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Communicable Diseases and Epidemiological Surveillance After Sudden Natural Disasters

During the last decade, disasters from all causes have stirred growing interest among the authorities and the public in the stricken countries and in scientific quarters. This rebirth of interest is unquestionably due as much to the brutality and spectacular nature of major disasters, which have triggered international concern, as to the increasing risk of disasters in most developing countries * These hazards are associated with expanding population settlements in areas under threat from natural disasters such as floods, earthquakes and hurricanes The rapid urbanization of many countries inevitably increases the number of victims and the potential amount of damage in future disasters.

The problems raised by these and other disasters are many and varied. Health problems are only one, and often not the most important, aspect of a complex situation. In disasters, confusion, if not actual chaos, and a lack of objective health information and unsubstantiated rumours, make up the general background from which vital and far-reaching decisions have to be determined.

Hearsay reports of imminent outbreaks of communicable diseases rapidly reach the epidemiological services of the government and, unfortunately, the mass media which is too often ready to amplify indiscriminately the concerns of the population traumatized by the natural disaster.

In this chapter the risk of increased incidence of diseases following disasters will be analyzed, the principle of epidemiological surveillance under emergency conditions will be outlined and appropriate control measures proposed. The analysis will be limited to natural disasters such as earthquakes, hurricanes, tornados, floods and volcanic eruptions.

The problems for countries afflicted by chronic famine or protracted conflicts, when acute clinical malnutrition and total disruption of the public services occurring as a consequence of a sudden disaster add a new dimension to the already dismal situation, will also be considered briefly.

* In 1985 alone, catastrophic earthquakes devastated Chile on 3 March, when 150 people were killed and 2000 injured, and Mexico City, where an estimated 10 000 persons died or were reported missing following the seisms of 18 and 19 September Over 420 buildings totally collapsed and 5000 hospital beds were instantly destroyed (Source Epidemiologia, Boletin Mensual, Mexico, Vol 1, 1 enero 1986, p 5)

In Colombia, the dormant volcano Nevado del Ruiz brutally erupted following several weeks of precursory seismic activity and mild emissions of ashes and gas The moderate-sized eruption of 14 November 1985 caused the thawing of an estimated 5 7 per cent of the glacial ice cap Forty-five minutes later, the mudflow obliterated the city of Armero, resulting in a death toll of 23 000

RISK FACTORS FOR INCREASED INCIDENCE OF COMMUNICABLE DISEASES FOLLOWING DISASTERS

An epidemic is generally defined as the occurrence of cases in greater number than normally expected. In the special and emotional context of emergency situations when dead bodies are counted by thousands, we will reserve the use of the term 'epidemic' or 'outbreak' for a sudden and geographically-defined occurrence of a large number of cases—a definition more akin to that accepted by the general public, the press and the politicians. The term 'increased incidence' will be used otherwise.

Undeniably, disasters, in the absence of preventive and corrective measures, can favour the transmission of certain diseases. The major plagues of earlier centuries were often associated with natural disasters. There are three ways in which an increased incidence can be triggered by a disaster: by the increased transmission of local pathogens, by a change in the receptivity of the population and by the introduction of a new specific pathogen into the environment

Enhancement of Transmission

Disasters may increase the transmission of communicable diseases by a wide variety of devices: (*a*) an increase of promiscuity, (*b*) a deterioration of environmental health and (*c*) a partial or total disruption of control programmes. To judge the extent to which these factors are affected by a disaster, it is necessary to know the situation prior to it. In developing countries, the scarcity of baseline data on environmental health services and the lack of effective immunization coverage associated with widespread disease may lead inexperienced relief medical personnel or researchers to blame a natural disaster for chronic problems in the health situation erroneously.

Promiscuity most often increases when temporary settlements quickly become overcrowded, resulting in 'outbreaks' of scabies and lice and flea infestations. The sanitation and administration problems that inevitably arise, and the tendency of such camps to become permanent, are some of the many reasons for the authorities to avoid encouraging their establishment (*Fig.* 18.1).

Deterioration of sanitary conditions in the environment is the most important factor and the one most responsive to energetic action. The potential impact of the disaster on health is determined by the level of sanitation prior to the disaster. If there is no sanitary infrastructure, no water supply network, no sewage system, and personal hygiene is poor, a natural disaster can hardly aggravate the existing situation. At the other extreme, an urban area where sanitation services are strained to the limit of their capacity by population growth is particularly vulnerable.

