Illness in Returned Travelers and Immigrants/Refugees: The 6-Year Experience of Two Australian Infectious Diseases Units

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Background. Data comparing returned travelers and immigrants/refugees managed in a hospital setting is lacking.
Methods. We prospectively collected data on 1,106 patients with an illness likely acquired overseas who presented to two hospital-based Australian infectious diseases units over a 6-year period.
Results. Eighty-three percent of patients were travelers and 17% immigrants/refugees. In travelers, malaria (19%), gastroenteritis/diarrhea (15%), and upper respiratory tract infection (URTI) (7%) were the most common diagnoses. When compared with immigrants/refugees, travelers were significantly more likely to be diagnosed with gastroenteritis/diarrhea [odds ratio (OR) 8], malaria (OR 7), pneumonia (OR 6), URTI (OR 3), skin infection, dengue fever, typhoid/paratyphoid fever, influenza, and rickettsial disease. They were significantly less likely to be diagnosed with leprosy (OR 0.03), chronic hepatitis (OR 0.04), tuberculosis (OR 0.05), schistosomiasis (OR 0.3), and helminthic infection (OR 0.3). In addition, travelers were more likely to present within 1 month of entry into Australia (OR 96), and have fever (OR 8), skin (OR 6), gastrointestinal (OR 5), or neurological symptoms (OR 5) but were less likely to be asymptomatic (OR 0.1) or have anaemia (OR 0.4) or eosinophilia (OR 0.3). Diseases in travelers were more likely to have been acquired via a vector (OR 13) or food and water (OR 4), and less likely to have been acquired via the respiratory (OR 0.2) or skin (OR 0.6) routes. We also found that travel destination and classification of traveler can significantly influence the likelihood of a specific diagnosis in travelers. Six percent of travelers developed a potentially vaccine-preventable disease, with failure to vaccinate occurring in 31% of these cases in the pretravel medical consultation.
Conclusions. There are important differences in the spectrum of illness, clinical features, and mode of disease transmission between returned travelers and immigrants/refugees presenting to hospital-based Australian infectious diseases units with an illness acquired overseas.

In Australia, health care providers are being increasingly faced with patients who have recently traveled overseas or immigrated. In 2002, 3.5 million Australian residents traveled overseas,[1] 4.8 million travelers visited Australia[1] and 110,000 permanent immigrants arrived in Australia.[2] These patients often develop illnesses acquired overseas, many of which require hospital care, yet the illnesses may be uncommon in the country in which they are managed. If not recognized and managed correctly, these illnesses can have significant morbidity and mortality. Thus, to provide accurate diagnosis and high quality management, health care providers need to be aware of the common diagnoses, spectrum of diagnoses, travel characteristics, and clinical patterns of the patient population that present in their region having crossed international borders.

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Despite this, few prospective studies have been performed on returned travelers managed in a hospital setting with an illness acquired overseas, and these have focused on those with fever,[3–5] inpatients,[6] or children.[7,8] To our knowledge, none have been performed examining the whole spectrum of illness in adult returned travelers in this setting, and thus important clinical and epidemiological information for this patient population is lacking.

In addition, although immigrants from developing to developed countries have been reported to have high rates of infectious diseases acquired in their country of origin, most of these studies have been performed in the nonhospital setting and focused on specific health problems[9–11] or immigrants from specific regions.[12,13]

Due to likely differences in such things as the type and duration of exposure to endemic infections, access to immunization and disease prophylaxis, prior medical screening, and health-seeking behaviors, the spectrum of disease and clinical characteristics in immigrants/refugees are likely to differ from those in returned travelers. However, as far as we are aware, no previous studies have compared the spectrum of illness in returned travelers with that in immigrants/refugees managed in a hospital setting.

We aimed to prospectively study travelers and immigrants/refugees with an illness acquired overseas presenting to two hospital-based Australian specialist infectious diseases units over a 6-year period. We planned to describe and compare the demographics, common diagnoses, clinical features, and mode of disease transmission for these two patient groups.

