

## CHAPTER 8.

# ENVIRONMENTAL HEALTH MANAGEMENT

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### PRIORITY AREAS FOR INTERVENTION

The continuation or quick rehabilitation of effective environmental health services is of primary importance in emergency health management after the onset of a natural disaster. First consideration should be given to areas where health risks have increased. These are areas with high population densities and severe disruption of services. Secondary priority areas are those with high population densities and moderate disruption, or those with moderate densities with severe disruption. Third priority should be given to areas with low population density and minor disruption of services.

Areas with high population densities are urban areas and their peripheries, camps for refugees and displaced persons, and temporary settlements. Hospitals and health clinics are among the facilities needing priority environmental health services.

Shelters are, by definition, short-term accommodations where the affected population can sit out the event—a hurricane, for example—and return to their homes as soon as possible. Such facilities are not designed to provide the required basic services for hundreds of people for prolonged periods. However, experience has shown that shelters remain occupied long after the event, preventing the resumption of the facility's normal operation.

Temporary camp settlements often create areas of extremely high population density where suitable services may be absent. Lack of water and basic sanitation facilities lowers the existing level of hygiene and increases the risk of communicable diseases. Diseases that are endemic in the areas of origin, transit, and settlement of displaced populations are of special concern. The International Federation of Red Cross and Red Crescent Societies (IFRC) reports that up to 50% of deaths among displaced people are caused by water-borne diseases. In selecting sites for temporary settlements, it is critical to ensure that the camp has access to a dependable water supply and other environmental health services.

### Priority Environmental Health Services

Primary consideration should be given to services essential for protecting and ensuring the well-being of the people in high risk areas, with emphasis on prevention and control of communicable diseases. Post-disaster environmental health measures can be divided into two priorities:

1. Ensuring that there are adequate amounts of safe drinking water; basic sanitation facilities; disposal of excreta, wastewater, and solid wastes; and adequate shelter.
2. Providing food protection measures, establishing or continuing vector control measures, and promoting personal hygiene.

A checklist of possible disruptions in environmental health services is presented in Table 8.1.

The following actions are recommended to quickly re-establish adequate environmental health services and conditions:

1. Obtain information on population movements in or near stricken areas and map the location of camps for refugees and displaced persons, partially and/or totally evacuated areas, relief worker settlements, and hospitals and other

**TABLE 8.1. Natural disaster effects matrix.**

Most common effects of specific events on environmental health		Earthquake	Hurricane	Flood	Tsunami	Volcanic eruption
Water supply and wastewater disposal	Damage to civil engineering structures	1	1	1	3	1
	Broken mains	1	2	2	1	1
	Damage to water sources	1	2	2	3	1
	Power outages	1	1	2	2	1
	Contamination (biological or chemical)	2	1	1	1	1
	Transportation failures	1	1	1	2	1
	Personnel shortages	1	2	2	3	1
	System overload (due to population shifts)	3	1	1	3	1
Equipment, parts, and supply shortages	1	1	1	2	1	
Solid waste handling	Damage to civil engineering structures	1	2	2	3	1
	Transportation failures	1	1	1	2	1
	Equipment shortages	1	1	1	2	1
	Personnel shortages	1	1	1	3	1
	Water, soil, and air pollution	1	1	1	2	1
Food handling	Spoilage of refrigerated foods	1	1	2	2	1
	Damage to food preparation facilities	1	1	2	3	1
	Transportation failures	1	1	1	2	1
	Power outages	1	1	1	3	1
	Flooding of facilities	3	1	1	1	3
	Contamination/degradation of relief supplies	2	1	1	2	1
Vector control	Proliferation of vector breeding sites	1	1	1	1	3
	Increase in human/vector contacts	1	1	1	2	1
	Disruption of vector-borne disease control programs	1	1	1	1	1
Home sanitation	Destruction or damage to structures	1	1	1	1	1
	Contamination of water and food	2	2	1	2	1
	Disruption of power, heating, fuel, water, or supply waste disposal services	1	1	1	2	1
	Overcrowding	3	3	3	3	2

1— Severe possible effect

2— Less severe possible effect

3— Least or no possible effect

medical facilities. This information will assist in determining which localities need priority attention.

