

# Travel, migration and emerging infectious diseases

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## ARTICLE INFO

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## ABSTRACT

Emerging infectious diseases (EID) threaten public health and are sustained by increasing global commerce, travel and disruption of ecological systems. Travelers could play a role in importing EIDs and could be a sentinel of major epidemics. In connection with the extension of poverty, urbanization, extensive livestock rearing and globalization, we could be exposed to a third epidemiological transition characterized by zoonotic diseases and infections with multidrug-resistant bacteria. The risk appears low for emerging infectious diseases, or very low for high-risk emerging infectious diseases, but higher for multidrug-resistant enterobacteriaceae carriage with possibly limited consequences. The role played by migrants is weaker than imagined. Immigrants don't play the role of sentinel epidemic so far. They could play a role in importing multidrug-resistant enterobacteriaceae, but it is poorly evaluated.

Emerging infectious diseases (EIDs) have led to cooperation between countries, the first international epidemic response conference in 1851 and the establishment of WHO in 1948.

EIDs are diseases that have appeared recently or that have recently increased in frequency, geographical distribution or both (1). Since the end of the 20th century, there has been a constant stream of newly identified pathogens and an increasing occurrence of pandemic threats to global health (2).

These infections are due to new agents (HIV-1, Severe Acute Respiratory Syndrome Coronavirus -SARS-CoV- (2003), avian influenza virus H5N1 (2005), H1N1 (2009)), geographical area in extension (West Nile, Dengue, Chikungunya, and Zika viruses), increased incidence of infectious disease (HIV, tuberculosis, plague), modification of virulence (*Neisseria meningitidis*) or acquisition of resistance (Extended-spectrum beta-lactamases -ESBL- or carbapenemase producing enterobacteriaceae and multidrug-resistant -MDR- tuberculosis).

We can also compare the re-emerging infections (polio virus (2014), Ebola virus (2014), etc.) (3, 4).

EIDs threaten public health and are sustained by increasing global commerce, travel and disruption of ecological systems and in particular urbanization. Urbanization is characterized by rapid intensification of agriculture, socioeconomic change, and ecological fragmentation, which can have profound impacts on the epidemiology of infectious disease (5). However, their interactions with travel and migrations are less well known.

Travelers could play a role in importing EIDs and could be a sentinel of major epidemics.

In France, there are more than 20 million travelers every year, 4.5 million of which are destined for areas at high risk for health. There are several modes of travel: tourist, business or visiting

friends and relatives. Trips can be very short or extended in time.

Infectious diseases are rare health events, with the exception of common infectious diseases such as traveler's diarrhea and are a single cause of death, far behind accidents and cardiovascular disease (6).

The risk of emerging infections such as dengue in a risk zone was estimated at 1% for one month of travel (7).

We have seen (re-)emergence of diseases imported by travellers in Europe, such as chikungunya and dengue in France and Italy, and malaria in Greece (8-10). Apart from these examples, these are rare situations. However, with global travel growth, the risk could become more tangible (11).

A particular concern is that of Multidrug Resistant Enterobacteriaceae (MRE) carriage. MRE acquisition is very frequent among travellers to tropical regions (12). The acquisition was higher in Asia (72%) than in sub-Saharan Africa (48%) or Latin America (31%). However, the same study showed that MRE carriage was limited in time and disappeared after a few months.

Migration is a global phenomenon that influences the health of individuals and populations over the course of their lives (13). Migrants are special travellers who, in most cases, do not migrate by choice. Migrants are considered at higher risk for a range of health problems including infectious diseases as HIV, hepatitis B, tuberculosis, schistosomiasis and malaria (14, 15). This higher risk is partly due to poor socioeconomic conditions and, in some countries, is due to the lack of rights to health coverage for undocumented migrants (16-19).

Existing evidence from different European countries highlights the difficulties to access health services that migrants are facing (20-23). These infectious diseases unequally expose the majority

population, from none at all (e.g., malaria) to a little (e.g., tuberculosis).

One can take the examples of epidemics of Middle East Respiratory Syndrome Coronavirus -MersCov- and Ebola, for which no secondary case has been reported in France.

Among the published studies on migrants and infectious diseases, the majority were non-emergent diseases with the exception of MDR tuberculosis and multidrug-resistant bacteria (24, 25).

In connection with the increased use of antibiotics in low-resource countries, there is a worrying increase in the prevalence of multidrug-resistant bacteria (26, 27). This increase could lead to an increased risk for migrants and their relatives, but there are few data on this point (28). The risk seems particularly increased when they return home to visit friends and relatives (29). While antimicrobial resistance is of concern, the prospects for pandemic spread of a bacterial or fungal emerging pathogen by migrants seem less likely (30).

Endemic disease, as tuberculosis, impose a far higher public health burden than epidemic disease (31). Denmark experienced an increase in the incidence of tuberculosis in the 1990s in relation to the increase in the number of cases among migrants (32). The rate of tuberculosis in France is 10 times higher among immigrants than in the majority population. Refugees and asylum seekers may have a heightened risk of MDR-TB infection and worse outcomes but the data remains poor (33).

