Communicable disease transmission and prevention of following disasters.

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Abstract

Numerous disasters occur around the world each year as a result of natural hazards. These hazards can result in damage to infrastructure, population displacement, interruption of healthcare programs, and unsanitary conditions. As a result, the health of the public may be desperately weakened and vulnerable on many fronts. Situations such as these provide the ideal environment for resurgence and propagation of endemic diseases, potentially leading to epidemics. In order to maintain public health, interventions must be implemented early to alleviate the strain experienced by communities and prevent transmission of communicable diseases.

Keywords: Disasters, Communicable diseases, Public health, Infectious diseases

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Introduction

In the last decade, 3,809 disasters have been reported, impacting almost two billion people, and fatally injuring 764,204 people [1]. Disasters occur as a result of hazards when the affected population does not have the resources to cope with the problem, and external assistance is required in order to recover [2]. However, hazards are a natural component of the environment, and do not always result in disasters. Hazards can be classified as hydro-meteorological, geo-morphological or geophysical. Hydro-meteorological hazards include floods, storms, typhoons, hurricanes and tornadoes [3]. Floods are the most common of all natural disasters to be experienced, accounting for 46% of the natural disasters to have been reported in the last decade [1]. Geo-morphological hazards include landslides and avalanches, and geophysical hazards encompass earthquakes, tsunamis and volcanic eruptions [3].

It is the after-effects of hazards such as these that promote spread of communicable diseases. Some of the possible after-effects are displaced populations, increased breeding of vectors, increased exposure to vectors, overcrowded shelters, poor sanitation and hygiene, poor nutrition, and interruption of healthcare services [3,4]. Diseases that are not endemic to the region are not an issue, since they are not present and hence not able to proliferate. This environment provides the ideal conditions for a communicable disease that is already endemic to an area to gain a foothold and spread extensively due to the weakened health of the population. The various communicable diseases that propagate vary based on endemicity, the specific after-effects the population is exposed to, and how vulnerable the population is to disease.

Hazards and Their Health Implications

Hydro-meteorological hazards, including floods, storms, typhoons, hurricanes and tornadoes, tend to result in population displacement, overcrowded shelters, water contamination and proliferation of mosquitoes [3]. Flooding and waterlogging provides the standing water that mosquitoes need for continuation of their life cycle. As a result, flooding events in China, Cote d'Ivoire, Brazil and the Dominican Republic were followed by vector-borne disease outbreaks of malaria or dengue fever [3,5]. In Pakistan, floods have also been associated with development of acute respiratory infections, which account for 20% of deaths in children under five years old [6]. Development of respiratory infections such as pneumonia, viral influenza, or tuberculosis, is thought to be due to loss of shelter, overcrowding, poor ventilation, poor nutrition, aerosolized bacteria and exposure to contaminated flood waters [3,6].

Contamination of surface water by pathogenic bacteria is common due to disruption of sewage systems [6,7]. As a result of this pathogenic contamination, floods and hurricanes tend to be followed by outbreaks of diarrheal diseases, which account for 40% of deaths in disaster settings. Diarrheal disease outbreaks were observed in the United States of America, Bangladesh, Indonesia and Mozambique [3]. Diarrheal diseases generally result from water contamination due to damaged sewage systems. In cases where populations are displaced and living in overcrowded conditions, diarrheal diseases can also arise as a result of elevated chance of fecal-oral spread of disease [6].

Floods in Australia, Thailand and India as well as typhoons in Taiwan and China resulted in outbreaks of leptospirosis, which can be propagated by contamination of food and water by urine of infected animals such as rats [3,8]. Leptospirosis can also spread through water contaminated with urine from infected vectors. Contaminated water such as this can collect on roads after floods, and people who walk around barefoot or children who play in rain puddles are at risk of contracting infection [6].

Geophysical hazards include earthquakes and tsunamis. Earthquake impact varies based on intensity and locale, and tends to cause population displacement, overcrowded shelters, and destruction of water and sanitation systems, which consequentially lead to a wide range of potential health impacts. Displacement often forces populations into overcrowded

environments, where communicable diseases are able to spread very easily due to minimal personal space. This particular classification of hazard also destroys water and sanitation systems due to geological changes, which impedes hygienic practices and likely contaminates the available water supply. Earthquakes were followed by outbreaks of diarrheal diseases and influenza in Japan, cholera in Haiti, and diarrheal disease and acute respiratory infections in Iran and El Salvador. In Pakistan, an earthquake was followed by outbreaks of diarrhea, hepatitis E, acute respiratory infections, measles, meningitis and tetanus [3]. Like diarrheal disease, hepatitis results from water contamination by human and animal waste or through fecal-oral transmission [6]. Meningitis, measles and tetanus are all avoidable if populations have been vaccinated. However, if a community is unvaccinated and experiences a disaster, the communities are weakened and are at greater risk of contracting and spreading illness. Tetanus in particular can become an issue if wounds become infected and are not cared for, such as might be observed in an emergency situation if healthcare is not available. In crowded conditions with poor hygiene, it is also very easy for meningitis to spread from person to person [3].

