Outbreaks and natural disasters – myths and realities

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Outline of lecture

1. Literature review
2. Climate change
3. Risk factors for outbreaks after natural disasters
4. Dead bodies and disasters
5. Priority interventions for communicable diseases following disasters
6. Preparedness
Fear over quake disease outbreak

With 23,000 people dead and more than 1m made homeless by the South Asian earthquake, fears of disease have been raised.

“The really important factor is this environmental health. Is there clean water to drink? Is sewage disposed off?”

"Dr Ron Behrens, disease expert"

Only two thirds of children are immunised against measles
Health officials and aid workers on the scene have warned unless fresh water and food are made available potentially-deadly diseases such as cholera, plague and diarrhoea-related illnesses will take hold.

This is not the first time outbreaks of disease have been warned about following natural disasters.

In the aftermath of the South Asia tsunami, experts predicted the death toll from disease could dwarf those killed by the wave.
Deaths on such a scale did not materialise, neither did they following Hurricane Katrina last month.

But some predict this time it will be different.
Dr Ron Behrens, a disease expert at the London School of Hygiene and Tropical Medicine, said: "In the case of the US (Hurricane Katrina) people were, eventually, removed from the area so disease never took hold.

"With the tsunami, what is interesting is that while many people died initially, it did not damage the infrastructure such as water supply and sewage disposal to the scale this earthquake may have.

"I would expect there to be a lot of disruption to this infrastructure and that could lead to cholera and diarrhoea.

"Insects are also likely to thrive in this environment, although it maybe too cold for malaria to take off. Plague is also a concern.

"The key is getting clean water to people and getting rid of sewage, it will be a hard task."
Literature review
Floret N, Viel J-F, Mauny F, Hoen B, Piarroux R.

- From 1985 to 2004, 516 earthquakes, 89 volcano eruptions, and 16 tidal waves or tsunamis (geophysical disasters) were identified in the Em-Dat database.

- Of 233 articles on geophysical disasters in Medline database, 18 (7.7%) reported on infectious disease data collected after disaster.

- Common respiratory tract infections and diarrhoea = most frequently reported diseases.

- Only 3 out of 233 articles on geophysical disasters reported outbreaks.
Literature review
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Available from http://www.cdc.gov/ncidod/EID/vol12no05/05-1569.htm

- Only 3 out of 233 articles on geophysical disasters reported outbreaks

  - June 1991 through May 1992, total 3,597 cases recorded, cf 549 and 681 cases for the same period during the 2 preceding years. Despite heavy rainfall in August 1991, authors suggested earthquake may have played a role.

- **Coccidioidomycosis outbreak** **after the 1994 California Northridge earthquake**, AR = 30 cases per 100,000 inhabitants. Associated with exposure to increased levels of airborne dust from landslides that occurred following the earthquake [Schneider E, Hajjeh RA, Spiegel RA, Jibson RW, Harp EL, et al. A coccidioidomycosis outbreak following the Northridge, Calif, earthquake. JAMA. 1997 Mar 19;277(11):904-8.]

More recent major disasters (1)

- Hurricane Mitch Nicaragua 1998 – 4-fold increase in acute respiratory infection
- Floods Brazil 1996 – Leptospirosis outbreak
- Floods Krasnodar region of the Russian Federation 1997 – Leptospirosis
- Floods West Bengal 1998 – large cholera (01, El Tor, Ogawa) epidemic – 16590 cases CFR 1.7%.
- Floods Argentina 1998 – Leptospirosis
- Floods Mozambique 2000 – increase in incidence of diarrhoea
- Floods Mumbai India 2000 - Leptospirosis
- Floods Taiwan, associated with Typhoon Nali 2001 - Leptospirosis
- Floods Bangladesh 2004 – >17000 cases of acute diarrhoea (ETEC and cholera)
More recent major disasters (2)

- **Tsunami** Asia 2004 – no major outbreaks, large cluster 106 tetanus cases (CFR 19%), clusters of measles & hepatitis A, sporadic cases of typhus, typhoid, dengue and DHF.

- **Hurricane Katrina** USA 2005 – 18 wound-associated (6 deaths) & 4 non wound-associated Vibrio infections.

- **Earthquake** South Asia 2005 – cholera (738c CFR 0%), Pakistan; some tetanus & hep E cases.