Methods

Study patients were managed at the Victorian Infectious Diseases Service (VIDS) at the Royal Melbourne Hospital (RMH), a 400-bed tertiary referral centre, or the Geelong Infectious Diseases Service (GIDS) at the Geelong hospital (GH), a 400 bed regional hospital. Data was collected prospectively over a 74-month period between July 1, 1998 and September 30, 2004 at the RMH, and a 37-month period between September 1, 2001 and September 30, 2004 at the GH. Retrospective data was collected by review of medical records for 18 months (January 1, 1997 to June 30, 1998) at RMH. To be included, patients had to be judged to have acquired their illness outside Australia by the treating infectious diseases specialists.

Data collected included patient demographics and classification, travel dates and destination, previous travel, date of presentation, presenting symptoms, pretravel vaccinations and malarial prophylaxis, examination findings, investigation results, diagnosis, treatment, and outcome.

The following definitions were used:

Patient Classification

a. Traveler included the following
   1. Australian traveler: An Australian resident who has traveled across international boundaries.
   2. An Expatriate: An Australian resident living outside Australia in a single country for the purpose of work or education for a period longer than 1 month.
   3. A visitor: A non-Australian resident traveling to Australia for reasons other than immigration or as a refugee.
b. Immigrant/refugee: A person living in Australia whose most recent travel was to Australia as a refugee or for immigration purposes.

Regions

Countries were assigned the following broad regional classification if they were situated within the following areas:

1. Asia: South East Asia and the Indian subcontinent.
2 Africa: The African continent.
3. The Pacific: In the Pacific Ocean east of Australia, including New Zealand and Papua New Guinea, but excluding Hawaii.
4. Latin America: Central and South America.
5. Middle-East
6. North America
7. Europe

Diagnosis

Diagnoses were established by (1) demonstration of a microorganism in a clinically relevant specimen or (2) seroconversion to an infectious agent considered to be acquired overseas and responsible for the patient's clinical illness. If a specific causative organism could not be identified, a clinical diagnosis was assigned. Presumptive diagnoses were based on epidemiological and clinical features, supporting laboratory investigations and response to specific treatment. Diagnoses were assigned by the authors of this study or by the specialist infectious diseases physicians of VIDS.

For analysis, patients classified as travelers were compared to those classified as immigrants/refugees.

Information was entered into an Access database (Microsoft) and analyzed using Epi-Info 6 (Centers for Disease Control, Atlanta). Statistical significance was determined using the χ^2 test for 2×2 tables for each of the categorical values.

Results

Demographics and Travel Characteristics

A total of 1,106 patients of which 626 (57%) were male were included in the study. The mean age was 34.2 years (range of 4–98 years). Only one patient was younger than 14 years of age (4 years). Fifty-four percent were managed as outpatients.

A total of 917 (83%) patients were classified as travelers, and 189 (17%) as immigrants/refugee. Of the travelers, 653 (71%) were Australian travelers, 152 (17%) were foreign visitors, and 112 (12%) were living as expatriates.

For immigrants/refugees, 82 (43%) were born in Africa, 80 (42%) in Asia, 12 (6%) in Europe, 7 (4%) in Oceania, 6 (3%) in the Middle-East, and 2 (1%) in Latin America.

For travelers, 515 (56%) had traveled to Asia, 134 (15%) to Africa, 128 (14%) to the Pacific, 76 (8%) to Europe, 50 (6%) to Latin America, 41 (4%) to North America, and 37 (4%) to the Middle-East. Sixty four (7%) had traveled to more than one of these regions, and 810 (88%) had traveled to a developing country.

The duration of travel for those classified as travelers could be determined in 871 (95%) cases: 528 (61%) had traveled for <30 days, 254 (29%) for 1 to 6 months, and 89 (10%) for >6 months.

Diagnosis

There were 1,220 separate diagnoses in the 1,106 patients. Malaria, gastroenteritis/diarrhea, and upper respiratory tract infection (URTI) were the most common diagnoses in all travelers (Table 1) and in febrile travelers (Table 3). In immigrants/refugees tuberculosis, schistosomiasis, helminthic infection, chronic hepatitis, and leprosy were the most common diagnoses (Table 2).

Comparison Between Travelers and Immigrants/Refugees (Table 4)

Demographics

There was no significant difference in gender or age.

Diagnoses

Travelers were eight, seven, and six times more likely to be diagnosed with gastroenteritis, malaria, or pneumonia, respectively. Other diagnoses found significantly more often in travelers were URTI, skin infection, dengue fever, typhoid/paratyphoid fever, influenza, rickettsial disease, and illness unknown.

