

Characteristics and Spectrum of Disease Among Ill Returned Travelers from Pre- and Post-Earthquake Haiti: The GeoSentinel Experience

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Abstract. To describe patient characteristics and disease spectrum among foreign visitors to Haiti before and after the 2010 earthquake, we used GeoSentinel Global Surveillance Network data and compared 1 year post-earthquake versus 3 years pre-earthquake. Post-earthquake travelers were younger, predominantly from the United States, more frequently international assistance workers, and more often medically counseled before their trip than pre-earthquake travelers. Work-related stress and upper respiratory tract infections were more frequent post-earthquake; acute diarrhea, dengue, and *Plasmodium falciparum* malaria were important contributors of morbidity both pre- and post-earthquake. These data highlight the importance of providing destination- and disaster-specific pre-travel counseling and post-travel evaluation and medical management to persons traveling to or returning from a disaster location, and evaluations should include attention to the psychological wellbeing of these travelers. For travel to Haiti, focus should be on mosquito-borne illnesses (dengue and *P. falciparum* malaria) and travelers' diarrhea.

INTRODUCTION

On January 12, 2010, a 7.0-magnitude earthquake struck the nation of Haiti 10 miles west of the capital of Port-au-Prince. According to the Haitian government, at least 217,000 Haitians perished, 300,000 were injured, and 1,000,000 more were left

homeless.¹ After the earthquake, a massive international relief and recovery effort ensued.²

Haiti is the Western hemisphere's poorest nation, and travelers to Haiti have long faced health hazards not typically encountered in other Caribbean countries. *Plasmodium falciparum* malaria and filariasis, both endemic to Haiti, have been eliminated everywhere else in the region outside of Hispaniola, the Caribbean island that Haiti shares with the Dominican Republic.^{3–5} Haiti has the highest incidence of human rabies in the Americas because of, in large part, incomplete control of canine disease.^{5,6} In addition, all four serotypes of dengue virus are endemic in that country; one recent study indicates a 40% prevalence of dengue serotype 1 infection among Haitian children.⁷ Besides these infectious diseases, other health risks to travelers are magnified by the effects of Haiti's sociopolitical and economic reality. Limited basic utilities (water, sanitation, and electricity), weak transportation and communication networks, an underdeveloped healthcare and public health infrastructure, and security issues^{8–11} likely contribute to elevated risk of acute and chronic diseases and injuries among foreign travelers. Aside from a few disease-specific case series and outbreak reports, limited data have been published describing or quantifying the risks of travel to Haiti.^{12–18} After the 2010 earthquake, Haiti's problems have deepened, although the impact on the health of travelers is currently undetermined.

To assess the health impact of the 2010 earthquake on travelers to Haiti, we used the GeoSentinel Global Surveillance Network data to compare post-travel illness for travelers to Haiti before and after the 2010 earthquake. We examined demographics, other traveler characteristics (including purpose of travel), and spectrum of disease among travelers to Haiti for the 3 years before the earthquake and compared these data with travelers to Haiti 1 year after the earthquake.

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MATERIALS AND METHODS

Data collection. GeoSentinel Global Surveillance Network sites are specialized travel or tropical medicine clinics located on six continents. All sites systematically collect anonymous data on ill travelers seen during and after international travel by using a standard reporting form. As previously described,¹⁹ data collected include demographics, travel history, reason for travel, pre-travel medical advice, inpatient or outpatient status, major clinical symptoms, and final diagnoses assigned by a GeoSentinel physician by using the best available reference diagnostic tests. Diagnoses are selected from a standardized list of > 500 diagnostic codes. These diagnoses are grouped into 21 broad syndromic categories. Individual patients could have more than one final diagnosis reported. Only data on whether a patient received pre-travel medical advice were collected; data on the specific components of the evaluation and what was or was not covered or provided to the patient are not collected. Data are compiled at a central site and were extracted for analysis.

Study inclusion criteria. Patients were included if they traveled to Haiti anytime during January 13, 2007 to January 12, 2011, were seen at a GeoSentinel site after their departure from Haiti (either during travel or after arrival home), and sought care at a GeoSentinel site for a condition identified by the evaluating physician to be related to their trip to Haiti. Only final confirmed and probable diagnoses were included. Patient records from Haitian nationals traveling or receiving medical care overseas or those patients who left Haiti for a permanent change of legal residence were excluded.

