Malaria in NYC Residents:

Examining the determinants of chemoprophylaxis use and adherence among immigrants who travel abroad to visit friends and relatives (VFR)

By

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ABSTRACT

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Examining the determinants of chemoprophylaxis use and adherence

among immigrants who travel abroad to visit friends and relatives (VFR)

By

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Background: Malaria is an infectious disease caused by *Plasmodium* parasite spread by the bite of an *Anopheles* mosquito in tropical areas. Though not transmitted in the United States (US), New York City (NYC) reports approximately 200 diagnoses of malaria annually predominantly in immigrants who traveled home to visit friends and relatives (VFR).[1] This study aimed to examine the associations between 1) reasons of travel and taking chemoprophylaxis, and 2) type of chemoprophylaxis used and adherence; and to understand the reasons why travelers do not take malaria preventive measures.

Methods: Two quantitative methods were used for this research study: 1) secondary data analysis of NYC malaria surveillance data 2004-2010 (n=1335), and 2) an in-depth open ended interview of a sample (n=32) of newly diagnosed malaria cases diagnosed in 2011. Descriptive and chi-square statistics were calculated for selected characteristics. Logistic regression was

used to estimate the strength of the association between a) reason for travel and chemoprophylaxis use and b) type of drug taken and adherence before and after controlling for age, gender, race, borough of residence, and travel region. SAS 9.2 was used for statistical analysis.

Results: No chemoprophylaxis was taken by, 84% of malaria cases and only 5% took and adhered to the complete regimen. The odds of not taking any chemoprophylaxis was 1.5 (OR: 1.48; 95% CI: 1.09-2.01) greater among VFRs than those that traveled for other reasons. However, after adjusting for age, gender, race, borough of residence, and travel region, this association was no longer significant. When compared to those who reported taking chemoprophylaxis daily, the odds of not adhering to the full regimen was 4.1 times (unadjusted) greater for travelers who stated chemoprophylaxis use, but the name of drug was unknown. A sub-sample of 2011 malaria cases found 59.4% did not take any chemoprophylaxis and 28.1% adhered. People's knowledge, attitude, and beliefs were more important in influencing chemoprophylaxis use (25% of the sub-sample stated that they did not know about malaria or chemoprophylaxis, and 34.4% knew but still did not take chemoprophylaxis) than having health insurance (84.4% had health insurance).

Conclusion: Outreach and education are recommended to travelers, immigrant communities, and healthcare providers on malaria awareness, the importance of pre-travel medical advice for the appropriate chemoprophylaxis and the necessity of taking and adhering to the dosage. To increase chemoprophylaxis use and adherence, malaria prevention programs must focus on individuals' knowledge, attitude, and beliefs regarding malaria risk and disease severity.

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CHAPTER 1

BACKGROUND

1.1 Introduction

The United States (US) has been experiencing one of the largest waves of immigration in the past 20 years with most new immigrants coming from developing countries.[2, 3] In 2002, over one million people were granted lawful permanent resident status in the US with 63% receiving family sponsorship, 16% entering because of employment opportunities, and 12% being refugees or asylees.[4] One fifth of the US population is either foreign-born or first generation Americans born to foreign-born parents, amounting to approximately 56 million people.[3, 5, 6] With increasingly affordable air travel and fewer socioeconomic and political obstacles, these immigrants and their families are more likely to return to visit their country of origin although not without potential health consequences.[5, 7] Travelers who return home to visit friends and relatives abroad are known as VFRs.[8] The definition of VFR is not standardized. In its most basic form, VFR simply describes a traveler's self-reported reason for travel. For this study, VFR is defined as foreign-born immigrants and their children who travel to their, or their parents', country of birth to visit friends or relatives.[9, 10]

International travel has boomed between 2004 and 2008. In 2009, there were approximately 30,300,000 US residents who traveled overseas.[6] Though travel to overseas destinations by US travelers declined overall by 2% in 2009, there was an increase to travel to regions of Africa, India, and the Dominican Republic where malaria is endemic.[6] Of the top 20 US outbound destination regions in 2009, Africa set regional records for the increase in numbers of US travelers visiting Africa.[6]

Over one third of US travelers to overseas destinations (37%) stated that the reason for travel was visiting friends and relatives representing over 10 million trips for VFRs for 2009.[6] Migration and global travel have long been recognized as key contributors to the transmission of infectious diseases, including immigrants who return to their country of origin to visit friends and relatives.[11, 12] This growing population of US VFRs can expose themselves to infectious diseases that are epidemic and hyper-endemic in some countries, and their US born children are particularly susceptible to new health risks that they have not been exposed to in the US. However, the prevention of diseases in the large population of immigrants who are potentially at high-risk for illness as VFR travelers receives limited attention.

Studies have found several diseases for which VFR travelers are at considerably higher risk compared with those who travel for other reasons.[5, 9, 10, 13, 14] These diseases include, but are not limited to, hepatitis A and B, typhoid fever, routine childhood vaccine preventable diseases, tuberculosis, and malaria. [5, 9, 10, 13, 14] Surveillance data has shown disparities between VFR and other travelers in the number of cases of malaria,[15, 16] typhoid fever,[17] and in the rates of hepatitis A.[18] Although malaria is no longer endemic nor transmitted locally by mosquitoes in the US, approximately 1,500 cases of malaria are diagnosed annually.[19] The vast majority of cases in the US occur in travelers and immigrants coming from countries where malaria is endemic. Research on malaria is important and timely not only because of the increase in travel overseas by US residents, but also due to the resurgence of malaria in previously eradicated regions. Some studies found the impact of the increase in temperature due to global warming is a factor in the emergence or resurgence of malaria in regions of Afghanistan, Indonesia, and highlands of East Africa. Other factors linked to the rise in malaria are drug and pesticide resistance,

changing land use patterns, and human migration.[19] For these reasons the US Department of Health and Human Services targeted malaria for prevention efforts in Healthy People 2010.[20]

1.2 Malaria overview

Malaria is an infectious disease spread from person to person by indirect transmission by a mosquito acting as a vector. It is caused by species of the *Plasmodium* parasite which is spread by the bite of a female *Anopheles* mosquito. Malaria is caused by the intraerythrocytic protozoa of the genus *Plasmodium*. The four common species of human malaria in decreasing order of worldwide prevalence are *P. falciparum, P. vivax, P. malariae, and P. ovale*.[19, 21] A fifth species, *P. knowlesi*, is simian malaria which mainly causes malaria in macaques but can also cause malaria in humans.[22]

Malaria is transmitted in tropical and subtropical areas, where it depends on climatic factors such as temperature, humidity, and rainfall for the mosquito to develop. It is endemic in 87 countries in Africa, Asia, and several countries in the Americas (Appendix A).[23] The most severe species of malaria, *P. falciparum*, cannot complete its growth cycle in the Anopheles mosquito in temperatures below 68 degrees F.[8, 19] Malaria is not spread from person to person by direct transmission such as from respiratory droplets from cough or sneeze, physical contact of touch, through airborne microorganism, or through fecal-oral route of contaminated food or water. However, a small number of congenital transmission (from mother to fetus) and transmissions from exposure to infected blood products (transfusion) or organ transplant does occur. In fact, from 1963 to 2009, there were 96 cases of transfusion-transmitted malaria reported in the US.[24]

Descriptive Epidemiology Worldwide

Malaria is a major cause of morbidity and mortality worldwide among some of the most vulnerable populations living in the poorest countries. Globally, there were 200 to 500 million malaria infections per year during 2004 to 2010.[25] In 2006, the World Health Organization (WHO) estimated that 3.3 billion persons, half of the world's population, were at risk of malaria infection.[26] Approximately 1.2 billion of those considered at high risk were living in Africa (49%).[26] In 2008, there were an estimated 243 million cases of malaria worldwide; the vast majority of these (85%) were in Africa followed by South East Asia (10%) (Appendix B).[19, 26] Malaria morbidity is higher in pregnant women and children.[19, 27] In malaria endemic countries, *P. falciparum* contributes between 8 and 14% to low birth weight in infants. Children are also more seriously impacted by malaria.[19, 27] In Africa, a child has on average between 1.6 and 5.4 episodes of malaria fever each year.[28]

Malaria accounted for an estimated 863,000 deaths in 2008, of which 89% were in the African region.[19, 26] Malaria mortality is disproportionately higher in pregnant women and children than in the rest of the population.[19, 28] In 2008, mortality was highest in young children in sub-Saharan Africa.[19] Of the estimated 600,000 to 1 million malaria deaths annually between 2004 and 2010, an estimated 10,000 pregnant women and up to 200,000 infants died from malaria each year in Africa alone.[25,28] Of these malaria deaths, approximately 91% of them were believed to have occurred in Africa and 85% in children under five years of age.[28] In Africa, a child dies of malaria every 30 seconds and one in every five childhood deaths (20%) is due to the effects of malaria.[28]

Descriptive Epidemiology in the United States

In 2009, 1,484 US malaria cases were reported to CDC in civilian and military personnel including three possible congenital cases, two transfusion-related cases, one transplant case, and four malaria deaths.[24] Except for the three transfusion/transplant cases and the three congenital cases, all malaria infections were imported and acquired through travel outside of the US. Of the 987 imported cases for which the region of travel was known, 735(74%) were acquired in Africa, 142 (14%) in Asia, and 103 (10%) in the Americas.[24] Of the cases traveling to Africa, 81% traveled to West Africa. Of those who traveled to Asia, 76% visited India. Of those who reported travel in the Americas, 61.2% traveled to the Caribbean with Haiti being the country most visited by those diagnosed with malaria, followed by Guyana, and Honduras.[24] Of the 659 US civilians with imported malaria, reason of travel was reported for 597 (91%) of them. The reasons for travel for the imported malaria cases were primarily VFR (70%), followed by missionary work (11%), and business travel (7%).[24]

Of the 659 US civilians with imported malaria in 2009, data on chemoprophylaxis use was reported for 611 (93%) of them. Of these civilian cases, only 25% reported taking any chemoprophylaxis. [24] There were 19 malaria cases reported in pregnant women in the US in 2009.[24] Only eight of the 19 were US residents with reported histories of travel to Africa and India. Of these eight, only three of the pregnant women took any chemoprophylaxis.[24] Though chemoprophylaxis is safe for pregnant women, and getting infected with malaria is more risky for pregnant women and their unborn child, none of the pregnant women adhered to a complete chemoprophylaxis regimen. [13, 22,29, 30]

