atlantis originates from a disaster.

An overriding consequence of this history is the thought that there is little that we can do to prevent disasters. The goal of this lecture is to put an end to this perception. While it may not be possible to prevent a volcano from exploding, or a hurricane from forming, there are, in fact, several steps that we can take to reduce the likelihood for disasters or reduce the loss of life and injuries associated with disasters when they occur.

Disaster Epidemiology

(A) Understanding the causes of
a disaster

(B) Understanding ways of
controlling a disaster
situation

Disaster epidemiology is a relatively new field of study. Only within the last twenty years have investigators thought of studying the characteristics of disasters from an epidemiologic perspective.

The epidemiologic investigation of disaster events focuses on two approaches. The first is the typical epidemiologic study of the underlying causes of the disaster. This may focus upon the event itself, or the mortality and morbidity associated with the event. Learning as much as possible about the reasons for disasters is important for developing prevention activities in the future.

The second approach is to use epidemiologic methods to investigate mechanisms for alleviating the burden of a disaster once it occurs. This may be applied at the stage of disaster preparedness or at the stage of disaster relief. The most direct application of epidemiology in this situation is the establishment of surveillance systems to identify injuries and the possible emergence of communicable diseases.

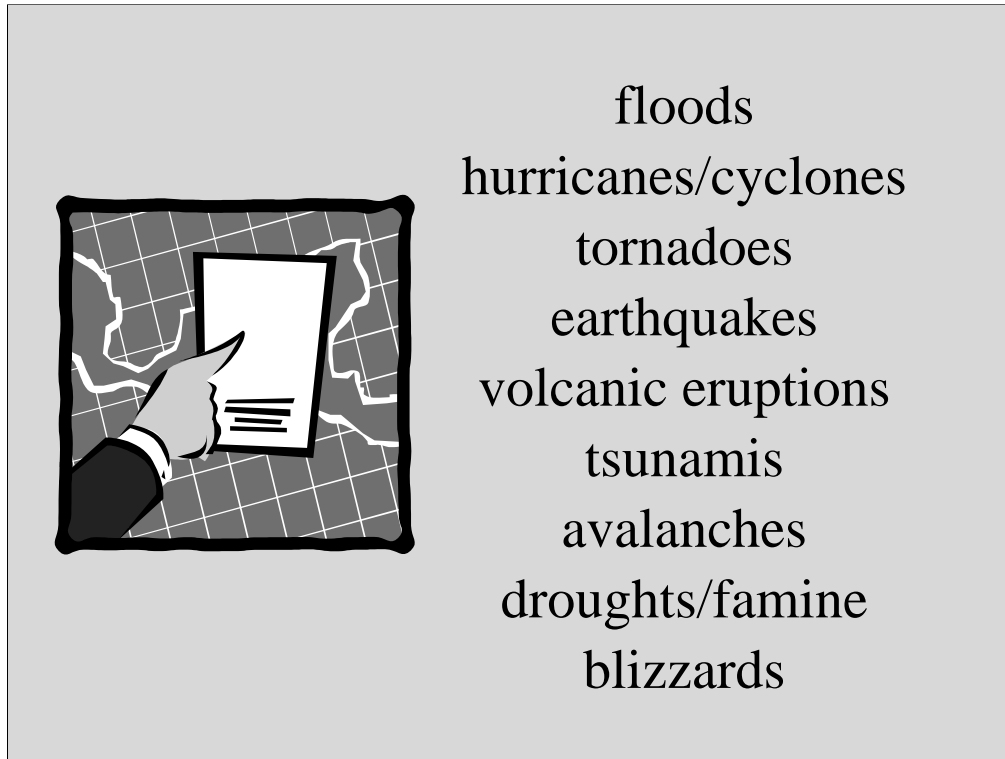
What is a Disaster?

- Extreme weather event
- Extreme geologic event
- Industrial mishap
- Famine
- Major population displacement

The first investigative issue that arises is the characterization of a disaster. This raises the question of “what exactly is a disaster?” Webster’s Dictionary defines a disaster as a “sudden calamitous event bringing great damage, loss, or destruction.” This is a broad classification, and the term may mean different things to different people.

Disasters may represent many different types of events. Those related to weather and the earth’s geology are the most widely recognized. Recent events, though, point out that several episodes of mass destruction have their links to our own actions. These may include industrial accidents, many episodes of famine, and significant population displacements.

