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# International mass gatherings and travel-associated illness: A GeoSentinel cross-sectional, observational study

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ABSTRACT

*Background:* Travelers to international mass gatherings may be exposed to conditions which increase their risk of acquiring infectious diseases. Most existing data come from single clinical sites seeing returning travelers, or relate to single events.

*Methods:* Investigators evaluated ill travelers returning from a mass gathering, and presenting to a GeoSentinel site between August 2015 and April 2019, and collected data on the nature of the event and the relation between final diagnoses and the mass gathering.

*Results:* Of 296 ill travelers, 51% were female and the median age was 54 years (range: 1–88). Over 82% returned from a religious mass gathering, most frequently Umrah or Hajj. Only 3% returned from the Olympics in Brazil or South Korea. Other mass gatherings included other sporting events, cultural or entertainment events, and conferences. Respiratory diseases accounted for almost 80% of all diagnoses, with vaccine preventable illnesses such as influenza and pneumonia accounting for 26% and 20% of all diagnoses respectively. This was followed by gastrointestinal illnesses, accounting for 4.5%. Sixty-three percent of travelers reported having a pre-travel encounter with a healthcare provider.

*Conclusions:* Despite this surveillance being limited to patients presenting to GeoSentinel sites, our findings highlight the importance of respiratory diseases at mass gatherings, the need for pre-travel consultations before mass gatherings, and consideration of vaccination against influenza and pneumococcal disease.

## 1. Introduction

Attendance at an international mass gathering (MG) may expose travelers to health risks related to crowded conditions, population movement, and inadequate sanitation [1,2]. According to the World Health Organization, an event can be classified as a MG if the number of people attending is sufficient to strain the planning and response resources of the community, state, or nation hosting the event [2]. However, much of the available literature describes mass gatherings as those exceeding 25,000 persons. We describe demographic characteristics and diagnoses among travelers who attended a MG and presented with a travel-associated illness to a GeoSentinel site.

## 2. Methods

Records of ill travelers attending a MG between August 17, 2015, and April 30, 2019, were collected by GeoSentinel, a global clinician-based surveillance network that monitors travel-related illnesses among international travelers and migrants [3]. GeoSentinel was established in 1995 as a collaboration between the Centers for Disease Control and Prevention and the International Society of Travel Medicine. It consists of 68 clinical sites in 28 countries. GeoSentinel records ill persons' visits to network sites; well travelers are not captured. Attendance at a MG is routinely recorded. During the study period, investigators were directed to enter supplemental details on the nature and location of the MG and to evaluate whether the diagnosis was likely associated with MG attendance. Records were excluded if the mass gathering was likely to have < 25,000 attendees or if data were missing regarding the type of MG. GeoSentinel's data collection protocol has been reviewed by a human subjects advisor at CDC's National Center for Emerging and Zoonotic Infectious Diseases and is classified as public health surveillance and not human subjects research. Additional ethics clearance was obtained by participating sites as required by their respective institutions or national regulations.

## 3. Results

A total of 327 records of ill travelers attending a MG during international travel had surveys completed by the investigator providing their care. Thirty-one records were excluded. Of 296 ill travelers included, 151 (51.0%) were female and the median age was 54 years (range: 1–88; IQR: 39–64). Purposes of MGs were religious (243 cases; 82.1%), cultural (e.g., music, dance, carnival) (19 cases; 6.4%), the World Scout Jamboree (17 cases; 5.7%), major sport events (13 cases; 4.4%), or a large conference (4 cases; 1.4%). The top three specific MGs were Umrah or Hajj in Saudi Arabia with 241 cases (81.4%), including 87 at Umrah and 154 at Hajj, followed by the World Scout Jamboree in Japan with 17 cases (5.7%), and the Olympics in Brazil and South Korea with 9 cases (3.1%) (Table 1). Ill travelers who acquired illness at Umrah or Hajj were older (median age: 57 years [range: 1–88; IQR: 47–66]) than those at the Olympics (median age: 36 years [range: 19–55; IQR: 31–46]) or the World Scout Jamboree (median age: 18 years [range: 14–52; IQR: 17–20]). Sixty-four percent of ill travelers who attended Umrah or Hajj were hospitalized because of their illness; one traveler who attended the World Scout Jamboree and no travelers who attended the Olympics were hospitalized.

Overall, 130 of 206 (63%) ill travelers with information available reported having a pre-travel encounter with a healthcare provider. The majority (260 of 296, 87.8%) of acquired illnesses were directly associated with MG attendance, while the relation between the illness and the MG was not ascertainable for 25 travelers (8.4%), and the illness was travel-related but not linked to MG attendance for 11 travelers (3.7%). Only three of nine (33.3%) diagnoses among travelers who attended the Olympics were associated with attending the MG.

