WHO/CDS/NTD/DCE/2006.4

Communicable diseases following natural disasters

Risk assessment and priority interventions

Programme on Disease Control in Humanitarian Emergencies
Communicable Diseases Cluster

Further information is available at:
NTD Information Resource Centre
World Health Organization
1211 Geneva 27
Switzerland
Fax: (+41) 22 791 4285

E-mail: ntddocs@who.int or cdemergencies@who.int

Web site: http://www.who.int/diseasecontrol_emergencies/en/

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Acknowledgements

Edited by John Watson, Maire Connolly and Michelle Gayer of the WHO Programme on Disease Control in Humanitarian Emergencies, Communicable Diseases Cluster.

Key contributions were made by Pamela Mbabazi (CDS/NTD), Jorge Castilla (CDS/NTD), Andre Griekspoor (DGO/IOS), Frits de Haan (FCH/CAH), José Hueb (SDE/PHE), Dominic Legros (CDS/EPR), David Meddings (CDS/NMH), Mike Nathan (CDS/NTD), Aafje Rietveld (HTM/GMP), Alice Croisier (CDS/EPR) and Peter Strebel (FCH/IVB).

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Introduction

Natural disasters are catastrophic events with atmospheric, geologic and hydrologic origins. They include earthquakes, volcanic eruptions, landslides, tsunamis, floods and drought. Natural disasters can have rapid or slow onset, and serious health, social and economic consequences. During the past two decades, natural disasters have killed millions of people, adversely affecting the lives of at least one billion more people and resulting in substantial economic damage (*1*). Developing countries are disproportionately affected because of their lack of resources, infrastructure and disaster preparedness systems.

The potential impact of communicable diseases is often presumed to be very high in the chaos that follows natural disasters. Increases in endemic diseases and the risk of outbreaks, however, are dependent upon many factors that must be systematically evaluated with a comprehensive risk assessment. This allows the prioritization of interventions to reduce the impact of communicable diseases post-disaster.

The Communicable Diseases Working Group on Emergencies (CD-WGE) at WHO/HQ has developed this document to describe the communicable disease risks in populations affected by natural disasters. It is hoped that this document, by detailing the priority measures that are necessary to reduce the impact of communicable diseases following natural disasters, will help to protect the health of disaster-affected populations.

1. Assessing the risk of communicable diseases

1.1 Communicable diseases associated with natural disasters

The sudden presence of large numbers of dead bodies in disaster-affected areas can heighten expectations of disease outbreaks (*2*), despite the fact that dead bodies do not pose a risk of outbreaks following natural disasters (*3*). Rather, the risk of outbreaks is associated with the size, health status and living conditions of the population displaced by the natural disaster. Crowding, inadequate water and sanitation, and poor access to health services, often characteristic of sudden population displacement, increase the risk of communicable disease transmission (*4*).

Although the overall risk of communicable disease outbreaks is lower than often perceived, the risk of transmission of certain endemic and epidemic-prone diseases can increase following natural disasters.

1.2 Waterborne diseases

Diarrhoeal disease outbreaks can occur following contamination of drinking-water, and have been reported following flooding and related displacement. An outbreak of diarrhoeal disease post flooding in Bangladesh in 2004 involved more than 17 000 cases, with the isolation of *Vibrio cholerae* (O1 Ogawa and O1 Inaba) and enterotoxigenic *Escherichia coli* (*5*). A large (>16 000 cases) cholera epidemic (O1 Ogawa) in West Bengal in 1998 was attributed to preceding floods (*6*), and floods in Mozambique in January–March 2000 led to an increase in the incidence of diarrhoea (*7*).

The risk of diarrhoeal disease outbreaks following natural disasters is higher in developing than in developed countries (*8*). In Aceh Province, Indonesia, a rapid health assessment performed in the town of Calang two weeks after the December 2004 tsunami found that 100% of the survivors drank from unprotected wells, and that 85% of residents reported diarrhoea in the previous two weeks (*9*). In Muzaffarabad, Pakistan, following the 2005 earthquake, an outbreak of acute watery diarrhoea occurred in an unplanned, poorly-equipped camp of 1800 persons. The outbreak involved over 750 cases, mostly adults, and was controlled following the provision of adequate water and sanitation facilities (*10*). In the United States, diarrhoeal illness was noted following hurricanes Allison (*11*) and Katrina (*12–14*), and norovirus, *Salmonella*, and toxigenic and non-toxigenic *V. cholerae* were confirmed among Katrina evacuees.

