PARIPEX - INDIAN JOURNAL OF RESEARCH

20	Irnal or Pa	OR	IGINAL RESEARCH PAPER	Zoology
Indian	PARIPET.	POST PREV	T DISASTER EPIDEMICS: POSSIBILITIES AND /ENTION	KEY WORDS: Disaster, epidemics, communicable diseases, outbreak, prevention.
Neena Kumar			Assistant Professor, Gargi College, University of Delhi, Delhi-110 049	
Rashmi Saini			Assistant Professor, Gargi College, University of Delhi, Delhi-110 049	
RACT	The relationship between natural disaster and diseases followed afterwards is misconstrued. The risk for outbreaks in the aftermath is often overemphasized by health officials and media leading to panic, confusion and sometimes irrelevant public activities. The fear is derived from association between corpses and epidemics. However, the risk factors for outbreaks after disasters are associated primarily with population displacement. The availability of safe water and sanitation facilities, the degree			

of crowding, underlying health status of the population and the availability of health care services all interact in relation to local disease ecology to influence the risk for communicable diseases and death in affected population. This comprehensive review

aims at describing potential infectious and communicable diseases after natural disasters and summarizing risk, prevention and control measures to be considered with preparedness and prior assessment.

INTRODUCTION

ABSTR

Natural disasters are catastrophic events with atmospheric, geologic, and hydrologic origins including earthquakes, drought, volcanic eruptions, landslides, tsunamis, floods, tropical cyclones (hurricanes and typhoons) and tornadoes. Natural disasters are defined as disruptions of ecological system that exceed the capacity of community to adjust. They can be divided into three groups such as hydro-meterological disasters (Floods, wave surges, storms, typhoons, hurricanes and tornadoes), geomorphological disasters (landslides and avalanches) and geophysical disasters (earthquakes, tsunamis and volcanic eruptions) Natural disasters lead to infectious disease outbreaks when they result in substantial population displacement and elevated synergic risk factors for disease transmission such as change in environment in human conditions and in vulnerability to existing pathogens. The infectious diseases include diarrheal diseases, acute respiratory infections (ARI), malaria, leptospirosis, measles, dengue fever, viral hepatitis, typhoid fever, meningitis, tetanus, cutaneous mucormycotic etc. Brazil, hit hard by the Zika virus in 2015 and 2016, is once again in the throes of a devastating mosquito-borne disease.

Epidemics is, therefore, an unusual increase in the number of cases of an infectious disease which already exists in a certain region or population or it can also refer to appearance of a significant number of cases of infectious diseases in a region or a population that was usually free from that disease before.

Natural disasters can have rapid or slow onset resulting into serious health and socio- economic consequences. During the past two decades, natural disasters have killed millions of people, adversely affected the lives of at least 1 billion more people, and resulted in substantial economic damages (United Nations Cultural Scientific and Cultural Organization, 2006). Developing countries are disproportionately affected when compared with developed countries because they may lack resources, infrastructure, and disaster-preparedness systems (Noji, 1997 and Ahern. et. al., 2005).

Deaths associated with natural disasters, particularly rapid-onset disasters, are due to blunt trauma, crush-related injuries, or drowning. Deaths from communicable diseases after natural disasters are less common. Corpses pose serious health risks only in situations that need special precautions such as deaths from cholera (Sack et al, 1998) or hemorrhagic fevers (Boumandouki et al, 2005) for which recommendations are included for management of dead bodies.

Prolonged health impacts of natural disasters on a community may see the collapse of health facilities and health care systems, disruption of surveillance and health programs like immunizations and vector control programs, limited farming activities like scarcity of food and food production, interruption of ongoing treatments and use of unprescribed medications. These after effects include displaced populations, environmental changes, increasing vector breeding grounds, increasing population of disease vectors like rodents, mosquitoes, unplanned and over-crowded shelters, poor water and sanitation conditions, poor nutritional status and poor personal hygiene, low levels of immunity to vaccine-preventable diseases or insufficient vaccine coverage (Kouadio et al, 2009) and limited access to health care services. These changes in human conditions, ecosystem of pathogens and environment leads to epidemiologic triad.

