

Mobile populations across the Mediterranean Sea and beyond: travel medicine, mass gathering medicine and homeless health

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Abstract

The Méditerranée Infection institute is internationally recognized for its expertise in infectious diseases and tropical medicine, and is one of the most active research centres for infectious diseases in Europe. Surveillance and research addressing infectious diseases in globally mobile populations is one of the strong components of the research conducted at the institute. A significant amount of clinical, microbiologic and epidemiologic works have been conducted in international travellers, pilgrims participating in large international religious gatherings, economic migrants and homeless migrant people over the last decades by our group. Our strong anchoring in several countries around the Mediterranean Sea and beyond, as well as the pivotal role of Marseille in the EuroTravNet and GeoSentinel international networks that monitor travel-associated diseases, reinforce our leading position in the fields of travel and tropical medicine, mass gathering medicine and homeless health.

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Introduction

One of the most salient characteristics of the human population today is its global international mobility, with increasing numbers of international tourists, economic migrants and asylum seekers, including homeless people (Box 1). The Mediterranean Sea is bordered by ten European countries, five Middle Eastern countries and five North African countries plus the islands of Cyprus and Malta. In 2017, according to the United Nations, there were 161 338 migrant arrivals in Europe by sea in the Mediterranean area, with an estimated 3049 dead

and missing as of 5 December 2017 (<http://data2.unhcr.org/en/situations/mediterranean>). Most of them were from Africa, Syria and Iraq. Marseille, in southern France, is the second Mediterranean port following Algeiras, in Spain. It is the main town in Mediterranean France and includes an urban and periurban population of over 1.5 million inhabitants. The economy of Marseille and its region is still partly linked to its commercial port and has always been one of the main gateways into France. Successive waves of migrants have settled in Marseille over several decades, originating mostly from Corsica, Armenia, Lebanon, Algeria, Morocco, Tunisia, Portugal, Italy and the Comoros. In 2017, an estimated 70 000 inhabitants of Comorian origin and more than 120 000 inhabitants with an epidemiologic link with the Maghreb (70 000 with Algeria, 30 000 with Tunisia and 15 000 with Morocco) or sub-Saharan Africa were living in Marseille. This population often travels to Africa to visit friends and relatives, and to Saudi Arabia for performing the Muslim pilgrimages (the Umra and the Hajj).

BOX 1. Worldwide human international mobility and homelessness estimates according to United Nations

Mobility	Estimate	Source
International tourist arrivals in 2016	1237 million	http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_barom17_05_october_excerpt.pdf
International tourist arrivals between January and August 2017	901 million (7% increase)	http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_barom17_05_october_excerpt.pdf
International migrants living outside their origin country in 2015	243.7 million (58% in developed countries)	http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates15.shtml
Forcibly displaced people worldwide in 2017	65.6 million	http://www.unhcr.org/figures-at-a-glance.html
Homeless people in 2005	100 million	https://www.habitat.org/volunteer/build-events/world-habitat-day

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Travel medicine and migrant health

The Infectious Diseases and Tropical Medicine units in Marseille civilian and military hospitals, in conjunction with military research institutions and reference centres on rickettsioses, malaria and arboviruses based in our city, have long contributed to the international reputation of Marseille as a leading place for tropical medicine. In particular, and thanks to the specific migrant populations in Marseille, we have been involved in the surveillance and description of several diseases and outbreaks. Representative recent examples include the description of malaria cases imported from the Comoros with the surveillance of *Plasmodium falciparum* chemosensitivity [1], the description of chikungunya cases and virus during the outbreak that started in 2005 and spread globally [2,3], the description of rickettsioses in travellers [4] and the documentation of dengue outbreaks or other spreading agents based on sentinel travellers [5–7]. Thanks to this expertise, our centre joined the GeoSentinel global network in 2003, and in 2008 we launched in Marseille EuroTravNet, a sister network with the aim to survey travel-associated diseases in European travellers and migrants [8]. EuroTravNet has produced recurrent surveillance reports over the last decade [9–11], providing valuable information on the frequency of a large panel of travel-related diseases, including place of exposure and trends over time. The

information gained from EuroTravNet and other networks like TropNet Europe has provided important data for the practice of travel medicine in Europe [12]. EuroTravNet also identified sentinel events (i.e. single case or clusters of cases of a given disease in travellers that allows identifying or better characterization of an outbreak in the country of exposure). For instance, the circulation pattern of dengue was identified in the Comoros and Zanzibar thanks to sentinel travellers [13]. Surveillance data also provide reliable data on which to base risk assessment for specific destinations or events like the 2016 Olympics in Brazil [14].

