Malaria Prevention Strategies: Adherence among Boston Area Travelers Visiting Malaria-Endemic Countries

Rhett J. Stoney,* Lin H. Chen, Emily S. Jentes, Mary E. Wilson, Pauline V. Han, Christine M. Benoit, William B. MacLeod, Davidson H. Hamer, and Elizabeth D. Barnett, for the Boston Area Travel Medicine Network

Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, Atlanta, Georgia; Division of Infectious Diseases, Travel Medicine Center, Mount Auburn Hospital, Cambridge, Massachusetts; Department of Medicine, Harvard Medical School, Boston, Massachusetts; Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, Massachusetts; Maxwell Finland Laboratory for Infectious Diseases, Boston Medical Center, Boston, Massachusetts; Center for Global Health and Development, Boston University School of Public Health, Boston, Massachusetts; Department of Global Health, Boston University School of Public Health, Boston, Massachusetts; Section of Infectious Diseases, Boston University School of Medicine, Boston, Massachusetts

Abstract. We conducted a prospective cohort study to assess adherence to malaria chemoprophylaxis, reasons for nonadherence, and use of other personal protective measures against malaria. We included adults traveling to malaria-endemic countries who were prescribed malaria chemoprophylaxis during a pre-travel consultation at three travel clinics in the Boston area and who completed three or more surveys: pre-travel, at least one weekly during travel, and post-travel (2–4 weeks after return). Of 370 participants, 335 (91%) took malaria chemoprophylaxis at least once and reported any missed doses; 265 (79%) reported completing all doses during travel. Adherence was not affected by weekly versus daily chemoprophylaxis, travel purpose, or duration of travel. Reasons for nonadherence included forgetfulness, side effects, and not seeing mosquitoes. Main reasons for declining to take prescribed chemoprophylaxis were peer advice, low perceived risk, and not seeing mosquitoes. Of 368 travelers, 79% used insect repellent, 46% used a bed net, and 61% slept in air conditioning at least once. Because travelers may be persuaded to stop taking medication by peer pressure, not seeing mosquitoes, and adverse reactions to medications, clinicians should be prepared to address these barriers and to empower travelers with strategies to manage common side effects of antimalarial medications.

INTRODUCTION

Every year, millions of U.S. residents travel to countries where malaria is endemic.¹ In 2011, 1,920 cases of malaria were diagnosed in U.S. travelers returning from trips abroad, the highest number in 40 years.² Increased travel to malaria-endemic countries may be contributing to an increase in cases.³ Further, travelers visiting friends and relatives (VFRs) in malaria-endemic countries account for most imported malaria in the United States. Of 871 U.S. civilians with malaria in 2011, who reported purpose of travel, 607 (70%) were VFRs, 96 (11%) were missionaries, and 78 (9%) traveled for business.²

Malaria prevention consists of a combination of personal protective measures and adherence to malaria chemoprophylaxis.⁴ Protective measures include use of insect repellent, insecticide-treated bed nets, and sleeping in air-conditioned rooms. Several different medications are available for malaria chemoprophylaxis, depending on the traveler's destination and medical history. These include atovaquone/proguanil, chloroquine, doxycycline, mefloquine, and primaquine. Despite the availability of these medicines, in 2011, 94% of patients with malaria in the United States did not take malaria chemoprophylaxis at all, or as prescribed.² Few studies have assessed traveler adherence to these five recommended malaria medicines in the same cohort.

We sought to understand traveler adherence to malaria prevention strategies by surveying travelers before, during, and after international travel regarding use of personal protective measures, adherence to malaria chemoprophylaxis, and reasons for nonadherence and declination.

METHODS

Study sites. We recruited participants aged ≥ 18 years attending a pre-travel health consultation at three clinics, two in urban, academic hospitals and one in a suburban hospital, in the Boston Area Travel Medicine Network (BATMN) from 2009 through 2011. Written consent was obtained from all participants, and institutional review board (IRB) approvals were obtained at all clinic sites. The U.S. Centers for Disease Control and Prevention's Human Research Protection Office reviewed and approved reliance on Boston University Medical Center's IRB.

