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Travel-acquired infections and illnesses in British Columbians: Surveillance report from CanTravNet surveillance data, 2009–2018

This first published analysis of illnesses contracted by British Columbians during international travel to disease-endemic areas highlights the need to promote pretravel health advice and prompt posttravel assessment in order to reduce incidences of communicable and potentially life-threatening infectious diseases.

ABSTRACT

Background: Previous studies have described travel-related infections among Canadians; however, a provincial-level analysis of British Columbians has not been published.

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Methods: We extracted and analyzed data from the Canadian Travel Medicine Network database for returning ill British Columbian travelers who presented to a GeoSentinel surveillance network site between March 2009 and September 2018.

Results: In total, 1153 ill travelers were assigned travel-related diagnoses; of those, 37% (n = 426) required inpatient management. The most common diagnoses (n = 1494) were tuberculosis (n = 174, 12%), malaria (n = 89, 6%), and enteric fever (n = 81, 5%). British Columbians who traveled to visit friends and relatives were disproportionately represented among travelers diagnosed with malaria (n = 35/89, 39%) and enteric fever (n = 69/81, 85%).

Conclusions: International travel introduces British Columbia residents to risk of communicable, preventable, and potentially life-threatening infectious diseases, which could be mitigated by promoting pretravel consultation.

Background

The COVID-19 pandemic highlights the importance of recognizing and diagnosing travel-related infections. In 2018, 67 million passengers enplaned and deplaned in Canadian airports for international travel.¹ Vancouver International Airport was the point of nexus for 13 million of these international travelers,

of whom 4.9 million were returning Canadian residents.² Since 2015, transnational travel between Canada and countries other than the US has represented most of the increase in air traffic at Canadian airports.¹ This shift in Canada's international air travel coincided with an increased rate in Canadian population growth due to international immigration, which doubled both nationally and in British Columbia from 2015 to 2019.³ In 2019, international immigration to Canada reached a record high of 436 689 people, which represented 80% of Canada's total population growth, surpassing the peak baby boom period in Canada, and was highest among all G7 countries.⁴

International travel to low- and middle-income countries introduces travelers and migrants to the risk of contracting communicable and preventable infectious diseases. In BC, most reported cases of shigellosis, rabies, and enteric fever are among international travelers.⁵ International travel is associated with at least 25% of exposures to vaccine-preventable diseases, including influenza, measles, mumps, and meningococcal infections.⁵ Multinational studies report 6% to 87% of travelers become ill during or posttravel; this estimate narrows to 43% to 79% for travelers to low-income and middle-income countries.^{6,7} Boggild and colleagues described the diseases and syndromes acquired by

Canadian international travelers and migrants who reported to a Canadian GeoSentinel surveillance network site between September 2009 and September 2011; however, British Columbians represented only 7.3% of the travelers analyzed.⁸ In 2019, Canadians most frequently traveled to Mexico and the UK; among BC travelers, top destinations were China and the UK.⁹ Research on patterns of travel-related communicable diseases is hindered because the proportion of BC travelers that become ill posttravel has not been systematically assessed. The BC Centre for Disease Control collects provincial data and reports communicable diseases among British Columbians. However, if travel-related illnesses diagnosed in community laboratories are not reported to the BCCDC, travel-related illness may be underestimated, resulting in the underreporting of infections acquired by BC residents during travel.

Our analysis describes travel-related illness among British Columbians who were assessed

posttravel by infectious diseases physicians who specialize in tropical medicine at dedicated Canadian Travel Medicine Network (CanTravNet) clinics in Vancouver, Surrey, and Victoria. Our aim is to describe BC travelers who acquired illness abroad in order to further inform public health infrastructure and enhance strategies that increase the use of pretravel and posttravel/tropical medicine clinics for prospective and returning BC travelers, respectively.

