Post-Disaster Infectious Disease Management

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Objectives

By the conclusion of this session, you should be able to:

- Define the different concepts of communicable disease occurrence after a disaster.
- Identify the different modes of transmission of communicable diseases.
- List the causative factors in developing communicable diseases following disasters.
- Describe the management concepts of infectious disease after disasters.
- Describe different health interventions in managing infectious diseases.

Note: It is not the goal of this session to address infectious disease prevention and management for team members. That issue is addressed in the Preventive Medicine session of this training program. We assume that disaster responders will know the contents of that session well, and will additionally practice on the disaster site the same universal precautions they use in their daily clinical practice.

Definitions

An **epidemic** is defined as the occurrence in a community or region of a group of diseases of similar nature, clearly in excess of normal expectancy, and derived from a common or propagated source. If a disease has habitual presence within a geographical area, it is considered to be **endemic**. The term endemic may also refer to the usual occurrence of a disease within an area. **Pandemic** refers to a worldwide epidemic.

Similarly, **outbreak** refers to a sudden and rapid increase in the number of cases of a disease in a certain population and is usually limited to people who share common exposure to the disease. Sometimes it is often used interchangeably with epidemics to demonstrate public health concerns.

Incidence refers to the number of *new* cases of a disease in a specific population within a specified time period, whereas **prevalence** refers to the total number of cases of a disease within a population at a specific point of time. Therefore, prevalence shows the total disease load in the population for a specific disease, while incidence demonstrates the spread of the disease. Both concepts are important in the management of infectious disease, although you are likely to find incidence rates used more frequently by epidemiologists trying to track or control an infectious disease outbreak, while chronic disease specialists are more likely to rely on prevalence rates.

A **rate** is simply a disease statistic with a numerator and denominator. The numerator is the number of cases (could be incidence or prevalence) over the size of the at-risk population (the denominator). We try to express all disease statistics as rates, so that we can easily convey the impact of the disease in a manner that is comparable from one outbreak (or population) to another. To increase comparability, we usually use a standardized denominator. For example, a measles incidence of 10.3/10,000/month

means that the population in question was experiencing 10.3 new cases of measles for each 10,000 inhabitants per month.

A **Communicable Disease** refers to the transmission of a disease by a causative organism from one person to another either directly or indirectly through a carrier or a vector. An **Infectious Disease** refers to diseases resulting from the presence of a pathogenic organism in the body. Lastly, **Epidemiology** – refers to the science and study of diseases and health conditions in a human population. It uses the tools of medicine, public health, and statistics.

Causative Factors

-What Causes Outbreaks of Infectious Disease in Disasters, and How Common are they?

1. Presence of a pathogen in the area

If a pathogen does not exist before and after a disaster, the disease caused by that pathogen is not likely to occur even if the conditions are ideal for transmission. For example, if Anchorage, Alaska, were to be hit be a massive earthquake, it would be unlikely for the earthquake to lead to an outbreak of cholera, due to the fact that the *vibrio cholera* pathogen is not endemic in Alaska. However, the pathogen could be introduced at a crucially vulnerable time by rescue personnel coming in from an infected area, spreading the disease while normal sanitary systems are down.[1],[2]

2. Population displacement- and camps

Massive displacement of a population may lead to an increase in disease transmission. Populations may move into areas where pathogens exist, to which the immigrants have no specific immunity. Evacuation to camps following mass migration or loss of housing is particularly dangerous from an infectious disease perspective. Camps tend to combine high population density and poor sanitary conditions, a perfect prescription for fecal-oral and airborne droplet transmission of disease pathogens. [3]

3. Environmental changes

Environmental changes due to a disaster can effect infectious disease increases both directly and indirectly.[4] The direct route is when the environmental changes wrought by the event directly changes the relationship between humans and their microbiological surroundings. Examples of this might be an earthquake-caused cross connection between a potable water main and a sewage line, or an increase in malaria-carrying mosquitoes due to a hurricane-caused expansion of mosquito breeding sites. The indirect route is when the human response to the event causes a change in the microbe-human relationship. For example, Saenz et al demonstrated an increase in malaria after an earthquake in Costa Rica, due in part to the fact that humans chose to sleep outside, not trusting their houses for fear of collapse in the numerous aftershocks.[5] Sleeping outside put the population in direct contact with the mosquitoes that serve as malaria vectors. Another example might be humans who crowd together in a shelter to escape a storm, only to increase microbe transmission within the shelter.

