Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

J Travel Med. Author manuscript; available in PMC 2019 May 07.

Published in final edited form as:

J Travel Med. 2018 January 01; 25(1): . doi:10.1093/jtm/tay074.

Illness among US resident student travellers after return to the USA: a GeoSentinel analysis, 2007–17

Kristina M. Angelo, DO, MPH&TM[1,*], **N. Jean Haulman, MD, MPH**[2], **Anne C. Terry, ARNP**[2], **Daniel T. Leung, MD, MSc**[3], **Lin H. Chen, MD**[4,5], **Elizabeth D. Barnett, MD**[6], **Stefan H. F. Hagmann, MD, MSc**[7,8], **Noreen A. Hynes, MD, MPH**[9], **Bradley A. Connor, MD**[10,11], **Susan Anderson, MD**[12], **Anne McCarthy, MD**[13], **Marc Shaw, MD**[14,15], **Perry J. J. Van Genderen, MD, PhD**[16], and **Davidson H. Hamer, MD**[17,18]

[1]Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, Atlanta, GA 30329, USA [2]Hall Health Center, University of Washington, Seattle, WA 98195, USA [3]Division of Infectious Diseases, University of Utah School of Medicine, Salt Lake City, UT 84132, USA [4]Division of Infectious Diseases, Mt. Auburn Hospital, Cambridge, MA 02138, USA [5]Department of Medicine, Harvard Medical School, Boston, MA 02115, USA [6]Department of Pediatrics, Section of Infectious Diseases, Boston Medical Center, Boston, MA 02138, USA [7]Division of Pediatric Infectious Disease, Steven and Alexandra Cohen Children's Medical Center of New York, New Hyde Park, NY 11557, USA [8]Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Hempstead, NY 11549, USA [9]Division of Infectious Diseases, Johns Hopkins University, Baltimore, MD 21205, USA [10]New York Center for Travel and Tropical Medicine, New York, NY 10022, USA [11]Weill Department of Medicine, Weill Cornell Medical College, New York, NY 10065, USA [12]Department of Medicine/Infectious Diseases, Stanford University, Palo Alto, CA 94305, USA [13]Department of Medicine, University of Ottawa, Ottawa, Canada [14]James Cook University, Queensland, Australia [15]Worldwise Travellers' Health Centres, Auckland, New Zealand [16]Institute for Tropical Diseases, Harbour Hospital, Rotterdam, The Netherlands [17]Department of Global Health, Boston University School of Public Health, Boston, MA 02118, USA [18]Department of Medicine, Section of Infectious Diseases, Boston Medical Center, Boston, MA 02118, USA

Abstract

Background: The number of US students studying abroad more than tripled during the past 20 years. As study abroad programmes' destinations diversify, students increasingly travel to resource-limited countries, placing them at risk for infectious diseases. Data describing infections acquired by US students while travelling internationally are limited. We describe illnesses among

[*]To whom correspondence should be addressed. kangelo@cdc.gov.

Author Contributions

Study design: KMA, NJH, ACT, DHH.

Data collection: NJH, ACT, DTL, LHC, SHFH, NAH, BAC, SA.

Analysis: KMA, NJH, ACT, DHH.

Interpretation: KMA, NJH, ACT, DTL, LHC, EDB, SHFH, NAH, BAC, SA, AM, MS, JJJvG, DHH.

Writing: KMA, NJH, ACT, DTL, LHC, EDB, SHFH, NAH, AM, PJJvG, DHH.

Conflict of interest: NJH: Speaker list for Sanofi Pasteur, DTL: Author royalties from UpToDate, Inc., DHH and EDB: Receive some salary funding from GeoSentinel, LHC is an advisor for Shoreland, Inc., All remaining authors have no conflicts of interest.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

students who returned from international travel and suggest how to prevent illness among these travellers.

Methods: GeoSentinel is a global surveillance network of travel and tropical medicine providers that monitors travel-related morbidity. This study included the records of US resident student international travellers, 17–24 years old, who returned to the USA, had a confirmed travel-related illness at one of 15 US GeoSentinel sites during 2007–17 and had a documented exposure region. Records were analysed to describe demographic and travel characteristics and diagnoses.