Methods

Data source

Data were collected from the GeoSentinel global surveillance network surveillance platform (www.istm.org/geosentinel). The US Centers for Disease Control and Prevention Institutional Review Board classifies this data collection protocol as public health surveillance. The seven Canadian GeoSentinel sites constitute CanTravNet, which works in collaboration with the Public Health Agency of Canada. The BC

CanTravNet sites consist of three referral-based posttravel outpatient clinics in Vancouver, Surrey, and Victoria that are staffed by specialists in tropical medicine. The anonymous, delinked, clinician-based travel surveillance data on ill travelers include demographics, travel details, purpose of travel, pretravel consultation, symptoms, and final diagnoses as specific etiologies and syndromes. Etiologic diagnoses are supported by microbiologic confirmation.

Definitions

The primary purpose for travel designations include tourism, immigration, visiting friends and relatives, missionary and volunteer work, business, and other. Immigration-related travel was designated regardless of migration status. Visiting friends and relatives was defined as first-generation and second-generation immigrants traveling from a high-income country of current residence to a low-income country of origin for the purpose of visiting friends

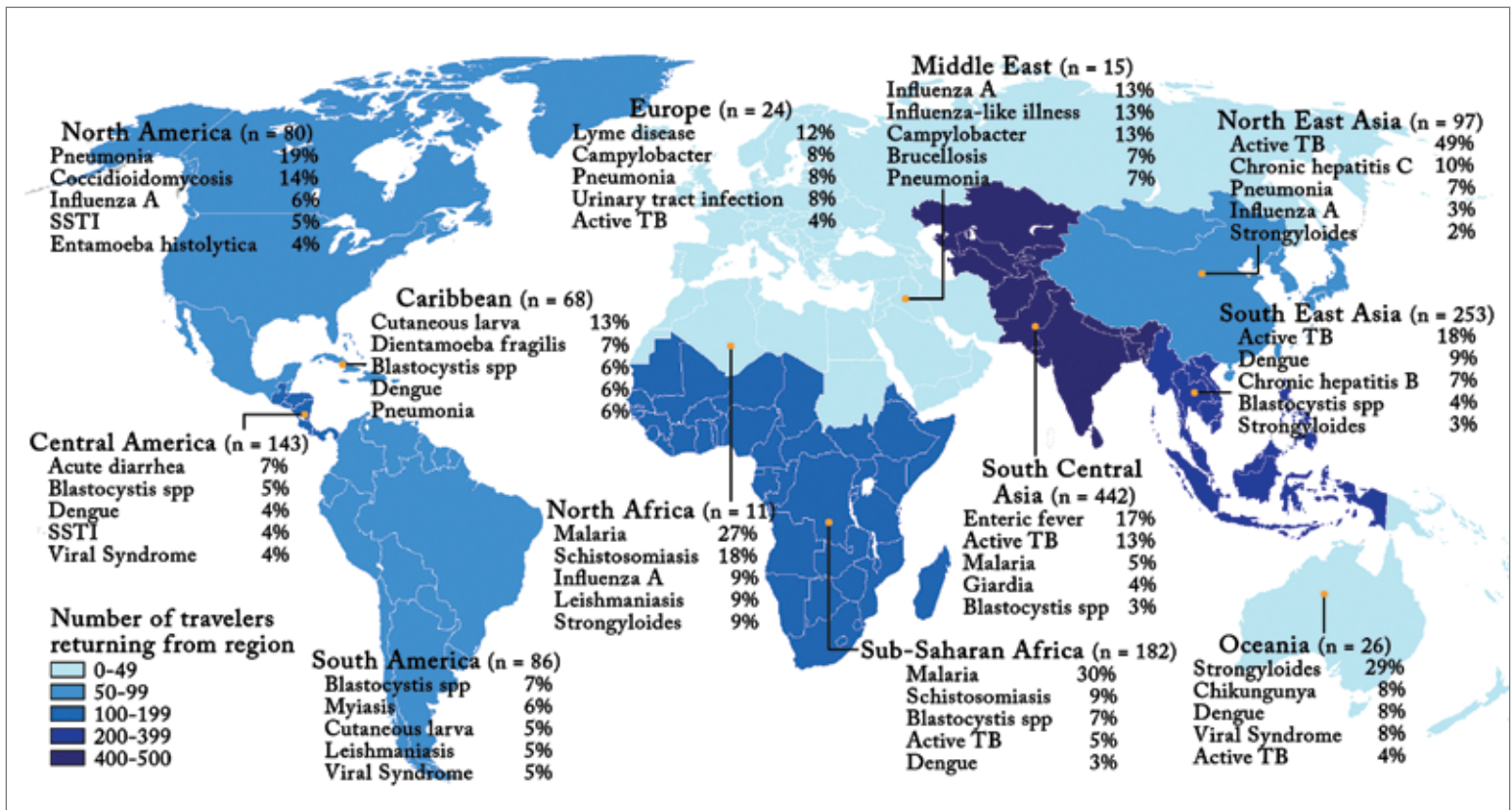


FIGURE. Regional exposure for returning British Columbia travelers (2009–2018).

TB: *Mycobacterium tuberculosis*; SSTI: skin and soft tissue infection. Proportions shown represent the proportion of each diagnosis per total number of diagnoses within each region. There were 67 diagnoses that were not assigned a region; indeterminate/multiple regions of travel (n = 33), not ascertainable (n = 8), and missing data (n = 26).

