



# HHS Public Access

Author manuscript

*Travel Med Infect Dis.* Author manuscript; available in PMC 2016 October 25.

Published in final edited form as:

*Travel Med Infect Dis.* 2016 ; 14(5): 475–480. doi:10.1016/j.tmaid.2016.08.011.

## Knowledge and use of prevention measures for chikungunya virus among visitors — Virgin Islands National Park, 2015

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### Summary

**Background**—In June 2014, the mosquito-borne chikungunya virus (CHIKV) emerged in the U.S. Virgin Islands (USVI), a location where tourists comprise the majority of the population during peak season (January–April). Limited information is available concerning visitors' CHIKV awareness and prevention measures.

**Methods**—We surveyed a convenience sample of Virgin Islands National Park visitors aged 18 years. Respondents completed a questionnaire assessing CHIKV knowledge, attitudes, and practices; health information-seeking practices; and demographics.

**Results**—Of 783 persons contacted, 443 (57%) completed the survey. Fewer than half (208/441 [47%]) were aware of CHIKV. During trip preparation, 28% of respondents (126/443) investigated USVI-specific health concerns. Compared with persons unaware of CHIKV, CHIKV-aware persons were more likely to apply insect repellent (134/207 [65%] versus 111/231 [48%];  $p <$

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the National Park Service.

### Conflict of interest

None.

0.001), wear long-sleeves and long pants (84/203 [41%] versus 57/227 [25%];  $p < 0.001$ ), and wear insect repellent-treated clothing (36/204 [18%] versus 22/227 [10%];  $p = 0.02$ ).

**Conclusions**—The majority of visitors surveyed did not research destination-related health concerns and were unaware of CHIKV. However, CHIKV awareness was associated with using multiple prevention measures to reduce disease risk. These findings underscore the importance of providing tourists with disease education upon destination arrival.

### Keywords

Chikungunya virus; Health knowledge; attitudes; practice; Travel; Preventive measures; United States Virgin Islands

## 1. Introduction

Chikungunya virus (CHIKV<sup>1</sup>) is a mosquito-borne alphavirus primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes. Common clinical symptoms of CHIKV infection include sudden onset of high fever and polyarthralgia. Additional symptoms can include headache, conjunctivitis, nausea, vomiting, or maculopapular rash [1]. Before 2013, CHIKV had been limited to areas in Africa, Southeast Asia, India, and islands in the Indian and Pacific oceans [2,3].

In December 2013, the first known locally transmitted CHIKV case in the Western Hemisphere was reported on the Caribbean island of Saint Martin [2,4–7]. By the end of December 2014, approximately 1 million suspected and confirmed cases of CHIKV disease in 43 countries were reported in the Americas [8].

The spread of CHIKV in the Americas affects the tourism industry, which is an important source of income and employment for the region [9]. In the U.S. Virgin Islands (USVI), tourism industry income accounts for approximately 60% of gross domestic production [10]. Approximately 2.8 million visitors came to USVI during 2014 [11]. Certain areas, such as the island of St. John, have more visitors than full-time residents year round. Virgin Islands National Park (VINP) covers approximately 60% of St. John and is a top-rated tourist attraction in USVI [12,13]. The resort that operates inside of VINP is the fifth largest private employer in USVI [14]. During peak tourist season (January–April) VINP averages 40,000–50,000 visitors per month, which is  $>10\times$  the resident population of St. John (2014 census: 3,989 residents) [15,16].

The first reported case of CHIKV in USVI occurred in June 2014. During the remaining six months of 2014, a total of 468 locally transmitted, laboratory-confirmed cases were reported; 19 of these occurred among visitors to USVI [17]. Although substantial effort has focused on educating and detecting illnesses among residents, limited information is available about visitors' awareness of local disease risks. Previous research has reported that a limited number of visitors research health-related concerns before departure [18]. Recent disease emergence and high volumes of transient tourists might result in limited CHIKV awareness and substantial at-risk populations. We surveyed VINP visitors to assess CHIKV knowledge and mosquito prevention practices.

## 2. Methods

On the basis of visitor statistics and employee input, we identified 10 survey locations in VINP. These locations included three popular visitor destinations and seven less trafficked destinations located parkwide. Popular destinations were surveyed multiple times during the week, although other locations were surveyed only once or twice. In these locations, we surveyed park visitors aged 18 years, who visited VINP during February 2–8, 2015. Local residents, park and concessions employees, and persons who could not read or comprehend the English language were excluded.