Tsunamis have the added water-related consequences as a result of flooding, such as probable water contamination and vector proliferation. In Thailand, the after-effects of a tsunami led to an outbreak of diarrheal disease. A tsunami in Indonesia was followed by outbreaks of diarrheal disease, hepatitis A and E, acute respiratory infections, measles, meningitis and tetanus [3]. Monsoons in Pakistan have been associated with outbreaks of diarrhea, leptospirosis, malaria, leishmaniasis, acute respiratory infections, hepatitis, as well as skin and eye infections. Leishmaniasis is propagated by the bites of sand flies. Bites cause formation of deep disfiguring sores and can potentially lead to damage of internal organs. Poor sanitation, undernutrition and overcrowded conditions are risk factors for propagation of leishmaniasis. Skin and eye infections such as wound infections, dermatitis and conjunctivitis result from contact with water polluted by pathogens. These infections are unlikely to cause epidemics but may require medical care for recovery [6].

All of the common health impacts that were discussed can be further exacerbated by interruption of healthcare programs and lack of access to healthcare facilities and medicine. This can result from either direct damage to healthcare facilities or by damage to surrounding infrastructure so that community members are not able to travel to such a facility. This was experienced first-hand in Vietnam, where flooding compromised access to healthcare and medications for up to a month after the disaster occurred [9].

There is a major lack of data and studies that examine the relationship between geomorphological hazards and propagation of communicable disease. Geomorphological hazards include avalanches and landslides, which have the potential of destroying communities, as well as water and sewage systems, as has been observed with many other hazards that were previously described. Therefore, it would be logical to think that populations who experience these hazards have the potential of experiencing displacement, overcrowding and contaminated water supply. These after-effects are associated with diarrheal diseases, acute respiratory infections, hepatitis, and many other possible communicable diseases. More research needs to be done in this area due to the lack of information pertaining to communicable disease outbreaks after hazards of this classification.

Prevention and Control

In these vulnerable situations after a disaster, prevention of disease is the key to maintaining public health. Hazards have a wide range of after-effects on populations, as well as a wide range of possible health impacts, which all need to be taken into account when planning interventions. Post-disaster risk assessments should be conducted to determine what health impacts are likely to be observed as a result of the specific hazard and associated after-effects being experienced [3].

Prevention, early diagnosis, and early treatment would lessen the impact of common outbreaks on public health [4]. Communicable disease management programs, which should have surveillance and immunization components, are integral parts of disaster response [10]. Surveillance within shelters or communities is an important component to disaster management as it can be used in identification of potential clusters of disease [11]. Implementation of surveillance systems after earthquakes in Iran resulted in swift collection of data and increased the confidence of health authorities that disease would be controlled [12]. In the Philippines, the Surveillance for Post Extreme Emergencies and Disasters (SPEED) program was created to allow for early detection and monitoring of disease trends. SPEED was used during a flood, an earthquake and a typhoon, and was helpful in assisting healthcare leaders in making informed decisions for response, preparedness and recovery [4].

Sites for shelters need to be planned in ways to avoid overcrowding which can lead to acute respiratory infections or pneumonia. They also need to be organized with hygiene in mind, so that there are enough facilities for all inhabitants and so that there is no chance for contamination of water supply. Maintenance of hygiene is especially vital for meal preparation, when eating, after using the bathroom, when caring for a sick individual, as well as when handling garbage and other waste [3]. Hygiene helps to prevent spread of leptospirosis, hepatitis and many other communicable diseases [6]. In the case of leptospirosis, if waste is not being disposed of correctly, rats will likely be attracted to it and spread disease to any people in the environment. Improper waste management can also lead to stagnation of water which allows for propagation of mosquitoes and proliferation of their associated diseases.

Vector control needs to be geared towards the specific vector and the diseases likely to be prevalent. Insecticide treated nets are useful for combatting malaria because it is spread by the Anopheles mosquito which is active between dusk and dawn. At this time most people are unmoving or sleeping so the best prevention method is to avoid bites. The Aedes mosquito is responsible for the spread of dengue fever. This mosquito bites during the day, so removing sites of stagnant water through proper water storage and waste disposal is the best method of prevention of mosquito proliferation. This is

also useful for prevention of proliferation of the Anopheles mosquito. Following Typhoon Haiyan in the Philippines, there was no outbreak of dengue due to the rapid, multidimensional response that was employed. Targeted vector control and strong surveillance was used for early detection. Spray and larvicide can also be effective methods for extermination of mosquito populations and preventing further spread of dengue [13]. Leishmaniasis is best prevented through similar methods as malaria, particularly through insecticide and use of bed nets. More important aspects of prevention are through sanitation and improved living conditions [6]. Veterinary public health should also be incorporated in disaster management plans. In the past veterinary public health workers have been charged with disposal of animal carcasses and waste, prevention and control of zoonotic diseases, food sanitation and vector or pest control [7].

