Infectious diseases acquired by international travellers visiting the USA†

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Abstract

Background: Estimates of travel-related illness have focused predominantly on populations from highly developed countries visiting low- or middle-income countries, yet travel to and within high-income countries is very frequent. Despite being a top international tourist destination, few sources describe the spectrum of infectious diseases acquired among travellers to the USA.

Methods: We performed a descriptive analysis summarizing demographic and travel characteristics, and clinical diagnoses among non-US-resident international travellers seen during or after travel to the USA at a GeoSentinel clinic from 1 January 1997 through 31 December 2016.

Results: There were 1222 ill non-US-resident travellers with 1393 diagnoses recorded during the 20-year analysis period. Median age was 40 (range 0–86 years); 52% were female. Patients visited from 63 countries and territories, most commonly Canada (31%), Germany (14%), France (9%) and Japan (7%). Travellers presented with a range of illnesses; skin and soft tissue infections of unspecified aetiology were the most frequently reported during travel (29 diagnoses, 14% of during-travel diagnoses); arthropod bite/sting was the most frequently reported after travel (173 diagnoses, 15% after-travel diagnoses). Lyme disease was the most frequently reported arthropod-borne disease after travel (42, 4%). Nonspecific respiratory, gastrointestinal and systemic infections were also among the
most frequently reported diagnoses overall. Low-frequency illnesses (<2% of cases) made up over half of diagnoses during travel and 41% of diagnoses after travel, including 13 cases of coccidioidomycosis and mosquito-borne infections like West Nile, dengue and Zika virus diseases.

Conclusions: International travellers to the USA acquired a diverse array of mostly cosmopolitan infectious diseases, including nonspecific respiratory, gastrointestinal, dermatologic and systemic infections comparable to what has been reported among travellers to low- and middle-income countries. Clinicians should consider the specific health risks when preparing visitors to the USA and when evaluating and treating those who become ill.

Key words: International travellers, infectious diseases, USA, GeoSentinel, travel medicine, Lyme disease, coccidioidomycosis

Introduction

The annual number of international tourist arrivals may reach 1.8 billion by 2030. As international travel increases, travellers are increasingly acquiring infectious diseases not endemic in their home countries and may act as sentinels for outbreaks, spreading infectious diseases within a destination country, the next country on a traveller’s itinerary or the travellers’ own country after returning home. Increased globalization has brought an influx of international travellers to regions of the world with emerging economies, and best estimates of travel-related illness in international travellers have predominantly reflected populations of travellers from highly developed countries visiting low- or middle-income countries. Though more people are travelling to the developing world than ever before, it can be easy for travellers and health care professionals to overlook Western destinations as a perceived low risk for infectious disease, yet international travel to and within the developed world has only increased.

In 2015, 9 of the top 10 international destinations identified by the United Nations World Tourism Organization were in North America or Europe. Combined, these destinations accounted for 454.5 million tourist arrivals. In the USA, 77.5 million international tourists visited in 2015, the most ever recorded. Despite being the second largest international tourist destination overall (only France sees larger volumes), few sources describe travellers to the USA and the spectrum of illnesses they may acquire. This gap in knowledge may impact the health care received by ill travellers who seek care both during travel in the USA and after travel once they return home. Familiarity with the illnesses seen in international travellers to the USA can inform the development of appropriate pre-travel messages and the medical management of ill international travellers. We describe the demographic and travel characteristics, and the clinical diagnoses, of non-US-resident international travellers who acquired an illness in the USA and presented to clinics in the GeoSentinel Global Surveillance Network.

Methods

Data source

GeoSentinel is a global clinician-based sentinel surveillance system, established in 1995 as a collaboration between the Centers for Disease Control and Prevention (CDC) and the International Society of Travel Medicine (ISTM). It consists of 70 specialized travel and tropical medicine clinics in 30 countries, mostly affiliated with academic medical centres. All sites have experience diagnosing and treating patients with travel-related infectious diseases and contribute systematic surveillance data on international travellers and migrants seen for a travel-related illness. Analysis of GeoSentinel surveillance data has been approved as non-research by a CDC human subject advisor.