Results: The study included 432 students. The median age was 21 years; 69% were female. More than 70% had a pre-travel consultation with a healthcare provider. The most common exposure region was sub-Saharan Africa (112; 26%). Students were most commonly exposed in India (44; 11%), Ecuador (28; 7%), Ghana (25; 6%) and China (24; 6%). The median duration of travel abroad was 40 days (range: 1–469) and presented to a GeoSentinel site a median of 8 days (range: 0–181) after travel; 98% were outpatients. Of 581 confirmed diagnoses, the most common diagnosis category was gastrointestinal (45%). Acute diarrhoea was the most common gastrointestinal diagnosis (113 of 261; 43%). Thirty-one (7%) students had vector-borne diseases [14 (41%) malaria and 11 (32%) dengue]. Three had vaccine-preventable diseases (two typhoid; one hepatitis A); two had acute human immunodeficiency virus infection.

Conclusions: Students experienced travel-related infections, despite the majority having a pre-travel consultation. US students should receive pre-travel advice, vaccinations and chemoprophylaxis to prevent gastrointestinal, vector-borne, sexually transmitted and vaccine-preventable infections.

Keywords

Student; study abroad; GeoSentinel; diarrhoea

Introduction

US universities encourage students to study internationally to increase cultural awareness and expand foreign language skills.[1–3] During the 2015–16 academic year, more than 325 000 US students (1.6% of all US students enrolled in higher education institutions[4]) studied abroad, an increase of 3.8% from 2014 to 20 15.[5] The number of students studying abroad has more than tripled in the past 20 years. Most US students studying abroad are undergraduates, Caucasian and female. Most students travel to western Europe, but study abroad programme diversification has led to increasing numbers of students travelling to resource-limited countries (23% of students in 2015–16).[5]

Students might encounter health risks abroad. One examination of US study abroad students found that despite both self-reported confidence in their ability to engage in preventive behaviours and 60% receiving a pre-travel health consultation, 25% reported travel-related health problems.[6] Most US undergraduates are 17–24 years old, and young adults might be subjected to stressors such as sleep deprivation,[7] culture shock, navigation of a new language, loneliness[8] and new relationships, which might contribute to experimentation and risky behaviours while travelling.[9] Students have reported risky sexual behaviour[10–14] and

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

excessive alcohol consumption[15–17] during international travel. Student travellers might also experience physical trauma from extreme sports or road traffic injuries.

Students travelling abroad are also at risk for infectious diseases. Few studies describe infectious diseases acquired while studying abroad; most articles are case reports[18–20] or small prospective observational studies.[13–22] Post-travel surveys directed at students are subjected to recall and response biases. Students who become ill might seek care at various domestic and international sites; only reportable conditions are systematically collected, and reportable diseases vary by state and country.[23]

Using data from GeoSentinel, the global surveillance system that collects data on ill travellers, we aim to describe the spectrum of illness among US students who returned to the USA after international travel and presented for care.

Methods

Data Source

GeoSentinel is a global clinician-based sentinel surveillance system that monitors travel-related illness among international travellers, including students. Established in 1995 as a collaboration between the Centers for Disease Control and Prevention (CDC) and the International Society of Travel Medicine,[24,25] GeoSentinel currently consists of 70 specialized travel and tropical medicine clinical sites in 31 countries. These sites collect data on international travellers, including traveller demographics, trip details, region and country of exposure, clinical information and diagnoses; clinical treatment and outcomes are not routinely reported.[25] 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.

Inclusion Criteria

Records of US residents, 17–24 years old, whose reason for travel was 'student', who returned ill to the USA after international travel, and who were given a confirmed diagnosis at the US GeoSentinel site during 2007–17, were included. Those with an unascertainable exposure country were excluded. Exposure countries were classified by income level using the World Bank classification scheme.[26] GeoSentinel diagnosis codes were classified based on physical exam systems (cardiovascular, dermatologic, head/eyes/ears/nose/throat, gastrointestinal, genitourinary, lymphatic, musculoskeletal, neurologic, pulmonary and psychiatric). Two additional classifications were developed for systemic febrile syndromes and other diagnoses. If applicable, diagnoses were further classified as vector-borne, sexually transmitted or vaccine-preventable infections.