Risk assessment in post disaster conditions is essential so that rapid implementation of control measures can be done and primary healthcare delivery should be given at high priority.

1. EPIDEMICS OF DISEASES: POSSIBILITIES AND PREVENTION

For those who survived the disaster but lost their homes face additional risks. The diseases associated with populations displaced by natural disasters should be considered important as post disaster assessment are to be performed.

1.1. Water-Related Communicable Diseases

After contamination of drinking water takes place due to flooding and related displacements, diarrheal disease outbreaks can occur. The risk for diarrheal disease outbreaks after natural disasters is higher in developing countries than in industrialized countries. (Noji, 1997 and Ahern et al, 2005)

In Muzaffarabad, Pakistan acute watery diarrhea outbreak occurred in poorly equipped camp of 1800 persons after 2005 earthquake (WHO, 2006). In Acez province, Indonesia tsunami brought diarrhea in 85% of residents. (WHO, 2005). In United States, diarrheal illness was noted after hurricanes Allison (Waring et al, 2002) and Katrina (Centers for disease control and prevention, 2005 and 2006). Norovirus *Salmonella* and *Vibrio* cholerae were confirmed culprits for Katrina evacuees. Diarrheal disease outbreak in Bangladesh in 2004 involved *V. cholerae* and *Escherichia coli.* (Qadri et al, 2005)

1.1.1. Cholera: An intestinal infection which is mainly spread by drinking contaminated water and eating contaminated food with feces. This poses biggest threat to survivors of disaster because it progresses rapidly. The infection leads to excessive dehydration

PARIPEX - INDIAN JOURNAL OF RESEARCH

followed by shock and risk of death.

Incubation period is 1-12 days and severe cases need hospitalization. Less severe cases can be handled with precautions and ensuring a safe water supply and good hygiene (Table 1).

1.1.2. Typhoid fever and Dysentery: Typhoid fever and dysentery are caused by eating food or drinking contaminated fluids handled by an infected person or by infected sewage gets access to water for drinking and washing purpose.

A lack of access to treatment in post disaster areas increases the risk of complications which may prove fatal.

1.1.3. Hepatitis A and E: These diseases spread under unsanitary conditions, through human feces in contaminated water or food which follows floods and heavy rains. Those suffering are urged to rest, stay hydrated and try to eat nutritious foods and maintain hygiene. Both hepatitis A and E were noted in Acez after 2004 Tsunami and earthquake in Pakistan in 2005 (WHO, 2006).

1.1.4. Balantidiasis: Another gut-wrenching infection caused by contacts with contaminated water. It is prevalent in areas where people and pigs live in close proximity. Many pigs carry the bacteria that cause balantidiasis and it can be passed from pigs to humans when pig feces get into water humans use for washing or drinking. If left untreated, it can kill (Table 1).

1.1.5. Leptospriosis: Contaminated drinking water by the urine of animals that carry the bacteria that causes leptospriosis — cattle, pigs, horses, dogs, rodents and wild animals can bring on leptospriosis. In rare cases, leptospriosis can kill. It can be treated through antibiotics (Table 1). There was an outbreak of the disease in 1996 in Puerto Rico in the aftermath of a hurricane. And outbreaks of leptospirosis occurred in Taiwan, China with typhoon Nali in 2001 (Yang et al, 2005), in India after flooding in 2000 (Karande et al, 2003)

1.2. Diseases Associated with Crowding

1.2.1. Measles: Crowding living conditions facilitate measles transmission which is highly communicable viral infection that can result in very high mortality rate especially among children and malnourished population. Measles immunization has been documented as one of the most cost effective public health intervention in disaster and refugee settings (Kouadio et al, 2009). Measles vaccination campaigns together with vit A supplementation provide protection against ARIs and measles both (Fawziww et al, 2000). In case of limited vaccination supplies, the priority should be malnourished and hospitalized children next followed by six months to two-year-old children. High incidences of measles were reported in measles outbreak in Philippines in 1991, after tsunami in Acez and South Asia earthquake in Pakistan in 2005.