2. Carry out rapid assessments to determine the extent of damage to the public water supply and waste disposal systems and the food production, storage, and distribution networks.
3. Determine the remaining operational capacity for delivering these basic environmental health services.
4. Make an inventory of available resources, including undamaged food stocks, human resources, and readily available equipment, materials, and supplies.
5. Determine the stricken population's immediate needs for water, basic sanitation, housing, and food.
6. Meet the needs of essential facilities as quickly as possible after basic human consumption needs are satisfied. Hospitals and other medical facilities may need increased water supplies if there are numerous casualties.
7. Ensure that refugees and displaced persons are properly housed and that the temporary settlements and other identified high risk areas have basic environmental health services.

For the efficient use of overburdened resources, it is important to immediately and accurately assess damages and identify needs for repair. Reports of damage and needs should include the following information:

1. Type, location, and extent of damage;
2. Accessibility and required means of transport to site of damage;
3. Remaining operational capacity;
4. Estimate of resources needed for repairs (personnel, equipment, and materials);
5. Estimated repair time.

Rapid assessment will assist in identifying resources required to restore the system immediately. If a list of needs is to be submitted to the donor community, it should be compiled quickly. Donor response is generally high in the days following a disaster, but soon subsides.

### **Human Resources**

The unavailability of environmental health specialists will be a limiting factor when managing an emergency situation. Experts unfamiliar with local conditions and local environmental health services might misjudge priorities. First consideration should therefore be given to using locally available manpower. The local population should be actively encouraged to assist in providing needed resources and services. It should be clear that all immediate or short-term activities are directed to restoring pre-disaster services and not to making improvements beyond the pre-existing level. Nevertheless, the rehabilitation phase of the emergency provides an excellent opportunity to assess vulnerability of the water supply and sanitation system, and to carry out measures that will mitigate the effects of future events on water supply.

## WATER SUPPLY

A survey of all public water supplies will have to be made, beginning with the distribution system and advancing to the water source. It is essential to determine physical integrity of system components, the remaining capacities, and bacteriological and chemical quality of the water supplied.

The main public safety aspect of water quality is microbial contamination. The first priority for ensuring water quality in emergency situations is chlorination; it is the best means for disinfection and emergency treatment of water because of its effectiveness, cost, and availability.

It is advisable to increase residual chlorine levels and raise water pressure as part of the relief operations. Low water pressure will increase the likelihood of infiltration of pollutants into water mains. Repaired mains, reservoirs, and other units require cleaning and disinfection.

A minimum free residual chlorine level of 0.7 mg/l is recommended in emergency situations. Routine testing of residual chlorine should start immediately with simple residual chlorine test kits and should continue well into the rehabilitation phase. In the absence of test kits, check if water has a distinct chlorine smell. Microbial contamination is likely if tests indicate the absence of residual chlorine in drinking water, unless bacteriological analyses prove otherwise. However, such analysis requires long periods of incubation (at least 8–24 hours), while residual chlorine levels can be measured in the field in a few minutes.

Chemical contamination and toxicity are a second concern in water quality and potential chemical contaminants have to be identified and analyzed. If there is justified concern that the water source is contaminated with toxic substances from a spill or heavy metals from volcanic activity, alternative water sources should be sought.

### Alternative Water Sources

In general order of preference, consideration should be given to the following alternative water sources:

1. Deep groundwater;
2. Shallow groundwater and spring water;
3. Rain water;
4. Surface water.

Private water supply sources belonging to dairies, breweries, food and beverage plants, tourist resorts, and other industrial and agricultural developments often exist in the vicinity of a disaster stricken community. Pre-emergency arrangements with the owners of these systems will facilitate the use of the source in case of emergency.

Sources located near and/or downstream from sewage outfalls, chemical plants, abandoned or operational solid waste disposal sites, abandoned or operating mines, and any other hazardous sites should be considered suspect until an environmental health specialist familiar with the local conditions recommends otherwise.

Existing and new water sources require the following protection measures:

1. Restrict access by people and animals. If necessary, erect a fence and appoint a guard;
2. Ensure adequate excreta disposal at a safe distance from the water source;
3. Prohibit bathing, washing, and animal husbandry upstream of intake points in rivers and streams;
4. Upgrade wells to ensure they are protected from contamination. Include proper drainage of spilled water into a soak pit at a safe distance from the well opening;
5. Estimate the maximum yield of wells; over-extraction might bring about saline intrusion (in coastal areas) or cause the well to dry up. If necessary, ration the water supply.

