**Part I:**

# Epidemiologic Surveillance and Disease Control after Natural Disaster

Chapter 1

# Risk Factors for Communicable Diseases after Disasters

Until approximately 1850 and the onset of the era of science, administrators of the day were well aware of the triad of famines, epidemics and social disruption, and their consideration of the major causes of disaster was focused on famine and epidemics of quarantinable diseases. With improved sanitary conditions and the documentation of natural catastrophe beyond Europe and North America, brought about by more rapid communication and transportation, interest in natural disaster gradually grew.

In industrialized societies today, advances in economic conditions and in public health have virtually eliminated the problem of communicable diseases as disasters. In developing countries, however, communicable diseases continue to cause primary disasters. This is frequently true of such diseases as measles, poliomyelitis, malaria, typhoid fever, and arthropod-borne viruses such as dengue and yellow fever. When this occurs, national authorities usually seek assistance from agencies where there is expertise with communicable disease control, such as the Pan American Health Organization or the Centers for Disease Control, rather than from disaster relief agencies.

## Epidemiologic Factors that Determine the Potential of Communicable Disease Transmission

The potential risk of communicable diseases after disaster is influenced by six types of adverse change. These are changes in preexistent levels of disease; ecological changes which are the result of the disaster; population displacement; changes in population density; disruption of public utilities; and interruption of basic public health services.

### *Changes in preexistent levels of disease*

Usually the risk of a communicable disease in a community affected by disaster is proportional to the endemic level. There is generally no risk of a given disease when the organism which causes it is not present beforehand. Developing countries frequently have such poor systems for reporting communicable disease, however, that their national authorities lack adequate information about levels of specific organisms. Political pressure is nonetheless sometimes exerted for taking public health measures against diseases such as smallpox, cholera, yellow fever or other vector-borne diseases in geographic areas considered free of them by communicable disease specialists.

Relief workers can conceivably introduce communicable disease into areas affected by disaster. Diseases potentially introduced include new strains of influenza, foot-and-mouth disease, and those borne by insect vectors, particularly by *Aedes aegypti*. Also, nonimmune relief workers may be susceptible to endemic diseases to which the local population is tolerant or immune, and they may become ill.

### *Ecological changes caused by the disaster*

Natural disasters, particularly droughts, floods and hurricanes, frequently produce ecological changes in the environment which increase or reduce the risk of communicable disease. Vector-borne and water-borne diseases are the most significantly affected. A hurricane with heavy rains which strikes the Caribbean coastal area of Central America may, for example, reduce the number of *Anopheles aquasalis* hatched, since the vectors prefer brackish tidal swamps and increase *A. albimanus* and *A. darlingi*, which breed easily in fresh, clear water and overflows. The net effect of the hurricane on human malaria, of which both mosquitoes are vectors, would be difficult to predict. Rain from such a hurricane would also cause flooding of streams and canals which in rural areas are often the source of drinking water. Under some circumstances, a water-borne zoonotic disease, such as leptospirosis, may become more widely disseminated via water-contact or drinking from contaminated sources. There is evidence that the short term effect of diluting supplies of already contaminated drinking water with rain may, however, reduce the level of disease (*1*). The population may, moreover, avoid drinking water contaminated by flooding for a cultural/psychological reason such as the presence of animal carcasses.

### *Population displacement*

Movement of populations away from the areas affected by a disaster can affect the relative risk from communicable diseases in three ways. If the population moves nearby, the existing facilities and services in the receiving community will be strained. When resettlement occurs at some distance, the chances increase that the displaced population will encounter diseases not prevalent in their own community, to which they are susceptible. For example, nonimmunized, rural Andean populations brought together in camps after an earthquake may then be exposed to measles. Alternatively, displaced populations may bring the agents or vectors of communicable diseases with them. The latter concern frequently occurs when populations from low-lying coastal areas with malaria are evacuated further inland before a hurricane.

*Julio Vizcarra, PAHO.*

**Residents walk down the flooded streets of Maraba, Brazil. Floods and other natural disasters frequently produce changes in the environment that may increase the risk of vector- and water-borne disease.**

### *Population density*

Population density is a critical factor in the transmission of diseases spread by the respiratory route and through person-to-person contact. Because of the destruction of houses, natural disasters almost invariably contribute to increased population density. Survivors of severe disaster seek shelter, food and water in less affected areas. When the damage is less severe, crowding may occur when people move in with other families and congregate in such public facilities as schools and churches. The resulting problems most commonly mentioned are acute respiratory illness, and include influenza and non-specific diarrheas.

### *Disruption of public utilities*

Electricity, water, sewage disposal and other public utilities may be interrupted after a disaster. In a village with no electric power and where there are promiscuous defecation habits and contaminated sources of water in normal times, very little (if any) additional risk from communicable diseases follows the disaster. However, in economically more developed areas the extended disruption of basic services increases the risks of food-borne and water-borne disease. Insufficient water for washing hands and bathing also promotes the spread of diseases transmitted by contact.

### *Interruption of basic public health services*

The interruption of basic public health services like vaccination, ambulatory treatment of tuberculosis and programs for the control of malaria and vectors are frequent, but often overlooked factors that increase the probability of disease transmission after disaster in a developing country. The risk of transmission increases proportionally to the extent and the duration of the disruption. An outbreak of communicable disease may, therefore, occur months or years after a drought, a famine or a civil disturbance. The interruption causing such an occurrence is usually the result of the diversion of staff and financial resources to the relief effort, beyond the critical period. In addition or in conjunction with this, the failure to reestablish resources at sufficient levels contributes to the interruption.

### The Relative Risk of Communicable Disease after Natural versus Manmade Disasters

Manmade disasters fall into two categories. In the first are those that result from accidental destructive activity. Such events may be acute, as with airplane crashes, explosions, fires and intoxications, or they may be chronic processes like deforestation and the contamination of the environment. Accidental manmade disasters, which usually pose little, if any, additional risk of communicable disease to the community, are beyond the scope of this manual.

The second category consists of manmade disasters caused by warfare, economic or social disruption and civil disturbance. Warfare is frequently subdivided into the conventional type, including siege and blockade, and the nonconventional type, including biological, chemical (toxic gas) and nuclear warfare. Experience with the effect of nonconventional warfare on communicable disease is limited. Biological agents

*Courtesy, Il Mattino, Italy*

**Tent camps set up after a major earthquake shook northern Italy in November, 1980. The increased population density and lack of adequate sanitary services that often characterize camps and temporary settlements make them undesirable from a health standpoint.**

capable of producing epidemics that incapacitate military or civilian populations (e.g., anthrax and plague) are handled through taking the same public health measures as those used for naturally occuring outbreaks. Information about these is available elsewhere (*2*).

The relationship of social disruption and conventional warfare to communicable disease is similar to that of chronic disasters such as drought. Warfare and drought are the most common causes of widespread serious malnutrition and famine. Communicable diseases, which have adverse nutritional effects in previously well nourished individuals, compromise malnourished patients further, and many, like measles, are more severe in extremely malnourished individuals. There is also anecdotal evidence that some parasitic diseases, like malaria, and viral diseases, like herpes, tend to reactivate during refeeding (*3*). Decision makers may not have political interest or may not be able to assist affected populations during wars and insurrections, unlike during drought where civil authorities usually support relief efforts.

The six factors which contribute to the risk of communicable diseases after natural disasters mentioned earlier are generally valid in the event of conventional manmade disaster. Military activities, however, frequently involve movement through and extended stays in geographic areas which are not ordinarily inhabited by man. In the process, military populations may be exposed to a large variety of zoonotic and vector-borne diseases which are ordinarily of little concern to civilian relief administrators. Examples of such diseases are leishmaniasis, rickettsial diseases, and most arthropod-borne viral diseases. Military surgeons are aware of these risks and, thus, civilian physicians rarely become involved. The probability that these diseases will be spread to dependents and to the civilian population varies, but is quite low overall.

## Postdisaster Experience with Communicable Disease

Historically, a variety of communicable dieseases have reached epidemic proportions after disaster (*4,5*) or because patients are malnourished and thus more susceptible ot many diesease agents (*6,7*). Indeed, until World War II more deaths during wartime or famine were caused by communicable disease than by hostile action or starvation. The diseases classically associated with war and famine and the most effective methods for controlling them are enumerated in Table 1. Human transmission of smallpox has now been certified to be globally eliminated and several other conditions (i.e., louse-borne typhus, plague, and relapsing fever) have a severely limited geographic distribution, in remote and largely unpopulated areas.

World War II represented a transitional period for industrialized combatant countries. The five years of continual war and occupation had affected civilian populations in Europe surprisingly less than did warfare in previous conflicts. The most notable increases in disease levels were those of new cases of pulmonary tuberculosis, which rose steadily throughout Western Europe, and of reported cases of typhoid fever, the total of which doubled (*8-10*). Most seriously affected were displaced persons, encamped refugees and inmates of concentration camps (*11-13*). In marginally nourished and starving patients, typhus, dysentery, scarlet fever, and diphtheria caused sporadic outbreaks and many deaths.

Serious outbreak of communicable disease after disaster has not been documented in Western Europe, the Continental United States or Canada since 1945. This improvement is associated with generally improved sanitary conditions and with the disappearance of certain vector-borne diseases from many countries, as in the case of malaria, or the restriction of diseases to isolated areas after the development and usage of effective insecticides and pesticides. The immunization of susceptible populations with vaccines effective against diseases such as diphtheria, pertussis, tetanus, poliomyelitis and measles and the adequate treatment and interruption of transmission by antibiotics of diseases like typhoid, streptococcal diseases, and tuberculosis is also associated with the lack of serious outbreaks. In caring for populations affected by disasters in industrialized countries, physicians have observed apparent increases in nonspecific diarrhea, and influenza and minor respiratory infections. The magnitude of the problem created by these, however, is such that population density alone may adequately explain it.