In 2009, approximately 50% of the cases diagnosed in the US were reported from seven reporting jurisdictions: New York City (209), California (126), New Jersey (103), Florida (94),

Texas (87), Maryland (80), and Georgia (74).[24] New York State (NYS) had an additional 56 cases of malaria in residents that lived in NYS but outside of NYC.[24] NYC had more malaria cases from 1998 to 2009 than any other US jurisdiction.[24] In 2004, out of all malaria cases diagnosed in the US, 15% were among people who lived in NYC, even though people in NYC only make up 2.6% of the US population.[31,32] In NYC 2004-2006, malaria cases were diagnosed in residents of all five boroughs, with the majority of cases residing in the Bronx (Appendix C).[33]

Clinical presentation and diagnosis

Malaria has a spectrum of disease manifestation ranging from malaria infection without symptoms, mild symptoms, severe disease, to death and is categorized as either uncomplicated or severe (complicated).[19, 21] The time from malaria infection to onset of symptoms differs depending on species and can range from 7 to 14 days for *P. falciparum, P. ovale, and P. vivax*, and up to 30 days for *P. malariae* species. The *ovale and vivax* species are unique in that they develop into a dormant liver stage, called hypnozoites, which can hide latent for at least six months to 1 year. They have symptomless intervals that can reactivate up to 4 years after infection. This longer incubation and late relapse of the *P. vivax and P. ovale* parasites is responsible for the increased time between infection and diagnosis with malaria for these two species.[21, 34]

Common symptoms of uncomplicated malaria include undulating fever, chills, sweats headaches, nausea/vomiting, body aches, and general malaise. Physical findings include elevated temperature, jaundice, enlarged spleen, enlarged liver, and increased respiration.[19, 21] Severe malaria occurs when the patient develops complications involving organ failure or abnormalities in their blood or metabolism such as severe anemia, cerebral malaria, kidney

failure, and hyperparasitemia.[19, 35, 36] Pregnant women are more susceptible to malaria and their infections can progress to a more severe presentation of malaria disease due to being immunocompromised.[19, 27] Malaria can increase the risk for serious pregnancy outcomes, including prematurity, miscarriage, and stillbirth.[19] Children are more susceptible to a severe case of malaria since they are less likely to have immunity from a previous infection due to their young age. *P. falciparum* is the type of malaria that is most likely to result in severe malaria infections and, if not promptly treated, may lead to death.[19, 21] Complications of malaria include[19]:

- Cerebral malaria, with abnormal behavior, seizures, coma
- Severe anemia due to hemolysis (destruction of the red blood cells)
- Hemoglobinuria (hemoglobin in the urine) due to hemolysis
- Acute respiratory distress syndrome (ARDS)
- Abnormalities in blood coagulation
- Low blood pressure caused by cardiovascular collapse
- Acute kidney failure
- Hyperparasitemia, > 5% of the red blood cells are infected by malaria parasites
- Metabolic acidosis (excessive acidity in the blood and tissue fluids),
- Hypoglycemia (low blood glucose).

For confirmation of malaria in a clinical patient, there are three laboratory blood test that can be conducted: serology to detect malaria antigens, polymerase chain reaction (PCR) to detect for malaria parasite DNA, and microscopy. Microscopic examination of blood films continues to be the best way to confirm malaria diagnosis.[37] It is an economic, reliable, and preferred diagnostic method since not only can malaria be visualized under the microscope, but the distinctive characteristics of each of the four malaria species can be distinguished from one another. There are two types of blood films used, thick smears and thin smears, and both can be utilized to make a definitive diagnosis of malaria. Thick films can first be used to view a larger volume of blood and are 11 times more sensitive in finding malaria in patients with low level of

infection. However, this method is not useful in distinguishing between species since the parasite rings appear distorted. Thin smears are similar to the blood films used for microscopy for diagnosis of other infections and can be used to get a better view of the parasitic rings and identify which species the patient is infected with.[38] The best and most common method for diagnosing malaria disease and specie is to use a thick smear to confirm malaria infection followed by a thin smear to identify species type.[19]

Treatment, prevention, and chemoprophylaxis

After a malaria diagnoses is confirmed, treatment options vary depending on species identified, country of travel, and severity of illness. Species and country of malaria acquisition are important information to obtain to ensure the proper treatment medication is prescribed. *P. falciparum* is known to be resistant to chloroquine and mefloquine in many regions, but nearly all the drugs used for the treatment of malaria are showing resistance to *P. falciparum* in some regions of the world.[19, 27]

Prevention is the preeminent way to avoid malaria infection, morbidity, treatment, hospitalization, and mortality from malaria. Malaria in travelers is a preventable disease with correct use of preventive measures such as avoiding mosquitoes and taking chemoprophylaxis drugs to prevent infection if bitten by a mosquito infected with malaria.[39,21] Measures to avoid mosquito bites include sleeping under a treated bed-net at night in malaria endemic countries, using air conditioners, ceiling fans as well as window and door screens to avoid unprotected open windows and doors. Other preventive measures are using insect repellants containing DEET or picaridin, wearing long sleeve shirts and pants especially in rural areas and at night, and treated clothes with permethrin-based products.[19, 39]

The most effective measure is taking the appropriate chemoprophylaxis drug before travel, to an endemic country, and adhering to drug as prescribed during the stay, and after return.[40] Yet only 18% of NYC VFRs diagnosed with malaria between 2004 and 2006 reported taking any medication to prevent malaria infection and not all persons beginning chemoprophylaxis adhered to the full drug regimen.[33, 36] This resulted in 72% of those malaria cases requiring hospitalization.[1, 33] Non-adherence to medication in general is a public health issue in the US. It causes between 33 - 66% of all medication related hospital admissions in the US[41-43] which results in approximately $100 billion in direct healthcare costs.[44] Although adherence to chemoprophylaxis may not prevent malaria in all travelers, studies show that chemoprophylaxis use can prevent the malaria infection from progressing to a severe malaria infection with complications requiring hospitalization.[1, 19] In NYC, 69% of cases diagnosed between 2004 and 2006 had malaria severe enough to require hospitalization.[33, 36] Just taking some chemoprophylaxis could have decreased the impact of the malaria infection and would have avoided the need for hospitalization as well as prevented the two fatal malaria cases during that time period of 2004-2006.[1, 8, 19]

1.3 Description of the problem

NYC has had approximately 200 malaria diagnoses reported annually between 2004 and 2006.[1, 36] Between 2004 and 2006 there were 565 malaria cases diagnosed in NYC with 84% being among Black individuals, 69% in males, and 24% among persons under 19 years of age.[8,33] Reason for travel was obtained for only 83.7% of these diagnosed cases and 65% of them reported recent VFR travel abroad.[8, 33] West Africa was the region of travel for 75% of VFR travel with Ghana and Nigeria together accounting for 53% of NYC malaria cases.[8, 33] Those

individuals who resided in NYC, traveled home to visit friends and relatives, and returned to be newly diagnosed with malaria, reflect missed opportunities in malaria prevention.

The failure to take chemoprophylaxis or adhere to their prescribed drug regimen is responsible for the high rate of morbidity and mortality from malaria in travelers to endemic regions.[1, 45, 46] This is a process, travelers must first know have the knowledge that they need to take chemoprophylaxis, see a medical provider to get a prescription, obtain the chemoprophylaxis drugs, and then, take and adhere to the drug as prescribed. However, it is unclear why there is such low compliance with chemoprophylaxis among travelers, especially VFRs. There are individual, population, and structural level barriers that are known to cause immigrant travelers visiting friends and relatives in their malaria endemic country of origin to be less likely to receive, take, and adhere to appropriate chemoprophylaxis drug regimen.[33, 47-49] This makes VFRs more likely for infection with malaria than those traveling to malaria endemic areas for other reasons of travel. This higher risk for illness in immigrant VFR travelers compared with travelers for other reasons is most commonly explained by characteristics considered typical or unique to VFR travel such as staying longer in the malaria endemic country.[9]

Individual level barriers

Individual level factors that place VFR travelers at risk for malaria include the fact that they are less likely to seek pre-travel medical care than other travelers despite their often sophisticated knowledge of disease in a destination country.[10, 50, 51] Studies have shown that even if VFRs do receive pre-travel medical care, their low perception of risk for disease make them less likely to take any or adhere to any medications recommended compared with those who

travel for other reasons. [1, 30, 33,45 52-54] Many immigrant VFRs do not perceive themselves at risk for malaria infection or feel that even if they get infected, malaria is a mild disease and that they can deal with the illness. This impression may be based on their prior personal experience or that of others[9] and feel provider's recommendations exaggerate the risk and severity of malaria disease.[48, 53]

Many VFRs feel that it is better to take a chance of getting a mild case of malaria and get treated for it after than to take chemoprophylaxis drugs for a long time and deal with its problematic issues or side effects. Chemoprophylaxis medication must be taken up to two weeks before travel through four weeks after return from overseas.[19] Some medications are daily dosages while others are weekly. Adverse events and side effects vary depending on the chemoprophylaxis drug taken. They include gastrointestinal problems such as abdominal pain, nausea, vomiting, heartburn, mouth ulcers, seizures, psychosis, nightmares, and anxiety.[39] VFRs feel they are immune to malaria from a prior infection. Studies suggest that people previously infected with malaria have partial immunity that protects them from the complications and fatal outcomes of malaria disease.[55] However, protection is not complete. Immunity wanes as seen by the number of VFR travelers who return to the US with severe and fatal malaria.[56] Children of VFRs are considerably at high risk during travel to malaria endemic countries if they were not born there and lack the pre-existing immunity to travel-related disease that their parents may have gained through their early childhood exposure.[19]