Base map adapted from PresentationLoad PowerPoint Maps: www.presentationload.com/powerpoint-maps/.

and relatives. “Other” includes seasonal or temporary work, education, military service, and medical tourism travel purposes. Countries were grouped into 12 regions: North America, Central America, the Caribbean, South America, Europe, North Africa, Sub-Saharan Africa, the Middle East, South Central Asia, Northeast Asia, Southeast Asia, and Oceania.

Inclusion criteria

The study group included all patients with travel-related diagnoses recorded in the

GeoSentinel database after assessment at a BC CanTravNet site from 30 March 2009 to 12 September 2018.

Statistical analysis

Extracted data were managed in a Microsoft Access database. Statistical analyses were performed using SPSS Statistics 25 software (SPSS Inc.).

Results

In total, 1153 travelers with travel-related diagnoses were evaluated by CanTravNet sites in

BC during the 9-year surveillance period. There were 1494 diagnoses from the 1153 travelers examined: 891 travelers (77%) had a single diagnosis, and 262 (23%) had multiple diagnoses. The most common diagnoses overall (n = 1494) were tuberculosis (n = 174/1494, 12%), malaria (n = 89/1494, 6%), and enteric fever (n = 81/1494, 5%) [Table 1]. The most common syndromic diagnoses were febrile syndromes (30%), gastrointestinal syndromes (22%), respiratory syndromes (16%), dermatologic syndromes (9%), and genitourinary syndromes (3%).

TABLE 1. Top 10 syndromic and etiologic diagnoses from 1153 ill returning travelers, by reason for travel (2009–2018).