Survey procedures and definitions. Travelers were recruited to participate in a longitudinal cohort study involving the completion of pre-, during-, and post-travel surveys spanning several topics including malaria prevention strategies, gastrointestinal illness, and knowledge, attitudes, and practices of other travel-related illnesses (i.e., dengue and influenza). This investigation focused specifically on malaria adherence and malaria prevention strategies. At the initial pre-travel consultation, travelers were asked to complete a survey that included questions on demographics, trip characteristics, and medical history. Multiple responses were allowed for destination countries, purpose of travel, medical conditions, and accommodation types. Destination countries were defined as malaria-endemic according to *CDC Health Information for International Travel* if any malaria transmission was present in country at the time of the consultation.^{5,6} Specifically, countries were classified as entirely endemic (transmission present everywhere in country), partially endemic (transmission present in some areas in country), or non-endemic.^{5,6} The type and number of doses of chemoprophylaxis prescribed and pre-travel advice given were collected from data entered by clinicians into patients' medical records. We were unable to confirm sub-national destination data; therefore, we relied on the clinicians'

*Address correspondence to Rhett J. Stoney, Division of Global Migration and Quarantine, Centers for Disease Control and Prevention, 1600 Clifton Road NE, MS E-03, Atlanta, GA 30329. E-mail: uyn2@cdc.gov

individual malaria risk assessment of the traveler that use of malaria chemoprophylaxis was appropriate for their trip. Participants were asked to complete a survey each week during travel and a post-travel survey within 2–4 weeks after return. To complete the study in a reasonable amount of time, only participants with shorter durations of travel (approximately 2 months) were included. During-travel surveys included questions regarding how often travelers used personal protective measures. Both during- and post-travel surveys included questions regarding how often chemoprophylaxis was taken. To obtain number of doses taken during travel, the number of doses that the participant reported as having missed during travel was subtracted from the number of pills prescribed to be taken during travel. Those who completed all doses were categorized as adherent; those who completed doses but missed at least one were nonadherent, and those who did not take any of their prescribed malaria chemoprophylaxis were categorized as declined. Participants were asked to report reasons for not taking chemoprophylaxis on the during- and post-travel surveys. Participants could indicate multiple reasons for not taking chemoprophylaxis. When a reason was reported on the during-travel survey for multiple weeks, it was counted only once.

Inclusion criteria. Travelers were included from among all those enrolled if they received a prescription for chemoprophylaxis, traveled to at least one malaria-endemic area, and completed pre- and post-travel surveys and at least one during-travel survey.

Data analysis. We performed a bivariate analysis comparing participants who completed all doses of their chemoprophylaxis regimen to those who did not. Using a method similar to a previous study,⁷ we also compared participants who took at least 75% of their prescribed pills during their stay to those who took less than 75%. Because most participants were prescribed atovaquone/proguanil, we performed a sub-analysis assessing participant adherence to atovaquone/proguanil. Pearson's χ^2 and Fisher's exact tests were used to compare categorical variables. A Wilcoxon rank-sum test was used to calculate differences in travel duration. Determinants of at least 75% adherence to chemoprophylaxis were expressed as prevalence rate ratios (PRRs) with 95% confidence intervals (CIs). Statistical significance was determined at the two-sided 0.05 level. SAS Enterprise Guide v5.1 (SAS Institute, Cary, NC) was used for all analyses.

RESULTS

Demographic and trip characteristics. Among 628 participants who completed all three surveys, 370 (59%) were prescribed chemoprophylaxis and traveled to an endemic area (Figure 1). Of the 370 participants, 61% were female; median age was 47 years (Table 1). Of the participants, 67 (18%) were born outside the United States and 35 (9%) were born in a malaria-endemic country. The most common purpose of travel was tourism/vacation (66%), followed by volunteer/missionary/aid work (21%), business (16%), and VFR (14%).

FIGURE 1. Malaria prevention strategies study inclusion and exclusion criteria, Boston Area Travel Medicine Network (BATMN), 2009–2011.

