Welcome to the lecture entitled “Disasters & Infectious Disease Prevention”. There is only one lecture for this topic.

This definition of a disaster comes from Webster’s Dictionary, “a great or sudden misfortune that results in loss of life, property, etc. or that is ruinous to an undertaking.” Disasters are also known as mass casualty events.

Required Reading #1 divides disasters and mass casualty incidents into **two categories**. The first is by **source**: 1) those caused by natural forces and 2) those resulting from man-made events. Natural forces involve floods, earthquakes, hurricanes, tornadoes, etc. Man-made events involve traditional, biological, chemical, nuclear, or radiological terrorism. The second way to categorize mass casualty incidents is by the **nature of the event**: whether or not it involves an infectious disease. Noninfectious disease disasters include all natural and man-made events that do not have an infectious agent as the source of the incident (e.g., hurricanes, floods, earthquakes, and all forms of terrorism EXCEPT bioterrorism). Infectious disease disasters include all events that involve a biological agent or disease, such as a bioterrorism attack, a pandemic, or an outbreak of an emerging infectious disease. You learned about bioterrorism last week and about the 1918 influenza pandemic during the first week of the course.

What are the public health effects of a disaster? Unfortunately, there are an unexpected number of deaths, injuries, and illnesses that exceed the local capacity. The public health and hospital infrastructures break down. If you have a disaster that is large or severe enough, entire populations may move from one area to another. Also, if severe enough, there will be an interruption in communication. If communication is not already well developed, then in a disaster this can result in no communication. That is very important, because from the beginning of a disaster you have to be able to have a communication command center.

What about the potential consequences of a disaster? What is important to know is that the factors that affect the consequences of a disaster are related to how well that community or that agency or that location is protected. What is their health status to start with? Is it poor? If you have a disaster on top of that, it is going to make it worse. What is the event? Is it an earthquake, which is city wide or just a fire in one building? Thus, the consequences of disasters are influenced by several factors.
There are several general public health effects of a natural disaster. Large scale power outages occur. There is a shortage of food, water, and safety. Inadequate sanitation is one of the biggest problems in a healthcare facility, but it also affects people in their homes. Environmental effects such as, pollution in the air, debris in the air, flooding, and animals that are running lose, are just a few effects of a disaster. Finally, there are psycho-social issues from loss of life, illness, social disruption, etc. We are not going to discuss everyone, but are focusing on infectious diseases and infection control prevention categories.

In the Required Reading, the four phases of a disaster are listed as: 1) preparedness, 2) impact, 3) response, and 4) recovery.

Preparedness should be done in the time prior to the disaster. That is the whole point of pandemic influenza preparedness. When preparing a plan, ideally, you are not expecting to be hit with that disaster tomorrow. Therefore, the length of this phase can vary from years to days. Some disasters have a warning period, so that you have some notice that something is going to occur. Others do not.

For example, during a hurricane you may have a one or two day warning. However an earthquake may happen at anytime. Local authorities report river levels before a potential flood, alerting if the level is one inch above normal, for example, or whether evacuations are necessary. Tornadoes have a very short warning time but they are improving early warning systems. For earthquakes, unfortunately, they do not have an immediate warning system. For acts of terrorism, if it is covert, where mass casualties are intended, there is not going to be ANY warning.

Phase 2 is the time during the actual occurrence of the disaster, and again, this can vary. For example, for earthquakes, it is only seconds. For a flood, it could go for weeks, and for a pandemic influenza, can go on for a year or longer. Activities during the impact phase, when the disaster actually hits, vary depending upon the duration and how quickly it is detected.
### Slide 11
**Phase 3: Response**

- Depends on type of disaster & when the event is detected
- Regardless of when response begins, consists of intervention efforts to cope with immediate disaster aftermath
- In most disasters, more injuries occur during the response phase (cleanup & recovery) than the impact phase

Phase 3, the response phase, depends on the type of disaster and when the event is detected. With floods or hurricanes that have advance warning, the response most likely begins in conjunction with the impact phase. For bombings or earthquakes, the response most likely begins after the impact phase. With a covert bioterrorism situation, it may be two weeks before it is even recognized. So any infectious disease prevention (PEP, treatment, activation of a bioreadiness plan, etc.) that you could have done, can’t be done until it is recognized. Regardless of when response begins, phase 3 consists of the interventions necessary to cope with the immediate effects of the disaster. There are more injuries that occur during the response phase during clean up and recovery, than during the impact phase, in most disasters.