Rank	All travelers (n = 1153)	Immigration (n = 236)	Tourism (n = 424)	Visiting friends and family (n = 324)	Missionary and volunteer (n = 80)	Business (n = 61)	Other* (n = 28)
Total number of travel-related diagnoses	(n = 1494)	(n = 323)	(n = 555)	(n = 382)	(n = 115)	(n = 82)	(n = 37)
1	Active TB†	Active TB	<i>Blastocystis</i> spp.	Enteric fever	Malaria	Malaria	Malaria
	174 (12%)	145 (45%)	32 (6%)	69 (18%)	15 (13%)	13 (16%)	3 (8%)
2	Malaria	Chronic hepatitis B	Pneumonia	Malaria	<i>Blastocystis</i> spp.	Pneumonia	Active TB
	89 (6%)	29 (9%)	32 (6%)	35 (9%)	12 (10%)	5 (6%)	3 (8%)
3	Enteric fever	<i>Strongyloides</i>	Dengue	Active TB	Schistosomiasis	Active TB	Bacteremia
	81 (5%)	19 (6%)	32 (6%)	18 (5%)	7 (6%)	4 (5%)	2 (5%)
4	<i>Blastocystis</i> spp.	Chronic hepatitis C	Cutaneous larva migrans	Dengue	Dengue	Dengue	<i>Blastocystis</i> spp.
	60 (4%)	16 (5%)	20 (4%)	15 (4%)	6 (5%)	4 (5%)	2 (5%)
5	Dengue	Malaria	Viral syndrome	<i>Entamoeba histolytica</i>	<i>Entamoeba histolytica</i>	<i>Blastocystis</i> spp.	Leishmaniasis
	55 (4%)	9 (3%)	20 (4%)	11 (3%)	6 (5%)	4 (5%)	2 (5%)
6	Pneumonia	Schistosomiasis	Acute diarrhea	Acute diarrhea	Febrile illness	Influenza-like illness	Schistosomiasis
	51 (3%)	9 (3%)	19 (3%)	11 (3%)	5 (4%)	4 (5%)	2 (5%)
7	Acute diarrhea	Latent TB	SSTI‡	Brucellosis	<i>Giardia</i>	SSTI	<i>Shigella</i>
	35 (2%)	7 (2%)	18 (3%)	9 (2%)	4 (4%)	4 (5%)	2 (5%)
8	Chronic hepatitis B	Echinococcosis	<i>Giardia</i>	Urinary tract infection	<i>Rickettsia</i>	Influenza A	SSTI
	33 (2%)	4 (1%)	16 (3%)	9 (2%)	3 (3%)	3 (4%)	2 (5%)
9	<i>Entamoeba histolytica</i>	Leprosy	Insect bite	<i>Blastocystis</i> spp.	Enteric fever	<i>Campylobacter</i>	Urinary tract infection
	32 (2%)	4 (1%)	15 (3%)	8 (2%)	2 (2%)	2 (2%)	2 (5%)
10	<i>Strongyloides</i>	<i>Dientamoeba fragilis</i>	Malaria	<i>Giardia</i>	<i>Campylobacter</i>	Coccidioidomycosis	Viral syndrome
	31 (2%)	3 (1%)	14 (3%)	7 (2%)	2 (2%)	2 (2%)	2 (5%)

* Other: includes reason for travel related to military, education/student, or planned medical care

† TB: tuberculosis

‡ SSTI: skin and soft tissue infection

A total of 620 diagnoses were assigned to 426 patients who required inpatient management: the most common inpatient diagnoses were active TB (n = 147/620, 24%), malaria (n = 49/620, 8%), pneumonia (n = 45/620, 7%), enteric fever (n = 41/620, 7%), and dengue (n = 18/620, 3%) [Table 2].

Among travelers who required outpatient management, the most common etiologic diagnoses were *Blastocystis* spp. infection (n = 57/874, 7%), enteric fever (n = 40/874, 5%), malaria (n = 40/874, 5%), dengue (n = 39/874,

5%), and chronic hepatitis B (n = 28/874, 3%).

Among all 1153 travelers, the top reasons for travel were tourism (n = 424, 37%), visiting friends and relatives (n = 324, 28%), immigration (n = 236, 21%), missionary and volunteer work (n = 80, 7%), and business (n = 61, 5%). Among nonimmigration travelers, the most common diagnoses were enteric fever (7%), malaria (7%), *Blastocystis* spp. infection (5%), dengue (5%), and pneumonia (4%). The Figure summarizes the top five diagnoses per region of exposure: the most common regions of exposure

overall were South Central Asia, Southeast Asia, and Sub-Saharan Africa.

Tuberculosis

Active tuberculosis was the most common diagnosis among all travelers [Table 1]; most cases were diagnosed among those traveling for immigration purposes (145/174, 83%). Hospitalization was required for 84% (147/174) of all active tuberculosis diagnoses. Five patients with tuberculosis (3%) were diagnosed with drug-resistant tuberculosis; additional

TABLE 2. Top five syndromic or etiologic diagnoses from 1153 ill returning travelers, by posttravel level of care required (2009–2018).