Besides large international network analyses, we conducted single-centre and multicentre studies on specific destinations including the Comoro Islands [1], Senegal [15] and North Africa [16,17], as well as on specific diseases, including loiasis [18], schistosomiasis in Corsica [19], larva migrans [20], and rabies and exposure to rabies [21,22]. Additionally, our laboratory is associated with the national reference centre for malaria. It has conducted surveillance of imported malaria cases from migrants, travellers or French soldiers returning from malaria-endemic countries and evaluation of parasite susceptibility to antimalarial drugs and clinical efficacy to adapt chemoprophylaxis and treatment. Consequently, control strategies in French armed forces and in civilian recommendations were implemented [23,24]. A traveler database can be used as a surveillance system to assess and monitor the emergence of drug resistance in endemic African areas where information is limited [25].

Mass gathering medicine

Over the last decade, we conducted multiple prospective cohort studies on the epidemiology of infectious diseases among Muslim pilgrims departing to Saudi Arabia for the Hajj. Many of these projects were conducted in collaboration with the Saudi Ministry of Health as part a large international collaboration. We investigated the occurrence of clinical events based on syndromic surveillance and noted a high rate of respiratory tract infection symptoms and diarrhoea among pilgrims, likely due to crowding conditions at the Hajj [26,27]. We investigated respiratory virus and bacteria carriage using a real-time quantitative PCR-based approach and demonstrated significantly high acquisition rates of rhinovirus, coronaviruses, influenza virus, *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Klebsiella pneumoniae* and *Streptococcus pneumoniae* by pilgrims after travel to Saudi Arabia compared to baseline carriage before departure from their home country [28–31]. We investigated the acquisition of antibiotic-resistant bacterial genes using a similar approach and found that pilgrims acquired

digestive extended-spectrum β -lactamase-producing and mcr-1 plasmid-mediated colistin-resistant *Escherichia coli* and *K. pneumoniae* as well as colistin-resistant *Salmonella enterica* [32–34]. Finally we demonstrated the acquisition of respiratory and digestive carbapenemase-encoding genes [35]. We are currently investigating possible associations between microbiologic carriage and clinical features in pilgrims and the role of preventive measures. Recently we started a new research project addressing the epidemiology of infectious diseases at another religious mass gathering in Senegal, Africa: the Grand Magal in Touba [36].

Homeless health

In Marseille, since 2000, a large mobile team is sent once a year to perform snapshot interventions in the main two homeless shelters. These investigations can reach a category of homeless people who do not usually seek healthcare. During interventions, homeless persons who choose to participate are interviewed and physically examined. Clothes are carefully screened for body lice, and specific treatment is provided when appropriate. Blood, skin and respiratory specimens as well as arthropods are collected and screened for pathogens. This population comprises more than 70% of migrants [37]. These snapshot interventions have led to successively identifying a high prevalence of louse infestation, louse-borne diseases such as *Bartonella quintana* infection, epidemic typhus and relapsing fever [38]. This strategy of wide systematic testing of infectious diseases in this population also led to the unexpected discovery of an outbreak of acute Q fever in a homeless shelter in Marseille [39]. Also, high rates of murine typhus [40] and high rates of hepatitis E infections were found in both shelters [41]. High rates of respiratory infection symptoms and respiratory virus carriage were also found in homeless people in Marseille [42]. Interventional studies aiming at delousing homeless people using ivermectin or permethrin were conducted [43–45]. Current studies aim at investigating risk factors for body lice, scabies and respiratory infections [37].

Conclusion

The city of Marseille, given its geographical situation, is a unique place for conducting studies on internationally mobile populations. The Institut Méditerranée Infection hosts the busiest international vaccination centre in the area, where tourists, business travellers, those who visit friends and relatives, and pilgrims can be easily recruited for prospective cohort studies. The participation of French military structures involved in

medical assistance, surveillance and research in French forces deployed abroad allows us to conduct studies in this specific population. Returning ill travellers and migrants are frequently assessed in our outpatient department, where more than 35 physicians consult, then hospitalized in one of our three 25-bed inpatient wards when required. The diagnostic laboratory teams can identify all common and most rare pathogens that can affect international travellers and describe new species. The involvement of our institute in international networks which specialize in travel-associated disease surveillance allows us to lead or participate in multicentre surveys. Our connection with Saudi Arabia and Senegal allows productive collaborations in the field of mass gathering medicine. Our strong anchoring in Senegal, Algeria and in the Comoros makes fruitful scientific collaborative projects possible. Our long-term collaboration with homeless shelters in Marseille enables us to survey infectious diseases in this hard-to-reach migrant population. Our involvement in the surveillance of imported malaria (travellers, migrants and soldiers) allows us to predict the emergence of drug resistance in malaria-endemic African countries.

Conflict of interest

None declared.

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