- **Floods** Horn of Africa 2006 – Rift Valley Fever, Kenya (684c CFR 23%), Tanzania (290c, CFR 40%), Somalia (114c, CFR 45%)

- **Cyclone Myanmar** 2008 – no outbreaks

- **Earthquake China** 2008 – no outbreaks

- **Hurricanes Caribbean** 2008 – no outbreaks
Climate change


- Intergovernmental Panel on Climate Change (established by the United Nations Environment Program and the World Meteorological Organization in 1988) – 2007 report provided projections on impact of climate change:
  - Warmer temperatures, most severe in northernmost latitudes,
  - More rainfall because of increased fraction of precipitation falling as rain rather than snow,
  - More frequent droughts, wildfires and extreme weather events such as hurricanes and tornados.
Climate change


- **North America**, infectious diseases may expand ranges due to northern expansion of vector populations (e.g. tick-borne diseases i.e. Lyme disease, & mosquito-borne diseases i.e. dengue);

- **Europe**, the expansion of the range of ticks and other vectors (e.g., sandflies) may increase incidence & distribution of Lyme disease, boutonneuse fever, and leishmaniasis.

- **Australia**, southern expansion of mosquito ranges is expected to increase endemic diseases as Ross River virus, Barmah Forest virus and Murray Valley encephalitis.
– Prolonged amplification cycles and warmer winter temperatures may facilitate the establishment of imported mosquito-borne diseases in countries from which they have historically been absent.

– E.g. chikungunya fever, a mosquito-borne disease endemic in parts of Africa and Asia, caused a large outbreak of disease in northeastern Italy, presumably following importation of infected mosquitoes via boat or air.
Increased rains

- Increased mosquito breeding sites → increased transmission risk

- Increased distribution of water sources → increased numbers of mosquito predators and decreased geographic concentrations of amplifying hosts (i.e., birds) → may lower the risk of transmission

- Large water-borne disease outbreaks linked to extreme precipitation events likely to increase

- Increased food- and water-borne illness likely to increase with increased rains and increased temperatures
China: Earthquake - Dec 2008
Guyana: Floods - Dec 2008
Pacific Islands: Severe Sea Swell Floods - Dec 2008
Malaysia: Floods and Landslides - Dec 2008
Kyrgyzstan: Energy/Water/Food Insecurity Nov 2008
Tropical Cyclone Nisha - Nov 2008
Brazil: Floods and Landslides - Nov 2008
Costa Rica: Floods - Nov 2008
Panama: Floods - Nov 2008
Philippines: Flash Floods - Nov 2008
Cuba: Floods - Nov 2008
Viet Nam: Tropical Storm Noul - Nov 2008
Ethiopia: Flash Floods - Nov 2008
Indonesia: Earthquake - Nov 2008
Indonesia: Landslide - Nov 2008
OPT: Flash Floods - Nov 2008
Bolivia: Severe Local Storm - Nov 2008
Haiti: School Collapse - Nov 2008
Tropical Storm Maysak - Nov 2008
Colombia: Volcanoes - Nov 2008
Hurricane Paloma - Nov 2008
China: Landslides - Nov 2008
Bolivia: Drought - Oct 2008
Pakistan: Earthquake - Oct 2008
Sudan: Floods - Oct 2008
Bangladesh: Tropical Storm Rashmi - Oct 2008
Indonesia: Floods - Oct 2008
Morocco: Flash Floods - Oct 2008
Yemen: Floods - Oct 2008
Central America: Floods - Oct 2008
Viet Nam: Floods - Oct 2008
Hurricane Omar - Oct 2008
Mexico: Hurricane Norbert - Oct 2008
Burundi: Floods - Sep 2008
China: Earthquake - Oct 2008
Kyrgyzstan: Earthquake - Oct 2008
Rwanda: Floods - Oct 2008
Somalia: Floods - Oct 2008
Algeria: Flash Floods - Oct 2008
Tajikistan: Drought - Oct 2008
Syria: Drought - Sep 2008
Typhoon Mekkhala - Sep 2008
Typhoon Jangmi - Sep 2008
Hurricane Kyle - Sep 2008
Colombia: Floods and landslides - Sep 2008
Guatemala: Floods - Sep 2008
Typhoon Hagupit - Sep 2008
Nepal: Floods and Landslides - Sep 2008
Uganda: Floods - Sep 2008
Typhoon Sinlaku - Sep 2008
Iran: Earthquake - Sep 2008
Paraguay: Drought - Sep 2008
Philippines: Floods and landslides - Sep 2008
Egypt: Landslide - Sep 2008
Hurricane Ike - Sep 2008
Panama: Floods - Sep 2008
Chile: Floods - Sep 2008
Hurricane Hanna - Aug 2008
China: Earthquake in Yunnan - Aug 2008
Typhoon Nuri - Aug 2008
Tropical Storm Fay - Aug 2008
Cameron/Chad: Floods - Aug 2008
Paraguay: Severe Local Storm - Aug 2008
Sudan: Floods - Aug 2008
Tropical Storm Kammuri - Aug 2008
Pakistan: Floods - Aug 2008
Typhoon Fung-Wong - Jul 2008
Central and Eastern Europe: Floods - Jul 2008
Hurricane Dolly - Jul 2008
Guatemala: Landslides - Jul 2008
Typhoon Kalmaegi - Jul 2008
Philippines: Ferry Disaster/Toxic Cargo - Jul 2008
Madagascar: Rift Valley Fever - Jul 2008
Peru: Cold Wave - Jul 2008
Nepal: Floods and Landslides - Jul 2008
West Africa: Floods - Jul 2008
Nicaragua: Floods - Jun 2008
Bangladesh: Floods - Jun 2008
South East Asia: Typhoon Fengshen - Jun 2008
Suriname: Floods - Jun 2008
India: Floods - Jun 2008
Gambia: Severe Local Storm - Jun 2008
Philippines: Flash Floods - Jun 2008
Central America: Tropical Storm Arthur - May 2008
Central America: Tropical Storm Alma - May 2008
Chile: Floods - May 2008
Philippines: Tropical Cyclone Halo
Philippines: Flash Floods - May 2008
China: Earthquake in Sichuan Province
Chile: Volcano Chaitén - May 2008
Myanmar: Tropical Cyclone Nargis
Southeast Asia: Floods - May 2008
Sri Lanka: Floods - Apr 2008
China: Typhoon Neoguri - Apr 2008
DR Congo: Airplane Crash - Apr 2008
Colombia: Nevado del Huila Volcano
Papua New Guinea: Landslides - Apr 2008
Argentina: Floods - Mar 2008
Albania: Explosions - Mar 2008
Paraguay: Floods - Mar 2008
Mozambique: Cyclone Jokwe - Mar 2008
Kazakhstan: Floods - Mar 2008
Peru: Floods - Feb 2008
Philippines: Floods and Landslides - Feb 2008
Madagascar: Cyclone Ivan - Feb 2008
Ecuador: Floods - Feb 2008
Great Lakes: Earthquake - Feb 2008
South Pacific: Tropical Cyclone Gene
Tajikistan: Cold Wave - Jan 2008
China: Cold Wave - Jan 2008
Brazil: Floods - Jan 2008
Tanzania: Floods - Jan 2008
Colombia: Volcanic Eruption - Jan 2008
Afghanistan: Avalanches and Heavy Snow
Chile: Volcano - Jan 2008
Ecuador: Tungurahua Volcano - Jan 2008
Kyrgyzstan: Osh Earthquake - Jan 2008
What have we learned about CD threat after natural disasters?