The evaluation of recent experiences with communicable diseases in Latin America, the Caribbean and other parts of the developing world is complicated by several factors related to changing patterns of disease, development, and the public health infrastructure. Most important of these are the persistence of many serious communicable diseases; the decline of some serious communicable disease; a lack of base-

**Table 1. Communicable Diseases of Public Health Importance Classically Associated with War and Famine, with Traditional Methods of Prevention and Control (21)**

| | Disease | Public Health Measures |
|---|---|---|
| A. | ***Water and/or Food-Borne Diseases*** | |
| | 1. Typhoid and Paratyphoid Fevers<br>2. Food Poisoning<br>3. Sewage Poisoning<br>4. Cholera<br>5. Leptospirosis | a. Adequate disposal of feces and urine.<br>b. Safe water for drinking and washing.<br>c. Sanitary food preparation.<br>d. Fly and pest control.<br>e. Disease surveillance.<br>f. Isolation and Treatment of early cases (typhoid and paratyphoid fevers, cholera).<br>g. Immunization (typhoid fever and cholera). |
| B. | ***Person to Person Spread*** | |
| | *Contact Diseases*<br>1. Shigellosis<br>2. Nonspecific diarrheas<br>3. Streptococcal skin infections<br>4. Scabies<br>5. Infectious hepatitis | a. Reduced crowding.<br>b. Adequate washing facilities.<br>c. Public health education.<br>d. Disease surveillance in clinics.<br>e. Treatment of clinical cases.<br>f. Immunization (infectious hepatitis). |
| | *Respiratory Spread*<br>1. Smallpox<br>2. Measles<br>3. Whooping Cough<br>4. Diphtheria<br>5. Influenza<br>6. Tuberculosis | a. Adequate levels of immunization before the disaster.<br>b. Reduced crowding.<br>c. Disease surveillance in clinics and community.<br>d. Isolation of index cases (especially smallpox).<br>e. Immunization of entire population (smallpox) or children (measles).<br>f. Continue primary immunization of infants (diphtheria, whooping cough, tetanus). |
| C. | ***Vector-Borne Diseases*** | |
| | 1. Louse-borne typhus<br>2. Plague (rat flea)<br>3. Relapsing fever<br>4. Malaria (mosquito)<br>5. Viral encephalitis | a. Disinfection (except malaria and encephalitis).<br>b. Vector control.<br>c. Disease surveillance.<br>d. Isolation and treatment (no isolation for malaria). |
| D. | ***Wound Complications*** | |
| | 1. Tetanus | a. Tetanus toxoid immunization.<br>b. Postexposure tetanus antitoxin. |

line surveillance data; the inadequate number of laboratory diagnostic facilities; and in adequate converage with vaccines.

### *Persistence of many serious communicable diseases*

In spite of the rarity of documentation of outbreaks of communicable diseases after disasters in developing countries, there is a consensus that the probability of outbreak is considerably higher in Latin America and the Carribbean than it is in the U.S.A. This opinion is based upon morbidity and mortality data in which patterns of many communicable diseases are at levels comparable to those in Europe and North America at the turn of the century (*14*). The most revalent of these diseases are acute respiratory infection, tuberculosis, diarrheal diseases of various etiologies and diseases which are preventable through vaccination.

### *Decline of some serious communicable diseases*

In counterbalance to the high levels of most of the communicable diseases transmitted by person-to-person contact, in most of Latin America and the Caribbean the classical diseases associated with disasters have declined or disappeared. The Americas have also been spared the widespread severe malnutrition and recurrent famines which have afflicted Africa and Asia.

### *Lack of baseline surveillance data*

Lack of information regarding levels of communicable diseases between disasters in developing countries makes it extremely difficult for epidemiologists to confirm subsequent reported "increases" and to attribute them to an acute event. A medical team which moves into an area without previous health services or regular disease reporting may, for example, encounter clinical cases of typhoid fever or tetanus. When this happens it is frequently difficult for field workers or relief agencies to determine if an acute public health emergency exists or whether the true level of endemic disease is finally being appreciated. The potential of epidemic levels of communicable disease after disaster and the appropriate organization of surveillance systems are the subjects of Chapters 2 and 3.

### *Inadequate laboratory diagnostic facilities*

Documentation of communicable diseases such as typhoid or dengue fever is frequently frustrated after disasters in Latin America and the Caribbean when physicians rely exclusively on their clinical acumen to diagnose communicable diseases. This is the end result of medical curricula in which the effective use of the laboratory is not included, of poorly run microbiology laboratories in which the clinician or epidemiologist has little confidence, and of the policy of not providing adequate support to public health laboratories which are seen as too expensive, as using inappropriate technology, or as unnecessary to primary health care in developing countries.

### *Inadequate vaccination coverage*

The probability of occurrence of vaccine-preventable diseases is related to the percentage of the population that has acquired natural immunity, and the percentage of unvaccinated susceptibles. Most of the vaccines in common use are directed against childhood diseases, such as diphtheria, pertussis, tetanus, poliomyelitis and measles. Indiscriminate or improvised vaccination programs are neither feasible nor effective in the aftermath of disaster. Therefore, the extent to which the children have completed their primary series of vaccinations before a disaster will determine the likelihood of epidemic after a disaster.

Chapter 2

# Postdisaster Potential of Communicable Disease Epidemics

The preexistent level of disease in a community affected by disaster is one of six risk parameters. In theory, the absence in a country of a disease such as cholera eliminates the need for surveillance, but in practice, the need is not so simply perceived. Rumors and other unofficial sources of information frequently give rise to concern about cholera, plague, and other exotic conditions not otherwise believed endemic in an area. The epidemiologist cannot necessarily assume that because diseases have never been reported they do not persist in remote communities or in populations where there is no access to public health diagnostic laboratories. The recent discovery of an endemic focus of *Vibrio cholerae* in the United States (*15*) is an excellent example of this point. If the patients in Louisiana had by chance been diagnosed after a hurricane or a period of flooding, public opinion would have accepted a cause-effect relationship without question.

A second consideration is the possibility that an infectious disease agent may be brought into an affected area by relief workers, or in transport vehicles or supplies. This may occur within a country or, more dramatically, from another country. The 1976 earthquake in Guatemala, for example, occurred during the winter influenza season in North America. Vectors and agents of communicable disease can also be introduced by transport vehicles (particularly the airplane) or in relief supplies. In Latin America and the Caribbean, the *Aedes aegypti* mosquito could easily be reintroduced into an area free of the vector by air or surface transport vehicles which originate in or pass through an infested area. When an explosive outbreak points to a common source of infection, epidemiologists should also consider the possibility that tinned or processed food used for relief was contaminated. Aftosa, or foot-and-mouth disease, is a prime example of a serious veterinary problem of public health nature that may be introduced via infected meat, contaminated relief supplies and the shoes of relief workers. A major natural disaster does not provide justification for abandoning such accepted public health precautionary measures as limiting the contact of patients with ill relief workers, and spraying aircraft or inspecting them at ports of entry.

## Exposure of Susceptibles to Endemic Communicable Disease

There are three ways in which susceptibles may be exposed to endemic diseases which cause subsequent epidemics or increased levels of disease after disaster. Briefly, this occurs through the migration of rural populations to congested areas; the migration of urban populations to rural areas; and the immigration of susceptibles into areas affected by the disaster. Anticipating these problems and implementing preventive measures require an appreciation of the patterns of disease in the countries stricken by disaster.

### *Migration of rural populations to congested areas*

In medieval times, the privileged classes tried to avoid the effects of epidemics by fleeing the pestilential cities. The present pattern of reaction to drought, civil disturbance, and many natural disasters is one in which populations congregate for food, safety and medical attention. In general, the more rural and isolated are such migrants, the greater is their susceptibility to common communicable diseases, particularly those transmitted by aerosol or person-to-person contact. Individuals from dispersed communities are also less likely to have received routine childhood immunization. When populations migrate from highlands to camps or population centers at lower altitudes, the risk of vector-borne diseases not transmitted at higher elevations is also added.

### *Migration of urban populations to rural areas*

More rarely, urban populations may be forced by civil disturbance, an earthquake or a hurricane to move to a rural environment. In so doing they may be exposed to vector-borne diseases, in particular to malaria. The destruction of Managua by earthquake in 1972 was such an event in the Americas (*16*). The severity of chloroquine-resistant falciparum malaria among Kampouchean refugees is another recent example of acquisition of communicable disease through urban-rural migration. The refugees, first expelled from population centers to rural areas with low malaria indices, then migrated to the Thailand border through holoendemic areas (*17*).

### *Immigration of susceptibles to affected areas*

The poorly briefed or underprovisioned international relief worker is the most obvious type of susceptible entering an area affected by disaster. During the Nigerian Civil War a decade ago, this was a serious enough problem that the effectiveness of some foreign medical teams was jeopardized. Failure to appreciate the risk of malaria and/or unwillingness to take chemosuppressive drugs (e.g., chloroquine) caused several cases of the disease, which included cerebral malaria and one fatality. One group, assigned to Biafra, neglected to obtain prophylactic gammaglobulin, and before it could be flown in, members of the team were incapacitated by infectious hepatitis (*18*).

Established relief agencies have long been aware of the risk of disease which susceptibles incur, but they do encounter difficulty convincing skeptical, inexperienced and unsupervised volunteers of the dimensions of the problem. Ad hoc voluntary groups are usually established in the aftermath of a particular major disaster and are also formed in donor countries with special geographic interest in the affected nation. Organizers and their medical staff of ad hoc groups should consult the more experienced agencies or one of the excellent manuals about preserving the health of travelers to the tropics (*19-20*).

## Increases in Levels of Endemic Communicable Disease in Local Populations

It must be appreciated that reports of communicable diseases should be expected to increase during medical relief periods in communities with high levels of contagious diseases. If medical services were not in existence before a disaster, instituting them afterwards will certainly increase the apparent levels of disease. Even when primary health services do exist before disaster, regular disease reporting is usually very incomplete. After a disaster, reports increase because the number of reporting units is augmented. The total population served may also be swollen by movement into the area. Clinicians used to practicing under other local conditions may be confronted with clinical syndromes with which they are unfamiliar, and try to make etiologic diagnoses without diagnostic laboratory support.

During an epidemic—defined as an unexpected number of cases of a communicable disease—it is extremely important to determine whether increases in disease are real or are only apparent. Except in encamped refugees, the precise figure of the total population at risk is rarely available for the calculation of reported case rates, which is the number of reported cases divided by total population at risk. Thus, it may be necessary to perform a rapid survey in the community to reach an approximation of how common a communicable disease is in the general population. Trends can be monitored by examining retrospective and prospective clinic reports of patients seen with the condition. However, even when evaluation is performed, it may be difficult to decide whether an increase in rates is significant enough to warrant taking emergency control measures or requesting additional medical supplies or staff.

## Special Problems with Communicable Disease in Encamped Populations

Experience in both the historic and the modern eras has repeatedly shown that the threat of communication of disease is greatest among crowded encamped populations, and that the likelihood of a serious outbreak increases with time. The danger is rather independent of the natural or manmade disaster which produced the encampment (*21*). The preventive medical officer should, therefore, prefer to have affected populations return to their homes or be promptly resettled. When this is not feasible, housing the population in dispersed temporary quarters with unaffected kin, or in nearby communities, is preferable to instituting encampment. However, the relief administrator often responds to the instinctive feeling that the situation can be better managed and the needs of those most affected by the disaster more efficiently provided when they are congregated.