1.2.2. Meningitis: Neisseria meningitidis is transmitted from person to person in situations of crowding. Deaths from meningitis among those displaced in Acez and Pakistan have been well-documented (WHO,2005-2006). Meningococcal meningitis is an acute bacterial disease to affect children and young adults of especially crowded conditions. The disease is transmitted by direct contact with nose and throat discharges. Infected individuals should be separated from others. Rapid treatment is essential. Emergency immunization camps are also effective (Table 2).

1.2.3. Acute Respiratory Infections (ARI): This is major cause of illness and death among displaced populations particularly in children below 5 years of age. Risk factors among displaced

persons include crowding, exposure to indoor cooking using open flame and poor nutrition. Tsunami displaced people in Acez in 2004 (WHO, 2005) and earthquake displaced people in Pakistan in 2005 accounted for highest number of cases and deaths due to ARI.

1.3. Vector borne diseases (Table 3)

1.3.1. Malaria: An infectious disease spread by vectors mosquitoes, mainly in tropical climates. Symptoms begin showing up 10 to 15 days after infection. The people at great risk are refugees. An earthquake in Costa Rica in 1991 provided the congenial breeding grounds to mosquitoes resulted into malaria epidemics (Saenz et al, 1995)

1.3.2. Dengue: Another infectious disease spread by mosquitoes. Cases often clear up within six to seven days. However, in severe cases, death can result. Transmission of the disease and further is influenced by rainfall and humidity and changing human behavior patterns like sleeping outside, overcrowding when displaced.

1.3.3. Yellow fever: Yellow fever is a deadly and fast-spreading mosquito-borne virus occurring only in parts of Africa and South America. The disease is highly communicable.

Action to control an epidemic should include mass vaccination of people at risk; screening and spraying of patients' rooms or hospital wards to prevent mosquito access; elimination or use of larvicide on all existing or potential mosquito breeding sites; spraying with insecticide of all houses in the community. Vaccination available provides a ten-year immunity for yellow fever.

1.3.4. Avian flu: Avian influenza (AI) is a viral infection primarily affecting birds (chickens, ducks, geese etc., both domestic and migratory species), but also sometimes other species such as pigs and tigers. Rarely, bird flu can cause severe infections in humans. There are many different strains or varieties of AI viruses. They are a sub-group of influenza viruses, which includes the flu virus that causes seasonal outbreaks in humans around the world every year.

1.4. Other diseases (Table 4)

1.4.1. Tetanus: Tetanus is not transmitted person to person but is caused by a toxin released by the anaerobic tetanus bacillus *Clostridium tetani*. Contaminated wounds, particularly in populations where vaccination coverage levels are low, are associated with illness and death from tetanus. A cluster of 106 cases of tetanus, including 20 deaths, occurred in Acez and peaked 2 1/2 weeks after the tsunami. (WHO, 2005) Cases were also reported in Pakistan following the 2005 earthquake (WHO, 2006)

1.4.2. Tuberculosis: Tuberculosis (TB) is the single most deadly infectious disease and kills two million people each year. Asia and sub-Saharan Africa are the hardest hit, but Eastern Europe has recently seen a major increase in the incidence and deaths related to TB.

In 1993, the World Health Organization (WHO) launched the Stop TB initiative in response to the growing crisis. Since 1998, the International Federation of Red Cross and Red Crescent Societies has been working closely with National Societies and the WHO to control the TB epidemic in Eastern Europe.

1.4.3. Ebola and Marburg: Two distinct viral dis-eases with similar symptoms. Both have a high fatality rate up to 90 per cent for Ebola and transmission is through contact with all body fluids and organs, use of contaminated needles and syringes, and the aerosol route.