Water Supply

The most critical and best known environmental factor is the provision of water. A few commonsense observations are worth stating:

1. People will need and seek to obtain the basic amount of water regardless of its quality, cost, time or the legal considerations to acquire it.
2. A supply of bacteriologically safe water is a priority for relief personnel,

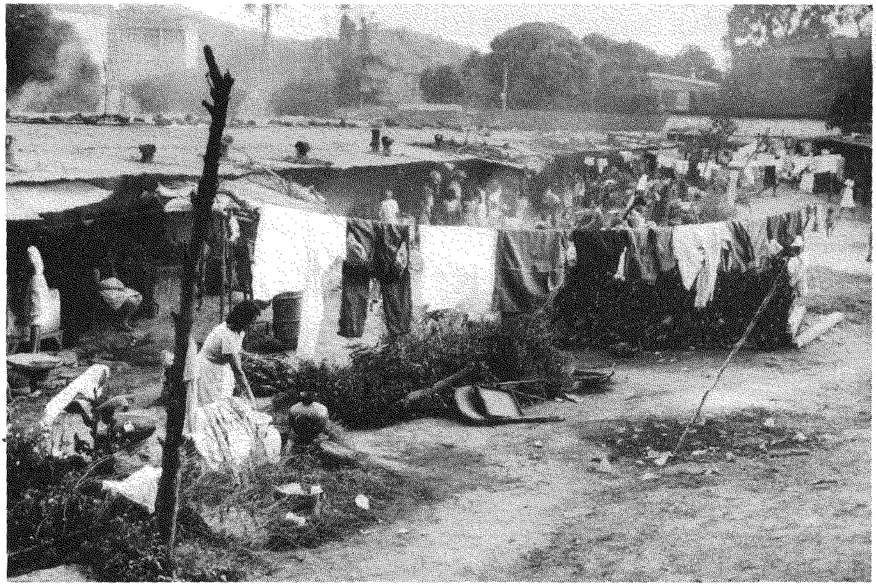

Fig. 18.1. Overcrowding and the lack of basic sanitation in temporary settlements is a major fact in the incidence of communicable diseases following disasters.

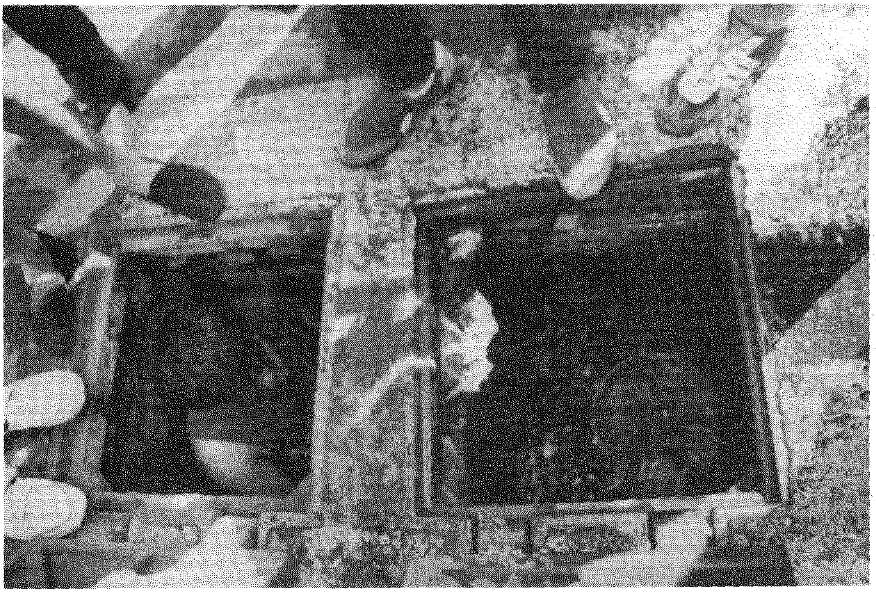

Fig. 18.2. Unsafe break-in into the main water pipe following the earthquake in Mexico, 1985.

health authorities and a small educated segment of the population in developing countries.

3. Short-term (days/weeks) emergency measures to provide drinking water to large populations are a logistical nightmare and extremely expensive. Each natural disaster may affect the amount of drinking water available in a distinctive manner.
4. Direct physical damage to water plants and distribution networks is common following earthquakes. Leak detection and emergency repair became a top health priority immediately after the initial treatment of mass casualties following the well-studied urban earthquakes in Nicaragua (1972), Guatemala (1976), Chile and Mexico City (1985) (*Fig.* 18.2). Similar shortages of drinking water were reported following floods (Jamaica, June 1986) and mud flows (volcanic explosion of Nevado del Ruiz, Colombia, 1985).
5. Indirect effects such as lack of electricity or failure of key staff to report for duty are both common following any large scale catastrophe, and have caused water shortages, usually of short duration.
6. A large population increase in the areas served by an existing (and intact) water supply system is the direct consequence of migration towards urban centres. The formal establishment of temporary settlements/refugee camps will not be considered in this chapter.

