Infectious Disease in Disaster

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Risk for Infectious Disease Outbreak after Disaster associated with:

- Population displacement
- Availability of safe water and sanitation facilities
- Degree of crowding
- Underlying health status of the population, including level of immunity to VPDs and malnutrition
- Availability of healthcare services
- Local disease ecology
- Degree of disruption of public health infrastructure

Population Displacement

- Natural disasters, regardless of type, that do not result in population displacement rarely associated with outbreaks
- Conflict affected populations that have been displaced have been more commonly reported to have outbreaks of infectious disease. Up to 2/3 of deaths in these populations may be due to communicable disease.
- Risk for outbreak after disaster is often exaggerated by health officials and by media.

http://www.globalissues.eu/additional.html
Endemic Organisms Predominate

- Northridge Earthquake 1994
  nine fold increase in coccidiomycosis from Jan-March, risk factor of being in dust cloud
- Mount St. Helen's eruption 1980
  giardiasis outbreak after increased run off in Red Lodge, Montana from increased ash
- Would be rare in US to see outbreak of Hepatitis A, typhoid, cholera, malaria, measles, etc.

Epidemics after Disaster
Influence of Public Health Infrastructure

<table>
<thead>
<tr>
<th>Year</th>
<th>Disaster Type</th>
<th>Disease</th>
<th>Infrastructure Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF 1907</td>
<td>Fire</td>
<td>Plague</td>
<td>Quarantine failure</td>
</tr>
<tr>
<td>Duluth, MN 1918</td>
<td>Forest Fire</td>
<td>Influenza</td>
<td>Crowding, pandemic</td>
</tr>
<tr>
<td>Haiti, 1963</td>
<td>Hurricane</td>
<td>Malaria</td>
<td>Vector control stopped</td>
</tr>
<tr>
<td>Italy, 1976</td>
<td>Earthquake</td>
<td>Salmonella carriers</td>
<td>Water sanitation stopped</td>
</tr>
</tbody>
</table>

Sandrock C. Infectious Diseases and Natural Disasters (1)
Influence of Phase of Disaster

- Impact Phase (day 0-4)
  - extrication
  - immediate soft tissue infections
- Post Impact Phase (4d – 4 weeks)
  - airborne, foodborne, waterborne and vector borne/zoonotic infections
- Recovery Phase (>4 weeks)
  - infections with long incubation, vector borne or zoonotic

Impact Phase

- Skin and soft tissue disruption
  - infected wounds, inc. from staph and MRSA, vibrio species if exposure to sea/brackish water
  - tetanus prevention

<table>
<thead>
<tr>
<th>Vaccination history</th>
<th>Clean, minor wounds</th>
<th>All other wounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown or ≤3 doses</td>
<td>Td or Tdap (Tdap preferred for ages 11-64 if not previously received)</td>
<td>Td or Tdap PLUS IG</td>
</tr>
<tr>
<td>≥3 doses and 6-10 years since last dose</td>
<td>Td or Tdap</td>
<td>Td or Tdap</td>
</tr>
<tr>
<td>≥3 doses and &gt;10 years since last dose</td>
<td>Td or Tdap</td>
<td>Td or Tdap</td>
</tr>
</tbody>
</table>

http://emergency.cdc.gov/disasters/disease/tetanus.asp
Post Impact Phase - Water borne and/or Food borne (Disruption of Sanitation)

- Gastroenteritis (nonspecific) - hydration and improved hygiene
- Gastroenteritis - viral: Norovirus, Rotavirus, Hepatitis A, E - hydration and improved hygiene
- Gastroenteritis - bacterial: shigellosis, salmonellosis, cholera; cholera more likely in developing world, relatively rare in developed world; hydration mainstay of therapy