The common characteristic to each of these events is their severity. These events represent extremes. We normally live with the underlying features of these events present with us every day. They become disasters when the extremes express themselves.



The most widely recognized types of disasters are those listed here. Disasters related to extreme weather events (floods, cyclones, tornadoes, blizzards, droughts) occur regularly. Events related to extremes of the earth's geology (earthquakes, volcanic eruptions) occur less frequently, but result in major consequences when they happen. Tsunamis often result from earthquakes. Avalanches result from massive accumulations of snow.

Disasters are commonly categorized by their origin; natural or man-made. Most disasters investigated in the literature are natural disasters. Recently, however, industrial accidents have been categorized as disasters. The Bhopal gas release and the Chernobyl nuclear accident are two examples of a man-made disaster. Forest fires (initiated by man) may be another example.

Disasters may occur suddenly in time (a quick onset), or they may develop over a period of time (a slow onset). Most occur suddenly and perhaps unexpectedly. However, some events develop gradually, including some floods and famines related to drought.

Definition of a Disaster

- “an overwhelming ecological disruption occurring on a scale sufficient to require outside assistance” ... PAHO 1980
- “disasters are exceptional events which suddenly kill or injure large numbers of people” ... Red Cross/Red Crescent

One of the most difficult concepts in the literature is to arrive at a definition of a disaster. There have been many attempts to define disasters, but all run into the problem of either being too broad or too narrow. Having a definition of a disaster is extremely important in epidemiology for identifying which events to include or exclude from your analysis. If events are identified with a common definition, then they can also be more easily compared.

In general, most disaster events are defined by the need for external assistance. Perhaps, one reason for this observation is that the disaster relief agencies are often the only organizations with comprehensive and systematic data. There should be some caution applied to data defined in this circumstance. Notably, the decision on which situations require external assistance may differ by country or region. In some situations, it may be a political decision as well.

The Center for Research on the Epidemiology of Disasters (CRED) in Brussels, Belgium, uses the following definition. “A disaster is a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance.” CRED maintains a database of disaster events from 1900 to present. Much of their data is derived from relief groups, including the Red Cross/Red Crescent Agency.

What is a Disaster?

- A disaster is the result of a vast ecological breakdown in the relation between humans and their environment, a serious and sudden event (or slow, as in a drought) on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid

(From Noji, Gunn and Lechat)

Eric Noji is a prominent scientist involved in disaster epidemiology. He provides a broad definition to encompass the wide array of events that lead to disaster, as well as the efforts involved in responding to it.

Global Impact of Disasters

1972-96	Annual deaths	Annual injuries
Africa	77,852	2,093
Americas	9,354	10,555
Asia	46,353	53,964
Europe	3,124	3,960
Oceania	108	634
TOTAL	136,790	71,206

Source: Center for Research on the Epidemiology of Disasters
World Disaster Report, 1998

The latest data on disasters from the databases of the Center for Research on the Epidemiology of Disasters can be found in the publication, “World Disaster Report” (Oxford University Press). The data suggest that there are approximately 136,000 deaths each year from disasters, and 71,000 injuries. The annual costs associated with disasters exceeds \$ 136 thousand million US.

The continents of Africa and Asia appear to be the hardest hit. Nearly 9 out of every 10 deaths from disasters occur in these areas. This is not surprising as there have been several observations that disasters cause fewer deaths in rich countries than in poor countries. This is primarily due to differences in the level of vulnerability and disaster preparedness between the rich and the poor. However, Africa and Asia also have large populations. The numbers above reflect absolute numbers and not rates. Thus, one should consider the impact by continent adjusted for population size.

Global Impact of Disasters

1972-96	Annual deaths	Annual injuries
Earthquake	18,715	27,012
Drought	73,606	0
Flood	12,696	21,874
High wind	15,960	12,824
Landslide	793	264
Volcano	1,017	285

Source: Center for Research on the Epidemiology of Disasters
World Disaster Report, 1998

The largest disasters from a human suffering viewpoint are droughts/famines. These generally represent extremes of weather and extremes of man (war) and were widespread in sub-saharan Africa in the 1980s. Significant numbers of deaths and injuries, though, are also attributed to earthquakes, floods, and cyclones/hurricanes/tornadoes.

Two notes concerning the data presented in the last two slides.