A study conducted at NYC's John F. Kennedy International Airport reported that 22% of individuals traveling to the developing world were unaware of the need for pre-travel health advice and vaccinations, and 20% did not perceive a risk of infection.[48] Moreover, a qualitative study conducted in Nigerian VFR travelers residing in Houston, Texas, suggested that

participants believed they were susceptible to contracting malaria when they visited Nigeria, but felt malaria was not a severe illness. They described malaria as "normal," "expected," and "like the flu".[53] In a survey of migrants attending a public health clinic in Italy, researchers found that 70% of VFR travelers knew of malaria in their country of origin.[54] However, of those who traveled home in the previous year, 82% did not go for pre-travel medical advice and 52% stated the reason they did not seek care was because they did not perceive malaria as a personal risk.[54] Even if VFR travelers begin chemoprophylaxis, a large percentage of them do not adhere to the complete regimen.[1,25] US malaria surveillance for 2009 found that of the 91 malaria cases who stated they took a CDC recommended chemoprophylaxis, 55% did not adhere to the complete regimen.[57] According to the CDC, the proportion of US travelers taking chemoprophylaxis and those adhering to their medication has been trending downward since 2005.[57]

Besides lack of any or an incomplete regimen of chemoprophylaxis, there are other risk factors for malaria infections among VFRs.[58] VFR travelers have higher risks for malaria infection than tourists because of environment-related characteristics of VFR travel that increase their risks of exposure to malaria such as staying in developing countries or in rural areas.[59] VFR travelers are more likely to have close contact with the local population and may use local health facilities than those who travel for other reasons. VFRs are more likely to go to more remote areas not developed for tourism, often with poor public health infrastructure and higher transmission of local pathogens than those who travel for other reasons. They usually have longer stays since they are returning to visit friends and relatives and can stay up to several months in the malaria endemic country vs. tourists who may travel for a week or two.[10] VFRs may stay in homes that may not have air conditioning, window and door screens or bed nets.[30, 52]

Population level barriers

Population level influences that impact travelers, especially VFRs, are known to include receiving poor medical preparation for international travel for a number of reasons.[48, 53] This is not only due to lack of access to travel clinics, or not seeking pre-travel care from their primary care providers, but also due to the quality of care received when they do go to a doctor. Providers do not routinely conduct travel risk assessments which include ascertaining the places, season and duration of planned travel from their patients.[59] Providers are not always knowledgeable of issues of drug resistance in the country of travel, medication side effects, or fail to prescribe enough medication for the longer duration of stay of VFRs.[9, 52, 60] Healthcare provider must conduct a travel risk assessment to ascertain the countries, date, and length of travel for their patients in order to prescribe the correct chemoprophylaxis (Appendix D).[39]

Country of travel is important since particular chemoprophylaxis drugs are recommended for different countries.[19, 56] Certain drugs, such as chloroquine, are known to be resistant to the malaria species in some countries such as in Ghana and Nigeria and would not prevent malaria infection in those countries.[19, 56] Date of travel is important for the healthcare provider to know because chloroquine must be started 1 to 2 weeks before travel, whereas atovaquone/proguanil is a great choice for last minute travel since it can be started 1 to 2 days before travel.[19, 56] Several studies have demonstrated high rates of inappropriately prescribed malaria chemoprophylaxis suggesting inadequate training and knowledge of travel medicine.[11, 15, 52, 60-62] For example, in a Canadian departure lounge study, only 7% of travelers to malaria endemic areas had been prescribed an appropriate anti-malarial drug regimen.[52] French VFR travelers departing from Paris were twice as likely to be taking unsuitable chemoprophylaxis compared with tourists on vacation.[62]

Most primary care providers are not trained in travel medicine and VFRs do not seek pre-travel medical advice at travel clinics which historically cater to tourists.[63, 64] They do not conduct travel risk assessment on their patients during routine medical appointments. When travelers do seek pre-travel advise, providers do not always have knowledge of the malaria resistance in certain countries and issues with obtaining chemoprophylaxis, or their side effects. Therefore, primary care providers do not always provide appropriate travel health education or medications to their patients.[11, 13, 53] Despite having malaria chemoprophylaxis recommendations listed on their website, many primary care providers do not utilize this information for their patients who travel abroad.[19] CDC surveillance documented that among the 155 US residents diagnosed with malaria in 2009 who reported taking any chemoprophylaxis, only 66% took a CDC recommended drug.[57] For 24% of these cases the specific drug taken was unknown, and at least 10% of all those who took any chemoprophylaxis took a drug not recommended for the country they traveled to.[57]

Previous studies identified other issues of pre-travel medical care including primary care providers having difficulty communicating with VFRs because of language differences and the lack of culturally competency in risk communication.[9, 65, 66] A provider's emphasis on the threat of disease due to poor environmental conditions in the VFRs country of origin may be in conflict with the VFR traveler's expectations, and therefore, they may reject the recommendations.[9] Doctors also do not take advantage of providing travel education to adult VFRs when they bring their children for routine health care or advise parents who bring their children for pre-travel care.[53, 60]

On the structural level, access to care, lack of health insurance, cost of medications, and lack of funding for preventive services are barriers to malaria prevention in VFR travelers. In

the US, being foreign-born makes one more likely to be poor.[5] Obtaining chemoprophylaxis is dependent on an individuals' health insurance status and their ability to pay for the medications for themselves and their families. Lack of medical insurance is a barrier for many immigrants for obtaining anti-malarial drugs or malaria prevention education.[3, 5] VFRs without health insurance are less likely to seek adequate medical advice before travel and if they do, they often cannot afford the price of the chemoprophylaxis drugs. Medicaid recipients can see a provider, but cannot get their medications paid for by Medicaid. The same is true for many working VFRs with health insurance; their health plan covers primary care visits, but most drug plans will not pay for those medications. Obtaining ineffective counterfeit drugs in their native countries to save money is another factor that places VFRs at greater risk for malaria.[19]

Identifying and understanding the specific individual, population/community, and structural/policy level barriers to malaria prevention and the behaviors that place NYC travelers at risk is essential to decrease morbidity and mortality from imported malaria. By discovering predictors of failing to take or adhere to malaria chemoprophylaxis regimen before VFR travel, tailored pre-travel intervention programs can be proposed for specific populations. Knowing the reason why travelers are not taking or not adhering to chemoprophylaxis is vital. This is a major gap in knowledge in malaria research. Most studies explain who is diagnosed with malaria and how they are at risk, but do not examine why they did not take preventive measures. Examining why VFRs do or do not take, or adhere to a chemoprophylaxis regimen could contribute to our understanding of malaria prevention. This study plans to investigate these issues.

Ascertaining the characteristics of travelers that are predictive of infection by malaria can also guide travel medicine "academic detailing" programs for neighborhood physicians that provide healthcare to immigrant communities.[67, 68] Academic detailing is an innovative method

of service-oriented outreach education for physicians by combining the university evidence-based, noncommercial information of academia with the details of pharmaceuticals recommended for a particular disease.[67, 68] It involves one on one education of primary care providers by trained healthcare or public health professionals. By training primary care providers in screening and health education as well as specific barriers to chemoprophylaxis use with immigrants, providers would be more knowledgeable and effective preparing their immigrant patients with the appropriate malaria preventive measures for their country of travel.

Studies have shown that VFRs comprise a significant proportion of international travel and are at a marked increased risk for travel related mortality and morbidity of diseases such as malaria.[5, 33, 63, 64] However, literature is limited on reports of pre-travel disease prevention health services such as travel clinics for this risk group.[63, 64] There are few studies on VFRs, adults and children, from large urban communities like NYC where the healthcare system is not addressing the needs of its residents who are immigrant travelers.[63, 64]

The setting of this study is significant because NYC is the largest city by population in the US and has a large urban immigrant population that travels. NYC is a gateway to the world with three major airports serving the area which makes travel back to their country of origin more accessible to immigrants residing in NYC. John F. Kennedy airport (JFK) is the international airport for NYC and between September 1, 2009 and August 31, 2010, JFK had 143,225 international flights carrying 22,773,650 passengers to overseas destinations.[69] Having the highest number of malaria diagnoses than any other jurisdiction in the US also makes NYC an ideal setting for this research.[25]

1.4 Specific Aims

This dissertation is an original research study with the goal of identifying predictors of chemoprophylaxis use in NYC residents who travel abroad and then diagnosed with malaria, and to identify barriers to malaria prevention efforts. The findings of this research could be used to create and implement malaria prevention programs for NYC residents and healthcare providers. The specific aims of this dissertation are:

1a) to determine whether there is an association between reasons of travel and chemoprophylaxis use among all NYC residents diagnosed with malaria between January 1, 2004 and December 31, 2010 before and after controlling for age, gender, race, borough of residence, and region of travel;

1b) to investigate the association between type of chemoprophylaxis taken and adherence to drug regimen among all NYC residents diagnosed with malaria who took any chemoprophylaxis before and after controlling for age , gender, race, borough of residence, region of travel, and reason for travel;

2a) to understand VFRs perception of risk, individual level risk factors for not taking or adhering to chemoprophylaxis, and structural level barriers to obtaining and taking chemoprophylaxis in a sub-sample of VFRs only; and

2b) to understand why there is an association between traveling to visit friends and relatives and less use of chemoprophylaxis, if an association was found.

CHAPTER 2

METHODS

2.1 Introduction

This study utilized a cross sectional approach to address research questions (RQ) related to malaria prevention in travelers. This study objectives is to answer the following questions "Is there an association between travel to visit friends and relatives (VFR) and use of chemoprophylaxis?", and "Among those who take chemoprophylaxis, is there an association between type of chemoprophylaxis taken and adherence to drug regimen?" This study also aims to understand why travelers diagnosed with malaria failed to take or adhere to chemoprophylaxis and what the individual and structural level barriers that prevented them from obtaining, taking, and adhering to chemoprophylaxis.

The setting for this study was the Bureau of Communicable Disease (BCD) in the Division of Disease Control at the New York City (NYC) Department of Health and Mental Hygiene (DOHMH). BCD's mission is to monitor communicable diseases in NYC in order to rapidly recognize and respond to infectious disease threats and to identify populations at risk in order to prevent or control ongoing transmission. Key BCD activities include: conducting case investigations for 80 infectious diseases or conditions (Appendix E) as mandated by the New York City Health Code and to provide education and consultation to the public, medical and animal health communities on the prevention and control of communicable diseases. As one of the 80 infectious diseases, staff in BCD's General Surveillance Unit (GSU) investigated all reports of malaria diagnoses in NYC. Between 50,000 and 80,000 disease reports are received by BCD annually.[1]

Two methods were utilized to answer this study research questions: 1) A quantitative analysis focusing on all malaria cases diagnosed in NYC residents between 2004 and 2010 was conducted; and 2) An analysis of open-ended interviews using data from a supplemental questionnaire to malaria cases conducted on a sub-sample of malaria cases in NYC residents diagnosed between August 14 and October 8, 2011.