Compared to travelers, leprosy (31 times), chronic hepatitis (30 times), tuberculosis (21 times), schistosomiasis (4 times), and helminthic infection (3 times) were significantly more likely in immigrants/refugees.

Clinical and Laboratory

Compared to immigrants/refugees, travelers were significantly more likely to present with fever (8 times), skin (6 times), gastrointestinal (5 times), or neurological symptoms (5 times). However, they were less likely to have anemia or eosinophilia.

Time to Presentation From Return to, or Entry into, Australia

Travelers were 96 times more likely to present within 1 month of return, while immigrants/refugees were 93 times more likely to present more than 6 months after their entry into Australia.

Mode of Transmission

The mode of transmission was determined for 761 diagnoses in travelers and 169 diagnoses in immigrants/refugees. Vector-borne (13 times) and food- and waterborne diseases (4 times) were significantly more likely in travelers, but respiratory (5 times) and skin diseases (2 times) were significantly more likely in immigrants/refugees.

Comparison of Travel Destination and Patient Classification for the Common Diagnoses in Travelers

For the most common diagnoses found in travelers, travel characteristics involving *travel destination* and *classification of traveler* for a specific diagnosis were analyzed against travelers without that diagnosis to look for significant associations between the diagnosis and one of these specific patient characteristics (Table 5). For example, travel to Asia was five times more likely for travelers diagnosed with dengue fever than those without that diagnosis, three times more likely for those with typhoid and paratyphoid fever, and eight times more likely for those with tuberculosis. In addition, those diagnosed with pneumonia were 11 times more likely to be classified as Australian travelers than those without a diagnosis of pneumonia, and malaria was four times more likely in those classified as expatriate. Further associations can be seen in Table 5.

Pretravel Advice/Vaccination for Travelers

Pretravel vaccinations in our patients included hepatitis A (331 patients, 36%), typhoid fever (322 patients, 35%), hepatitis B (213 patients, 23%), diphtheria/tetanus (177 patients, 19%), polio (160 patients, 17%), yellow fever (96 patients, 11%), meningococcal disease (93 patients, 10%), rabies (47 patients, 5%), Measles Mumps Rubella (MMR) (36 patients, 4%), tuberculosis (Bacille Calmette-Guérin [BCG]; 28 patients, 3%), Japanese encephalitis (28 patients, 3%), cholera (22 patients, 2%), influenza

Table 1 Most common diagnoses in travelers (n = 917)

Diagnosis*	Number of cases†	% of travelers
Malaria	174	19
Gastroenteritis/diarrhea	136	15
URTI	61	7
Illness unknown	53	5
Dengue fever	50	5
Skin infection	50	5
Tuberculosis	42	5
Rabies PEP	36	4
Schistosomiasis	35	4
Bite, animal	33	4
Helminth infection	30	3
Pneumonia	29	3
Typhoid/paratyphoid fever	28	3
Viral syndrome	25	3
Influenza A/B	23	3
Entamoeba histolytica	20	2
Rickettsial disease	18	2
Urinary tract infection	17	2
Acute hepatitis	17	2
CNS infection	9	1
Eosinophilia	7	1
Herpes virus	6	1
Deep abscess	6	1
HIV	4	<1
STI	4	<1
Bacterial sepsis	4	<1
Lyme disease	4	<1
Acute arthritis	4	<1
Chronic hepatitis	3	<1
Leprosy	2	<1
Leptospirosis	2	<1
Other	84	11

URTI = upper respiratory tract infection.

*Note for specific diagnoses (number of cases in brackets):