Thus, there is little evidence to support the theories by which migrants would expose the host population to significant infectious risk. However, human diseases acquire a social status based on their perceived risk that determines their acceptability (31).

In a study that we conducted with a number of 347 doctors in France (infectious diseases and

general practitioners), they were asked if first-time migrant people represent a vector of infectious diseases different from the majority population: 8% answered no, 13% yes but weakly, 44% yes but moderately, 27% yes significantly and 9% did not know.

Thereby, apart from infections such as tuberculosis and multidrug-resistant bacteria, the introduction of EIDs into human populations seems to be more often a consequence of economic development that brings zoonotic reservoirs in closer proximity to people.

Indeed, most pandemic threats are caused by viruses from either zoonotic sources or vector-borne sources (30). There is a need for rapid diagnosis of EIDs. Systems biology approaches can lead to a greater understanding of EIDs pathogenesis and facilitate the evaluation of newly developed vaccine-induced immunity in a timely manner (30, 34).

Close collaboration is therefore needed between specialists in tropical medicine, in public health, immunologists and biologists to anticipate the risk of EIDs in order to achieve the Sustainable Development Goals established by the United Nations in 2015 (35).

The WHO established a Department of Pandemic and Epidemic Diseases in 2011 to better prepare for and respond to EIDs.

In conclusion, in connection with the extension of poverty, urbanization, extensive livestock rearing and globalization, we could be exposed to a third epidemiological transition characterized by zoonotic diseases and infections with multidrug-resistant bacteria (36).

The risk appears low for EIDs, or very low for high-risk EIDs, but higher for MRE carriage with possibly limited consequences. The role played by migrants is weaker than imagined (except for tuberculosis). Immigrants don't play the role of

sentinel epidemic so far. They could play a role in importing MRE, but it is poorly evaluated.

## REFERENCES

1. Metcalf CJE, Lessler J. Opportunities and challenges in modeling emerging infectious diseases. *Science*. 2017;357(6347):149-52.
2. Fauci AS, Morens DM. The perpetual challenge of infectious diseases. *N Engl J Med*. 2012;366(5):454-61.
3. Drosten C, Gunther S, Preiser W, van der Werf S, Brodt HR, Becker S, et al. Identification of a novel coronavirus in patients with severe acute respiratory syndrome. *N Engl J Med*. 2003;348(20):1967-76.
4. Ungchusak K, Auewarakul P, Dowell SF, Kitphati R, Auwanit W, Puthavathana P, et al. Probable person-to-person transmission of avian influenza A (H5N1). *N Engl J Med*. 2005;352(4):333-40.
5. Hassell JM, Begon M, Ward MJ, Fevre EM. Urbanization and Disease Emergence: Dynamics at the Wildlife-Livestock-Human Interface. *Trends Ecol Evol*. 2017;32(1):55-67.
6. Hargarten SW, Baker TD, Guptill K. Overseas fatalities of United States citizen travelers: an analysis of deaths related to international travel. *Ann Emerg Med*. 1991;20(6):622-6.
7. Steffen R, Amitirigala I, Mutsch M. Health risks among travelers--need for regular updates. *J Travel Med*. 2008;15(3):145-6.
8. Delisle E, Rousseau C, Broche B, Leparç-Goffart I, L'Ambert G, Cochet A, et al. Chikungunya outbreak in Montpellier, France, September to October 2014. *Euro Surveill*. 2015;20(17).
9. Tseroni M, Baka A, Kapizioni C, Snounou G, Tsiodras S, Charvalakou M, et al. Prevention of Malaria Resurgence in Greece through the Association of Mass Drug Administration (MDA) to Immigrants from Malaria-Endemic Regions and Standard Control Measures. *PLoS Negl Trop Dis*. 2015;9(11):e0004215.
10. Marchand E, Prat C, Jeannin C, Lafont E, Bergmann T, Flusin O, et al. Autochthonous case of dengue in France, October 2013. *Euro Surveill*. 2013;18(50):20661.
11. World Tourism Organization. UNWTO Annual Report 2016. Madrid: UNWTO; 2017.
12. Ruppe E, Armand-Lefevre L, Estellat C, Consigny PH, El Mniai A, Boussadia Y, et al. High Rate of Acquisition but Short Duration of Carriage of Multidrug-Resistant Enterobacteriaceae After Travel to the Tropics. *Clin Infect Dis*. 2015;61(4):593-600.
13. Zimmerman C, Kiss L, Hossain M. Migration and health: a framework for 21st century policy-making. *PLoS Med*. 2011;8(5):e1001034.
14. Simon J, Kiss N, Laszewska A, Mayer S. Public Health Aspects of Migrant Health: A Review of the Evidence on Health Status for Labour Migrants in the European Region. WHO Health Evidence Network Synthesis Reports. Copenhagen2015.
15. De Vito E, de Waure C, Specchia ML, Ricciardi W. Public Health Aspects of Migrant Health: A Review of the Evidence on Health Status for Undocumented Migrants in the European Region. WHO Health Evidence Network Synthesis Reports. Copenhagen2015.
16. Vazquez ML, Vargas I, Jaramillo DL, Porthe V, Lopez-Fernandez LA, Vargas H, et al. Was access to health care easy for immigrants in Spain? The perspectives of health personnel in Catalonia and Andalusia. *Health policy*. 2016;120(4):396-405.
17. Derosé KP, Bahney BW, Lurie N, Escarce JJ. Review: immigrants and health care access, quality, and cost. *Med Care Res Rev*. 2009;66(4):355-408.
18. Magalhaes L, Carrasco C, Gastaldo D. Undocumented migrants in Canada: a scope literature review on health, access to services, and working conditions. *J Immigr Minor Health*. 2010;12(1):132-51.
19. Vignier N, Desgrees du Lou A, Pannetier J, Ravalihasy A, Gosselin A, Lert F, et al. Access to health insurance coverage among sub-Saharan African migrants living in France: Results of the ANRS-PARCOURS study. *PLoS One*. 2018;13(2):e0192916.
20. Rechel B, Mladovsky P, Ingleby D, Mackenbach JP, McKee M. Migration and health in an increasingly diverse Europe. *Lancet*. 2013;381(9873):1235-45.
21. Scheppers E, van Dongen E, Dekker J, Geertzen J, Dekker J. Potential barriers to the use of health services among ethnic minorities: a review. *Fam Pract*. 2006;23(3):325-48.
22. Gray BH, van Ginneken E. Health care for undocumented migrants: European approaches. *Issue Brief (Commonw Fund)*. 2012;33:1-12.
23. Dourgnon P, Jusot F, Silva J, Sermet C. Immigrants' access to ambulatory care in France. *Questions d'économie de la santé*. 2009;146.
24. Napoli C, Dente MG, Karki T, Riccardo F, Rossi P, Declich S, et al. Screening for Infectious Diseases among Newly Arrived Migrants: Experiences and Practices in Non-EU Countries of the Mediterranean Basin and Black Sea. *Int J Environ Res Public Health*. 2015;12(12):15550-8.
25. Kentikelenis A, Karanikolos M, Williams G, Mladovsky P, King L, Pharris A, et al. How do economic crises affect