Inclusion and exclusion criteria

Records with at least one confirmed or probable diagnosis among nonmigrant, non-US-resident international travellers exposed in the USA, as designated by the treating clinician, and seen during or after travel at a GeoSentinel clinic in either the USA or their country of residence from 1 January 1997 through 31 December 2016 were included in this analysis. Data were extracted on traveller demographics (i.e. sex, age and country of residence), trip details (i.e. travel duration, travel reason, destinations) and clinical information (i.e. date of clinic visit, inpatient or outpatient status, if there was a pre-travel consultation with a healthcare provider and other diagnoses). The proportion who attended a pre-travel consultation was determined among those who visited the USA as their only destination country to better approximate those who received care specifically for the USA and not another country on the traveller’s itinerary. GeoSentinel first started collecting data on pre-existing conditions (e.g. pregnancy, HIV infection, immunosuppressing/immunomodulating agents) in March 2013. Consequently, only a subset of records had this data available for analysis. We performed descriptive analyses of demographic and travel characteristics and diagnoses using SAS Enterprise Guide 7.1 (Cary, NC, USA).

Results

There were 1222 ill non-US-resident travellers with 1393 diagnoses reported to GeoSentinel with travel to the USA during the analysis period. The median age of patients was 40 (range 0–86 years); 52% were female (Table 1). Patients visited from 63 countries and territories, most commonly Canada (31%), Germany (14%), France (9%), Japan (7%), the United Kingdom (4%), Israel (4%), Hong Kong (4%), Switzerland (3%) and Singapore (3%). The majority travelled for the purpose of tourism (82%) or business (14%). The median travel duration was 14 days (range 1–2584 days). Among 959 who travelled to the USA and no other destination, 913 had information on pre-travel consultation attendance; 81 (9%) attended a pre-travel health consultation. Of the 1222 patients with illness
acquired in the USA, 177 (14%) were seen during travel and 1,045 (86%) were seen after travel (Table 1).

**During travel**

Among the 177 patients seen during travel in the USA, 213 diagnoses were reported. Nonspecific skin and soft tissue infections were most frequent (29 diagnoses, 14% of all diagnoses made during travel), followed by acute gastrointestinal illnesses of unspecified aetiology (15, 7%) and pneumonia of unspecified aetiology (14, 7%) (Table 2A). One hundred and thirteen (64%) patients seen during travel were hospitalized, including seven with sepsis. Of 69 patients with an illness acquired in the USA and seen at a US GeoSentinel site since March 2013 when data on pre-existing conditions began being collected, 23 (33%) were reported to have at least one such pre-existing condition; all were hospitalized. Three deaths were reported: one in a person with pneumonia who subsequently died of an unspecified acute cardiac event; one in a person with a pulmonary embolism and one in a cancer patient with pre-existing peritonitis who died in the hospital from sepsis.

**After travel**

Among the 1,045 patients seen after travel to the USA, 1,393 diagnoses were reported. The most frequent was arthropod bite/sting (173 diagnoses, 15% of all diagnoses made after travel); 81 (47%) of which were tick bites. This was followed by influenza-like illness (ILI, 66, 6%), upper respiratory tract infection of unspecified aetiology (URI, 54, 5%), acute gastrointestinal illnesses of unspecified aetiology (53, 4%) and skin and soft tissue infections of unspecified aetiology (53, 4%) (Table 2B). Sixteen percent of after-travel patients were hospitalized, primarily with respiratory infections. There were no deaths. Respiratory infections including ILI, URI, influenza and pneumonia combined accounted for 204 (17%) diagnoses made after travel overall, however 60% of these infections were reported in 1 year, 2009 (Figure 1). Forty-seven (71%) of the 66 ILI diagnoses, 42/52 (81%) of the influenza diagnoses, 26/54 (48%) of the URI diagnoses and 7/32 (22%) of the pneumonia diagnoses were recorded after travel in 2009.

