

PIDP

Pacific Islands Development Program

A MODEL PROGRAM FOR
PUBLIC HEALTH PREPAREDNESS

This paper was prepared by the
Pacific Islands Development Program for the
Disaster Preparedness Strategies Seminar,
March 23-25, 1983
Suva, Fiji



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Pacific Islands Development Program
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INTRODUCTION

A. Background: Public Health Concepts and Terms

Public health is the protection and improvement of community health status. The primary focus of public health is on the prevention of illness and injury. This is accomplished through a variety of environmental measures that reduce the risk of disease transmission, the most important of which relate to food and water supplies, immunity, sanitation, and vector control.

The public health sector is a broad, loosely-integrated consortium of disciplines that contribute to community health maintenance. In the context of disasters in developing countries, manpower resources for public health include a broad range of para-professional and professional personnel, from primary health care workers to laboratory technicians to sanitary engineers. Public health differs from curative medicine in terms of its emphasis on the community and preventive measures that can be taken to protect a population as a whole, while curative medicine focuses on individuals.

Community health problems are diagnosed using epidemiologic methods. Epidemiology involves the investigation of the causes of disease using knowledge of the occurrence, frequency, and distribution of disease in a human population. The method is dependent upon obtaining reliable information for diagnosing the problem before appropriate treatment can be identified. In public health, the major emphasis in treatment is placed on prevention and control rather than curative medical care.

The implications for disaster preparedness planners in this context involve recognition that post-disaster health needs are much broader than simple first aid or curative medical services. Planners must consider health on a population-wide basis, and must prepare disaster plans using public health methodology. The most significant preparedness activity to be undertaken is therefore to strengthen the existing national public health sector and to integrate public health and many environmental engineering activities. A strong, functioning public health sector will require little more than the careful reordering of priorities after a disaster. Data collection, disease control, and general preventive health activities carried out under normal circumstances for all practical purposes remain unchanged after a natural disaster.

The strengthening of a country's public health capabilities for disasters should not be viewed entirely in terms of preparedness and emergency response. There are many disaster-related measures and activities which can be started during normal periods as part of regular public health programs. These can have developmental consequences, as well as mitigating, or even preventing, health problems from being a major concern in disasters. Thus disaster activities in this sector should not be viewed as a totally separate or distinct branch of public health, but rather as an added dimension of the discipline. For governments, this means that an investment in public health for disasters will have dual benefits, serving both post-disaster and normal needs.

B. Public Health Consequences of Disasters and Appropriate Responses

1. Hurricanes

Hurricanes destroy buildings, lines of communication and crops.

TABLE 1. Summary of the Typical Impact of Disasters Creating Immediate Needs for Assistance, with Emphasis on Developing Countries(1)

Relief need created by disasters	Disaster type					
	Famine caused by drought or pesti- lence	Flood or wind- storm (2)	Earth- quake	Epidemic	Mass acci- dent	Refugees/ displaced persons
Replace or repair infrastructure/ communications	0	3	3	0	1	2
Replace or repair shelter/bedding/ clothing	0	3	3	0	1	3
Restore or initiate agriculture	3	3	0	0	0	2
Provide public health services:						
- general food rations	3	3	0	1	0	3
- feeding programs for vulnerable groups	3	3	0	1	1	3
- curative medical services(3)	1	2	3	3	3	3
- preventive health services(4)	3	3	2	3	1	3

(1) scale of importance: 0-3 with 3 most important

(2) assuming impact deaths and injuries, and crop loss leading to famine

(3) including rescue, attention to trauma injuries, in-patient and out-patient services

(4) including potable water, sanitation, health education, immunization, garbage disposal, and vector control

However, they produce a relatively moderate number of deaths and trauma injuries, unless accompanied by a storm surge or widespread flooding. Indirectly, hurricanes affect health by causing damage to water supplies and sanitation facilities as a result of flooding, by causing physical destruction of health facilities, equipment and supplies, and by causing manpower shortages until communications can be re-established.

Disaster preparedness health planning for hurricanes focuses on the resumption of normal water supply and sanitation services. The moderate number of trauma injuries requiring emergency medical assistance can usually be handled by nearby clinics or hospitals.

2. Earthquakes

Major earthquakes destroy or damage buildings and lines of communication. Because they strike unexpectedly, their immediate effect may often be high rates of mortality and trauma injuries. Crush injuries and all kinds of fractures usually result from earthquakes occurring in areas where multi-story buildings and/or heavy, unreinforced construction materials are customarily utilized. Indirectly, earthquakes affect health by disrupting water supplies through changes in subterranean geology which affect springs and wells, and by damaging community water distribution networks.

In this case, the immediate concern for disaster preparedness planning is the large number of trauma victims requiring emergency medical and first aid services. Under extreme

conditions on islands with limited hospital resources, it might become necessary to evacuate some patients by air to other nearby hospitals. In general, however, it is very likely that emergency rooms will be able to cover all local needs. In this regard, it is vital to ensure that roads and other transportation facilities remain open for evacuation of the injured to medical facilities. In mountainous regions, it may be necessary to plan for search-and-rescue missions on foot, by jeep, or using aircraft to locate the injured.

After the initial emergency period, resources must be diverted to the resumption of temporary water supply and sanitation services. These services will be permanently rehabilitated later as part of broader reconstruction programs designed to replace buildings and infrastructure destroyed by the earthquake.

3. Floods

Floods may occur as a result of hurricanes and other weather-related phenomena. They destroy or damage crops and may, in extreme cases, cause some loss of human life due to drowning. Indirectly, floods affect health conditions through the cross-contamination of water supplies and sanitation facilities, and in some instances by providing mosquito vectors with an increased habitat of standing water in which to reproduce.

