HHS Public Access

Author manuscript

J Travel Med. Author manuscript; available in PMC 2019 January 01.

Published in final edited form as:

J Travel Med. 2018 January 01; 25(1): . doi:10.1093/jtm/tax097.

Business travel-associated illness: a GeoSentinel analysis†

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Abstract

Background—Analysis of a large cohort of business travelers will help clinicians focus on frequent and serious illnesses. We aimed to describe travel-related health problems in business travelers.

†Parts of the analysis were presented at the 64th Annual Meeting of the American Society of Travel Medicine and Hygiene in Philadelphia, PA, USA, 27 October 2015.

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Conflict of interest: L.H.C. is an advisor for Shoreland, Inc., serves on DSMB for Valneva, and has received speaker travel support and honorarium from GSK. K.L. has received travel support and honorarium from GSK, research support from Sanofi Pasteur, and a consultancy from Immuron. P.S. has provided consultancy services to EXXon Mobil, SOS International and F. Hoffmann-La Roche. D.H.H. is a member of the iJet advisory board and has served as a consultant to Glaxo Smith Kline's and Inovio's vaccine division. All other co-authors report no conflict of interest.

Methods—GeoSentinel Surveillance Network consists of 64 travel and tropical medicine clinics in 29 countries; descriptive analysis was performed on ill business travelers, defined as persons traveling for work, evaluated after international travel 1 January 1997 through 31 December 2014.

Results—Among 12 203 business travelers seen 1997–2014 (14 045 eligible diagnoses), the majority (97%) were adults aged 20–64 years; most (74%) reported from Western Europe or North America; two-thirds were male. Most (86%) were outpatients. Fewer than half (45%) reported a pre-travel healthcare encounter. Frequent regions of exposure were sub-Saharan Africa (37%), Southeast Asia (15%) and South Central Asia (14%). The most frequent diagnoses were malaria (9%), acute unspecified diarrhea (8%), viral syndrome (6%), acute bacterial diarrhea (5%) and chronic diarrhea (4%). Species was reported for 973 (90%) of 1079 patients with malaria, predominantly *Plasmodium falciparum* acquired in sub-Saharan Africa. Of 584 (54%) with malaria chemoprophylaxis information, 92% took none or incomplete courses. Thirteen deaths were reported, over half of which were due to malaria; others succumbed to pneumonia, typhoid fever, rabies, melioidosis and pyogenic abscess.

Conclusions—Diarrheal illness was a major cause of morbidity. Malaria contributed substantial morbidity and mortality, particularly among business travelers to sub-Saharan Africa. Underuse or non-use of chemoprophylaxis contributed to malaria cases. Deaths in business travelers could be reduced by improving adherence to malaria chemoprophylaxis and targeted vaccination for vaccine-preventable diseases. Pre-travel advice is indicated for business travelers and is currently under-utilized and needs improvement.

Keywords

Travel; business; diarrhea; malaria; occupational medicine; vaccine-preventable disease; death

Background

Globally, business travel comprises ~14% of all international travel.[1] The destination, frequency and duration of travel among business travelers are highly variable.[2] A review of more than 800 000 international trips by employees and reports of medical assistance provided to 48 multinational corporations found that 26% of corporate travelers had at least three international trips per year, 17% traveled at least 30 days during the year, and 11% had at least one trip with a duration of 30 days or more; this cohort reported 1188 illnesses.[3]

Illness in an employee while traveling has additional consequences that may be less relevant if in their country of residence (with respect to healthcare, reduced productivity as harder to find replacement, potential repatriation).[4] Other than the study described above, most analyses of illness in these travelers have focused on a single company or small cohorts. The GeoSentinel Surveillance Network consists of 64 travel and tropical medicine clinics in 29 countries with representation from six continents, arguably provides one of the largest global sample of business travelers, and allows a systematic analysis of their health problems.[5] We describe the travel patterns of ill business travelers entered in the database and identify illnesses that affect this group.

Methods

GeoSentinel Surveillance Network data on travelers seen after travel from 1997 through 2014 were analyzed. GeoSentinel captures data on travelers that have crossed an international border and have been evaluated for a presumed travel-associated illness.[5] Business travelers who presented to a GeoSentinel site and who had at least one travel-related diagnosis were included. We defined business travel as 'travel for the purpose of working, (encompassing a range of occupational-related travel, including corporate travel, field work) or attending a meeting or other work-related event such as conferences; travelers accompanying the business traveler (often family members) are also defined as 'business' travelers. Patients missing data on age or under the age of 20 years at time of diagnosis were excluded from analysis.

Final diagnoses are assigned by the clinician and chosen from a list of >500 standard GeoSentinel diagnosis codes, which may be etiologic (e.g. falciparum malaria, influenza, *Salmonella* Typhi) or syndromic (e.g. diarrhea, fever, rash).[5] Diagnosis codes were also categorized into broad syndrome groups.[5] Each traveler may have more than one diagnosis, and each diagnosis is recorded as confirmed, probable or suspected. We included only diagnoses that were confirmed or probable, and were determined by the clinician to be 'travel-related.' We excluded the diagnoses 'healthy,' 'lost to follow up' and 'screening'; non-infectious diagnoses not directly related to travel (Appendix); and diagnoses with uncertain relationship to travel or uncertain time and place of exposure (Appendix).