Lyme disease was the most frequently reported arthropod-borne disease, diagnosed in 42 travellers; 18 were diagnosed with early or acute Lyme, 24 with late stage Lyme. No other clinical information was available. Of the 42 Lyme cases, 35 (83%) travelled to the USA only; a more specific place of exposure was available for 21 (57%) travellers: New York (6), Massachusetts (4), Wisconsin (3), Maine (2), Maryland (2), New Jersey (2), Minnesota (1) and Vermont (1).

**Notable low-frequency diagnoses**

Low-frequency illnesses (<2% cases), made up 51% of diagnoses made during travel and 41% of diagnoses made after travel. Non-Lyme tick-borne diseases were observed in three travellers.

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**Table 1. Demographic and travel characteristics of ill non-US-resident travellers visiting the USA and presenting to GeoSentinel clinics, 1997–2016**

<table>
<thead>
<tr>
<th></th>
<th>All travellers (n = 1,222)a</th>
<th>Presented to clinic during visit in USA (n = 177)a</th>
<th>Presented to clinic after visit to USA (n = 1,045)a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>591 (48)</td>
<td>100 (57)</td>
<td>491 (47)</td>
</tr>
<tr>
<td>Female</td>
<td>628 (52)</td>
<td>75 (43)</td>
<td>553 (53)</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>40</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Range</td>
<td>0–86</td>
<td>0–86</td>
<td>0–86</td>
</tr>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤17 years</td>
<td>107 (9)</td>
<td>18 (10)</td>
<td>89 (9)</td>
</tr>
<tr>
<td>18–34</td>
<td>373 (31)</td>
<td>46 (27)</td>
<td>327 (31)</td>
</tr>
<tr>
<td>35–49</td>
<td>332 (27)</td>
<td>45 (25)</td>
<td>287 (27)</td>
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<tr>
<td>50–64</td>
<td>266 (22)</td>
<td>39 (22)</td>
<td>227 (22)</td>
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<tr>
<td>≥65 years</td>
<td>140 (11)</td>
<td>29 (16)</td>
<td>111 (11)</td>
</tr>
<tr>
<td><strong>Travel reason</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>999 (82)</td>
<td>147 (83)</td>
<td>852 (82)</td>
</tr>
<tr>
<td>Business</td>
<td>171 (14)</td>
<td>22 (13)</td>
<td>149 (14)</td>
</tr>
<tr>
<td>Student</td>
<td>29 (2)</td>
<td>4 (2)</td>
<td>23 (2)</td>
</tr>
<tr>
<td>Missionary/volunteer/researcher/aid work</td>
<td>14 (1)</td>
<td>2 (1)</td>
<td>12 (1)</td>
</tr>
<tr>
<td>Military</td>
<td>2 (&lt;1)</td>
<td>0 (0)</td>
<td>2 (&lt;1)</td>
</tr>
<tr>
<td>Medical tourism</td>
<td>3 (&lt;1)</td>
<td>1 (1)</td>
<td>2 (&lt;1)</td>
</tr>
<tr>
<td><strong>Travel duration (days)b</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>14</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Range</td>
<td>1–2,584</td>
<td>1–339</td>
<td>1–2,584</td>
</tr>
<tr>
<td><strong>Pre-travel care receivedb</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>81 (9)</td>
<td>12 (8)</td>
<td>69 (9)</td>
</tr>
<tr>
<td>No</td>
<td>559 (61)</td>
<td>99 (62)</td>
<td>460 (61)</td>
</tr>
<tr>
<td>Do not know</td>
<td>273 (30)</td>
<td>48 (30)</td>
<td>225 (30)</td>
</tr>
</tbody>
</table>

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*aAll data are reported as number (%) of travellers.
*bAmong those who travelled to the USA only.
Two Germans presented with unspecified tick-borne spotted fever rickettsioses, one in 2004 and the other in 2014, and a Canadian with ehrlichiosis was reported in 2014. Mosquito-borne arboviral diseases were also observed, including dengue virus (DENV; three patients), West Nile virus (WNV; two patients) and Zika virus (ZIKV; one patient) infections. No
Chikungunya virus (CHIKV) infections were reported. The three patients with DENV infections had exposure times and places consistent with known past focal outbreaks in the USA, including south Florida (one German traveller; 2013) and Hawaii (two Canadian travellers; 2015). Of the two patients with WNV infection, one was hospitalized in the UK after their return. The ZIKV infection was in a 30-year-old Israeli female who visited Miami, Florida, in August 2016.