Preparedness planning to deal with flood disasters should focus on public health issues, especially the resumption of

normal water supply and sanitation services. Particular attention may have to be paid to the decontamination of water sources such as ponds and wells.

4. Salt water inundation

Storm surges or tsunamis may overrun low coastal land or even entire islands whose elevation is minimal, causing salt water inundation. In extreme cases, some direct deaths and trauma injuries may result as unprotected individuals are swept away. Indirectly, salt water inundation affects health in the same way as simple flooding, described above, with the additional complication of filling wells with brackish water.

Preparedness planning in the case of salt water inundation parallels that required after simple flooding. In addition, wells must be desalinated before normal use may be resumed.

5. Volcanoes

Volcanic eruptions near human habitation destroy property and crops, but in general most people have sufficient warning to escape to safer ground. Indirectly, volcanic eruption may threaten health by causing pulmonary problems associated with the inhalation of large amounts of irritating volcanic dust.

The immediate concern to disaster preparedness planners is treatment of pulmonary distress. It may be wise to create a small, highly accessible stockpile of surgical-type face masks for rapid distribution in communities affected by volcanic dust.

6. Droughts and food emergencies

Severe long-term drought of the kind occurring in Africa does not occur in the South Pacific region. Large-scale food emergencies of the kind experienced in Africa and Asia do not, therefore, result. However, water shortages and crop failures do result from occasional short-term changes in normal meteorologic patterns.

Appropriate disaster preparedness activities for drought in this region should focus on establishment and maintenance of emergency fresh water reserves. Food shortages accompanying crop loss can generally be dealt with on an individual basis through the release of national food reserves or, in extreme cases, appeals for international assistance.

C. Primary Areas of Concern

A natural disaster may change the risk of preventable diseases, although cholera or typhoid epidemics which are frequently rumored after disasters have not been confirmed by epidemiologists in the field. The effect of natural disasters is usually to permit increased transmission of the endemic communicable diseases

normally present in the region, for one or more of the following reasons:

- normal public health programs including vector control may be disrupted due to the physical destruction of facilities, equipment and supplies, due to the death or incapacitation of public health personnel, or due to the diversion of financial, human and/or material resources to other sectors;
- homeless families may be housed temporarily in crowded accommodations, such as surviving public buildings or makeshift camps or shelters, where public health services are generally inadequate;
- existing public health services, particularly water supply and sanitation systems, may be cross-contaminated, damaged or destroyed as a result of natural disasters.

For these reasons, the primary areas of public health concern after disasters are necessarily those which facilitate the reduction of communicable disease transmission, and hence resume protection of the health status of the population. Although the order of priority may vary from one disaster situation to another, these areas of public health concern are as follows:

1. water supply (dealing both with quantity and quality of water);
2. sanitation (particularly human waste disposal);
3. vector control (mosquitoes, flies, and rodents).

Epidemics of some childhood diseases have occurred after disasters affecting unimmunized populations. These usually occur as

a result of people clustering in shelters or camps, and the threat to people remaining scattered near their homes is almost non-existent. Immunization campaigns, therefore, represent a dubious use of scarce manpower and transport resources after disasters, and they would be particularly inappropriate in most well-protected South Pacific societies.

Changes in the incidence rates of water-borne diseases may occur rapidly after a disaster and are most likely to be associated with crowding and problems concerning water supply and sanitation. Changes in incidence rates of vector borne diseases generally take longer to occur due to the characteristics of the vectors' life cycles, and are most likely to be associated with the breakdown of public health services, particularly those pertaining to vector control.

For more specific information, see Table 2 following.

TABLE 2. Potential Risk of Selected Communicable Diseases
Following Disasters(1)

Disease	Disaster Potential	
	Qualitative	Quantitative
Amebiasis	contamination of water/food	?
Chickenpox-Herpes Zoster	overcrowding in emergency situations	3+
Cholera	contamination of water/food, crowding in primitive conditions	1+
Diarrhea, nonspecific	contamination of water/food, crowding	4+
Diphtheria	crowding of susceptible groups	2+
Ebola/Marburg Virus	direct contact with infected blood secretions, organs or semen. Possible by vector-borne aerosol routes	?
Food Poisoning - Staphylococcal	mass feeding and inadequate refrigeration/cooking facilities	4+
- Bacillus cereus	mass feeding and inadequate refrigeration/cooking facilities	3+
Gastroenteritis - Epidemic Viral	contamination of water/food, crowding	?
- Rotavirus	contamination of water/food, crowding	?
Viral Hepatitis - Viral Hepatitis A	contamination of water/food, inadequate sanitary facilities	4+
- Viral Hepatitis B	improper sterilization procedures	4+
Influenza	crowding	4+
Leprosy	interruption of case detection and therapy	?
Leptospirosis	contamination of water/food, flooding of areas with high water table	?

TABLE 2 (continued)

Malaria	availability of water for mosquito breeding	?
Measles	introduction of measles to susceptible isolated population	?
Meningitis, Meningococcal	crowding	?
Pediculosis	crowding, clothing	?
Poliomyelitis	crowding of nonimmune groups, contaminated food, inadequate sewage disposal	?
Rabies	stray dogs	2+
Relapsing Fever	overcrowding, malnourishment poor personal hygiene	2+
Salmonellosis	overcrowding, contamination of food in mass feeding, poor sanitation	3+
Scabies	overcrowding	2+
Shigellosis	crowding, poor sanitation, malnourishment	4+
Streptococcal Diseases caused by Group A (Beta Hemolytic streptococci)	contamination of food	2+
Tetanus	flood, hurricanes, earthquakes	3+
Tuberculosis	crowding	1+
Typhoid Fever	disruption of usual sanitary control of food and water	2+
Typhus Fever (Endemic Louse-Borne)	unhygienic conditions, crowding	2+
Whooping Cough	crowding	2+
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*? potential	1+ rare	
2+ occasional	3+ frequent	4+ usual

(1) Source: Pan American Health Organization (1982) Sci. Pub. No. 420, based on information from Benenson.