### Slide 12
**Response to Disaster**

- Response will vary from incident to incident
  - Unique risks posed by each disaster
  - Requires interventions specific to the situation even among disasters caused by the same type or source
  - Basic principles of disaster management remain the same for all types of disasters

Responses to a disaster vary from incident to incident. Each disaster has its own unique risks. Thus, each disaster requires interventions specific to the situation, even if caused by same source (e.g., earthquake, flood, tornado). Even so, the basic principles of disaster management remain the same for all types of disasters.

### Slide 13
**Phase 4: Recovery**

- Begins after the disaster has been officially declared over & no additional victims likely to be rescued
- For some, the switch from response to recovery may be clearly delineated
- For some, recovery may begin during the response phase without a clear delineation between phases
- Recovery period interventions include those necessary for rebuilding the facility & the community in terms of physical, psychological & economic reasons

The final phase of a disaster is recovery and this is after the disaster is officially declared over and it is unlikely that additional victims will be rescued. For some, the switch from response to recovery is clearly delineated, and for others, it is not. For example, with a collapsed building disaster - recovery begins around 72 hours after the second phase. Recovery period interventions include those necessary for rebuilding the facility and the community in terms of physical, psychological and economic reasons.

### Slide 14
**Planning for Managing Disaster Response**

- One of the most critical elements of disaster planning
- Different levels of disaster plans:
  1. Personal disaster response plan
  2. Facility disaster response plan
  3. Community disaster response plan
  4. National
  5. Global

One of the most critical elements in disaster planning is to realize that there different levels: personal, facility, community, national and global. For the purposes of this class, we are going to focus on the healthcare facility disaster plan.

### Slide 15
**Priority Public Health Issues**

- Safe Food/Water
- Shelter
- Health/Medical Care
- Safe Environment
- Communication

Priority public health issues in a disaster are: safe food/water, shelter, health/medical care, safe environment, and communication.
Communicable diseases are widely feared following disasters. Studies have found varied results regarding the impact of communicable diseases following mass casualty incidents. In general, the greatest impact on morbidity and mortality related to communicable diseases after a disaster results from increased occurrence of already endemic diseases. Any disaster that results in overcrowding has the potential to result in a communicable disease incident, especially if an agent is already circulating among some of the members. That is because overcrowding leads to airborne, waterborne, and foodborne disease outbreaks. Major infectious disease outbreaks after mass casualty incidents have been rare in industrialized countries. After the 2004 tsunami & Hurricane Katrina in 2005, most infectious diseases involved skin, diarrheal or respiratory infections. In developing countries, infectious disease outbreaks following disasters are more common and usually related to endemic pathogens.

Routine communicable disease reporting will need to continue during a mass casualty incident. In addition, certain communicable diseases may need to be reported in a more timely manner during a disaster because of the risk of secondary spread. It is important to report communicable diseases as soon as possible after a disaster, such as chickenpox and measles. These two diseases are very highly communicable. Tuberculosis (TB) precautions for inpatients must be maintained. The disaster plan should state how the following will be maintained: evaluation of ventilation systems while on emergency power, observing for TB & continued treatment of TB cases.

Healthcare facility disaster planning, which is what will be discussed in the next couple of slides, includes numerous categories. It includes considerations for employees, visitors, patients, the community, medications, treatment, vaccinations, isolation, PEP, post-mortem care, and the worried well. These categories should prepare a facility for any type of disaster: bioterrorism, an earthquake, a flood, pandemic influenza, etc. There is an excerpt from an incident command checklist in Required Reading #1.

