



Gastrointestinal infections after earthquake

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ABSTRACT

Natural disasters such as earthquakes resulting in infrastructural damage in affected areas can also result in outbreaks of infectious diseases, with infections usually beginning within 4 days of the initial impact. Gastrointestinal diseases are prevalent due to the lack of food and water supplies. The rates of diarrheal illnesses following natural disasters are mainly influenced by the (i) endemicity of intestinal pathogens before the disaster, (ii) the availability of safe water and sanitation facilities, (iii) the severity of the disaster, (iv) the degree of crowding and (v) the availability of healthcare resources. Among the causative agents of gastroenteritis, viral infections are the most common ones, followed by bacterial and parasitic infections. Maintenance of sanitation and availability of primary healthcare are critical for early diagnosis, treatment and prevention of infectious disease outbreaks following natural disasters.

Keywords: diarrhoeal illness, diarrhoea in resource-limited settings, earthquake, enteric pathogens, gastroenteritis, gastrointestinal illness, natural disaster, outbreak, public health.

Introduction

Earthquakes are the second most documented natural disasters and the most recorded geophysical catastrophe, particularly in regions of high seismic activity.¹ The devastation of an earthquake can create a potential for infectious disease outbreaks because of prevailing circumstances, such as the socioeconomic conditions of the affected area.^{1,2} Research demonstrates that infectious diseases occur not only after destructive earthquakes that cause mortality and morbidity but also following earthquakes that severely affect structural elements with limited immediate impact on human life. Infections can manifest within 4 days and up to 4 weeks after the initial impact of the earthquake. However, symptoms and clinical signs may appear up to 4 weeks after the disaster if a pathogen can cause latent infection or has a longer incubation period. In addition, conditions such as water source contamination or over-crowded communal living increase the risk of infectious diseases.³ A significant increase in the incidence of infectious diseases in the post-earthquake period compared to the pre-earthquake period for gastrointestinal infections (163.4 per 100 000 people) was reported.⁴ Infectious disease outbreaks are thus one of the most significant factors that can exacerbate the effects of a disaster and delay recovery. Accordingly, a comprehensive understanding of natural disaster characteristics and risk factors of post-disaster outbreaks can enable better preparedness, response, and surveillance and strengthen region-specific disaster risk reduction in the future.⁵

Risk factors

The primary risk factors include displacement, poor access to safe drinking water and poor hygiene. If flooding occurs this can also result in the breakdown of sanitation, leading to outbreaks of waterborne illnesses such as leptospirosis, cholera, and dysentery. Additionally, following extensive damage to infrastructure, overcrowding due to inadequate or temporary shelters, and camps are more likely to occur, with subsequent displacement where young females and children constitute the most affected category.⁵ Other factors that affect the likelihood of outbreaks of infectious diseases include the scale and intensity of the earthquake, the prevalence of aftershock effects, the demographic and epidemiological characteristics of the region, the socioeconomic aspects and living conditions of the community, and the damage to public health infrastructure and facilities.³

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The sudden appearance of unexpectedly large numbers of dead bodies can raise concerns about disease outbreaks.⁴ However, most pathogens do not survive for long in the post-mortem body, exceptions being deaths due to cholera or haemorrhagic fever related. Interestingly, there is no documented evidence that corpses pose a risk of triggering an epidemic following natural disasters.⁶

Aetiology and epidemiology reference

Post-earthquake infectious disease rates are well documented, with gastrointestinal, skin, and respiratory infections being the most reported ones.^{3,7} The intensity of the earthquake, its location, tsunami and other possible events that might occur afterwards may play an essential role in infectious diseases. The incidence of post-earthquake gastrointestinal tract infections was reported to be as high as 456.6 cases for 100 000 for viral hepatitis and 56.8 cases for 100 000 for diarrhoeal diseases.⁷

Shigella

Following a natural disaster, *Shigella* infections represent a significant threat for children under 5 years of age in endemic regions where climatic conditions and lack of water supply create a conducive setting. Antibiotics are essential in limiting the impact of severe illness, death and transmission of causative agents in small and large outbreaks as a result of natural disasters; thus their supply can be critical.⁸