Hepatitis A and E are also transmitted by the faecal–oral route, in association with lack of access to safe water and sanitation. Hepatitis A is endemic in most developing countries, and children are exposed and develop immunity at an early age. As a result, the risk of large outbreaks is usually low in these settings. In endemic areas, hepatitis E outbreaks frequently follow heavy rains and floods; it is generally a mild, self-limited illness, but in pregnant women case-fatality rates can be up to 25% (*15*). Clusters of both

hepatitis A and hepatitis E were noted in Aceh following the December 2004 tsunami (*16*).

Leptospirosis is a zoonotic bacterial disease that is transmitted through contact of the skin and mucous membranes with water, damp vegetation, or mud contaminated with rodent urine. Infected rodents shed large amounts of leptospires in their urine. Flooding facilitates the spread of the organism due to the proliferation of rodents and the proximity of rodents to humans on shared high ground. Outbreaks of leptospirosis occurred in Taiwan, China, associated with Typhoon Nali in 2001 (*17*), and following flooding in Mumbai, India, in 2000 (*18*).

1.3 Diseases associated with crowding

Measles and the risk of transmission in the disaster-affected population is dependent on the baseline vaccination coverage rates among the affected population, and in particular among children aged <15 years. Crowded living conditions, as is common among people displaced by natural disasters, facilitate transmission and necessitate even higher immunization coverage levels to prevent outbreaks (*19*). A measles outbreak in the Philippines in 1991 among people displaced by the eruption of Mt. Pinatubo involved more than 18 000 cases (*20*). In Aceh following the tsunami, a cluster of measles involving 35 cases occurred in Aceh Utara district, and continuing sporadic cases were common despite mass vaccination campaigns (*16*). Sporadic cases and clusters of measles (>400 clinical cases in the six months following the earthquake) also occurred in Pakistan following the 2005 South Asia earthquake (*21*).

Meningitis caused by *Neisseria meningitidis* is transmitted from person to person, particularly in situations of crowding. Cases and deaths from meningitis among those displaced in Aceh and Pakistan have been documented (*16, 21*). Prompt response with antibiotic prophylaxis, as occurred in Aceh and Pakistan, can interrupt transmission.

Acute respiratory infections (ARI) are a major cause of morbidity and mortality among displaced populations, particularly in children aged <5 years. Lack of access to health services and to antibiotics for treatment further increases the risk of death from ARI. Risk factors among displaced persons include crowding, exposure to indoor cooking and poor nutrition. The reported incidence of ARI increased four-fold in Nicaragua in the 30 days following Hurricane Mitch in 1998 (*22*), and ARI accounted for the highest number of cases and deaths among those displaced by the tsunami in Aceh in 2004 (*16*) and by the 2005 earthquake in Pakistan (*21*).

1.4 Vector-borne diseases

Natural disasters, particularly meteorological events such as cyclones, hurricanes and flooding, can affect vector breeding sites and vector-borne disease transmission. While initial flooding may wash away existing mosquito breeding sites, standing-water caused

by heavy rainfall or overflow of rivers can create new breeding sites. This can result (with typically some weeks delay) in an increase of the vector population and potential for disease transmission, depending on the local mosquito vector species and its preferred habitat. The crowding of infected and susceptible hosts, a weakened public health infrastructure and interruptions of ongoing control programmes are all risk factors for vector-borne disease transmission (*23*).

Malaria outbreaks in the wake of flooding are a well-known phenomena. An earthquake in Costa Rica's Atlantic Region in 1991 was associated with changes in habitat that were beneficial for breeding and preceded an extreme rise in malaria cases (*24*). Additionally, periodic flooding linked to El Nino-Southern Oscillation has been associated with malaria epidemics in the dry coastal region of northern Peru (*25*).