We used descriptive analyses to describe overall demographics and itinerary characteristics of business travelers seen after travel, as well as diagnoses and seriousness (outpatient/inpatient/death). We distinguished diagnoses among *expatriates* (designated by reporting sites for persons living in a destination country with an independent residence, using mostly the infrastructure used by local residents of the same economic class, independent of duration of residence) from *non-expatriate* business travelers. We also describe the top diagnoses geographically by region of exposure according to modified United Nations' world regions; we combined Australia, New Zealand, North America and Western Europe since each held high human development index and represented less frequent locations of illness acquisition.[5]

GeoSentinel's data collection and analysis protocol has been reviewed by a human subjects advisor for the Centers for Disease Control and Prevention and is classified as public health surveillance; for this reason, it has been determined that IRB review is not required.

Results

This analysis included 12 203 ill business travelers (14 045 confirmed or probable diagnoses) who presented post-travel to a GeoSentinel clinic (Table 1). Median age was 40 years and 11 779 (97%) travelers were aged 20–64 years; two-thirds were male. Most were seen as outpatients; fewer than half reported a pre-travel health encounter. Three-quarters were reported from Western Europe or North America. Frequent regions of exposure were sub-Saharan Africa (37%), Southeast Asia (15%), South Central Asia (14%), South America

(7%), Northeast Asia (6%) and Central America (4%). Twelve percent were expatriate business travelers.

Syndromes and diagnoses

The most frequently reported disease syndromes among the 14 045 total diagnoses were acute diarrhea (24%), febrile/systemic illness (24%), dermatologic (13%), respiratory (10%), other gastrointestinal problems (8%) and chronic diarrhea (8%) (Table 2). The most frequent diagnoses were malaria (9%), acute unspecified diarrhea (8%), viral syndrome (6%), acute bacterial diarrhea (5%) and chronic diarrhea (4%). Among non-expatriate business travelers, the most frequent diagnoses were acute unspecified diarrhea, viral syndrome, acute bacterial diarrhea, chronic diarrhea and *Plasmodium falciparum* malaria (each <10% of total) (Table 2 Among expatriate business travelers, the most frequent diagnosis was *P. falciparum* malaria (6%), followed by viral syndrome, chronic diarrhea, acute unspecified diarrhea, dengue, *Blastocystis* and upper respiratory tract infection (3% each).

Analysis by regions highlighted the frequency of diagnosis of *P. falciparum* malaria for sub-Saharan Africa (13% of diagnoses from the region) and *P. vivax* malaria for Oceania (12%) (Table 3). Uncomplicated dengue infection was the most frequent specific diagnosis for the Caribbean (9%); dog bite for Eastern Europe (9%). For the combined group that included Australia, New Zealand, North America and Western Europe, the most frequent diagnosis was upper respiratory tract infection (8%). Acute unspecified diarrhea was the most frequent diagnosis for the remaining regions, ranging from 10% to 19% of diagnoses (Table 3). Acute bacterial diarrhea and chronic diarrhea of unknown cause were frequent diagnoses for many regions.

Malaria diagnoses

Among 1079 patients with malaria, 973 had species reported (90%); 706 (65%) were infected with *P. falciparum*, 171 (15%) with *P. vivax*, 49 (5%) with *P. ovale*, 29 (3%) with *P. malariae*, 1 (<1%) with *P. knowlesi*, and 17 (2%) with mixed infections. The majority of 1079 had exposure in sub-Saharan Africa (79%); other exposure regions included Southeast Asia (8%), South Central Asia (4%), Oceania (3%), South America (2%) and North Africa (2%) (Table 4). Of 584 (54%) with chemoprophylaxis information, 519 (89%) took no chemoprophylaxis and 19 (3%) took incomplete chemoprophylaxis. There were 112 patients with severe malaria (46 cerebral). Among 103 severe cases with species available, 100 had *P. falciparum* (one co-infected with *P. ovale*) and three had *P. vivax*. All severe malaria cases had exposure in Africa except for two *P. vivax* cases (acquired in India and Myanmar) and one *P. falciparum* cases (acquired in Guyana). Among the 1079 patients with malaria, 589 (55%) were hospitalized and 466 (43%) reported pre-travel encounters. Seven patients died; all malaria fatalities with species information were due to *P. falciparum* (Table 5).

Species distributions for the regions are presented in Table 4. *Plasmodium falciparum* was the predominant species acquired in Africa, and *P. vivax* was the main species acquired in other regions.

Deaths

Thirteen deaths occurred in business travelers seen after travel, of which 7 (54%) were from malaria. All but two fatalities occurred in male travelers. Age ranged from 24 to 82 years. Other causes of deaths are shown in Table 5.

Vaccine-preventable diseases

A total of 847 potentially vaccine-preventable diagnoses (7% of total diagnoses) were identified. The most frequently recorded were 320 influenza and influenza-like illness (38% of potential VPD), 200 animal exposure with potential for rabies (24%), 124 bacterial lobar pneumonia without specified organism (15%) and 56 typhoid (7%). There were 32 cases of hepatitis A, nine cases of hepatitis B, and 35 cases of acute unspecified hepatitis. Also identified were measles (8), mumps (2), rubella (5), pertussis (15), varicella (13), zoster (16), bacterial meningitis (3), and one case each of meningitis due to *Haemophilus influenzae* and *Streptococcus pneumoniae*. One case of tick-borne encephalitis was reported, as were an additional six cases of acute encephalitis without proven viral etiology. No cases of Japanese encephalitis or yellow fever were identified.