Diagnosis	Total number of diagnoses in database (n = 1494)	Total number of diagnoses requiring hospitalization (n = 620)	Three most common source countries
Active TB*	174	147 (84%)	India, China, Philippines
Pulmonary	111	106 (95%)	India, China, Philippines
Extrapulmonary	51	29 (57%)	India, China, Vietnam
Intracranial TB	26	13 (50%)	India, Philippines, China
Abdominal	14	9 (64%)	India, China, Vietnam
Skeletal	5	4 (80%)	China, Pakistan, Vietnam
Other	6	3 (50%)	Philippines, China, India
Miliary	7	7 (100%)	India, Hong Kong, Vietnam
XDR/MDR†	5	5 (100%)	China, Philippines, Vietnam
Malaria	89	49 (55%)	India, Nigeria, Uganda
<i>Plasmodium falciparum</i>	46	35 (76%)	Nigeria, Uganda, Kenya
<i>P. vivax</i>	27	9 (33%)	India, Indonesia, Pakistan
<i>P. ovale</i>	5	2 (40%)	Uganda, Ghana, Sierra Leone
<i>Plasmodium</i> spp.‡	11	3 (27%)	Nigeria, India, Ghana
Pneumonia	51	45 (88%)	United States, China, India
Lobar	32	29 (91%)	United States, China, India
Atypical	13	11 (85%)	United States, China, India
Other	6	5 (83%)	US, Hong Kong, Dominican Republic
Enteric fever	81	41 (51%)	India, Mexico, Pakistan
<i>Salmonella</i> Typhi	42	25 (60%)	India, Pakistan
<i>Salmonella</i> Paratyphi	23	12 (52%)	India, Mexico, Pakistan
Unspeciated	16	4 (25%)	India
Dengue	55	18 (33%)	India, Indonesia, Philippines

*TB: *Mycobacterium tuberculosis*

†XDR: extensively drug-resistant tuberculosis/MDR: multidrug-resistant tuberculosis

‡unspeciated *Plasmodium* spp. infections

resistance to rifabutin was identified in one patient, another patient was resistant to streptomycin, and one patient was resistant to streptomycin, pyrazinamide, and rifabutin. The most common regions of exposure to tuberculosis were South Central Asia (n = 56/174, 32%), Northeast Asia (n = 48/174, 28%), and Southeast Asia (n = 47/174, 27%). Three countries accounted for most (71%) of the active tuberculosis exposures [Table 2]: India (n = 50, 29%), China (n = 45, 26%), and the Philippines (n = 27, 16%).

Malaria

Malaria was the second-most common diagnosis among all travelers, most of whom were traveling for visiting friends and relatives (35/89, 39%), missionary and volunteer work (15/89, 17%), tourism (14/89, 16%), or business (13/89, 15%) [Table 1]. Table 2 shows the *Plasmodium* species of infection, the proportions of malaria cases requiring hospitalization, and the top countries of exposure for all malaria diagnoses. Nine patients (10%) were diagnosed with severe malaria: one due to infection with *P. vivax* acquired in India, seven due to infection with *P. falciparum* acquired in Sub-Saharan Africa, and one case was unspciated. The three most common regions of exposure to malaria were Sub-Saharan Africa (n = 54, 61%), South Central Asia (n = 22, 25%), and Southeast Asia (n = 5, 6%). Three countries accounted for nearly half (44%) of the malaria exposures [Table 2]: India (n = 19, 21%), Nigeria (n = 11, 12%), and Uganda (n = 10, 11%).

Enteric fever

Enteric fever was the third-most common diagnosis, with nonimmigration travelers accounting for all diagnoses. Those traveling to visit friends and relatives accounted for 85% (69/81) of all enteric fever diagnoses [Table 1]. *Salmonella enterica* serotype Typhi and Paratyphi were isolated from blood and/or stool in 42 (52%) and 23 (28%) patients, respectively; the remaining cases of typhoidal *Salmonella* isolates were unspecified. The three most common regions of exposure to enteric fever were South Central Asia (n = 75, 93%), Central America (n = 5, 6%), and Southeast Asia (n = 1, 1%). Three countries accounted for most (93%) of the active enteric

fever exposures [Table 2]: India (n = 70, 86%), Mexico (n = 3, 4%), and Pakistan (n = 2, 3%).