In relief operations or emergency situations, the quality of the water is not the issue. What matters is the potential *change* in water quality experienced by the population as a consequence of the natural disaster or subsequent population movements.

Earthquakes affecting areas with water and sewage systems increases the possibility of cross-contamination. However, daily bacteriological monitoring of water samples following the earthquakes in Latin America did not reveal any massive water contamination.

It is accepted that the flooding of wells or other water supply sources may lead to an increased incidence of water-borne disease. However, hard data and research results are scarce on the magnitude of the problem. The possibility of a beneficial dilution of pathogens following heavy flooding or tidal waves (e.g. Bangladesh 1970 and 1984) in densely populated rural areas cannot be discarded.

Outbreaks of leptospirosis caused by direct contact with water contaminated by infected animal urine has been reported following floods in Portugal (1967), Amazonia, Brazil (1973) and Jamaica (1979).

Food Hygiene

In the past, increased incidence of disease has been attributed more to poor hygiene of relief foods than to contaminated water supplies. Small outbreaks of mass food poisoning are commonly reported among victims and relief personnel in the aftermath of earthquakes or other natural disasters.

Vector and Rodent-Related Diseases

The importance of vector-related diseases following natural disasters is well summarized by the Pan American Health Organization.[1] Mosquito-borne diseases, especially malaria, dengue and arboviral encephalitis, eventually cause significant concern after disasters associated with heavy rain and flooding. The immediate effect is, however, the destruction of larval habitats and a reduction of the vector population with the secondary creation of new larval habitats. It is difficult to determine the probability that greater adult densities will be produced in these habitats and whether an increase in disease transmission will occur subsequently.

Vector-related diseases such as endemic typhus and certain rickettsial diseases, will be of concern when they are already endemic in or near a disaster area. In addition, fly, cockroach, bedbug, human louse and rodent infestations may pose problems. Immediately after a natural disaster, the fly and rodent densities may appear to be greater, either because they become more visible or have indeed really increased. This is partly due to disruption of sanitary services, such as garbage collection and disposal, and also because human overcrowding is accompanied by an increase in the numbers of rodents and other vermin seeking the same sources of food and accommodation.[1]

One of the best documented examples of a vector-born outbreak occurred in Haiti in 1963 when hurricane Flora struck shortly after households had been sprayed with DDT in the malaria eradication campaign. The availability of breeding sites, the destruction of homes protected by the insecticide and migration of the population helped to cause an explosive epidemic of malaria from Plasmodium falciparum (more than 75 000 cases were reported). A resurgence of malaria with high mortality has often been seen following the rains ending a prolonged period of drought.

Other examples include the dramatically increased incidence of malaria following major floods in Ecuador and Peru

The extensive rains and consequential flooding which characterized the El Niño phenomenon during 1982–3 along South America's Pacific coastline created an ecological environment which favoured the spread of malarial diseases into susceptible geographical areas.

In Peru the northern provinces of Piura and Tumbes suffered the heaviest rains. In 1983 alone, 11 075 new cases of malaria were recorded there. The number of cases reached a peak in September and October registering a figure 7 times greater than the average between 1976 and 1982.[2]

The simultaneous flooding which occurred in Ecuador encouraged a similar situation. Not only were new breeding places for mosquitos created but many carriers and potentially susceptible people moved out of rural areas into areas where malaria was already endemic, creating suitable conditions for additional outbreaks, such as those which occurred in Guayaquil. The incidence of malaria in Ecuador's coastal area jumped from 4000 registered cases in 1982 to 28 000 cases in 1984.[3]

Corpses

Other factors may exist but often they are given exaggerated importance· the public and the administrative authorities seem under a misapprehension concerning the part played by corpses in the transmission of diseases. Examples abound in which the press and television have evoked the spectre of cholera, typhoid fever or plague epidemics, to which the population is supposedly

Fig. 18.3. Dead bodies are not a major public health problem following natural disasters (volcano eruption, Colombia, November 1985).

Fig. 18.4. Unsubstantiated fear of epidemics leads to the disinfection of relief personnel handling dead bodies following the 1985 earthquake in Mexico.