Sexually transmitted infections

There were 213 potential sexually transmitted infection (STI) diagnoses (2% of total diagnoses), most frequently acute human immunodeficiency virus (HIV; $n = 45$), scabies ($n = 40$), herpes simplex virus (HSV; $n = 27$), and syphilis ($n = 22$). There were also cases of pelvic inflammatory disease/vaginitis/cervicitis/endometritis ($n = 18$), <5 cases each of *Chlamydia*, gonorrhea, genital warts, genital ulcer, molluscum contagiosum, *Trichomonas vaginalis* and nine cases of unspecified STI.

Discussion

Our analysis shows a broad spectrum of illness related to business travel. Malaria diagnoses comprised 7% and 13% of ill returning non-expatriate and expatriate business travelers, respectively. Notably, half of the deaths reported in this population were due to malaria. We also found a large number of potentially vaccine-preventable diseases. Furthermore, we established gastrointestinal diagnoses as the most frequent diagnoses related to business travel. These results underscore the need to promote pre-travel preparation – in our analysis, less than half of the ill presenting business travelers reported a pre-travel medical consultation.

It is in the best interest of employers to ensure the health of their employees working internationally. Corporations sending staff overseas usually are expected to cover the costs of providing effective health education, vaccination and risk mitigation programs,[3] either via a contractual arrangement with a provider organization or via an on-site occupational health clinic.[6] A company culture that focuses on health, safety and security can contribute positively to high knowledge scores about health risks among business travelers.[7] Additionally, corporations may be legally liable.[6] Not specifically addressed, but also to be considered, are the consequences from acquisition of infectious diseases that are potentially transmissible to the employees' families and home and work communities. Consequently,

some large corporations now require pre-travel medical consultation before international trips.[4] Despite this trend, several reports have identified business travelers as a major risk group for acquiring malaria.[8–14] An analysis in China of 1 420 imported malaria cases found overseas workers accounted for 82%; complications occurred in 8% and 12 died.[8] Another report[11] described almost 8000 labor-related *P. falciparum* infections acquired in Africa, with increased cases likely related to recent business contracts between China and Africa combined with a lack of malaria awareness and prevention among this group. In the US, business was found to be the purpose of travel in 19% of fatal malaria cases.[14]

Our results underscore the importance of malaria as a cause of death in business travelers. Long-term business travelers, compared with short-term, have been shown to be more likely to have *P. falciparum* or *P. vivax* malaria,[9] but even short-term, frequent business travelers can have a high cumulative risk. A recent analysis found that the pre-travel consultation was associated with a lower proportion of *P. falciparum* malaria morbidity and less severe disease in travelers, including business travelers.[10] Occupational medicine advisors and travel medicine experts are, however, confronted with challenges in malaria prevention in this group. Adherence to personal protection measures and chemoprophylaxis, particularly in long-term and frequent business travelers, is a major hurdle[15,16] and requires constant audit. Some large companies have initiated innovative approaches involving adherence and motivator enablers to overcome noncompliance, including urine tests to verify intake of chemoprophylaxis.[17]

Dengue was diagnosed much less frequently than malaria in this population, possibly due to the self-limited nature of dengue or the short incubation of dengue that may have led to evaluation during the trip and not captured by GeoSentinel sites. Although some business travelers work primarily in urban areas, these are still sites of active dengue transmission in tropical and subtropical countries, and business travelers are expected to be at risk for dengue. To date, studies of dengue fever or seroconversion in travelers generally have not analyzed reason for travel for those infected; thus, there are currently no systematically collected data on risk to business travelers relative to other travelers.

The frequency of vaccine-preventable diseases diagnosed in business travelers raises concern that business travelers underestimate the risk of these potentially preventable diseases. Prior GeoSentinel analyses of vaccine-preventable diseases found that travel for business was associated with a diagnosis of influenza.[18] Our results affirm that influenza-like illness is a frequent diagnosis in business travelers. Although no cases of yellow fever were reported in the GeoSentinel Surveillance Network, the recent acquisition of yellow fever by numerous Chinese nationals working in Angola, and returning to parts of China that may be receptive to yellow fever introduction, is a reminder of the role that corporations should play in ensuring the health of their employees and in averting a potential public health disaster.[19] Notably, the estimated incidence of animal-related exposures requiring rabies post-exposure prophylaxis is 1.3 per 1 000 per month in expatriates,[20] and among 60 cases of rabies in international travelers reported from 1990 to 2012, 10 were in business and expatriate travelers.[21] Along with our results, evidence has accumulated regarding rabies risk in business travelers, and advice regarding rabies risk should be provided systematically at pre-travel encounters. Given the unreliable access to rabies vaccine and immune globulin in

many areas, and in consideration of cumulative exposure risk, preventive pre-travel vaccination may be indicated.