Dengue transmission is influenced by meteorological conditions including rainfall and humidity and often exhibits strong seasonality. However, transmission is not directly associated with flooding. Such events may coincide with periods of high transmission risk and be exacerbated by increased availability of vector breeding sites – mostly artificial containers – caused by disruption of basic water supply and solid waste disposal services.

The risk of vector-borne disease outbreaks can be influenced by other complicating factors, such as changes in human behaviour (increased exposure to mosquitoes while sleeping outside, movement from non-endemic to endemic areas, a pause in disease control activities, overcrowding), or changes in the habitat which promote mosquito breeding (landslide deforestation, river damming and re-routing).

1.5 Other diseases associated with natural disasters

Tetanus is not transmitted from person to person, but is caused by a toxin released by the anaerobic tetanus bacillus *Clostridium tetani*. Contaminated wounds, particularly in populations where routine vaccination coverage levels are low, are associated with morbidity and mortality from tetanus. A cluster of 106 cases of tetanus, including 20 deaths, occurred in Aceh and peaked 2½ weeks following the tsunami (*26*). Cases were also reported in Pakistan following the 2005 earthquake (*21*).

An unusual outbreak of **coccidiomycosis** occurred following the January 1994 southern California earthquake. The infection is not transmitted from person to person, but is caused by the fungus *Coccidioides immitis,* which is found in soil in certain semi-arid areas of North and South America. This outbreak was associated with exposure to increased levels of airborne dust subsequent to landslides in the aftermath of the earthquake (*27*).

1.6 Disaster-related disruptions

Power cuts related to disasters may disrupt water treatment and supply plants, thereby increasing the risk of water-borne diseases. Lack of power may also affect proper functioning of health facilities, including preservation of the cold chain. An increase in diarrhoeal incidence in New York City followed a massive power outage in the United States in 2003. Investigation of the outbreak revealed an association with the consumption of meat and seafood after the onset of the power outage, when refrigeration facilities were widely interrupted (*28*).

2. Dead bodies and the risk of communicable diseases

Deaths associated with natural disasters are overwhelmingly caused by blunt trauma, crush-related injuries or drowning. The sudden presence of large numbers of dead bodies in the disaster-affected area can fuel fears of outbreaks (*2*). There is **no evidence that dead bodies pose a risk of epidemics** following natural disasters (*3*).

When death is directly due to the natural disaster, human remains do not pose a risk for outbreaks; the source of infection is more likely to be the survivors than those killed by the natural disaster (*29*). Even when death is directly due to communicable diseases, pathogenic organisms do not survive long in the human body following death (*30*). Dead bodies pose health risks only in a few situations requiring specific precautions, such as deaths from cholera (*31*) or haemorrhagic fevers (*32*).

Management of dead bodies *(3)*

The mass management of dead bodies is often based on the false belief that they represent an epidemic hazard if not buried or burned immediately.

- Burial is preferable to cremation in mass casualty situations.
- Every effort should be made to identify the bodies.
- Mass burial should be avoided if at all possible.
- Families should have the opportunity, and access to materials, to conduct culturally appropriate funerals and burials according to social custom.
- Where existing facilities such as graveyards or crematoria are inadequate, alternative locations or facilities should be provided.

For workers routinely handling dead bodies

- Ensure universal precautions for blood and body fluids
- Ensure use and correct disposal of gloves
- Use body bags if available
- Wash hands with soap after handling dead bodies and before eating
- Disinfect vehicles and equipment
- Dead bodies do not need disinfection before disposal (except in case of cholera, shigellosis, or haemorrhagic fever)
- The bottom of any grave must be at least 1.5 m above the water table, with a 0.7 m unsaturated zone.

3. Prevention of communicable diseases following natural disasters

The following priority measures are critical to reduce the impact of communicable diseases after natural disasters:

3.1 Safe water, sanitation, site planning

Ensuring uninterrupted provision of safe drinking-water is the most important preventive measure to be implemented following a natural disaster. Chlorine is widely available, inexpensive, easily used and effective against nearly all waterborne pathogens.

Settlement planning must provide for adequate access for water and sanitation needs and meet the minimum space requirements per person, in accordance with international guidelines (*33*).

