The Emergence of Infectious Diseases

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Emergence and re-emergence of infectious diseases

Severe acute respiratory syndrome (SARS) was first reported in Asia in February 2003. Before this viral respiratory illness was officially declared contained just five months later, it had spread to more than two dozen countries in North and South America, Europe and Asia, killing 774 people and making more than 8000 others ill. The SARS outbreak – caused by a previously unknown coronavirus (SARS-CoV) which likely had spread from bats to humans – was a stunning example of human populations, economic activities, environmental conditions and air travel coming together, creating a global health threat.

Human infectious diseases are caused by pathogenic microorganisms such as bacteria, viruses, parasites and fungi that spread directly or indirectly via a vector from one person to another or from an animal to people. The 2004/5 Year Book reported that 15 million people died annually from infectious diseases, making them the world’s leading cause of death and accounting for 25% of global mortality. Contributing to this impact was the growing resistance of many vectors to pesticides and of some parasites to medicines, as well as the slow development of affordable new vaccines.

Diseases carried by agents that are outside the human host during most of their lifecycle are especially susceptible to being affected by environmental conditions.

Land use change and deforestation can bring people closer to wildlife, allowing previously unknown diseases to spread to humans. Ebola and Lyme disease are examples, but other diseases also have one or more animal reservoirs in the wild. The vast majority of emerging infectious diseases are zoonotic.

Environmental change plays a major role in the emergence and re-emergence of infectious diseases. For example, the deterioration or destruction of natural habitats can reduce the number of natural predators, change the dominance of species, or create favourable conditions for disease hosts. Infrastructure, such as dams and irrigation channels, creates ideal environments for mosquitoes, which are the vector responsible for diseases like malaria and dengue fever.

Many people worldwide lack adequate sanitation, waste management or vector control. In 2012, 863 million people lived in slum-like conditions. Whether overcrowding results from poverty, or displacement due to conflicts or natural disasters, it can lead to contagion – creating a breeding ground for infectious diseases like influenza, malaria and West Nile virus that are carried by water, air, food, mosquitoes or rodents.

Read more about emerging and re-emerging infectious diseases in the 2004/5 Year Book.
Combatting infectious disease while addressing environmental challenges

Infectious diseases are the world’s leading cause of death for children and adolescents. They are the second leading overall cause of death after heart disease. Continuous outbreaks of infectious diseases have been reported during the past decade. In the first half of 2014, ebola caused over 200 deaths in West Africa and over 500 people contracted Middle East Respiratory Syndrome (MERS). There were more than 145 fatal cases of MERS.

Although great strides have been made, millions of people continue to die each year from infectious diseases and millions more suffer permanent disabilities or poor health. A triple threat is represented by new infectious diseases, the re-emergence of infectious diseases that were once under control, and the continuous development of antibiotic resistance. Along with changes in society and technology – and in the microorganisms themselves – these factors are contributing to a ‘perfect storm’ of vulnerability.

Environmental factors play a major role in the development and transmission of infectious diseases. Science increasingly shows that human-induced changes in the environment linked to population dynamics, climate change, land use and globalization are associated with infectious disease patterns. Biodiversity, which can play an important role as a buffer, helps protect against infectious diseases. Several studies have suggested that as biodiversity is lost, there is an increase in the rate of disease transmission. A range of factors may be involved, including changes in the abundance and altered behaviour of a host, vector or parasite. This effect of biodiversity loss has been reported for diseases including malaria, Lyme disease, Chagas disease, leishmaniasis and schistosomiasis.

Major progress in malaria control in the past decade has also been made partly through environmental management. By preventing or removing the breeding sites of mosquitoes that carry the malaria parasite, and keeping the mosquitoes out of living spaces (e.g. with screens and treated mosquito bed nets, coupled with spraying), malaria transmission has been reduced to close to zero in some communities. Mortality rates dropped by 42% globally and by 49% in Africa between 2000 and 2012, with an estimated 450,000 lives saved in a single year.

However, global climate change is expected to result in increased rainfall and higher temperatures. It also will lead to changes in habitats and in the presence of vectors such as mosquitoes, which will be able to move into new areas and reach vulnerable populations that have had little or no previous exposure to the diseases. A recent study in the highlands of Ethiopia and Colombia showed that malaria is already spreading in warmer years to higher elevations where it was not previously seen. This implies that there may be further exposures of densely populated regions of Africa and Latin America to malaria as a result of climate change.

Preventing infectious diseases through environmental management and climate change mitigation is highly cost-effective. For example, malaria costs Africa US$12 billion annually while a comprehensive African malaria control programme would cost an average of US$3 billion per year.

Understanding how a changing climate and environment drive the emergence and re-emergence of infectious diseases can lead to effective strategies to combat their development and spread. Ecosystem- and community-based approaches have proven to be valuable tools.

Climate change: a game changer?

Climate change has implications for human health, especially with respect to vector-borne and water-borne infectious diseases such as cholera and dengue. Parasites and water-borne pathogens and vectors may find a more hospitable environment not only where there are warmer temperatures, but also where there is rising humidity or disaster events are occurring. In countries where some infectious diseases have essentially been eradicated, climate change could expand vector range and some diseases could make a comeback.
Taking actions to combat infectious diseases

The effectiveness of ecosystem and environmental management approaches in fighting the spread of infectious diseases is gaining recognition from governments and local communities. For example, a new project in Central America is taking an ‘ecohealth approach’ to combating Chagas disease in El Salvador, Guatemala and Honduras. Researchers are working to reduce the transmission of this disease by controlling the insect species that infest poorly constructed homes and carry the disease-causing parasite. This project builds on the success of previous efforts in Guatemala (2003-10), where Chagas disease was controlled by combining community education with housing improvements.