1. *Upper respiratory tract infection* included nonspecific URTI (35), streptococcal pharyngitis (9), bronchitis (7), acute sinusitis (5), tonsillitis (4), unspecified pharyngitis (4), and pertussis (1).
2. *Tuberculosis* included tuberculous infection (77) and tuberculous disease (59). Sites of disease were extrapulmonary (31), pulmonary (22), and disseminated (6).
3. *Gastroenteritis/diarrhea* included gastroenteritis (74), chronic diarrhea (32), acute diarrhea (13), gastritis (8), bacterial diarrhea (7), parasitic diarrhea (5), and tropical sprue (1).
4. S*kin infection* included cutaneous larva migrans (18), cellulitis (10), nonspecific skin infection (6), insect/marine bite (5), cutaneous fungus (3), cutaneous leishmaniasis (2), impetigo (2), infected bite (2), erysipelas (1), and sporotrichosis (1).
5. *Helminthic* cases comprised Strongyloides (16), Taeniae (7), hookworm (5), Echinococcus (4), onchocerciasis (3), gnathostomiasis (2), Ascaris (2), Fasciola (1), Clonorchis (1), and unspecified (7).
6. *HIV* included cases of AIDS (4), acute seroconversion (2), and asymptomatic infection (1).
7. *Urinary tract infection* included acute urinary tract infection (9), pyelonephritis (8), and epididymitis (1).
8. *CNS infection* included acute encephalitis (4), viral meningitis (4) and bacterial meningitis (1).
9. *Acute hepatitis* included hepatitis A (10), hepatitis E (5), and nonspecified cases (2).
10. *Chronic hepatitis* included hepatitis B (13) and hepatitis C (7).
11. *STI* included gonorrhoea (2) and syphilis (2).
12. *Herpes virus* included Epstein-Barr virus (4), Herpes simplex virus (2), and Cytomegalovirus (1).

(3 patients, <1%) and *Hemophilus influenzae* infection (2 patients, <1%).

Compared to other diagnoses in travelers, those who were not known to be vaccinated against *Salmonella typhi* (19/595) were 11 times more likely to be diagnosed with typhoid fever than those who had been vaccinated (1/322) [odds ratio (OR) 11, 95% CI 2–213, $p < 0.01$].

There were no vaccine failures for those diagnosed with hepatitis A. However, for 3 of 9 cases of hepatitis A who had sought pretravel advice, a preventative vaccine was not administered. Ten of 23 (43%) patients diagnosed with influenza had sought pretravel medical advice but had not been vaccinated against influenza. Only 1 of 36 (3%) patients who presented for rabies post-exposure prophylaxis (PEP) had received pretravel rabies vaccination. Thirteen (36%) of these patients had traveled <1 month.

Mortality Rate

The mortality rate was 0.2% (2 of 1,106). Both deaths were due to bacterial pneumonia, one in an Australian traveler and one in a visitor.

Discussion

We have prospectively described and compared the common causes and range of diagnoses for illness acquired overseas in a large number of adult travelers (917) and immigrants/refugees (189) seen in two hospital-based Australian infectious diseases units over a 6-year period (Tables 1, 2, and 3).

Several important differences in the likelihood of infections were found when returned travelers were compared to immigrants/refugees (Table 4). For immigrants and refugees, these differences likely reflect a combination of factors, which may include a higher intensity and greater duration of exposure to endemic infections, lack of vaccination and prophylactic medication, medical screening

13. *Bacterial sepsis* included that caused by *Neisseria meningitidis* (1), *Streptococcus pneumoniae* (1), *Hemophilus parainfluenzae* (1), *Escherichia coli* (1), and an undefined Gram-negative bacillus (1).
14. *Pneumonia* included 2 cases due to Mycobacterium kansassii and 1 due to Legionella pneumophila.
15. *Typhoid/paratyphoid* fever included *Salmonella typhi* (20) and *Salmonella paratyphi* (8) infections.
16. *Other* included screening (23), noninfectious medical condition (19), rash (17), fatigue (13), drug adverse reaction (6), trauma (4), allergic reaction (2), psychosis (2), endocarditis (1), otitis externa (1), dental (1), tropical pulmonary eosinophilia (1), myiasis (1), measles (1), toxoplasmosis (1), viral syndrome (1), illness unknown (1), and lymphadenopathy (1).

†Travelers may have more than one diagnosis.

Table 2 Most common diagnoses in immigrants/refugees (n = 189)

Diagnosis*	Number of cases†	% of immigrants/refugees
Tuberculosis	94	50
Schistosomiasis	24	13
Helminth infection	18	10
Chronic hepatitis	17	9
Leprosy	12	6
Malaria	6	3
Gastroenteritis/diarrhea	4	2
URTI	4	2
HIV	3	2
Eosinophilia	3	2
Entamoeba histolytica	2	1
Other	17	9

URTI = upper respiratory tract infection.
*See footnote to Table 1.
†Immigrants/refugees may have more than one diagnosis.

prior to arrival into Australia, and reduced access to health care services upon arrival.