PLANNING A PROGRAM OF HEALTH PREPAREDNESS

One of the most critical steps in pre-disaster planning is to ensure the involvement of all relevant national agencies, in order to produce a coordinated approach to post-disaster relief. Appropriate agencies must be designated upon the establishment of a public health task force whose objective is to plan and implement disaster preparedness actions in the public health sector.

A. Define appropriate national agencies

Those national agencies that are responsible for the provision of public health services under normal circumstances should be involved in the preparation of disaster mitigation plans. The precise list of agencies to be represented may vary from country to country, but logical candidates include:

- Ministry of Public Health;
- National Red Cross Society;
- National Water Board;
- Public Works Department;
- Ministry of Agriculture and Fisheries;
- Ministry of the Interior.

Government leaders should designate the appropriate national agencies concerned in each country, and ensure that those agencies appoint representatives to the public health task force.

B. Designate action groups

The public health task force can facilitate its broad task by designating technical action groups in a number of specific areas. Each team is required to undertake detailed planning in its specific area of competence and submit its contribution to the overall preparedness plan. The task force is subsequently required to piece

together the components of the overall plan in a standardized and integrated fashion. Appropriate teams should be created with the professional composition described below.

1. Epidemiologic surveillance team: The technical plan for monitoring health conditions should be carried out by an epidemiologic surveillance team. This team should consist of three or four professionals selected according to availability from among the following candidates:
 - the chief epidemiologic officer from the Ministry of Public Health;
 - communicable disease control officers from the Ministry of Public Health;
 - regional epidemiologists or medical directors;
 - epidemiologists from national university departments, research institutions, or international agencies.
2. Water supply team: A separate team should likewise be appointed to develop the technical plan concerning water supply. This team should consist of three or four professionals selected according to availability from among the following candidates:
 - the chief engineer from the National Water Board;
 - regional water supply directors;
 - water engineers from national university departments, research institutions or international agencies.

There may be overlap between members of this team and members of the sanitation control team.

4. Vector control team: The vector control team responsible for the technical plan concerning vector control may have a multi-disciplinary composition due to the particular nature of this area of concern. This team should consist of several professionals selected according to availability from among the following candidates:

- the chief vector control officer from the Ministry of Public Health;
- entomologists at the national and regional levels concerned with disease control, particularly malaria, dengue, etc.
- expert technicians from the National Water Board, Public Works Department, or Ministry of Agriculture and Fisheries;
- expert technicians from private sector pesticide manufacturers or distributors, assuming no serious conflict of interest occurs.

C. Develop action plans

1. Surveillance plans:

- a. Description and role. Epidemiologic surveillance is the continuing scrutiny of all aspects of the occurrence and spread of a disease that are pertinent to its effective control. In practice, this procedure requires that specific information be gathered that is critical for the rational planning, implementation, and evaluation of public health activities. Under normal conditions, national surveillance systems have already

been instituted in many countries, in order to monitor locally endemic communicable diseases of public health importance, some of which are notifiable, subject to international health regulations. Where surveillance does not exist, or where it is feared that the system may break down as a consequence of disaster (such as cutting of communications), a more focused, symptom-based surveillance system should be planned. Only where surveillance had been operational prior to a natural disaster will it be feasible to compare post-disaster disease trends with pre-disaster baseline data. Such comparative analysis is tremendously useful to the confirmation of suspected changes in disease rates and, hence, to rational decision-making concerning public health priorities.

b. Information needs.

- 1) Data on pre-disaster risk: Disaster preparedness planning will require a comprehensive compilation of regional information concerning disease endemicity and its relationship with socioeconomic status, geographic remoteness from health care services, vulnerable population groups, and health care resources (financial, human, and material) available to communities. Preferably, governments should develop and provide a compilation of this kind of information at the municipal level, coupled with brief reports derived from the ongoing national

disease surveillance of the population. A typical form for surveillance under normal conditions is presented in Table 3.

- 2) Data on post-disaster disease risk: The effect on natural disasters on communicable disease transmission in a given population, as noted above, depends upon the extent to which:
- normal public health programs, including vector control, may be disrupted;
 - homeless families may be housed temporarily in crowded accommodations;
 - existing public health services, particularly water supply and sanitation systems, may be cross-contaminated or destroyed.

Preparedness plans should include provision for the rapid survey assessment of these specific public health risks, in order to quantify the disruption generated in the wake of a natural disaster. Clearly this information will permit the establishment of post-disaster reconstruction and repair priorities according to public health needs. Further, it should permit prediction of the disease categories most likely to increase in incidence both in the short and long term. These data are essential to the implementation of disaster relief operations in the public health sector, maximizing the effective commitment and

Table 3: Example of Weekly Reporting Form
for Communicable Diseases

Health Region _____ Week ended _____

Disease and Category (International Classification of Diseases, 9th Revision)	Total for Week	Cumulative Total for Year
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Diseases Subject to the International
Health Regulations

Cholera (001)
Plague (020)
Yellow fever (060)
(Others as required)

Diseases under International Surveillance

Influenza (487)
Malaria (084)
(Others as required)

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 or National Interest

Typhoid fever (002.0)
Dengue (061)
Meningococcal infection (036)
Mosquito-borne viral encephalitis (062)
Other encephalitides (specify)
Other (specify)

deployment of scarce financial, human, and material resources.