A total of 303 diagnoses were reported among the 260 ill travelers whose illness was associated with MG attendance (Table 2). Respiratory diseases were the most frequently reported disease category with 236 diagnoses (77.9%), followed by gastrointestinal diseases (14 diagnoses; 4.6%). Diagnoses related to attendance at the three most common MGs

**Table 1**
Mass gathering characteristics, ill traveler demographics, and most frequent illnesses acquired at Umrah and Hajj, the 23rd Scout Jamboree, and the Olympics (n = 296).

| | Umrah or Hajj | 23rd World Scout Jamboree | Olympics |
|---|---|---|---|
| Location | Mecca, Saudi Arabia | Yamagushi, Japan | Rio de Janeiro, Brazil Pyeongchang, South Korea |
| Dates | Hajj: 21–26 September 2015<br>10–15 September 2016<br>30 August-4 September 2017<br>19–29 August 2018<br>Umrah: At any time during the year, but preferentially during Ramadan | 28 July to 8 August 2015 | 5–21 August 2016<br>9–25 February 2018 |
| Attendance [4–7] | Hajj 2015: 1,384,941 foreign attendees<br>Hajj 2016: 1,325,372 foreign attendees<br>Hajj 2017: 1,752,014 foreign attendees<br>Hajj 2018: 1,758,722 foreign attendees<br>Umrah 2017: 6,532,074 foreign attendees in 2017 (data not available in other years) | 33,628 attendees | > 6,000,000 entrances<br>> 1,000,000 entrances |
| Number of GeoSentinel cases | 241 | 17 | Rio: 8<br>Pyeongchang: 1 |
| Patient age, median (years) | 57 (range: 1–88; IQR: 47–66) | 18 (range: 14–52; IQR: 17–20) | 36 (range: 19–55; IQR: 31–46) |
| Female gender (%) | 51.0 | 47.1 | 22.2 |
| Pre-travel encounter (%) | 67.1[a] | Not documented | 71.4 |
| Inpatient (%) | 63.9 | 5.9 | 0 |
| Association of illness(es) with MG (%) | 96.7 | 100 | 33.3[b] |
| Most frequent diagnoses associated with MG (% of patients) | Pneumonia (28.6)<br>Confirmed influenza (22.7)<br>Acute bronchitis (21.9)<br>Influenza-like illness (9.9)<br>Upper respiratory tract infection (7.3) | Upper respiratory tract infection (29.4)<br>Viral syndrome without rash (29.4)<br>Influenza-like illness (17.7)<br>Pharyngitis (17.7)<br>Skin infection (5.9) | Viral syndrome without rash (2 patients)<br>Viral syndrome (1 case)<br>Acute bronchitis (1 case) |
| Death | 1 | 0 | 0 |

[a] Of 173 records for which information was available.
[b] Of 7 records for which information was available.

— Umrah or Hajj, World Scout Jamboree, and Olympics — are presented in Table 1.

## 4. Discussion

GeoSentinel sites evaluated 260 pilgrims with Umrah- or Hajj-related illnesses among an estimated 32 million foreign MG attendees over the study period [4], 17 Scouts among 33,628 attendees [5] and 9 Olympic spectators among 7 million attendees [6,7]. It should be noted, however, that GeoSentinel collects data only on ill travelers presenting to a network site and some GeoSentinel sites may care for more MG attendees than others, which may not be representative of all travelers attending a MG. In particular, the Scouts reported to GeoSentinel were from a single site in Sweden and were identified because of an international alert following a meningococcal outbreak (W ST11 serotype) among six Scottish and Swedish nationals who attended this event [8].

Ill MG attendees seen at a GeoSentinel site most frequently attended Umrah or Hajj, likely due to the large number of travelers to these pilgrimages. These findings are consistent with previously published literature demonstrating that outbreaks are not frequently reported during or after MGs other than Umrah and Hajj pilgrimages, although they sometimes occur at Muslim, Christian, and Hindu religious events, sports events, and large-scale open-air festivals [9,10]. Its size, international recognition, unique multinational component, and yearly recurrence, likely account for the preponderance of Umrah and Hajj among international MGs responsible for outbreaks. Our data are also consistent with previous reports regarding the older age of Umrah and Hajj travelers [11], and the younger age of Scout Jamboree travelers. The finding that almost three-quarters of ill travelers who attended Umrah or Hajj were hospitalized is likely due to a recruitment bias, given that ill travelers seen at GeoSentinel sites may be sicker because of the specialized infectious disease or tertiary care nature of these sites; or to initial clinical suspicion for Middle East respiratory syndrome, resulting in hospitalization and isolation pending testing. The paucity of reported trauma is also likely a reflection of the infectious disease specialization of most GeoSentinel network sites, and of the fact that trauma usually requires immediate attention and is most likely to occur during travel [12].

The predominance of respiratory tract infections reported in this analysis, including 4 cases of pneumococcal disease with one death, corroborates results obtained in Saudi hospitals of pneumonia diagnoses among Umrah and Hajj attendees [13] as well as the high number of influenza virus infections observed among both patients in Saudi hospitals and patients hospitalized on returning to their home countries from Umrah and Hajj [14]. Crowded conditions with close proximity of large numbers of attendees at Umrah and Hajj are a likely explanation for the frequency of respiratory infections among pilgrims, given the transmissibility of these infections. Our results confirm the importance of influenza vaccination for Umrah and Hajj travelers [15]. Although the availability of influenza vaccine may be limited depending on the time of year Hajj occurs [16], immunization with expired influenza vaccine from the recently ended influenza season may have few associated adverse events [17]. By contrast, most illnesses among travelers attending the Olympics were linked to travel, but not to attending the Olympics, and these illnesses' were mild, which may be due to the physical separation of various sporting events at the Olympics, the propensity to hold the Olympics in high income countries, the relatively short travel duration of attendees and participants, and the relatively young age of participants. This is supported by the rarity of documented outbreaks during Olympic Games between 1984 and 2014 [9,18].

