

# Human migration and infectious diseases

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## Abstract

Emerging infectious diseases (EID) are defined as diseases that have appeared recently or that have recently increased in their frequency, geographical distribution or both. Commercial globalisation, population movements and environmental changes are the main factors favouring the international spread of microorganisms. Transport and communication development constitutes also a remarkable factor in the worldwide dispersion of microorganisms. The mass movement of large numbers of people creates new opportunities for the spread and establishment of common or novel infectious diseases. A surveillance system to detect emergent and re-emergent infections, a rapid responsiveness of healthcare systems and laboratories, vector control, and the provision of healthcare education programmes to inform the population of how to avoid infections are needed in order to stop the spread of infectious diseases.

**Keywords:** Dissemination, emerging infectious diseases, human migration

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Emerging infectious diseases (EIDs) are defined as diseases that have appeared recently or that have recently increased in frequency, geographical distribution or both [1]. EIDs can be caused by: (i) microorganisms that are unrecognized (e.g. coronavirus, [2]); (ii) microorganisms whose geographical range is increasing (e.g. West Nile virus); (iii) microorganisms whose incidence has increased (e.g. human immunodeficiency virus (HIV) and *Mycobacterium tuberculosis*); (iv) microorganisms whose virulence has changed (e.g. *Neisseria meningitidis*); or (v) microorganisms that have acquired antimicrobial resistance (e.g. *Mycobacterium* spp. and *Salmonella* spp.). New strains of microorganisms that cause known diseases but that have acquired new immunological and virulence characteristics, or that have newly acquired resistance against antimicrobial agents, are frequent causes of EIDs. Infectious diseases caused 15 million deaths in 2002, with respiratory infections (3.9 million), AIDS (2.9 million), diarrhoeal illnesses (1.9 million), tuberculosis (1.6 million) and malaria (1.1 million) being the main causes (<http://www.who.int>); many of these had EID components.

Increasing geographical distribution of microorganisms is a hallmark of EIDs, and commercial globalization, population movements and environmental changes are the main factors

favouring the international spread of microorganisms. Globalization has resulted in the increased movement of people, animals, and food products [3]. Changes in global commerce of livestock and food, including marketing, freightage and storage techniques, have increased the numbers of outbreaks of infectious diseases [4].

Ships represent a mechanism of microorganism dissemination. Most ships use water as a ballast system, and, for example, the ports of the USA receive about 79 millions tons of ballast water every year. In 1990, *Vibrio cholerae* O1, Inaba, biotype El Tor, originating in India was isolated in ballast water from five ships in the ports of Mexican Bay. In addition, cruise ships can disseminate infectious diseases such as diarrhoea, legionellosis (through hot tubs), or influenza.

The development of transport and communication constitutes a remarkable factor in the worldwide dispersion of microorganisms. Ships, aeroplanes or other vehicles can disseminate vectors of microorganisms, such as birds and insects. When insects arrive in a new environment, they have to adapt to the new ecosystem and establish themselves—dissemination to adjacent areas may then follow. An example of this situation is the West Nile virus, which was first identified in 1990 in blood collected from a woman from Uganda. This virus is a common pathogen in tropical Africa, the Middle East, and Eurasia. The first outbreak in western countries occurred in New York in 1999 and affected 59 persons. West Nile virus is disseminated by mosquitoes belonging to the *Culex* genus and by birds. Its propagation has a seasonal component, because mosquitoes are quiescent in winter. Recently, an outbreak was reported in

Italy [5]. Chikungunya fever is another example of the contribution of commerce and tourism to the dispersion of vectors of infectious diseases. This infection is caused by the CHIK virus, a zoonotic virus endemic to Africa, India and Southeast Asia and transmitted by *Aedes* mosquitoes, mainly members of the subgenera *Aedimorphus*, *Diceromyia* and *Stegomyia* [6]. In Europe, it was first recorded in Albania in 1974 [7], and the most recent outbreak occurred in north-eastern Italy in the province of Ravenna during the summer of 2007. About 200 human cases with high fever, arthralgia, myalgia, severe headache and rash were recorded [8]. *Aedes albopictus* was considered to be the most likely vector for this outbreak. An additional potential problem is the capacity of this mosquito to transmit other arboviruses, e.g. dengue virus. For this reason, arboviruses previously believed to cause only tropical diseases must now be considered as potential agents of disease in Mediterranean countries [9].

The main sources of intercontinental movements are migration, political refugees, cooperating persons, and international adoptions. Throughout history, there are many examples of the role of missionaries, explorers, wanderers or other types of travellers who introduced a human pathogen into a susceptible population. Population movements associated with wars or violent conflicts, as well as environmental disasters, can lead to epidemiological outbreaks (e.g. cholera and typhoid fever), which are the consequence of population overcrowding, malnutrition, unhygienic conditions, and basic medical services. One of the infectious diseases most frequently associated with these situations is cholera.

Migrations are constituted by persons who go to a country or region and stay for a long time. The 20th and 21st centuries have witnessed the migration of multiple populations due to war, civil unrest, ethnic cleansing, genocide, economic migration, and geographical catastrophes [3]. At the end of the 20th century, approximately 150 million people lived elsewhere than their native country (2.5% of the world's population); of these, about 15 million were refugees.