- c. Determine surveillance procedures. As noted above, certain populations in the region may not currently be subject to national disease surveillance or, in particular cases, preparedness planners may predict that the existing system may break down as a consequence of a disaster. In such cases, a more focused, symptom-based surveillance procedure should be prepared in anticipation of a disaster.

Surveillance data may be provided by health professionals and relief workers operating private practices, public facilities such as health posts, health centers, and/or hospitals, or rapidly-organized periodic population surveys. The correct blend of information sources will depend upon the existing inventory of health care resources, particularly the distribution of health manpower throughout the affected communities. Certain informal sources of information from the field may also prove to be important.

Contingency plans should be prepared for the collection, compilation, and interpretation of surveillance data generated when these procedures become operational. Since the purpose of disease surveillance is to facilitate rational, information-based decision-making, it is critical that quality

interpretations of disease trends be forwarded to policy-makers promptly and in clear language. The epidemiologic surveillance team on the public health task force should be made responsible for interpretation of disease trends after a disaster.

- d. Establish surveillance reporting requirements. Data for both morbidity and mortality should be submitted at useful time intervals. The time period to be covered in each report will depend on the type and severity of the disaster and its presumed health effects, and the frequency with which the data will be analyzed. In a widespread disaster with a long recovery period, it may be advisable to have reports from an area submitted to regional level personnel, who will forward summaries to a central level. Whatever the system, data requested should be the minimum necessary, and have a clear purpose.

- 1) Morbidity: Where a sophisticated reporting system is in place, and most health facilities are staffed by physicians and other personnel trained in establishing diagnoses, morbidity reporting may be according to traditional disease classifications. Where community health workers or other paraprofessionals attend patients, or where laboratory facilities for confirmation of diagnoses are lacking, a more simplified, symptom-based classification may be more appropriate (see Table 4).

Table 4:

DISEASE SURVEILLANCE DAILY REPORT

Symptoms or clearly recognisable diseases

Health facility
or
relief team

Date:

	CASES		DEATHS	
	Under 15 yrs.	Over 15 yrs.	Under 15 yrs.	Over 15 yrs.
Fever (no diarrhea/cough) ¹	_____	_____	_____	_____
Fever with diarrhea ²	_____	_____	_____	_____
Fever with cough ³	_____	_____	_____	_____
Measles	_____	_____	_____	_____
Meningitis	_____	_____	_____	_____
Dog bite	_____	_____	_____	_____
Snake bite	_____	_____	_____	_____
Burns	_____	_____	_____	_____
Trauma	_____	_____	_____	_____
Protein-energy malnutrition	_____	_____	_____	_____
Other	_____	_____	_____	_____

Daily total

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Comments: _____

¹ Indicative of malaria, dengue

² Can be subdivided on basis of blood, mucus, vomiting

³ Indicative of respiratory infections

Either way, there should be clear instructions given as to what constitutes a "case", to avoid arbitrary classification of patients which would detract from the usefulness of the system.

- 2) Mortality: The same form as that designed to report morbidity may be used to report deaths. Useful information would include primary cause of deaths, where known, and age and sex of deceased.

- e. Pre-print necessary reporting forms. Once the necessary information and reporting period has been determined, supplies of the forms may be drafted, field-tested, reviewed, and printed. A reasonable supply should be distributed to each government health clinic or hospital, private physicians and other practitioners who would be expected to report. A list of these with the number of forms required for at least the first reporting period would need to be prepared prior to distribution.
- f. Train local personnel and distribute surveillance reporting forms. Everyone expected to use reporting forms must be instructed in their use. It may be possible to achieve this through written instructions distributed with the forms. However, it would probably be advisable to train at least one person in each region or large health facility in more depth. The most important factors to emphasize are consistency of classification and promptness of report completion.

Another value of training personnel is that it will motivate them to provide better information.

Surveillance systems under the best of circumstances may only detect a small percentage of actual cases of many diseases for a variety of reasons. Expectations for reporting should always be modest. Good relationships with field level staff will encourage unofficial communications that may fill gaps in the official reporting system.

- g. Identify public information needs and public awareness and information materials. A surveillance system involves not only the collection of data, but also appropriate feed-back to those who provide the information and to the general public. Misinformation is often spread informally via rumors or in the press regarding post-disaster disease occurrence. Every effort should be made to counter such threats by planning a public education campaign before the disaster strikes. Provision should be made for regular press releases giving accurate numbers of killed and injured as a result of a disaster, and major or unusual disease problems, if any. Forms summarizing collected surveillance data to be distributed to health care providers may also be prepared.
- h. Formalize plan. Once the information required to establish a post-disaster reporting system is available, it should be assembled into a formal written

plan. This plan should be distributed to members of the public health task force for discussion and review. The plan should be revised annually.

The plan should be prepared in the form of an Operations Handbook. The Handbook would set out responsibilities by agency and/or individual for each task. It would be organized in a logical time sequence so that activities to be carried out in each phase of a disaster relating to surveillance are grouped together and easy to follow. Needs for material, human, or financial resources at each phase would also be set out.

2. Water supply control plan:

- a. Description and role. The purpose of the disaster water supply plan is to minimize interruption in water supplies and to rapidly resume the provision of safe, adequate supplies should interruption indeed occur. The resumption of water services after a disaster is one of the most urgent public health actions facing relief workers.

Minimal human needs for drinking alone vary depending on climate and activity level, but usually average about one liter per person per day. However, beyond this survival ration, water is required for a wide variety of human activities, such as cooking, washing and bathing, each of which have public health consequences.