Significant differences, regarding the time to presentation and the clinical features, were also found when travelers were compared to immigrants/refugees (Table 4). These differences may be explained by the fact that they might have had difficulties accessing hospital care, that they accessed other health care sources for more acute conditions upon arrival, that most of the conditions were chronic and took time to become clinically evident, or that as they were more likely to be asymptomatic, they required targeted screening by clinicians experienced in immigrant/refugee health for diagnosis. In addition, when comparing travelers relative to immigrants/refugees, it was found that in travelers, more focus should be placed on considering diseases that are vector- or food- and waterborne, as they are more likely, and less focus on those acquired via the respiratory or skin routes, which are less likely (Table 4). We feel all the above comparisons reveal important differences that can aid the clinician in the assessment and management of illness in returned travelers or immigrants/refugees.

Table 3 Most common diagnoses in febrile travelers (n = 624)

Diagnosis	Number of cases*	%
Malaria	167	27
Gastroenteritis/diarrhea	75	12
URTI	51	8
Dengue fever	46	7
Unknown	45	7
Typhoid/paratyphoid fever	28	4
Pneumonia	25	4
Influenza A/B	23	4
Viral syndrome	23	4
Rickettsial disease	16	3
Urinary tract infection	16	3
Skin infection	10	2
Helminth infection	10	2
Hepatitis A	9	1

*Travelers may have more than one diagnosis.

Another hospital-based study on immigrants/refugees also found high rates of tuberculosis, helminthic infection, and chronic hepatitis.[11] However, conversely, they found high rates of filariasis (onchocerciasis and mansonella), which was due to the high proportion of patients seen from Western Africa (>55%), and malaria, which was probably related to their high proportion of immigrants from sub-Saharan Africa (77% vs 43%), and the high proportion (72%) of undocumented migrants who had likely not undergone prior medical screening.

We have previously described the common causes of fever in 232 returned travelers admitted to our institution.[3] In the present study, we have analyzed 624 febrile returned travelers and found that the top 10 most common diagnoses remained unchanged except that *Hepatitis A* has been replaced by *viral syndrome*. This may represent a reduced incidence of hepatitis A over time in returned travelers due to better coverage with pretravel hepatitis A vaccination.

Our study has also shown that travel to specific regions and the classification type for the traveler can influence the likelihood of a traveler presenting with a specific diagnosis (Table 5). For example, compared to those who have not, patients in our study who had traveled to Africa were nine times more likely to be diagnosed with schistosomiasis, five times more likely with rickettsial disease, and twice as likely with malaria. However, they were significantly less likely to be diagnosed with dengue fever or gastroenteritis/diarrhea. In addition, those classified as visitors were significantly more likely to present with tuberculosis or typhoid/paratyphoid fever, and less likely to present with schistosomiasis and an URTI compared to other travelers.

Similarly, although malaria should always be considered in returned travelers, in our patient population, special attention should be paid to those who have traveled to Africa and the Pacific or have traveled as expatriates, as they had a significantly higher likelihood of having malaria than other travelers.

Again, we believe these are important findings, as it allows the treating clinician to use this information regarding travel epidemiology and patient classification to make informed judgments regarding illness probability when assessing returned travelers in their hospitals.