Definitions. Pre-earthquake was defined by trip end date occurring during January 13, 2007 to January 12, 2010. Post-earthquake was defined as presence in Haiti anytime during January 13, 2010 to January 12, 2011; trips that began on or before January 12, 2010 and ended after January 12, 2010 were categorized as post-earthquake. For those patients with multiple trips to Haiti during the study period, only the most recent trip was analyzed.

Purpose of travel in GeoSentinel is a mutually exclusive variable consisting of tourism, business, aid work/mission work/research/volunteer, visiting friends and relatives (VFR), medical tourism, student, or military. For the purpose of simplicity, the aid work/mission work/research/volunteer purpose of travel was relabeled international assistance, and a person engaged in assistance activities was labeled an international assistance worker (IAW).

Receipt of inpatient care was used as an indication of severe illness.

Statistical analysis. SAS (version 9.2) was used to perform all statistical analyses. Demographics, travel characteristics, diagnoses, and syndrome groupings of diagnoses were compared post- versus pre-earthquake. χ^2 or Fisher exact test (categorical variables) and Wilcoxon rank sum tests (continuous variables) were used to assess statistical differences. A two-sided P value < 0.05 was considered statistically significant.

RESULTS

Patient characteristics. A total of 280 ill returned travelers in GeoSentinel met the inclusion criteria: 95 (34%) during the

3-year pre- and 185 (66%) during the 1-year post-earthquake periods. Approximately one-half were female for both pre- and post-earthquake time periods. The median age was 37 years in post-earthquake versus 44 years in pre-earthquake travelers ($P = 0.005$); this difference largely reflected an increase in the proportion of 20- to 39-year-old persons and a decrease in the proportion of ≥ 60 -year-old persons post-earthquake (Table 1). Median duration of travel during both periods was approximately 3 weeks. IAWs comprised the largest proportion of travelers during both periods, but their proportion increased markedly during the post-earthquake period (77% post- versus 39% pre-earthquake). The proportion of VFRs decreased significantly post-earthquake (6% post- versus 31% pre-earthquake). Ill business travelers represented a small but steady proportion across both periods, and there were few tourists pre- and no tourists post-earthquake. The greatest proportion of ill travelers overall came from the United States. The proportion of ill travelers from Canada decreased post-earthquake, whereas the proportions from all other countries increased. The proportion of patients hospitalized with a travel-related disease was similar across both periods, averaging 12% (total $N = 33$).

Pre-travel medical advice. Data about whether pre-travel medical advice was received were available for 242 (86%) ill returned travelers from Haiti: 72 (76%) in the pre- and 170 (92%) in the post-earthquake periods (Table 1). Overall, 148 (61%) were medically counseled before their trip, but the proportion was significantly higher post-earthquake (71% compared with 37% pre-earthquake [$P < 0.001$]). Only 2 (6%) of 31 VFR travelers with data available had received pre-travel medical advice. When VFR travelers were excluded from the analysis, the proportion of returned travelers that had received pre-travel medical advice rose to 73% post-earthquake compared with 56% pre-earthquake ($P < 0.05$).

Spectrum of disease. Seventy-eight percent of the specific diagnoses among the ill returned travelers from Haiti fell into five syndromic categories: febrile systemic illnesses, acute infectious diarrheas, dermatologic conditions, respiratory illnesses, and psychological disorders (Table 2). The proportion of patients with respiratory illnesses increased significantly post-earthquake.

The six most frequently diagnosed diseases were acute unspecified diarrhea, uncomplicated dengue, *P. falciparum* malaria, upper respiratory tract infection (URI), acute bacterial diarrhea, and work-related stress (Table 2); these six diagnoses represented 40% of the total diagnoses. Two of six conditions (URI and work-related stress) increased significantly post-earthquake, but these diagnoses were reported in small numbers of travelers. No fatalities and no cases of cholera, typhoid, or animal bites or exposures requiring rabies post-exposure prophylaxis were identified.