When water supply becomes limited after a disaster, preparedness plans should anticipate the provision for all domestic purposes of 15-20 liters per day.

- b. Information needs. To formulate a water plan, data should be compiled by the water control team on the general vulnerability of existing water supplies to different types of disasters. Information should also be collected on types and locations of water sources and distribution networks, on the identification of high-risk systems, existing engineering methodology for risk reduction, and so on.

- 1) Data on hazards: Disease transmission related to water may occur because of inadequate quality or quantity. Water-borne disease transmitted directly by water of poor microbiological quality of significance in developing countries include typhoid, cholera, and hepatitis. Many other diseases may be indirectly facilitated in their transmission when hygiene is reduced as a consequence of water shortage. These diseases include infections and infestations spread by fecal-oral contamination and certain skin diseases.

The frequency and distribution of the most significant water-related diseases should be compiled by the water supply team, and information on the role of water in disease control programs should be collected.

Health hazards from water may also result from chemical rather than microbiological contamination. While usually a less widespread problem in developing countries, major bodies of water with potentially harmful chemical content should be identified and placed off limits, in case victims seek alternate water indiscriminately after a disaster.

- 2) Data on water systems in use: The following information should be gathered for each major public water system:
- population served;
 - type of water source;
 - volume provided;
 - map of systems, lines and capacities;
 - pre-treatment quality;
 - type of equipment used for pumping and treatment;
 - details of treatment procedures;
 - supplies used for treatment, cost, availability, and source.

In addition, similar but less detailed information should be collected on private water systems which the public health task force might need to requisition as alternate public sources.

Data on the quality and annual availability of water in more remote bodies of water such as springs, lakes, or rivers which might be utilized in an

emergency, should be obtained from the relevant government ministries.

- 3) Data on threatened systems: A technical assessment should be made to determine which water systems are most threatened by disasters. Those systems that are more vulnerable because of the type of system, location, or dependence on fragile technology, should be listed. The number and location of water systems that might be damaged should be recorded according to the disaster type and severity.

- 4) Data on methods to counteract damage risk:

Adequate methods which may guarantee the provision of relatively safe water supplies after a disaster should be determined by the water supply team. In the event of microbiological contamination of a normally treated system, several technical methods are available to purify water at the municipal level, distribution point, or household. These include flushing systems through disinfection with various chemical agents, or boiling at home.

- c. Establish priorities. In the event of a disaster that affects major water systems, it is unlikely that it will be possible to restore complete service in a short time because of shortages of personnel and equipment. The prioritization of consumers or geographic regions should therefore be assigned in advance. For example, geographic

areas with higher population density would usually be considered higher priority.

Within larger geographical areas, institutional consumers, such as hospitals, schools, or military bases, must be given priority for quick restoration of water supply. The existence of a pre-arranged plan will help to avoid disputes that could occur in time of emergency.

- d. Explore disaster response alternatives. In the event of disaster, there are likely to be several approaches available for immediate solutions to water supply problems. These should be examined beforehand for feasibility.
 - 1) Emergency repair of damaged systems: Where damage to water systems is not too extensive and personnel and equipment are available, an adequate solution may be to immediately undertake repairs to the system to restore it to normal. This may be the most satisfactory solution in a system that serves a large population concentration, since it may be more difficult to find safe alternative sources for many people. Many systems may be partially closed off during repairs so that undamaged pipes may continue to function to provide water to part of the population.
 - 2) Emergency supply of water: In cases where water systems are heavily damaged, or where the population

is forced to move away from normal water sources, it may be necessary to establish emergency water distribution systems. The sources for emergency supply may be undamaged private systems, springs, or wells or, as a last resort, surface water. An inventory of other major available water sources in each geographic area should be compiled, including information on quality (microbiological, chemical, and appearance), quantity (liters/minute or other measure) and accessibility.

In addition, detailed information on how water could be distributed from these sources should be acquired. Equipment, personnel, and supplies needed, for example, to drill wells or protect springs, should be ascertained. In addition, equipment, including tanker trucks where necessary, personnel, and fuel to distribute the water to the affected population, should be estimated.

- 3) Emergency purification: Plans to purify water after a disaster must also be investigated. Where consumers are accustomed to high microbiological quality of water, this should be re-established as quickly as possible after the disaster. Disinfection of flooded water supply systems may be achieved by flushing them and using a strong chlorine solution.

During the time period required for this operation, alternate supplies may be disinfected by chemical treatment with a variety of chlorine compounds. Equipment for emergency disinfection of municipal supplies is available for post-disaster situations, and improvised chlorinators may be possible in some situations. The choice of methods, supplies, and equipment as alternatives for each water system should be determined in advance. It should be noted that water purification tablets have little demonstrated effect as a disinfectant and should not be considered a safe alternative to other methods.

A health education program for the public on safe water in the event of disaster should also be prepared. This would include information on advisability of disinfection of doubtful supplies of drinking water by boiling or chemicals in the home, choosing safe supplies where possible, and so on.

- 4) Emergency desalinization of wells: Plans for emergency desalinization of fresh water wells contaminated as a result of a storm surge must also be made. Lists of equipment, supplies, and methods for this activity are available.

e. Identify actions that can be taken before a disaster.

It may be possible to undertake some activities before a disaster strikes that mitigate its effects by minimizing the time necessary to re-establish functioning water systems.

1) Prepositioning of equipment, materials, or supplies:

It should be possible to ensure that critical items are located in proximity to high priority geographic regions and/or near priority public facilities, for example, by placing an emergency pump at a hospital with a well that may be used if the municipal supply is cut off. This is especially critical where a disaster would be likely to affect normal transportation routes, or where transportation may be requisitioned for other purposes at the time of the disaster.