**Chagas disease**

Chagas disease is one of the most serious public health challenges in Latin America and the Caribbean. It is caused by a parasite transmitted from wildlife or domestic animals to people by the bite of a triatomine bug. More than 10 million people in the region are infected with this disease, which is endemic in many poor, rural areas. One-third of those who are infected develop chronic Chagas. It kills more than 10,000 people per year.

Important messages about disease transmission need to be disseminated to communities in simple but innovative ways. Educational campaigns by non-governmental organizations (NGOs) and others help raise awareness and change community health and sanitation practices. In India a campaign promoting hand-washing with soap, SupperAmma, has brought about long-lasting behavioural changes in mothers and children that have helped reduce the rate of diarrhoea and respiratory infections.

Improving a community’s access to water, sanitation and hygiene (WASH) is another effective way to minimize the risks of infectious disease. In 2012, WASH initiatives implemented through the United Nations Children’s Fund (UNICEF) non-emergency programmes helped more than 10 million people gain access to improved sanitation, largely thanks to the expansion of community approaches. Such activities are also actively supported by NGOs and other UN organizations, including the United Nations Development Programme (UNDP), WHO and Oxfam.

Effective prevention of infectious diseases requires global cooperation and coordination. International travel and trade contribute to the rapid spread of infectious diseases. Surveillance is therefore another important line of defence. At the international level, WHO has established the Global Outbreak Alert and Response Network (GOARN), which links medical institutions, organizations and networks around the world to provide rapid identification of any outbreaks that might be of international importance. HealthMap is an innovative surveillance network established by a team of researchers, epidemiologists and software developers. Its freely accessible website uses data from traditional and public health information systems including online news, eyewitness and official reports, to provide real-time online surveillance information on emerging diseases. There is evidence that HealthMap increases the sensitivity and timeliness of alerts and reduces false alarms.

There were almost 7 billion mobile phone subscriptions globally in 2014. Mobile phones have the potential to support informal infectious disease surveillance networks in developing countries. An example is Alerta DISAMAR in Peru, which has received contributions from over 600 individuals and collected information on more than 80,000 cases and 31 disease outbreaks.

**Roles of host species in the transmission of Lyme disease in the northeastern USA**

A multi-sectoral approach to ensure healthy life for all

The control of infectious diseases can be further strengthened through recognition of the potential contribution of environmental management to preventing their emergence and spread. Climate change remains one of the biggest threats with respect to the spread of vectors and water-borne disease, especially diarrhoeal diseases. Evidence, and better understanding, of the multiple benefits of climate change mitigation are growing. In addition, practical initiatives such as ensuring adequate access to safe water and sanitation (e.g. through the Sanitation and Water for All Global Partnership) and appropriate shelter contribute to combatting infectious diseases. International dialogue and cooperation have been essential in the past and will continue to be required in the future.

There is increasing recognition of the role ecosystems and biodiversity play in protecting and enhancing human health. This goes beyond undiscovered plants that might provide new treatments, or undisturbed wetlands that filter disease-causing organisms (e.g. in drinking water) – although these benefits are also important arguments for biodiversity conservation.

Environmental disruption leads to the emergence, amplification and spread of new diseases, while intact ecosystems have a protective effect. This suggests an exciting new approach to infectious disease control: by working to ensure a strong and healthy environment, we can help protect people against the devastating impacts of infectious disease. There are formidable challenges to be met. Interactions within ecosystems are complex. However, there is much to be gained by pursuing this approach, which can supplement more traditional public health activities.

Like other urgent environmentally related problems (e.g. air and water pollution), infectious diseases know no boundaries. Efforts to prevent, detect and respond to infectious diseases cannot be carried out successfully at the local or national level alone, or by a single group of stakeholders. Combatting their spread requires well coordinated actions, based on reliable information and effective communication among various partners. Multi-sectoral approaches that recognize the roles of actors at all levels need to be better recognized and supported, particularly in developing countries, in order to address the links between human health, the environment and economic activities and make healthy lives for all possible.
Further information about infectious diseases

Altizer, S., et al. (2013) Climate Change and Infectious Diseases: From Evidence to a Predictive Framework (abstract) http://www.sciencemag.org/content/341/6145/514.abstract


CDC (2014). Middle East Respiratory Syndrome (MERS) http://www.cdc.gov/coronavirus/mers/


IRDC (International Development Research Centre) (2014). Ecosystems and human health: Why we do what we do http://www.idrc.ca/EN/Programs/Agriculture_and_the_Environment/Ecosystem_Approaches_to_Human_Health/Pages/About.aspx


ITU (International Telecommunication Union) (2014). Mobile subscriptions near the 7 billion mark! Does almost everyone have a phone? https://itunews.itu.int/En/3741-Mobile-subscriptions-near-the-78209billion-markbDoes-almost-everyone-have-a-phone.note.aspx