When it is unavoidable to institute encampment for extended periods, the risks of communicable disease can be reduced through strict supervision of meticulous attention to sanitation. Measures that should be taken are described in detail by Asar (*22*) and are summarized in Annex 4. Civilian authorities often find it difficult to organize and then indefinitely sustain needed military discipline. If the camps are occupied by refugees or independent-minded citizens, they are likely to eventually rebel.

## Communicable Diseases after Disasters

Even in very poor developing countries, serious outbreaks of communicable disease very rarely occur after natural disasters which do not involve the encampment of populations (*21*). Known exceptions to this include cases of leptospirosis, which increased in Brazil after flooding (*23*), the aggravation of an ongoing typhoid fever problem following hurricanes in Mauritius (*24*), and cases of food poisoning in both Dominica and the Dominican Republic (*25*). It is probably more likely that the diversion of scarce resources from normal public health activities to disaster relief, or subsequent economic problems aggravated by a disaster, will lead to epidemic long after the acute event, such as in the resurgence and subsequent failure to eradicate malaria from Haiti (*26*).

With this in mind, in the thirteenth (1981) edition of the American Public Health Association handbook entitled *Control of Communicable Diseases in Man* (*27*) there is a consensus described that was reached by specialists in communicable disease, liaison representatives, and Pan American Health Organization/World Health Organization officials about the relative risk of individual communicable disease after disaster. This information is presented in a simplified form in Table 2 (see next page). For a further discussion of each disease, the reader should consult the thirteenth edition or a tropical medicine text (28).

**Table 2. Epidemic Potential of Selected Communicable Diseases Following Disaster in Latin America and the Caribbean (27, 28)**

| **Disease** | **Disaster Potential** Qualitative/Quantitative* | | **Geographic Areas at Risk** |
|---|---|---|---|
| Amebiasis | contamination water/food | ? | cosmopolitan |
| Chickenpox-Herpes Zoster | overcrowding in emergency situations | 3+ | worldwide (infection nearly universal) |
| Cholera | contamination water/food, crowding in primitive conditions | 1+ | none |
| Diarrhea, nonspecific | contamination water/food, crowding | 4+ | universal |
| Diphtheria | crowding of susceptible groups | 2+ | universal |
| Ebola/Marburg Virus | direct contact with infected blood secretions, organs or semen. Possible by vector-borne/ aerosol routes | ? | Rhodesia, Kenya, Sudan, Zaire |
| Food Poisoning —Staphylococcal | mass feeding and inadequate refrigeration/ cooking facilities | 4+ | universal |
| —Bacillus cereus | mass feeding and inadequate refrigeration/ cooking facilities | 3+ | universal |
| Gastroenteritis —Epidemic Viral Gastroenteritis | contamination water/food crowding | ? | universal |
| —Rotavirus Gastroenteritis | contamination of water/food, crowding | ? | universal |

**Table 2. Epidemic Potential of Selected Communicable Diseases Following Disaster in Latin America and the Caribbean (27, 28)** ***(Continued)***

| **Disease** | **Disaster Potential** Qualitative/Quantitative* | | **Geographic Areas at Risk** |
|---|---|---|---|
| Hemorrhagic Fevers of Argentinian and Bolivian Types | contamination of food | ? | Argentina, Bolivia |
| Hepatitides Viral | | | |
| —Viral Hepatitis A | contamination of water/food, inadequate sanitary facilities | 4+ | universal |
| —Viral Hepatitis B | improper sterilization procedures | 4+ | universal |
| —Viral Hepatitis, Non-A, Non-B | ? | ? | universal |
| Influenza | crowding | 4+ | universal (pandemics, epidemics, localized and sporadic outbreaks) |
| Leprosy | interruption of case detection and therapy | ? | endemic |
| Leptospirosis | contamination of water/food, flooding of areas with high water table | ? | worldwide |
| Malaria | availability of water for mosquito breeding | ? | Tropical South America, Panama, and Haiti |
| Measles | introduction of measles to susceptible isolated population | ? | universal |
| Meningitis, Meningococcal | crowding | ? | endemic |
| Pediculosis | crowding, clothing | ? | endemic worldwide |

**Table 2. Epidemic Potential of Selected Communicable Diseases Following Disaster in Latin America and the Caribbean (27, 28) *(Continued)***

| **Disease** | **Disaster Potential** Qualitative/Quantitative* | | **Geographic Areas at Risk** |
|---|---|---|---|
| Plague | crowding, inappropriate rodent control, unhygienic conditions | ? | endemic in certain areas of North and South America |
| Poliomyelitis | crowding nonimmune groups, contaminated food, inadequate sewage disposal | ? | worldwide |
| Rabies | stray dogs | 2+ | worldwide |
| Relapsing Fever | overcrowding, malnournishment, poor personal hygiene | 2+ | endemic |
| Salmonellosis | overcrowding, contamination of food in mass feeding, poor sanitation | 3+ | worldwide |
| Scabies | overcrowding | 2+ | endemic |
| Shigellosis | crowding, poor sanitation, malnournishment | 4+ | worldwide |
| Streptococcal Diseases caused by Group A (Beta Hemolytic streptococci) | contamination of food | 2+ | common in temperate zones and semitropical areas |
| Tetanus | flood, hurricanes, earthquakes | 3+ | worldwide |
| Tuberculosis | crowding | 1+ | worldwide |
| Typhoid Fever | disruption of usual sanitary control of food and water | 2+ | worldwide |

**Table 2. Epidemic Potential of Selected Communicable Diseases Following Disaster in Latin America and the Caribbean (27, 28) *(Continued)***

| **Disease** | **Disaster Potential** Qualitative/Quantitative* | | **Geographic Areas at Risk** |
|---|---|---|---|
| Typhus Fever (Endemic Louse-Borne) | unhygienic conditions, crowding | 2+ | endemic foci |
| Yellow Fever | availability of infected mosquitoes | ? | enzootic in Northern South America and parts of Africa |
| Whooping Cough | crowding | 2+ | worldwide |

*? potential
1+ rare
2+ occasional
3+ frequent
4+ usual

Chapter 3

# Setting up Surveillance Systems

Disease surveillance essentially concerns gathering information that is critical for rationally planning, operating and evaluating public health activities. Participants of disease surveillance programs receive reports from sources which are both official and unofficial. Information from official sources originates from the local health care providers who see patients, passes from the local public health officer to one or more intermediate levels (such as city, state and province) and from there, goes to the national epidemiology group. Member Governments of the World Health Organization have agreed about procedures for international notification of selected diseases, and the method of reporting and emergency measures to be taken (*29*). In the handbook *Control of Communicable Diseases in Man*, the procedures re discussed in detail and the category of each contagious disease is in dicated (*27*). Only cholera, plague, smallpox and yellow fever are currently subject to the International Health Regulations. Four other diseases, influenza, louse-borne epidemic typhus, louse-borne relapsing fever, and malaria, are under international surveillance.

## Surveillance of Diseases between Disasters under Normal Conditions

Figure 1 is a reproduction of the Pan American Health Organization weekly report form for communicable diseases. It contains a list of the diseases that countries are asked to investigate through their national system of surveillance. The diseases included in the national surveillance program of each country vary considerably. Diseases given the highest priority for international reporting are invariably investigated, but in some countries certain diseases are not unless they are endemic

**Figure 1: Form for Weekly Report of Communicable Diseases Used at the Pan American Health Organization**

Country ________________ Week ended ____________ 19________ Number______

| Disease and Category International Classification of Diseases (1975 Revision) | Total for Week | Cumulative Total for Year |
|---|---|---|
| Diseases Subject to the International Health Regulations + | | |
| Cholera (001) | | |
| Plague (020) | | |
| Smallpox (050) | | |
| Sylvatic yellow fever (060.0) | | |
| Urban yellow fever (060.1) | | |
| Unspecified yellow fever (060.9) | | |
| Diseases under International Surveillance | | |
| Influenza (487) | | |
| Louse-borne (epidemic) typhus (080) | | |
| Louse-borne relapsing fever (087.0) | | |
| Malaria (084) | | |
| Diseases of the Expanded Program on Immunization | | |
| Poliomyelitis, acute (045) | | |
| Measles (055) | | |
| Diphtheria (032) | | |
| Tetanus (excludes neonatorum) (037) | | |
| Tetanus neonatorum (771.3) | | |
| Whooping cough (033) | | |
| Other Diseases of Regional Interest | | |
| Typhoid fever (002.0) | | |
| Dengue (061) | | |
| Meningococcal infection (036) | | |
| Arenaviral hemorrhagic fever (Argentinian or Bolivian hemorrhagic fever) (078.7) | | |
| Mosquito-borne viral encephalitis (062) | | |

Western equine encephalitis (062.1)

Eastern equine encephalitis (062.2)

St. Louis encephalitis (062.3)

Venezuelan equine fever (066.2)

Other encephalitides (specify)

Other Diseases of Sub-regional or National Interest

+ Complete information on reverse. ... Data not available. - Quantity zero.
* Disease not notifiable.

| | | | |
|---|---|---|---|
| Return one copy to: | Pan American Sanitary Bureau<br>525 Twenty-third St., N.W.<br>Washington, D.C. 20037<br>U.S.A. | and one copy to: | Caribbean Epidemiology Center<br>P.O. Box 164<br>Port-of-Spain, Trinidad |

Date: ____________________ Signature: ____________________
Title: ____________________

or unless the control program is organized. At the other extreme, a few countries still maintain a surveillance list of nearly one hundred diseases. The Pan American Health Organization's Caribbean Epidemiology Center, CAREC, uses a modified form in that region.

Promulgating official reporting forms and diagnostic guidelines, and complying with international reporting requirements does not per se constitute an effective system for the surveillance and control of disease. In a surveillance system in operation, close ties to the reporting units are maintained, data analysis is prompt, and regular reports about disease conditions and recommendations for locally appropriate action are circulated to the field. In active programs, assistance is often provided in investigating epidemics, with laboratory diagnosis, in organizing intensified control measures, and with inservice training of local health workers, from epidemiologists at the intermediate to the national level.