2.2 Aim 1

The quantitative aim of this study proposed to address two important issues: a) to determine whether there is an association between reasons of travel and chemoprophylaxis use among all NYC residents diagnosed with malaria between January 1, 2004 and December 31, 2010 before and after controlling for age, gender, race, borough of residence, and region of travel, and b) to investigate the association between type of chemoprophylaxis taken and adherence to drug regimen among all NYC residents diagnosed with malaria who took any chemoprophylaxis before and after controlling for age , gender, race, borough of residence, region of travel, and reason for travel. To answer these questions, a cross-sectional analysis of existing data was used.

Data Source and Sample

The NYC Health Code 11.05 mandates the reporting of malaria diagnoses by laboratories and primary care providers (PCP) to the NYC DOHMH.[70] The DOHMH receives electronically transmitted reports daily from laboratories, healthcare facilities, primary care providers, and hospital infection control nurses (ICNs). The reports of diseases investigated by BCD are selected from other disease reported to DOHMH electronically and transmitted to BCD's

communicable disease surveillance system (CDSS) database. This database contains all cases reported to the NYC DOHMH with any of the 80 reportable communicable diseases in people either residing in NYC or diagnosed at a NYC medical facility. DOHMH also receives paper reports through US postal mail from NYC providers, laboratories, and other state health departments. These mailed reports are delivered to BCD, reviewed and coded by a supervisor of Public Health Epidemiologists (PHE), and given to data entry staff for manual entry into the CDSS database.

Once a report of a positive laboratory result for malaria was received into CDSS, it is assigned to one of 12 PHE for case investigation. PHEs are trained to collect data for case investigations in a standardized way to avoid bias.[71] PHEs are not only trained, but highly experienced in interviewing and medical chart abstractions for malaria and other communicable diseases. Quality assurance checks are conducted annually by supervisors to ensure the validity and reliability of all case investigations.[71]

Malaria reports are investigated to obtain necessary clinical, demographic, and travel information required for reporting malaria cases to CDC.[1, 36] The primary method of case investigation is through patient interviews. In general, interviews are conducted over the phone and a CDC malaria case surveillance report (Appendix F) is completed. However, if the patient is hospitalized, a PHE will visit the patient in the hospital and conduct the interview in person. If the patient is medically unable to be interviewed, a family member will be interviewed. If no family is available for interview, the PHE will conduct a medical chart review to obtain the required information for malaria the malaria case surveillance form. If the patient is a child, his/her parents are interviewed. If the patient does not speak English, a PHE with that language skill will conduct the interview, an English speaking family member will translate, or third party

translation service is utilized. If the patient was not located for interview or refuses, a chart review is conducted at the medical facility where the malaria case was diagnosed and relevant information is abstracted from the chart and reported to BCD. If the chart is not available, the patient's physician is contacted and asked to complete the malaria case report form faxed to them, or the physician can answer the questions over the phone.

After the investigation is concluded, the data from the completed malaria case surveillance form is given to a specialized clerical staff for data entry into the BCD's malaria surveillance database. The surveillance system is an Access database stored on a secured DOHMH network. This database contains all patients reported to the NYC DOHMH with a diagnosis of malaria who either are residents of NYC or diagnosed at a NYC medical facility. Patient information includes individual demographic, clinical, and travel information on all malaria diagnoses. Data includes patient's name, DOB, sex, zip code, doctor's and facility name, chemoprophylaxis taken, travel history, treatment given, and malaria complications.

The malaria surveillance database contained 1,590 cases reported to NYC DOHMH January 1, 2004 through December 31, 2010 with a report of malaria from a hospital, healthcare facility, laboratory, or medical provider. However, nearly 9% of those cases were either in persons seen in a NYC healthcare facility, but did not live in NYC or were not confirmed as a malaria diagnosis. A new database for this research study was created containing only laboratory confirmed cases of malaria diagnoses in NYC residents (n=1,447). Cases (n=112) were removed from the dataset if they were missing information on key variables such as age (n=9), gender (n=1), race/ethnicity (n=6), borough of residence (n=3), chemoprophylaxis use (n=58) and case confirmation related data (n=35). These exclusions yielded an analytical sample

of 1,335 malaria cases diagnosed in NYC between 2004 and 2010. The names and other unique identifiers were removed from this database to protect patients' confidentiality before analysis.

Outcomes

The outcomes are chemoprophylaxis use and medication adherence among those who used chemoprophylaxis. Chemoprophylaxis use was collected through the question "Was malaria chemoprophylaxis taken?" with choices yes/no as answer from the routine malaria questionnaire. A follow-up question was asked to each participant 'Was all chemoprophylaxis taken as prescribed?" to ascertain adherence to the chemoprophylaxis regimen. This question's choices were: Yes, missed no doses; No, missed some doses, or Unknown. Unknown was chosen if a patient was unavailable for interview and the chemoprophylaxis use information ascertained form the healthcare provider or chart review was incomplete.

The responses to the two questions "Was malaria chemoprophylaxis taken?" and "Was all chemoprophylaxis taken as prescribed?" were combined to create a variable to measure medication adherence. This variable had three response levels to determine how individuals took or did not take pills in the following categories: took all pills (adhered), only took some pills, and did not take any chemoprophylaxis pills. If "yes" was answered to both questions then patient coded as adhered to dosage. If "no" was answered to first question, "Was chemoprophylaxis taken?", then patient coded as not taking any chemoprophylaxis. If patient answered "yes" to taking chemoprophylaxis, but "no" to "Was all chemoprophylaxis taken as prescribed?", then patient coded as "only took some doses".

Exposures

The exposures were reasons for travel and type of chemoprophylaxis. Reasons for travel was collected from the CDC's standardized malaria surveillance questionnaire and was determined from the question "What was the principal reason for travel from/to US for most recent trip?" with the following eleven choices: tourism, military, business, Peace Corps, visiting friends/relatives, airline/ship crew, missionary or dependent, refugee/immigrant, student/teacher, unknown and other (write-in). All reasons of travel except VFR were grouped and recoded into a new category, "all other reasons for travel". Reason of travel was re-coded as VFR for those who travel to visit friends and families and all other travel reasons for those providing other reasons as response categories.

The questions "Was chemoprophylaxis taken?" and "If yes, which drugs were taken?" were used to determine the type of chemoprophylaxis used. The latter question offers seven choices: chloroquine, mefloquine, doxycycline, primaquine, atovaquone/proguanil, unknown, and other (write-in). The response with these drug names was re-coded into categories for how the drug was taken, daily or weekly. The name of each drug was checked against the CDC's list of chemoprophylaxis drugs and their recommended dosage. If the drugs were recommended to be taken daily, the patient was coded as taking a "daily dose" chemoprophylaxis drug. If the drugs were recommended to be taken weekly, the patient was coded as taking a "weekly dose" chemoprophylaxis drug. If a respondent did not remember the name of the chemoprophylaxis medication they had taken, or it was not documented in the patient's medical record, chemoprophylaxis type was coded as drug name not reported. This variable, chemoprophylaxis type, had three response levels: daily dose, weekly dose, or drug name not reported or unknown.

Covariates

Covariates identified as potential confounders in previous studies[29, 33] were included in this analysis. Age, race, ethnicity, sex, borough, zip code, pregnancy status, region of travel, country of travel, and length of stay were collected as self-reported from the routine surveillance interview. Age was collected as a continuous variable and recoded as a categorical variable using the following four levels: 0-17, 18-39, 40-59, and 60 years and older.

Race was collected through the question "what is your race? you can select one or more" with the following categories: American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander, Black or African American, Asian, White, and unknown. Ethnicity was collected through the question "what is your ethnicity?" with two choices, Hispanic/Latino, or Not Hispanic/Latino. Race was re-coded for analytical purposes into two categories, non-Hispanic Black and "all other race/ethnicities". If respondent chose Hispanic/Latino as ethnicity, then race/ethnicity was coded as Hispanic/Latino. If respondent stated not Hispanic/Latino, then race/ethnicity was reported as non-Hispanic Black or non-Hispanic White. All racial categories other than non-Hispanic Black were grouped together into the "all other race/ethnicities" category.

Sex variable was collected as male, female, or unknown. For this analysis, only responses to male and female were considered. Borough variable was determined from the patient's address and specified as Bronx, Manhattan, Brooklyn, Queens, Staten Island, and outside NYC. Cases with residence outside NYC were excluded from analysis. Pregnancy status at diagnosis was collected through the question "Is patient pregnant?" with choices of yes or no. Country of travel was collected through the question "Has the patient traveled or lived outside the US during the past 2 years, yes or no?" and "if yes, specify country." Region of travel

variable was created based on country of travel. Since 77% of all cases stated travel to West Africa, region of travel was re-coded as West Africa and all other regions of travel. Nigeria was the most frequent country of travel with 368 (28%) of all cases traveling to Nigeria, country of travel was re-coded as a dichotomous variable as Nigeria and all other countries worldwide.

Data Analyses

Descriptive statistics were calculated for selected characteristics of the study population according to reason for travel, chemoprophylaxis use and type of chemoprophylaxis taken. To assess significant associations of each characteristic with reason of travel, chemoprophylaxis use and type of chemoprophylaxis taken, chi-square statistics were used. Covariates were assessed as confounders by examining their univariate association with the exposures and outcomes. Covariates significantly associated with the exposure at a 0.15 significance level were considered as a possible confounder of the association of interest. In addition, descriptive statistics were calculated for selected characteristics of the 112 excluded cases and these excluded cases were compared to the 1,335 cases included in this study.

Logistic regression models were used to estimate the strength of the associations between a) reasons of travel and chemoprophylaxis use and b) type of chemoprophylaxis taken and adherence to drug regimen before and after controlling for selected characteristics. SAS 9.2 was used for the data management and statistical analysis.

2.3 Aim 2

This aim proposes to understand VFRs' knowledge about need for chemoprophylaxis, perception of risk, individual level risk factors for not taking or adhering to chemoprophylaxis,

and structural level barriers to obtaining and taking chemoprophylaxis in a sub-sample of VFRs only and why there is an association between traveling to visit friends and relatives and less use of chemoprophylaxis, if an association was found. The goal was to investigate travelers knowledge, attitudes, and behaviors by examining their perception of risk for malaria, individual level risk factors for not taking or adhering to chemoprophylaxis, and structural level barriers to obtaining and taking chemoprophylaxis.