2) Stockpiling of supplies: There is a case for

stockpiling supplies of items that are normally used but may be difficult to replace immediately following a disaster, and items that are not normally used but would be needed in the event of a disaster. Chemicals for water treatment, replacement pipe fittings, and pump fuel may be examples of the first category; family water carriers or storage containers and iodine tablets may be examples of the latter.

Appropriate storage facilities in the areas likely to need them, and storage methods to prevent their damage during disaster, are required.

Stockpiling of emergency supplies of water is also a possibility. Obviously, dams and community water tanks already represent one way of accomplishing this. The possibility of other storage methods which are less susceptible to disasters should be investigated. These may include, for example, underground earthquake-resistant tanks for capturing rainwater.

- 3) Strengthening storage systems: Where water storage facilities already exist, it is desirable to ensure that these are capable of withstanding the types of disasters likely to occur. Engineering analyses of major structures should be undertaken, and strengthening of facilities where necessary.

- f. Form and train reaction teams. Key qualified individuals should be selected and trained to go into action as soon as a disaster has been predicted or actually occurs. The team should be known to each other and have complementary skills. Contact phone numbers and addresses should be provided to each. Training of the teams may be done in seminars, through distribution of reading materials, and through simulation drills, where feasible.

- 1) Disaster assessment team: This team will be required to assimilate all information available on damage to water supply systems through second-hand reports and site visits to the disaster area.
- 2) Emergency repair team: A team of technical experts should be prepared to leave for the field with

very little notice, to carry out repairs to water systems themselves, implement use of alternative systems where necessary, and supervise other workers. The members of this team should have recent on-site experience with the water systems most commonly used.

- 3) Water testing team: Where no structural damage has been observed in water systems, or where alternate water supply has been implemented, analysis of the microbiological (and in some cases, chemical) quality of water being provided in a disaster area should be carried out as quickly as possible. The team will work closely with the water repair team, where these are dispatched to the same area. The water testing team should be accustomed to the use of rapid field methods in the event usual laboratories are not functioning, and must have access to items stockpiled particularly for this purpose as soon as possible. Routine water surveillance procedures should be implemented when feasible.

- g. Prepare a written plan. The above information should be assimilated into a written plan to be used as a guideline for water supply operations in the event of a disaster. Copies of the plan should be submitted to all members of the water supply action group and other interested parties. Discussion and revision should be encouraged.

The plan should be prepared in the form of an Operations Handbook. The Handbook would set out responsibilities for each agency and/or individual for each water-related task in case of emergency. It would be organized in a logical time sequence so that activities to be carried out in each phase of a disaster relating to surveillance are grouped together and easy to follow. Needs for material, human, or financial resources at each phase would be set out.

3. Sanitation control plan

- a. Description and role. The purpose of a sanitation control plan is to minimize disruption to current sanitation programs following disasters, to re-establish disrupted systems as rapidly as possible, and to provide interim sanitation facilities when necessary. (Sanitation here will refer primarily to human waste disposal.)

Adequate sanitation programs are critical public health tools that prevent the transmission of fecal-oral diseases, such as many diarrheal diseases. In addition, good sanitation discourages flies and other pests. A clean environment carries the additional benefit of psychological well-being.

- b. Information needs. To develop an adequate sanitation control plan, information is necessary concerning the types of sanitation facilities in use; the agency responsible for their maintenance, if any; what

equipment, materials, and supplies are necessary for their functioning and repair; and how they might be affected in a disaster.

1) Data on hazards and how they threaten sanitation:

Health hazards related to sanitation are mostly communicable diseases which may be spread from feces by contamination of water or food. Transmission may be by vectors, lack of human hygiene, cross-contamination through sewer and water lines, or through the direct use of feces as fertilizer for agricultural crops.

The significant diseases related to sanitation in each country should be identified, and their most common mode of transmission documented. In addition, information on how their spread may be affected due to breakdown of normal sanitation systems should be compiled.

2) Data on sanitation systems in use: There are a wide variety of sanitation systems in use in developing countries, including sewerage flush toilets, septic tanks, and latrines. The types in use in each country should be identified, along with their geographic distribution, population served, maintenance requirements, and likelihood of disruption following a disaster.

3) Data on threatened systems: More detailed information should be obtained on those systems likely to be

disrupted in the event of a disaster. This would include the number of units likely to be affected, population served, location, etc.

4) Data on methods to counteract threats:

Information should be collected on methods to counteract public health threats in the event of a breakdown in sanitation systems. Clearly, the institution of projects of health education to the general public on the need to avoid spreading disease should be considered.

- c. Establish priorities. It will be necessary to decide which geographic areas and which specific sanitation systems will receive priority in a post-disaster situation. Since lack of excreta disposal facilities may have a larger public health impact in an area of greater population density, priority should be given to these areas. An area may be assigned a higher priority because the prevalence of diseases of fecal-oral transmission is known to be high, or it may be assumed that an urban population accustomed to modern sanitation would have reduced gastrointestinal resistance resulting in more acute disease. In addition, the repair of a municipal sewer system is likely to be more important than on-site disposal systems because the area of possible contamination of the former is greater. Once priorities are established, they should be strictly adhered to following a disaster, in order to avoid disputes.

d. Explore disaster response alternatives. There are usually several alternative responses to be considered for post-disaster action.