Fig. 18.5. Over 500 patients and health personnel were buried under the ruins of the Hospital Juarez in the Mexican earthquake of September 1985.

exposed by the presence of human corpses. These alarmist claims overlook the fundamental epidemiological fact that these diseases are transmitted by *Vibrio cholerae, Salmonella typhi* (or *paratyphi*) and *Yersinia pestis* respectively, and not by the bacteria of putrefaction. Therefore, there seems to be no public health reason for cremating corpses or mass burial without respect for traditions and legitimate demands from the families (*Figs.* 18.3 and 18.4).

During the Mexican earthquake in 1985, the health authorities used polyethylene bags and ice to slow down the process of organic decomposition in order to allow relatives to identify the victims. After 72 hours the unclaimed corpses were transferred to wooden coffins for final disposal in common graves (*Fig.* 18.5).

During this experience a seminar for the press on 'health aspects in disaster situations' and the dissemination of properly documented information calmed public fears and contained a wave of rumours about the possibilities of epidemic outbreaks such as the plague, typhoid fever, typhus and other diseases.[4]

Disease Control Programmes

The interruption of regular disease control programmes is probably one of the most often overlooked factors. The epidemic of malaria from *P. falciparum* triggered by hurricane Flora in Haiti may be indirectly blamed both on the suspension of normal spraying and on ecological change itself. Temporary interruption of the ambulatory tuberculosis treatment in Bangladesh has also been cited as the cause of many complications reported in the wake of the cyclone of 1970. Though few reliable statistics are available for assessing the importance of this factor, it is essential to resume normal primary health care and disease control activities as quickly as possible rather than to divert scarce material and human resources to highly visible improvized emergency programmes of dubious health benefit

Receptivity of the Population

The importance of the host–pathogen relationship cannot be overestimated. No further proof is needed of the synergism between malnutrition and infections. In famines caused by serious and prolonged food shortage, infectious diseases are the major cause of death. Measles, gastroenteritis and respiratory ailments have a higher than normal fatality rate. In times of famine the mortality from diseases rises considerably (up to 50 per cent for measles), but evidence of increased incidence and transmission of disease during the same period remains controversal.

The role of weather and climate is still more difficult to gauge. It is generally accepted by the public that exposure to severe cold following an earthquake, for example, inevitably raises the incidence of respiratory infections. This association between exposure and the incidence of respiratory infections is not reflected in the morbidity statistics in tropical or warm climates.

Paradoxically, some disasters have left behind a surviving population that is temporarily more resistant, as a group, to communicable diseases. The hurricane that ravaged the coasts of Bangladesh in November 1970 took about 250000 lives. Two consecutive surveys made on representative samples reported high mortality, attributable to the hurricane, in the groups that were also the most vulnerable to diseases; children under 5 years (29 2 per cent), persons over 70 (20·7 per cent), and those who were too weak or ill to escape from the force of the hurricane and its accompanying tidal wave. This natural selection of the inhabitants most resistant to the elements and to diseases resulted in a lower morbidity during the months following the disaster

Introduction of a New Pathogen

When the causal agent of a disease is not present in the environment, it is not possible for that disease to be transmitted. *Vibrio cholerae*, for example, is, for all practical purposes, not prevalent in Latin America. Hence, no natural disaster (either flood, earthquake or hurricane) is likely to affect its incidence. Similarly, since the prevalence of *Salmonella typhi* is very low in most industrialized urban areas, the risk of an epidemic outbreak of typhoid fever during temporary stoppages of sanitary services is somewhat fanciful.

In special situations with widespread massive migration over long distances, pathogens or new strains might be brought into areas of low prevalence and immunity or, conversely, immunized populations might traverse an area of high prevalence (e.g. malaria). The significance of this mechanism is usually negligible compared to the magnitude of population flow and local travel during normal times.

In the first 6 months following the March 1983 earthquake in Popayan, Colombia, 49 cases of imported malaria (an increase of 245 per cent over the preceding year) were reported. The majority were residents from high endemic areas on the Pacific Coast seeking employment in the reconstruction of the city.

Independent of nationality and culture, populations and communities affected by sudden impact disasters tend to remain as close as possible to their land and major properties. Displacement is limited and generally accepted only for the most compelling reasons (rising water level, etc.). One tragic example was the failure of the population living on the slopes of volcano Nevado del Ruiz to follow official evacuation instructions prompted by alarming signs of a likely second catastrophic eruption in mid 1986.

Heightened surveillance at borders and a stricter enforcement of national and international regulations already in force will suffice to contain the problem without recourse to further restrictions (new requirements of immunization certificates, vaccination on arrival, quarantine, etc.).