To achieve this aim, a cross-sectional sub-sample of new malaria cases in VFRs diagnosed in 2011 was conducted. Participants were identified from newly reported cases diagnosed between August 14 and October 8, 2011. This eight-week timeframe was selected because of the annual increase in malaria diagnoses during this time period. This seasonal increase is due to travelers returning to NYC after their summer vacation travel.

Analytic sample

The malaria surveillance database contained 59 malaria cases reported to NYC DOHMH for the eight weeks period between August 14 and October 8, 2011 from a hospital, healthcare facility, laboratory, or medical provider. Malaria cases who resided in another country and were just visiting NYC or had recently immigrated to NYC when they were diagnosed with malaria (n=6) were excluded from this sample. Malaria cases that were unavailable for interview (n=21) were also removed. The interview was conducted using the routine surveillance questionnaire on those patients that DOHMH staff could contact by phone. If the patient stated travel from the US to another country during the routine questionnaire, the supplemental semi-structured interview was then conducted. In addition, the same variables collected in the CDC's routine surveillance

questionnaire in Aim 1 were collected and analyzed as part of this aim. The final sample contained 32 recently diagnosed malaria cases in NYC residents.

Data Collection

For Aim 2, the routine surveillance questionnaire, as well as the supplemental in-depth telephone interview, was conducted by one NYC DOHMH Research Scientist in BCD. These interviews were conducted within four weeks of their malaria diagnoses. The open-ended interview instrument contained 22 questions, 10 multiple choice and 12 in-depth open ended questions (Appendix G). For the open-ended questions, participants were asked to describe their beliefs, opinions, and actions in their own words without being lead to pick an answer. Knowledge, attitudes, and practice was assessed through interview questions such as belief of health impact of malaria, how worried they were of getting sick, reason did not take chemoprophylaxis, reason why did not adhere to medication, and what other preventive measures were taken while traveling (e.g., mosquito avoidance measures and use of bed nets).

Participants were treated as partners in this malaria research, and considered as key informants with knowledge and expertise in the subject matter rather than as just interviewees. Several questions were worded to get participants opinions concerning other people like them who travel as opposed to asking a sensitive question about them personally. Questions to identify structural barriers were "Is money a reason people do not take malaria medication?", "What can healthcare workers do to help other travelers take malaria medication?", "What policies/services/messages do you think would help prevent malaria in other travelers?". Questions to identify individual barriers to malaria prevention were "What advice would you

give someone who is traveling to the country you went to?", and "Is there anything you would like to add about your experience with malaria or medicine to prevent it?".

Multiple choice questions were also included to collect information not captured by CDC's routine surveillance questionnaire including socioeconomic status (SES) indicators such as highest education completed, insurance status, and if patient sought pre-travel medical advice. Data were collected on reason for travel, country of travel, chemoprophylaxis use, and adherence in this supplemental depth interview to validate the data collected by the routine surveillance questionnaire.

Covariates

As with Aim 1, individual level covariates collected from the routine surveillance interview include age, race, ethnicity, sex, borough, zip code, pregnancy status, region of travel, and country of travel. The supplemental questionnaire posed questions to identify both individual and structural level barriers to malaria prevention. Individual level covariates collected on the supplemental open ended survey included, "Did any children travel with you?", "How worried were you about getting sick from travel?", "Did you use anything to prevent you from getting malaria?" and "What prevention measures used?". Structural level covariates were identified from questions such as "Did you have health insurance?", "Did you have Medicaid?", "Did you receive pre-travel medical advice?", "What advice did your doctor give you?", "What can healthcare workers do to help travelers take chemoprophylaxis?", and "What policies, services, or messages would help prevent malaria in others?"

Data Analysis

Descriptive statistics were calculated for selected characteristics of the sub-sample to describe this population and to compare this sub-sample to the entire sample to ensure representation and generalizability to the NYC malaria cases diagnosed from 2004 to 2010.

Responses to the twelve open ended questions on the supplemental interview for the 32 participants were reviewed by two Research Scientists in BCD independently. A first read of the open ended responses was conducted to identify recurring themes. During the second read of the responses, open structural coding[72] was conducted and responses were divided into two to three main themes. Those responses that did not fall into a main theme category were coded as others. The two Research Scientists compared their coding, discussed and resolved any discrepancies, and finalized open-ended questions themes and the number of participants' responses that fell under each theme. Calculations were conducted for each of the 12 questions to calculate the percentage of participants that responded to each main theme.

CHAPTER 3

RESULTS

3.1 Introduction

This chapter presents the results of this study. There are two sections to this chapter. First, results addressing Aim 1 are presented and included an overview of the characteristics of the study population, a comparison of characteristics according to travel reasons, chemoprophylaxis use, and type of drugs as well as the associations of a) reasons of travel and chemoprophylaxis use and b) type of drugs taken and adherence. Second, Aim 2's findings on the individual and structural level barriers to malaria prevention are discussed.

3.2 Aim 1 Results

Table 1 presents the distribution of selected characteristics for the study population. The mean number of cases annually was 191 with a range between 159 and 241. More than one third (38.5%) of the cases were between 40 and 59 years old and 21.6% were children 17 years old and younger. The study population was predominantly male (67%) vs. female, and non-Hispanic Black (86.7%) vs. any other race/ethnicity. Over one-third of the cases were identified in the Bronx (35.2%), followed by one-fourth (25.2%) of the cases identified in Brooklyn. West Africa was the region of travel for over three-fourths of NYC malaria cases (77.1%). The remainder of people stated travel to regions of the Caribbean (6.0%), South Asia (5.7%) of the cases, and twelve other travel regions (11.1%; Appendix H). The country where most cases report to travel was Nigeria (27.6%). Other countries of travel reported by the malaria cases were Ghana (19.0%), Haiti n=68 (5.1%), and India (4.8%; Appendix I). Over two-thirds of cases reported

visiting friends and families (VFRs) as the reason for travel (68.9%). Other reasons for travel included refugee/immigrant (8.0%) and tourism (5.8%; Appendix J).

The majority of this study population did not take any chemoprophylaxis drugs (84%) and only 5% took and adhered to the full chemoprophylaxis regiment. The type of drug dose taken most often was a weekly dose (54.9%). Of the 441 females in this study, 43(9.8%) were pregnant, but among study females of child bearing ages 18-39 years old, 36 (20.6%) were pregnant at the time of malaria diagnosis. Malaria infection was severe enough to require hospitalization in 77.9% of all NYC malaria cases. These hospitalizations were due to complications of malaria including anemia (12.1%), thrombocytopenia (4.9%), renal failure (1.9%), and cerebral malaria (1.8%; data not shown in table). While there were few variations across the years, these characteristics reported in the total population were consistently observed across the years 2004 and 2010.

Table 2 compares the characteristics of travelers who traveled to visit friends and relatives compared to those who traveled for other reasons. When compared to those traveling for other reasons, VFRs were more likely to be aged 40 to 59 years (43.5%) than any other age, male (67.1%), to report being Non-Hispanic Black (92.1%), report the Bronx (38.8%) as the borough of residence, and traveled to West Africa (79.5%; all p-values were <0.01). Moreover, when compared to those who travel for other reasons, VFRs were more likely to travel to Nigeria than elsewhere (29.5% vs. 23.4%), and less likely to use chemoprophylaxis (14.2% vs. 19.8%; $p<0.05$).

Table 3 shows the strength of the association between reasons of travel and chemoprophylaxis use. The odds of not taking any chemoprophylaxis was 1.5 (OR: 1.48; 95% CI: 1.09-2.01) greater among VFRs than those that traveled for other reasons. However, after

adjusting for age, gender, race, borough of residence, and travel region, this association was no longer significant.

Table 4 compared the characteristics of all malaria cases who took at least some chemoprophylaxis compared to those that did not take any chemoprophylaxis. Only 16% (n=213) of all malaria cases took any chemoprophylaxis drugs. `When compared to those who took some chemoprophylaxis, those who did not take any chemoprophylaxis, were less likely to be younger than 17 years of age (20% vs. 30.1%) but more likely to be aged 40 to 59 years (40.1% vs. 30.1%). Findings also showed chemoprophylaxis use decreased as age increased with children 0-17 years more likely to take chemoprophylaxis (22.2%) than people 60 and older (10.2%; data not shown in Table 4).

When compared to those that took at least some chemoprophylaxis, those who did not take any chemoprophylaxis were more likely male (68.7% vs. 57.8%), non-Hispanic Black (87.9% vs. 80.7%), resided in the Bronx (36.1% vs. 30.5%), and traveled as VFR (70.3% vs. 61.5%; all p-values <0.05).

Table 5 describes the characteristics of malaria cases by the type of chemoprophylaxis drug (daily, weekly, or unknown) taken. More than half (54.9%) of those taking chemoprophylaxis are known to have taken a weekly dose drug. Those taking a weekly dose drug were more likely to be female (54.7%) than male, and non-Hispanic Black (83.8%) compared to any other race/ethnicity. The majority of people who took a weekly dose were 18-39 years (33.3%) which was less than the percent of 18-39 years that took a daily dose (64.1%). All variables, with the exception of gender, region, admitted to the hospital, and country of travel, had p-values <0.05.

Of those who took a weekly chemoprophylaxis drug, nearly two-thirds (62.4%) were VFR, and of those taking a daily dose chemoprophylaxis, 59% were VFRs. Of the 213 people that reported any chemoprophylaxis use, 26.8% did not state the chemoprophylaxis drug taken. VFRs were more likely to report not knowing the chemoprophylaxis they took with type of drug unknown (32.1%) compared with other travelers (18.3%; all p-values <0.05).

Table 6 presents the strength of association between type of drug taken and adherence to that drug regimen. When compared to those who reported taking chemoprophylaxis daily, the odds of not adhering to the full regimen was 4.1 times (unadjusted OR:4.12; 95% CI: 1.59-10.68) greater for travelers who stated chemoprophylaxis use, but the name of drug was unknown. After adjustment for age, gender, race, borough of residence, travel region, and reason for travel, this association remained nearly identical (OR:4.24; 95% CI: 1.41-12.73). No association was observed between those who took chemoprophylaxis weekly and adherence before or after adjustment.