We used a nonprobability sample design, asking the majority of persons or groups who encountered a study investigator during the data collection period to complete a survey. For groups of visitors traveling together, only one representative (nonrandomly selected by self-volunteering) from each participating group completed the survey unless other group members also requested to participate. After verbal consent was obtained, respondents completed a 17-question paper questionnaire addressing knowledge, attitudes, and practices related to CHIKV, practices and resources for seeking health information, travel details, and demographics. Surveys were self-administered unless assistance was requested from a participant. After survey completion, each participant received a CHIKV informational flyer.

### 2.1. Statistical analysis

Survey data were entered into a standardized database and analyzed by using Epi Info™ 7.1.4.0 (Centers for Disease Control and Prevention, Atlanta, Georgia). Category variables were described as counts and proportions; continuous variables were described by using median and range. Tests of comparison were conducted by using chi-square. Missing data or questions that were completed incorrectly (e.g., multiple answers provided for a question with directions to select only one answer) were excluded from analysis.

## 3. Results

Overall, 446 of 783 persons contacted completed the survey (response rate 57%). Three surveys were completed by USVI year-round residents and were excluded; 443 surveys were used in final analyses. Among the 443 respondents, 229 (52%) were women and the median age was 60 years (range, 23–92 years; Table 1). The majority of respondents (421/440 [96%]) were U.S. residents. A substantial number of respondents had completed advanced education degrees with 44% (194/439) reported having a master's or doctorate degree and 43% (190/439) identifying as a college or trade school graduate. Forty-three percent (189/443) of respondents were first-time VINP visitors. The majority of participants (373/441 [85%]) arrived to the Caribbean by commercial airline; only 13% (57/441) reported arriving by cruise ship.

Fewer than half (208/441 [47%]) of respondents were aware of CHIKV. Among CHIKV-aware respondents, 88% (182/208) correctly identified that the virus is spread to humans through mosquitoes. The media (e.g., Internet, television, or newspaper) was the most common source of knowledge (106/208 [51%]) for CHIKV-aware respondents (Table 2). Other sources of CHIKV knowledge included friends (25/208 [12%]), NPS VINP website

(20/208 [10%]), and USVI tourism bureau (7/208 [3%]). First time visitors to VINP were less likely to be aware of CHIKV (73/189 [39%]) than persons who had visited VINP previously (135/252 [54%]) ( $\chi^2 = 9.68$ ,  $p = 0.002$ ).

During trip preparation, 28% of all respondents (126/443) investigated health concerns specific to USVI. Those who investigated health concerns were significantly more likely to be aware of CHIKV (102/126; 81%), compared with visitors who had not investigated health concerns (106/315 [34%]) ( $\chi^2 = 80.81$ ;  $p < 0.001$ ). The top reported primary sources for health-related information among all respondents were Internet search engine (144/443 [33%]) and healthcare provider (94/443 [21%]; Table 3).

A total of 201 of 442 (45%) respondents reported being bitten by mosquitoes while in USVI. Forty-nine percent (219/443) of visitors were mildly concerned about getting a mosquito-borne illness during their trip, 7% (33/443) were very concerned, and 43% (191/443) were not concerned. Visitors who knew about CHIKV before taking the survey were significantly more concerned about mosquito-borne illness (148/208 [71%]), compared with those who did not know about CHIKV before taking the survey (103/233 [44%]) ( $\chi^2 = 32.54$ ;  $p < 0.001$ ).

Adherence to mosquito avoidance measures was varied. The majority of respondents reported that during the past three days they had not worn long-sleeve shirts or long pants (290/432 [67%]); had not worn clothing treated with insect repellent (375/433 [87%]); and had not used a bed net (398/433 [92%]). The top two mosquito avoidance measures (always or sometimes practiced) were staying in screened or air-conditioned rooms (75%) and using insect repellent on skin (56%; Table 4). Persons who were aware of CHIKV were more likely to apply insect repellent (134/207 [65%] versus 111/231 [48%]) ( $\chi^2 = 12.33$ ;  $p < 0.001$ ), wear long-sleeved shirts and long pants (84/203 [41%] versus 57/227 [25%]) ( $\chi^2 = 12.87$ ;  $p < 0.001$ ), and wear clothing treated with an insect repellent (36/204 [18%] versus 22/227 [10%]) ( $\chi^2 = 5.84$ ;  $p = 0.02$ ), compared with those who had not heard of CHIKV (Table 5).