TABLE 1

Characteristics of international travelers who were prescribed malaria chemoprophylaxis and traveled to malaria-endemic countries, BATMN, 2009–2011

Traveler characteristics (N = 370)	n (%)
Female	266 (61)
Median age, years (range)	47 (20–82)
Born outside United States	67 (18)
Born in a country endemic for malaria	35 (9)
Top reported chronic medical conditions*	
Asthma	30 (8)
Cancer	15 (4)
Diabetes	10 (3)
Heart disease	9 (2)
Trip characteristics	
Travel to entirely endemic country	104 (28)
Duration of travel, days (range) (N = 366)	13 (4–65)
Purpose of travel*	
Tourism/vacation	243 (66)
Volunteer/missionary/aid work	76 (21)
Business	61 (16)
VFR	53 (14)
Education/research	16 (4)
Seeking medical care outside the United States	1 (< 1)
Type of accommodation during trip* (N = 364)	
Hotel	117 (32)
Home/local residence	29 (8)
Tent	22 (6)
Dormitory	18 (5)
Hostel	16 (4)
Ship	4 (1)
Other	22 (6)
Multiple types of accommodations	135 (37)
Top travel destinations (N = 552 trips)†‡	
India	69 (13)
Tanzania	44 (8)
Kenya	39 (7)
South Africa	38 (7)
Haiti	36 (7)

BATMN = Boston Area Travel Medicine Network; VFR = visiting friends and relatives.

*Travelers could choose ≥ 1 response.

†The denominator reflects the total number of times a particular response was chosen.

‡Includes those traveling to more than one country.

There were 552 country visits by 370 participants. Countries visited most frequently were India (13%), Tanzania (8%), Kenya (7%), South Africa (7%), and Haiti (7%). The median travel duration was 13 days. Of 370 participants, 104 (28%) went to a country entirely endemic; the remaining 266 participants went to partially-endemic countries. More than 98% of the 370 participants who were prescribed chemoprophylaxis received pre-travel advice on how to take their prescription and avoid mosquito bites. Atovaquone/proguanil

TABLE 2

Malaria chemoprophylaxis prescribed and pre-travel advice received in travelers to malaria-endemic countries, BATMN, 2009–2011*

Antimalarial prescribed (N = 364)	n (%)
Atovaquone/proguanil	297 (82)
Chloroquine	35 (10)
Doxycycline	18 (5)
Mefloquine	11 (3)
Primaquine	3 (1)
Pre-travel advice received† (N = 368)	n (%)
Avoidance of insect bites	364 (99)
Malaria chemoprophylaxis	360 (98)
Travel medical/evacuation insurance	260 (71)

BATMN = Boston Area Travel Medicine Network.

*Malaria endemicity of countries determined by CDC Health Information for International Travel.^{5,6}

†Advice given not mutually exclusive.

was prescribed most frequently (82%) followed by chloroquine (10%), doxycycline (5%), mefloquine (3%), and primaquine (1%) (Table 2). No cases of malaria were reported in this cohort.

Malaria chemoprophylaxis adherence. Of the 370 travelers prescribed chemoprophylaxis, 335 (91%) took at least one dose and reported the number of doses missed, if any, during travel. Of these 335, 265 (79%) were adherent, in that they reported taking all prescribed doses during travel. The exact number of pills prescribed was available for 300 (90%) of the 335 participants; 267 (89%) participants took at least 75% of the doses prescribed for during travel. There were no significant differences in how often participants took chemoprophylaxis for each of the following characteristics: sex, U.S. versus foreign birth, malaria endemicity of birth country, travel destination, travel duration, daily versus weekly chemoprophylaxis, and purpose of travel (Table 3). Seventy participants were nonadherent in that they missed doses during travel. Of these, 36 provided a reason; the most common reasons included forgetting to take chemoprophylaxis (50%), experiencing a side effect (31%), and observing no mosquitoes (11%) (Table 4). Eleven participants reported a side effect during travel; all had been prescribed atovaquone/proguanil. Of these, eight (73%) reported gastrointestinal symptoms, two (18%) reported headaches, and one (9%) reported intense nightmares; 10 (91%) discontinued the medication after experiencing side effects.