In general, direct environmental impacts can be anticipated if you know something of the physical effects of the event, and how the event may have changed

human ecology. For example, the flooding caused by hurricanes frequently pollutes fresh water supplies.[6] However, for the responder to attempt to anticipate the indirect (human response) effects of environmental changes, a significant amount of on-site information must be collected regarding post-disaster human activities. This will require some information gathering, but can play a very important role in anticipating what kind of infectious disease management program may be needed.

4. Loss of public utilities

Provision of a safe and potable water supply remains to be a major factor in preventing the occurrence of communicable diseases following disasters. Damage to public utilities during earthquakes such as water pipes, sewage systems and power supplies may cause the contamination of water sources with water borne pathogen such as E.coli, E. hystolitica, and Salmonella typhii. This may lead to increased incidence of bacillary dysentery, acute gastroenteritis and typhoid fever. Other diseases that can occur include hepatits A, cholera and protozoal diseases such as ascariasis and helminthiasis.

5. Disruption of basic health services

Disruption of basic health services may give pathogens opportunities to spread rapidly. Interruption of control of acute infectious disease programs may increase the reservoir of infection promoting transmission of disease. The longer the disruption continues, the greater is the risk for communicable disease outbreaks.[7] A secondary effect of basic health service disruption is that it also disrupts the collection of health status information for the population, meaning that a disease outbreak could be well underway before it is noted and investigated.

6. Impact of food scarcity and hunger

Food shortages and crop destruction after heavy floods may increase the prevalence of malnutrition in some populations: thereby increasing the host susceptibility to disease. Though malnutrition is usually based on a chronic food shortage, acute disaster-induced food shortages may trigger serious malnutrition in an otherwise nutritionally marginal population, thus increasing susceptibility of the population to disease and high mortality rates.[8]

7. Frequency

How frequently do disasters result in disease outbreaks? This is difficult to answer in an absolute sense, but some general rules apply:

- Any disaster, regardless of type, has the potential of increasing disease transmission if it results in either direct or indirect changes in the human ecology.
- Flooding and crowding both have a high probability of increasing disease transmission, if not responded to immediately with sound public health measures.
- Events that cause population dispersion may actually decrease disease transmission.
- The level of population immunity, either via vaccination or prior disease exposure, can play an important role in deciding whether or not a disaster results in a disease outbreak.

- Population poverty and/or malnutrition prior to the disaster increase susceptibility to disease transmission after the event. Correspondingly, post-disaster disease outbreaks are more common in developing countries than in industrialized nations like the United States. However, an outbreak is possible in any part of the world, given the right (or wrong!) circumstances.

Modes of Transmission

- Direct person-to-person contact – e.g. scabies
- Water-borne – diseases which are mainly transmitted through water. Examples are gastrointestinal diseases resulting in diarrheic states (e.g. amebic dysentery, cholera, amebiasis, shigellosis, viral gastrointestinal diseases, etc.), as well as some diseases that attack other organ systems (e.g. hepatitis)
- Air-borne – transmitted mainly through droplet infection, air-borne transmission oftentimes involve large number of population. (e.g. tuberculosis, influenza and other viral respiratory diseases, diphtheria, pertussis, measles, etc.)
- Vector-borne –
    - rodent borne – transmission by rodents such as rats, mouse, moles, etc. Examples include the great plague and rat-borne typhus infections, or the more recent Hanta virus in the southwestern U.S.
    - insects – mosquitoes, fleas, lice, etc., carrying diseases such as encephalitis, dengue, Lyme disease.
    - animal – bats, skunks, dogs, etc, carrying rabies.
- Fomites – inanimate objects which act as reservoirs of disease pathogens. E.g. plates, spoons, glasses, soaps, etc.

Corpses as a Mode of Transmission

It must be stressed here that human cadavers of disaster victims do not give rise to epidemics.[9] There have been exaggerations on the part of the public media and officials that the presence of putrefaction from corpses can lead to diseases such as cholera or typhoid fever. Unless the corpses were diseased themselves prior to the disaster, the occurrence of diseases in corpses has yet to be established. Proper information dissemination may help allay fears among the public. There may be other sound social, religious and psychological reasons for dealing with human corpses in an expeditious manner, but disease transmission is not one of them.

