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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 Algesiras, 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).
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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 ricketsioses 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 Comoros 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 chemophylaxis 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 pneumonia 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 microbio-
logic 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 inter-
ventions, 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]. Intervenional studies aiming at delousing homeless peo-
ple 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 popu-
lations. 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 than
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 in-
fecious 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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