Since 26.8% (n=57) of those taking chemoprophylaxis had unknown type of drug, sensitivity analysis was conducted to compare the characteristics of those who took daily and weekly with those who took an unknown drug. In general, when compared to those who took a daily dose, those who took an unknown type of drug were more likely to be non-Hispanic Black, reside in the Bronx, travel for VFR, and travel to Nigeria (all p-values < 0.05). However, there was no significant differences between those diagnosed with malaria who took a weekly dose and those who took an unknown drug (Appendix K).

When compared to the NYC cases that were included in the analysis (n=1335), the excluded cases (n=112) were less likely to be Black (59.8% vs. 86.7%), reside in the Bronx (25% vs. 35.2%), admitted to hospital (57.1% vs. 77.9%), traveled to West Africa (51.8% vs. 77.2%),

and VFR (44.6% vs. 68.9%; all p values < 0.0001). However, included and excluded cases were similar with regards to age, sex, chemoprophylaxis type, and country of travel (all p-values> 0.05).

3.3 Aim 2 Results

The study population for Aim 2, while small (n=32), is a representative sample of NYC residents diagnosed with malaria and is comparable to all reported malaria cases 2004-2010 (Aim 1) on gender, race, borough of residence, reason for travel, and region of travel. As with the total population, the sample for Aim 2 was predominantly between the ages of 40-59 years (40.6%), male (62.5%) vs. female, non-Hispanic-Black (87.5%) vs. every other race/ethnicity, resided in the Bronx (34.4%) vs. any other borough, were VFRs (87.5%) vs. having any other reason for travel, and traveled to West Africa (75%) vs. any other travel region. Nigeria, Ghana, and Guinea had 15.6% of the sub-sample traveling to each of those countries (data not shown in Table 7).

This sub-sample of 2011 differed from the sample 2004-2010 in being more likely to have taken chemoprophylaxis and less likely to be hospitalized. Compared to the larger sample, this sub-sample population took at least some chemoprophylaxis (40.6%vs. 10.9%), adhered to complete regimen (28.1% vs. 5.0%), took a unknown drug (78.1% vs. 26.8) vs. a weekly dose (15.6% vs. 54.9%) vs. a daily dose (6.3% vs. 18.3%), and only 59.4% were ill enough to require hospitalization vs. 77.9% of the cases in the larger sample.

Besides the routine interview that generated the above data, the supplemental 22 item interview of 10 short answer and 12 open-ended questions was conducted in this sub-sample. The responses to the short answer questions found that though 84.4% of the sample had health

insurance, only 37.5% sought pre-travel medical advice. Some chemoprophylaxis was taken by 40% of the population and 28% stated adherence to the full drug regimen. Children traveled with 40.6% of the diagnosed malaria cases and 15.6% said someone else that traveled with them also got sick from malaria. Less than one-third (31.3%) reported using any other malaria preventive measures other than chemoprophylaxis and only six (18.8%) reported having slept under a mosquito bed net and two (6.3%) used insect repellant. The sample population was educated with 46.9% having at least a college degree of which 18.8% had a graduate or professional degree. Private health insurance was had by 66.7% of those that had health insurance (n=27), and 31.3% believed money was the reason why some travelers did not take chemoprophylaxis.

The open-ended questions focused on travelers' knowledge, attitude and behaviors regarding malaria before and after travel (Appendix L). When asked how worried they were about getting sick from travel, 87% of the sub-sample reported not being worried about getting sick. When asked what they believed about health impact of malaria before they traveled, respondents reported they knew malaria could be bad and that they were at risk so they took chemoprophylaxis (40.6%) and another one-third said they knew of the impact of getting malaria, yet they did not take any chemoprophylaxis (34.4%), and 25% stated they did not know about malaria or chemoprophylaxis. After being infected with malaria, 65.6% stated the illness was worse than they expected and 75% stated they would advise travelers to the country they returned from to take chemoprophylaxis. The responses to these open-ended questions add to the knowledge of malaria risk by better understanding VFRs perception of their risk for malaria and the severity of the illness.

When compared to those that took at least some chemoprophylaxis (n=13), those who did not take any chemoprophylaxis (n=19) in this VFRs in the sub-sample were more likely male (84.2% vs. 30.8%), any other race except non-Hispanic Black (15.8% vs. 7.7%), and took an unknown drug (46.2%) vs., a weekly dose (38.5%) vs., a daily dose (15.4%) chemoprophylaxis. All variables were significant unadjusted and had p-values <0.05.

The full tabulations of responses for the open-ended question are in Appendix L.

Table 1: Distribution of selected characteristics of NYC residents diagnosed with malaria by year of diagnosis: 2004-2010

	2004 n=195	**2005** n=177	**2006** n=159	**2007** n=202	**2008** n=171	**2009** n=190	**2010 n=241**	**P-Value***	**TOTAL n=1,335**
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Age (years)								0.03	
0 – 17	40(20.5)	35 (19.8)	42 (26.4)	33 (16.3)	50 (29.2)	37 (19.5)	51 (21.2)		288 (21.6)
18 – 39	81 (41.5)	54 (30.5)	44 (27.7)	69 (34.2)	54 (31.6)	56 (29.5)	87 (36.1)		445 (33.3)
40 -59	66 (33.9)	80 (45.2)	63 (39.6)	84 (41.6)	55 (32.2)	84 (44.2)	82 (34.0)		514 (38.5)
60+	8 (4.1)	8 (4.5)	10 (6.3)	16 (7.9)	12 (7.0)	13 (6.8)	21 (8.7)		88 (6.6)
Gender								0.22	
Female	62 (31.8)	49 (27.7)	45 (28.3)	67 (33.2)	61 (35.7)	75 (39.5)	82 (34.0)		441 (33.0)
Male	133 (68.2)	128 (72.3)	114 (71.7)	135 (66.8)	110 (64.3)	115 (60.5)	159 (66.0)		894 (67.0)
Race								0.15	
Non-Hispanic Black	158 (81.0)	153 (86.4)	145 (91.2)	174 (86.1)	153 (89.5)	165 (86.8)	210 (87.1)		1158 (86.7)
Other races/ethnicities	37 (19.0)	24 (13.6)	14 (8.8)	28 (13.9)	18 (10.5)	25 (13.2)	31 (12.9)		177 (13.3)
Residence								0.45	
Bronx	52 (26.7)	67 (37.9)	47 (29.6)	72 (35.6)	70 (40.9)	71 (37.4)	91 (37.8)		470 (35.2)
Brooklyn	61 (31.3)	43 (24.3)	49 (30.8)	43 (21.3)	40 (23.4)	48 (25.3)	53 (22.0)		337 (25.2)
Manhattan	41 (21.0)	31 (17.5)	23 (14.5)	36 (17.8)	25 (14.6)	30 (15.8)	45 (18.7)		231 (17.3)
Queens	33 (16.9)	29 (16.4)	33 (20.8)	37 (18.3)	25 (14.6)	31 (16.3)	39 (16.2)		227 (17.0)
Staten Island	8 (4.1)	7 (4.0)	7 (4.4)	14 (6.9)	11 (6.4)	10 (5.3)	13 (5.4)		70 (5.2)
Reason for Travel								0.02	
VFRs	115 (59.0)	125 (70.6)	115 (72.3)	141 (69.8)	128 (74.9)	123 (64.7)	173 (71.8)		920 (68.9)
Other reasons	80 (41.0)	52 (29.4)	44 (27.7)	61 (30.2)	43 (25.2)	67 (35.3)	68 (28.2)		415 (31.1)
Region of Travel								0.003	
West Africa	141 (72.3)	129 (72.9)	134 (84.3)	158 (78.2)	145 (84.8)	151 (79.5)	172 (71.4)		1030 (77.2)
Other regions	54 (27.7)	48 (27.1)	25 (15.7)	44 (21.8)	26 (15.2)	39 (20.5)	69 (28.6)		305 (22.9)
Country of Travel								<.0001	
Nigeria	70 (35.9)	45 (25.4)	64 (40.3)	63 (31.2)	43 (25.2)	58 (30.5)	25 (10.4)		368 (27.6)
Other countries	125 (64.1)	132 (74.6)	95 (59.8)	139 (68.8)	128 (74.9)	132 (69.5)	216 (89.6)		967 (72.4)
Chemoprophylaxis Use (any)								0.07	
Yes	41 (21.0)	24 (13.6)	29 (18.2)	32 (15.8)	27 (15.8)	35 (18.4)	25 (10.4)		213 (16.0)
No	154 (79.0)	153 (86.4)	130 (81.8)	170 (84.2)	144 (84.2)	155 (81.6)	216 (89.6)		1122 (84.0)

Adherence								0.41	
Adhered to all pills	13 (6.7)	7 (4.0)	11 (6.9)	10 (5.0)	8 (4.7)	11 (5.8)	7 (2.9)		67 (5.0)
Took some pills,	28 (14.4)	17 (9.6)	18 (11.3)	22 (10.9)	19 (11.1)	24 (12.6)	18 (7.5)		146 (10.9)
No pills taken	154 (79.0)	153 (86.4)	130 (81.8)	170 (84.2)	144 (84.2)	155 (81.6)	216 (89.6)		1122 (84.0)
Type of Chemoprophylaxis								0.32	
Daily	7 (17.1)	2 (8.3)	5 (17.2)	8 (25.0)	3 (11.1)	7 (20.0)	7 (28.0)		39 (18.3)
Weekly	28 (68.3)	16 (66.7)	15 (51.7)	15 (46.9)	18 (66.7)	16 (45.7)	9 (36.0)		117 (54.9)
Drug Unknown	6 (14.6)	6 (25.0)	9 (31.0)	9 (28.1)	6 (22.2)	12 (34.3)	9 (36.0)		57 (26.8)
Pregnant								<.0001	
All females (n=441)	7 (11.3)	3 (6.1)	2 (4.4)	5 (7.5)	5 (8.2)	6 (8.0)	15 (18.3)		43 (9.8)
Females 18-39years (n=175)	7 (24.1)	3 (18.8)	2 (16.7)	3 (9.4)	4 (17.4)	6 (25.0)	11 (28.2)		36 (20.6)
Admitted to Hospital								0.01	
Yes	153 (78.5)	123 (69.5)	119 (74.8)	151 (74.8)	143 (83.6)	158 (83.2)	193 (80.1)		1040 (77.9)
No	42 (21.5)	54 (30.5)	40 (25.2)	51 (25.3)	28 (16.4)	32 (16.8)	48 (19.9)		48 (22.1)
Species									
P. falciparum	143 (73.3)	144 (81.4)	128 (80.5)	160 (79.2)	147 (86.0)	155 (81.6)	192 (79.7)		1069 (80.0)
P. vivax	31 (15.9)	16 (9.0)	12 (7.6)	15 (7.4)	10 (5.9)	8 (4,2)	22 (9.1)		114 (8.5)
P. ovale	6 (3.1)	4 (2.3)	5 (3.1)	9 (4.5)	5 (2.9)	8 (4,2)	5 (2.1)		42 (3.2)
P. malariae	6 (3.1)	6 (3.4)	5 (3.1)	9 (4.5)	2 (1.2)	8 4.2)	5 (2.1)		41 (3.1)
Mixed, 2 species	1 (0,5)	0 (0.0)	1 (0.6)	1 (0.5)	1 (0.6)	3 (1.6)	1 (0.4)		8 (0.6)
Species not specified	8 (4.1)	7 (4.0)	8 (5.0)	8 (4.0)	6 (3.5)	8 (4.2)	16 (6.6)		61 (4.6)