### Bacterial Gastroenteritis

<table>
<thead>
<tr>
<th>Agent</th>
<th>Sx/course</th>
<th>Incub</th>
<th>Infect</th>
<th>Exclude</th>
<th>Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shigella</td>
<td>Diarrhea from food, febrile, abd cramps</td>
<td>1-3 d</td>
<td>must run stool for C/W</td>
<td>Ill contacts from food handling, pt care, infant care</td>
<td>If severe, mimics sepsis, may need intensive care / local R trends</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Diarrhea, fever, abd cramps, H/A, N, see V</td>
<td>12-48 hrs</td>
<td>Through sx, variable if carrier</td>
<td>*</td>
<td>Sd or, elderly, debilitated, aboard, col, HIV, pts w/post GI; quinolone or ampicillin</td>
</tr>
<tr>
<td>Salmonella enterica subsenterica serovar typhi</td>
<td>Fever, rash, cough, malaise, headache, cough, rash, fever</td>
<td>4-14 d</td>
<td>1-14 d for V. Paratyphoid</td>
<td>*</td>
<td>Carries, Sd or, elderly, debilitated, HIV; pseudomonas, local R trends</td>
</tr>
</tbody>
</table>

### Typhoid Fever Rash

- “rose spots” - flat red spots

## Bacterial Gastroenteritis and other Post Impact Phase Infections

<table>
<thead>
<tr>
<th>Agent</th>
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<th>Infect</th>
<th>Exclude</th>
<th>Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibrio cholerae, Serogroup 01 &amp; 0139 FLOODS</td>
<td>Mild-severe watery diarrhea, often in immunocompromised or w liver disease</td>
<td>2-5 d</td>
<td>Few if different but carriers</td>
<td>None</td>
<td>Tetracyclines</td>
</tr>
<tr>
<td>Leptospirosis contact w water, food or soil contaminated w urine of infected animals FLOODS</td>
<td>1st phase: fever, chills, myalgia, V, D, jaundice, conjunctival suffusion, abdominal pain, transient rash 2nd phase: renal failure, liver failure, meningitis, hemorrhage w resp failure</td>
<td>5-14 d</td>
<td>N/a</td>
<td>N/a</td>
<td>Penicillin, amoxicillin, doxycycline Dx w serology</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Image 1</th>
</tr>
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Hogs on a Hot Tin Roof: Stranded on a roof in flooded Osilville, Iowa these hogs try to stay high and dry. Expect livestock prices to be on the rise too.

Source: Wall Street Journal 6/20/08

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<thead>
<tr>
<th>Image 2</th>
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 Conjunctival suffusion
Post Impact Phase – Vector borne Infections

- West Nile Virus, SLE endemic in US
- Malaria very significant worldwide; regularly see introduced cases in US – theoretically could get to effective vector (Anopheles), especially if disrupted vector control activities and increased mosquito breeding habitat
- Dengue – endemic cases in Texas and is at increased rates in northern Mexico; vector (Aedes aegypti and albopictus) widespread in S. United States
- Yellow Fever – rare in US; vector Aedes aegypti present
- Typhus – endemic in mountainous Mexico, Central and S. America, central and eastern Africa, Asia (cooler areas where lice are common); zoonosis of flying squirrels in US

Global distribution (Robinson projection) of dominant or potentially important malaria vectors. From Koveshik et al., 2004, American Journal of Tropical Medicine and Hygiene 70(5):486-498.
Malaria

- 1,337 cases in US in 2002, >50% *P. falciparum*
- Sx (uncomplicated) non-specific: fever, chills, sweats, H/A, GI sx, body aches, malaise; complicated (*P. falciparum*): jaundice, hepatomegaly, respiratory distress, neurologic sx
- Dx: microscopy – identify parasite, quantify degree of parasitemia
- Rapid antigen tests (not in US)
- PCR

Malaria continued

- Severe illness w *P. falciparum* with multiple organ failure: CNS (impaired consciousness, coma), severe hemolytic anemia, hemoglobinuria, pulmonary edema, ARDS, thrombocytopenia, abnormal coags, acute renal failure, hyperparasitemia (>5% RBCs w parasites), metabolic acidosis, hypoglycemia.
- *P. vivax* and *P. ovale* must treat dormant hypnozoites in liver after completing primary therapy to prevent relapses
- *P. falciparum* and *P. vivax* species have different drug sensitivities dependent on geography
- Treat uncomplicated malaria w oral meds, complicated malaria w parenteral meds
Dengue