OCCURRENCES OF INCREASED INCIDENCE OF COMMUNICABLE DISEASES (*see Table* 18.1)

In a few well-documented instances, satisfactory evidence points to a direct causal relationship. Nevertheless, in most cases, the comparison of reported cases before and after the disaster cannot be regarded as a valid estimation since post-disaster reporting and case finding generally improves with the influx of attention by health officials or the temporary increase of health services by volunteers and outside medical teams.

In Latin America, a region highly vulnerable to disaster, considerable epidemiological efforts have been made to detect and document an increased incidence of diseases after disasters with remarkably little success so far.

A recent study of the relationship between the incidence of disease and the impact of a sudden natural disaster concluded that, following natural disasters, such outbreaks have been the exception rather than the rule.[5]

Reports of lower levels of disease after the impact probably reflect the acutely increased awareness of the authorities and public for basic hygiene and water safety rather than the 'success' of improvized high profile medical measures.

In brief, review of past disasters indicates that severe oubreaks, a common occurrence following famine and mass starvation, are far from inevitable and even rare following natural disasters such as earthquakes, cyclones, hurricanes and floods. When a moderate increase of incidence is reported, it concerns local endemics with which the health authorities are already familiar, rather than exotic diseases unknown to the affected area.

Epidemiological Surveillance

For a traumatized population in need of protective measures, the most sensible decision is to set up close epidemiological surveillance that will enable the authorities to make the most of the resources available to keep the public informed and their fears allayed.

In countries where surveillance systems are already in operation, the following actions must be taken:

1. Identification, preferably prior to the disaster, of the diseases already

Table 18 1. Summary of a number of recorded occurrences of communicable diseases associated with national disasters (excluding prolonged drought)

Disease	*Location*	*Disaster/date*	*Observations*
Malaria	Haiti	Hurricane 1963	75 000 cases[1]
	Peru	Floods 1983	28 560 cases[2]
	Ecuador	Floods 1982–3	28 000 cases[3]
	Colombia	Popayan earthquake 1983	35 imported cases[4]
Leptospirosis	Brazil	Floods 1966, 1970, 1975	100+ cases[5]
	Jamaica	Floods 1978–9	40 cases[5]
	Portugal	Floods 1967	Under 10 cases[5]
Gastroenteritis	Dominican Republic	Hurricanes 1979	28 000 cases[6]
	Jamaica	Floods 1979	70 cases from fish poisoning[7]
Typhoid fever	Puerto Rico	Hurricane 1956	23 cases[5]
	Chile	Earthquake 1985	Significant decline in case numbers[8]
Diarrhoea	Colombia	Popayan earthquake 1983	15 000 cases[4]
Tetanus	Colombia	Floods from volcano eruption 1985	4 cases[9]
Gangrene	Colombia	Floods from volcano eruption 1985	30 cases, all died[9]
Hepatitis	Colombia	Popayan earthquake 1983	241 cases, 121% increase over previous year[4]

SOURCES

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2 Poves P R (1985) *Epidemia de Malaria Post Fenómeno del Nino, 1983* Lima, Peru, Ministerio de Salud, pp 1–25
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5 Leus X (1985) *Natural Disaster and Communicable Diseases* Paper presented at the Symposim on Natural Disaster, Epidemiology and Environmental Health, 14–17 October, 1985, Havana, Cuba, pp 1–12
6 Bissell J (1983) Delayed-impact infectious disease after a natural disaster *J Emerg Med* **1**, 59–65
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8 Ortiz M R (1985) *Las Infecciones Eutericas en el Terremoto de Marzo de 1985* Santiago, Chile, Ministerio de Salud, pp 1–10
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Table 18.2 Representative form for daily report of disease surveillance/post-disaster surveillance

Daily Report by____________________ For____________________
Name of Reporter

Date ____________________

From		Location Address	Phone No
	Evacuation Centre		
	Hospital OPD		
	Health Centre		
	Clinic		
	Other		
	Specify____________________		

	Number of new cases with	Total
1	Fever (100°F+ 38°C+)	
2	Fever and cough	
3	Fever and diarrhoea	
4	Vomiting and/or diarrhoea	
5	Fever and rash	
6	Other new medical problems Specify________________	

Comments

Complete for evaluation centre only
No of persons accommodated today

Report significant changes in Sanitation/Food Supply Situation

Note Complete back portion of the form for first report only

(Reproduced from *Epidemiologic Surveillance after Natural Disaster* (1982) Scientific Publication No 420, Pan American Health Organization, pp 31) under surveillance which will require enhanced monitoring: diseases whose transmission could be increased by the disaster, diseases whose epidemic potential is recognized in the country and diseases about which the public or the political authorities are especially concerned.