In practice, in a country where communications and laboratory services are good, the communicable disease control officer rarely

Marcelo Montecino, PAHO

**If none existed beforehand, a surveillance system should be established immediately after disaster strikes. The data gathered are critical for determining the order of health relief activities. Paramedical personnel, such as the one above, who are responsible for health programs in the community, should be included in the reporting system.**

learns of a serious or urgent problem through the weekly forms sent from the field. Telephone notification, consultation or notification through the public health laboratory usually precede official reporting. Moreover, epidemiologists are increasingly using interested clinics and physicians as "sentinel" reporting units (*30*). Regular telephone or mail surveys of a sample of physicians can also yield a good appreciation of actual levels of disease in the population (31). Indirect measures, such as school or industrial absenteeism, may be useful in such special situations as the surveillance of influenza (*32*). The effective communicable disease epidemiologist also monitors unofficial sources of information —such as television news programs, newspaper clippings, enquiries from the public, and even casual conversations—for early information about unconfirmed or potential communicable disease problems.

Descriptive material and operational research concerning the effectiveness of surveillance systems is not only surprisingly scanty, but that which does exist is usually devoted to only a single disease. While very exotic and fatal, or uncommon, diseases are reported frequently to health authorities, common communicable diseases are grossly underreported, even where the physicians have the legal obligation to do so. For example, in the United States it has been demonstrated in telephone surveys that, prior to the current national effort to eliminate the disease, only about 10% of measles cases were reported (*31*). In a national survey only 11% of gonorrhea cases treated by private physicians were shown to have been actually reported (*33*). Results of a state survey were that 42% of cases with gonorrhea listed in physicians' medical records were reported to authorities (*34*).

**Surveillance Sources following Disaster**

If only 10-20% of all notifiable diseases are reported under optimal conditions, how does an epidemiologist set up a meaningful system of communicable disease surveillance, and plan for control of disease after a major disaster? Should the epidemiologist not be familiar with the local conditions in a disaster stricken area, this is an even more pertinent question.

The first principle is to maximize use of preexisting surveillance data for "baseline" information, and to modify established epidemiologic surveillance systems to meet disaster conditions. At present there is a designated epidemiologist and a national surveillance unit within the health ministry of every country in Latin America and the Caribbean (See Annex l). In addition, there are considerable health and surveillance data available to relief agencies, from Pan American Health Organization offices in twenty-seven countries (See Annex 2). Additional, intercountry resources of the Organization include officials in the Caribbean Epidemiology Center (CAREC) in Port-of-Spain, Trinidad, and staff epidemiologists located in larger countries.

The need for coordination of efforts after disaster with the normal surveillance activities in the health sector must be emphasized. The usual impulse after disaster is, however, for relief authorities to set up a separate postdisaster surveillance/assessment system. Of the three factors which aid and abet this tendency, perhaps the most critical is that the national authority responsible for coordinating health activities after a disaster in countries throughout the Americas is usually not the health ministry or the principal health provider of normal times. A fundamental objective of the Emergency Preparedness and Disaster

Relief Coordination Program of the Pan American Health Organization is, therefore, to encourage health relief coordinators to better use those health resources already available in the country (*35*).

The second factor contributing to the unfortunate tendency to separate routine and emergency surveillance is that international relief agency authorities are not always familiar with existing systems and epidemiologic resources. They may, thus, inadvertently duplicate efforts. Thirdly, because of the understandable inclination to provide rescue and relief immediately, administrators try to avoid unnecessary red tape procedures such as documenting predisaster conditions and organizing systems of surveillance. Becoming familiar with the epidemiology of endemic diseases and with the national surveillance system is, however, the proper response of epidemiologists contributing to relief. Since the lead time between an acute disaster and secondary epidemics of communicable disease can be weeks or months, opportunity for epidemiologists to assimilate the available surveillance data and to anticipate communicable disease problems is usually sufficient.

The health authorities of countries that are very poor, or in which there is civil disturbance, often lack an institutionalized mechanism for epidemiologic surveillance in the areas affected by disaster. Still, every effort should be made to coordinate the relief surveillance of communicable diseases with activities of national health authorities.

Any attempt to establish a traditional form of surveillance systems in an affected area during the immediate postdisaster period is fruitless. Since unofficial reporting systems may still be operational they should, however, be exploited to the fullest extent possible. Intelligence (albeit frequently in the form of rumors) spreads from affected areas extremely rapidly via the media, survivors and relief officers returning from the field, even when telephone services and road travel have been interrupted. Invaluable documentation, which may never be actually communicated to persons at the central level, may also exist in hospitals and clinics at the intermediate level.

In addition to using the official and unofficial surveillance systems, in a disaster relief effort the epidemiologist has the opportunity to develop and employ a supplemental, ad hoc surveillance system in which the medical relief workers take part. This third option may not be called for where the infrastructure in public health is a strong one or where relief efforts are only of short duration. Surveillance information from ad hoc relief sources are, however, critical in areas hit by disaster which lack a preexisting mechanism of surveillance, and in response to chronic disasters such as famine and warfare and where there are refugee camps. The remainder of this chapter is concerned with the mechanics of setting up such a supplemental surveillance system of limited duration in the aftermath of disaster.

## Diseases to Include in the Surveillance

Special difficulties are posed by disaster. The situation usually necessitates limiting the number of diseases under surveillance, becoming more flexible in regard to diagnostic criteria in laboratory work, and relying on the symptom complexes reported. The epidemiologist must consider increased risks of epidemics of certain disease(s); service oriented relief workers' limited tolerance of "paper-work" and bureaucratic requisites; the surveillance unit's inability to process and evaluate large amounts of information; impaired communication with reporting units; a reduced capacity to respond to certain communicable disease problems because of logistical difficulties and/or problems concerning resources; and the destruction of, or reduced access to, laboratory diagnostic services.

Sound and practical clinical criteria will be needed for diagnosis of particularly important communicable diseases, in order to reduce mistaken diagnoses and make comparison between reporting units possible. The constellation of fever, conjunctivitis, cough and subsequent development of skin rash, has been used, for example, to diagnose measles in dark-skinned populations subject to famine (*36*). There is a line-listing of communicable diseases of public health importance, derived from experience in previous relief efforts and/or epidemic investigation of representative definitions of a case in Annex 3.

Selection of communicable diseases for surveillance and clinical criteria for case reporting should both be developed after consultation with the national epidemiologist and the health relief coordinator of an affected country. Under some circumstances, the decision to institute a symptom or symptom complex reporting system for common conditions may be taken, rather than attempting etiologic diagnoses. Use of case definitions and symptom complexes must be standardized throughout the relief effort. Relief agencies should incorporate them in predisaster training of those who may be health volunteer workers after disaster. Health providers should at the very least be drilled concerning diagnostic criteria before they report for duty after disaster.

The most common symptoms used in postdisaster surveillance include fever, fever-diarrhea and fever-cough. If fever-diarrhea is accepted as a reporting category, the need is not, however, eliminated for the epidemiologist to give clinicians the working definition of fever and diarrhea. This prevents including minor illnesses and normal variants in case reporting.

Disaster surveillance often includes that of noncommunicable conditions, thus assisting relief administration and monitoring the late emergence of effects of the disaster. Burns and trauma are examples of the former and animal bites and protein malnutrition, or kwashiorkor, of the latter. It is often desirable to report selected conditions among younger age groups, such as the newborn (0-30 days), infant (newborn-walking), preschool, school age (5-14), and postpubertal (over 15 years of age) groups, because infants and children are the most susceptible (non-immune) of the local population to endemic communicable diseases.

Figure 2 is a representative report form for daily disease surveillance, used after disaster in the Caribbean. The form is presented as a model and elsewhere should be modified to accord with local conditions, but it does demonstrate simplicity of design, adoption of clinical criteria, symptom complex reporting, inclusion of noncommunicable problems, and of age-specific notifications essential to postdisaster surveillance.

## The Collection, Interpretation and Utilization of Data

Participation of field health units in the surveillance system must be as complete as possible after a disaster. It is critical to motivate reporting units. The participation of predisaster units should be continued when possible, with emphasis in reporting placed upon the diseases or symptom complexes targeted for surveillance. Public health nurses and inspectors have proven to be valuable reporting sources in the Caribbean. Health teams mobilized for the relief effort should be adequately briefed about the importance of surveillance, and should be given the case definitions to be used and be amply provided supplies of reporting forms. Briefing is ideally undertaken by the epidemiologist before the teams depart for the field. In practice, however, and usually for the investigation of rumors of epidemics, the surveillance system is often initiated once the teams are already in place. Visits by the epide-

**Figure 2: Representative Form for Daily Report of Disease Surveillance Postdisaster Surveillance**

Daily Report by ____________________ For ____________
Name of Reporter Date ____________

| From | | Location Address | Phone No. |
|---|---|---|---|
| | Evacuation Center<br>Hospital OPD<br>Health Center<br>Clinic<br>Other<br>Specify________ | | |

| NUMBER OF NEW CASES WITH | TOTAL |
|---|---|
| (1) Fever (100°F + 38°C +) | |
| (2) Fever and Cough | |
| (3) Fever and Diarrhea | |
| (4) Vomiting and/or Diarrhea | |
| (5) Fever and Rash | |
| (6) Other New Medical Problems Specify. . . . . . . . . | |

COMMENTS

COMPLETE. FOR EVALUATION CENTER 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.

miologist to field units is psychologically beneficial and provides feedback and stimulates reporting.

Two operational aspects of data collection deserve emphasis. First is the importance of regularly sending "negative" reports whenever no patients with notifiable diseases are seen in a unit. A report form with a line of zeros provides valuable information. It also permits assessment of the number of units participating in the surveillance system. Failure to report, on the other hand, can either mean a lack of disease, or that a unit has dropped out of the surveillance effort.

Speed of reporting, always critical in communicable disease surveillance, is especially vital following disaster. Mail and telephone services are most likely to be interrupted or erratic at that time. In general, weekly reporting from all units by telephone, telegraph or shortwave radio is preferable to reporting by mail. Immediate consultation about any unusual condition or suspected epidemic, at any time during the week, should be encouraged. Clear instructions about how to reach the central epidemiologist should be provided to workers in the field.

Innovative ways to facilitate rapid reporting during the period of severe disruption in transportation and communication should be sought by members of the epidemiology unit. This will frequently involve utilizing other elements of the relief effort. Previous sensitivity of the relief coordinator and national authorities to the importance of adequate surveillance for an effective overall effort will pay dividends. Example procedures used with success in previous disasters include daily or weekly radio reporting of selected diseases from the field; the distribution and retrieval of reporting forms by members of the drug and/or food distribution system; gaining access to the national security force's communication network; incorporating disease surveillance into a more general regular report required by the relief coordinator; and regular visiting to field units by the epidemiologist or a member of the surveillance team.