TABLE 1. WATER RELATED COMMUNICABLE DISEASES

Disease	Causative agent	Symptoms	Cure
Cholera	Vibrio cholerae	Dehydration due to profuse secretory diarrhoea	Rehydration therapy, Vaccine (Vaxchora,) Antibiotics (Furazolidone, ampicillin, erythromycin)
Typhoid	Salmonella typhi	Sustained high fever (39°C-0°C), Acute diarrhoea with abdominal discomfort, skin rash, headache, intestinal bleeding and perforation	Antibiotics (Azithromycin, chloramphenicol, amoxicillin, ciprofloxacin, sulfamethoxazole), typhoid vaccine
Dysentery	Amoebic and Bacillary	Diarrhoea with blood, mucus and pus, sudden onset of fever and chills, flatulence, loss of appetite, vomiting, dehydration and other abdominal discomforts, headache and fatigue	Rehydration therapy, antibiotics (Metronidazole, lodoquinole, ciprofloxacin, ofloxacin, azithromycin)
Hepatitis A and E	HAV HEV	Flu like symptoms, abdominal discomfort, light coloured stools, dark urine, loss of appetite and weight, jaundice	Vaccine, medication (Ribavirin)
Balantidiasis	Balantidium coli	Chronic diarrhoea, dysentery, abdominal pain, colitis, intestinal ulceration and perforations, weight loss	Antibiotics (Tetracyclin, metronidazole, iodoquinol, doxycycline)
Leptospirosis	Leptospira	High fever, chills, headache, muscle aches, vomiting, diarrhea, jaundice, skin rash, kidney damage, respiratory distress, meningitis	Antibiotics (Doxycycline or penicillin)

TABLE 2. DISEASES ASSOCIATES WITH CROWDING

Disease	Causative agent	Symptoms	Cure
Measles	Virus	Cough, sneeze, runny nose, fever, red eyes, skin rash as red spots	Vaccination with vitamin A supplementation, Medication (Acetaminophen, Ibuprofen)
Meningitis	Neisseria meningitis	Sudden high fever, stiff neck and severe headache, nausea, vomiting, seizures	Penicillin or ampicillin
Acute Respiratory infection (ARI)	Adenovirus Rhinovirus Pneumococcus	Runny nose or nasal congestion, sneezing, cough, sputum, lung infection	Branchiodilators, salbutamol, steroids

TABLE 3 VECTOR BORNE DISEASES

Disease	Causative agent	Symptoms	Cure
Malaria	Plasmodium spp.	Headache, fever, chills, muscle and joint pain, vomiting,	Chloroquine, hydroxychloroquine,
		nausea and convulsions	sulfonamide, doxycycline, pyrimethamine
Dengue	Aedes egypti,	Sudden onset of fever, severe headache, muscle and	Paracetamol for fever, Oral Rehydration
_	DenV 1-4 viruses	joint pain, rashes,	therapy
Yellow fever	Aedes egypti	Haemorrhagic condition, high fever, liver cell death and jaundice, renal problem, respiratory distress	Mass vaccination, avoid aspirin

TABLE 4 OTHER DISEASES

Disease	Causative agent	Symptoms	Cure
Tetanus	Clostridium tetani	Impairs motor neurons, lock jaw, spasm, difficulty swallowing, fever, sweating	Tetanus immunoglobulin vaccine, antibiotics (Penicillin, doxycycline) Sedatives
Tuberculosis	Mycobacterium tuberculosis	Swollen lymph nodes, lung infection, chest pain, coughing up blood or sputum, loss of weight, appetite and energy. Night sweats and low-grade fever	Medication (Isoniazid, rifampin, ethambutol, pyrazinamide) and vaccination

2. EPIDEMICS OF DISEASES: PRECAUTIONS AND CONTROL MEASURES

A rapid disease risk assessment should be conducted by public health responders within first week of disaster in order to identify disaster impacts and health needs.

2.1. Precautions for handling corpses: Dead bodies pose health risks only if death occurs from handling of dead bodies with cholera infection or hemorrhagic fevers (Sack, 1998 and Boumandouki, 2005).

Burial is preferable to cremation in mass casualty situations. Alternative locations should be provided where existing graveyards or crematoria are inadequate. Bodies should be disinfected before disposal if carrying cholera infection. Bottom of grave should be above water table. Use of body bags and gloves should be encouraged and their afterwards disposal after burial.