Emerging Infectious Diseases

Recent global and environmental changes and advanced research have identified various pathogens which can have the capability of producing diseases in pandemic proportions. An example is the Paninfluenza virus. These diseases have the capability of becoming a disaster in their own right, or may reach expanded distribution due to the effects of a natural or human-caused disaster.[10]

Methods of Control

Control of infectious disease is based on five simple principles (but not always easy to implement):[11]

1. Restore normal public health services as quickly as possible, paying particular attention to potable water, sanitation, shelter, and safe food. These issues are addressed in the Preventive Medicine session of this training program.
2. Find out what's happening. Establish monitoring and surveillance systems, coupled with specific assignment of a trained health professional to review and evaluate the collected data in search for disease trends.
3. Share information with local health authorities, to the extent that this is possible.
4. Investigate all suspected cases to confirm or negate their existence.
5. Depending on the pathogen identified, develop a strategy to contain it, treating victims of the disease and preventing their passing the pathogen to others.

DMATs are not expected to carry the primary responsibility for the detection and management of infectious diseases in disaster situations, but there may be circumstances in which the team will be asked to take on this role for some part of the affected population. It is therefore imperative that teams have the following basic strategies and skills:

Monitoring and Surveillance of Disease

The occurrence of epidemics after disasters in industrialized countries is an exception, rather than the rule. This observed low level of post-disaster disease is largely due to purposeful increases in public health awareness for basic hygiene and sanitation rather than the success of high technology and advanced medical measures.
This increased public health awareness utilizes the following tools in order to prevent or contain post-disaster disease outbreaks.

Epidemiologic Surveillance

1. <u>Establish the presence of diseases</u>

It is of utmost important to identify and confirm the presence of disease in a disaster area. Special attention can be given to diseases that are most likely to occur for the type of disaster you are responding to, diseases, which have a history of endemicity in the area, and diseases about which the public is very concerned. Local health sources may provide information on diseases that are prevalent in the disaster area. It is important that you be thinking in terms of incidence rates (new cases of a disease) not prevalence (total disease load, most of which may have carried over from before the event), if you are focusing on disaster-caused or disaster-mediated diseases. Prevalence rates would be useful in estimated the total disease load, and, therefore, the amount of medical care or public health intervention needed. Realistically, however, most DMATs will not have a viable method of estimating what the denominator is, i.e. the size of the population at risk, making it nearly impossible to come up with epidemiologically sound

rates. Knowing this makes it even more important that the team be sure of the numerator numbers it does collect and report, using these next steps.

2. Establish a method of data collection and analysis

It is best if someone with experience in health services data collection and analysis can do this. At the most basic, DMAT teams should keep standardized medical records, which can be collected and reviewed on at least a daily basis, in order to identify any disease trends and establish crude rates among patients seen. A more sophisticated approach, if possible, would be to collect and review the same kind of patient care data from all providers in the area, so more accurate trending could be analyzed. This approach may not be possible in the first 48-72 hours after a sudden onset disaster, but it should be possible thereafter, and will also be most needed after the first 48 hours have passed…when victims start entering into the period of time when incubation periods are elapsing. In doing so, you will be establishing a rudimentary surveillance system. *As a matter of team safety, be sure that you compare any reports of illness within the team to patient-centered data, so that team members can be included in all protective measures possible.*

3. Establish vital routes of communication and transportation

Vital routes of communication and transportation must be established to ensure continuous flow of information from the site where a communicable disease is supposed to have occurred.

4. Immediate investigation

Investigate promptly any unusual occurrence of diseases patterns detected by surveillance systems. Confirm clinical findings with appropriate laboratory sampling previously identified. *Note that any deployment likely to entail significant infectious disease management should be provided with basic mobile laboratory capability, and the personnel needed to run the lab.* Raw and unconfirmed information from other sources such news, radio, politicians and field workers should be taken seriously and investigated, so as to confirm the need for action or quash rumors.[12]

5. Reporting procedures

Reporting should be initially done as frequent as possible. Initially, once a day or twice a day reporting can be done until the situation normalizes. All reporting of data collected by the DMAT should be shared with the local jurisdictional health department or its representative.