Salmonellae

An outbreak of *Salmonella enterica* among Italian children was reported 4 years after the great earthquake of 6 April 2009, and the underlying factor of this outbreak was reported to be contamination of natural spring water due to geological processes.^{3,9} There is no Centers for Disease Control and Prevention (CDC) recommendation for typhoid vaccination when responding to disasters within the USA, as the likelihood of exposure in the region is low.¹⁰ Current typhoid vaccines are not recommended for mass vaccination campaigns,¹¹ however, such recommendation can be reviewed based on regional epidemiology and risk assessments.^{11–13}

Cholera

Vibrio cholerae can be transmitted by consuming contaminated food and water. Fomites and insects may additionally be involved. Specific characteristics of the causative agent such as the ability to remain infectious for up to 24 h after faecal excretion and its ability to grow in liquid environments at 30°C, with a salinity of 1–2% and a pH of 8.5, are the factors that can facilitate the spread of the pathogen and the emergence of an epidemic.¹⁴

After a 7.0-magnitude earthquake struck Haiti in 2010, cholera quickly spread across the country caused by *V. cholerae*, Ogawa biotype, serogroup O1. Notably, most affected patients had previously consumed contaminated water from a nearby river.¹⁵ Similarly, following the 2015 Gorkha earthquake, Kathmandu, Nepal's capital and largest

city, encountered cholera outbreaks. Twenty-nine people contracted cholera from *V. cholerae* serogroup O1 serotype Ogawa after consuming contaminated water in heavily populated areas of the region.¹⁶

Since the first cholera case was documented in Syria on 10 September 2022, more than 50 000 suspected cases were reported in Idlib and Aleppo governorates. By mid-February 2023, the reported cases decreased by 63%. Continuous surveillance resumed, and in Syria, 1784 new cases were reported by the end of February 2023.¹⁷ Yet, no cases of cholera were officially documented in Türkiye following the earthquake. On 4 March 2023, the Turkish Ministry of Health announced that health screenings did not identify any infectious disease epidemics.¹⁸

The CDC have no recommendation for a cholera vaccine when responding to disasters in the USA, primarily because the likelihood of exposure in the region is low.¹⁸ The WHO and UNICEF launched a cholera vaccination campaign in north-western Syria in response to the devastating earthquakes of 6 February 2023 near the epicentre Kahramanmaraş in Türkiye.¹⁷

Tularaemia

In 2005, the first cases of tularaemia were detected in the Gölcük district of Kocaeli province in Türkiye. The underlying cause of the outbreak was contaminated water, consumed by individuals in a newly formed settlement.¹⁹ Further research aimed at preventing tularaemia infections or epidemics is essential for public health in an event of a natural disaster or earthquake in regions where *Francisella tularensis*, a highly virulent as well as a recognised bioterrorism agent, is endemic.

Rotavirus

Earthquake damage that leads to widespread contamination of drinking water sources, such as the 2005 Kashmir earthquake, can result in rotavirus outbreaks, which are globally prevalent and cause diarrhoea in children under 5 years of age. Insufficient living conditions, inadequate water supplies, and poor hygiene contribute to mortality.^{3,20} For this reason, irrespective of the region in which the earthquakes strike, improvement of the existing conditions and increasing vaccination rates are important precautions to prevent outbreaks of rotavirus and other pathogens among vulnerable populations.