Table 4 Comparison between travelers and immigrants/refugees

	Travelers (917)	Immigrants/refugees (189)	Significance*
Inpatient	472 (52%)	36 (19%)	4.5, (3.0–6.7), $p < 0.0001$
Demographics			
Mean age	33.9 yr	35.5 yr	NS
Median age	30 yr	32 yr	NS
Age range	4–98 yr	16–84 yr	NS
Male	526 (57%)	100 (53%)	NS
Diagnoses†			
Malaria	174 (19%)	6 (3%)	**7.1** (3.0–18.2), $p < 0.0001$
Gastroenteritis	136 (15%)	4 (2%)	**8.1,** (2.8–25.9), $p < 0.0001$
URTI	61 (7%)	4 (2%)	**3.3**, (1.1–10.8), $p = 0.02$
Illness unknown	53 (6%)	1 (<1%)	**11.5**, (1.7–226), $p < 0.01$
Tuberculosis	42 (5%)	94 (50%)	**0.05**, (0.0–0.1), $p < 0.0001$
Schistosomiasis	35 (4%)	24 (12%)	**0.3**, (0.2–0.5), $p < 0.0001$
Helminth	30 (3%)	18 (9%)	**0.3**, (0.2–0.6), $p < 0.001$
Pneumonia	29 (3%)	1 (<1%)	**6.1**, (0.9–122), $p = 0.04$
Chronic hepatitis	3 (<1%)	17 (9%)	**0.04**, (0.0–0.2), $p < 0.0001$
Leprosy	2 (<1%)	12 (6%)	**0.03**, (0.0–0.2), $p < 0.0001$
Clinical and laboratory			
Fever	589 (64%)	35 (18%)	**7.9**, (5.3–11.9), $p < 0.0001$
Gastrointestinal symptoms	392 (43%)	27 (14%)	**4.5**, (2.9–7.0), $p < 0.0001$
Respiratory symptoms	180 (20%)	30 (16%)	NS
Skin symptoms	344 (38%)	18 (10%)	**5.7**, (3.4–9.8), $p < 0.0001$
Neurological symptoms	333 (36%)	12 (6%)	**4.5**, (4.5–16.1), $p < 0.0001$
Asymptomatic	61 (7%)	69 (37%)	**0.1**, (0.1–0.2), $p < 0.0001$
Splenomegaly	39 (4%)	7 (4%)	NS
Hepatomegaly	36 (4%)	4 (2%)	NS
Anemia (HB < 11.0)	50/572 (9%)	13/84 (15%)	**0.4**, (0.2–0.8), $p < 0.01$
Eosinophilia	49/640 (8%)	17/79 (22%)	**0.3**, (0.2–0.6), $p < 0.0001$
Time to presentation			
<1 mo	479 (73%)	5 (3%)	**96**, (38–270), $p < 0.0001$
1–6 mo	148 (23%)	36 (19%)	NS
>6 mo	29 (4%)	142 (78%)	**0.01**, (0.01–0.02), $p < 0.0001$
Mode of transmission			
Vector-borne	250 (33%)	6 (4%)	**13.3**, (5.6–33.7), $p < 0.0001$
Food- and waterborne	213 (28%)	15 (9%)	**4.0**, (2.2–7.2), $p < 0.0001$
Respiratory	156 (20%)	99 (59%)	**0.2**, (0.1–0.3), $p < 0.0001$
Skin	143 (18%)	45 (27%)	**0.6**, (0.4–0.9), $p < 0.01$
Sexual	8 (1%)	4 (2%)	NS

*Figures in bold represent odds ratio, and figures in parentheses represent 95% confidence intervals.
†Only diagnoses with significant differences shown.
NS = Not significant

It is worth noting that rabies PEP accounted for the ninth most common diagnosis in returned travelers; yet, only 5% of travelers had pretravel rabies vaccination. Pretravel vaccination avoids the need for the often difficult to obtain, and potentially dangerous, rabies immunoglobulin postexposure,[14] and also reduces the number of postexposure vaccinations required, while giving some protection for unreported exposures or where postexposure prophylaxis may be delayed. In Australia, pretravel rabies vaccination is recommended for travelers to endemic countries for periods of >1 month or when undergoing high-risk activities.[15,16] Considering more than one-third of our patients requiring rabies PEP traveled for <1 month, the vaccine is safe and effective,[17] and rabies is a uniformly fatal disease; we would emphasize the need to consider this vaccination in all travelers to endemic areas.

Mycobacterium tuberculosis is increasingly recognized as a common infection acquired in travelers going from tuberculosis low-endemicity to high-endemicity countries.[18–20] The risk of acquisition is estimated to be the same as that of the general population of the countries to which they have traveled.[18,21] Although tuberculosis was the seventh most common diagnosis in travelers in our study, it was significantly more common in visitors to Australia (OR 7.9) than in Australian residents traveling overseas. In fact, travelers who were not visitors or expatriates were significantly less likely to present with tuberculosis than other diagnoses (OR 0.1), despite this population representing 26% of cases in travelers. Thus,

Table 5 Comparison of travel destination and classification of traveler for specific diagnoses in travelers*