Statistical Analysis

Data were managed using Microsoft Access (Redmond, Washington, USA). All analyses were descriptive and performed using SAS Version 9.4 (Cary, NC, USA).

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Results

From 2007 to 2017, 432 students from 15 US GeoSentinel sites met the inclusion criteria. Eleven (73%) sites were affiliated with an undergraduate university; two sites contributed just over half (57%) of the records, both of which are affiliated with undergraduate universities with large study abroad programmes located in the Midwest and West, respectively.

The median age was 21 years; 69% were female. Almost all students (95%) were born in the USA. Among 383 records with information available, 70% of students received a pre-travel consultation with a healthcare provider. Students who did not have a pre-travel visit most commonly travelled to Central America (29 of 116; 25%), western Europe (19 of 116; 16%), and north-east Asia (15 of 116; 13%); students who had a pretravel visit most commonly travelled to sub-Saharan Africa (90 of 267; 34%), South America (66 of 267; 25%) and south central Asia (37 of 267; 14%).

The median length of travel abroad was 40 days [range: 1–469; interquartile range (IQR): 21–96]. Exposures occurred in 69 countries; 56 (81%) were classified by the World Bank as low- or middle-income countries (LMICs). The most common regions of exposure were sub-Saharan Africa (112; 26%), South America (82; 19%) and Central America (62; 14%) (Table 1). The top five exposure countries were India (44; 11%), Ecuador (28; 7%), Ghana (25; 6%), China (24; 6%) and Peru (19; 5%). The most common exposure countries among the 112 students with an exposure in sub-Saharan Africa included Ghana (25; 22%), Tanzania (12; 11%), Sierra Leone (11; 10%) and Uganda (10; 9%).

The median duration between the end of travel to presentation to the US GeoSentinel site was 8 days (range: 0–181; IQR: 2–29). Ninety-eight percent of students were seen as outpatients. Students returned from travel with various infectious, non-infectious and symptom-based diagnoses (Table 2). Of 581 confirmed diagnoses, the gastrointestinal system (261; 45%) was most commonly involved; acute diarrhoea was the most common gastrointestinal diagnosis (113 of 261; 43%). There were six regions where acute diarrhoea was the most common diagnosis (Table 3). Dermatologic diagnoses were also commonly reported (101; 17%), most frequently insect bite(s) (26 of 101; 26%). Nine travellers (9%) with a dermatologic diagnosis had animal bites or exposures, which were sustained in Brazil (one monkey bite and one monkey exposure; $n = 2$), Honduras (dog bite; $n = 1$), India (dog bites; $n = 2$), Indonesia (monkey bite; $n = 1$), Peru (‘other’ unspecified animal bites; $n = 1$), the Republic of Tanzania (cat bite; $n = 1$) and Thailand (monkey bite; $n = 1$). Five students received rabies post-exposure prophylaxis at a GeoSentinel site.

Systemic febrile illnesses (83 of 581; 14%), including malaria (14 of 83; 17%) and dengue (11 of 83; 13%), were also reported. *Plasmodium falciparum* malaria was acquired in Ghana ($n = 3$); *Plasmodium vivax* was acquired in Brazil ($n = 1$), the Republic of Tanzania ($n = 2$), Senegal ($n = 1$) and South America with no country ascertainable ($n = 1$). Six students had malaria without a species identified. Thirteen (93%) students with malaria had a pre-travel visit; one student who neither had a pre-travel visit nor took malaria prophylaxis acquired *P. falciparum* in Ghana. Information on malaria prophylaxis was available for 9 of the 13

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

students with malaria who had a pretravel consultation; five (56%) did not take malaria prophylaxis. Students acquired dengue in Asia (Thailand or India; $n = 5$), sub-Saharan Africa (Ghana; $n = 4$) and Central America (Nicaragua; $n = 2$). Among students with dengue, eight of nine (89%) with information available had a pre-travel consultation. Seven percent (31 of 432) of students were diagnosed with a vector-borne disease [in addition to malaria and dengue, four students were diagnosed with cutaneous leishmaniasis (three with *Leishmania braziliensis* and one with species unknown), and one each with Zika and endemic typhus] (Table 4). Five students were diagnosed with a sexually transmitted infection [acute febrile human immunodeficiency virus (HIV) infection ($n = 2$), chlamydia ($n = 1$), genital herpes ($n = 1$) and syphilis ($n = 1$)]. Both acute HIV infections were acquired in sub-Saharan Africa; the one student for whom pre-travel consultation information was available did not attend a consultation. Three student travellers were diagnosed with a vaccine-preventable disease: two with typhoid fever (the one student for whom pretravel consultation information was available did not attend a consultation) and one with hepatitis A (this student had a pretravel consultation but vaccination status was not available).