Of the 370 participants, 25 (7%) declined to take any of their prescribed chemoprophylaxis, with 24 indicating reasons: 12 (50%) were told by someone other than their prescribing clinician that chemoprophylaxis was unnecessary, seven (29%) reported that they self-determined malaria risk to be low, four (17%) reported they observed no mosquitoes, and four (17%) cited cost (Table 5). Of the 25 travelers who declined prophylaxis, 24 traveled to a partially-endemic country. Of the 12 participants who were told by others not to take their prescribed chemoprophylaxis, four went to India, three to Namibia, two to Tanzania, and 1 participant each visited Ecuador, Costa Rica, or Honduras. Eight of the 12 participants specified who told them not to take chemoprophylaxis: six were told by friends and two by local guides. Of the seven participants who decided their risk for malaria was low, three went to India and two went to Belize. One participant each visited Ecuador or Costa Rica.

Of 364 participants for whom information on type of chemoprophylaxis prescribed was available, 318 (87%) were prescribed a daily chemoprophylaxis (atovaquone/proguanil, doxycycline, or primaquine) and 46 (13%) were prescribed a weekly chemoprophylaxis (chloroquine or mefloquine). Of the 282 participants who took daily chemoprophylaxis and recorded the number of missed doses, 65 (23%) missed ≥ 1 dose compared with 5 (11%) of 46 weekly takers who recorded missing ≥ 1 dose ($P = 0.06$). Participants who missed at least one dose traveled for a median 14 days compared with 11 days for participants who completed all doses ($P = 0.08$).

Overall, 253 (80%) of 318 participants reported how often they took their daily chemoprophylaxis after leaving an endemic area, and rates of chemoprophylaxis completion were lower post-travel than during travel. Those taking atovaquone/proguanil continued for a mean 5.7 days after leaving endemic areas; 64% completed all seven of the recommended doses. Doxycycline users took the medication for a mean of

TABLE 3

Proportion of malaria chemoprophylaxis regimen taken during trip among those prescribed chemoprophylaxis and who visited at least one malaria-endemic country, BATMN, 2009–2011*

	Proportion of antimalarial doses taken during trip, <i>n</i> (row %)		PRR	95% CI	<i>P</i> value
	≥ 75%	< 75%			
Sex					
Female (<i>N</i> = 183)	162 (89)	21 (11)	0.99	(0.91, 1.07)	0.74
Male (<i>N</i> = 117)	105 (90)	12 (10)			
Location of birth					
U.S. born (<i>N</i> = 249)	223 (90)	26 (10)	1.04	(0.92, 1.17)	0.49
Foreign born (<i>N</i> = 51)	44 (86)	7 (14)			
Endemicity of country of birth					
Endemic (<i>N</i> = 27)	24 (89)	3 (11)	1.0	(0.87, 1.15)	1.0
Not endemic (<i>N</i> = 273)	243 (89)	30 (11)			
Type of chemoprophylaxis					
Daily (<i>N</i> = 254)	223 (88)	31 (12)	0.92	(0.85, 1.00)	0.19
Weekly (<i>N</i> = 42)	40 (95)	2 (5)			
VFR					
Yes (<i>N</i> = 45)	42 (93)	3 (7)	1.06	(0.97, 1.16)	0.44
No (<i>N</i> = 255)	225 (88)	30 (12)			
Destination					
Entirely endemic‡ (<i>N</i> = 94)	84 (89)	10 (11)	1.01	(0.92, 1.10)	0.89
Partially endemic§ (<i>N</i> = 206)	183 (89)	23 (11)			
Duration of travel†					
< 14 days (<i>N</i> = 133)	124 (93)	9 (7)	1.06	(0.96, 1.17)	0.19
≥ 14 days (<i>N</i> = 74)	65 (88)	9 (12)			

BATMN = Boston Area Travel Medicine Network; CI = confidence interval; PRR = prevalence rate ratio; VFR = visiting friends and relatives.

*Malaria endemicity of countries determined by *CDC Health Information for International Travel*.^{5,6}

†Adherence was calculated among those traveling to one country only.

‡The 94 travelers went to 18 different entirely endemic countries. Of these countries, the most visited were Haiti (33), Ghana (13), and Zambia (13).

§The 206 travelers went to 28 different partially endemic countries. Of these countries, the most visited were India (53), Tanzania (36), and Kenya (24).