Consumption of contaminated food/drink is a frequent route of exposure for ill business travelers. Generally the estimated incidence of travelers' diarrhea has declined from 65% 20 years ago to 10–40% currently, attributed to improved economic development, tourism infrastructure, availability of bottled water and greater awareness of risk.[22] However, gastrointestinal problems, especially travelers' diarrhea, continue to rank at the top of travel-related health problems in all international travelers.[5,23] It is important to advise business travelers on basic precautions, including hand hygiene and choice and preparation of food and beverages, although the effectiveness of pre-travel advice in reducing travel-related diarrhea appears poor.[22]

Dermatologic diagnoses were the third most frequent syndromic group. (Tables 2–3) Some reports have suggested that business travelers experience dermatologic problems less frequently than tourist travelers, specifically cutaneous larva migrans, insect bites, and allergic or generalized rash.[5,24,25] Nonetheless, 7% of 226 international business travelers employed by the Coca Cola Company responding to a survey reported using a topical antibiotic or hydrocortisone cream during their trip.[26] Although specific etiologies of rashes were not reported, self-treatable and superficial skin conditions appeared frequent, which supports advising business travelers to carry these over-the-counter medications for self-management and also when to seek medical evaluation.

For expatriate business travelers, malaria, dengue, gastrointestinal problems and respiratory illness were the most frequent diagnoses, illustrating the risks resulting from increased exposure to host-country environmental risks and lifestyle choices.[27] A frequent challenge for expatriate travelers is adherence to malaria chemoprophylaxis; expatriates discontinue prophylaxis progressively over time during residence abroad,[28,29] so travel medicine specialists should consider prescribing standby emergency malaria self-treatment. For expatriate business travelers, preparation should include comprehensive travel insurance including adequate coverage for medical, surgical, and dental healthcare abroad, 24-h emergency telephone access and emergency medical evacuation from their destinations, and, optimally, availability of local service providers to assist in non-critical medical problems.

Business travelers have been consistently identified as a high-risk group for acquiring STIs.[30–33] Matteelli *et al.* found that business travel was the most frequent reason for travelers with STI diagnoses seen during travel, accounting for 62.5%.[30] Our analysis identified a small proportion of psychological problems in business travelers, despite reports that precipitation or aggravation of psychological disorders have been the most frequent causes for failure of overseas assignments and repatriation among business travelers,[34,35] and that frequent international travel has been associated with increased insurance claims for psychological illness.[36] This analysis illustrates that GeoSentinel surveillance is less sensitive at detecting STIs, non-infectious conditions and psychological illness.

Our data did not capture whether the travelers were evacuated for severe disease. Among business travelers, analysis of nearly 1 million trips showed that one trip in 36 000 required

evacuation (1 in 6400 for 'high-risk' destinations).[3] Among 504 patients evacuated by a single German medical evacuation service, the majority were for trauma (26%), stroke (15%), and myocardial infarction (8%), with less frequent infectious causes being pneumonia (3%) and meningitis (1%).[37] For Shell International employees, medical evacuation occurred at a rate of 4 per 1000 during 2008–2012, most frequently for trauma (18%), digestive (14%), musculoskeletal (12%), cardiac (11%) and neurological (9%) diagnoses.[38] Importantly, 9% were due to acute complications of a pre-existing diagnosis, illustrating the value of pre-travel health assessments and stabilization of any underlying condition.[38] The risk of hospitalization and evacuation of expatriate workers has been strongly linked to the World Health Organization Human Development Index for the destination country.[39] We found that expatriate workers appear less likely to require evacuation for medical problems than non-expatriate business travelers, perhaps due to more stringent screening, better knowledge of local resources, and better local support structures, or reporting bias.

The GeoSentinel database does not distinguish among the diverse population of business travelers or employment status, and lacks details of occupation, activities, and exposures. In this heterogeneous population, future data collection will benefit from more detailed occupational information to ascertain whether certain groups are at increased risk of illnesses. To refine the classification of business travelers in the GeoSentinel database, data collection will be revised to delineate whether the traveler is a family member accompanying a business traveler. Also, GeoSentinel sites are mainly outpatient clinics and, thus, may under-report travelers who are hospitalized subsequent to their outpatient evaluation at GeoSentinel sites; information such as malaria chemoprophylaxis taken may be incomplete or biased. Moreover, the sites specialize in tropical and travel medicine and infectious diseases, and typically do not capture trauma and injury, and likely also underestimate other problems such as psychological issues and STIs that are evaluated in other centers outside the GeoSentinel network. Finally, denominators of travelers are lacking, and descriptive analysis cannot derive rates of risk.

The strength of our analyses is that we provide robust, systematic, clinician-verified diagnoses on more than 12 000 business travelers from all continents, with supporting demographic and geographic details.

Conclusion

Diarrheal illness is a major cause of morbidity in business travelers; clear advice on travelers' diarrhea prevention and self-treatment should be provided. Malaria contributes to significant morbidity and mortality in both non-expatriate and expatriate business travelers, is associated with high hospitalization rates and fatalities, and is a particular risk for the business traveler to sub-Saharan Africa. Underuse or non-use of malaria chemo-prophylaxis contributes to the problem, and new approaches to improve adherence are needed. Deaths in business travelers could likely be reduced by improving adherence to malaria chemoprophylaxis, targeted vaccination for vaccine-preventable diseases, and provision of advice to avoid contaminated food and drink. Given the severity and mortality associated with identified malaria cases and vaccine-preventable diseases, it is critical to engage the

employers. To optimize prevention, occupational health programs could seek ways to improve adherence to malaria chemoprophylaxis, target immunizations, and provide advice to avoid contaminated food and drink. Non-infectious disease hazards, not reflected in GeoSentinel data, might have even greater impact on business travelers. Our analysis shows that pre-travel health advice is currently under-utilized (or not provided) by business travelers, and our findings provide an evidence base to support geographically tailored guidelines for occupational medicine clinicians and business travelers.