	Asia	Africa	Oceania	LA	ME	Visitor	Expatriate	Australian traveler
Dengue	5.1, 2.2–12.7, <0.0001	0.1, 0.0–0.7, <0.0001	NS	NS	†	NS	NS	2.6, 1.1–6.4, 0.02
Malaria	0.4, 0.3–0.5, <0.0001	2.4, 1.5–3.6, <0.0001	4.6, 3.0–7.0, <0.0001	NS	0.1, 0.0–0.8, <0.01	NS	3.9, 2.5–6.0, <0.0001	0.5, 0.4–0.7, <0.001
Schistosomiasis	0.1, 0.0–0.3, <0.0001	9.0, 4.3–19.1, <0.0001	NS	NS	NS	0.1, 0.0–0.98, 0.03	NS	NS
URTI	NS	NS	NS	NS	NS	0.3, 0.1–0.98, 0.03	NS	3.3, 1.4–8.1, 0.002
Typhoid/ Paratyphoid fever	3.0, 1.1–8.2, 0.02	NS	NS	†	NS	2.9, 1.2–6.8, <0.01	NS	NS
Pneumonia	NS	NS	NS	†	†	NS	NS	11.0, 4.2–30.4, <0.0001
Tuberculosis	7.9, 2.7–26.4, <0.0001	NS	NS	†	†	13.6, 6.6–28.5, <0.0001	NS	0.1, 0.1–0.3, <0.0001
Rickettsial disease	0.2, 0.1–0.7, <0.01	4.9, 1.7–13.8, <0.001	NS	†	NS	NS	NS	NS
Gastroenteritis/ diarrhea	NS	0.4, 0.2–0.8, <0.01	NS	2.4, 1.2–4.7, <0.01	NS	NS	NS	NS
Rabies PEP	42, 16–116, <0.0001	NS	NS	NS	NS	NS	NS	NS
Acute hepatitis	NS	†	NS	†	NS	NS	†	12.9, 3.5–57, <0.0001
Helminthic infection	NS	NS	NS	NS	6.9, 2.3–19.5, <0.0001	NS	NS	NS
Entamoeba histolytica	NS	NS	NS	NS	NS	NS	4.1, 1.4–11.2, 0.002	NS

LA = Latin America; ME = Middle-East; NS = not significant

*Figures represent odds ratio (OR), 95% confidence intervals, and *p* values respectively. OR compares the likelihood of a patient with a certain characteristic (eg, travel to Asia) having a particular diagnosis (eg, dengue fever) by comparing them against the rest of the travelers in the dataset.

†No cases found.

our study confirms that tuberculosis occurs in travelers, but it especially needs to be considered in visitors from high-endemic countries.

Immigrants and refugees who migrate from countries with high tuberculosis endemicity to those with low endemicity have high rates of developing tuberculous disease in their adopted country.[22–24] Immigrants and refugees represented the majority of tuberculosis cases in our study being 21 times more likely to present with tuberculosis than travelers.

Six percent of travelers (53/917) developed a potentially vaccine-preventable disease (influenza, 23 cases; typhoid fever, 20 cases; hepatitis A, 10 cases; measles, 1 case), and in 15 of 48 (31%) cases, where the information was known, the vaccine had not been administered despite pretravel medical consultation. Furthermore, those who had been vaccinated for typhoid fever and hepatitis A were significantly less likely to be diagnosed with these respective conditions as compared to other diagnoses. This reemphasizes the need to consider these diagnoses in returned travelers, especially if they have not been vaccinated, and also to remind practitioners of the need to consider pretravel vaccination for travel to highly endemic areas.

Finally, we acknowledge that our study describes only the spectrum of illness in returned travelers and immigrants/refugees seen by specialist infectious diseases units in large teaching hospitals. This results in a referral bias where the more severe and exotic infections are more likely to be seen. In addition, as the study involves travelers and immigrants/refugees presenting in Australia, the type of diagnoses reflects the travel or immigration patterns of those entering Australia. In our population of travelers, 70% had returned from the local region (Asia and the Pacific) and only 15% from Africa and 2% from Latin America. This differs from studies performed in Europe or North America[4,5,11,25] where increased proportions travel to Africa and Latin America.

Conclusions

We have described the spectrum of illness, epidemiology, clinical features, and modes of transmission of overseas acquired illness in returned travelers and immigrants/refugees presenting to two hospital-based Australian infectious diseases units. We have found that important differences exist between travelers and immigrants/refugees and that travel

destination and classification of traveler can influence the likelihood of specific diagnoses. These findings present important diagnostic clues for the clinical assessment of this patient population.

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Declaration of Interests

The authors state they have no conflicts of interest.

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