2. The selection of particularly sensitive indicators even before disaster strikes. It is preferable to trade off some specificity in exchange for sensitivity. Symptom or syndrome-based reporting is recommended. *Table* 18.2 presents a sample form used for gathering symptomatic data for daily reports during disease surveillance.
3. The routine frequency (weekly or monthly) and means (by mail or administrative report) of disease reports may not be suited to the needs of the emergency. Reports must be sent to the central level by the most rapid means (telecommunications networks of the armed forces, police and Red Cross) and with increased frequency (on a daily basis). Negative reports, that is, the absence of cases should be included but lack of information should not be assumed as lack of disease.
4. The investigation of rumours of epidemic outbreaks. When a natural disaster strikes, rumours frequently circulate about epidemic episodes that have purportedly followed in its wake. So long as they are not officially investigated by the health services, such rumours can only grow and nullify the benefits of surveillance, based exclusively on reports received at the central level. While it may not be possible to track down the source of each rumour, a maximum of resources (personnel and vehicles) must still be assigned to the task. There can be no doubt, however, that any unusual event detected by the surveillance system must be immediately investigated in order to determine its nature and magnitude and to take any specific measures of control that may be necessary.
5. The rapid circulation and use of results. In the situation created by major disasters, it is particularly desirable to circulate epidemiological information promptly and widely. The bureaucratic obstacles and resistance that are often encountered in disseminating sensitive information must be overcome. A summary of the main results and their interpretation in terms of operational decisions may be usefully circulated to, for example, the national emergency committee and to any other official bodies in charge of relief co-ordination (such as civil defence), the local representative of the United Nations Disaster Relief Office (UNDRO), the Red Cross, and the major voluntary agencies in the health field. A daily summary report should also be given to the press. If necessary, or if there is some particular problem, a periodic press conference will prevent the media from paying too much heed to alarmist rumours.
6. A gradual return to the regular surveillance system. Most emergencies are fairly short-lived, and special operations should give way to the normal programmes as soon as possible. The epidemiological characteristics of diseases placed under intensified surveillance in a disaster must determine the moment when such heightened attention is no longer needed. The incubation period and the time needed for an epidemic to break out are essential factors. For example, massive water pollution might give rise to gastroenteritis epidemics in the very first week. Since the risk can persist as long as pollution is a possibility, the surveillance must also be continued.

Conversely, an epidemic of type B viral hepatitis—a real possibility after mass immunization campaigns which in major disasters are all too often conducted in conditions of uncertain asepsis—is only likely to break out between 45 and 160 days after the campaign.

In some regions the surveillance system cannot provide the required infrastructure for intensified monitoring. It may then be necessary to organize a provisional surveillance system which, as happened in Guatemala in 1976 and in Italy in 1980, can provide the stimulus for a permanent programme.

Circumstances are unlikely to allow the recommended stages to be followed in strict sequence Surveillance in times of disaster cannot be improvized without some compromise on the quality of the data and hence on the validity of conclusions and decisions based on them Problems may occur with broken lines of communication and insufficient means of transportation can thwart effective surveillance. The principal difficulty, as illustrated by the surveillance set up following the earthquake in Italy in 1980, lies in translating the findings into decisions at the highest level. Too often, surveillance conclusions have been overshadowed by emotional or political considerations leading to counterproductive health measures.

Epidemiologists and public health experts should refrain from taking shelter behind rows of statistics and tests of significance and instead should actively seek the support of the relief co-ordinator, politicians and the public opinion to implement the most appropriate and cost-effective action based on technical evidence.

PREVENTION AND CONTROL MEASURES

The techniques and methods of national prevention and control of communicable disease programmes in normal times often remain the most effective and inexpensive under emergency conditions. A disaster is not necessarily a commanding reason for changing to more sophisticated methods whose effectiveness has not been demonstrated in the country.

Public health measures to prevent or control communicable diseases fall into two categories: environmental health and medical measures.

Environmental Health Measures

Emergency environmental health measures aim to restore the situation (and risk level) prior to the disaster. Emergency measures (expensive and temporary by essence) must give way as soon as possible to rehabilitation and reconstruction efforts directed towards permanent improvement. During the emergency phase, particular focus should be placed on public water supply, food hygiene, human waste disposal and vector control.

Water supply: Access to minimum quantity (at least 10 litres per person per day with up to 40 litres in urban areas) of reasonably safe water is the first concern in most instances.