(A) You will notice that the figures represent an average of the data identified over a 25 year period. This time frame is used because disasters are relatively rare events. They fluctuate in number from year to year. A long time frame helps to eliminate misinterpretation of the data due to these fluctuations.

(B) The data most often represent those reported to relief agencies. In general, data on death and, more specifically, injuries from disasters have been called into question regarding their quality. Information on mortality and morbidity from a disaster may be captured in existing surveillance systems or special systems established at the time of the disaster. Questions about the accuracy of the figures arise for several reasons. For example, populations are often not fully enumerated. If large numbers of persons are missing, then one must estimate the impact from existing population records. Another example is the inability of many medical records systems to distinguish disaster-related events from other, non-disaster, events.

Are the Number of Disasters Increasing?

This question continues to receive extensive debate. In 2005, the number and magnitude of hurricanes led to a vigorous debate over the role of global warming in the development of hurricanes. The perception was that more hurricanes were related to global warming. The answer to this question and others will involve more scientific study. There is, however, an emerging consensus our role (human kind) in creating an environment that is conducive to more disasters.

Disasters Over Time

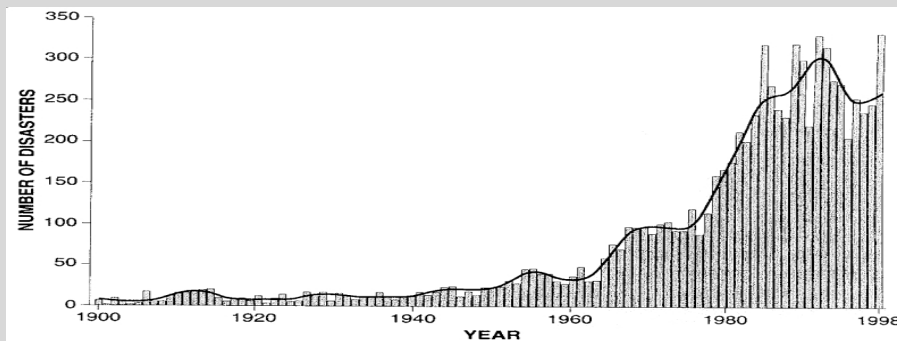


Figure 2.1 The annual total of natural disasters archived in the CRED database, 1900–98. Increases in the number of recorded events occur after 1964 (when OFDA was created) and after 1973 (when CRED was created). Part of the overall rise since the 1960s is due to improvements in communications and reporting efficiency.
Source: After CRED

Available evidence from CRED indicates that the sheer number of disaster events is increasing dramatically around the world. While arguments might be put forward that the quality of reporting of disaster events in the early 1900s was poor, and CRED cites the potential for differences in reporting disasters, there is support for the notion that this increase is real. The arguments to support this increase focus on the issues that accompany economic development and human growth.

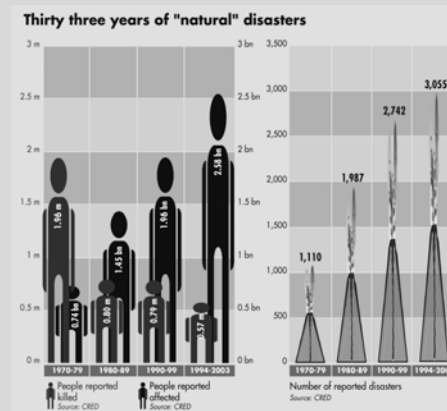
Environmental changes related to economic development may affect the potential for disasters. Deforestation may increase the potential for soil erosion and landslides (on hillsides). Global warming may increase the propensity for extreme weather events. Industrialization without controls may increase the risk for technological disasters (I.e. Bhopal). Population growth and Urbanization may increase the number of individuals at risk should a disaster strike.

More disasters – more affected

Since 1970s:

- ‘Natural’ disasters nearly 3 X as many
- Deaths drop 70%
- Numbers affected more than triple

Source: Centre for Research on the Epidemiology of Disasters, Belgium (CRED)



Here is another portrayal of the number of disasters over time. From 1970-2000, the number of reported natural disasters tripled. The number of people affected also increased. However, the number of deaths attributed to disasters declined. What factors may account for this decline in mortality in the face of an increase in events?

Note: CRED defines a disaster as an emergency in which more than 10 people are reported killed or 100 are reported affected. This data does not include technological disasters, or human displacement related to war or outbreaks of disease.