3.2 Primary health-care services

Access to primary care is critical to prevention, early diagnosis and treatment of a wide range of diseases, as well as providing an entry point for secondary and tertiary care. The immediate impact of communicable diseases can be mitigated with the following interventions:

- Ensure early diagnosis and treatment of diarrhoeal diseases and ARI, particularly in those aged <5 years.
- Ensure early diagnosis and treatment for malaria in endemic areas (within 24 hours of onset of fever, using artemisinin-based combination therapy ACT for *falciparum* malaria).
- Ensure the availability and application of treatment protocols for the main communicable disease threats.
- Ensure proper wound cleaning and care. **Tetanus** toxoid with or without tetanus immunoglobulin, as appropriate, should accompany wound treatment post-disaster.
- Ensure availability of drugs included in the interagency emergency health kit, e.g. oral rehydration salts for management of diarrhoeal diseases, antibiotics for ARI.
- Distribute health education messages, including:
  - encouraging good hygienic practices;
  - promoting safe food preparation techniques;
  - ensuring boiling or chlorination of water;
  - encouraging early treatment seeking behavior in case of fever;
  - encouraging use of insecticide-treated mosquito nets as a personal protection measure in malaria-endemic areas.

- Vector control interventions adapted to the local context and disease epidemiology

3.3 Surveillance/early warning system

Rapid detection of cases of epidemic-prone diseases is essential to ensure rapid control. A surveillance/early warning system should be quickly established to detect outbreaks and monitor priority endemic diseases.

- Priority diseases to be included in the surveillance system should be based on a systematic communicable disease risk assessment. In some situations, the threats may include rare diseases such as viral haemorrhagic fevers, plague or tularaemia. A comprehensive communicable disease risk assessment by WHO can identify and prioritize these threats.
- Ensure health-care workers are trained to detect priority diseases and that prompt reporting to lead health agency occurs.
- Ensure sampling and transport materials for investigation, and appropriate stockpiles are readily available for rapid response to outbreaks, e.g. cholera kits, in areas where cholera is considered a risk.

3.4 Immunization

- **Mass measles immunization** together with vitamin A supplementation are immediate health priorities following natural disasters in areas with inadequate coverage levels. Where baseline coverage rates among those aged <15 years are below 90%, mass measles immunization should be implemented as soon as possible. The priority age groups are 6 months to 5 years, and up to 15 years if resources allow.
- Current **typhoid** vaccines are not recommended for mass immunization campaigns to prevent typhoid disease. Typhoid vaccination in conjunction with other preventive measures may be useful to control typhoid outbreaks, depending on local circumstances.
- **Hepatitis A** vaccine is generally not recommended to prevent outbreaks in the disaster area.
- The cost of the **cholera** vaccine, and the logistic difficulties involved with the administration, have prohibited its widespread use. Although helpful in specific circumstances, it should not be viewed as a replacement for the provision of adequate water and sanitation. The usefulness of the cholera vaccine, relative to other public health priorities, has not been evaluated in disaster-affected areas.

3.5 Prevention of malaria and dengue

- Specific preventive interventions for malaria must be based on an informed assessment of the local situation, including on the prevalent parasite species and the main vectors.
- An increase in mosquito numbers may be delayed following flooding, allowing time for implementation of preventive measures such as indoor residual spraying of insecticides, or the re-treatment/distribution of insecticide-treated nets preferably long-lasting insecticidal nets (LLIN) in areas where their use is well-known and accepted.
- Early detection of a possible malaria outbreak can be enhanced by monitoring weekly case numbers must be part of the surveillance/early warning system. Periodic laboratory confirmation of rapid test-positive fever cases is recommended to track the slide/test positivity rate.
- Treatment with artemisinin-based combination (ACT) therapy should be provided free of charge to the user in disaster-affected areas with falciparum malaria. An active search for fever cases may be necessary to reduce mortality.
- For dengue, the main preventive efforts should be directed towards vector control. Social mobilization and health education of the community should emphasize elimination of vector breeding sites as much as possible, specifically by:
  - continuous covering of all stored water containers;
  - removal or destruction of solid debris where water can collect (bottles, tyres, tins, etc.).