Coccidioidomycosis was reported in 13 patients seen post-travel, 4 (31%) of whom were hospitalized. The median age of coccidioidomycosis patients was 61 years (range 0–78 years). Of nine coccidioidomycosis patients with information available, eight travellers were exposed in Arizona and one in California.

Clostridium difficile infection was reported in six travellers: three during travel (all hospitalized) and three after travel (two hospitalized). Of those seen during travel, all had visited Florida and presented 1 week to 5 months after arrival in the USA, two were also diagnosed with lobar pneumonia. Of the two hospitalized after return, one was a 72-year-old Swedish male who visited Orlando, Florida, for 29 days in the summer of 2013 and presented with other co-morbidities including a skin and soft tissue infection, vancomycin-resistant enterococci and sepis and the other was a 57-year-old Canadian who visited the USA for 12 days in September 2014.

Discussion

We highlight the most frequently reported, and some noteworthy but less frequent diagnoses in GeoSentinel, among non-US residents visiting the USA from 1997 through 2016. Overall, most patients in the study were tourists and acquired a diverse array of mostly cosmopolitan infectious diseases, including non-specific respiratory, gastrointestinal, dermatologic and systemic infections comparable to what has been reported among travellers to other international destinations, including the tropics.5,6 Nonspecific respiratory infections were among the most frequently reported illnesses of ill-returned travellers from the USA, however, 60% of nonspecific respiratory infections were diagnosed in 2009, likely due to increased screening among some GeoSentinel sites for influenza A H1N1. Acute gastrointestinal illnesses and skin and soft tissue infections were also frequently diagnosed, though each accounted for only 5% of diagnoses made after travel overall. Similar to studies of persons travelling to lower-income countries,6–8 it is important for travellers and health care professionals to recognize that travel-related respiratory, gastrointestinal and dermatologic illnesses also occur among international travellers to developed countries8 and may vary in relation to specific traveller characteristics, including travel purpose, diet, activities during travel and the health profile of the individual traveller.10

Some notable, less frequently encountered but potentially severe diseases endemic to the USA also occurred. Arthropod exposure, reflecting tick bites and tick-borne disease diagnoses (e.g. Lyme disease), was diagnosed more often than other conditions. Ticks transmit the greatest diversity of arthropod-borne pathogens in the USA and are responsible for the largest number of vector-borne diseases there.11,12 In recent decades, the reported number of notifiable tick-borne diseases has steadily increased as the geographic distribution of many ticks and tick-borne diseases has expanded and new tick-borne pathogens have emerged.13 Human vaccines for tick-borne diseases that occur in the USA are lacking.13 Therefore, travellers to the USA should avoid tick habitats whenever possible. If that is not possible, travellers should use tick repellents containing DEET, picaridin, IR3535, oil of lemon eucalyptus, para-methane-diol or 2-undecanone on exposed skin and use products containing 0.5% permethrin to treat clothing, check for ticks daily and properly remove them, if found.13

Lyme disease is the most frequently reported vector-borne disease in the USA and was diagnosed in 42 patients seen after travel.14 Incidence rates are underreported in the USA, but the true magnitude is estimated at 240 000 to 440 000 cases annually.11 Approximately 96% of Lyme disease cases have been reported from 14 states in the Northeast, mid-Atlantic and upper Midwest, though evidence suggests that endemic foci have expanded over time.14 The expansion of areas with high incidence mirrors the geographic expansion of Ixodes scapularis in the eastern USA; infection is less common in the far western USA, where I. pacificus is the vector.11