Discussion

In this study, the demographics of ill students studying abroad and seeking post-travel care at a US GeoSentinel site were consistent with previous study findings. Females more frequently sought post-travel care at a GeoSentinel site than males, possibly because, as previous studies have found, more females participate in study abroad programmes than males.[5] Over 70% of the students in this analysis received pre-travel counselling, similar to a previous study showing 60% of students received pretravel counselling.[6] In both studies, this percentage is higher than that reported by other travellers, such as individuals visiting friends and relatives, or tourists, where <50% attended a pre-travel consultation.[25] The percentage of students receiving a pre-travel consultation may reflect the pre-travel requirements of the universities that provided data for this study. Students studied abroad for a median of 41 days or about 7 weeks, consistent with national data in which 80% of US study abroad students in 2015–16 studied abroad for approximately one term, the equivalent of 8 weeks.[5]

Ill students who received pre-travel consultations travelled most frequently to high-risk destinations, such as sub-Saharan Africa. However, despite attending a pre-travel consultation, students still became ill with preventable diseases, such as malaria, hepatitis A and typhoid. The reasons for this finding are unknown but may be due to pre-travel preparation deficiencies or vaccine refusal leading to a lack of pre-travel vaccine coverage, or high out-of-pocket costs of vaccines and chemoprophylaxis.[27] Also, several students in the study returned with malaria. Most students with malaria did not take malaria prophylaxis, despite attending a pre-travel consultation; this behaviour may be related to non-engagement in prevention due to low perceived risk,[6,28] or may be due to possible cost constraints of filling a prescription or forgetting to take the medication as prescribed. Both study abroad programmes and healthcare providers should emphasize location-specific disease risks, particularly for diseases with a high prevalence in the destination or diseases with high morbidity or mortality, such as malaria. Universities may require students to attend

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

a pre-travel consultation if they are travelling to LMICs; further studies are needed to delineate university practices and study abroad programme requirements.

Most of the destination countries in which students acquired an illness, including four of the top five exposure countries, were LMICs. The trend towards study abroad globalization may foster cultural sensitivity,[29] but students may have increased exposure to infectious diseases not endemic in their home countries. For example, students in this analysis acquired infectious diseases non-endemic in the USA, such as typhoid and malaria; both diseases cause a high burden in LMICs due to limited access to clean water,[30] or poor mosquito control and prevention measures.[31] Between 43% and 79% of travellers to developing countries may become ill,[32] and students must be aware of infectious diseases in the country in which they are travelling, particularly in LMICs. The number of students with illnesses acquired in LMICs in this analysis may also reflect a referral bias; students travelling to LMICs may be more likely to become ill and thus more likely to seek care.

The most frequently reported illnesses in this study were related to the gastrointestinal system, with acute diarrhoea representing the majority of cases. Acute diarrhoea affects 30–70% of travellers and is the most common travel-related illness[33] regardless of travel purpose. Given the number of students in this report who travelled to LMICs, it is not surprising that diarrhoeal illness was common. The most frequent diagnosis reported after travel to sub-Saharan Africa, Central America, South America and South Central, south-east, and north-east Asia was acute diarrhoea, which likely reflects the high prevalence of travellers' diarrhoea in regions without adequate levels of safe water, sanitation and hygiene. Pre-travel counselling by a healthcare provider typically includes advice on hand hygiene, water purification, limitation to drinking sealed bottled beverages and avoidance of foods washed with water, raw or undercooked foods and ice.[34] Although 70% received pre-travel advice, diarrhoea was still the most common complaint, suggesting the need to integrate information on diarrhoeal management in addition to information on prevention during the pre-travel consultation.