21.0 days after leaving endemic areas; 42% completed all 4 weeks of the daily recommended doses. Two (66%) of three participants prescribed primaquine reported using the medication for the recommended 7 days after leaving endemic areas. Those prescribed chloroquine took it for a mean of 3.2 weeks after leaving endemic areas; 54% completed the entire recommended 4-week regimen. Mefloquine users took the medication for a mean 3.4 weeks of the recommended 4-week regimen; 56% completed all recommended doses after leaving endemic areas.

Personal protective measures for malaria prevention. Among those who responded, 354 (96%) of 369 participants used at least one type of personal protective measure. Further, 292 (79%) of 368 participants used insect repellent, 167 (46%) of 366 used a bed net, and 225 (61%) of 367 slept in air conditioning at least once.

Atovaquone/proguanil sub-analysis. Of 297 atovaquone/proguanil users, 269 (91%) reported the number of doses

missed during travel. Of these, 207 (77%) reported completion of all doses during travel. The exact number of pills prescribed was available for 245 (91%) of 269 participants; of these, 218 (89%) took the chemoprophylaxis at least 75% of the time. Of the 28 participants who did not report the number of doses they missed, 21 (7%) did not take any doses of the medication; the remaining seven reported that they did not know how many doses they missed. Of the 21 that declined to take malaria chemoprophylaxis, 11 (52%) reported that their peers deemed it unnecessary (four went to India, three to Namibia, two to South Africa, while one participant each

TABLE 5

Reasons for declining malaria chemoprophylaxis reported during and after travel in travelers who did not take any doses of prescribed malaria chemoprophylaxis, BATMN, 2009–2011*†

	Reported during travel‡ (<i>N</i> = 25 travelers), <i>n</i> (%)	Reported after travel (<i>N</i> = 24 travelers), <i>n</i> (%)
Advised by peers not to take malaria chemoprophylaxis	8 (32)	12 (50)
Visited an area of self-perceived low risk	7 (28)	7 (29)
No mosquitoes present during trip	4 (16)	4 (17)
Fear of side effects	4 (16)	2 (8)
Cost§	2 (8)	4 (17)
Other reason	2 (8)	1 (4)
Had a side effect	1 (4)	0 (0)
Unable to fill prescription before trip	1 (4)	3 (13)
Total reasons reported	29	33

BATMN = Boston Area Travel Medicine Network.

*Travelers could report more than one reason.

†Percentages refer to the proportion of travelers that indicated the specific reason.

‡Of these 25 travelers, one went to an entirely endemic country (Ghana). Twenty-four travelers visited 11 different partially-endemic countries: the most visited were India (9), Namibia (3), and Tanzania (2).

§These six responses were made by four travelers. These participants traveled to India (2), Ghana (1), and Ecuador (1).

TABLE 4

Reasons for nonadherence reported during and after travel in travelers who took malaria chemoprophylaxis and missed at least one dose, BATMN, 2009–2011*†

	Reported during travel (<i>N</i> = 36 travelers), <i>n</i> (%)	Reported after travel (<i>N</i> = 13 travelers), <i>n</i> (%)
Forgot to take	18 (50)	1 (8)
Had a side effect	11 (31)	8 (62)
No mosquitoes seen during trip	4 (11)	2 (15)
Visited an area of self-perceived low risk	3 (8)	0 (0)
Lost medication	2 (6)	4 (31)
Other reason	2 (6)	0 (0)
Total reasons reported	40	15

BATMN = Boston Area Travel Medicine Network.

*Travelers could report more than one reason.

†Percentages refer to the proportion of travelers that indicated the specific reason.

went to Ecuador or Honduras). Five (24%) of 21 participants reported believing that their risk was low (three went to India, one to Belize, and one to Ecuador); four did not take any medication because of cost.