Please note that how to manage patients is the largest component of disaster response in a healthcare facility. When you think about all of the issues that have to do with patients in a disaster that are related to infection control and infectious diseases it can become very involved. The challenge it creates is, what are you going to do with the already large number of acutely ill people in the hospital? You can’t send them home, that is why they are at the hospital or clinic. What are you going to do with people coming in that are injured from the disaster? You may have a whole other group of people that are well that will be coming in because they think they have been exposed to something. They may want a vaccine or they may want PEP. What is the facility’s ability to deal with surge capacity? Surge capacity is the ability of a healthcare facility to handle an influx of patients requiring medical care. This is a complex and critical component of healthcare facility disaster planning.
### Slide 20

**Patient Management**
- Patient assessment (triage), placement & isolation
- Surveillance
- Evacuation plans
- Quarantine decisions
- Post-mortem care & morgue surge capacity

Within patient management are numerous subcategories. These include patient assessment (or triage), placement & isolation; surveillance; evacuation plans; quarantine decisions; post-mortem care and morgue surge capacity. Plans for maintaining airborne infection isolation for patients with TB must be outlined before a disaster. Quarantine differs from isolation in that it restricts the movement of individuals who have a known or suspected exposure to an infectious disease but who are not yet showing signs of infection. With disasters resulting in extensive mortality, temporary and off-site morgues may need to be used. It is important to maintain adequate supplies of body bags. *Please read more detail on these issues in Required Reading #1.*

### Slide 21

**Sewage Disposal**
- Critical info. in disaster is functional level of sewage system
- Do NOT flush toilets if sewers broken
  - Contract with reliable chemical toilet service beforehand
  - Determine if waste removal included
  - How many units & where placed
  - Plan alternatives until these arrive
    1. Plastic bags in a bucket
    2. 1 small bag for single use
    3. Commercial disposable urinals

In a healthcare facility, the functional level of the sewer system is critical. Imagine, if you can, the enormous volume of patients’ drainage, from waste materials, secretions, ventilators, catheters, surgery, and suctioning. Service contracts with chemical toilet companies should be negotiated before a disaster occurs, the number of necessary units assessed ahead of time, and a determination made of whether these companies can assist with waste disposal before arrival of these toilets. It is very important to first assess whether the sewage system is broken. In many disasters, the sewage system is NOT broken. An example would be during a hurricane. If the sewers ARE broken, you absolutely cannot flush the toilets. In that case, alternatives must be planned, such as using plastic bags in a bucket for small group use, 1 small bag for single use, and commercial disposable urinals for larger groups. There is more detail regarding the advantages and disadvantages of these plans in chapter 117. The military solution of a trench is not suitable for an urban environment.

### Slide 22

**Sewage Disposal**
- If sewer intact:
  - Use toilets without flushing FIRST
  - Next, use water (don’t waste clean sources) to flush toilet (but this wastes water)
  - Crews with water on cart can make rounds (labor-intensive)
  - With bedpans: empty into available containers, discard full, or use plastic bag liners

If your sewage system is intact, water can be used to flush the toilet and it doesn’t have to be clean water. If the sewer is intact, you can use the toilets and first fill them up without flushing them. That is because if you are using water to flush them, water is a precious commodity, and thus should not be wasted in the beginning. Another alternative is to have crews going around with water that they empty into the toilet to flush, but this is labor intensive. If using bedpans and urinals, then how will the waste be discarded? Bedpans can be emptied into available waste collection containers, discarded full or used with plastic liners that can then be discarded. With the last option, the bedpan can then be reused.

### Slide 23

**Sanitation**
- Trash pick-up disrupted following a disaster
- Plan should identify where to store solid & regulated medical waste until routine sanitation practices resume
- Plan should include short & long-term strategies

Trash pick-up will likely be disrupted during a disaster. The emergency plan should identify areas for sanitary storage of solid waste as well as regulated medical waste until routine sanitation practices can be resumed. There may not be trucks picking up or they may come at irregular intervals, so there should be a plan for a short term waste disposal and long term waste disposal. Trash is an item that piles up very fast in a healthcare facility.
Decontamination is the reduction or removal of chemical or biological hazardous agents. Decontamination may or may not be necessary after a disaster depending on the type of disaster, how soon the event is identified and the source of concern (environment or patient). For most disasters, patient decontamination will not be necessary, with the exception of chemical and biological terrorism attacks. Environmental decontamination may be required after flooding, with overcrowded living conditions, lack of clean water, or release of a hazardous or infectious agent spread by hand-to-hand contact or contact with fomites.