Almost one in five students who returned ill after travelling abroad had a dermatologic diagnosis, most frequently an insect bite or sting. Eight percent of students acquired a vector-borne disease spread by mosquitoes, fleas or sand flies. Healthcare providers should advise students on how to avoid vector-borne diseases, emphasizing preventive measures such as behavioural modification, repellent use or prophylaxis use (such as for malaria) to avoid acquiring a potentially fatal disease.

Students should be advised on how to prevent or manage health-related issues related to jet lag, stress or high-risk activities (e.g. touching animals or engaging in unprotected sexual encounters that may result in unintended pregnancy or sexually transmitted infections) and when to seek clinical advice and care. Students should be informed of the risk of petting or contacting animals and be offered pre-travel rabies vaccination, if travelling to areas where rabies is enzootic and immediate access to appropriate medical care including biologics is limited. They should be aware that rabies post-exposure prophylaxis available if bitten or scratched by an animal but could be difficult to get in some settings.[35] Students should also get information on safe sex, be provided condoms and pre-exposure HIV prophylaxis should

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

be discussed with high-risk students. Students should be directed to report any trauma, crimes or assaults to their study abroad programme and local authorities as appropriate.

Analyses using GeoSentinel data have several limitations. GeoSentinel data are not generalizable; over half of the records in this study were from two US GeoSentinel sites. GeoSentinel is an event-based surveillance system and is not population-based; therefore, we cannot derive rates or risk estimates. GeoSentinel may not adequately capture the following data: severe illness or death, because GeoSentinel records are from a single point in time during the patient's illness; outcome data, which are not routinely reported; route of transmission; or risk factors for certain diseases (such as HIV). GeoSentinel also does not collect data on pre-travel vaccinations, antimalarial medications or what was discussed at the pre-travel consultation. Although GeoSentinel reporting includes infectious, non-infectious and symptom-based diagnoses, the latter two categories are not routinely or systematically collected, and no assumptions can be drawn from these data. Also, activities while abroad and behavioural risks, such as alcohol or drug use, are not collected. Diagnosis data depend upon the GeoSentinel site clinician following standardized diagnosis codes. Fianlly, this report does not include US students who were seen at an international GeoSentinel site during travel, since this information was biased. Thus, illnesses acquired during travel that resolved by the time of departure may not have been captured.

Students may acquire infectious diseases while studying abroad. Students should adhere to strict food and water precautions, use insect repellent to prevent vector-borne diseases, receive destination-specific immunizations and malaria prophylaxis and receive behavioral counselling on how to avoid sexually transmitted infections. Both universities and study abroad programmes should encourage a pre-travel consultation for all students studying abroad, regardless of destination. Additional prospective studies are needed to analyse the entire spectrum of illnesses acquired by students studying abroad. The use of smartphone applications to facilitate research data collection or schedule reminders should be considered in this population.[36] These studies should collect information on specific pre-travel preparations (including vaccines) and advice received or reasons for refusal, reasons for non-adherence to malaria chemoprophylaxis, risk behaviours during travel and both infectious and non-infectious conditions acquired while abroad.

Acknowledgements

The authors would like to thank William Stauffer, MD, DTM&H and Pat Walker, MD, DTM&H (St. Paul, MN); Jesse Waggoner, MD and Henry Wu, MD (Atlanta, GA); John D. Cahill, MD and George McKinley, MD (New York, NY); L. Scott Benson, MD, PhD, MPH (Salt Lake City, UT); Paul Kelly, MD (Bronx, NY); Johnnie Yates, MD (Honolulu, HI); Carmello Licitra, MD and Alena Klochko, MD (Orlando, FL) for the contribution of cases and Ms Kayce Maisel from ISTM for manuscript coordination.