Arboviral diseases, including WNV, DENV and ZIKV infections occurred in travellers to the USA. WNV is the leading cause of domestically acquired arboviral disease in the USA and is primarily spread by mosquito species of the Culex genus.15 During 2015, 2,282 cases of domestic arboviral disease were reported to CDC; 2,175 (95%) were WNV cases. Most human infections are asymptomatic; symptomatic infections commonly manifest as a systemic febrile illness, and, less commonly, as neuroinvasive disease. DENV and ZIKV infections were also reported, but only from known outbreak areas. Unlike WNV, Aedes aegypti and A. albopictus species are known to variably transmit DENV, ZIKV and CHIKV. Although Aedes species are common in the southern USA, DENV is endemic in northern Mexico, and the US population is largely immune-naïve, the lack of DENV transmission in the continental USA likely reflects more limited contact between people and Aedes species mosquitoes than occurs where transmission is more common.16 Preventing mosquito bites is important when travelling in the USA, especially in Hawaii and the southern states.

Coccidioidomycosis is endemic in the southwestern USA and is underreported.17 Evidence suggests coccidioidomycosis causes 15–29% of community-acquired pneumonia in certain highly endemic areas.18 Of states endemic for coccidioidomycosis, the 2016 incidence was highest in Arizona (89.3 per 100,000 population) and California (13.7 per 100,000 population).19 Some groups may be at higher risk for developing severe forms of coccidioidomycosis, including immunocompromised individuals, pregnant women, individuals with diabetes, persons of African or Filipino descent and adults in older age groups.17 Travellers can prevent infection by avoiding areas where Coccioidoides spores may be present, such as construction or excavation sites, and by avoiding activities that involve close contact with soil or dust, including yard work, gardening and digging.17–19 Health care providers should be aware of this increasingly common infection when treating persons with influenza-like illness or pneumonia who live in or have travelled to endemic areas.18

Though the majority of patients were seen after travel with an acute illness, a disproportionate number of patients were hospitalized during travel, many with pre-existing health
conditions. In addition, three travellers died during their visit to the USA, while there were no records of deaths among those who visited the USA and were seen at a clinic after travel. Noninfectious conditions are known to cause considerable morbidity and mortality among international travellers, and unspecified chronic health conditions have been associated with health problems experienced during and after travel, including hospitalization. Medical advances are enabling individuals with chronic health conditions opportunities to travel despite their health limitations, but travellers with these problems may have unique health risks making them more susceptible to illness or injury while travelling, leading to exacerbation of their underlying conditions.

This analysis has several limitations. First, GeoSentinel surveillance data are not population-based, so disease risks and rates cannot be determined. Further, GeoSentinel sites are travel/tropical medicine focused, therefore our findings may not be representative of all international travellers. Other health problems (e.g., traumatic injuries and chronic disease exacerbations) may be underrepresented. GeoSentinel does not routinely collect detailed information on traveller co-morbidities and only began collecting limited information on this parameter in 2013. As such, the number of travellers with underlying chronic health conditions could not be determined. Death is not well captured in the GeoSentinel surveillance network; data are collected from a single time point and may not capture a death that follows the initial clinic visit. Similarly, GeoSentinel has not routinely collected information on antibiotic exposure among travellers, either during travel or since return from travel. Diagnostic codes in GeoSentinel include specific aetiologic diagnoses and non-specific syndromic diagnoses, and nonspecific diagnosis codes are assigned when an aetiologic diagnosis cannot be determined or are not pursued. Finally, GeoSentinel relies on the judgement of its clinicians for assignment of diagnoses and place of exposure; diagnostic testing information that could be used to validate assigned diagnoses was not routinely collected during the analysis period.

Travellers to the USA should be aware of the diseases they may acquire, paying particular attention to vector-borne infections. Practising appropriate arthropod avoidance measures may prevent these infections. Persons with chronic underlying conditions should take ample supplies of their medications and plan for unanticipated medication shortfalls or possible chronic disease exacerbations. Clinicians, including primary care practitioners, should consider the specific health risks when preparing visitors to the USA and when evaluating and treating those who become ill.

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Author contributions


References