Acknowledgments

*Additional members of the GeoSentinel Surveillance Network who contributed data but did not author this article are: Frank von Sonnenburg and Camilla Rothe (Munich, Germany), Kevin Kain and Andrea Boggild (Toronto, Canada), Jakob Cramer, Sabine Jordan, and Christof Vinnemeier (Hamburg, Germany), Cedric Yansouni (Montreal, Canada), Francois Chappuis (Geneva, Switzerland), Eric Caumes and Alice Perignon (Paris, France), Joe Torresi (Melbourne, Australia), Shuzo Kanagawa and Yasuyuki Kato (Tokyo, Japan), Martin Grobusch and Bram Goorhuis (Amsterdam, Netherlands), Emilie Javelle (Marseille, France), Phyllis Kozarsky and Henry Wu (Atlanta, USA), Yukiriro Yoshimura and Natsuo Tachikawa (Yokohama City, Japan), Poh-Lian Lim (Singapore), Watcharapong Piyaphanee and Udomsak Silachamroon (Bangkok, Thailand), Holly Murphy and Prativa Pandey (Katmandu, Nepal), Hilmir Ásgeirsson and Hedvig Glans (Stockholm, Sweden), Mogens Jensenius (Oslo, Norway), Sarah Borwein (Hong Kong SAR, China), Devon Hale, Daniel Leung, and Scott Benson (Salt Lake City, Utah), Perry van Genderen (Rotterdam, Netherlands), Noreen Hynes (Baltimore, USA), Rainer Weber (Zurich, Switzerland), William Stauffer and Pat Walker (St. Paul, USA), Jean Haulman and David Roesel (Seattle, USA), Frank Mockenhaupt and Gundel Harms-Zwingenberger (Berlin, Germany), Christoph Rapp and Cecile Ficko (Paris, France), Peter Vincent (Cape Town, South Africa), Francesco Castelli and Alberto Matteelli (Brescia, Italy), Susan Anderson (Palo Alto, USA), Johnnie Yates (Honolulu, USA), Carmelo Licitra and Alena Klochko (Orlando, USA), Effrossyni Gkrania-Klotsas and Ben Warne (Cambridge, UK), Rogelio Lopez-Velez and Francesca Norman (Madrid, Spain), Jean Vincelette and Sapha Barkati (Montreal, Canada), John Cahill and George McKinley (New York, USA), Phi Truong Hoang Phu (Ho Chi Minh City, Vietnam), Cecilia Perret Perez (Santiago, Chile), David Lalloo and Nicholas Beeching (Liverpool, UK), Christina Coyle (Bronx, USA), Jan Hajek and Wayne Ghesquiere (Vancouver, Canada), Hugo Siu and Luis Manuel Valdez (Lima, Peru), Paul Kelly and Stefan Hagmann (Bronx, USA), Elizabeth Barnett and Natasha Hochberg (Boston, USA), Denis Malvy and Alexandre Duvignaud (Bordeaux, France), Susan Kuhn (Calgary, Canada).

Funding

GeoSentinel, the global surveillance network of the International Society of Travel Medicine (ISTM), is supported by a cooperative agreement (U50CK00189) from the Centers for Disease Control and Prevention, International Society of Travel Medicine, and Public Health Agency of Canada. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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Appendix to Methods: Excluded Diagnoses

- Non-infectious diagnoses with no plausible relationship to travel were excluded (236 diagnoses): hypertension, asthma, hemorrhoids, diabetes, hepatitis, chronic unspecified, autoimmune disorders, heart disease, arrhythmia, heart disease, coronary artery disease, angina, heart disease, other, cancer, hematologic, cancer, celiac disease, fibromyalgia, cirrhosis, hernia, palpitations, Crohn's disease, multiple sclerosis, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), tumor, benign superficial, transient ischemic attack (TIA), thyroid disease, menstrual disorder, colonic polyposis, metabolic disorder, ovarian cyst, thalassemia.
- Diagnoses with uncertain relationship to travel and time and place of exposure were excluded (245 diagnoses): latent tuberculosis, asymptomatic HIV, AIDS, chronic hepatitis C, chronic hepatitis B, asymptomatic hepatitis B carrier and pregnancy.
- Diagnoses coded as 'Other' were matched with existing GeoSentinel diagnoses, when possible. Where no corresponding eligible GeoSentinel diagnosis existed, the diagnosis was excluded (154 diagnoses).