Vaccinations should be used to prevent outbreaks of measles or any other vaccine-preventable communicable diseases that are endemic and high in prevalence in the affected region. Typhoid vaccination campaign in the Republic of Fiji following a cyclone was able to reduce incidence of typhoid fever. The typhoid vaccine is not necessarily always useful in post-disaster settings, but because there was a high incidence of typhoid in this region it was deemed an important component in a post-disaster environment [14]. Measles, meningitis, and tetanus are other vaccinations that should be taken into consideration pre-disaster so that populations are effectively immune from diseases that may otherwise reach epidemic proportions in a weakened post-disaster population. Vitamin A supplementation can also be used as a protective measure against acute respiratory infections and measles.

Communities need to prepare for likely disasters by being aware of any weaknesses their environment has. For example, high slope of mountainous regions increases the risk of landslide [15]. Similarly, regions that experience high seismic activity need to be aware of how to handle earthquake disaster management. Communities in high risk areas need to be aware of the danger they face and how they can best protect themselves from any communicable diseases associated with possible after-effects [16,17]. Hazard-vulnerability analyses can be used to determine the hazards facing different regions and to educate the populations affected [16].

Public Health Implications

In a world that is undergoing epidemiological shift away from communicable diseases and towards chronic diseases, disasters allow endemic communicable diseases to take root and continue to plague populations. Disasters are associated with various after-effects, which then directly impact the health of communities. These high stress situations leave populations weak, vulnerable, and unable to fight off diseases that are commonly endemic. These diseases gain the upper hand and can cause outbreaks or possibly epidemics. Continued propagation of communicable diseases is a major public health concern that needs to be managed through disaster risk reduction.

Ban Ki-moon, United Nations Secretary General, stated that "The more governments, UN agencies, organizations, businesses, and civil society understand risk and vulnerability, the better equipped they will be to mitigate disasters when they strike and save more lives" [2]. Public health workers need to become more involved with disaster risk reduction so that they can understand the factors at work and how such factors need to be managed so their impact on public health is minimized. Public health is all about prevention of disease, and if public health workers are able to be trained in disaster risk reduction, they will be doing just that. By minimizing risk and educating the general public about hazards they are in danger of experiencing, injury and disease can be avoided and public health can be maintained.

As explained earlier in this review, different after-effects of hazards are associated with different health impacts. In an emergency situation, public health workers need to be aware of the relationships between these factors. Through understanding and awareness of these relationships, public health workers can recognize risks before they are fully formed, and hopefully prevent them from negatively impacting population health. Through training in disaster risk reduction, public health workers are able to minimize risk of disaster effects on communities through preventive measures prior to occurrence of an emergency. This serves to lessen vulnerability of populations, which improves their outlook in the face of an emergency situation.

A part of disaster risk reduction is disaster management. In particular this outlines what is to be done once an emergency has occurred. Through disaster management, workers are then able to analyze how the hazards and the associated after-effects can be managed to minimize their impact on public health. This is the ideal location for public health workers to put their skills to use. They must be trained to look at particular hazards and always be thinking of how that hazard and its associated effects can impact the health of individuals and the public as a whole. With this type of thinking, public health workers can create and implement interventions so that exposure to such a hazard is as minimal as possible, and any effects of the remaining exposure can be managed. Integration of the public health and disaster management fields will assist in the fight against spread of communicable disease as a result of disasters.

Conclusion

The high frequency of natural disasters that threaten communities around the world each year poses a public health problem. Complications that arise as a result of natural disasters are still very common, especially in developing countries with limited resources and poor infrastructure. These emergencies negatively impact public health by straining local infrastructure and causing unsanitary conditions where communicable diseases are able to thrive amidst a weakened population. Once diseases gain a foothold in a population during these situations, they have the potential of creating outbreaks and epidemics.

Disease prevention following emergency situations needs to be a public health priority. Disaster risk management programs and surveillance systems need to be designed and enforced in order to maintain and promote public health. The best way for this to be accomplished is through integration of the public

health and disaster management fields. Through such a union, population vulnerability can be minimized, and extra attention can be placed on maintaining public health throughout a disaster. Understanding of the relationships between hazards and their after-effects will assist public health workers with implementing interventions to prevent spread of communicable disease after disasters. This will reduce the worldwide burden of communicable disease and serve as a major factor to improve global health.

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