Migration of large numbers of people creates opportunities for the spread and establishment of common or novel infectious diseases. Diseases that are imported can be classified as: (i) cosmopolitan imported diseases, when they are distributed worldwide; and (ii) tropical imported diseases, when they exist in tropical and subtropical areas but are nearly non-existent in developed countries because of the lack of an adequate vector or eradication. Roca *et al.* [10] analysed 1321 African immigrants in Spain, and the cosmopolitan imported diseases most frequently found were ankylostomiasis, HIV disease, chancre, tuberculosis, gonorrhoea, and diarrhoea caused by *Giardia lamblia*. Among the tropical imported diseases that they found were schistosomiasis,

intestinal amoebiasis, and malaria. Cosmopolitan diseases have a greater likelihood of increasing their incidence than tropical diseases, because cosmopolitan diseases may have vectors previously adapted to the environment.

International travel, tourism and commerce are increasing, and they constitute an efficient transport system for pathogens and vectors [4]. The introduction of budget and low-cost airlines has revolutionized the travel industry, making travel significantly cheaper [5]. The World Traveller's Organization reported that the destination of about 40% of intercontinental journeys is an underdeveloped country. In 2000, 79 million people chose an exotic country as their destination for holidays. The SARS outbreak is an example of how travel aided the rapid spread of an emerging pathogen from China to susceptible populations worldwide [3]. Tourists risk acquiring infections when they are in new environments, because they are exposed to illnesses for which they have no resistance. Traveller's diarrhoea caused by different diarrhoeagenic *Escherichia coli* strains is one of the most common infectious diseases imported from exotic countries.

Antimicrobial resistance has been considered to be an EID. The easy acquisition of antibiotics and their incorrect and abusive use play an important role in the increase of bacterial resistance to these antimicrobial agents. In addition, resistance can be spread to bacteria belonging to the same or different species by mobile genetic elements such as plasmids, transposons, or integrons.

Finally, the role of environmental change, a global problem, is important in dissemination of infectious diseases. There are multiple ways by which environmental changes could contribute to the emergence and spread of infectious diseases: natural disasters (e.g. flood, drought, earthquake, and famine), deforestation, global warming, and climate change [1]. Deforestation, road construction, irrigation, intensive agriculture and animal production systems, uncontrolled spread of human habitat, lack of public health and contamination are examples of environmental changes caused by human activity that facilitate the emergence of infectious diseases. Zoonotic transmission of infectious diseases is facilitated by encroachment of human habitation and the loss of niche environments [3]. However, the pathogen must first establish itself in the new environment, and pathogens that need a vector or an intermediate host will have a restricted distribution, depending on vector or host adaptation to, or availability in, the new environment. Non-zoonotic means of transmission, such as person-person or faecal-oral transmission of infectious diseases, can be affected by living conditions, size or density of population, sexual habits, and population levels of immunization. In addition, human behaviour has contributed to a number of EIDs within different

populations. The most recognized is the role of sexual behaviour in the transmission of sexually transmitted diseases, such as HIV disease. Alcoholism, body piercing, tattooing, intravenous drug abuse and changes in eating habits have also been responsible for EIDs.

For a country to defend itself against the emergence and spread of infectious diseases, it must have a surveillance system to detect emergent and re-emergent infections, responsive healthcare systems and laboratories, vector control, and education programmes to inform the population of how to avoid infections.

### Transparency Declaration

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### References

1. McMichael AJ, Woodruff EF, Hales S. Climate change and human health: present and future risks. *Lancet* 2006; 367: 859–869.
2. Cheng VC, Lau SK, Woo PC, Yuen KY. Severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection. *Clin Microbiol Rev* 2007; 20: 660–694.
3. Miller BC, Moore JE. Emerging pathogens in infectious diseases: definitions, causes and trends. *Rev Med Microbiol* 2006; 17: 101–106.
4. Rey JR. *Enfermedades infecciosas emergentes*. IFAS Extension. ENY-7405. Gainesville: University of Florida, 2007.
5. Hubalek Z. An annotated checklist of pathogenic microorganisms associated with migratory birds. *J Wildl Dis* 2004; 40: 639–659.
6. Vazeille M, Jeannin C, Martin E, Schaffner F, Failloux A. Chikungunya: a risk for Mediterranean countries? *Acta Trop* 2008; 105: 200–202.
7. Adhami J, Reiter P. Introduction and establishment of *Aedes albopictus* Skuse (Diptera: Culicidae) in Albania. *J Am Mosq Control Assoc* 1998; 14: 340–343.
8. Sabatini A, Raineri AV, Trovato G, Cluzzi M. *Aedes albopictus* in Italia e possibile diffusione della specie nell'area Mediterranea. *Parassitologia* 1990; 32: 301–304.
9. Charrel RN, de Lamballerie X, Raoult D. Chikungunya outbreaks—the globalization of vectorborne diseases. *N Engl J Med* 2007; 356: 769–771.
10. Roca C, Balanzó X, Fernandez-Roure JL et al. Imported diseases in African immigrants in Spain: study of 1,321 patients. *Med Clin (Barc)* 2002; 119: 616–619.