DISCUSSION

Assessing adherence to malaria chemoprophylaxis among travelers is challenging, and methods of defining adherence among travelers who missed doses are not universal.² Much of the literature defines malaria chemoprophylaxis adherence in terms of whether all pills were taken as prescribed. When defining adherence in this manner, we found 79% of participants reported adherence during travel, similar to other studies that measured adherence in this way (range = 63–89%).^{3,7–10} In a prospective study of Dutch short-term travelers to malaria-endemic areas, adherence was defined as the proportion of travelers who took at least 75% of their chemoprophylaxis during travel.⁷ We found 89% of travelers took at least 75% of their chemoprophylaxis as prescribed compared with 84% in the Dutch study. Although recommendations for the length of a chemoprophylaxis course have been defined, for some medications there is contention over what proportion of a recommended chemoprophylaxis course is necessary to provide protection.¹¹

We found that the proportion of travelers who took $\geq 75\%$ of their recommended chemoprophylaxis during travel did not vary significantly when stratifying by various traveler and trip characteristics. Although VFR travelers made up the largest group of travelers returning to the United States with malaria in 2011, VFR participants in our investigation were as likely as other participants to adhere to chemoprophylaxis. A larger proportion of travelers taking daily medication missed doses compared with those taking weekly medication, but this comparison was not statistically significant. Missing doses diminishes the protective effect of several types of chemoprophylaxis¹²; however, one study found that a protective effect may not be hindered in users who discontinue atovaquone/proguanil 1 day after leaving a malaria-endemic area.¹¹ Travel duration was not significantly associated with adherence to chemoprophylaxis; however, those who missed doses traveled marginally longer than those who completed all doses. When assessing adherence to chemoprophylaxis after leaving malaria-endemic areas, more atovaquone/proguanil users completed their course than those taking other medications, except for the two of three individuals taking primaquine. This is likely because atovaquone/proguanil and primaquine only need to be taken for 7 days after travel. Our results support another study that observed higher rates of adherence after leaving a malaria-endemic area in travelers using atovaquone/proguanil compared with travelers using other types of malaria chemoprophylaxis.⁹

Among those who missed doses during travel, the main reason reported was that the traveler forgot to take his/her pills, a finding that has been corroborated elsewhere.³ Clinicians should inform travelers in the pre-travel consultation what to do if they forget to take a dose, which may be different depending on the specific medication or destination. Side effects were also reported; all 11 travelers who reported side effects took atovaquone/proguanil. Other than one report of nightmares while taking atovaquone/proguanil, the side effects experienced were consistent with those reported in the literature though we were unable to conclude if the side effects

experienced were actually caused by the medication and not something else.^{13–16} Clinicians should discuss the possibility of side effects and make sure travelers recognize when they should stop taking a medication entirely or use an appropriate side effect management strategy. For example, travel medicine providers may want to emphasize taking atovaquone/proguanil with food or changing the time of day the medication is taken as strategies that could be used by travelers to manage medication side effects.

The reason reported by 50% of travelers who declined to take any of their prescribed chemoprophylaxis was advice by someone other than their prescribing clinician that chemoprophylaxis was unnecessary. Although none of the countries visited by these 12 individuals had high transmission rates of *Plasmodium falciparum*, travelers' risk for malaria is not necessarily correlated with rates in the local population.¹⁷ Prescribing clinicians should inform travelers that friends or local guides may not understand that malaria attack rates in the local population are generally much lower than attack rates in foreign visitors because of immunity in the local population.¹⁷ In addition, recommendations for chemoprophylaxis may be inconsistent in the international travel medicine community, creating the opportunity for mixed messages that can confuse travelers and contribute to nonadherence. Clinicians should emphasize in the pre-travel consultation that travelers may hear advice from other travelers or members of the local population that conflict with travel advice from their clinician. Communicating these messages may prepare the traveler for possible alternative advice and recommendations they may receive abroad and influence them to adhere to chemoprophylaxis.

We found one reason for malaria chemoprophylaxis non-adherence and declination was not seeing mosquitoes during the trip. Though travelers may not observe mosquitoes, clinicians should reiterate to travelers that many malaria-transmitting *Anopheles* mosquitoes prefer to feed in the latter half of the night when humidity is high and susceptible people are likely sleeping and unaware of their bites.^{18,19} Overall, 98% of travelers were advised on how to prevent mosquito bites, however, less than half of travelers used bed nets and 79% of travelers used insect repellent at least once. Traveler sleeping accommodations also varied greatly in our analysis; 37% reported that they stayed in more than one type of accommodation and 39% reported that they did not sleep in an air-conditioned room at all during travel. In addition to explaining the importance of personal protective measures despite not seeing mosquitoes, clinicians may want to counsel travelers planning on staying in multiple types of dwellings (e.g., hotel, local residence, and tent) on the best personal protective measures to use for each type of accommodation.