Funding

GeoSentinel, the Global Surveillance Network of the International Society of Travel Medicine, is supported by a cooperative agreement (U50CK00189) from the Centers for Disease Control and Prevention, as well as the International Society of Travel Medicine, and the 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.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

References

1. Goldstein SB, Kim RI. Predictors of US college students' participation in study abroad programs: a longitudinal study. Int J Intercult Rel 2006; 30:507–21.
2. McMillan LR. Exploring the world outside to increase cultural competence of the educator within. J Cult Div 2012; 19:23–5.
3. Rhodes G, DeRomaña I, Pedone BN. Study abroad & other international student travel In: Brunette G (ed.). Yellow Book. New York, NY: Oxford University Press, 2018, pp.621–6.
4. NAFSA. Trends in study abroad 2015/2016 data. http://www.nafsa.org/Policy_and_Advocacy/Policy_Resources/Policy_Trends_and_Data/Accessed (20 February 2018, date last accessed).
5. International Institute of Education. U.S. students study abroad 2015/2016 data. 2017 https://www.iie.org/Research-and-Insights/Open-Doors/Data/US-Study-Abroad. (26 December 2017, date last accessed).
6. Hartjes LB, Baumann LC, Henriques JB. Travel health risk perceptions and prevention behaviors of US study abroad students. J Trav Med 2009; 16:338–43.
7. Wheaton AG, Olsen EO, Miller GF, Croft JB. Sleep duration and injury-related risk behaviors among high school students—United States 2007–2013. MMWR Morb Mortal Wkly Rep 2016; 65:337–41. [PubMed: 27054407]
8. Hunley HA. Students functioning while studying abroad: the impact of psychological distress and loneliness. Int J Intercult Rel 2010; 34:386–92.
9. Haulman NJ, Kohl S. Students traveling abroad, Chapter 13 In: Sanford C, Jong E, Pottinger P (eds.). The Travel and Tropical Medicine Manual E-Book. Elsevier, 2016, pp.184–91.
10. Angelin M, Evengard B, Palmgen H. Illness and risk behavior in health care students studying abroad. Med Educ 2015; 49:684–91. [PubMed: 26077216]
11. Lewis MA, Patrick ME, Mittmann A, Kaysen DL. Sex on the beach: the influence of social norms and trip companion on spring break sexual behavior. Prev Sci 2015; 15:408–18.
12. Marcantonio T, Angelone DJ, Sledjeski E. Using a pattern-centered approach to assess sexual risk-taking in study abroad students. J Am Coll Health 2016; 64:165–73. [PubMed: 26629983]
13. Kupper T, Rieke B, Neppach K et al. Health hazards and medical treatment of volunteers aged 18–30 years working in international social projects of non-governmental organizations (NGO). Trav Med Infect Dis 2014; 12:385–95.
14. Flack W, Kimble MO, Campbell BE et al. Sexual assault victimization among female undergraduates during study abroad: a single campus survey study. J Interpers Violence 2015; 30:3453–66. [PubMed: 25524266]
15. Pederson ER, LaBrie JW, Hummer JF et al. Heavier drinking American college students may self-select into study abroad programs: an examination of sex and ethnic differences within a high-risk group. Addict Behav 2010; 35:844–7. [PubMed: 20510524]
16. Pederson ER, Neighbors C, Lee CM, Larimer ME. Not all those who wander are lost: examining the impact of sojourner adjustment and drinking motives on alcohol consequences experienced by Americans studying in foreign countries. J Stud Alcohol Drugs 2012; 73:1005–15. [PubMed: 23036220]
17. Mitchell MA, Poyrazli S, Broyles LA. Hazardous alcohol use and cultural adjustment among U.S. college students abroad in Italy: findings and recommendations for study abroad staff and researchers. Subst Abuse 2015; 37:215–21.
18. Steiner F, Ignatius R, Friedrich-Jaenicke B et al. Acute schistosomiasis in European students returning from fieldwork at Lake Tanganyika, Tanzania. J Trav Med 2013; 20:380–3.
19. Cottle LE, Gkrania-Klotsa E, Williams H et al. A multinational out-break of histoplasmosis following a biology field trip in the Uganda rainforest. J Trav Med 2013; 20:83–7.
20. Viroj W A report on a cluster of travelers' diarrhea among Cambodian students visiting Thailand. J Trav Med 2007; 14:245–7.
21. Risquez A, Marrero A, Naranjo N et al. Diseases and injuries associated with travel [domestic] among students, employees and teachers of the Central University of Venezuela during the national summer vacations. Travel Med Infect Dis 2010; 8:41–6. [PubMed: 20188305]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