Reporting units should be made to understand that the primary responsibility is theirs to collate and interpret weekly totals, and to act on the information they collect through surveillance. The epidemiologist, rather than being bureaucratically annoying, should help reporting units efficiently carry out these tasks in a standardized fashion. The epidemiologist should also be available for consulting about the diagnosis and management of infectious diseases with the antibiotics or biologics available, to investigate suspected outbreaks and to supervise the

*Courtesy Brooks-La Touche Photographers, Barbados*

*Julio Vizcarra, PAHO*

**Hurricanes and other natural disasters frequently disrupt communications. The designation of alternative communications systems is a key step in preparedness.**

disease control efforts. In a well run surveillance effort it is not acceptable to passively report the appearance of measles or fever-bloody diarrhea in a population by mail. When this occurs, the situation gets out of control before the epidemiologist is aware of the problem.

It is also imperative that incoming notifications are evaluated immediately upon receipt by the epidemiology unit, rather than at the end of the reporting period. This will permit prompt response to rumors or enquiries, recognition of unusual reports (e.g., typhus, human rabies) and comparison of individual units of the current reporting period with previous ones. It will also make it possible to recognize sudden increases in more common conditions such as diarrhea and acute respiratory illness.

There should be a firm and immutable deadline established by the epidemiology unit for receipt of notifications before the daily and weekly tabulations are compiled. The unit frequently works twenty-four hour shifts immediately after a major disaster strikes. Under less urgent conditions or in long term relief efforts, the reporting week should end on Friday, notifications received on Monday and the weekly report completed Tuesday. In long term refugee camps, it has sometimes been necessary to resort to clinic reporting only one day per week in order to reduce the bookkeeping demand placed on field workers. These pragmatic changes do not, however, change the need for immediate reporting of epidemics or unusual cases of disease.

A firm deadline for weekly tabulations is required to ensure prompt evaluation and action. The epidemiologic week actually decided upon is of minor importance, but its scheduling should be agreed upon by national and relief epidemiologists to avoid confusion about actual case counts in formal reports. For instance, if a case of malaria is reported by the national group in week 30 and in week 31 by the relief effort, the question is raised of whether one or two cases existed. Disagreement on this rather trivial point has in the past been a source of friction in international relief where epidemiologists of the donor and host countries differ in what constitutes an epidemiologic week.

Figure 3, derived from Figure 2, is a model for a weekly tabulation report at the central level. This model entails a summary sheet in which disease in children (under 15 years) and adults (15 years and older) are separately notified and combined totals are given. In this model, cases and deaths are combined in a total notification because the central summary sheets should be kept as uncluttered as possible for easy scan-

**Figure 3: Representative Form for Weekly Summary of Central Epidemiological Surveillance**

| Reporting Unit | Disease | Fever (100°F + 38°C +) | | Fever and Cough | | Fever and Diarrhea | | Vomiting and/or Diarrhea | | Fever and Rash | | Other New Medical Problems Specify. . . . | | Total >15 Yrs Old | Total <15 Yrs Old | Combined Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | >15 Yrs Old | <15 Yrs Old | >15 Yrs Old | <15 Yrs Old | >15 Yrs Old | <15 Yrs Old | >15 Yrs Old | <15 Yrs Old | >15 Yrs Old | <15 Yrs Old | >15 Yrs Old | <15 Yrs Old | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

COMMENTS

Weekly Report by ____________________
Name of Reporter

For ____________________

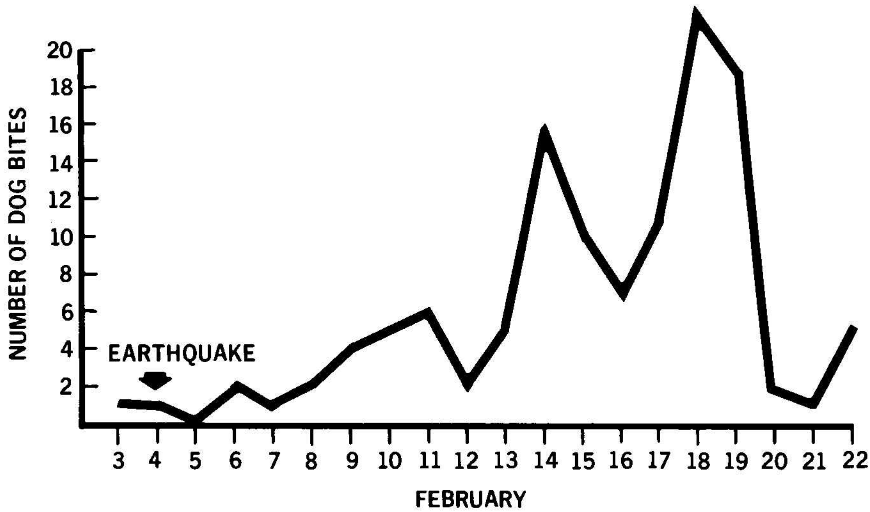
Date ____________________

Locating Address ____________________

____________________

Phone No. ____________________

**Figure 4: Number of Dog Bites in Guatemala City, February 1976**



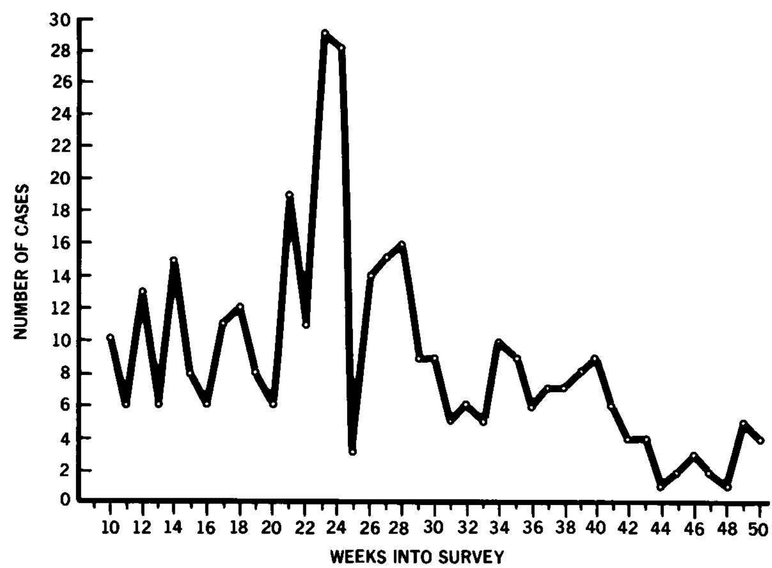

ning. Of course, deaths can be followed on a separate weekly summary sheet. Diseases not singled out for postdisaster surveillance should be tabulated on the regular weekly report form presented in Figure 1.

Weekly tabulations can occupy an inordinate amount of the time of staff members, unless care is taken to limit their proliferation. The guiding principle of reporting is to keep the number of diseases under surveillance and tabulation to an absolute minimum. Cardinal sins are, on the one hand, to not evaluate the surveillance data collected by members of the field staff and, on the other hand, to sacrifice field investigation of epidemics and disease control activities in order to keep up with tabulating the data. Arrangements should be made to whatever extent possible to delegate responsibility for tabulation to national statisticians or local individuals such as teachers, tax officers, or such volunteers as students.

The epidemiologist should also extensively use maps and graphs for visual appreciation of disease trends. This is frequently a more productive investment of the scarce time of staff members than is generating columns and figures. Maps with pins indicating the geographic clustering of cases are particularly useful for following the spread of a disease and in international relief operations in which members of the epidemiology staff may lack intimate knowledge of reporting units' proximity to each other. Well charted graphs can more sensitively indicate disease trends than numbers. This is demonstrated in Figure 4, in which reported cases of dog bites in Guatemala City following the earthquake in 1976 (*37*) are shown, and in Figure 5, in which reports of gastroenteritis in the disaster area are charted by weekly intervals (*38*). There are publications available about drafting epidemiologic visual material and graphs (*39-43*).

In summary, the epidemiologist and his superiors in the relief effort must anticipate that organizing effective postdisaster surveillance will itself lead to increased levels of reported disease, which may be real or only apparent. Some reports of increase in levels of disease will require field investigation, but despite efforts to document trends in the field it may be impossible to ascertain whether or not changes in levels are in fact real. However, there are three simple measures which will provide independent evidence of the validity of trends of reported dis-

**Figure 5: Example of Simplified Method of Surveillance of Epidemics in Zones of Disaster: Number of Reported Cases of Enteritis by Half-Week, Locality of Zaragoza, Guatemala, March 1-December 10, 1976**



ease. The following should be monitored in the weekly epidemiologic tabulations: the total number of potential reporting units; the percentage of units from which reports are submitted during the period of surveillance summaries the cornerstone of surveillance feedback. Beter, such as the registration of refugees or the opening of clinics in new areas.

## Providing Feedback to the Field from the Central Level

Providing feedback is of particular importance to postdisaster surveillance, insofar as it promotes the cooperation of newly established reporting units and those which did not participate in the preexisting surveillance. Furthermore, many relief workers will not be familiar with the surveillance system and, even when they are, many give higher priority to providing health services than to carrying out daily or weekly surveillance reporting. Efforts to provide feedback will, however, be frustrated by limitations of diagnostic resources, epidemiologic manpower, communications and transport, as well as in obtaining access to existing facilities (e.g., space on helicopters, radio time and duplicating machines).

The situation which necessitates the relief effort, on the other hand, is a special one in that whatever feedback which can be provided is especially welcome. A disaster is invariably stressful to members of health teams in the field, be they of national or international composition, since they are placed in unfamiliar circumstances. Furthermore, most relief workers have little or no firsthand experience with disaster, and few feel they are adequately trained to cope with either the immediate or potential problems in public health. There is also personal concern about the risk of acquiring a communicable or tropical disease with which they may be unfamiliar. Relief workers are, moreover, particularly conscious of being isolated from one another and of their ignorance of events in adjacent areas. Factors such as these may explain why relief workers are so psychologically vulnerable, and prone to disseminating rumors of outbreaks. It is important to remember that these concerns are also shared by the general public, especially in areas where literacy is high.

These considerations render widespread promulgation of weekly surveillance summaries the cornerstone of surveillance feedback. Because few relief workers have training in epidemiology or significant knowledge of communicable diseases, commentary, informational material and graphics should also accompany the summaries. Duplicating machines or printing presses are available under most circumstances. The epidemiologist may, however, experience difficulty in gaining access to them because of competition with colleagues, and even when there is access there may be no funds for publishing the reports. The airlifting or local purchasing of such equipment may, thus, be more effective forms of relief assistance than is the donation of medical supplies. Innovation may be required for distribution to the field, but distribution usually can be arranged through the system developed for collection of relief deliveries, personal mail to relief workers, and so forth.