Understanding the Causes of a Disaster



What are the reasons that may explain the observed trends?

Why?

- Population growth: 70 m more people each year
- Rapid and unplanned urbanization, environmental degradation, misguided development, poverty
- Disasters disproportionately affect slum dwellers: poorest live in unfit places, seen as illegal, without services
- Disasters set back progress and growth = a vicious spiral
- Disaster preparedness saves lives

Several changes in the world over the last 30 years may explain the changes observed in both the frequency of disasters and their impact in terms of mortality.

Population growth is a significant component in the trend towards more disasters. The number of people exposed is increasing, while the case definition of a disaster remains the same. Exposure is a critical element here. Many risks for disasters are concentrated in select areas, low lying geographical areas, unplanned urban slums, etc. Also, with increasing population and development, there is the advent of environmental degradation, which increases risk for disaster.

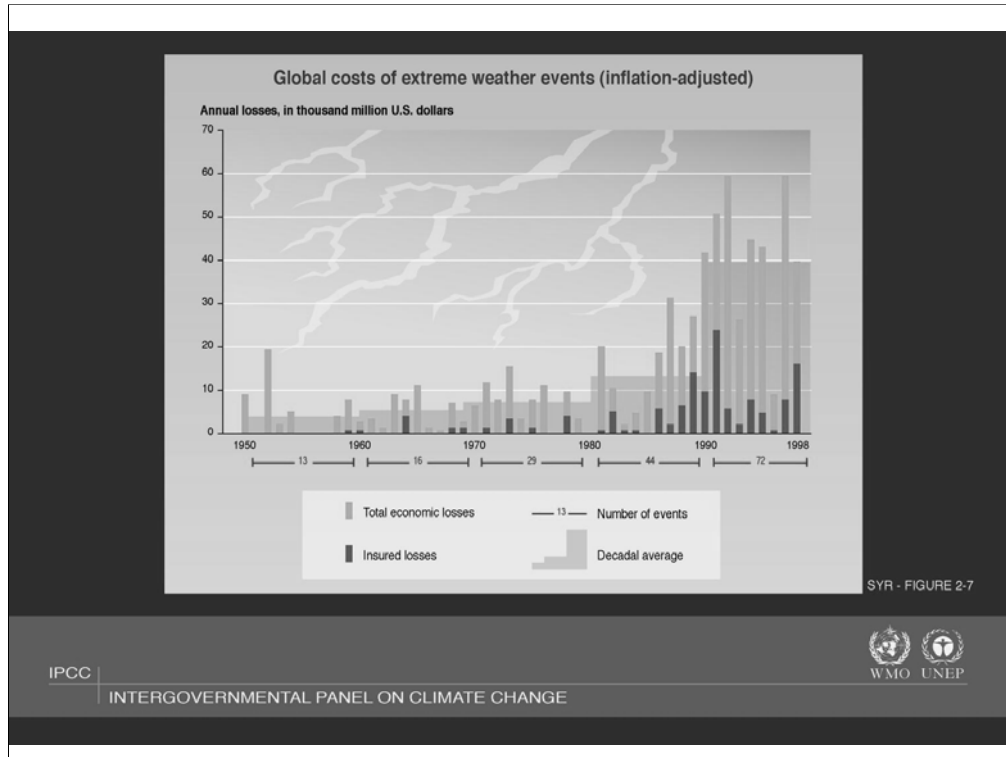
Declines in mortality may be due to the learning experience gathered from past events. Disaster preparedness and prevention messages are much more common in occurrence now than they were 30 years ago. Public health response to disasters is better. International relief efforts are better too.

The Environment and Disasters

- Increasing deforestation
 - Hurricane Mitch
- Industrialization in developing areas
 - Bhopal
- Global Climate Change
 - extreme weather events
 - sea level rise

There are several factors which have been linked to the risk for disaster occurrence or the risk for heightened mortality in the event of a disaster. One such factor is the environment. Anecdotal evidence suggests that changes in the environment may have an impact on disasters. For example, deforestation is increasing worldwide. Deforestation, though, increases the risk for landslides and soil erosion. Some believe that deforestation on the hillsides of Central America contributed to the disaster from Hurricane Mitch in 1998.

