Section of Epidemiology & Community Medicine

President R E O Williams MD

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Paper

The Epidemiology of Disasters

by Professor Michel F Lechat MD DPH
(*Ecole de Santé Publique,*
Clos Chapelle aux Champs 30,
Bruxelles,
Belgium)

Definitions

n any discussion of disaster epidemiology, the first essential is to define a disaster and, more specifically, a natural disaster. For the World Health Organization, a disaster is 'a situation which implies unforeseen, serious and immediate threats to public health'. And the Committee on the Challenges of Modern Society (CCMS) defined a disaster as 'an act of nature or an act of man, which is or threatens to be of sufficient severity and magnitude to warrant emergency assistance'. The crucial point is the need for assistance, and it seems fair to say that a disaster is any unforeseen and sudden situation with which the affected community cannot cope.

Social sciences can be helpful here in describing how individuals and social groups deal with the stresses and strains of daily life – diseases, death in the family, interpersonal conflicts, unfulfilled expectations, social and material deprivation. These are individual crises and those who undergo them have to find their own solutions according to the models of acceptable behaviour within their own social or cultural group. There are, for example, socially recognized ways of handling an incurable disease, the loss of a relative, bankruptcy, or a car crash. These individual disasters do not induce change in society as long as they occur at random in time and place. Clustering of such disasters, however, may upset the ecological and social balance and produce effects which far exceed what might be expected from the simple addition of individual sufferings.

Of course, what might constitute a disaster for one community might not necessarily do so for another. Some populations with high exposure to disasters develop a kind of social adaptation which has been described as 'disaster culture'. This was the case in towns with frequent mining disasters in the Europe of the Industrial Revolution. And it is true today of Pacific atoll populations repeatedly exposed to typhoons.

Understanding of this disaster culture has important implications for prevention. Why do people live on the slopes of a volcano, why do they rebuild a city on the exact site of repeated earthquakes, why do they refuse to move when flooding is imminent? There has been some investigation, including field observation, on these subjects over the last few years, and a number of interesting explanations have been suggested. People often live in exposed areas, for example, simply because there is nowhere else for them to live, and this problem is bound to increase with population growth in many disaster-prone areas. There is also a remarkable degree of unawareness. People in communities which were wiped out by a nearby volcano some eighty years ago went playing cards on a night when the volcano was again beginning to erupt. Subsequent explanations included the idea that it was only a flying saucer which had landed on the next island with a few Martians aboard!

If the main criterion of disaster is the inability of a community to cope with deaths and damage, there will be a wide range of situations which may or may not be considered disastrous. Large-scale sporadic and highly localized events with an ecological dimension, such as earthquakes, undoubtedly qualify as disasters anywhere. In more elaborate societies, small-scale events can assume the proportions of a disaster. Technologically developed communities are more exposed to

serious breakdown of vital utilities. And their members are also generally highly differentiated and thus incapable of facing any disruption of the ecology. It has been said that 'the more one goes to school, the less one knows of current daily life'. While in disaster cultures everybody is a fireman or a doctor, in our western societies everything becomes the job of an expert – people are trained to have skills in one particular area and are assumed to be unskilled in all the rest. This is very important in terms of relief work, especially in planning for relief personnel.

It is now known that within 30 minutes of a major disaster, such as an earthquake, up to 75% of the healthy survivors are actually engaged in efficient rescue activities. But a number of rescue workers, coming from outside the disaster area and often foreigners, have no appropriate skills whatsoever, have often received no briefing, and may in fact impede the rescue operation. And this does not include the swarms of well-intentioned volunteers, medical students among others, who may often constitute a second disaster on top of the first! Nevertheless, there is a definite need for some kind of training in disaster preparedness for all professional workers in disaster-prone countries, be they agricultural extension workers, community workers or paramedical workers. Investment of this sort would be more profitable in the long run than sending in expatriate rescue and relief teams. Universities and schools of public health could play a useful role in making simple training material available.