Febrile systemic illnesses. Uncomplicated dengue was an important cause of morbidity among ill returned travelers from Haiti and accounted for 9% of the overall diagnoses and 18% (6/33) of the severe disease requiring inpatient care. Although less common, *P. falciparum* malaria caused a substantial proportion of severe disease, accounting for 42% (14/33) of hospitalizations. Of the 13 *P. falciparum* malaria patients with data available on whether they received pre-travel medical advice, only 2 (15%) were medically counseled before their trip.

TABLE 1

Characteristics of ill returning travelers from Haiti seen at GeoSentinel Global Surveillance Network sites from January 13, 2007 to January 12, 2011

Characteristic	Total patients (N = 280)*	Pre-earthquake patients (N = 95)*†	Post-earthquake patients (N = 185)*‡	P values§
Female sex	148 (53%)	55 (58%)	93 (50%)	0.23
Age, median (range) in years	39 (6–85)	44 (16–74)	37 (6–85)	0.005
Age group in years				< 0.001
≤ 19	9 (3%)	5 (5%)	4 (2%)	
20–39	131 (47%)	31 (34%)	100 (54%)	
40–59	106 (39%)	36 (40%)	70 (38%)	
≥ 60	30 (11%)	19 (21%)	11 (6%)	
Duration of travel, median (range) in days¶	20 (1–3,636)	19 (1–3,636)	21 (1–607)	0.84
Country of residence				< 0.001
United States	110 (39%)	32 (34%)	78 (42%)	
Canada	66 (24%)	49 (52%)	17 (9%)	
United Kingdom	44 (16%)	4 (4%)	40 (22%)	
Switzerland	18 (6%)	3 (3%)	15 (8%)	
France	15 (5%)	4 (4%)	11 (6%)	
Other	27 (10%)	3 (2%)	24 (13%)	
Purpose of travel				< 0.001
Tourism	15 (5%)	15 (16%)	0 (0%)	
Business	37 (13%)	10 (11%)	27 (15%)	
International assistance	179 (64%)	37 (39%)	142 (77%)	
Visiting friends and relatives	40 (14%)	29 (31%)	11 (6%)	
Other**	9 (3%)	4 (4%)	5 (3%)	
Documented pre-travel medical advice††	148 (61%)	27 (38%)	121 (71%)	< 0.001
Inpatient care	33 (12%)	12 (13%)	21 (11%)	0.75

*Data are number (%) of individuals unless otherwise noted.

†Pre-earthquake was defined by trip end date occurring during January 13, 2007 to January 12, 2010.

‡Post-earthquake was defined as presence in Haiti anytime during January 13, 2010 to January 12, 2011.

§P values based on χ^2 or Fisher exact test (categorical variables) and Wilcoxon rank sum test (continuous variables).

¶Eight total records were missing data (eight in the pre- and zero in the post-earthquake periods).

||Other countries of residence were Belgium, Chile, Germany, Japan, Kenya, The Netherlands, South Africa, Spain, Brazil, Haiti, and Israel.

**Other purposes of travel were student and military.

††Information on the pre-travel medical evaluation was missing for 38 total records (23 in the pre- and 15 in the post-earthquake periods). Denominators for the total, pre-earthquake, and post-earthquake patients columns are 242, 72, and 170, respectively.

Acute diarrheas. A pathogen was identified in less than one-third of travelers with diarrhea; most cases were categorized as acute unspecified or acute bacterial diarrhea without a specific etiology. Pathogen-specific acute diarrheas included *Giardia* ($N = 8$), cyclospora ($N = 4$), *Clostridium difficile* ($N = 3$), cryptosporidium ($N = 2$), *Shigella dysenteriae* ($N = 1$), nontyphi/paratyphi salmonellosis ($N = 1$), and non-*Entamoeba histolytica* intestinal amebas ($N = 1$).

Respiratory illnesses. The increase in post-earthquake respiratory illnesses (26 [14%] versus 5 [5%], $P = 0.03$) was attributed to the increase in URIs (16 [9%] versus 1 [1%], $P = 0.01$). Notably, 12 of 16 (75%) post-earthquake URIs were reported from the same GeoSentinel site, and at least 9 of 12 (75%) had the same dates of travel and sought medical evaluation within days of each other, thus seeming to have traveled and/or worked together in Haiti. No other patterns among the remaining respiratory diagnoses were identified.