Pediatric diagnoses

Children and adolescents aged 18 years and younger (n = 49) accounted for 4% (n = 61/1494) of all diagnoses. The most common diagnoses were enteric fever (n = 8, 13%), malaria (n = 5, 8%), and active tuberculosis (n = 4, 7%). Inpatient management was required in 31% of children and adolescents (15/49). The

This analysis showed that potentially life-threatening infections were commonly acquired by British Columbians during travel abroad. Active tuberculosis, malaria, and enteric fever were encountered most frequently, with clear overrepresentation among specific cohorts of travelers and geographic regions.

most common diagnoses among those hospitalized were enteric fever caused by *Salmonella* Typhi (n = 5), falciparum malaria (n = 2), dengue (n = 2), and active tuberculosis (n = 2); one pediatric patient was hospitalized with melioidosis.

Young people aged 16 to 18 years were more commonly diagnosed with travel-related illness (n = 34, 56%) than those aged 0 to 5 years (n = 12, 20%) and 6 to 10 years (n = 10, 16%). Among those aged 0 to 10 years, visiting friends and family and tourism represented all reasons for travel. Children older than 10 years increasingly traveled for missionary and volunteer work (7/39, 18%). India was the most common source country for illness among those aged 0 to 10 years and 16 to 18 years; Thailand was the most common source country for illness among 11- to 15-year-olds.

Discussion

This analysis showed that potentially life-threatening infections were commonly acquired by British Columbians during travel abroad. Active tuberculosis, malaria, and enteric fever were encountered most frequently, with clear overrepresentation among specific cohorts of travelers and geographic regions. Inpatient management was required for 37% of travelers, among whom the most common diagnoses were active tuberculosis, followed by malaria, pneumonia, enteric fever, and dengue.

Travel-related active TB was disproportionately represented in those who traveled for immigration. This is consistent with active TB incidence reported by the BCCDC.¹⁰ The Canadian tuberculosis standards identify individual and public health benefits of latent TB infection treatment for individuals migrating from countries with a high incidence of TB.¹¹ Our analysis found that 70% of tuberculosis diagnoses occurred among immigrants who originated from three countries: India, China, and the Philippines. This highlights the need for proactive measures for those who might benefit from latent TB infection treatment in order to prevent treatable and potentially serious pulmonary and extrapulmonary TB infections.

Malaria due to *P. falciparum* infection, which can cause severe and potentially fatal disease, was reported in more than half of ill returning travelers who had malaria. While malaria infections due to *P. vivax* less commonly cause severe disease, it is notable that one-third of *P. vivax* infections required hospitalization. Of the 10% of malaria-infected travelers who had severe malaria, most cases were acquired by those traveling for business or tourism in Sub-Saharan Africa; however, there was one severe malaria case caused by *P. vivax*, which was acquired in India. Although there were no deaths among the severe malaria cases, one to two Canadians die annually due to delayed diagnosis or treatment.¹² Overall, most travel-related malaria was acquired by those traveling to visit friends and relatives, followed by missionary or volunteer work, tourism, and business travel. Our analysis showed that *P. falciparum* malaria was most commonly acquired in Sub-Saharan Africa, whereas *P. vivax* malaria was most commonly acquired in South Asia and Indonesia, consistent with the

literature on malaria acquired by travelers.^{8,13} Targeted strategies are needed to increase appropriate malaria prophylaxis prescribing and adherence among these differing populations of travelers to high-risk malaria endemic regions in order to reduce malaria infections.