For purposes of application to this course, Infectious Disease Prevention Strategies, let’s list and describe 3 areas of focus during disasters: water safety, food safety and hand hygiene. We will discuss water safety first.

The most serious health hazard after most types of mass casualty incidents is the deterioration in environmental conditions, particularly in the water supply and disposal of human wastes. Water is essential for numerous hospital functions including but not limited to: hand washing, bathing, washing dishes and linen, sterilizing, cooking, dialysis, hydrotherapy, flushing toilets, processing scopes, etc. For sterilization, water is used for steam. All of these activities need to be maintained in a disaster and therefore water is a very important priority for numerous reasons, including infection control issues.

During disaster planning, the amount of water to maintain patients, workers, & necessary hospital functions for at least 3-5 days needs to be estimated. Back-up water supplies should provide 25 gallons/day/patient. How much water is stored on site, off-site, & obtained during disasters from outside resources should be included in the disaster plan.

Continuing on with the water discussion, experts recommend that during or right after a disaster the healthcare facility should immediately test the tap water. Though it may not be used for drinking, there are other uses for tap water, such as for bathing patients or wound care. The wound can become infected if the water is contaminated. If the water quality is at all questionable, it must be cleared by public health professionals for use. If there are some questionable tap water areas, that information has to be given to workers, patients, and visitors, so that they don’t use water that is unsafe. Experts recommend that sources of unfit drinking water be labeled or hooded, (in other words, to put covers over the sources), so that its use will be restricted. Safe water is a very high priority.
| Slide 29 | Drinking Water  
- Drinking water must be available immediately  
- Minimum of 2 liters/person/day must be provided for both patients & employees  

The very first thing that has to be available is drinking water and the recommendation is a minimum of 2 liters per person per day, for patients and employees. |
| --- | --- |
| Slide 30 | Purifying Water  
- Rolling boil for 1 minute  
- Add 1/8 teaspoon of bleach per gallon of water, mix, & allow to stand for 30 minutes before using  

If water quality is uncertain, there are 2 recommendations for purifying it. The first is bringing the water to a rolling boil for 1 minute. The second is to add 1/8 teaspoon of bleach (sodium hypochlorite) per gallon of water, mix it thoroughly, and allow it to stand for 30 minutes before using. If the water is very cloudy, a larger amount of bleach may be necessary. |
| Slide 31 | Food Provisions  
- Food must be provided for all individuals remaining on premises  
- During disaster planning, food requirements should be determined  

Good planning is essential for food provision during a disaster, the second infection prevention and control focus area. Food must be provided for all individuals who must remain on the premises, including quarantined individuals. Balanced meals are necessary to maintain both physical & psychological well-being. The food requirements needed for a mass casualty incident need to be determined during disaster planning. |
| Slide 32 | Food Provisions  
- Assess power supply to dietary department to ensure food safety after disaster  
- At least 1 refrigerator & 1 freezer should be on emergency power  
- Specify order of food to be used: 1) refrigerated food on hand  
  2) food from unpowered freezers  
  3) disaster reserve supplies  

The power supply to the dietary department of a healthcare facility should be assessed to ensure its ability to ensure food safety after a disaster. Experts recommend there be at least one refrigerator and one freezer on emergency power. If the power goes out, the recommended order in which food is to be used is as follows: 1) the refrigerator food on hand, 2) food from unpowered freezers, and 3) disaster reserve supplies last. |
| Slide 33 | Food Provisions  
- Monitor food service practices for basic sanitation  
- Monitor holding temperatures & length of time food held in danger zone (40-140°F)  
- When to discard food…  