2.2. Food and water sanitation: Adequate supply of water per person should be there for drinking, bathing, washing and for excreta disposal and for management of solid wastes.

Community should be educated on personal hygiene and encouraged for hand washing (CDC, 2005). Cholera remains important for water disinfection. Chlorine remains the most used disinfectant and most affordable also for disinfection of drinking water. (Wilder, 2005)

2.3 Vector borne disease control: Diseases which are spread through mosquitoes like malaria, dengue can be controlled by defensive measures taken against proliferation of vectors, controlling their population by terminating their breeding grounds.

2.4. Vaccination: Effective immunization and vaccination should be considered to control outbreak of epidemics after natural disasters. Vaccination is available against yellow fever, measles, tetanus and in severe cases of cholera and meningitis.

2.5. Management: Several management protocols are available but those in accordance with national guidelines must be used to ensure appropriate treatment. Emergency and preparedness plans along with surveillance system and basic clinical and laboratory facilities should be implemented.

PARIPEX - INDIAN JOURNAL OF RESEARCH

CONCLUSION

It is important for public, policy makers and health officials to understand the concepts that disasters do not transmit infectious diseases; corpses from disasters are not a source of epidemics and disease outbreaks result from exacerbation of disease risk factors.

Control measures should be rapidly implemented in disaster displacement communities. Surveillance in disaster affected areas, in camps, hospitals, clinics and at other points where victims are treated is very important. Ideal prevention and control measures should include a strong preparedness plan for early case detection and treatment, appropriate management of water and sanitation systems, adequate food supplies and storage, strong vector control and vaccination programs. Management protocols in accordance with the national guidelines must be followed. In such situations educating victims on hygiene to follow hand washing practices becomes mandatory. Adequate water supplies, sanitation facilities and appropriate shelter becomes need of the hour to combat aftermath of diseases due to natural disasters.