Having attempted to define a disaster and to introduce some of the problems, the scene is set for epidemiology which could perhaps do more than any other discipline to improve the lot of disaster-struck communities at the present time. But first I should perhaps stress that my remarks are confined to natural disasters. Man-made disasters, such as fire, explosion, and even war, raise many of the same problems. However, they also have a number of distinctive characteristics which cloud the picture. They are ideally suited for prevention, for example, as regards transport of dangerous material or industrial accidents. They have specific, often toxic, effects. And lastly, they are occasionally planned, the expected effects being calculated in advance. This introduces a psychological dimension in what is almost a game context, and separates them from their natural counterparts.

There are many kinds of natural disasters – earthquakes, floods, tsunamis (tidal waves), landslides, avalanches, typhoons, volcanic eruptions. Drought associated with famine can be added for the sake of simplicity since, although easily predictable and not sudden, there is a similar need for external assistance.

Disaster epidemiology is born from the increasing realization that the effects of natural disasters on the health of populations are amenable to study by epidemiological methods. Death rates, according to type of disaster, and attack rates for various types of disorder in survivors could be computed, for example, and these indices used in planning appropriate supplies for rescue and relief. The effectiveness of various types of assistance and the long-term effects of aid on the restoration of predisaster conditions could be evaluated. To say that natural disasters are so diverse that nothing can be systematized is basically an excuse for inaction. If epidemiology is the study of health and disease in populations then there is absolutely no reason why disaster-struck populations cannot be studied by epidemiological methods. Drought in Somalia, an avalanche in Peru or floods in Florence may not have much in common, but they are surely no more dissimilar than cholera in mid-nineteenth century London, amyotrophic lateral sclerosis in Guam or lung cancer, in the investigation of all three of which the epidemiological approach has proved powerful. The health effects of disasters are many and appropriate indicators *must* be devised.

Impact Deaths

Death rates in disasters are highly variable. The Yellow River Floods in China in 1931 are said to have caused several million deaths and the East Bengal Floods of 1970 accounted for an estimated minimum of 224 000. The earthquake at Anchorage, Alaska, in 1964, on the other hand, claimed only 115 victims. And this is the more remarkable when one remembers that this is considered to have been the strongest earthquake ever recorded (it registered over 8.4 on the Richter scale).

On a global scale, earthquakes kill fewer persons than most other natural disasters. It has been estimated that between 10 and 15 million people have lost their lives in earthquakes during the last four to six thousand years. There are on average about 3000 to 5000 deaths from earthquakes per year (3650 reported per year for the period 1951–68) and this is probably less than the annual number of deaths from snakebite. Of course, this figure varies widely from one year to the next. On 23 December 1972 the earthquake at Managua, Nicaragua, alone killed an estimated 5000 people. And it has been calculated that,

should an earthquake of the same magnitude as the one which hit the Shanshi Province in China in January 1556, killing about 830 000, occur again, it would cause over one and a half million deaths. Similar unpublished predictions have been made for the next quakes in the Tokyo and San Francisco areas. Antiseismic engineering has made remarkable advances over the last decade or two, and deaths from earthquakes can now be prevented to a great extent by appropriate building techniques. These are expensive, however, and add at least 15% to the cost of the building – and to be really effective they have to be used very widely throughout earthquake-prone areas.