In a disaster, there are stressed people in less than optimal working conditions. Therefore, it is important to ensure that basic sanitary procedures for food preparation are maintained. One of the most important issues is the safe food temperature zone. Food should be monitored for the length of time it is in the danger zone (40-140°F). Food that requires refrigeration that has been kept at room temperature for > or equal to 2 hours or ANY food that has been kept for an hour or more in a room above 90°F must be discarded, because it is not safe. As mentioned in the lectures on the “Prevention of Foodborne Illnesses”, the importance of a food thermometer is that it can monitor the proper temperature. |
The 3rd infection prevention area of focus after a disaster is hand hygiene. We already know how important that is from regular infection control practice. We also learned that an alcohol hand rub or a rinse is an acceptable and an actually recommended alternative to water, unless hands are visibly soiled. It is essential that hand hygiene supplies be readily available in sufficient amounts for a disaster. There is a formula for determining how much hand hygiene rub is needed during a disaster. Conservatively estimate that a nurse performs 4 hand hygiene episodes per hour (32 per shift) and uses 1 mL of alcohol based hand rub (ABHR) per episode. If the bottle of alcohol hand rub has 4 oz. (118 mL), it can supply one nurse for 3 shifts. The number of nurse shifts in a 24-hour period is the number of 4 oz. bottles needed for a 3-day supply. As some infectious disease disasters (e.g., pandemic) can last for more than 3 days-it is best to maintain a large stockpile of ABHR agents.

Next, let’s discuss infection control priorities for specific disasters, starting with earthquakes. Earthquakes are similar to other disasters except that there is NO warning phase. Thus, all preparations, both human and material, must be immediately available. In an earthquake, transportation can be severely impacted, as debris may become spread out and could block roads, impeding the way to get to work or home. The sewer system is also an urgent priority and can be damaged during an earthquake. Very quickly after an earthquake, water sources have to be assessed.

The other thing that happens after an earthquake that is different from a flood, is that there is a lot of dust generated. Dust can contain Aspergillus, or other organisms from the soil. In fact, in the 1994 Northridge earthquake in southern California, there was an outbreak of coccidioidomycosis, otherwise known as Valley Fever, because there was so much dust generated. In an earthquake, consider what kind of personal protective equipment is available in case people have to breathe dust. Obviously, some people may not have a mask on or with them. As an alternative, a t-shirt, handkerchief or other cotton material can be placed over the face, nose and mouth. If there are a lot of debris in the air, the respiratory system needs to be protected.
### Slide 38: Infection Control Priorities for Specific Disasters

**Floods**
- Usually have some warning period
- Allows for immediate preparations
- Evaluate area roads for flooding history
- Prepare maps with routes that are likely to be open
- How do healthcare workers get to work?

With a flood, there may be some warning period, which allows for immediate preparations to be made. Access roads to the healthcare facility need to be evaluated ahead of time, with emphasis on determining what routes are going to remain open and how to evacuate. Part of the plan needs to be for how healthcare workers (HCWs) will get to work.

### Slide 39: Infection Control Priorities for Specific Disasters

**Bioterrorism**
- May already be infectious cases by the time it is discovered
- Need to train HCWs to recognize agents of biological terrorism
- Mass PEP, treatment for patients, HCWs, & community

As you learned last week, we may not recognize the signs of bioterrorism until people already have the disease, especially if it is an intentional covert situation. HCWs must be trained to recognize anthrax, smallpox, and tularemia, as early as possible. HCW recognition of bioterrorism is going to be the determining factor for bioterrorism response. Once an incident occurs, mass post exposure prophylaxis and treatment for patients, HCWs, and the community must be implemented.

### Slide 40: Case Example: December 26, 2004 Tsunami

- 4th largest earthquake since 1900 (9.0) off west coast of northern Sumatra, Indonesia
- Tsunami left 229,866 people lost, including 186,983 dead and still 42,883 missing

On December 26, 2004 a 9.0 earthquake occurred off of the coast of Sumatra, resulting in a tsunami. This slide shows the erosion that occurred all the way inland. Human consequences equaled 229,866 casualties, including 186,983 dead and still 42,883 missing. Let's use this as a case example for a disaster and its aftermath, in terms of infectious disease prevention strategies.

### Slide 41: Aftermath of 2004 Tsunami

This slide shows some dramatic images of the aftermath of the 2004 tsunami.