- Type of disaster / Geographical area / Level of development of the disaster-affected region

- In the immediate aftermath of a disaster, most deaths are due to trauma or drowning.

- Communicable Diseases caused mostly by secondary effects and NOT by primary hazard.

- May be an increase in epidemic diseases such as cholera, bacillary dysentery or meningitis, or endemic diseases such as malaria, acute respiratory infections

- Natural disasters rarely cause large scale outbreaks unless certain risk factors persist that increase infectious disease transmission
GROUP WORK 1:

List any risk factors you think would INCREASE communicable disease transmission after a natural disaster?
Factors influencing communicable disease transmission after disasters -

Epidemiologic Triad

- Environment
- Agent
- Host
Potential risk factors for CD transmission (i)

Environment:
- Loss of shelter
- Location of temporary housing / overcrowding / poor ventilation
- Lack of water (or contaminated water)
- Inadequate sanitation
- Disruption of public utilities (e.g. electricity, water and sewage treatment)
- Environmental changes increasing vector breeding sites (rats, mosquitoes)
- Population displacement from low to high endemic area (e.g., malaria)
- Lack of access to health services
- Poor surveillance/response systems

South Korean Emergency Relief Centre sets up kitchen stoves in the Bassian relief camp, near Balakot, Pakistan. UNHCR PHOTO/B. Baloch
Potential risk factors for CD transmission (ii)

Host:
- Health status / stress
- Low levels of immunity
- High levels of malnutrition
- Low levels of vaccination coverage
- Increased exposure to disease vectors (mosquitoes, fleas, lice) while sleeping outside or in crowded conditions
- Lapse in hygiene practices – hand washing, boiling of drinking water
- HIV seroprevalence
- Underlying chronic disease

Agent:
- Presence in affected area
- Hardiness / ability to survive in environment
- Virulence
- Pathogenicity
- Drug resistance
Most important risk factors for increase CD transmission in emergencies (review)

1. Overcrowding
2. Inadequate shelter
3. Insufficient vaccination coverage
4. Poor water, sanitation and hygiene conditions
5. High exposure to and/or proliferation of disease vectors
6. Insufficient nutrient intake / malnutrition
7. Lack of and/or delay in treatment
Group work 2:

List some effects the following disasters (tsunami, floods, earthquake, drought, hurricane/cyclone, volcanic eruption) could have on vital infrastructure, living conditions and environment that could affect the health status of the population?
Different disasters – different effects?