- 1) Emergency repair of damaged systems: It may be possible to rapidly repair systems, or parts of systems, following a disaster. The likelihood of various types of damage according to disaster type and severity, together with probable requirements of personnel, equipment, and supplies, should be considered to determine if post-disaster repair would be feasible.
- 2) Emergency sanitation system alternatives: In the event that public systems are damaged and cannot rapidly be made operable, alternative systems are available, and their suitability in various situations in each country should be assessed. Alternatives include portable chemical toilets, rapid installation of communal pit latrines, aqua-privies, etc. Each of these is associated with specific installation times and financial, human, and material requirements.
- 3) Emergency clean-up activities: It may be necessary to organize clean-up activities following disasters that destroy sewer lines or septic tanks. Responsibility for such activities must be determined in advance, as well as equipment, materials, and personnel needs. Clean-up

activities would need to be closely coordinated with water and vector control teams to avoid duplication of efforts.

4) Emergency monitoring and testing of systems:

Emergency procedures for examining the functioning of sanitation systems should be established by the water supply team. These should be closely coordinated with emergency procedures for surveillance of water quality, since problems with sanitation systems may manifest themselves in the form of the deterioration of water quality. This is especially true where waste water is recycled and released into sources of drinking water.

e. Identify actions that can be taken before a disaster.

Based on an assessment of likely responses following the disaster, activities that may be undertaken beforehand to mitigate its effects should be identified.

1) Stockpiling and prepositioning of supplies, materials,

and equipment: A reasonable supply of items that would be required to maintain the functioning of major sanitation systems under normal circumstances should be stored in anticipation of disaster. In addition, the advisability of storing items which might be needed for emergency repair or installation of sanitary facilities should be examined. A technical decision on which items to stockpile should

be made on the basis of projected needs, their cost, storage requirements, availability, procurement sources, and so on.

The location of storage facilities should also be examined. It may be sensible to preposition some items safely in the area where they will most likely be needed, rather than in a distant central warehouse.

- 2) Replacement of vulnerable systems: Where an examination of the sanitation systems currently installed in a country reveals that certain systems are vulnerable to severe damage in some types of disasters, the feasibility of their replacement should be determined. Some systems may never have been suitable for the particular environment in which they are installed. Others may be partially vulnerable because of the quality of materials used or their location. A gradual program to replace or up-grade systems may be feasible in some countries.
 - 3) Protection of facilities: Where it is not possible to replace vulnerable systems, it may be possible to protect them against damage from some disasters, for example, by building reinforced retaining walls around sewage treatment plants.
- f. Form and train reaction teams. Two teams should be selected and trained in a manner similar to the

water supply control reaction teams:

- 1) Disaster assessment team
- 2) Emergency repairs team

- g. Prepare a written plan. An emergency Operations Handbook should be prepared in the same manner as for the water supply control team.

4. Vector control plan

Many diseases of concern to public health in developing countries are vector-borne, that is, they are transmitted to man by a vector by biological or mechanical means. Common vectors are mosquitoes, flies, fleas, and lice. Rodents are considered vectors since they may harbor fleas or lice, but they do not assist directly in the transmission of disease. The vector of greatest public health significance to the South Pacific region is probably the mosquito, the vector for both malaria and dengue.

Vector control programs therefore form an integral part of disease eradication or control programs. On the other hand, fly or rodent control programs may be carried out primarily because of the nuisance value of the pest.

- a. Description and role. The purpose of a vector control plan is to establish guidelines for the prompt resumption of existing programs which may be disrupted after a natural disaster. This plan should facilitate the vector control team in moving quickly to contain vector-related problems occurring as a consequence of disaster. The plan should therefore contain a

detailed analysis of priority areas of concern, what actions will be taken under particular circumstances, what manpower must be made available to take responsibility for such actions, and what equipment and supplies should be stockpiled in anticipation of disaster.

b. Information needs.

- 1) Data on endemic vectors and the potential effects of disasters: The vector control team should gather from the appropriate national agencies current information on vectors and vector-borne diseases in the country, with emphasis on those of major public health significance. The information should include a list of the endemic vector-borne diseases, the vector responsible, its natural habitat, and geographic distribution. The team should then determine the most likely effect of each type of natural disaster on the population and behavior of each vector.

It should be remembered that the effect may vary with disaster severity and the time elapsed since impact, so plans should take these variations into account. For example, the immediate effect of flooding may be to disturb the breeding grounds of certain mosquito species due to the rapid influx of flood water. The long-term effect, however, as

the waters recede is generally to leave more standing water which provides the mosquitoes with additional breeding sites.

- 2) Data on vector control methods in use: Information on existing vector control programs should be obtained from the agencies carrying them out. The data required include the organization of programs, personnel job descriptions, details of pesticides in use (frequency of application, cost, availability, and source), equipment in use, equipment maintenance, transportation facilities, fuel and other support equipment, spare parts, and related supplies.
- 3) Data on alternative methods and materials: Information should be accumulated on alternative pesticides that are technically acceptable in case of shortage, and on alternative suppliers of essential equipment and supplies. It would also be useful to gather information concerning other methods of controlling vectors that were used previously in that country, and their relative efficacy. Post-disaster experience with alternative methods used in neighboring countries should be brought to bear if possible on the development of the preparedness plan. Such information may reveal if current vector control methods are subject to excessive disruption as a consequence of certain natural disasters.