### Slide 42: Aftermath

- Majority of deaths related to drowning
- Numerous traumatic injuries
- Contamination of water & food supplies
- Loss of shelter

In terms of morbidity and mortality, a majority of the deaths were related to drowning. When you have a wave coming at you at 20 to 30 mph with no warning, nothing to hold on to, the odds are not in your favor. There were also numerous traumatic injuries cause by structures, equipment and trees crushing people. In addition, the large influx of water contaminated the food and water supplies, food and water that hadn’t been treated.

### Slide 43: Traumatic Injuries

- Medical care critical where few health services exist

As one can imagine, medical care was critical and there were very few healthcare services available in some of these affected countries. This shows a boy reacting as he receives a tetanus shot from a medic at a relief camp at Nagore in the southern Indian state of Tamil Nadu. (AP Photo)
The tsunami impacted many underdeveloped countries, so one of the main issues, as mentioned earlier under infection control priorities, was water quality. Experts were concerned that wells that were inundated with water were contaminated with microorganisms, chemicals, sea salts from the ocean; and other cisterns and rain-catchment systems had to be assumed contaminated.

When assessing the different risks among water sources, salt water posed one of the smallest threats. It has an unpleasant taste. Nonetheless, microorganism infections can result from ingestion or exposure to open wounds, even from salt water. One example is *Mycobacterium marinum* that can be acquired from sea water, and it can cause infections in wounds.

The use of safe water after the tsunami had several applications. Either bottled, boiled or treated water should have been used to wash dishes, prepare food, brush teeth, wash hands, and make ice or baby formula.

The second and third infection prevention focus areas food safety, and hand hygiene, could be applied to the tsunami. Hand hygiene could have been accomplished either with clean water and soap or a waterless hand hygiene agent. Food should have only be eaten from sealed, waterproof containers or it could become a source of foodborne illness.

The loss of shelter isn’t something of great consideration in healthcare facilities. However, with a disaster such as the tsunami, it exposes people to infectious disease and physical dangers, such as misplaced animals, heat, insects, and crowding. Let’s say, for example, in one particular country there was already an outbreak of meningococcal meningitis or cholera. Then the problem is compounded by putting people without shelter in bad situations. That is only going to make the severity and prevalence of endemic illnesses increase.
There are specific threats that could result from a tsunami and this is also a good review for other disasters that result in flooding. The risk of tetanus is high when tiny breaks in the skin allow *Clostridium tetani* to enter through the skin in susceptible persons. Fortunately, as we learned earlier in the course, pre and post-exposure prophylaxis is available for tetanus.

There are numerous threats from water exposure, both in the tsunami and wherever disasters with flooding occur. One of these threats is leptospirosis. This is a bacterial disease that is transmitted by water infected with animal urine and feces. People are exposed to leptospirosis when they are swimming, or when they are in water for prolonged periods, such as when they are walking around in contaminated water. Fortunately, there is PEP available. Another important disease that can result from increased water exposure is cholera. Cholera is an acute, diarrheal illness produced by *Vibrio cholerae* bacteria. It is transmitted by the fecal-oral route when there is inadequate treatment of sewage and drinking water. Mass chemoprophylaxis of whole communities is NOT recommended in a cholera outbreak. Additional specific disease threats from potentially contaminated water include all of the following: amebiasis, cryptosporidiosis, cyclosporiasis, giardiasis, rotavirus, shigellosis, and typhoid fever. This slide shows all of these conditions, as well as their causative agent or agents.

Here are specific threats that could occur after a tsunami or a flood, from insect vectors: dengue fever, malaria & Japanese encephalitis. The important thing to remember on this slide is that two important points contribute to specific insect threats and include 1) large amounts of pooled water and 2) lack of shelter. If you have those two situations there is more of a chance that people are going to be infected.