REFERENCES

- 1. Ahern M et al. (2005) Global health impacts of floods: epidemiologic evidence.
- Ahern M, Kovats RS, Wilkinson P, Few R, Matthies F (2005) Global health impacts of floods: epidemiologic evidence. Epidemiol Rev. 27:36–46
- Ahern M, Kovats RS, Wilkinson P, Few R, Matthies F. (2005) Global health impacts of floods: epidemiologic evidence. Epidemiol Rev. 27 : 36–46
- Boumandouki P, Formenty P, Epelboin A, Campbell P, Atsangandoko C, Allarangar Y, et al. (2005)Clinical management of patients and deceased during the Ebola outbreak from October to December 2003 in Republic of Congo. Bull Soc Pathol Exot. 98:218–23
- Boumandouki P, Formenty P, Epelboin A, Campbell P, Atsangandoko C, Allarangar Y, et al. (2005). Clinical management of patients and deceased during the Ebola outbreak from October to December 2003 in Republic of Congo Bull Soc Pathol Exot. 98:218–23
- CDC, 2005.Centers for Disease Control and Prevention Infectious disease and dermatologic conditions in evacuees and rescue workers after Hurricane Katrina—multiple states. Morb Mortal Wkly Rep 54:961–4
- Centers for Disease Control and Prevention (2006) Two cases of toxigenic Vibrio cholerae O1 infection after Hurricanes Katrina and Rita. Morb Mortal Wkly Rep 55:31–2
- Centers for Disease Control and Prevention (CDC) (2005) Norovirus outbreak among evacuees from hurricane Katrina–Houston, Texas. Morb Mortal Wkly Rep. 54:1016–8
- Centers for Diseases Control and Prevention. Infection control guidance for community evacuation centers following disasters. Emergency preparedness and response. http://www.bt.cdc.gov/disasters/commshelters.asp
- Fawzi WW, Mbise R, Spiegelman D et al. (2000) Vitamine A supplements and diarrheal and Respiratory tract infections among children in Dar es Salaam, Tanzania. J. Pediatr. 137: 660–667.
- 11. Gerard, Fryer (2011). Japan earthquake and tsunami. Pacific Tsunami Warning Center (PTWC) (www.telegraph.co.uk)
- Karande S, Bhatt M, Kelkar A, Kulkarni M, De A, Varaiya A (2003). An observational study to detect leptospirosis in Mumbai, India, 2000. 88:1070–5 10.1136/adc.88.12.1070
- Kouadio IK, Koffi AK, Atoh-Toure H et al. (2009) Outbreak of measles and rubella in refugee transit camps. Epidemiol. Infect. 137: 1593–1601.
- Kouadio Isidore K., Aljunid S., Kamigaki T., Hammad K. and Oshitani H. (2012). Infectious diseases following natural disasters: Prevention and Control measures. Expert Rev. Anti infect. Ther. 10 (1): 95-104.
- Noji E, (1997) ed. Public health consequences of disasters. New York: Oxford University Press;
- Noji E, 1997. eds. Public health consequences of disasters. New York: Oxford University Press
- Qadri F, Khan AI, Faruque ASG, Begum YA, Chowdhury F, Nair GB, et al. (2005). Enterotoxigenic Escherichia coli and Vibrio cholerae diarrhea, Bangladesh. Emerg Infect Dis.11:1104–7
- 19. Qadri F, Khan AI, Furuque ASG et al (2005). Enterotoxigenic Escherichia coli and Vibrio cholerae diarrhea, Bangladesh. Emerg. Infect. Dis. 11: 1104–1107
- 20. Sack RB, Siddique AK (1998) Corpses and the spread of cholera. Lancet 352:1570 10.1016/S0140-6736(05)61040-9
- Sack RB, Siddique AK. (1998) Corpses and the spread of cholera. Lancet, 352:1570. Sack RB, Siddique AK. (1998) Corpses and the spread of cholera. Lancet. 352:1570 10.1016/S0140-6736(05)61040-9 [PubMed] [Cross Ref]
- 22. Saenz R, Bissell RA, Paniagua F (1995). Post-disaster malaria in Costa Rica. Prehosp Disaster Med. 10:154–60
- Sur D (2000) Severe cholera outbreak following floods in a northern district of West Bengal. Indian J Med Res.112:178–82
- Tempark T, Lueangarun S, Chatproedprai S, and Wananukul S. Flood-related skin diseases: a literature review. 52(10), 1168–1176, 2013
- United Nations Cultural Scientific and Cultural Organization [homepage on the internet]. Paris. About natural disasters. [cited 2006 Aug 10]. Available from http://www.unesco.org/science/disaster/about_disaster.shtml
- United Nations Cultural Scientific and Cultural Organization [homepage on the internet]. Paris. About natural disasters. [cited 2006 Aug 10] Available from http://www.unesco.org/science/disaster/about_disaster.shtml

- Waring SC, Reynolds KM, D'Souza G, Arafat RR (2002). Rapid assessment of household needs in the Houston area after Tropical Storm Allison. Disaster Manag Response.3–9
- Watson John T., Michelle gayer, Maire A. Connolly. 2007.communicable diseases associated with natural diasters. Emerging infectious diseases. 13 (1)
- Wilder-Smith A. (2005) Tsunami in south Asia: what is the risk of post disaster infectious disease outbreaks? Ann. Acad. Med. 34:10.
- World Health Organization (2005). Acute water diarrhea outbreaks. Wkly Morb. Mortal. Rep. 1: 6.
- World Health Organization (2005).Epidemic-prone disease surveillance and response after the tsunami in Aceh Province, Indonesia. Wkly Epidemiol Rec.. 80:160–4
- World Health Organization Acute jaundice syndrome (2006) Weekly Morbidity and Mortality Report. 23:8. [cited 2006 Aug 10]. Available from http:// www.who.int/ hac/crises/international/pakistan earthquake/sitrep/ Pakistan WMMR VOL23 03052006.pdf
- Yang HY, Hsu PY, Pan MJ, Wu MS, Lee CH, Yu CC, et al. (2005). Clinical distinction and evaluation of leptospirosis in Taiwan—a case-control study. J Nephrol 18:45–53