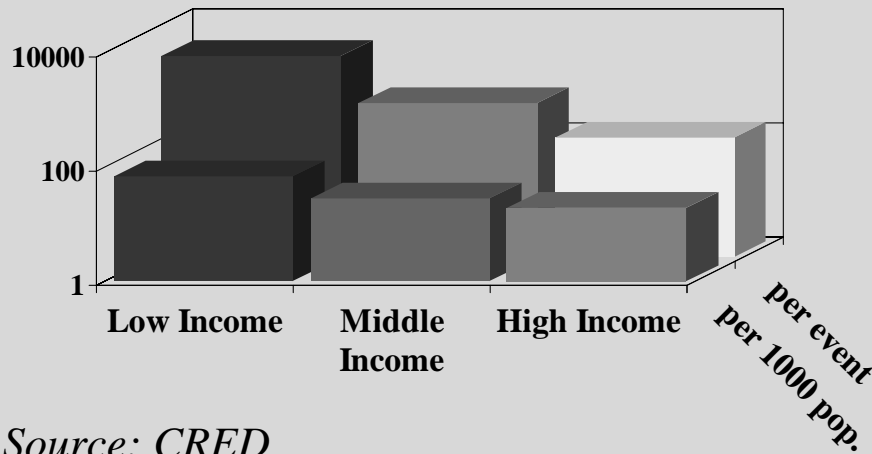
Another example is the increase in consumption of fossil fuels with industrialization. Global climate change from the build-up of greenhouse gases may lead to a greater frequency of extreme weather events (heat waves) in the future, as well as sea level rise. Several existing coastlines may be threatened in this event.



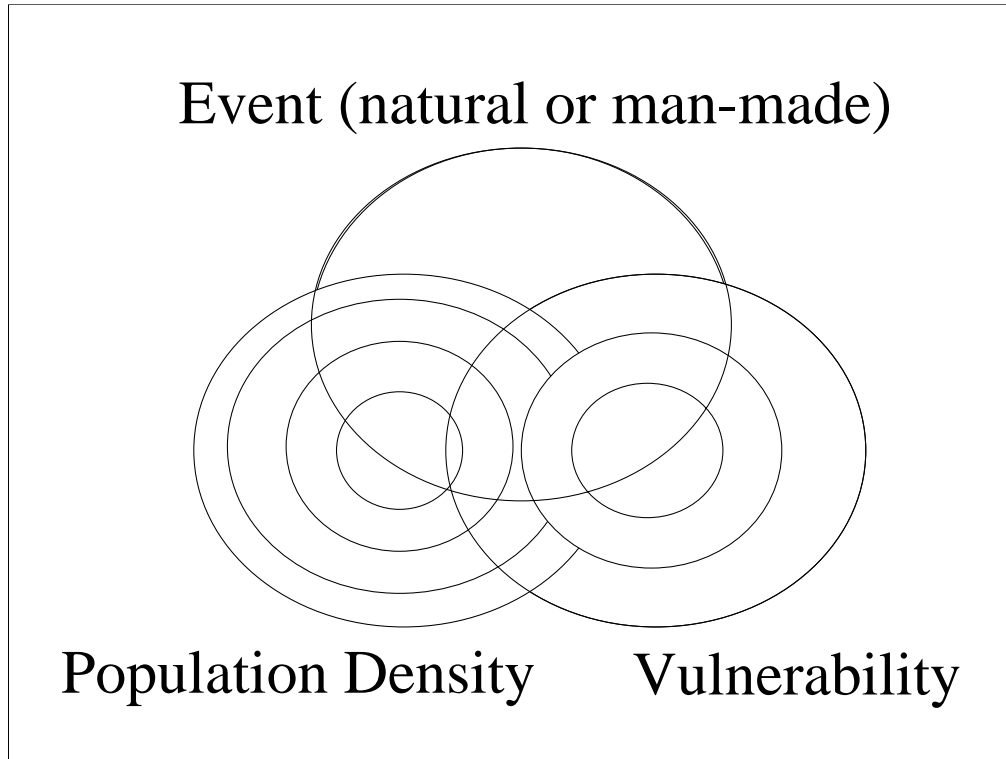
The link between disasters (extreme weather events) and global climate change is a contentious issue. Most evidence, though, indicates that weather patterns are changing with global warming, and these changing patterns include more extreme events (such as storms, hurricanes, cyclones, etc.).