Psychological disorders. The proportion of psychological disorders increased post-earthquake (20 [11%] versus 4 [4%]), but this trend did not reach statistical significance ($P = 0.06$). Although numbers were small, there was a statistically significant increase in the specific work-related stress diagnosis within the category (12 [6%] versus 0, $P = 0.01$); of the 12 patients with work-related stress, 11 (92%) were reported from a single GeoSentinel site that screens all travelers for psychological conditions. There was no site-specific pattern to the remaining 13 specific diagnoses in the psychological disorders syndromic category: generalized anxiety ($N = 3$), substance/alcohol abuse ($N = 2$), post-traumatic stress disorder ($N = 2$), delusional parasitosis ($N = 1$), depression not otherwise stated ($N = 1$), insomnia

($N = 1$), jet lag ($N = 1$), marital/family stress ($N = 1$), and violence exposure ($N = 1$).

DISCUSSION

We identified important differences in the characteristics and the spectrum of disease among ill returned travelers from post-earthquake Haiti. In addition, we found that a significant proportion of disease among these travelers was caused by conditions that did not vary significantly across the two periods examined. This finding was especially true for diseases that caused the most severe illness—specifically, dengue and *P. falciparum* malaria.

Our finding that more than 75% of post-earthquake patients were IAWs, up from nearly 40% pre-earthquake, is not surprising. In Haiti, nongovernmental organizations (NGOs) have long delivered a substantial proportion of the healthcare. According to World Health Organization estimates, approximately 250 NGOs were operating in the health sector in Haiti just before the earthquake.⁸ Shortly after January 12, 2010, the Haitian government reported that more than 400 registered, and an unknown number of unregistered health sector NGOs were delivering services.^{2,20} Although GeoSentinel does not differentiate the various specific activities within the international assistance purpose of travel category (aid work/mission work/research/volunteer), a substantial proportion of these IAWs likely contributed directly to the relief and recovery effort.

We cannot fully explain the observed decrease in the proportion of ill travelers from Canada. A study looking at the quality and accuracy of information received by international travelers from North America found that Canadians received more accurate pre-travel preparation than travelers from the

TABLE 2

Syndromic categories of diagnoses and selected specific diagnoses for ill returning travelers from Haiti seen at GeoSentinel Global Surveillance Network sites from January 13, 2007 to January 12, 2011

Diagnosis	Total patients (N = 280)*	Pre-earthquake patients (N = 95)†	Post-earthquake patients (N = 185)*‡	P value§
Systemic febrile illnesses	66 (24)	24 (25)	42 (23)	0.63
Dengue, uncomplicated	25 (9)	8 (8)	17 (9)	0.83
<i>Plasmodium falciparum</i> malaria	17 (6)	6 (6)	11 (6)	0.90
Febrile illness, unspecified (< 3 weeks)	9 (3)	2 (2)	7 (4)	0.72
Viral syndrome (no rash)	9 (3)	4 (4)	5 (3)	0.49
Acute diarrheas	63 (23)	20 (21)	43 (23)	0.67
Diarrhea, acute unspecified	26 (9)	10 (11)	16 (9)	0.61
Diarrhea, acute bacterial	15 (5)	3 (3)	12 (6)	0.40
<i>Giardia</i>	8 (3)	2 (2)	6 (3)	0.72
Dermatologic disorders	33 (12)	16 (17)	17 (9)	0.06
Insect bite/sting	8 (3)	2 (2)	6 (3)	0.72
Respiratory illnesses	31 (11)	5 (5)	26 (14)	0.03
Upper respiratory tract infection	17 (6)	1 (1)	16 (9)	0.01
Sinusitis	5 (2)	1 (1)	4 (2)	0.67
Psychological disorders	24 (9)	4 (4)	20 (11)	0.06
Work-related stress	12 (4)	0 (0)	12 (6)	0.01
Chronic diarrheas	19 (7)	9 (9)	10 (5)	0.20
Post-infectious irritable bowel syndrome	8 (3)	4 (4)	4 (2)	0.33
Diarrhea, chronic unknown	7 (3)	3 (3)	4 (2)	0.69
Nonspecific symptoms or findings	17 (6)	7 (7)	10 (5)	0.51
Other gastrointestinal¶	19 (7)	11 (12)	8 (4)	0.02
Healthy	13 (5)	2 (2)	11 (6)	0.15
Genitourinary and sexually transmitted diseases	10 (4)	4 (3)	6 (3)	0.68
Chronic disease	8 (3)	5 (5)	3 (2)	0.08
Other**	31 (11)	8 (8)	23 (12)	0.31

* Data are number (%) of persons; columns do not add up to 100%, because patients could have more than one diagnosis.