The weekly report provides more than feedback to field workers. The epidemiologist should ensure that the weekly report and adequate background information (personal visit or covering note) are circulated to the relief coordinator and other national authorities and local representatives of voluntary agencies. The relief coordinator should be responsible for distributing the report to members of the media and the community.

Chapter 4

# Operational Aspects of Disease Surveillance after Disaster

While a complete discussion of operational considerations of surveillance after disaster is beyond the scope of this manual, there are four aspects which specially warrant inclusion. These are the investigation in the field of rumors and reports of communicable disease; gaining access to laboratories for obtaining definitive diagnoses and support in epidemiologic investigation; presenting epidemiologic information to decision makers; and carrying out surveillance activities during the recovery phase and afterward.

## Field Investigation of Rumors and Reports of Communicable Disease

Rumors and unconfirmed reports frequently circulate after a major disaster, but until recently epidemiologists were not asked to take part in relief efforts except when there was need to investigate the more serious of these. Political issues and the nature of public outcry, rather than public health priorities, often determined the perceived severity of a rumor or report. Rumors of increase in snake-bites after flooding, or the discovery of patients with residual poliomyelitis would, for example, lead invariably to an official government request for scarce antivenom or polio vaccine.

Following the Nigerian Civil War, a major bilateral agency initiated the sending of medical epidemiologists to evaluate the substance of such reports before responding to requests for assistance. This practice rapidly expanded to one in which requests for massive supplies of drugs and supplies for health services, and the long term impact of disaster on health services and nutritional status, are now routinely evaluated (*44-46*). Immediately consulting the medical epidemiologists of major relief agencies has become a definite feature in decision making. Now, epidemiologists are sent to affected areas to organize surveillance before rumors and unconfirmed reports are even generated.

In recent major disasters the appropriate evaluation of rumors has been made possible through this increasingly earlier involvement of epidemiologists in the relief response. This can be attributed to two factors. The most obvious is that prompt investigation can take place before a situation gets out of hand. Perhaps more important, however, has been the existence of the opportunity to educate members of disaster agencies, the media and national health authorities about appropriate ways to interpret and respond to rumor.

Epidemiology staff members who participate in relief should expect the appearance of rumors and unconfirmed reports and should be prepared to deal with them. Rumors from many sources may come to the epidemiologist's attention. Perhaps easiest to handle are reports communicated to field relief workers and visitors to the field from relief headquarters. Of the most frequent and difficult to handle are reports promulgated in the media, and reports directly brought to the attention of national leaders.

The most efficient and effective way of handling rumors of any origin is to undertake surveillance. To confirm and/or quantify the magnitude of a problem indicated by rumor, the epidemiology staff should try to canvass reporting units in the area by radio. Negative responses will frequently satisfy the need for information on the part of media, political authorities and participating agencies. This is particularly true when negative results are coupled with the promise of repeating the survey and of sharing surveillance information. Sources should also be encouraged to report any rumors they might hear in the future to the epidemiology unit or the relief coordinator for investigation. In general, maintaining a positive attitude toward receiving rumors instills trust in the source, as well as in the public. When convinced that efforts to substantiate the reports are underway, responsible persons of the media will delay publication of rumors until after discussion with relief authorities.

Reports of disease in the media originate at local, regional, or national levels. It is common in this age of satellite communications for a television or newspaper item to have directly reached the international services from the area affected by the disaster, thus bypassing authorities in the capital. Although estimates of death and disease are not usually reported in the media, so that sensationalism is minimized and panic and anxiety are prevented, breakdowns of respect of such a policy do occur. Reporters often assume that information provided by a doctor or nurse on the scene is more accurate and reliable than that in releases from official, central sources. Inexperienced and tired health personnel have on occasion locally released information, subsequently shown to be mistaken or exaggerated, to members of the media. The likelihood of such an occurrence will be reduced if seasoned health workers lead relief teams, there are briefings about the policy of dealing with the media, and an open relationship is developed between the media and the relief coordinator.

It is always possible that individual reporters may be more concerned with publicity than accuracy and that precautions do not prevent the publication of rumor. Also, the extent of disaster or of an epidemic may be exaggerated in order to embarrass authorities or to seek political advantage. The only recourse to take under these circumstances is to provide the relief coordinator the most accurate information available.

When influential local citizens or authorities report a rumor, it can be difficult to convince decision makers to wait for the results of an epidemiologic investigation before taking unnecessary or counterproductive action. Fortunately, it is usually possible to convince policy makers that immediately dispatching a team to look into the report is the quickest and most visible and effective response available. A potentially more serious operational problem exists when local or national authorities deny rumors which have not been investigated.

The majority of rumors of epidemic communicable disease after a disaster will not be confirmed. Nevertheless, the epidemiology team should not discount rumors without canvassing reporting units and/or undertaking field investigations. It may be necessary to exercise selectivity in investigating rumors, based on public health implications and/or political sensitivity, since lack of manpower is a frequently limiting factor. When the central epidemiologist is not satisfied with the field staff's ability to investigate a rumor, one or more epidemiologists should be sent to the field. In international relief efforts, national epidemiologists and members of their staff should be responsible for investigations.

The principles involved in investigating rumors are very similar to those of any other epidemic investigation. These are discussed by

Langmuir (*47*). Western (*48*), Sommer (*1*), and Blake (*44*) have demonstrated how to adapt these principles to disaster situations.

### Gaining Access to Laboratories to Obtain Definitive Diagnoses and Support for Epidemiologic Investigations

Selected issues concerning the use of laboratories in disaster situations, particularly in remote areas and in poorer countries, are discussed in this section. Details not contained here are presented in documents available elsewhere (*49-51*).

When the epidemiologist investigating a rumor encounters patients with symptoms compatible with the disease in question, it is imperative to collect specimens appropriate for diagnosis, and to properly handle and transport them to a competent laboratory, where they should receive priority attention. Selected laboratory investigation of symptoms or symptom complexes (such as fever-diarrhea) reported to be increasing may also be required for undertaking appropriate public health measures and developing guidelines for proper management of patients.

There are four reasons that it may be necessary to obtain laboratory confirmation of selected notifiable diseases from a sample of patients. The first of these is that not all notifiable communicable diseases can be diagnosed with confidence on the basis of clinical criteria alone. The probability of reaching a mistaken diagnosis is increased during a period of relief in which medical staff members lack experience in recognizing tropical or endemic communicable diseases. In addition, experienced physicians from the affected area may fail to consider recently introduced diseases in their differential diagnoses. In Latin America and the Caribbean, for example, influenza, dengue and typhoid fever are frequently confused in surveillance reports.

Second, the public health laboratory is essential to the promotion of efficient communicable disease control. The epidemiologist and preventive medical officer are primarily concerned with communicable diseases in general populations, rather than in individual patients. For such persons, the diagnosis of typhoid fever or measles in a hospitalized patient only represents the tip of an iceberg. Examination of the disease in family members, close contact and neighborhood populations is frequently indicated. To determine the prevalence of disease and initiate control measures, it may also be necessary to undertake community-wide surveys.

The importance of precise diagnosis of an agent causing outbreak or a prevalent communicable disease for patient management, and particularly antibiotic management, is the third reason to obtain laboratory confirmation. For example, of influenza, dengue and typhoid fever, the first two require supportive care. Typhoid fever ordinarily requires treatment with chloramphenicol or ampicillin, but not penicillin or sulfonamides. The typhoid organism has developed resistance to chloramphenicol or ampicillin in some areas, however.

The final reason why access to diagnostic laboratory facilities is important to disaster relief is that critical vaccines, antibiotics and antisera may not be immediately available or may only exist in extremely short supply. Definitive laboratory diagnosis can be of considerable help in deciding in which areas there is a real demand for such scarce resources and for planning the relief effort.

Health authorities establish priorities for processing diagnostic specimens during times of disaster. Systematic confirmation of all suspected cases of the diseases subject to international notification and/or those of selected emphasis in surveillance is of highest priority. Next to these are more common conditions (febrile diarrhea) of which there are outbreaks, which require confirmation through a sample of cases. Laboratory diagnosis of disease for the purpose of individual case management is of lower priority. Since public health and clinical directors compete for limited laboratory resources, and because emergency conditions may make it necessary for national relief authorities to utilize hospital and private laboratory facilities, it is important to pay heed to these priorities.

In Table 3 is a line-listing of the most important communicable diseases found in patients affected by disaster, and the indications for seeking laboratory diagnosis for preventive medical officers and clinicians. This is as a general guideline for emergency usage during times of disaster. As such, it presents minimal, instead of optimal, standards.

The response to be taken to suspect yellow fever exemplifies the appropriate response to one type of internationally notifiable disease. Laboratory diagnosis should be sought on all suspect cases. Viral isolation is only feasible during the first three days of illness. Acute and convalescent sera should be collected from all patients. Postmortem hepatic tissue should be obtained for histologic examination from all fatal cases. Viscerotomy, rather than autopsy, is practiced in many areas of Latin America. In contrast to suspect yellow fever is influenza, for which clinical reporting of outbreaks to the epidemiology unit is re-

**Table 3. Criteria for Collection of Specimens of Selected Communicable Diseases for Laboratory Diagnosis after Disaster (27, 49)**

| Disease | Class** | Specimens for Isolation |
|---|---|---|
| Amebiasis | 3C | Stool<br>Blood |
| Chickenpox-<br>Herpes Zoster | 3C | Vesicular fluid<br>Lesion scrapings<br>Crusts |
| Cholera | 1 | Rectal swabs<br>Stool<br>Vomitus |
| Diarrhea<br>Nonspecific | 4 | Fecal material |
| Diphtheria | 2A | Nose/throat swabs |
| Ebola-Marburg<br>Viral Disease | 2A | Blood |
| Food Poisoning | | |
| —Staphylococcal<br>Food poisoning | 4 | Samples of ingested material<br>Fecal material |
| —Bacillus cereus | 4 | |
| Gastroenteritis | | |
| —Epidemic Viral<br>Gastroenteritis | 4 | Fecal material |
| —Rotavirus<br>Gastroenteritis | 4 | Stool<br>Rectal swab |
| Hemorrhagic Fevers<br>of Argentinian and<br>Bolivian Types | | Blood<br>Spleen<br>Throat washings |
| Hepatitides, Viral | 2A | |
| —Viral Hepatitis A | | Blood |
| —Viral Hepatitis B | | Blood |
| —Viral Hepatitis<br>Non-A, Non-B | | Blood |
| Influenza | 1 (under surveillance by WHO)<br>4 (other jurisdictions) | Pharyngeal/nasal swabs |
| Leprosy | 2B | Tissue fluid from lesion<br>Biopsy of nerve |