Enteric fever was among the top diagnoses requiring hospitalization. This was the most common diagnosis among travelers who visited friends and relatives, most of whom traveled to South Central Asia. A high proportion of enteric fever in North America is consistently reported among travelers who visit friends and relatives in South Asia, which has among the highest incidence of the disease.^{8,14,15} Population-based estimates of the medical costs of enteric fever in Ontario highlight the substantial avoidable health care spending required for diagnosing and treating these infections.¹⁶ The World Health Organization has proposed a policy on the programmatic use of oral live-attenuated Ty21a typhoid and parenteral unconjugated Vi polysaccharide in endemic countries. Despite countries having limited vaccine uptake in routine immunization programs, the global incidence rates of enteric fever have decreased.^{15,17} The newer generation typhoid conjugate vaccines have the potential to effectively reduce the global burden of enteric fever.¹⁸ Until the programmatic use of the newer generation typhoid conjugate vaccines is established in endemic countries, British Columbians are at risk of acquiring enteric fever when traveling to those countries. Typhoid immunization with an appropriate vaccine that is available in Canada, which has shown moderate effectiveness in travelers, is recommended for travelers to South Asia.^{19,20} However, pretravel consultation to facilitate vaccination is infrequently sought by travelers who visit friends and relatives in high-burden regions.^{21,22} The reasons for not seeking travel health advice are multifactorial; thus, the approach to identifying British Columbians at risk for enteric fever and the tailoring of prevention strategies is critical.

Study limitations

This analysis is representative only of BC international travelers who were assessed at referral-based CanTravNet sites in BC. For example, although sexually transmitted infections

are commonly acquired during travel, only 1% of travelers in this data set had a diagnosis of sexually transmitted infection. Thus, the severity and frequency of illness among returning travelers in BC is underestimated. With a lack of denominator data (i.e., the total number of travelers), travel-related disease rates and risks cannot be determined, and the proportion of hospitalized patients is likely overrepresented. However, the descriptive analysis specific to BC travelers does highlight the utility of travelers being assessed at a BC CanTravNet site

Fever in returning travelers is a medical emergency, but chemoprophylaxis, vaccines, or other prevention strategies are available for many of the serious travel-related infections reported in this analysis.

after travel, as this information can be used to tailor strategies for improving pretravel and posttravel health care. Previous Canadian GeoSentinel studies have shown that low numbers of travelers receive pretravel consultation, which is consistent with international GeoSentinel reporting. While limited data preclude definitive reporting of British Columbia pretravel practices, our data indicate that similarly low numbers of travelers received pretravel consultation. Public health strategies for encouraging pretravel and posttravel assessments could help reduce rates of potentially communicable travel-related illness and morbidity in BC.

Conclusions

This analysis highlights the effect of travel-related illness on British Columbians. The detailed data on travelers may contribute to provincial public health strategies for increasing tailored pretravel health advice and posttravel assessment in order to prevent, control, and manage travel-related infectious diseases.

Broader and more accessible information on travel-related illness could benefit those at high risk of acquiring infectious diseases. This may further benefit British Columbians by reducing travel-related illness and morbidity, and potentially reducing costs to the health care system. As British Columbia's public health policies related to COVID-19 shift and international travel increases, referrals for prompt specialized posttravel assessment at a CanTravNet site in order to differentiate travel-related illness may facilitate improved patient outcomes. Further, a CanTravNet collaboration with BC public health promoting assessment at the dedicated posttravel clinics within the CanTravNet network (located in Vancouver, Surrey, and Victoria) may enhance the ability of the existing sentinel system to prospectively detect trends, monitor the burden of disease, and identify outbreaks among traveling British Columbians.

Summary

In response to the COVID-19 pandemic, global public health networks have demonstrated the value of using and sharing public health surveillance data. Further, the pandemic highlights the significant public health effects of travel-acquired illness. There is a paucity of research on travel-related illness among British Columbians. Fever in returning travelers is a medical emergency, but chemoprophylaxis, vaccines, or other prevention strategies are available for many of the serious travel-related infections reported in this analysis. This highlights the opportunity to prevent illnesses acquired during travel by promoting pretravel health advice and to reduce morbidity by conducting rapid posttravel assessment by specialists in tropical medicine. Proactive and prompt posttravel assessment of British Columbians traveling to endemic areas is beneficial at both an individual level and a population level by detecting communicable diseases and reducing costs to the health care system, and may further facilitate global surveillance of travel-related infectious diseases. ■

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Competing interests

None declared.

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