† Pre-earthquake was defined by trip end date occurring during January 13, 2007 to January 12, 2010.

‡ Post-earthquake was defined as presence in Haiti anytime during January 13, 2010 to January 12, 2011.

§ P values based on χ^2 or Fisher exact test.

¶ Other gastrointestinal includes 13 specific diagnoses, 12 of which were diagnosed in less than or equal to two patients each; therefore, this finding was based on small numbers.

|| Patients diagnosed as healthy presented to a GeoSentinel site with symptoms or a history of symptoms but were found to be well and free of a travel-related disease.

** Other syndromic category includes neurologic, injury and musculoskeletal, miscellaneous tissue parasites, adverse events to medication or vaccine, oral and dental, cardiovascular, lost to follow-up, obstetrics and gynecology, and ophthalmologic.

United States, although response rates were low, especially from United States clinics.²¹ It is possible that Canadian travelers to Haiti were better prepared for their trips and acquired fewer travel-related diseases than travelers from the United States. We cannot, however, postulate a reason why the quality of preparation would have varied in a way that would have led to differentially less travel-related disease among Canadians post-earthquake. Other potential explanations for the observation are that there may have been proportionately fewer travelers from Canada post-earthquake or that a greater proportion of ill Canadian travelers presented to non-GeoSentinel clinics for evaluation during the post-earthquake period.

There are at least three possible explanations for the increase in the proportion of patients who received pre-travel medical advice after the earthquake. First, a greater proportion of NGOs working in Haiti post-earthquake might have required their workers and volunteers to be medically prepared. Second, in the weeks and months after the earthquake, Haiti received a great amount of media attention, attention that was later fueled by a cholera outbreak first reported in October of 2010²² and flooding caused by Tropical Storm Tomas in early November of 2010.²³ This attention could have inspired caution among travelers to Haiti and prompted them to seek medical advice in preparation for their trip. Third, a heightened awareness on the part of GeoSentinel physicians of the events that occurred in Haiti could have led them to more carefully identify and document an ill patient's pre-travel medical preparation after January 12, 2010. Nevertheless, it is concerning that greater than one-quarter of ill post-earthquake travelers in our study went to Haiti without the benefit of having received pre-travel medical advice. Although at least a portion of these

persons were among those people who deployed rapidly, with little or no time for medical preparation, these data serve as a reminder of the importance of efforts to increase the number of persons receiving a pre-travel medical evaluation, an effort that could help reduce travel-related morbidity among future travelers to Haiti and other disaster locations.

Dengue and *P. falciparum* malaria were important contributors of morbidity and severe disease both before and after the earthquake. Together, patients with these two conditions accounted for 15% of the total diagnoses and 61% of the severe disease requiring hospitalization. Most patients with *P. falciparum* malaria had no documented pre-travel counseling and were, therefore, unlikely to be taking malaria prophylaxis. Because malaria in Haiti is chloroquine-sensitive, any of the currently recommended malaria chemoprophylactic agents would have been appropriate, if taken correctly.²⁴ These data correspond with a recent report of malaria in Haiti in which all cases of malaria among aid workers occurred in persons who had not taken malaria prophylaxis, and no cases were identified among 52 aid workers who took 346 person-weeks of chloroquine prophylaxis.¹⁶ The importance of providing all travelers to Haiti with accurate information on methods for mosquito bite avoidance and *P. falciparum* malaria prophylaxis cannot be overemphasized. Mosquito bite avoidance counseling should be provided and is particularly relevant to the prevention of dengue virus infection, because there is no vaccine or chemoprophylaxis regimen. However, preventing dengue might not always be given the focus needed during pre-travel counseling. In a recent investigation of an outbreak of dengue among a group of missionaries returned from Haiti, 88% indicated that they had received pre-travel medical advice

during a healthcare appointment; however, fewer than one-third knew about potential dengue virus exposure in Haiti, and only one-quarter used mosquito bite avoidance measures.¹⁷