**Table 3. Criteria for Collection of Specimens of Selected Communicable Diseases for Laboratory Diagnosis after Disaster (27, 49) *(Continued)***

| Disease | Class** | Specimens for Isolation |
|---|---|---|
| Leptospirosis | 2B | Blood<br>Urine |
| Malaria | 1 (under surveillance by WHO in non-endemic areas) 3C (endemic areas) | Blood |
| Measles | 2B | Blood<br>Conjunctivae/nasopharynx<br>Urine |
| Meningitis —Meningococcal | 2A | Spinal fluid<br>Blood<br>Nasopharyngeal swabs<br>Petechial scrapings<br>Ventricular/cisternal/ subdural fluid |
| Pediculosis | 5 | Hair/clothing |
| Plague | 1 | Bubo fluid<br>Portions of bubo<br>Spleen<br>Bone marrow<br>Sputum<br>Blood<br>Ectoparasites |
| Poliomyelitis | 1 | Feces<br>Oropharyngeal secretions |
| Rabies | 2A | Brain<br>Frozen skin sections<br>Corneal impressions<br>Mucosal scrapings |
| Relapsing Fever | 1 (Louse-borne)<br>3B (Tick-borne) | Blood |
| Salmonellosis | 2B | Fecal material<br>Blood |
| Scabies | 5 | Scraping from lesion |
| Shigellosis | 2B | Fecal material<br>Rectal swabs |

**Table 3. Criteria for Collection of Specimens of Selected Communicable Diseases for Laboratory Diagnosis after Disaster (27, 49) *(Continued)***

| Disease | Class** | Specimens for Isolation |
|---|---|---|
| Streptococcal Diseases Caused by Group A (Beta Hemolytic Streptococci) | 4 | Blood |
| Tetanus | 2A | Materials from wounds |
| Tuberculosis | 2B | Sputum<br>Gastric washings<br>Pus<br>Urine<br>Spinal/pleural/synovial fluid |
| Typhoid Fever | 2A | Blood<br>Rectal swabs<br>Urine specimen |
| Typhus Fever, Endemic Louse-borne | 1 | Blood |
| Yellow Fever | 1 | Blood |
| Whooping Cough | 2B | Nasopharyngeal swabs |

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Class 1: Case Report Universally Required by International Health Regulations

This class is limited to the diseases subject to the International Health Regulations (1969) (quarantinable diseases)—cholera, plague, smallpox and yellow fever, and to the diseases under surveillance by WHO: louse-borne typhus, poliomyelitis, influenza and malaria.

Obligatory case report to local health authority by telephone, telegraph, or other rapid means; in an epidemic situation, collective reports of subsequent cases in a local area on a daily or weekly basis may be requested by the next superior jurisdiction—as for example, in an influenza epidemic. The local health authority forwards the initial report to next superior jurisdiction by expeditious means if it is the first recognized case in the local area already reported; otherwise, weekly by mail or telegraphically in unusual situations.

Class 2: Case Report Regularly Required Whenever the Disease Occurs

Two subclasses are recognized, based on the relative urgency for investigation of contacts and source of infection, or for starting control measures.

A. Case report to local health authority by telephone, telegraph, or other rapid means. These are forwarded to next superior jurisdiction weekly by mail, except that the first recognized case in an area or the first case outside the limits of a known affected local area is reported by telegraph; examples—typhoid fever, diphtheria.

B. Case report by most practicable means; forwarded to next superior jurisdiction as a collective report, weekly by mail; examples—brucellosis, leprosy.

Class 3: Selectively Recognized Endemic Areas

In many states and countries, diseases of this class are not reportable. Reporting may be prescribed in particular regions, states or countries by reason of undue frequency or severity. Three subclasses are recognized; A and B (below) are primarily useful under conditions of established endemicity as a means leading toward prompt control measures and to judge the effectiveness of control programs. The main purpose of C (below) is to stimulate control measures or to acquire essential epidemiological data.

A. Case report by telephone, telegraph, or other rapid means in specified areas where the disease ranks in importance with Class 2A; not reportable in many countries; examples—tularemia, scrub typhus.

B. Case report by most practicable means; forwarded to next superior jurisdiction as a collective report by mail weekly or monthly; not reportable in many countries; example—bartonellosis, coccidioidomycosis.

C. Collective report weekly by mail to local health authorites; forwarded to next superior jurisdiction by mail weekly, monthly, quarterly, or sometimes annually; examples—clonorchiasis, sandfly fever.

Class 4: Obligatory Report of Epidemics—No Case Report Required

Prompt report of outbreaks of particular public health importance by telephone, telegraph, or other rapid means; forwarded to next superior jurisdiction by telephone or telegraph. Pertinent data include number of cases, within what time, approximate population involved, and apparent mode of spread; examples—food poisoning, infectious keratoconjunctivitis.

Class 5: Official Report Not Ordinarily Justifiable

Diseases of this class are of two general kinds: those typically sporadic and uncommon, often not directly transmissible from man to man (chromoblastomycosis); or of such epidemiological nature as to offer no practical measures for control (common cold).

Diseases are often made reportable but the information gathered is put to no practical use. This frequently leads to deterioration in the general level of reporting, even for diseases of much importance. Better case reporting usually results when official reporting is restricted to those diseases for which control services are provided or potential control procedures are under evaluation, or epidemiological information is needed for a definite purpose.

quired. The unit should arrange throat washings and the obtaining of acute and convalescent sera from a small sample of acutely ill patients.

Clinicians and epidemiologists from developed countries may feel that the guidelines in Table 3 are restrictive, but most public health officers in Latin America and the Caribbean would consider them excessive, in light of the inadequate or deteriorating state of public health diagnostic facilities throughout most of Latin America and the Caribbean. There are two reasons why such a view, even if true, is not an acceptable reason for failing to secure essential laboratory support during a period of emergency relief. First of all, the debilitated status of national public health laboratories does not necessarily provide indication of the diagnostic capability of hospital microbiology laboratories or of those in the private sector. In a major disaster, the opportunity is present to overcome normal institutional and bureaucratic barriers to the use of such facilities. The second reason for the inexcusability of failing to obtain laboratory support is that there is an international system of collaborating and reference laboratories for most diseases of public health importance that has been developed at the Pan American Health Organization and the World Health Organization. These laboratories can be called upon through national public health laboratories and PAHO/WHO to provide emergency diagnostic support. Furthermore, international relief transported by air permits the prompt shipment of specimens to reference laboratories in neighboring or industrialized countries. Annex 5 contains a list of centers and laboratories which collaborate in regard to the diseases covered in Table 3.

### Presenting Epidemiologic Information to Decision Makers

The institution of control measures must be the result of the epidemic investigation with appropriate laboratory diagnostic support. There are reasons why the instituting of control should not, however, be taken for granted during an emergency. Even under normal conditions, a country may not have the internal capacity for emergency control. Whether or not this is true, decision makers may assign higher priority to undertaking relief activities or providing medical services than to putting prevention or control measures into effect. The staff needed to carry out control measures may be diverted elsewhere during the emergency. Finally, control measures may not be taken because the responsibility for these may be divided between the relief coordinator and the national authorities who are ordinarily responsible for vector control, immunization programs, etc.

Because epidemiology units do not have the authority or resources to adequately carry out control measures, it is critical to, as effectively as possible, present information from surveillance and the field investigations to key decision makers. Epidemiologic information, implications, and an outline of alternatives of action must be summarized in the presentation in nontechnical terms understandable to laymen. Ordinarily, first presentation should be made by the epidemiologist to the relief coordinator and/or the staff person responsible for health. Support on the part of the relief coordinator should suffice to secure available services and resources, since the relief coordinator has access to national and international resources, such as the Pan American Health Organization, and bilateral and voluntary agencies. This official is also able to initiate discussion with national authorities about overall responsibility for carrying out control measures. In the guide, *Emergency Health Management after Natural Disaster* (52), there is an overview of sources of international assistance and ways in which assistance is coordinated within the disaster-affected country.

**Surveillance during and after the Recovery Phase**

With increasing passage of time after a disaster, both decision makers and the public become progressively less concerned with the probability of epidemic disease. Initial enthusiasm also wanes for providing emergency health services to affected communities and temporary settlements, and many bilateral and voluntary disaster relief agencies begin phasing out activities. Normal communications and transportation, as well as disease notification systems and control efforts, are restored. The phasing out of the intensified, disaster-related surveillance activities should take place after consultation with members of the national epidemiology group. Certain areas, such as permanent encampments of refugees, may require indefinite special surveillance.

In rural or remote areas, the phasing out of postdisaster surveillance may mean that all notification of disease ceases. Organized effort to maintain effective surveillance in such areas has not, in the few instances when it has been tried, been particularly successful. On the other hand, such an effort has never been of high priority or received significant economic support from authorities of disaster-affected countries or development agencies. In the past several years, however, the Pan American Health Organization has assigned high priority to developing or strengthening epidemiologic surveillance programs after disaster. In some countries, the monitoring of postdisaster recovery in the health sector has been an additional objective.

Chapter 5

# The Control of Communicable Disease after Disaster

The activities of communicable disease control which are effective in normal times are usually also appropriate and effective in postdisaster periods. The twelfth and thirteenth editions of *Control of Communicable Diseases in Man* (2, 27) are very useful compendia in which these procedures are summarized disease by disease. Situations precipitated by disaster are often characterized by unique features, however, which warrant discussion in this final chapter. Comments will be divided for purposes of simplicity into sections on environmental health management, immunization, chemotherapy, and quarantine and isolation.

## Environmental Health Management

The management of environmental health after disaster consists of activities related to basic sanitation—the disposal of excreta, the maintenance of water supply, personal hygiene, food supply and vector control, the burial of the dead, and the provision of shelter. Disaster relief administrators appreciate that limitations of time, manpower and resources demand establishing priorities. The factors brought into consideration for this purpose include the nature of preexisting conditions, cultural acceptability, creature comfort and risk to public health such as the occurrence of epidemics of communicable disease.

In general, the amount of disaster relief activity that is devoted to environmental health management is proportional to the sufficiency of sanitation facilities which existed beforehand. The limited duration of disaster relief activity renders it impractical to try to establish permanent sanitary facilities and safe sources of water and food if these were severely damaged by the disaster or were previously nonexistent. Populations in which there were low levels of personal hygiene and which lacked these amenities will not, in a short time period, be educated about the proper use of latrines, wells or bathing facilities. Previous exposure and the development of immunity to disease frequently means that rural populations without sanitary facilities are at lower risk than affected urban dwellers and relief workers of acquiring communicable diseases. In contrast, the interruption of water or electrical service in an industrialized community can cause severe disruption of social and sanitary services and thus facilitate the transmission of disease. Encamped populations in both poor and less poor nations always require that meticulous attention be paid to environmental health management.