*P-values for chi-square of independence

Table 2: Distribution of selected characteristics of NYC residents diagnosed with malaria according to reasons of travel: 2004-2010

	Visiting friends & relatives (VFR) n=920	All other reasons for travel n=415	P-value*
	n (%)	**n (%)**	
Age (years)			<.0001
0 – 17	177(19.2)	111(26.8)	
18 – 39	272(29.6)	173(41.7)	
40 -59	400(43.5)	114(27.5)	
60+	71(7.7)	17(4.1)	
Gender			0.91
Female	303(32.9)	138(33.3)	
Male	617(67.1)	277(66.8)	
Race			<.0001
Non-Hispanic Black	847(92.1)	311(74.9)	
Other races/ethnicities	73(7.9)	104(25.1)	
Residence			<.0001
Bronx	357(38.8)	113(27.2)	
Brooklyn	226(24.6)	111(26.8)	
Manhattan	129(14.0)	102(24.6)	
Queens	150(16.3)	77(18.6)	
Staten Island	58(6.3)	12(2.9)	
Region of Travel			0.003
West Africa	731(79.5)	299(72.1)	
All other regions	189(20.5)	116(28.0)	
Countries of travel			0.02
Nigeria	271(29.5)	97(23.4)	
All other countries	649(70.5)	318(76.6)	
Chemoprophylaxis Use			0.01
Yes	131(14.2)	82(19.8)	
No	789(85.8)	333(80.2)	
Adherence			0.04
Adhered to all pills	40(4.4)	27(6.5)	
Only took some pills	99(9.9)	55(13.3)	
No pills taken	789(85.8)	333(80.2)	
Type of Chemoprophylaxis			0.005
Daily	16(12.2)	23(28.1)	
Weekly	73(55.7)	44(53.7)	
Type of drug unknown	42(32.1)	15(18.3)	
Pregnant			0.004
Yes	20(2.2)	23(5.5)	
No	900(97.8)	392(94.5)	
Admitted to the Hospital			0.85
Yes	718(78.0)	322(77.6)	
No	202(22.0)	93(22.4)	

*P-values for chi-square of independence

Table 3: Odds ratios* and 95% confidence intervals for the association between reasons of travel and chemoprophylaxis use: NYC, 2004-2010

	Model 1	Model 2	Model 3**
		No Chemoprophylaxis Use	
Reasons of travel			
Other reasons	1.00	1.00	1.00
VFRs	1.48 (1.09-2.01)	1.25 (0.90-1.72)	1.14 (0.82-1.59)

*Chemoprophylaxis taken is the reference group

**Model 1: unadjusted; Model 2: adjusted for: age, gender, and race, Model 3: adjusted for age, gender, race, borough, and travel region

Table 4: Distribution of selected characteristics of NYC residents diagnosed with malaria according to chemoprophylaxis use: 2004-2010

	Yes n=213	No n=1122	P-value*
	n (%)	**n (%)**	
Age (years)			0.001
0 – 17	64(30.1)	224(20.0)	
18 – 39	76(35.7)	369(32.9)	
40 -59	64(30.1)	450(40.1)	
60+	9(4.2)	79(7.0)	
Gender			0.002
Female	90(47.3)	351(31.3)	
Male	123(57.8)	771(68.7)	
Race/ethnicity			0.005
Non-Hispanic Black	172(80.7)	986(87.9)	
Other races/ethnicities	41(19.3)	136(12.1)	
Residence			0.001
Bronx	65(30.5)	405(36.1)	
Brooklyn	52(24.4)	285(25.4)	
Manhattan	58(27.2)	173(15.4)	
Queens	29(13.6)	198(17.7)	
Staten Island	9(4.2)	61(5.4)	
Reasons of travel			0.01
VFRs	131(61.5)	789(70.3)	
Other reasons	82(38.5)	333(29.7)	
Region of travel			0.17
West Africa	172(80.8)	858(76.5)	
All other regions	41(19.3)	264(23.5)	
Countries of travel			0.06
Nigeria	70(32.9)	298(26.6)	
All other countries	143(67.1)	824(73.4)	
Adherence			-
Adhered to all pills	67(31.5)	0(0)	
Only took some pills	146(68.5)	0(0)	
No pills taken	0(0)	1122(100)	
Type of Chemoprophylaxis			-
Daily	39(18.30)	0(0)	
Weekly	117(54.9)	0(0)	
Type of drug unknown	57(26.8)	1122(100)	

Admitted to Hospital			0.03
Yes	154(72.3)	886(79.0)	
No	59(27.7)	236(21.0)	
Reason			0.01
VFR	131(61.5)	789(70.3)	
Every other reason	82(38.5)	333(29.7)	

*P-values for chi-square of independence

Table 5: Characteristics of people diagnosed with malaria according to type of chemoprophylaxis use for those who took chemoprophylaxis: NYC, 2004-2010

	Daily Dose n=39	Weekly Dose n=117	Drug Unknown n=57	P-value*
	n (%)	n (%)	n (%)	
Age (years)				0.0003
0 – 17yo	5(12.8)	38(32.5)	21(36.8)	
18 – 39yo	25(64.1)	39(33.3)	12(21.1)	
F b40 -59yo	7(18.0)	33(28.2)	24(42.1)	
60yo +	2(5.1)	7(6.0)	0(0)	
Gender				0.56
Female	14(35.9)	53(45.3)	23(40.4)	
Male	25(64.1)	64(54.7)	34(59.7)	
Race				<.0001
Non-Hispanic Black	21(53.9)	98(83.8)	53(93.0)	
All other races/ethnicities	18(46.2)	19(16.2)	4(7.0)	
Residence				<.0001
Bronx	6(15.4)	40(34.2)	19(33.3)	
Brooklyn	5(12.8)	36(30.8)	11(19.3)	
Manhattan	24(61.5)	22(18.8)	12(21.1)	
Queens	2(5.1)	15(12.8)	12(21.1)	
Staten Island	2(5.1)	4(3.4)	3(5.3)	
Reason for Travel				0.005
Visiting Friends & Relatives	16(41.0)	73(62.4)	42(73.7)	
All other reasons	23(59.0)	44(37.6)	15(26.3)	
Region of Travel				0.05
West Africa	26(66.7)	98(83.8)	48(84.2)	
All other regions	13(33.3)	19(16.2)	9(15.8)	
Countries of Travel				0.09
Nigeria	7(18.0)	42(35.9)	21(36.8)	
All other countries	32(82.1)	75(64.1)	36(63.2)	
Admitted to Hospital				0.68
Yes	30(76.9)	82(70.1)	42(73.7)	
No	9(23.1)	35(29.9)	15(26>3)	

*P-values for chi-square of independence

Table 6: Odds ratios* and 95% confidence intervals for the association between type of chemoprophylaxis taken and adherence for those who took any chemoprophylaxis drug: NYC, 2004-2010

	Model 1	Model 2	Model 3	Model 4**
		Only took some pills***		
Daily	1.00	1.00	1.00	1.00
Weekly	1.43 (0.69-3.00)	1.15 (0.52-2.54)	1.50 (0.62-3.60)	1.49 (0.62-3.57)
Drug unknown	4.12 (1.59-10.68)	3.11 (1.11-8.72)	4.19 (1.40-12.57)	4.24 (1.41-12.73)

*Adherence to all chemoprophylaxis is the reference group

**Model 1: unadjusted; Model 2: adjusted for: age, gender, and race, Model 3: adjusted for age, gender, race, borough, and travel region, Model 4: adjusted for age, gender, race, borough, travel region, and reason for travel

***Only those cases who took at least some chemoprophylaxis were included in the analyses

Table 7: Distribution of selected characteristics of a sub-sample of NYC residents diagnosed with malaria: August 14 – October 8, 2011

	2011 sub-sample n=32	2004-2010 sample n=1,335
Age (yrs.)	**n (%)**	**n (%)**
0 – 17	10(31.3)	288 (21.6)
18 – 39	8(25.0)	445 (33.3)
40 -59	13(40.6)	514 (38.5)
60+	1(3.1)	88 (6.6)
Gender		
Female	12(37.5)	441 (33.0)
Male	20(62.5)	894 (67.0)
Race		
Non-Hispanic Black	28(87.5)	1158 (86.7)
Other races/ ethnicities	4(12.5)	177 (13.3)
Residence		
Bronx	11(34.4)	470 (35.2)
Brooklyn	10(31.3)	337 (25.2)
Manhattan	6(18.8)	231 (17.3)
Queens	4(12.5)	227 (17.0)
Staten Island	1(3.1)	70 (5.2)
Reason for Travel		
VFR	28(87.5)	920 (68.9)
All other reasons	4(12.5)	415 (31.1)
Region of Travel		
West Africa	24(75.0)	1030 (77.2)
Other regions	8(25.0)	305 (22.9)
Country of Travel		
Nigeria	5(15.6)	368 (27.6)
Other countries	27(84.4)	967 (72.4)
Anyone else get malaria		
Yes	5(15.6)	N/A*
No	27(84.4)	N/A
Traveled with Children		
Yes	13(40.6)	N/A
No	19(59.4)	N/A
Pre-Travel Medical Advice		
Yes	12(37.5)	N/A
No	20(62.5)	N/A
Chemoprophylaxis use		
Yes	13(40.6)	213 (16.0)
No	19(59.4)	1122 (84.0)
Adherence		
Adhered to all pills	9(28.1)	67 (5.0)
Took some pills,	4(12.5)	146 (10.9)
No pills taken	19(59.4)	1122 (84.0)