Table 1

Demographics of 12 203 business travelers evaluated after travel at GeoSentinel sites from 1997 through 2014

Characteristic	*N*	%
Age[a]		
20–64	11 779	97
≥65	424	3
Gender[a]		
Male	8178	67
Female	3970	33
Patient type[a]		
Inpatient	1551	13
Outpatient	10 548	86
Pre-travel encounter		
Yes	5476	45
No	4148	34
Don’t know/Missing	2579	21
Interval from travel to presentation, weeks		
≤1	4646	38
1–6	3377	27
≥6	1346	11
Unknown	2834	23
Region of GeoSentinel site		
Australia/New Zealand	463	4
Middle East	726	6
North America	2989	24
North East Asia	1117	9
South America	64	1
South Central Asia	128	1
Southeast Asia	404	3
Sub-Saharan Africa	166	1
Western Europe	6146	50
Region of exposure[b]		
Australia/New Zealand	45	<1
Caribbean	391	3
Central America	504	4
Eastern Europe	109	1
Middle East	293	2
North Africa	358	3
North America	210	2
North East Asia	731	6
Oceania	198	2

Characteristic	*N*	%
South America	814	7
South Central Asia	1732	14
Southeast Asia	1785	15
Sub-Saharan Africa	4490	37
Western Europe	407	3
Risk qualifier Expatriate	1512	12

[a] Up to 1% of data are missing for the variable and are not displayed in the table.

[b] We excluded 1173 of 13 227 initial patients (9%) with no reported country or region of exposure; 136 (1%) included patients had unascertainable regions of exposure (two probable countries of exposure in two different regions).

Table 2

Syndromes/system groupings of 14 045 diagnoses of 12 203 business travelers evaluated after travel at GeoSentinel sites from 1997 to 2014, and most frequent diagnoses for 1512 expatriates and 10 691 non-expatriates

	All business travelers *N* = 14 045 diagnoses			Expatriate *N* = 1830 diagnoses			Non-expatriate *N* = 12 215 diagnoses		
	Syndrome	***N***	**%**	**Diagnosis**	***N***	**%**	**Diagnosis**	***N***	**%**
1	Acute diarrhea	3331	24	Malaria, *Plasmodium falciparum*[a]	112	6	Diarrhea, acute unspecified	1060	9
2	Febrile systemic illness	3314	24	Viral syndrome (no rash)	60	3	Viral syndrome (no rash)	755	6
3	Dermatologic	1781	13	Diarrhea, chronic unknown	55	3	Diarrhea, acute bacterial	639	5
4	Respiratory	1403	10	Diarrhea, acute unspecified	54	3	Diarrhea, chronic unknown	541	4
5	Gastrointestinal other	1131	8	Dengue, uncomplicated	52	3	Malaria, *P. falciparum*[a]	541	4
6	Chronic diarrhea	1060	8	*Blastocystis* sp.	50	3	*Giardia*	359	3
7	Nonspecific symptoms or findings	497	4	Respiratory tract infection (upper)	47	3	Respiratory tract infection (upper)	343	3
8	Genitourinary and sexually transmitted infections	320	2	Irritable bowel syndrome, post-infectious	45	2	Irritable bowel syndrome, post-infectious	305	3
9	Injury and musculoskeletal	279	2	Diarrhea, acute bacterial	44	2	Dengue, uncomplicated	304	2
10	Neurologic	211	1	Malaria, *Plasmodium vivax*[a]	44	2	Febrile illness unspecified (<3 weeks)	264	2
11	Psychologic	197	1	Febrile illness unspecified (<3 weeks)	41	2	*Blastocystis* sp.	250	2
12	Miscellaneous tissue parasites	174	1	Fatigue ≥1 month (not febrile)	36	2	Bite, insect (includes sting)	235	2
13	Oral and dental	166	1	*Giardia*	36	2	Gastroenteritis	224	2
14	Adverse reaction to medication or vaccine	60	<1	Bite, dog	33	2	*Campylobacter* spp.	202	2
15	Chronic disease[b]	33	<1	Malaria, species unknown	28	2	Influenza-like illness	191	2
16	Ophthalmologic	28	<1	Schistosomiasis, human species unknown	28	1	Bronchitis, acute	179	1
17	Cardiovascular	26	<1	Bronchitis, acute	23	1	Rash, unknown etiology (non-febrile)	148	1
18	Obstetrics and gynecology	21	<1	Rash, unknown etiology (non-febrile)	22	1	Malaria, *Plasmodium vivax*[a]	133	1
19	Death	13	<1	Malaria, severe and complicated, non-cerebral	20	1	Bite, dog	118	1
20				Skin and soft tissue infection, superficial	18	1	Pneumonia, bacterial (lobar)	113	1

[a] *Plasmodium species* diagnoses may include co-infection with other species.

[b] Chronic disease grouping included G6PD deficient (2), asymptomatic newly diagnosed HIV (20), Reiter's syndrome (11).