The geographical distribution of deaths from earthquakes shows a strong concentration in Turkey and Iran, both well-known areas of tectonic instability. In Turkey, in minor earthquakes, a linear relationship has been found between the number of deaths and number of houses destroyed – approximately 8.5 people killed per 100 houses destroyed or badly damaged. At times the rate is much higher. In the earthquake in Lice on 6 September 1975, for example, 1800 houses were destroyed or badly damaged with approximately 1200 deaths in the city itself, that is about 65 deaths per 100 houses. Bearing in mind the relatively low number of residents in each dwelling, this suggests some inadequacy in building technique which makes the houses particularly lethal in this part of the world. The distribution of damage and loss of life is not uniform throughout Turkey but is higher in the east, despite a smaller population at risk in that part of the country. This may be due to the type of building material available, since adobe (unburnt, sun-dried brick) is the main material as one travels east towards Lake Van. In Iran, high death rates are associated with houses whose walls are built of adobe insufficiently reinforced with concrete blocks and support large concrete slabs. Thus, high case-fatality rates from earthquakes in these countries are associated with the introduction of cheap new building technology. The socio-economic epidemiological determinants of earthquake mortality in these countries are not unlike those which influence the high attack rates for poisoning from eating seeds that have been treated with pesticides, in countries undergoing the so-called Green Revolution. In both instances there is a time lag between the introduction of new techniques associated with an increase in personal income, and effective education of the community. This highlights a need for control measures, such as appropriate building legislation and education, to reduce the number of deaths.

In other types of disaster the number of deaths may depend on the early recognition of an impending disaster and an appropriate warning system which allows the population enough time to take flight or seek refuge. This raises the obvious problem of striking a balance between sounding the alarm too soon or too late – whether to be on the safe side and run the risk of giving a false alarm, or to wait for definite signs of disaster and risk too late a warning. This is the dilemma of the sensitivity and specificity of means of detection. It passed widely unnoticed at the time, that the 300 000 or so deaths in the Gulf of Bengal cyclone in 1970 were due partly to a delay in warning. A false alarm had been given a few days previously for a very well-confirmed threat which did not materialize until later.

Post-impact Deaths

Little is known of death rates in the few minutes or hours after impact. This is due to lack of reliable observations, for which there are obvious and valid reasons. The generally small number of heavy casualties available for medical care after a disaster suggests that most of the injured die before they can be rescued. But these deaths should not be attributed necessarily to wounds suffered at the time of impact. After a flood, for example, it is likely that a number of the weakest survivors fall from the trees where they have taken refuge. A high rate of snake-bites in survivors clinging to trees for hours or days has also been reported in flood-disaster areas.

Surveys conducted among rescue workers on the use of drugs and equipment have shown that little is known about the conditions of survival immediately after impact. Responses received from some 80 workers interviewed by postal questionnaire revealed that the most universal drug given was aspirin, in addition to hot coffee. Similar difficulties in defining post-impact needs were met by a working group convened in 1974 by the League of Red Cross Societies to produce a standardized limited list of drugs and supplies which could cater for the widest possible range of needs in the early phase of relief. These gaps in knowledge emphasize strongly the need for more studies in this field. There is no doubt that many of the supplies, for example blood, isoniazide, paper cups, or contraceptive pills, rushed to the site of a disaster are almost wholly irrelevant.

Long-term Deaths

Remarkably little is known of the trends of death rates in populations that have been stricken by disaster. Disease-specific death rates (for example,

from tuberculosis) should be compared with the rates before the disaster, but there are often no previous figures to use as baselines.

Impact-associated Morbidity

Except in earthquakes the number of disaster casualties requiring medical attention is usually low in relation to the number of dead. In most natural disasters it seems as if people either die or survive, relatively unhurt. In floods the proportion of people requiring medical care has been reported to range from 0.2 to 2%. One of the most dramatic disasters of this century, the avalanche of the Callejon de Huaylas, in Huascaran, Peru, in 1970, caused 4600 casualties and killed approximately 70 000 (143 000 suffered light wounds). This gives a ratio of 1 injured to 15.2 killed. This may be due to patterns of flight, or to protection from, or capacity to survive, the early post-impact phase, as suggested by the peculiar distribution of impact-associated deaths. In the Bangladesh typhoon of 1970, age-specific death rates showed a bimodal distribution: 29% and 20% respectively in the 0–4 and over 70 year age groups, compared with 6% in the 35–39 year age group.