6. Analysis and evaluation of reports

Surveillance reports should be immediately analyzed and disseminated to those concerned in a timely manner. Rapid circulation of results may improve health response. Secrecy and slowness of release of information breed distrust and create credibility problems. Release of information to anyone other than health authorities must be a job of the public information officer. In order to make useful sense of the information gathered, the analysis must include a comparison between the level of the disease seen in the information gathered, and the expected ("background" or endemic) level of the disease

for the affected population. In order to accomplish this, the data must be converted to *rates* (using the numerator/denominator approach described earlier).

For example, if you have 27 new cases of gastroenteritis that occurred over one week and you have a population of 250 people, the rate calculation would go like this:

27/250 = x/10,000. 27 x 10,000 = 270,000 divided by 250 = 1,080.

The *rate* is then 1080/10,000 per week.

For the sake of simplicity, all rates can be easily converted to a percentage. In this case, 10.8% of the population has a new case of gastroenteritis in one week, which would exceed almost any population's normal background rate. It is important to always state the time period over which the data were collected for an incidence rate. A prevalence rate, which is a snapshot of all cases, new and old, existing at a given point of time (i.e. one day), is figured the same way, but does not include a time period.

Disaster responders should not make it their responsibility to resolve endemic health problems! Statistics showing normal disease levels for the population should be available through local health authorities, or through channels provided by the Centers for Disease Control and Prevention (CDC). CDC assistance can be contacted through the regional HHS Emergency Coordinator or Regional Administrator.

7. Continuous surveillance of disease

Surveillance must be continued even well after the emergency phase of the disaster. Some disaster-sensitive diseases, such as hepatitis, have a long incubation period. When the time comes for a DMAT to leave its assigned site, personnel should turn over to the responsible local health authority a copy of all data collected.

Medical Response and Containment

In general, once you have confirmed data indicating a disease outbreak, you must make the decision of what strategy to use to both treat victims and contain the disease from spreading to others. The following strategies have proven value, within certain circumstances.

Medical Measures - Chemoprophylaxis

As a general measure against post disaster infectious disease, mass use of chemoprophylaxis has proven ineffective unless a specific pathogen has been detected and verified. Each team should be in possession of the *Control of Communicable Diseases Manual* [13] (paperback handbook sized) published by the American Public Health Association as a primary source of guidance for specific treatment and containment strategies. While mass use of chemoprophylaxis may not always be effective as a preventive measure, treatment of confirmed cases via normal pharmaceutical protocol is the first step in controlling transmission to others.

Medical Measures – Mass Immunization

Politicians and the press may push for mass immunization programs, but they should not be considered unless a specific pathogen has been identified that poses a risk to the population and is responsive to rapid immunization programs.[14] For example, massive immunization against typhoid fever is not effective as it generally requires a

series of vaccinations to achieve adequate immunity. Measles vaccination remains to be the single most cost-effective public health intervention especially among children 6 months to 12 years old in a population with questionable immunity status. Such a population must have a measles vaccination once they arrive in evacuation centers if crowded conditions are likely to exist. Widespread tetanus immunization has not been shown to be of public health measure after disasters. Targeted tetanus immunization is of value for people who have suffered wounds and lacerations, who may need tetanus booster immunizations.

Medical Measures – Resumption of Basic Health Services

Basic health services must be resumed as soon after the disaster as possible. This is a first priority of the health care system. DMATs may be requested by local authorities to temporarily provide ambulatory primary care services in areas where such services have been damaged or destroyed. If a DMAT is to provide such a service, its members must be aware that they are contributing a most important component of the overall health services response to the disaster. DMAT leadership must work with local authorities to coordinate their services with the needs of the local health sector.

Medical Measures - Isolation

In cases where a highly communicable disease is detected, isolation and quarantine may be effective.

Environmental health measures – Water Supply

People will need and seek water regardless of its quality, quantity and costs. They should have access to a minimum quantity of water up to 40 liters per day per person in urban areas. WHO recommends 15-20 liters per day. Sanitation measures such as hand washing and personal hygiene are extremely important in regaining control of disease transmission. Please refer to the Preventive Medicine session of this training program for water supply details.