Hepatitis A and E

After the earthquakes in İzmit and Düzce, which struck Türkiye's north-west region twice in less than 3 months in 1999, the occurrence of Hepatitis A (HAV) and E (HEV) in children residing in temporary camps was 68.8 and 44.4% in Gölyaka and 17.2 and 4.7% in Düzce respectively.^{2,21}

The CDC recommends two doses of HAV vaccine, given at least 6 months apart for children aged 10 who are exposed to natural disasters if immunisation records are unavailable.¹⁰ Yet, the WHO's recommendations for preventing outbreaks of HAV in disaster areas do not include vaccination.¹¹

Giardia

Giardiasis is associated with poverty and unsafe water. Approximately 2 years after a severe earthquake in the Armenia region of Colombia on 25 January 1999, giardiasis was the most common parasitic infection, spread by shared toilets and water from municipal sewers.²² Similarly, two earthquakes in north-western Türkiye in 1999 destroyed 80% of the houses and schools in Düzce.²³ A comparison of two groups of children living and studying in different socioeconomic conditions after the earthquake demonstrated a significant increase in the prevalence of giardiasis in children still living and studying in temporary settlements years after the earthquake.²³

Role of microbiology laboratory and diagnostic approaches

The normalisation, maintenance and provision of essential laboratory services are urgently required after a natural disaster.² In addition to disaster-related events, laboratory support should continue for routine services such as maternal and child health and other ongoing disease control interventions. A multi-level laboratory system can be adopted to operate laboratory services effectively (see Fahri Yüce Ayhan article in this issue²⁴). The central and subordinate laboratories in the affected area need to be identified. Procedures such as routine laboratory services and sampling should be initiated at the site level.²⁵

Pre-diagnosis of potentially epidemic infectious diseases, such as cholera and rotavirus, can be achieved using field immunochromatography and lateral flow devices. As part of the post-disaster response, simple environmental tests, such as ortho-toluidine testing to monitor effective chlorination, can be used at the field level to maintain the use of water resources. Rapid diagnostic tests used in the field and primary care are essential for the early detection of increases in infectious agents, clusters of infections and even outbreaks. For laboratory confirmation of an infection or outbreak, samples should be sent to a next-level laboratory for retesting or further laboratory analysis.^{2,25}

Preventive measures and preparedness

An uninterrupted supply of safe drinking water, sanitation and site planning are essential. Chlorine can be used as an effective and inexpensive disinfectant against waterborne pathogens. In addition, settlement planning must meet water and sanitation requirements and the number and size of shelters should be follow international guidelines. Access to primary health care is crucial for the prevention, early diagnosis, and treatment of various diseases. It also provides a triage step to secondary and tertiary healthcare. The following interventions are recommended to reduce the impact of infectious diseases: early diagnosis and treatment of diarrhoea, use of treatment protocols for infectious diseases, availability of medicines such as oral rehydration, and distribution of health education messages.²⁵

Finally, good hand hygiene practices, safe food preparation techniques, boiling or chlorinating water, early interventions for fever, and insecticide-treated bed nets can help prevent infectious diseases. Public awareness of basic health measures is essential to reduce the risk of infectious diseases following natural disasters.^{2,25}

Conclusions

The main cause of mortality and morbidity during and after earthquakes and many natural disasters is the traumatic impact at the time of the event. By contrast, post-disaster health care for survivors determines the depth and duration of the effects of a disaster. The emergence of post-disaster epidemics is closely linked to the displaced population's size, health status and living conditions. Access to safe water resources is the main concern. Water and food-borne illnesses are prominent infections following an earthquake, with numerous gastrointestinal diseases, particularly diarrheal diseases. It is possible to reduce disaster-related infections and epidemics, including those of the gastrointestinal tract, through improved and more systematic disaster response and preparedness planning. The prevention of infections can significantly contribute to the post-disaster recovery and normalisation of affected communities.^{2,26} Understanding the connection between earthquakes and infectious agents (particularly *V. cholerae*, *Salmonella* spp., *Shigella* spp., *F. tularensis*, rotavirus and hepatitis A and E viruses), along with the identification of the causative agents, and efficient surveillance will be pivotal prevention and control.

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Biographies



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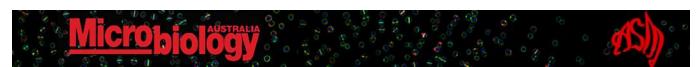
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In Prof. Sencak's biography, the sentence 'She is currently the Director of Microbiology Laboratory of the Medical School.' should be 'Her research interests are in areas of antimicrobial resistance, bacteriology and diagnostic microbiology.'

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