#### 4. Discussion

The majority of visitors surveyed did not conduct pretravel health research and were unaware of CHIKV. This is similar to other studies that reported a limited percentages of travelers accessing pretrip health resources (36%–54%) [18–20]. Although limited pretravel research among participants was noted, the majority of park visitors who investigated USVI-specific health concerns before travel were aware of CHIKV. Visitors who were aware of CHIKV were substantially more likely to be concerned about mosquito-borne illnesses and adhere to mosquito prevention practices (e.g., using insect repellent, wearing long-sleeve shirts and long pants, and wearing clothing treated with insect repellent). In this study, pretrip research and knowledge of CHIKV were associated with the use of mosquito preventive measures.

Past surveys have reported common reasons for not seeking pretravel health advice include lack of concern about health problems, belief the traveler knew what to do, and being

unaware of the need [18,20,21]. This survey did not ask participants to identify the reason they did not investigate health concerns before travel. However, 57% of respondents had been to VINP before and 96% lived in the continental United States. The possibility exists that U.S. citizens traveling to a U.S. Caribbean territory do not perceive different health risks than in the continental United States. Additionally, repeat visitors to VINP might believe they possess a current understanding of health-related concerns on the island.

Pretrip health research or counseling improves compliance with disease prevention measures and can modify high-risk behaviors [22]. Internet searches have become a popular tool for health information. According to a 2013 Pew Report, 59% of all U.S. adults looked online for health information during the past year and 8 of 10 online health inquiries started at a search engine [23]. An Internet search engine was the primary source of health-related information for the majority of our respondents who conducted research before their trip. Additionally, Internet searches continue to be the primary source of information during trip planning. Traditional travel products such as airline tickets, lodging, and rental cars are primarily purchased online [24]. Creative partnerships with online travel agencies, airlines, hotels, and other popular travel websites might be developed to provide destination health information, and links that direct travelers to government health websites, such as CDC Travelers' Health website. These partnerships might have the potential to reach a larger audience, compared with traditional public health messaging efforts.

Because a limited number of travelers research destination-specific health topics before travel, educating visitors during transit or at the destination is important. Local health and tourism departments might partner with the management of popular tourist locations to develop and display visually appealing educational signs in areas with substantial visitor traffic, including airports, docks, and popular attractions. Educational materials might also be shared with vacation rental homes and other hotels or resorts. Visitor public education campaigns regarding chikungunya and other mosquito-borne diseases should be tailored to reflect prevention strategies appropriate to common visitor activities. Popular visitor activities at VINP include swimming, snorkeling, sunbathing, and sailing; these vacation activities are often regarded as not conducive to mosquito avoidance measures. The majority of survey participants reported not having worn long-sleeve shirts or long pants, or insect repellent-treated clothing during the past three days. Because the majority of beachgoers are not going to wear long sleeves or pants, educational materials for beachgoers should emphasize using insect repellents. Ideally, messaging should be coupled with convenient access to EPA-approved insect repellents that can be sold at the beach, visitor centers, convenience stores, and other locations.

Multiple limitations to this study are noted, including that we used a convenience sampling method to survey visitors of one U.S. national park during one week in February and our results are likely not representative of all visitors to VINP and might not be generalizable. Because we did not collect basic demographic data from persons who declined survey participation, we are unable to determine representativeness of our sample. We hypothesize that a greater proportion of survey rejections were from cruise ship passengers who have a limited time to visit the park, compared with those who completed surveys. In 2014,

approximately 75% of visitors arrived to USVI by cruise ships, compared with 13% in our survey [11].

International tourism continues to increase with approximately 1.2 billion tourists traveling in 2015, a 4.4% increase from 2014. In 2014, the Caribbean reported a 7% growth in tourist arrivals to the region [25]. The last few years have also reported the geographic expansion of certain diseases, such as CHIKV and Zika virus, into new regions of the world [6,26]. The need to protect traveler health is growing as more persons travel and as disease range expands. Educating visitors at their travel destination is important and might require novel and creative approaches to capture a transient audience.