Bacteriological quality control follows. In urban areas, heavy chlorination is recommended to counteract possible cross-contamination. However, risk of contamination has been demonstrated to be much more serious at temporary

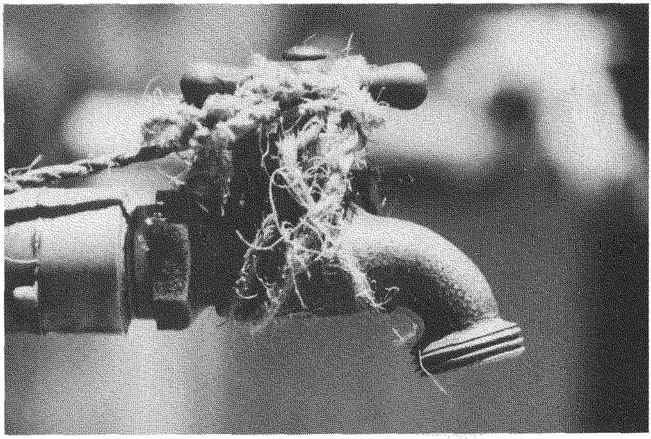

Fig. 18.6: The amount of available water is often more critical than its bacteriological quality in the immediate aftermath of a disaster.

storage sites (tanks, cisterns, home containers). Public education to boil water is more effective than mass distribution of water purification tablets, an item routinely requested from the international community. It is recommended to limit the use of water purification tablets to small groups of educated populations or relief workers able to read and understand the instructions for their use. The diversity of presentations (amount of water treated, duration, etc.), the lack of standardized containers for domestic use, and the risk of inaccurate quantities of disinfectant (too low or too high) make mass use counterproductive.

Hauling of drinking water (in bags, containers or tanks) is technically effective but difficult. It is only justified where availability of safe water has been interrupted by the disaster. Digging of wells or the extension of the existing water distribution network is preferable for temporary settlements likely to last over one month.

Food Hygiene

Community kitchens, donations of food and power failures make increased surveillance and control of food quality necessary. Although botulism has not been reported following disasters, measures should be taken to screen incoming food donations and to destroy suspicious or spoiled items.

Human Waste Disposal

Personal faecal habits are highly resistant to rapid change. Relief programmes focusing on the construction of latrines without investing considerable time educating those who are supposed to use them, enhance the after-action reports of the sponsoring agency rather than improve the actual public health situation. The sophistication (from trench latrines to chemical toilets) and privacy (communal or private facilities) will be determined by the prevailing cultural and social pattern.

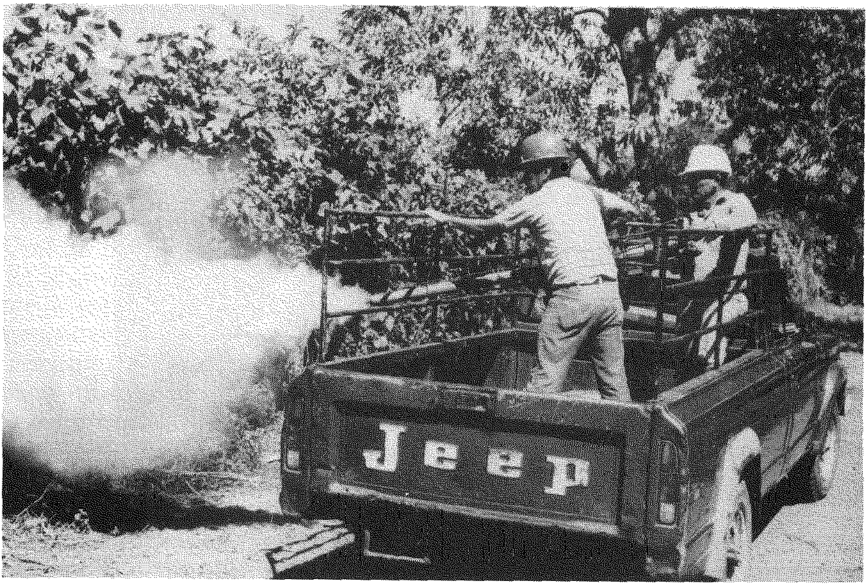

Fig. 18.7. Insecticide spraying following volcano eruption in Colombia, 1985.

Vector Control

Time-tested methods used in the country remain the best approach. Biological cycles, habits and vector characteristics of the local species are unaffected by natural hazards. The environment may become more favourable to the vector or the human being more vulnerable or accessible to infective contacts.

In any case, vector control should not be an immediate priority from a technical point of view, although it may become so from a political standpoint.

The decision to implement vector control measures is determined first by their impact on disease transmission and not by the nuisance of the vector itself. Filth, flies and rodents are best controlled by sanitation measures (waste disposal and proper food storage). Massive aerial spraying against flies has little health benefit and large scale use of rodenticide is unlikely to bring satisfactory results.