Our identification of respiratory tract infections, especially pneumonia, among Umrah and Hajj attendees suggests the need for additional research to document responsible pathogens. Such data may have important consequences regarding vaccine recommendations before

**Table 2**
Diagnoses (N = 303) among 260 ill travelers with diseases associated with attendance at an international mass gathering.

| Diagnosis | Number of Diagnoses[a] | % of Ill Travelers |
|---|---|---|
| Respiratory | | |
| Pneumonia[b] | 67 | 25.7 |
| Influenza[c] | 53 | 20.3 |
| Acute bronchitis | 52 | 19.9 |
| Influenza-like illness | 27 | 10.4 |
| Upper respiratory tract infection, unspecified | 22 | 8.4 |
| Acute exacerbation of chronic respiratory disease | 5 | 1.9 |
| Pharyngitis | 4 | 1.5 |
| Cough, no etiology | 2 | 0.8 |
| Enterovirus 68 infection | 1 | 0.4 |
| Pleural effusion | 1 | 0.4 |
| Pulmonary embolism | 1 | 0.4 |
| Pulmonary tuberculosis | 1 | 0.4 |
| Gastrointestinal | | |
| Acute gastroenteritis | 6 | 2.3 |
| Acute diarrhea | 4 | 1.5 |
| *Campylobacter* infection | 1 | 0.4 |
| Nausea and vomiting, no etiology | 1 | 0.4 |
| Non-pathogenic protozoa | 1 | 0.4 |
| *Salmonella* infection | 1 | 0.4 |
| Ear, nose, and throat | | |
| Acute sinusitis | 3 | 1.1 |
| Acute otitis media | 2 | 0.8 |
| Tonsillitis | 1 | 0.4 |
| Dermatologic | | |
| Skin and soft tissue infection | 7 | 2.7 |
| Insect bite | 1 | 0.4 |
| Urogenital | | |
| Pyelonephritis[d] | 2 | 0.8 |
| Acute renal failure | 1 | 0.4 |
| Cystitis | 1 | 0.4 |
| Vaginitis | 1 | 0.4 |
| Neurologic | | |
| Viral meningitis | 1 | 0.4 |
| Trauma | | |
| Injury | 1 | 0.4 |
| Strain | 1 | 0.4 |
| Blisters | 1 | 0.4 |
| Febrile systemic illness | | |
| Viral syndrome without rash | 9 | 3.4 |
| Sepsis or bacteremia | 3 | 1.1 |
| Viral syndrome | 1 | 0.4 |
| Miscellaneous | | |
| Antibiotic resistant organism[e] | 5 | 1.9 |
| Dehydration | 2 | 0.8 |
| Fatigue | 2 | 0.8 |
| Myalgia | 2 | 0.8 |
| Adverse drug event[d] | 1 | 0.4 |
| Dizziness | 1 | 0.4 |
| Heart disease | 1 | 0.4 |
| Osteomyelitis | 1 | 0.4 |
| Thrombophlebitis | 1 | 0.4 |
| Death[f] | 1 | 0.4 |

[a] All diagnoses were confirmed according to pre-established GeoSentinel Network criteria for each diagnosis, unless otherwise specified.
[b] Including *Streptococcus pneumoniae* infection (4 cases).
[c] Influenza A (38 cases) and influenza B (15 cases).
[d] One case was probable.
[e] One organism was specified (*Salmonella spp.*).
[f] Directly related to complications from pneumococcal pneumonia.

travel. In particular, it may be possible to validate that the influenza serotypes found are representative of strains circulating during the prior northern winter. These data also may provide justification for recommending pneumococcal vaccination for some high-risk travelers [19–21]. However, one-third of all travelers in this report did not attend a pre-travel consultation, and this will likely be a barrier to implementation of such recommendations. Many countries have a staging area where Umrah and Hajj attendees gather before departure, or have pre-Hajj classes at local mosques. Leaders there could raise awareness of recommended (but not required) vaccines and personal protective measures such as carrying and routinely using hand sanitizer may lead to higher level of protective behaviors of traveling pilgrims [22]. Also, primary care physicians should inquire about planned travel to mass gatherings and vaccinate travelers against meningococcus, influenza, and pneumococcus, as appropriate.

Given its broad international catchment, GeoSentinel plays a role in identifying emerging infectious diseases with epidemic potential, thus contributing to efforts to create enhanced international multidisciplinary surveillance of MG-associated illnesses, as recently recommended by experts [23]. Since our surveillance was limited to patients presenting to GeoSentinel sites, to better understand travel-associated illnesses acquired at MGs improved global surveillance mechanisms are needed.

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