This slide illustrates the economic losses associated with extreme events. They are rising exponentially.

Disaster Mortality and Economic Development



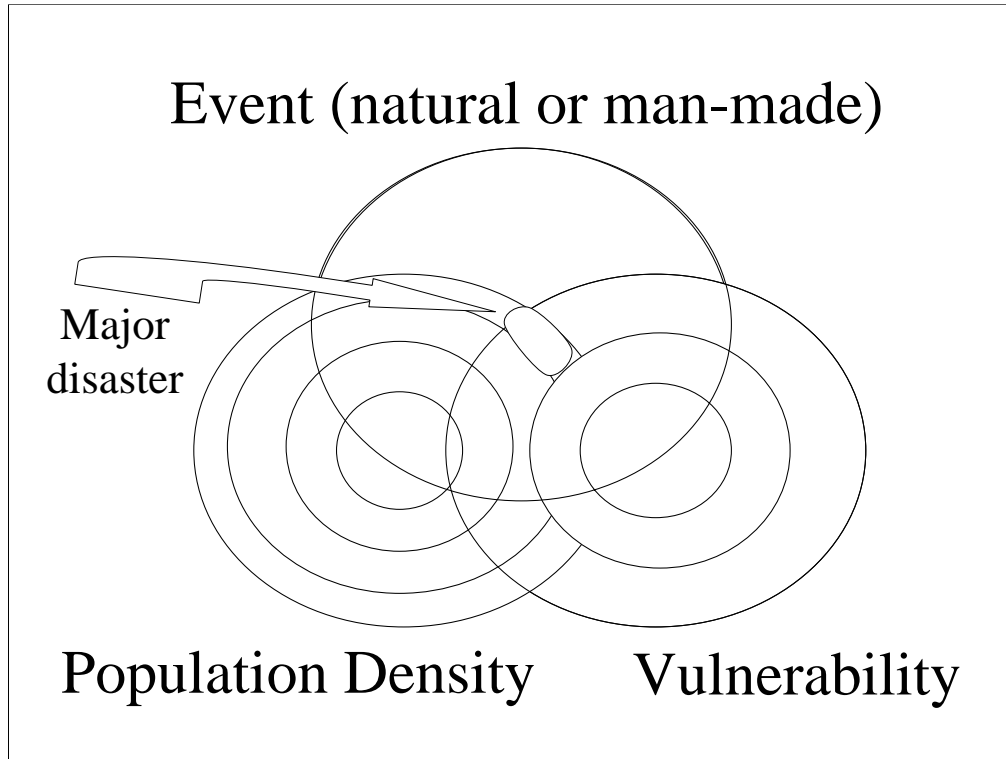
A major issue cited with respect to disaster development is the level of economic development. As noted earlier, the greatest degree of mortality and morbidity from disasters occur in lesser developed countries. This slide illustrates the strong link between income (GNP per capita) and mortality from disaster events. Both, overall, and adjusted for population, the risk for dying in a disaster is markedly higher in the low income countries.



The impact of a disaster and its relationship to population and environmental factors is illustrated here. From a human or economic perspective, the degree of calamity associated with a disaster will be associated with the population density of the area affected and the level of vulnerability in that area.

The diagram above illustrates the point that hazard events (such as earthquakes, hurricanes, floods, fires, etc.) do not occur in a vacuum. Events occurring in areas with dense population will result in greater harm (by absolute numbers) than events in less dense areas. Similarly, hazards occurring in areas made vulnerable by poor economic development will result in greater harm than those occurring in stable areas. Vulnerable areas include river water sheds, undefended coastal plains, and hillsides prone to landslides (perhaps from deforestation). Many lesser developed countries have large populations living on vulnerable ground.

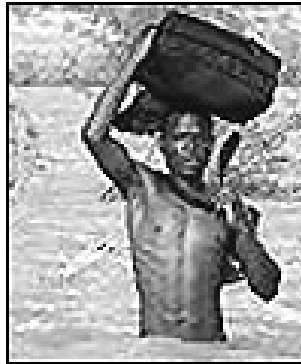
In the concentric circles above, areas of greater population density are represented in the outer circle. Similarly, areas of greatest vulnerability are depicted in the outermost circle.



The intersection of a hazard, high population, and high vulnerability results in a major catastrophe. This type of event will be associated with high mortality, high morbidity, and high economic costs (often uninsured).