In many emergency situations, water has to be trucked to disaster stricken areas or camps. Water tankers may be obtained locally from commercial water delivery companies, dairies, breweries, bottling plants, etc. All trucks should be inspected to determine fitness, and cleaned and disinfected before transporting water. As a rule, gasoline, chemical, and sewage trucks should not be used.

One of the reasons for recommending a higher residual chlorine level in disaster situations is to provide extra disinfection capacity to control contamination in temporary open storage tanks (primarily inflatable rubber). Risk of contamination of these tanks can be significantly reduced by providing a tap (if possible) or siphon to allow direct withdrawal of the water from near the bottom of the reservoir rather than "dipping" and possibly contaminating the tank. When such a tap or siphon is installed the reservoir can also be covered (e.g., with plastic sheeting). Closed water bladders should be given priority when ordering water reservoirs for emergency situations to circumvent the risk of outside contamination.

If *locally available*, mobile water purification equipment may be used in emergencies. However, such plants require skilled operators, auxiliary power, and maintenance and repair facilities, and they only produce limited amounts of drinking water. Extreme caution should be taken before requesting mobile equipment as part of emergency supplies. Experience shows many failures because imported equipment was not suited for the conditions at the disaster site. Shipment of mobile treatment plants always has low priority because they are expensive, bulky, and occupy valuable space.

### **Mass Distribution of Disinfectants**

The mass distribution of tablets, powder, or liquid disinfectants should only be considered in these conditions:

1. Affected persons have experience in their use;
2. Affected persons can receive training in their use immediately after the event through a vigorous education campaign;
3. Appropriate water storage containers are distributed;
4. Public health or community health workers assist in ensuring the appropriate and continued use of the tablets;

5. A distribution network is in place to ensure a proper and continuous supply as needed throughout the emergency phase and in the early rehabilitation phase.

In general, individuals in small and controlled groups may be given such disinfectants to purify small amounts of drinking water for one or two weeks. Every effort should be made to restore normal chlorination, and to protect individual wells and storage reservoirs. This can be accomplished by sealing cracks in well casings and reservoir roofs, providing adequate drainage around wells, and roofing reservoirs.

## **FOOD SAFETY**

Poor hygiene is the major cause of food-borne illness in disaster situations. Where feeding programs are used, as in shelters or camps, kitchen sanitation is of utmost importance. Utensils must be washed in boiled or treated water, and personal hygiene should be monitored in individuals involved in food preparation.

Food supplies should be stored in containers that will prevent contamination by rodents or insects. Refrigeration may have to be improvised.

## **BASIC SANITATION AND PERSONAL HYGIENE**

Many communicable diseases are spread through fecal contamination of drinking water and food. Therefore, every effort should be made to ensure the sanitary disposal of excreta. Emergency latrines should be made available to the displaced, refugees, relief workers, and residents in areas where toilet facilities have been destroyed. Even if toilets are physically intact, they cannot be flushed without a water supply. Lime should be used in communal trench latrines to reduce the development of methane gas and odors. If no sanitation facilities are available, people should bury their excreta.

Personal hygiene tends to decline after natural disasters, especially in densely populated areas and where there are water shortages. The following measures are recommended:

1. Provide basic hand washing facilities (shelters, temporary settlements and camps);
2. Provide washing, cleaning, and bathing facilities (camps for refugees and displaced persons);
3. Make adequate amounts of water available (disaster stricken areas and camps for refugees and displaced persons);
4. Avoid overcrowding in sleeping quarters;
5. Launch education campaigns on personal hygiene, basic sanitation, and waste management.

Wastewater from camps for refugees and displaced persons, field hospitals, feeding centers, washing facilities, etc., requires proper disposal. The most common means is through a soak away, seepage pit, or absorption trench.

## **SOLID WASTE MANAGEMENT**

Solid waste management often poses a special problem in emergency situations. In the aftermath of disasters authorities not only have to deal with refuse and garbage, but also with debris from buildings, utilities, trees, plants, and dead animals. The rapid commencement of debris removal is very important for the rehabilitation efforts. Clearing roads, for example, not only re-establishes access routes, but has a positive psychological impact on the population.