When you think about structures and forests that are displaced in a disaster, wild animals are displaced as well. If you are already have a high prevalence starting out, then the chances of animals invading where humans are, increases the potential for rabies. Transmission of rabies most typically occurs from the bite of infected animal, but also has been reported and is possible from mucous membrane contamination, aerosol transmission, and corneal transplantations. Rats may also be displaced, and this can be very problematic. Plague, caused by the bite of an infected flea found on rodents, can result is such situations.
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<tr>
<th>Slide 53</th>
<th>Disease Threats with Crowding</th>
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<tr>
<td><strong>Respiratory syncytial virus (RSV)</strong></td>
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<tr>
<td><strong>Tuberculosis (TB)</strong></td>
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After the tsunami, severe crowding existed in numerous areas. With crowding brings specific disease threats. It is possible to have respiratory syncytial virus (RSV) spread by close contact with respiratory secretions and inanimate objects contaminated with secretions; as well as tuberculosis, which is spread by the airborne route. In some of these disaster situations, strategies for maintaining negative pressure isolation must be formulated.

<table>
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<tr>
<th>Slide 54</th>
<th>Other Disasters as Exemplars</th>
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<tbody>
<tr>
<td>Review the following slides</td>
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<tr>
<td>Identify infectious disease hazards &amp; infectious disease prevention strategies to mitigate the hazards</td>
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<tr>
<td>This will be part of Quiz #8</td>
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<td>There will be questions on the final exam from this material</td>
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Review the following slides of four disasters that will serve as some of the disaster exemplars for this course. Identify infectious disease hazards and infectious disease prevention strategies to mitigate the hazards. This will be part of Quiz #8. There will also be questions on the final exam from this material.

| Slide 55 | Example #1. A powerful earthquake struck Haiti just before 5 p.m. Eastern time on Tuesday January 12, 2010, 10 miles southwest from the capital of Port-au-Prince, causing widespread damage and panic in the impoverished country. The earthquake had an estimated magnitude of 7.0. |

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| Slide 56 | This Jan. 13, 2010 aerial photo provided by The American Red Cross shows just a glimpse of the human toll the earthquake had in Haiti’s capital, Port-au-Prince. In the other photo, bodies of earthquake victims lie disregarded in a blood-strewn pile on a street in the Haitian capital of Port-au-Prince. |

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| Slide 57 | A wounded victim awaits treatment in a clinic. Delays in distribution of food, water and supplies from the city’s lone airport to the needy frustrated many survivors who slept in the streets and outdoor camps of tens of thousands. Afraid to spend the night in their homes, most residents of the city are camping out in neighborhood parks. |