It is important for epidemiologists to realize that the environmental measures to which relief administrators give priority are frequently not those most associated with the risk of communicable disease trans-

*Courtesy UN Photo Library*

**The availability of sufficient quantities of safe water is a critical health need at any time. Natural disasters may disrupt supply systems and cause contamination of water sources. Special measures should be taken to protect vulnerable installations and keep alternate water sources clean.**

mission. Among the first concerns of environmental health managers are the existence of shelter and potable water, the burial of the dead and the disposal of excreta. Vector control, food protection and promoting personal hygiene are invariably assigned lower priority. These latter activities are, however, extremely important in terms of the transmission of communicable disease. In major disasters, particularly in poorer countries, the availability at all levels of persons trained and available to practice environmental health management is the factor which limits the promotion of these measures of high priority.

Human and animal carcasses have rarely, if ever, been associated with epidemics of communicable diseases, but even though the problems related to health are not at issue, in most societies the acceptable disposal of corpses is extremely important for cultural reasons. In most circumstances, the stench of unburied or improperly buried animal carcasses will not be tolerated for long.

Environmental intervention also frequently fails to prevent the transmission of communicable disease because of limitations in existing techniques and/or misapplication. Chlorination and/or filtration of water, for example, may not destroy protozoa such as Giardia lamblia. Water disinfection tablets (such as Globaline and Halazone) will destroy enteric bacteria, amoebae, and some, but not all, enteric viruses. Massive distribution of water purification tablets following disasters has not been effective in poorly educated populations unfamiliar with proper usage and thus is not a recommended routine measure. Indeed, if such tablets are ingested whole like pills, fatality may result. The tablets may be useful, however, among well educated and motivated groups such as relief workers, military, civil servants, and so forth.

Such measures as vector control are too often directed at nuisance insects rather than vectors of human disease. Pesticides may be applied to outdoor vegetation in order to reduce populations of biting mosquitoes (e.g., *Culex*), instead of the vectors of malaria (*Anopheles*) or dengue and yellow fever (*Aedes aegypti*). Resistant housefly populations may also be treated with excessive amounts of pesticides when improved excreta and solid waste collection and disposal would be much more effective.

The Pan American Health Organization's manual, *Emergency Vector Control after Natural Disaster* (*53*), and the World Health Organization's *Guide to Sanitation in Natural Disasters* (*22*) provide a thorough review of the principles of environmental health management.

## Immunization

Historically, health authorities frequently advocated and carried out improvised emergency vaccination of the general population against typhoid fever, tetanus and cholera on a massive scale following disasters. Responsible disaster and relief agencies now recognize that these measures are unnecessary and counterproductive. At the base of the change in attitude are both scientific and practical considerations. Despite the compelling reasons to the contrary, though, mass immunization remains strongly linked with disaster in the psyches of the public and politicians. It may thus be extremely difficult to overcome demands for immediate vaccination campaigns.

The scientific factors which contribute to the inadvisability of massive vaccination have been reviewed by members of the Pan American Health Organization (see Annex 5). Considerations include the fact that epidemics of these diseases rarely occur, even in previously unvaccinated populations, after disaster; with presently available vaccines primary immunization requires two or three injections given at two- to

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**Emergency mass vaccination programs are a waste of resources. The best protection against communicable disease outbreaks following natural disaster is to maintain good health coverage before the disaster.**

four-week intervals; typhoid, paratyphoid, and cholera vaccines confer only partial protection, which may last only several months; and for the communicable diseases most likely to occur, effective vaccines have not yet been developed. The most prevalent diseases in populations stricken by disaster are food intoxication due to bacterial toxins, salmonellosis, shigellosis, nonspecific diarrhea, infectious hepatitis, and influenza.

The clinical manifestations of infectious hepatitis can be reduced by gamma globulin, but gamma globulin does not reduce infection or transmission. In most developing countries, it is also too costly to use. Vaccination against influenza should be restricted to the elderly, patients with chronic debilitating disease, and essential personnel before disease appears in the community. The vaccine used for this purpose is a potent, antigen specific influenza vaccine. Neither gamma globulin nor influenza vaccine is recommended for mass immunization after disaster.

Experience has shown that it is usually impractical to attempt mass immunization immediately following a disaster and that when attempted, it detracts from the overall relief effort without producing a discernible benefit. Effective immunization requires prior planning, good systems of communication and transport, and access to the populations at risk. These requirements cannot be met in the immediate postdisaster period. Efforts to achieve mass vaccination in the relief phase also drain whatever limited manpower, communication facilities, and transportation exist. In addition, the improper handling and storage of certain vaccines, particularly of those which require refrigeration (yellow fever, measles, poliomyelitis) leads to unacceptably high wastage, or administering vaccines which lack potency.

Primary vaccination should be considered for young children whenever populations are expected to remain encamped longer than thirty days. Older children should be offered boosters at the appropriate time. The strategy, age groups, vaccine, schedule and so forth adopted for vaccinations should be in accordance with that of the National Expanded Programme of Immunization (EPI). This includes vaccinations against diphtheria, pertussis, tetanus, poliomyelitis, measles, and tuberculosis (BCG administration). Proper concern must be given to the preservation of vaccine potency, through attending to the cold chain as well as documenting coverage by keeping immunization records.

As a component of the routine screening of persons entering camps, immunization can be offered and continued as part of primary health care service. Of the total encamped population, children are targeted for vaccination and women of childbearing age for tetanus immunization. This is because most older children and adults in previously well-immunized populations will already be protected by vaccination; in unimmunized populations, older individuals have already acquired natural immunity; and the logistical problems previously associated with mass campaigns are reduced when concentration of effort is placed only on the susceptible population.

Exceptions to these rules may be occasionally necessary for isolated populations in which diseases such as measles, poliomyelitis and influenza are not in routine circulation. Small island populations or isolated mountainous groups, evacuated for safety or displaced by a disaster, are examples of such populations.

Immunization has a real, but a limited role in adequately immunizing relief workers against the endemic diseases to which they may be susceptible (poliomyelitis, measles and immune serum globulin). The rationale for immunizing relief workers is that it preserves critically needed manpower by preventing unnecessary episodes of communicable disease. The immunizations required for volunteers from industrialized countries are the same as those recommended for other international travelers (*19*). These are ideally completed before departure to the disaster-affected area. If it is not possible to do so, second doses and booster doses should be administered in the field.

Manuals are available from the Pan American Health Organization/World Health Organization on immunization practices and the cold chain (*54-56*).

## Chemotherapy

The mass administration of anti-infective drugs in disaster-affected populations is not recommended. Scientific reasons why this is so include the fact that antibiotics are not effective against viral diseases, such as influenza, hepatitis and the common cold; no single antibiotic provides adequate coverage against all potential bacterial or rickettsial diseases; and antibiotics have to be taken indefinitely to prevent infection with a susceptible organism. Moreover, anti-infective agents can induce allergic reactions and toxic side effects which include death. The promiscuous use of antibiotics can rapidly lead to emergence of drug resistant bacteria, particularly of enteric organisms. Plasmid mediated antibiotic resistance is, moreover, frequently not just against the antibiotic administered, but against multiple antibiotics. In addition, perhaps more compelling reasons to avoid massive use of anti-infective drugs are the constraints of logistical and human resources, as already discussed in connection with mass immunization after disaster.

The prophylactic administration of antibiotics or sulfonamides to prevent diarrhea and the routine treatment of uncomplicated upper respiratory complaints with antibiotics should be discouraged for these reasons. It is sometimes advocated to administer anthelminthics, on the premise that children in the tropics are malnourished and have multiple intestinal parasites. Unfortunately, the cheapest anthelminthic drugs, such as piperazine, are of limited spectrum against *Ascaris lumbricoides* (round worm). Broader spectrum anthelminthics such as thiabendazole and mebendazole, cause toxic reactions unacceptably high for general use in asymptomatic patients, and they are too expensive for many relief efforts.

Providing chemosuppressive drugs against malaria to populations affected by disaster requires a more complex decision dependent upon local conditions and circumstances. Usually, the key factor is whether or not an affected population has moved from an area free of malaria to one with high levels. The presence of chloroquine resistant strains of malaria is also a factor to consider. In an organized or well educated community, it is feasible that local leaders or heads of families administer chloroquine once a week. The regimens which prevent chloroquine resistant falciparum malaria are either more complicated, such as weekly administration of chloroquine-primaquine and daily administration of dapsone, or consist of drugs which may not be readily available, Fansidar/pyrimethamine-sulfadoxine combination tablets. It is thus fortunate that stages II and III of chloroquine resistance are not the severe problem in the Americas that they are in southeast Asia.

Malaria chemosuppression is not usually practiced in areas where levels of malaria are high. This is because most members of the population have considerable immunity, which would be reduced by drug administration, and because community-wide chemosuppression cannot be maintained after the departure of relief agencies. Mass curative therapy is also discouraged among populations from holoendemic areas who have been displaced. It is argued that eliminating subclinical infection reduces acquired immunity and makes patients more susceptible to disease upon returning to their homes.

The mass administration of single parenteral doses of penicillin in communities where yaws (*Treponema pertenue*) is found needs brief mention. This may be the only universally accepted indication for community-wide anti-infective chemotherapy (*57*). Logistical constraints, demands for health services, and limited numbers of disease control personnel, however, create difficulties in undertaking even this response to yaws during an emergency.

## Quarantine and Isolation

In the *Handbook on Control of Communicable Diseases in Man* (*2*) there is a summary of currently recommended quarantine and isolation procedures for use with patients and their contacts. The Centers for Disease Control's guide, *Isolation Techniques for Use in Hospitals* (*58*), is directed toward limiting the spread of disease in acute care facilities. Unfortunately, the infection control programs which can, under normal circumstances, approach the standards in this guide are few in Latin America and the Caribbean. After disaster, conditions in the established hospital often include the lack of water and electricity essential for handwashing, disinfection and microbiological identification.

Infection rates in teaching hospitals in Latin America and the Caribbean approach fifty percent under normal circumstances. In studies of pediatric wards, prevalence of gastroenteritis has exceeded one hundred percent. Thus, if a child entered without diarrhea, he had it at least once before he was discharged. The nonexistence of effective and appropriate hospital infection control programs in developing countries must be taken into account by relief authorities charged with caring for casualties of disaster in existing institutions. A regional program is currently being developed at the Pan American Health Organization (*59*).