Sanitary disposal of refuse and other waste is also the most effective way to control vector-borne diseases. Garbage collection should be re-established as soon as possible in stricken areas. Burying or burning organic solid waste is recommended and open dumping should be avoided. Carcasses awaiting burial should be sprinkled with kerosene to protect them from predatory animals. Burning large carcasses is difficult unless special incinerators are built, which require huge amounts of fuel.

Heavy equipment will be necessary for debris removal, solid waste collection, and operation of the disposal site. Pre-emergency arrangements with private equipment owners may facilitate their services. The general public should be advised on sanitary waste handling where no services can be provided (such as burning or burying refuse in yards).

Established disposal sites might be inaccessible or unusable for a prolonged period, and new sites may have to be established. Great care must be taken in selecting these sites, since once disposal commences in an area, it often becomes a permanent dump site. Building debris can be used to improve access roads or in other areas where in-fill is needed. Other bulky materials should be flattened using bulldozers, if available.

Special care must be taken when disposing of hazardous materials (e.g., damaged high voltage transformers containing PCBs). Potentially hazardous waste must be safely stored in a place where it can be retrieved later for proper identification, recovery, treatment, and/or disposal.

## **VECTOR CONTROL**

Control programs for vector-borne diseases should be intensified in the emergency and rehabilitation period, especially in areas where such diseases are known to be endemic. Of special concern in emergency situations are: leptospirosis and rat bite fever (rats), dengue fever and malaria (mosquitoes), typhus (lice, fleas), and plague (fleas). In flooded areas rats will escape their burrows in search for dry hiding places, often in dwellings. Flood waters provide ample breeding opportunities for mosquitoes. Dead animals and other organic waste provide food for rats and other vectors.

The following are essential emergency vector control measures:

1. Resume collection and sanitary disposal of refuse as soon as possible;
2. Conduct public education campaigns to eliminate vector breeding sites in and near the home and on measures to prevent infection, including personal hygiene;

3. Survey camps and densely populated areas to identify potential mosquito, rodent, and other vector breeding sites;
4. Eliminate vector breeding sites permanently by draining and/or filling in pools, ponds, and swamps; overturning or removing receptacles; covering water reservoirs; and carrying out sanitary disposal of refuse;
5. Resume indoor spraying if used earlier as a routine control method in flooded areas;
6. In areas where typhus is known to exist, apply residual insecticide powder to louse-infested persons, their clothing, and bedding in camps and temporary settlements (use DDT or Lindane, or alternatively, Malathion or Carbaryl, depending on local resistant strains);
7. Store food in enclosed and protected areas.

Well-organized control of mosquito breeding sites greatly reduces the need for outdoor spraying, but if surveys show it is needed, local resources should be employed. Consideration should be given to the high cost of outdoor spraying and its limited benefits.

Vector control measures should be associated with other health measures, such as malaria chemoprophylaxis, to reduce or eliminate the risk of infection.

Successfully controlling houseflies and rodents is nearly impossible in the early aftermath of a natural disaster. The only acceptable measures against such pests are environmental sanitation and personal hygiene.

## **BURIAL OF THE DEAD**

The health hazards associated with cadavers are minimal. Especially if death resulted from trauma, corpses are quite unlikely to cause outbreaks of disease such as typhoid fever, cholera, or plague. If human bodies contaminate streams, wells, or other water sources, they may transmit gastroenteritis or food poisoning syndrome to survivors.

Despite the negligible health risks, dead bodies represent a delicate social problem. The normal local method of burial or cremation should be used whenever possible. Burial is simplest and the best method if it is ritually acceptable and physically possible. Cremation is not justified on health grounds and mass cremation requires large amounts of fuel.

Before burial or cremation, bodies must be identified and the identification recorded. In many countries, certification of death or an autopsy must precede the disposal of the body. Incorporating a waiver paragraph into legislation governing disaster situations should be considered.

## **PUBLIC INFORMATION AND THE MEDIA**

Besides specific measures already mentioned, public information should be disseminated about available environmental health services and resources, their location, and which authorities should be notified of specific problems. This helps the public to understand the extent of the emergency, reduces confusion, and improves the effectiveness of emergency environmental health activities.

The media will play an important role in providing such information to the public. It is essential that authorities and media practitioners have a common understanding of the objectives of information distribution as well as their respective roles in the disaster. Pre-emergency meetings or seminars to clarify these roles and responsibilities are strongly recommended.