Cost was another reason reported by travelers who declined to take any of their prescribed chemoprophylaxis. A recent study showed that health insurance companies could save money for both short- and longer-term trips to West Africa by covering antimalarial medications versus the costs of having to pay for malaria treatment.²⁰ Despite this finding, insurance coverage for prophylactic medications for travelers in the United States is still highly variable. Patients should review their insurance policies and discuss with clinicians when deciding which chemoprophylaxis is most appropriate.

Interpretation of our results may be influenced by several limitations. First, BATMN may not be representative of all

travelers to malaria-endemic areas. In addition, BATMN travelers sought pre-travel care and agreed to participate in a research study. In general, VFR travelers are less likely to seek pre-travel health consultations.^{21,22} VFR travelers in our study were not less adherent to chemoprophylaxis compared with others; however, previous research has shown that VFR travelers who attend a pre-travel health consultation at a travel health clinic adhere more to chemoprophylaxis than those who do not attend a consultation.²³ Therefore, VFRs in our study may not be representative of all VFR travelers. Participants may have underreported how many pills were missed. Because most travelers were prescribed atovaquone/proguanil, we could not draw comparisons of traveler adherence between chemoprophylaxes due to lack of statistical power. Further, we could not discriminate between high- and low-risk travelers based on location within a country because subnational destination data were not available. It is possible that some travelers traveled to areas of varying degrees of malaria transmission within a country or within multiple countries. It is also possible that clinicians may have over prescribed malaria chemoprophylaxis out of an abundance of caution in some cases where the clinician deemed the traveler risk to be low or variable. Though we cannot confirm, this may have been the case for some of the 24 travelers who went to partially endemic countries and declined to take malaria chemoprophylaxis. There may have been malaria protective measures such as insecticide-treated clothing, that were used more prominently or in place of insect repellent, air conditioning, or bed nets; however, this information was not captured in our dataset. Thus, the malaria protective measures included here may not be complete, and we might not have truly ascertained which measures were most appropriate for the individual situation. Finally, we selected participants with shorter durations of travel for logistical reasons (upper limit of travel duration was 65 days); therefore, we cannot assess adherence for longer durations of travel.

In summary, we found that most travelers visiting destinations with endemic malaria adhered to chemoprophylaxis for most of their trip and after leaving an endemic area. We did not see much variation in adherence among participants with different demographic and trip characteristics, but we identified several reasons for nonadherence and declination. Knowledge of these reasons can inform how clinicians craft their recommendations during the pre-travel consultation to counter at least two of these reasons (peer pressure and apparent absence of mosquitoes), particularly when advising those traveling to areas of intense transmission. Clinicians should continue to emphasize the importance of using malaria chemoprophylaxis along with personal protective measures in the pre-travel consultation to prevent malaria in travelers.

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Authors' addresses: Rhett J. Stoney, Emily S. Jentes, and Pauline V. Han, Division of Global Migration and Quarantine, Travelers' Health Branch, Centers for Disease Control and Prevention, Atlanta, GA,

E-mails: uyn2@cdc.gov, ejentes@cdc.gov, and pauline.han@gmail.com. Lin H. Chen, Travel Medicine Center, Mount Auburn Hospital, Cambridge, MA, E-mail: lchen@hms.harvard.edu. Mary E. Wilson, Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, MA, E-mail: mary_wilson@harvard.edu. Christine M. Benoit and Elizabeth D. Barnett, Maxwell Finland Laboratory for Infectious Diseases, Boston Medical Center, Boston, MA, E-mails: christine.m.benoit@gmail.com and elizabeth.barnett@bmc.org. William B. MacLeod and Davidson H. Hamer, Center for Global Health and Development, Boston University School of Public Health, Boston, MA, E-mails: wmacLeod@bu.edu and dhamer@bu.edu.

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