These observations must be related to the rush of mobile hospitals of all kinds, teams of specialized surgeons (on one day, following the Huascaran tragedy in 1970, 112 specialized foreign surgeons are said to have landed at Lima airport), and above all blood, blood and again blood by the hectolitre. The net result of this crisis-dominated convergence is usually to drain what few facilities remain in terms of accommodation, transportation and communication. This has clear implications for the planning of foreign aid.

Earthquakes present different problems. Many of those injured in earthquakes suffer from crush syndrome and their management raises special problems in devastated areas with few medical resources.

More should also be known with respect to health needs not associated with disasters. Medical services may have been disrupted and some services, such as surgical emergencies and complicated deliveries, have to be maintained at the pre-disaster level. In some disasters it had been said that obstetricians would have been more useful than surgeons.

Post-impact Morbidity

Nutrition and the control of communicable diseases in populations that have been stricken by disaster take priority in the efforts of rescue and relief authorities. In countries where cholera is prevalent it is generally assumed that this disease will spread in the aftermath of a tidal wave. On the contrary, the immediate effect of dilution of human excreta will be to distribute these over a large area instead of the confined surroundings of a hand pump or a shallow well. Nevertheless, outbreaks of cholera have been reported by health authorities and attributed to a disaster even when the timing was inconsistent with the shortest possible incubation period. If cholera has been associated with disasters, it has been due to overcrowding and promiscuous defæcation in refugee camps. The role played by some new types of food, which are diluted in cold water, should also be investigated.

Mass immunization against typhoid fever is widely practised in disaster situations, especially after floods, but the usefulness of this has never been evaluated. However, one of the first external reactions to disaster is generally to send large quantities of typhoid vaccine. In the Managua earthquake in 1972 about a million doses were flown in by donor countries and non-governmental agencies. Contrary to the instructions of the health authorities and the advice of national and foreign epidemiologists, a quarter of a million doses were injected. The result of such procedures is to divert useful and badly-needed personnel from more important activities and to run the risk of increasing the incidence of hepatitis.

The respective value of vaccination, sanitation, and early detection of foci of communicable diseases in time of disaster should be carefully evaluated for each disease. Clearly, there is a place for epidemiological surveillance and the machinery of such surveillance under emergency conditions should be defined. More needs to be known about the age-specific incidence of a number of communicable diseases, such as measles, in refugee camps. This could help to define the most vulnerable groups for preventive measures.

Disasters can also increase the incidence of diseases in the long term by interfering with current control measures. A well-documented instance is malaria in Haiti, following hurricane Flora in 1963. Sweeping across the southern districts of the country, Flora caused extensive damage to housing, about 68% of the houses being destroyed and most of the roofs blown away. This occurred in the course of an extensive malaria eradication campaign and flushed away the residual insecticide which had been sprayed on the walls of the dwellings. A severe malaria epidemic developed six to eight weeks after the

hurricane, with an estimated 75 000 cases. It is by no means sure that the ongoing transmission of malaria in the country to the present time is not in some way related to Flora.

There is, therefore, a great need to collect data systematically on the epidemiology of communicable diseases in populations affected by various types of disasters. There are at present no relevant guidelines to help agencies in charge of disaster management.

Long-term Morbidity

Epidemiological surveillance systems should be set up not only to monitor communicable diseases in the post-impact period, but to provide indicators which could assist in evaluating the long-term effectiveness of health measures. Of special concern is the negative, and possibly disastrous, effects of the provision by foreign agencies of sophisticated medical care for a temporary period. On the withdrawal of such care the population is left with a new level of expectation for health which just cannot be fulfilled.

A disaster can have a positive effect in the long run. It can be considered as an opportunity to get rid of obstacles to development and to promote new attitudes. This constructive approach, however, requires that long-term objectives be considered from the beginning of the disaster, in the very first moments of rescue and relief. More research should be done on ways of integrating the short-term objectives of immediate relief with the long-term objectives of restoring or improving health in the affected population.

Nutrition

Important changes of attitude have taken place since the time, not long ago, when some relief organizations were spending over a million dollars on food assistance without even asking for the advice of a nutritionist.