Acute diarrhea, as expected, was common.¹⁸ We identified no change in the proportion of these diagnoses after the earthquake, despite the massive destruction of Haiti's basic infrastructure. Travelers or their host agencies and organizations may have taken extra measures to avoid the transmission of diarrheal diseases or had widely available self-treatment medications because of their knowledge of the post-earthquake physical environment in Haiti, and these measures may have been effective. Despite the cholera outbreak that began in Haiti during the fall of 2010,²² no cases were reported by GeoSentinel network providers, although foreign national travelers to Haiti are known to have been infected.¹⁵

For victims of a natural disaster, an increased risk of psychopathology may persist for decades.^{25,26} Concomitantly, psychological issues among disaster first responders and aid workers are not uncommon and can include post-traumatic stress disorder, major depression, substance abuse, anxiety, sleep disturbances, and others.²⁷⁻³¹ We identified an increase in the proportion of post-earthquake travelers who were diagnosed with psychological disorders and a significant increase in work-related stress. Nevertheless, we believe the magnitude of psychological disorders among our study population is likely an underestimate. Recognizing that most current GeoSentinel Global Surveillance Network sites do not formally screen returned travelers for psychopathology and that, if such conditions are suspected, these patients would likely be referred elsewhere for definitive diagnosis and treatment, at least some GeoSentinel patients with travel-related psychopathology may go undiagnosed or uncounted in the database. Greater awareness among health professionals of the potential for psychological issues among travelers to disaster areas could lead to better identification of those people who might benefit from specialized psychological health services and support. Finally, we recommend that persons heading to disaster areas be provided with information about the psychological challenges that they may face and effective strategies to reduce stress and build resilience. These travelers should be made aware of normal and abnormal responses to stress and know when and how to seek additional help.

Natural disasters, such as earthquakes, have been linked to increases in respiratory complaints and disease.^{32,33} Such observed increases can be caused by the direct effects on the lung from exposure to amplified levels of airway contaminants from fires and building collapse or indirectly because of exposure to pathogens in situations of overcrowding and a disrupted basic infrastructure and healthcare delivery system. We identified an increase in respiratory illnesses specifically attributable to an increase in URI diagnoses among a group of early earthquake responders that traveled and/or worked together in Haiti. However, we found no increase in other respiratory conditions that might have been expected had there been widespread exposure to airborne contaminants and no evidence of a broader outbreak of communicable respiratory disease, but the numbers were small. Clinicians should emphasize good hand and general hygiene practices among travelers to Haiti, especially those people likely to be in an environment where clean free-flowing water might be limited, to try to lessen the risk of transmitting and acquiring communicable diseases. In the acute disaster setting or

situations where dust and other airway contaminants might be present, disaster responders should have access to and training in the use of proper fitting National Institute of Occupational Safety and Health-certified respirators (e.g., N-95).^{34,35}

These data have several limitations. First, GeoSentinel data are not population-based and therefore, cannot be used to calculate disease rates or estimate risks among ill returned travelers from Haiti. Second, most GeoSentinel sites collect data on persons seeking specialty care for suspected travel-related conditions, and therefore, the data are not representative of all ill returned travelers from Haiti. Many returned travelers seek care in primary care settings and are not captured by the GeoSentinel network. Additionally, some very ill patients who seek treatment at emergency departments and some patients receiving inpatient care might also not be captured. Third, diseases with short incubations, such as dengue and acute infectious diarrheas, may be underrepresented in our study. Such conditions could cause symptoms in a large proportion of travelers while still in Haiti and may not have been captured by GeoSentinel. Fourth, our analysis was limited by the fact that relatively few ill travelers with exposure in Haiti were seen at GeoSentinel sites during the specified study period. With larger numbers of ill travelers, additional differences and patterns between the post- and pre-earthquake periods may have emerged.

The data presented in this report show that the characteristics of travelers to a nation afflicted by a natural disaster and the health risks that they may face can differ greatly from travelers to non-disaster zones. These results highlight the importance of travelers receiving destination- and disaster-specific pre-travel counseling; correspondingly, clinicians should provide destination- and disaster-specific post-travel evaluations and medical management of ill persons returning from such locations.

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