- 4 serotypes, no cross immunity; severity of clinical disease increases w each infection
- Undifferentiated fever or no sx in up to 87%, esp kids
- Classic Dengue Fever (“break bone fever”)
  Sx: fever (3-14 d after mosquito bite), frontal H/A, retro-orbital pain, myalgias, arthralgias, N, V, maculopapular rash. Acute sx last ~1 week; weakness, malaise, anorexia may persist several weeks.
  Rx: symptomatic with emphasis on oral hydration. Avoid ASA/NSAIDS.
Rash of Dengue Fever

Dengue continued

- Dengue Hemorrhagic Fever (DHF)
  As fever from DF decreases, pt develops increased restlessness or lethargy, mild signs of circulatory failure and hemorrhagic sx - commonly mild such as petechiae, microscopic hematuria, but may progress to epistaxis, bleeding gums, hematemesis, melena. May see thrombocytopenia and hemoconcentration. May rapidly progress to Dengue Shock Syndrome (DSS), which has ~10% mortality if not treated.

Positive Tourniquet Test

- Inflate blood pressure cuff to a point midway between systolic and diastolic pressure for 5 minutes. Positive result if >20 petechiae in 1 square inch.

http://www.cdc.gov/ncidod/dvbid/dengue/slideset/set1/pps/slides-vi.pps#318,9,Tourniquet Test
Dengue continued

• Dengue Shock Syndrome (DSS)
  Shock caused by loss of intravascular volume from leaky capillaries rather than from hemorrhagic causes. Early warning signs: severe abd pain, protracted V, marked change in temp (↑ or ↓), change in mental status. May progress to shock - restlessness, cold clammy skin, rapid weak pulse, narrow pulse pressure, hypotension.
  Rx of DHS and DSS - mainstay is IV fluid replacement - can reduce fatality to <1%. Use acetaminophen based pain/fever control meds (ASA, NSAIDS may increase bleeding or cause Reyes syndrome in children).
• Dx: acute serum w/in 5 d onset fever for virus isolation or “convalescent” specimen ≥6 d after onset sx for serology.

Post Impact Phase Infections - Respiratory

• Viral, especially URI’s, especially in children under 5
• CAP

Recovery Phase Infections

Need longer incubation period
• Tuberculosis - may need to consider at earlier phases due to disruption of care for those in treatment
• Coccidioidomycosis
• Leptospirosis
Nature of the Disaster

• Earthquakes → crush injuries, soft tissue infections
• Floods → disruption of water and sanitation systems, will see more water borne and vector borne/zoonotic infections
• Famines, refugee generating armed conflicts → airborne and waterborne infections (measles, diarrheal illnesses and acute respiratory illnesses most common cause of infection related deaths)

General Disaster Reminders

• Vaccinations are the mainstay of outbreak control in many situations (less so in US).
• Dead bodies pose little to no infectious disease risk. Workers handling dead bodies should use universal precautions for blood/body fluids, use/correctly dispose of glove, use body bags if available, hand washing w soap after handling bodies and before eating, disinfect vehicles and equipment.
• Early surveillance and hygiene can stem outbreaks.

Measures to Reduce risk of Communicable Diseases after Disaster

• Early dx/rx of diarrheal disease and ARI, esp in <5 yrs
• Availability/use of treatment protocols for the main communicable disease threats, based on what is endemic
• Proper wound cleaning/care inc: appropriate tetanus proph
• Availability of meds/supplies such as oral/IV rehydration solutions, antimicrobials, etc
• Distribution of health education messages emphasizing good hand hygiene practices, safe food preparation techniques, boiling/chlorination of water, seek Rx early if fever, vector control adapted to local context/epi, mass vaccination if measles vax rate low
References


3. www.CDC.gov multiple sites