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Tsunami</th>
<th>Floods</th>
<th>Drought</th>
<th>Earthquake</th>
<th>Hurricane Cyclone</th>
<th>Volcanic eruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure destruction</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Loss shelter</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Population displacement</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Overcrowding</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Stagnant water</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+/-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Contaminated water/Poor sanitation</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Environmental damage</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Food insecurity</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## Which diseases when?

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Disease</th>
<th>Delay since disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding, intense rains, temperature abnormalities</td>
<td>Malaria, Dengue, Rift Valley Fever, Leptospirosis, West Nile Fever, Scrub Typhus</td>
<td>At least 1 month</td>
</tr>
<tr>
<td>Displacement from non-endemic to endemic area</td>
<td>Malaria</td>
<td>At least 1 month</td>
</tr>
<tr>
<td>Overcrowding</td>
<td>Measles, meningitis, influenza Faecal-oral diseases</td>
<td>As little as 2 weeks</td>
</tr>
<tr>
<td>Insufficient/contaminated water</td>
<td>Faecal-oral diseases (Cholera, shigellosis, rotavirus, typhoid fever, hepatitis A &amp; E, salmonella)</td>
<td>Within 2 weeks</td>
</tr>
<tr>
<td>Poor sanitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malnutrition</td>
<td>Affects all diseases esp measles, diarrhoeal diseases, ARI</td>
<td>Starting about 1-2 months</td>
</tr>
<tr>
<td>Interrupted vaccination</td>
<td>Measles</td>
<td>A few months</td>
</tr>
<tr>
<td>Injuries</td>
<td>Tetanus</td>
<td>Within few days-week</td>
</tr>
</tbody>
</table>
Aid workers in western India say the risk of a serious outbreak of disease is increasing due to the huge numbers of decomposing bodies lying unburied in the ruins of buildings.

About 16,000 bodies have been recovered so far from the worst hit areas in Gujarat state where the earthquake struck nine days ago, but the task is nowhere near complete.
Dead bodies

GROUP WORK 3:

How can dead bodies, resulting from a natural disaster, affect communicable disease transmission?
Dead bodies and outbreaks

- No evidence that corpses pose a risk of disease “outbreaks” after natural disasters.
- Most agents do not survive long in human body after death.
- Victims of natural disasters usually die from trauma and are unlikely to have "outbreak-causing" infections.
- Source of acute infections more likely to be survivors.
- However observe universal precautions for persons involved in close contact with human remains (burial teams)
  - as may be exposed to chronic infectious hazards — including hepatitis B, hepatitis C, HIV, enteric pathogens and Tuberculosis.
- A few special cases require specific precautions, such as handling dead bodies where cause of death was cholera or a haemorrhagic fever.
Key interventions after disasters in the short term

- GROUP WORK 4:

- What key interventions would you put into place to prevent outbreaks after natural disasters?
Key interventions after disasters – short term

1. Emergency medical and surgical care (incl tetanus toxoid/vaccination)
2. Ensure safe water and adequate sanitation/hygiene
3. Provision of safe food
4. Provision of shelter without overcrowding (site planning)
5. Immunization (measles = priority, restart routine EPI)
6. Primary & referral health care services & supplies – for treatment
7. Disease surveillance system (+ lab) and rapid outbreak response
8. Health education (e.g. safe water & food, excreta disposal, hygiene)
9. Vector control
10. Environmental sanitation/waste disposal
11. Appropriate handling of corpses
In the long term

- Legislative and administration issues: disaster committee functions/activities, water quality and quantity regulations, disaster preparedness and response planning.
- Technical issues: update guidelines/protocols accordingly, training, preparedness for potential outbreaks.
Preparedness for potential outbreaks

- Risk assessment of potential disease threats
- Standard & locally adapted guidelines & tools for CD control
- Consistent strategy for CD control among all partners
- Clear diagnostic and case management protocols
- Common disease surveillance/early warning system used by all partners for detection and reporting
- Laboratory capacity
- Raising community awareness among populations likely to be affected by disasters.
- Training of health and outreach staff on CD case identification and management.
- Pre-positioning local stocks of supplies and equipment for CD diagnosis, treatment and outbreak control.
Overall recap on outbreaks and disasters

- Risk factors for outbreaks after disasters associated primarily with population displacement and consequent living conditions
  - Degree of crowding
  - Availability of safe water and sanitation facilities
  - Environmental change causing vector proliferation
  - Underlying health status of the population (e.g. malnutrition, vaccination)
  - Availability of healthcare services

- All interact within context of local disease ecology to influence risk for CD transmission and risk of outbreaks and related disease/death in the affected population.
Thank You