## Acknowledgments

### Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Brion FitzGerald, Jayne Schaeffer, Dave Worthington, Elba Richardson, Kelly Hoeksema, Virgin Islands National Park; Jessica Sharpe, NPS Office of Public Health; Duane Howell, Marc Jerome, Kibwe Tom, Astia LeBron, USVI Department of Health; Beverly Nicholson-Doty, USVI Department of Tourism; Jennifer Wright, Danice Eaton, Morgan Hennessey, CDC.

## Abbreviations

<b>CHIKV</b>	Chikungunya virus
<b>VINP</b>	Virgin Islands National Park

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**Table 1**

Characteristics of survey respondents — Virgin Islands National Park, February 2–8, 2015 (N = 443).

	<u>Total</u>	
	No.	%
Sex		
Female	229	52
Male	214	48
Age (yrs.)		
18–39	61	14
40–59	146	33
60–79	224	51
80	8	2
Unknown	4	1
Highest level of education		
Some grade school or high school	3	1
High school graduate	24	5
Some college	38	9
College graduate	180	41
Masters or doctoral degree	194	44
Unknown	4	1
Place of residence		
United States	421	95
Other country	19	4
Unknown	3	1
Mode of arrival to the Caribbean		
Commercial airline	373	84
Cruise ship	57	13
Private boat or airplane	11	3
Unknown	2	1
First visit to Virgin Islands National Park		
Yes	189	43
No	254	57



**Table 2**

Information sources for chikungunya virus (CHIKV) awareness — Virgin Islands National Park survey, February 2–8, 2015 (N = 208).<sup>a</sup>

	No.	%
Media	106	51
Other <sup>b</sup>	96	46
National Park Service website	20	10
USVI tourism bureau	7	3
Tour guide	5	2
Travel agency	4	2
Airport	2	1
Cruise ship	1	1
Transit ferry	1	1

<sup>a</sup>Multiple selections were allowed, categories might total greater than 100%.

<sup>b</sup>Examples of other include friends, local persons and medical journals.

**Table 3**

Primary source for health-related information — Virgin Islands National Park survey, February 2–8, 2015 (N = 443).

	No.	%
Search engine	144	33
Health care provider	94	21
Multiple selections <sup>a</sup>	57	13
Governmental health website	44	10
Health-specific website	44	10
Other	31	7
Family or friend	21	5
Unknown	5	1

<sup>a</sup> Respondents were asked to select only one primary source. Multiple selections represents those who selected more than one source despite directions.

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**Table 4** Self-reported mosquito prevention measures among survey respondents — Virgin Islands National Park, February 2–8, 2015.<sup>a</sup>

	<u>Always</u>		<u>Sometimes</u>		<u>Never</u>		<u>Total</u>	
	No.	%	No.	%	No.	%	No. <sup>b</sup>	%
Applied insect repellent to skin	97	22	150	34	193	44	440	
Wore long-sleeves and long pants	14	3	128	30	290	67	432	
Wore clothing treated with insect repellent	8	2	50	12	375	87	433	
Stayed in screened or air conditioned rooms	177	41	147	34	109	25	433	
Used mosquito bed net	18	4	17	4	398	92	433	

<sup>a</sup>Responses were not provided for all fields and missing data are not reported.

<sup>b</sup>Total number of respondents.

Mosquito prevention measures among survey respondents, by prior knowledge of chikungunya virus (CHIKV) — Virgin Islands National Park, February 2–8, 2015.<sup>a</sup>

**Table 5**

	<u>Aware of CHIKV</u>		<u>Not aware of CHIKV</u>		Chi-square	p value
	No.	%	No.	%		
Applied insect repellent to skin	134	65	111	48	12.3	<0.001
Wore long-sleeves and long pants	84	42	57	25	12.9	<0.001
Wore clothing treated with insect repellent	36	18	22	10	5.8	0.016
Stayed in screened or air conditioned rooms	151	74	172	75	0.06	0.801
Used mosquito bed net	16	8	18	8	0.0005	0.981

<sup>a</sup>Reflects respondents who always or sometimes practiced the following preventions during the previous 3 days.