Environmental health measures – Food Hygiene

In feeding the affected population, community kitchens and feeding areas may be established to ensure adequate nutritional and vitamin intake especially among children. Food donations must be screened properly as they may be spoiled or rotten. This rule pertains also to food donated to rescue and DMAT teams. Some SAR team members at the Oklahoma City bombing became disabled due to diarrhea secondary to consuming spoiled donated pizza.[15] Please refer to the Preventive Medicine session of this training program for more detailed guidance on food safety.

Environmental Health Measures – Proper Waste Disposal

Proper waste disposal relies on the prevailing cultural patterns in determining the type of disposal program. Usual habits of human waste disposal may not necessarily change after a disaster. Reference to particular methods may be seen in the Preventive Medicine section of this training program.

Environmental Health Measures – Vector Control

Vector control programs such as spraying with insecticides may not necessarily be a priority in terms of short-term control of infectious diseases. However, politicians and public health officials, under pressure from the community to act, may prioritize these programs to assure the public that the government is acting. To consider vector control as an *emergency* measure, it is worthy to consider its impact on disease transmission rather on the presence of a vector itself. Use of massive aerial spraying to reduce vector population may not be effective. It is best to restore or strengthen previously existing vector control programs rather than institute new methods.

Summary

Disasters frequently change both the macro- and the microbiotic environments in which we live. These changes can lead to the introduction of new pathogens, or increased opportunity for existing pathogens to infect humans. If sufficient efforts are not immediately made to protect water and food supplies, provide viable sanitary measures, and monitor the health conditions of the affected population, communicable diseases may expand rapidly, with potentially devastating consequences for an already impacted community. Adequate attention to these issues in recent U.S. disasters has resulted in a low post-disaster disease rate compared to many other countries, but vigilance is continuously required, and DMATs may be asked to participate. Rapid re-establishment of normal health care services is one arena in which DMATs can provide important assistance. DMATs may also find themselves on-site when an infectious disease outbreak takes place, and should be familiar with basic investigation, confirmation and containment strategies. DMATs deployed to sites outside of the United States should be particularly aware of infectious disease potentials, and may be asked to play a more direct role in outbreak management for a limited target population. It is equally important for DMAT personnel to recognize that the measures frequently called for in the press and by local politicians are not necessarily effective or efficient for disease control.

Suggested Readings

Outline strategies for Malarial Control in Complex Emergencies
http://www.who.int/eha/disasters/tgcommunicable.shtml

WHO Guidelines for Epidemic Preparedness and Response to Measles Outbreaks
http://www.who.int/emc-documents/measles/whocdscsrisr991c.html

WHO Recommended Standards surveillance
http://www.who.int/emc-documents/surveillance/whocdscsrisr992c.html

WHO Epidemic Diarrhoel Disease Preparedness and Response: Participants manual
Recent Epidemics
http://www.who.int/emc-documents/cholera/whoemcdis973c.html

Guidelines for control of epidemics due to Shigella Dysentriae.
http://www.who.int/emc-documents/cholera/whocdr954c.html

Vector Control of Disaster Situations
http://www.paho.org/English/PED/te_vect.htm

Prevention of Measles Outbreaks Among Displaced Populations
http://www.paho.org/English/PED/te_mslo.htm

Vaccinations in Disaster Situations: Recommendations of the PAHO/WHO Special Program for Vaccines and Immunizations
http://www.paho.org/English/PED/te_vacc.htm

Equine Encephalitis in the Event of Disasters
http://www.paho.org/English/PED/te_equi.htm

Rodents in Disasters
http://www.paho.org/English/PED/te_rdes.htm#ratas

Hurricane Keith in Belize Rapid Health Assessment
http://www.paho.org/English/PED/keith-rapidhealthassessment.htm

Bio-terrorism
http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/rr4904a1.htm

Infectious Diseases and Disaster
http://www.cdc.gov/protect.htm

Second Earthquake in El Salvador Updated PAHO/WHO Request for Humanitarian Assistance
http://www.paho.org/English/PED/ElSalvador-appeal.htm

Control of Tuberculosis in Disaster Situations
http://www.paho.org/English/PED/te_tube.htm

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