Table 3

Most frequent diagnoses by region of exposure[a] among 10 567 non-expatriate business travelers[b] with 12 080 total diagnoses evaluated at GeoSentinel sites from 1997 to 2014

Sub-Saharan Africa (*N* = 3799)		**South Central Asia (*N* = 1569)**		**Southeast Asia (*N* = 1556)**		**South America (*N* = 742)**	
Diagnosis	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**
P. falciparum malaria	478 (13%)	Acute unspecified diarrhea	224 (14%)	Acute unspecified diarrhea	151 (10%)	Acute unspecified diarrhea	69 (9%)
Acute unspecified diarrhea	328 (9%)	Acute bacterial diarrhea	134 (9%)	Viral syndrome, no rash	105 (7%)	Viral syndrome, no rash	62 (8%)
Viral syndrome, no rash	306 (8%)	*Giardia*	115 (7%)	Acute bacterial diarrhea	96 (6%)	Insect bite	36 (5%)
Acute bacterial diarrhea	201 (5%)	Chronic unknown diarrhea	106 (7%)	Uncomplicated dengue	91 (6%)	Chronic unknown diarrhea	35 (5%)
Chronic unknown diarrhea	157 (4%)	Viral syndrome, no rash	102 (7%)	Chronic unknown diarrhea	68 (4%)	Acute bacterial diarrhea	34 (5%)
Unspecified febrile illness (<3 weeks)	145 (4%)	Uncomplicated dengue	84 (5%)	Upper respiratory tract infection	65 (4%)	*Giardia*	29 (4%)
Giardia	102 (3%)	Post-infectious irritable bowel syndrome	55 (4%)	*P. vivax* malaria	44 (3%)	*Blastocystis*	27 (4%)
Upper respiratory tract infection	97 (3%)	*Campylobacter*	52 (3%)	Gastroenteritis	43 (3%)	Uncomplicated dengue	26 (4%)
Insect bite	81 (2%)	*Blastocystis*	51 (3%)	*Campylobacter*	41 (3%)	Post-infectious irritable bowel syndrome	26 (4%)
Blastocystis	79 (2%)	Gastroenteritis	51 (3%)	Post-infectious irritable bowel syndrome	41 (3%)	*P. vivax* malaria	18 (2%)
Northeast Asia (*N* = 654)		**Australia/New Zealand, North America, Western Europe (*N* = 583)**		**Central America (*N* = 452)**		**Caribbean (*N* = 355)**	
Diagnosis	*N* (%)	Diagnosis	*N* (%)	Diagnosis	*N* (%)	Diagnosis	*N* (%)
Acute unspecified diarrhea	64 (10%)	Upper respiratory tract infection	44 (8%)	Acute unspecified diarrhea	49 (11%)	Uncomplicated dengue	33 (9%)
Acute bacterial diarrhea	47 (7%)	Acute bronchitis	25 (4%)	Acute bacterial diarrhea	38 (8%)	Acute unspecified diarrhea	31 (9%)
Viral syndrome, no rash	47 (7%)	Viral syndrome, no rash	23 (4%)	Chronic unknown diarrhea	35 (8%)	Chronic unknown diarrhea	25 (7%)
Chronic unknown diarrhea	36 (6%)	Chronic unknown diarrhea	22 (4%)	Post-infectious irritable bowel syndrome	33 (7%)	Viral syndrome, no rash	24 (7%)
Acute bronchitis	31 (5%)	Influenza-like illness	22 (4%)	*Giardia*	23 (5%)	Acute bacterial diarrhea	16 (5%)
Upper respiratory tract infection	27 (4%)	Bacterial lobar pneumonia	21 (4%)	*Blastocystis*	21 (5%)	Upper respiratory tract infection	15 (4%)
Influenza-like illnesses	26 (4%)	Acute unspecified diarrhea	19 (3%)	Viral syndrome, no rash	21 (5%)	Insect bite	14 (4%)
Post-infectious irritable bowel syndrome	22 (3%)	*Campylobacter*	18 (3%)	Insect bite	17 (4%)	Chikungunya virus infection	13 (4%)

Sub-Saharan Africa (*N* = 3799)		**South Central Asia (*N* = 1569)**		**Southeast Asia (*N* = 1556)**		**South America (*N* = 742)**	
Diagnosis	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**
Dog bite	21 (3%)	Post-infectious irritable bowel syndrome	18 (3%)	Gastroenteritis	10 (2%)	Cutaneous larva migrans	11 (3%)
Gastroenteritis	15 (2%)	Acute sinusitis	18 (3%)	Cutaneous leishmaniasis	10 (2%)	Unspecified febrile illness	9 (3%)
N Africa (*N* = 328)		**Middle East (*N* = 265)**		**Oceania (*N* = 163)**		**Eastern Europe (*N* = 101)**	
Diagnosis	*N* (%)	Diagnosis	*N* (%)	Diagnosis	*N* (%)	Diagnosis	*N* (%)
Acute unspecified diarrhea	62 (19%)	Acute unspecified diarrhea	30 (11%)	*P. vivax* malaria	19 (12%)	Dog bite	9 (9%)
Acute bacterial diarrhea	25 (8%)	Chronic unknown diarrhea	23 (9%)	Acute unspecified diarrhea	13 (8%)	Acute unspecified diarrhea	9 (9%)
Chronic unknown diarrhea	19 (6%)	Acute bacterial diarrhea	20 (8%)	Viral syndrome, no rash	12 (7%)	Acute bacterial diarrhea	7 (7%)
Viral syndrome, no rash	19 (6%)	Viral syndrome, no rash	17 (6%)	Chikungunya virus infection	8 (5%)	Chronic unknown diarrhea	7 (7%)
P. falciparum malaria	15 (5%)	*Campylobacter*	11 (4%)	Insect bite	6 (4%)	*Giardia*	6 (6%)
Giardia	12 (4%)	Cutaneous leishmaniasis	9 (3%)	Acute bacterial diarrhea	6 (4%)	*Campylobacter*	4 (4%)
Post-infectious irritable bowel syndrome	11 (3%)	Upper respiratory tract infection	9 (3%)	Skin and soft-tissue infection (secondary of existing lesion)	6 (4%)	Viral syndrome, no rash	4 (4%)
Sub-Saharan Africa (*N* = 3799)		**South Central Asia (*N* = 1569)**		**Southeast Asia (*N* = 1556)**		**South America (*N* = 742)**	
Diagnosis	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**	**Diagnosis**	***N* (%)**
Upper respiratory tract infection	11 (3%)	*Giardia*	8 (3%)	Gastroenteritis	5 (3%)	Upper respiratory tract infection	3 (3%)
Blastocystis	9 (3%)	Post-infectious irritable bowel syndrome	7 (3%)	Upper respiratory tract infection	5 (3%)	Non-septic arthritis	2 (2%)
Unspecified febrile illness (<3 weeks)	9 (3%)	Dog bite	6 (2%)	Uncomplicated dengue	4 (2%)	Tick bite	2 (2%)

