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).

This document was developed by the Communicable Diseases Working Group on Emergencies (CD-WGE) at WHO/HQ. CD-WGE provides technical and operational support on communicable disease control to WHO regional and country offices, ministries of health, other United Nations agencies, and nongovernmental and international organizations. The working group includes the departments of Epidemic and Pandemic Alert and Response (EPR), Neglected Tropical Diseases (NTD), Global Malaria Programme (GMP), Stop TB (STB), HIV/AIDS (HIV), Child and Adolescent Health and Development (CAH), Immunization, Vaccines and Biologicals (IVB), Sustainable Development and Healthy Environments (SDE) and Health Action in Crises (HAC).

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