- c. Estimate potential losses of supplies and equipment in a disaster. The quantity and type of supplies and equipment that may be lost in a disaster depend on the type of disaster and the severity. Losses may also depend on the vulnerability of the supplies and equipment to damage because of storage or maintenance requirements and location. Estimates of the potential losses of necessary vector control materials should be made on the basis of the likelihood of various types of disasters striking in various geographic areas.
- d. Establish potential for contamination from damaged supplies. Some disasters may turn vector control chemicals into public health hazards in themselves if they are inadvertently released into the environment. For each type of pesticide or other chemical used in vector control, the potential for contamination should be known. The information required will be a listing of all potentially dangerous chemicals stored, their quantities, how packaged, and effects of each disaster on packaging. A review should then be made of the areas and populations which might be affected, possible harmful effects, ways of measuring these effects, and possibilities for mitigating or preventing these effects.
- e. Establish priorities (by geographic area and hazard). Priority areas for vector control activities after a disaster should be established on the basis of

existing disease prevalence rates and the potential risk of increases following particular types of disaster. Geographic areas may be singled out for priority because of high human and/or vector population density or special characteristics, such as those regions where resistance either to treatment of illness or chemical spraying of the vector has occurred or is suspected. Particular vector control programs may be singled out for attention because of the severity of the disease or potential for rapid spread. The priority areas may be determined using maps constructed to illustrate the incidence or prevalence rates of vector-borne disease and including data concerning estimated vector populations and vector control activities.

f. Explore disaster response activities. Vector control programs usually aim at reducing the vector population by killing adults or larvae, by destroying potential breeding sites, limiting access to food, or reducing opportunities for contact with humans.

1) Chemical suppression: The appropriateness of chemical suppression of vectors following a disaster will depend on pre-disaster control activities, destruction of supplies and equipment, maintenance of communications and transportation, and availability of personnel. A disaster plan which relies on spraying or similar activities

will have to be developed taking all of these factors into consideration. The quantities of supplies and personnel required, alternative sources and costs should be calculated, and responsibility for carrying out the activities should be assigned in advance.

- 2) Rapid drainage of standing water: Following disasters such as floods that leave standing water, the opportunity for mosquitoes to breed may increase, and this is especially critical in areas with high malarial endemicity. The vector control plan should therefore include ways to identify potential breeding sites, and practical ways to rapidly drain standing water. This plan may involve an educational component, including the use of mass media, to enlist the public's assistance in identification and drainage of potential breeding sites.
- 3) Rapid debris clearance: Following many types of disaster, such as earthquakes, refuse from destroyed buildings may accumulate. Such debris may represent a public health hazard if rodents are attracted to the area, since rodents may be hosts of various disease vectors. Pre-disaster planning efforts should therefore include debris clearance as a possible disaster response activity. Again, possible ways to involve the

community safely in such activities should be explored.

4) Denial of access to vectors' food supply:

Another strategy for vector control after disasters is to deny vectors access to their food supply. In the case of mosquitoes, this involves protecting people from contact with the vectors. To do so may mean taking the same types of precaution as in pre-disaster situations, such as screens on openings in temporary housing, use of mosquito nets for sleeping, avoidance of outdoor activity at swarm times, etc. The mosquitoes will still have access to food in other animals' blood, however.

For the control of flies and rodents, it will be necessary to re-establish adequate garbage and other waste disposal facilities as soon as possible. This includes the rapid repair of damaged sewer lines and latrines. Disaster plans should contemplate personnel, equipment, and supplies required for all these activities.

g. Identify actions that can be taken before a disaster.

- 1) Protection of supplies: After supplies and equipment are inventoried, special efforts may be made to protect the most crucial items from the types of disasters likely to occur. This may include special packaging of insecticides to

protect against water damage, or decentralization of storage so that it is less likely that all supplies would be destroyed at once.

- 2) Prepositioning (and protection) of supplies and equipment: Since high risk areas where vector control efforts will have to be directed should have been identified, it would make sense to ensure that these areas have adequate supplies and equipment already in place to continue or begin appropriate activities following a disaster. This is especially important where transportation and communication facilities may be damaged. Supplies and equipment intended for later use in a particular area may be more effectively stored there than in a central warehouse.
- 3) Stockpiling supplies: For some supplies, it may be appropriate to increase the quantity usually stored in order to have a surplus available in case of disaster. The desirability of doing so would depend on the cost, the shelf-life, bulkiness, whether it could be packaged to withstand disaster, local availability, time required to obtain it from other sources should a disaster affect local sources, and difficulties of transport. Each item usually necessary for maintaining vector control programs should be examined in this light. Quantities should be determined according to use over a time

period when it would be likely to be difficult to acquire more, based on amounts used in normal programs and those additional amounts estimated to be necessary for post-disaster programs.

- h. Form and train reaction teams. Those individuals who will be the first to respond in a disaster should be designated and appropriately trained. It is assumed they will already have the necessary skills and qualifications for the positions. Additional disaster preparedness training may be provided in seminars, appropriate reading materials, drills, and simulation activities.

1) Disaster assessment team: The major task of the disaster assessment team will be to gather and evaluate information on the extent of the disaster as it relates to vector control. This will include estimates of damage to supplies, equipment, personnel, and vehicles needed to carry out usual activities. It will also require an assessment of increased risk of disease transmission by vectors due to change of breeding sites, population movements, breakdown of sanitation or water systems, etc.

2) Emergency vector control team: An emergency team should be prepared to undertake vector control activities immediately if the disaster assessment team determines that action is necessary. The

team should be assigned adequate transportation, equipment, and supplies necessary to perform independently. Its efforts should be closely integrated with other teams formed by the Public Health Task Force.

- i. Prepare a written plan. Once all the necessary information has been acquired to formulate a vector control plan, a formal, written plan should be developed by the vector control team. This should be submitted to the Public Health Task Force and other interested individuals for discussion. Periodic revisions should be made, where necessary.

The plan should be in the form of an Operations Handbook, similar to that described for water supply control and sanitation control.

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