[a] Regions of exposure are based on modified United Nations' world regions; we combined Australia, New Zealand, North America and Western Europe since each held high human development index and represented less frequent locations of illness acquisition.

[b] 124 patients excluded from table because regions of exposure were not ascertainable.

Table 4

Malaria species identified in business travelers evaluated after travel at GeoSentinel sites from 1997 to 2014, by region of exposure[a] (*N* = 1079)

Malaria species	Sub-Saharan Africa (854)	Southeast Asia (83)	South Central Asia (48)	Oceania (35)	South America (24)	North Africa (21)	Caribbean[b] (5)	Central America (3)	Middle East (1)	Missing (5)	Total (1079)
P. falciparum	644 (75)	27 (33)	3 (6)	4 (11)	4 (17)	17 (81)	4 (80)	1 (33)	0 (0)	2 (40)	706 (65)
P. vivax	32 (4)	48 (58)	40 (83)	28 (80)	17 (70)	2 (10)	0 (0)	2 (66)	1 (100)	1 (20)	171 (15)
P. ovale	44 (5)	0 (0)	1 (2)	1 (3)	1 (4)	1 (5)	0 (0)	0 (0)	0 (0)	1 (20)	49 (5)
P. malariae	26 (3)	1 (1)	0 (0)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	0 (0)	1 (20)	29 (3)
P. knowlesi	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (<1)
Multiple species	9 (1)	6 (7)	1 (2)	0 (0)	1 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	17 (2)
Species unknown	99 (12)	0 (0)	3 (6)	2 (6)	1 (4)	0 (0)	1 (20)	0 (0)	0 (0)	0 (0)	106 (10)

[a] Regions were classified based on modified United Nations world regions[8]: https://unstats.un.org/unsd/methodology/m49/. Last accessed March 28, 2017.

[b] Cases are from Hispaniola.

Table 5

Deaths in business travelers evaluated after travel at GeoSentinel sites from 1997 to 2014

Subject (1–14)	Year	Age (years)	Sex	Diagnoses	Reported cause of death	Country of birth	Country of residence	Country of exposure	Expatriate/ non-expatriate	Pre-travel encounter
1	2007	24	F	Uncomplicated dengue; *Salmonella typhi*	Typhoid	Indonesia	Singapore	Indonesia	Expatriate	No
2	2007	66	M	*P. falciparum* malaria; chloroquine resistant *P. falciparum* malaria; severe and complicated non-cerebral malaria	Shock	Canada	Canada	Burkina Faso	Non-expatriate	No
3	1999	50	M	*P. falciparum* malaria; severe and complicated cerebral malaria	Multi-organ failure	Israel	Israel	Ghana	Expatriate	No
4	2000	47	M	Pyogenic abscess (not skin, tonsillar, liver or dental)	Not available	India	Israel	India	Expatriate	No
5	2004	61	M	Severe and complicated cerebral malaria, *P. falciparum* malaria	Multi-organ failure	Israel	Israel	Sierra Leone	Non-expatriate	Yes
6	2006	65	M	Dog bite; rabies	Rabies	Japan	Japan	Philippines	Expatriate	No
7	2008	82	M	Bacterial pneumonia (lobar)	Not available	Israel	Israel	India	Non-expatriate	No
8	2008	53	M	Atypical, diffuse pneumonia	Pneumonia	Singapore	Vietnam	Vietnam	Non-expatriate	No
9	2009	57	M	Melioidosis	Sepsis	Australia	Australia	Thailand	Non-expatriate	Yes
10	2010	30	F	Severe and complicated cerebral malaria, *P. falciparum* malaria	Multi-organ failure	Israel	Israel	Equatorial Guinea	Expatriate	Yes
11	2010	53	M	*P. falciparum* malaria; severe and complicated non-cerebral malaria	Malaria, severe and complicated non-cerebral	Portugal	Portugal	Angola	Non-expatriate	Yes
12	2011	40	M	Severe and complicated cerebral malaria	Cerebral malaria	Portugal	Portugal	Angola	Non-expatriate	Yes
13	2013	33	M	Severe and complicated cerebral malaria; *P. falciparum* malaria	Malaria, *P. falciparum*	Japan	United States	Liberia	Non-expatriate	Yes