4. Disaster preparedness plans and control of communicable diseases

Although disaster-related deaths are overwhelmingly caused by the initial traumatic impact of the event, disaster preparedness plans should consider the health needs of the surviving disaster-affected populations. The health impacts associated with the sudden crowding together of large numbers of survivors, often with inadequate access to safe water and sanitation facilities, will require planning for both therapeutic and preventive interventions, such as rehydration materials, antibiotics and measles vaccination materials. Disaster response teams should be aware of and have access to the latest updated guidelines for communicable disease prevention and control, such as the WHO field manual on *Communicable disease control in emergencies* (*34*) and the Sphere project's *Humanitarian charter and minimum standards in disaster response* (*33*).

The risk of outbreaks following natural disasters, though often incorrectly connected to the presence of dead bodies, is closely related to the size, health status and living conditions of the displaced population. The risk of transmission of endemic communicable diseases, such as ARI and diarrhoeal diseases, is increased in displaced populations due to associated crowding, inadequate water and sanitation and poor access to health care. Improved detection and response to communicable diseases is important in order to monitor the incidence of diseases, to document their impact and to help to better quantify the risk of outbreaks following natural disasters.

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Appendix 1

Additional WHO information

WHO web sites

WHO Programme on Disease control in humanitarian emergencies
http://www.who.int/diseasecontrol_emergencies/en/

Health Action in Crises department
http://www.who.int/hac/en/

WHO guidelines

Child health in emergencies
http://www.who.int/child-adolescent-health/publications/pubemergencies.htm

Communicable Disease Control in Emergencies Field Manual
http://whqlibdoc.who.int/publications/2005/9241546166_eng.pdf

Diarrhoeal diseases
Acute diarrhoeal diseases in complex emergencies: critical steps:
http://www.who.int/topics/cholera/publications/critical_steps/en/
Cholera outbreak: assessing the outbreak response and improving preparedness:
http://www.who.int/topics/cholera/publications/cholera_outbreak/en/
First steps for managing an outbreak of acute diarrhoea:
http://www.who.int/topics/cholera/publications/first_steps/en/

Environmental health in emergencies
http://www.who.int/water_sanitation_health/hygiene/emergencies/en/

Food safety
Ensuring foodsafety in the aftermath of natural disasters
http://www.who.int/foodsafety/foodborne_disease/emergency/en/

Hepatitis A
http://www.who.int/csr/disease/hepatitis/whocdscsredc2007/en/

Hepatitis E
http://www.who.int/csr/disease/hepatitis/whocdscsredc200112/en/
http://www.who.int/mediacentre/factsheets/fs280/en/

HIV/AIDS
HIV/AIDS interventions in emergency settings: Interagency Standing Committee guidelines.
www.who.int/3by5/publications/documents/iasc/en/

Leptospirosis
http://www.who.int/water_sanitation_health/diseases/leptospirosis/en/

Dengue
Dengue haemorrhagic fever: diagnosis, treatment, prevention and control:
http://www.who.int/csr/resources/publications/dengue/Denguepublication/en/
Dengue haemorrhagic fever: early recognition, diagnosis and hospital management: an audiovisual guide for health care workers responding to outbreaks.
(WHO/CDS/EPR/2006.4).

Malaria
http://www.who.int/malaria/epidemicsandemergencies.html

Measles
WHO guidelines for epidemic preparedness and response to measles outbreaks:
http://www.who.int/csr/resources/publications/measles/WHO_CDS_CSR_ISR_99_1/en/

Meningitis
Control of epidemic meningococcal disease. WHO practical guidelines:
http://www.who.int/csr/resources/publications/meningitis/WHO_EMC_BAC_98_3_EN/en/

Laboratory specimen collection
http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_CSR_EDC_2000_4/en/

Travel advice – including for malaria
http://www.who.int/ith/en/

Vaccines and biologicals for emergencies
http://www.who.int/vaccines/en/emergencies3.shtml

Vector control
http://whqlibdoc.who.int/hq/2006/WHO_CDS_NTD_WHOPES_GCDPP_2006.1_eng.pdf

Medical waste in emergencies
http://www.who.int/water_sanitation_health/medicalwaste/emergmedwaste/en/