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<table>
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<tr>
<th>Slide 58</th>
<th>Jan. 22, 2010: People in the Belair neighborhood of Port-au-Prince get safe water for the first time after Norwegian Church Aid, installed a water system that provided homeless families with piped in water points. People stand among dust and flying debris kicked up from passing cars in Port-au-Prince. The 7.0-magnitude earthquake that hit Haiti left the capital in ruins.</th>
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<tr>
<td>Slide 59</td>
<td>Example #2. The summer of 2010 produced Pakistan’s worst flooding in 80 years. The number of people affected, who needed food, shelter and clothing to face a harsh Pakistani winter, was estimated to be about 20 million. Flooding began on July 22, 2010, in the province of Baluchistan. Estimates of the death toll of the floods range from 1,300 to 1,600. Even as Pakistani and international relief officials scrambled to save people and property, they despaired that the nation’s worst natural calamity had ruined just about every physical strand that knit the country together - roads, bridges, schools, health clinics, electricity and communications. The flooding, which began with the arrival of the annual monsoons, eventually affected about one-fifth of the country - nearly 62,000 square miles - or an area larger than England.</td>
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<td>Slide 60</td>
<td>Flood victims scramble for food rations as they battle the downwash from a Pakistan Army helicopter during relief operations on Monday, September 13 in Sindh province, Pakistan.</td>
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<td>Slide 61</td>
<td>The country's infrastructure was devastated by the floods. More than 5,000 miles of roads and railways were washed away, along with some 7,000 schools and more than 400 health facilities. On the top left, survivors jostle for relief food on the outskirts of Peshawar, Pakistan on Aug. 3. On the right, flood-displaced residents take shelter in a school at the Mohib Bhand area in Nowshera on July 31. On the bottom left, others camp out on a disabled railroad line. Relief work was hampered by submerged roads, washed out bridges, and downed communication lines.</td>
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<td>Slide 62</td>
<td>On the left, concerned people check an unconscious baby, who had been bitten by a snake inside her flooded house, after being rescued by a naval boat in Sukkur, Pakistan, on Aug. 8. Allah Ditta, 26, a flood affected villager suffering from high fever and spasms, receives medical treatment (on the bottom right), Aug. 25, at the makeshift medical center in the Sultan Colony Army flood relief camp.</td>
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<tr>
<td>Slide 63</td>
<td>Example #3: The most powerful earthquake to hit Japan in its recorded history, struck off the island nation's shore on Friday, March 11, 2011, collapsing buildings, touching off widespread fires and unleashing walls of water up to 30 feet high. The threat of a tsunami prompted the U.S. National Weather Service to issue a warning for at least 50 countries and territories after an 8.9-magnitude earthquake struck. The wide-ranging list included Russia and Central American countries like Guatemala, El Salvador and Costa Rica, and the U.S. states of Hawaii as well as those along the Pacific Coast. In this picture, a massive tsunami slams the coastal areas of Iwanuma in Miyagi prefecture.</td>
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<td>Slide 64</td>
<td>On the top left, houses are left in shambles in Natori after the powerful quake unleashed walls of water. On the bottom right, flames devastate houses in an aerial view from Natori.</td>
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<tr>
<td>Slide 65</td>
<td>On the top left, people make their way through the debris from destroyed homes after the earthquake and tsunami in Sendai. On the top right, evacuees line up for meals in a shelter in Soma city, Fukushima prefecture, Japan, Monday, March 14, 2011, three days after a massive earthquake and tsunami struck the country's north east coast. Cold weather increased the hardship for disaster victims and rescuers. Rescuers report some victims had been exposed to cold water and weather, in some cases for days (see the bottom right). On the bottom left, an evacuee who was injured during the earthquake and tsunami, is seen at the Red Cross hospital in Ishinomaki, northern Japan March 14, 2011.</td>
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<td>Slide 66</td>
<td>In this aerial picture on the left, smoke rises from Fukushima Daiichi power plant's Unit 1 in Okumamachi, Fukushima prefecture, March 12, 2011. On top of the losses of family and friends along with property, evacuees in the area are now faced with the fears of radiation contamination from damaged nuclear facilities nearby. On the bottom right, distressed victims must be screened by a technician in protective gear for signs of possible radiation.</td>
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<td>Slide 67</td>
<td>Example #4: Hurricane Sandy was the 18th named storm of the 2012 Atlantic hurricane season, and occurred in October 2012. It was also referred to as Superstorm Sandy. Its track left a path of damage and death from the Caribbean to the Bahamas, Florida, North Carolina, the Mid-Atlantic and Northeast. It then merged with the polar jet stream and an arriving cold front, slamming into southern New Jersey. Hurricane Sandy took over 100 lives in the United States. Most were over the age of 65. Most deaths were from drowning. On this slide are photos of the destruction caused by this storm, to physical property in the U.S.</td>
</tr>
</tbody>
</table>
### Slide 68

**Storm victims in Haiti**

On this slide are images of the storm’s aftermath in Haiti. Note people walking through dirty flood waters, barefoot people walking among debris and flooded buildings. In the bottom left picture there are 3 generations of one family.

### Slide 69

**U.S. Images**

These U.S. images of destruction also have implications for health issues. How many can you identify?

### Slide 70

**Resources Used in This Presentation**


On this slide are some sites used for the disaster photos in the last part of the lecture. Other disasters you may be interested in exploring can be searched for using internet resources.

### Slide 71

**Final Thoughts**

Infection preventionists have unique skills to contribute during mass casualty events, which is why they are usually included in disaster plans in any facility. It is essential to prepare ahead of time for disasters. Most disaster plans have similar preparation categories, but the response carried out differs according to each disaster. The tsunami of December 2004, no doubt, was a global disaster. Surprisingly, it didn’t result in as many infectious disease outbreaks as previously projected. The emphasis in emergency planning has now shifted to encompass the term “All Hazards Response.” The techniques & strategies used today in public health emergency planning, “All Hazards Response”, for the most part, transcend terrorism, infectious diseases & other disasters & can be used in ANY public health emergency.

This completes the lecture entitled “Disasters and Infectious Disease Prevention”.