Significant events can also occur in vulnerable areas with less dense population. Though the loss of human life will not be as great, there will often be similar levels of economic loss.

Understanding how to Control a Disaster Situation



Disasters and Health

- Injuries from the event
- Environmental exposure after the event
- Malnutrition after the event
- Mental health consequences
- Communicable disease outbreaks
- Excess NCD mortality

Disasters can influence human health in many ways. The largest impact of disasters on human health lies in the injuries which occur from the event itself. The types of injuries associated with disasters are discussed later in the lecture. The remaining areas of concern lie in events which take place after the disaster. Natural and man-made disasters will often destroy sizeable amounts of property, including houses and farms. From a health perspective, one is concerned with the effect of having no shelter (environmental exposure) foremost. In the long-term, this is concern over the ability to feed the population affected adequately.

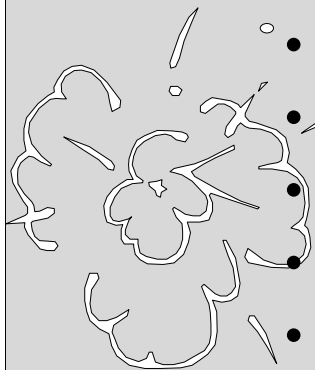
It is quite common to hear many individuals raise the issue of an increased risk for communicable diseases following a disaster. Certainly, the environment may be right for a disease outbreak to occur. However, several reports suggest that this risk is generally over-estimated.

Another area of interest is the mental health consequences of disasters. It is not uncommon for some victims of disasters to experience what is called “disaster syndrome”. The specific nature and pattern of this syndrome is not well defined. Most often the term is used to describe the segment of the population affected by depression and other mental health conditions arising from the disaster.

Recent studies also suggest that mortality from NCDs may be increased in the period of time following a disaster event.

Communicable Disease Outbreaks

- Limited evidence that they pose a major risk; but may occur due to



- Ecologic changes
- Population density changes
- Population displacement
- Disorganized health services
- Interruption of health services

Let's return to the issue of outbreaks of disease following a disaster. It is a common view that an increased occurrence of communicable diseases occurs after a disaster. One common perception is that dead bodies need to be buried as soon as possible to reduce the risk for the spread of disease.

In most disaster situations, however, disease outbreaks are not the primary concern. It is the view of many disaster professionals that the risk for outbreaks will not lie immediately after an event, but 1-2 weeks later. They regard the treatment of the injured as receiving the highest priority, rather than the disposal of dead bodies.

This is not to say that disease outbreaks cannot occur following a disaster. Several changes brought about by a disaster may increase the risk for such an outbreak. These include changes affecting vector populations, changes in housing for humans, the destruction of the health care infrastructure, and the interruption of normal health services geared towards communicable diseases. Relief workers should take a survey of these factors following a disaster to determine if the environment is favorable for an outbreak.

Role of Epidemiology in Disasters

- Identify major health problems
- Determine extent of disease
- Identify causes of disease and risk factors
- Prioritize health interventions
- Monitor health trends
- Evaluate impact of health programs

IFRC

Epidemiologic practice in disasters is similar to that observed in disease outbreaks. Descriptive epidemiologic practices are undertaken to understand the frequency of the health issue, those who are affected, characteristics of place and time, and the population at risk. Analytic epidemiologic practices are undertaken to test the hypotheses generated in the descriptive study activities.

The application of epidemiology, though, goes beyond the traditional practices. Relief programs can be managed better if all decisions are based upon epidemiologic findings. Training of relief workers can assist in the identification and evaluation of problems.

Should Disaster Strike ...

BE PREPARED

WHO

An overriding message of the study of individual hazards is that mitigation and preparedness can be effective in saving lives and preventing injuries. Should disaster strike, be prepared. Areas with established and practiced disaster plans have a marked advantage over areas with no preparations. Planning is particularly important for providing adequate levels of emergency health care, temporary shelter, and preventive health services.

The epidemiologic study of disasters is a relatively new area of research. Although there are strong concerns regarding the quality of existing mortality and morbidity data, unique patterns of death and injury have been noted by the type of disaster occurring. The analysis of past disasters provides several clues to the reduction of mortality and morbidity from future events. Future research in the epidemiology of disasters will likely focus on improving the surveillance of mortality and injuries related to disasters.