Nutrition in time of disasters has been widely studied over the last five years, following the political uprising in Bangladesh, the civil war in Nigeria, and the recent droughts in sub-Sahelian countries and in Ethiopia. Methods for nutritional assessment have been developed and the importance of caloric malnutrition, as compared to the often publicized specific protein malnutrition, has been recognized. The need to provide locally acceptable foodstuffs is increasingly taken into account by governments and relief organizations. Systematic observation should also be conducted on the nutritional status of the population once food aid has been withdrawn.

A recent development has been the identification of powdered skimmed milk as a major factor in vitamin A deficiency and associated blindness in children. Observations made in India and Bangladesh had previously drawn attention to a high incidence of xerophthalmia in children living in refugee camps. Very low levels of retinol were observed in drought-affected populations of the Sahel, in spite of an apparently adequate intake of proteins. A number of voluntary agencies and several governments have consequently decided to supplement food distribution programmes with a periodic (bi-annual) administration of vitamin A in high dosage. In the meantime, studies are being carried out on the epidemiology of vitamin A deficiency, with special consideration of the role of proteins.

It is surely surprising that, in spite of recommendations by UNICEF and pleas by assisted countries, most governments are still not prepared to take appropriate measures to add retinol to the skimmed milk they give away to developing countries. At the same time, huge quantities of unrequested and unnecessary multivitamins in inappropriate dosages and presentations are still shipped to affected countries at the first notice of a disaster. With surgeons, blood and mobile hospitals, multivitamins are one more myth, and a profitable one at that, in the disaster trade.

Conclusions

Over the last few years there has been an increasing awareness that some kind of disaster management should be possible. The emphasis is now moving from post-disaster improvisation to pre-disaster preparedness. The League of Red Cross Societies has increasingly encouraged pre-disaster planning in countries at risk. A new United Nations agency – United Nations Disaster Relief Office (UNDRO) – has been set up with headquarters in Geneva.

Coordination and exchange of information between agencies engaged in disaster relief are becoming the rule rather than the exception, and a number of groups have started with the specific objective of making professional expertise available to disaster management. A number of private initiatives have been taken, meetings have been organized, research centres set up, and research projects launched.

The study of disasters needs to be approached on a multidisciplinary basis, the more so since

the health component is only one part of the broad disaster problem and, perhaps, not the major one. Social scientists, psychologists, administrators, economists, geographers, have been or are conducting a number of studies on natural disasters. These studies have provided new insights and have proved most useful in preparing for disasters and increasing the effectiveness and acceptance of relief operations.

This is a vital and challenging field, wide open for research. It is now time for epidemiologists and community health scientists to enter the fray and provide much needed information on which a rational, effective and flexible policy for the management of disasters can be based.

Meeting 2 October 1975

Papers were read on the subject of **Community Medicine – What Does it Mean in a Developing Country?** as follows:

Community Medicine in the Tropics – The Problems
Professor D J Bradley
(*Ross Institute of Tropical Hygiene, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT*)

Rural Health Services in India
Dr V Jagdish
(*Department of Community Medicine, St Thomas Hospital Medical School, London SE1*)

Meeting 13 November 1975

The following papers were read:

The Role of Sociology in Medicine
Professor George W Brown
(*Department of Sociology, Bedford College, 51 Harley Street, London W1N 1DD*)

Role of the Social Sciences in the Health Care System
Dr T W Meade
(*MRC-DHSS Epidemiology and Medical Care Unit, Northwick Park Hospital, Harrow, HA1 3UJ*)

Meeting 12 February 1976

Papers were read on the subject of **Nonbacterial Meningitis and Encephalitis,** as follows:

Primary Amœbic Meningoencephalitis
Air Vice-Marshal W P Stamm
(*St Giles Hospital, London SE5*)

Some Viral Causes of Encephalitis and Meningitis in England and Wales
Dr N D Noah
(*Epidemiological Research Laboratory, Central Public Health Laboratory, London NW9*)