Mosquito control in malaria or dengue endemic areas should be a continuous integrated approach covering areas often larger than those affected by the natural disaster and continued after the immediate post-disaster period. Insecticides are hazardous in themselves, expensive and quickly become obsolete by vector resistance (*Fig.* 18.7). Labour-intensive control of breeding sites should be promoted with the active participation of the communities. Mosquito control where no transmissible disease exists is not a health concern.

Medical Measures

Medical measures range from chemoprophylaxis and vaccination to case treatment and the sanitary isolation of infected areas. Chemoprophylaxis has very limited application in disasters. Antibiotic prevention of gastroenteritis/diarrhoea

Fig. 18.8. Unnecessary immunization against T-fever following earthquakes.

is strongly discouraged by the World Health Organization. Chemoprophylaxis of malaria can be considered under some circumstances for non-immune populations migrating towards high endemicity areas, an uncommon occurrence in natural disasters. The decision is best left to experts in this field. (Individual prophylaxis for expatriate relief workers is, of course, a must!)

The drive toward mass immunization generally has full public and political support (*Fig.* 18.8). It is usually not an appropriate disease control measure under the special circumstances of a natural disaster for the following reasons:

a. Lack of epidemiological justification.
b. Difficult logistics (transportation and a cold chain) in an emergency situation.
c. Failure to keep records of the people vaccinated. They may be accidently vaccinated again by different teams or organizations, and it is difficult to arrange for the requisite booster shots to be administered.
d. Secondary effects are particularly unwelcome during rehabilitation and reconstruction.
e. Vaccines against typhoid fever and cholera in particular, confer only partial and short-lived immunity and do little to impede transmission of the disease or prevent epidemics.
f. The fact that massive vaccination campaigns induce a false sense of security in the population and the authorities outside the health sector is often overlooked by relief workers, and consequently the aspects of sanitation and education are neglected.

When epidemics mistakenly regarded as inevitable fail to materialize, the illusion can be reinforced that the campaigns were effective and support the maintenance of a counterproductive strategy. While massive campaigns that mobilize enormous amounts of resources should not be encouraged, strengthening routine immunization programmes or their careful expansion to particularly vulnerable groups remains a tool of high value. The Guatemalan experience is an example. Following the 1976 earthquake, the public demanded increased protection from predicted outbreaks through vaccination. Typhoid fever was a major concern. In response to the public demand for official action, the Ministry of Health advanced the date of the annual vaccination campaign (DPT and measles). The participation of the public in this previously planned routine campaign of established effectiveness exceeded all expectations. This experience illustrates the approach of reinforcing the quality and extending the coverage of usual activities instead of adopting entirely different methods and strategies when a disaster strikes.

Immunization (or booster) against tetanus should be encouraged for relief personnel and, of course, for every person wounded.

In temporary settlements of a population otherwise scattered, major efforts should be undertaken to improve the expectedly low coverage of routine immunization. It is, however, taking advantage of the situation for developmental purposes rather than an emergency-related measure.

Sanitary isolation or quarantine is increasingly less used as its ineffectiveness is recognized. It is often too late (transmission has already taken place) and unenforceable (people will bypass the check points). The best approach remains to re-establish and improve the delivery of primary health care through the restoration of affected health services.

Basic health services should continue to be provided and to contribute to disease control after outside medical teams (national or expatriate) have left the affected areas.

It is perhaps the time to emphasize that relief medical teams should not undertake disease prevention or control measures on their own initiative without approval or instruction from the local health authorities. Too many resources are wasted, and sometimes too much harm is done by well intentioned relief workers or medical personnel unfamiliar with the local conditions, priorities and resources for follow-up.

CONCLUSIONS

Epidemiology is defined as the discipline that studies the dynamics of health phenomena with a view to proposing the most effective control measures. Its usefulness in periods of general disaster can range from the surveillance of communicable diseases to the study of the surge of medical emergencies, the occurrence of mental disturbances, etc The enhanced part played by epidemiologists in recent disasters has permitted a start to be made on the development of techniques and methods that have helped to improve relief work and its integration into the long-term development programmes of disaster-stricken countries.

The solution to health problems created by disasters calls for a flow of accurate and viable information. Active participation of the health sector in national disaster preparedness planning will avoid costly improvization. Preparation for disasters, including public health activities such as the prevention of automotive and industrial accidents and the control of environmental pollution, must be a technical programme with its own funds and staff.

Only an on-going planning effort in conjunction with a research and personnel training programme will give the needed basis for the health services to promote a more effective and organized action in major national disasters.

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