22. Illness Shaw M. and injury to students on a school excursion to Peru. J Trav Med 2014; 21:183–8.
23. World Health Organization. Report on global surveillance of epidemic-prone infectious diseases. http://www.who.int/csr/resources/publications/introduction/en/index4.html. (20 February 2018, date last accessed).
24. Harvey K, Esposito DH, Han P et al. Surveillance for travel-related disease—GeoSentinel surveillance system, United States, 1997–2011. MMWR Surveill Summ 2013; 62:1–23.
25. Leder K, Torresi J, Libman MD et al. GeoSentinel surveillance of illness in returned travelers, 2007–2011. Ann Intern Med 2013; 158:456–68. [PubMed: 23552375]
26. World Bank. Countries and economies. https://data.worldbank.org/country. (11 February 2018, date last accessed).
27. Lammert SM, Rao SR, Buffat CN et al. Rufusal of recommended travel-related vaccines among U.S. international travellers in Global TravEpiNet. J Travel Med 2016; 24(1), doi: 10.1093/jtm/taw075.
28. Causer LM, Filler S, Wilson M et al. Evaluation of reported malaria chemoprophylaxis failure among travelers in a US university exchange program. Clin Infect Dis 2004; 39:1583–8. [PubMed: 15578355]
29. Jackson J (ed.). Globalization, internationalization, and study abroad In: Intercultural Journeys from Study to Residence Abroad. London, United Kingdom: Palgrave Macmillan, 2010, pp.1–21.
30. Mogasale V, Maskery B, Ochiai RL et al. Burden of typhoid fever in low-income and middle-income countries: a systematic, literature-based update with risk-factor adjustment. Lancet Glob Health 2014; 2:e570–580. [PubMed: 25304633]
31. Breman JG, Mills A, Snow RW et al. Conquering malaria In: Jamison DT, Breman JG, Measham AR et al. (eds). Disease Control Priorities in Developing Countries, 2nd edn. New York, NY: Oxford University Press, 2006, pp.413–32.
32. Angelo KA, Kozarsky PE, Ryan ET et al. What proportion of travelers acquire a travel-related illness? A review of the literature. J Trav Med 2017; 24(5), doi: 10.1093/jtm/tax046.
33. Connor B Travelers' diarrhea In: Brunette G (ed.). Yellow Book. New York, NY: Oxford University Press, 2018, pp.48–54.
34. Griffin PM, Hlavsa MC, Yoder JS. Food and water precautions In: Brunette G (ed.). Yellow Book. New York, NY: Oxford University Press, 2018, pp.69–77.
35. Manning SE, Rupprecht CE, Fishvein D et al. Human rabies prevention—United States, 2008, Recomendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2008; 57:1–26.
36. Flaherty GT. Research on the move: the potential appliactions of mobile health technology in travel medicine. J Travel Med 2016; 23.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 1.

Regions and top countries of exposure among ill students reported to GeoSentinel, 2007–17 (n = 432)

Regions and top countries of exposure[a]	*n* (%)
Sub-Saharan Africa	112 (26)
Ghana	25 (22)
United Republic of Tanzania	12 (11)
Sierra Leone	11 (10)
Uganda	10 (9)
South America	82 (19)
Ecuador	28 (35)
Peru	19 (23)
Brazil	9 (11)
Chile	5 (6)
Central America	62 (14)
Costa Rica	15 (24)
Mexico	15 (24)
Guatemala	13 (21)
South Central Asia	54 (13)
India	44 (81)
Nepal	4 (7)
North-east Asia	32 (7)
China	24 (75)
Japan	4 (13)
South-east Asia	25 (6)
Thailand	10 (40)
Vietnam	7 (28)
Cambodia	5 (20)
Western Europe	24 (6)
France	5 (21)
Italy	5 (21)
UK	4 (17)
Spain	3 (13)
Middle East	15 (3)
Turkey	10 (67)
Israel	4 (27)
Caribbean	10 (2)
Dominican Republic	4 (40)
Cuba	3 (30)
North Africa	8 (2)
Morocco	6 (75)
Egypt	1 (13)
Eastern Europe	5 (1)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Regions and top countries of exposure[a]	*n* (%)
Croatia	1 (20)
Czech Republic	1 (20)
Montenegro	1 (20)
Romania	1 (20)
Oceania	3 (1)
Fiji	2 (67)
French Polynesia	1 (33)

[a]Numbers of students in each country may not add up to the total in each region because 46 records had a region of exposure listed but no country of exposure.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 2.