migrants' risk of infectious disease? A systematic-narrative review. *Eur J Public Health*. 2015;25(6):937-44.

26. Laxminarayan R, Matsoso P, Pant S, Brower C, Rottengen JA, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. *Lancet*. 2016;387(10014):168-75.

27. Karanika S, Karantanos T, Arvanitis M, Grigoras C, Mylonakis E. Fecal Colonization With Extended-spectrum Beta-lactamase-Producing Enterobacteriaceae and Risk Factors Among Healthy Individuals: A Systematic Review and Metaanalysis. *Clin Infect Dis*. 2016;63(3):310-8.

28. Angeletti S, Ceccarelli G, Vita S, Dicuonzo G, Lopalco M, Dedej E, et al. Unusual microorganisms and antimicrobial resistances in a group of Syrian migrants: Sentinel surveillance data from an asylum seekers centre in Italy. *Travel Med Infect Dis*. 2016;14(2):115-22.

29. Khawaja T, Kirveskari J, Johansson S, Vaisanen J, Djupsjobacka A, Nevalainen A, et al. Patients hospitalized abroad as importers of multiresistant bacteria—a cross-sectional study. *Clin Microbiol Infect*. 2017;23(9):673 e1- e8.

30. Graham BS, Sullivan NJ. Emerging viral diseases from a vaccinology perspective: preparing for the next pandemic. *Nat Immunol*. 2018;19(1):20-8.

31. Medley GF, Vassall A. When an emerging disease becomes endemic. *Science*. 2017;357(6347):156-8.

32. Carballo M, Nerukar A. Migration, refugees, and health risks. *Emerg Infect Dis*. 2001;7(3 Suppl):556-60.

33. Hargreaves S, Lonroth K, Nellums LB, Olaru ID, Nathavitharana RR, Norredam M, et al. Multidrug-resistant tuberculosis and migration to Europe. *Clin Microbiol Infect*. 2017;23(3):141-6.

34. Oh SJ, Choi YK, Shin OS. Systems Biology-Based Platforms to Accelerate Research of Emerging Infectious Diseases. *Yonsei Med J*. 2018;59(2):176-86.

35. United Nations. Resolution adopted by the General Assembly on 25 September 2015. Transforming our world: the 2030 Agenda for Sustainable Development. 2015.

36. Zuckerman MK, Harper KN, Barrett R, Armelagos GJ. The evolution of disease: anthropological perspectives on epidemiologic transitions. *Glob Health Action*. 2014;7:23303.