System-based top diagnoses among ill students reported to GeoSentinel, 2007–17 (n = 581)

System and diagnoses	*n* (%)
Gastrointestinal	261 (45)
Acute diarrhoea	113 (43)
Post-infectious irritable bowel syndrome	29 (11)
Campylobacteriosis	16(6)
Giardiasis	14 (5)
Acute abdominal pain	10 (4)
Dermatologic	101 (17)
Insect or other arthropod bite or sting	26 (26)
Rash, dermatitis-like	19 (19)
Skin and soft tissue infection (abscess, impetigo, cellulitis, etc.)	12 (12)
Scabies	9 (9)
Animal bite or exposure[a]	9 (9)
Systemic febrile syndromes	83 (14)
Fever of unknown origin (<3 weeks)	17 (20)
Malaria[b]	14 (17)
Viral syndrome	13 (15)
Influenza-like illness	11 (13)
Dengue[c]	11 (13)
Pulmonary	38 (7)
Upper respiratory tract infection	19 (50)
Acute bronchitis	9 (24)
Lobar pneumonia	3 (8)
Asthma	3 (8)
Cough	2 (5)
Head, eyes, ears, nose, throat	25 (4)
Acute sinusitis	6 (25)
Streptococcal pharyngitis	5 (21)
Tonsillitis	4 (17)
Other pharyngitis	3 (13)
Acute otitis media	2 (8)
Genitourinary[d]	11 (2)
Schistosomiasis[e]	3 (28)
Pyelonephritis	2 (19)
Abnormal urinalysis (hematuria or proteinuria)	2 (19)
Chlamydia	1 (9)
Herpes simplex (genital)	1 (9)
Syphilis	1 (9)
Musculoskeletal	8 (1)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

System and diagnoses	*n* (%)
Myalgia	4 (50)
Arthralgia	2 (25)
Joint dislocation	1 (13)
Non-septic arthritis	1 (13)
Neurologic	7 (1)
Headache	5 (71)
Neurocysticercosis	1 (14)
Seizure disorder	1 (14)
Lymphatic	3 (1)
Lymphedema	3 (100)
Psychiatric	3 (1)
Anxiety or panic attacks	2 (67)
Post-traumatic stress disorder	1 (33)
Other	41 (7)
Fatigue	7 (16)
Rabies post-exposure prophylaxis	5 (11)
Eosinophilia	3 (7)
Jet lag	3 (7)

[a] Three monkey bites, three dog bites, one cat bite, one 'other' animal bite and one monkey exposure (unspecified type of exposure).

[b] Six had an unknown species, five were *P. vivax* and three were *P. falciparum.*

[c] All dengue cases were uncomplicated.

[d] One additional case had vaginitis (9%).

[e] Two cases of *Schistosoma mansoni,* and one case of *Schistosoma* with species unknown.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3.

Region of exposure with acute diarrhoea as the most frequent diagnosis, 2007–17

Region of exposure	Total number of diagnoses	Number of diagnoses of acute diarrhoea	%
Sub-Saharan Africa	172	30	17
South America	111	24	22
Central America	79	22	28
South Central Asia	65	12	18
North-east Asia	42	5	12
South-east Asia	29	6	21

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4.

Additional classification of diagnoses as vector-borne diseases, sexually transmitted and vaccine-preventable infections among students reported to GeoSentinel, 2007–17

Classification	*N*	*n* (%)
Vector-borne diseases	31	
Malaria[a]		14 (45)
Dengue (uncomplicated)		11 (35)
Leishmaniasis[b]		4 (13)
Zika		1 (3)
Endemic typhus		1 (3)
Sexually transmitted infection	5	
Acute HIV infection[c]		2 (40)
Chlamydia		1 (20)
Genital herpes		1 (20)
Syphilis		1 (20)
Vaccine-preventable diseases[d]	3	
Typhoid		2 (67)
Hepatitis A		1 (33)

[a]Six were an unknown species, five were *P. vivax* and three were *P. falciparum.*

[b]Three were *L. braziliensis* and one was an unknown species.

[c]No further details regarding risk factors or mode of transmission were available.

[d]No information was available regarding vaccination status.