Type of Chemoprophylaxis*		
Daily	2(15.4)	39 (18.3)
Weekly	5(38.5)	117 (54.9)
Drug Unknown	6(46.2)	57 (26.8)
Admitted to hospital		
Yes	19(59.4)	1040 (77.9)
No	13(40.6)	48(22.1)
Pre-Travel Medical Advice		
Yes	12(37.5)	N/A
No	20(62.5)	N/A
Use a preventive method other than chemoprophylaxis		
Yes	10(31.3)	N/A
No	22(68.7)	N/A
Type of preventive measure used (by those that stated using other prevention measures)		
Mosquito bed net	6(60)	N/A
Insect repellant	2(20)	N/A
Ceiling fan	1(10)	N/A
Window screen	1(10)	N/A
Have Health Insurance		
Yes	27(84.4)	N/A
No	5(15.6)	N/A
Have Medicaid		
Yes	9(28.1)	N/A
No	23(71.9)	N/A
Is Money a reason Travelers Don't Take Chemoprophylaxis		
Yes	10(31.3)	N/A
No	12(37.5)	N/A
Don't Know	10(31.3)	N/A
Highest Level of Education		
Less than high school	4(12.5)	N/A
Some high school	3(9.4)	N/A
High school grad	3(9.4)	N/A
Some college	3(9.4)	N/A
College grad	9(28.1)	N/A
Graduate/Professional degree	6(18.8)	N/A
Refused	4(12.5)	N/A

*Not available

CHAPTER 4

DISCUSSION

4.1 Conclusions

Results show that after adjusting for age, gender, race, borough of residence, and travel region, there was no association between reasons of travel and chemoprophylaxis use among NYC malaria cases diagnosed in NYC between 2004 and 2010. However, when compared to those who reported taking chemoprophylaxis daily, the odds of not adhering to the full regimen was 4.1 times greater for travelers who stated chemoprophylaxis use, but the type of dose could not be recalled or identified. After adjustment for age, gender, race, borough of residence, travel region, and reason for travel, this association remained nearly identical. No association was observed between those who took chemoprophylaxis weekly and adherence before or after adjustment. The results of the sub-sample of VFRs found that VFRs' knowledge of malaria and need for chemoprophylaxis, their perception of the severity of malaria infection, and the ability to access pre-travel medical advice and obtain prescriptions were the determinants of chemoprophylaxis use.

Several studies have examined the association between traveling to visit friends and relatives (VFR) and chemoprophylaxis use.[5, 9, 33, 65, 73] However, these studies have not performed multivariable analyses. The present study did not find an association between reasons of travel and chemoprophylaxis use after adjusting for age, gender, race, borough of residence, and travel region. An airport study conducted in two airports in Kenya surveyed all North American and European travelers returning home from East Africa on their use of preventive measures while visiting.[73] This airport study compared traveling for tourism to all other reasons

for travel. That study found that reason of travel other than for tourism was not a risk factor for compliance with chemoprophylaxis after controlling age, type of drugs, length of stay and adverse events.[74] However, the airport study focused on all travelers departing Kenya regardless of whether they contracted malaria or not. Though no association was found in this present study between VFR and chemoprophylaxis use, known factors associated with VFR travel, such as pre-existing beliefs, lack of pre-travel medical advice, and longer lengths of stay in country can cause VFRs to be at higher risk for malaria and other travel related illness.[10, 18, 75]

To the best of this author's knowledge, this is the first study to examine the association between type of chemoprophylaxis drug use and adherence to the medications among people diagnosed with malaria. The present study found that diagnosed cases of malaria who take weekly dose were as likely to adhere to chemoprophylaxis use as their counterparts taken daily dose drugs. A previous study by Lobel et al. found that all travelers to North America and Europe from East Africa who took a daily dose compared to those who took a weekly dose drug were more likely (OR 5.11, 95% CI 3.64-7.19) not to adhere to their chemoprophylaxis.[73] However, the major difference in these two studies was their populations. Lobel et al. study was in all travelers to East Africa regardless of their malaria status, while the present study was in travelers to all countries who were diagnosed with malaria upon return to NYC.

The present study found that those travelers who reported chemoprophylaxis use, but the dose type could not be identified were more likely to not adhere to the full regimen compared to their counterparts using daily dose chemoprophylaxis. Specifically, the study found that those that did not know the type of chemoprophylaxis drug used had a four-fold odds of not adhering to the drug regimen than those who took a daily dose drug after adjusting for age, gender, race, borough of residence, and travel region.

Finally, the findings of this study's descriptive analysis of those diagnosed with imported malaria were consistent with previous malaria studies in NYC. The characteristics of NYC residents diagnosed with malaria from 2004-2010 were similar to a previous DOHMH's surveillance data from 1993-2002.[1] For example, this present study was consistent with the earlier DOHMH study conducted on 1,015 NYC residents diagnosed with malaria 1993-2002 reporting that cases were more likely non-Hispanic Black (75%), male (64%), resided in the Bronx (35%), traveled to West Africa (66%), and took chemoprophylaxis (5-14%) each year. As what would be expected with the rise in immigration and international travel in the past decade, the percentage of malaria cases in non-Hispanic Blacks has increased from 75% to 86.7% and the percentage of malaria cases that traveled to West Africa increased from 66% to 77.2%. The percentage of cases who reported taking any chemoprophylaxis also increased slightly with a range of 5% to 4% 1993-2002 to 10.4%% to 21% in this study.

The sub-sample study corroborated the findings of the quantitative analyses. This interview found that travelers' knowledge, attitudes, and behaviors regarding malaria were either a barrier to chemoprophylaxis use or an enabler to take it. A couple of prominent themes emerged from the questions regarding the respondents' knowledge about the health impact of malaria and their attitudes toward taking any chemoprophylaxis or adhering to their regimen. The majority of cases in the 2011 sub-sample (87.5%) stated they were not worried about getting sick from traveling abroad. When participants were asked what they believed was the health impact of getting malaria, 40.6% stated they knew they could get sick from malaria and that was the reason they took chemoprophylaxis. However, over one-third (34.4%) of the sample stated that they knew about the health consequences of malaria during travel and their risk for infection, yet, they still did not or could not take chemoprophylaxis. This lack of worry about malaria risk

and/or severity of illness are the reason travelers do not seek pre-travel medical advice to obtain chemoprophylaxis drugs. Another reason is that they do not know about chemoprophylaxis; one-fourth (25%) of the sub-sample population reported they did not know about malaria in the country they traveled to or did not perceive they were at risk. These last two populations, those who do not know about malaria and those who know but do not worry are the populations that would most benefit from a malaria prevention intervention.

Not receiving pre-travel medical care is common among traveling VFRs due to individual factors such as pre-existing health beliefs, barriers to access to care, and provider level barriers.[52, 65] In order to seek pre-travel medical advice, a traveler would have to: 1) perceive their susceptibility to malaria in their country of travel, 2) believe in the severity of the health consequence of getting malaria infection, 3) perceive that there are benefits to seeking pre-travel advise for chemoprophylaxis, and 4) perceive they can overcome barriers to obtaining, taking, and adhering to the regimen.[40, 76-78] With these beliefs, a person traveling abroad to visit friends and relatives is more likely to seek pre-travel medical care.[76-78]

This sub-sample study of VFRs found that having health insurance does not predict VFRs accessing the healthcare system for pre-travel health advice. Though 84.4% of population had health insurance, only a little more than one-third (37.5%) of the sample population sought pre-travel medical advice. Studies have found that some VFRs do not perceive they are susceptible to malaria because they are still immune to malaria and therefore do not need to take precaution.[52] Some people who travel to malaria endemic countries feel that malaria is not a severe illness and if they do get infected it will not be that bad.[53] Some VFRs do not feel they would benefit from a pre-travel medical visit even if they had access to it because most doctors are not knowledgeable in travel medicine and they would not be able to pay for the

chemoprophylaxis if an appropriate drug was prescribed due to a lack of health insurance and money.[53] Among NYC residents in the sub-sample who did receive medical advice, there were three types of facilities where respondents saw a doctor: hospital-based clinics (50%), private medical doctors (33.3%), and freestanding clinics/health centers (16.7%). All twelve (100%) of the respondents that saw a doctor stated they were advised to take chemoprophylaxis. However, despite the doctor's advice, one respondent still did not take any chemoprophylaxis.

Among the people that took chemoprophylaxis, 63.6% adhered to the full regimen. This sub-sample population had a higher rate of chemoprophylaxis use and adherence than in the larger population of the quantitative study where only 16% took chemoprophylaxis and of those 31.5% reported adherence. This higher rate of chemoprophylaxis use in the sub-sample is likely due to the season of travel. The population of the sub-sample population was newly diagnosed malaria cases in 2011 who traveled between June and September. This is the peak travel time to malaria endemic regions because immigrants take their summer vacation when children are out of schools in NYC.[58] These travelers may be more likely experienced international travelers who had planned to travel in advance and had enough time for pre-travel medical advice and to obtain chemoprophylaxis.[79] This may account for the higher percent of chemoprophylaxis use in the sub-sample of 2011 compared to the sample 2004-2010. These travelers in the sub-sample may also have felt more at risk for mosquito bites during the summer season months, and therefore, more likely to take chemoprophylaxis.[79]

When asked "what was the reason respondents did not take any or complete all their chemoprophylaxis?", several themes emerged. Travelers in the sub-sample, all of whom were VFRs, responded that they did not know about malaria or that chemoprophylaxis was recommended for that country (30.4%), did not have time to get and take chemoprophylaxis

before travel because had to travel at last minute due to family emergency (26.1%), just forgot to take some doses (26.1%), thought they were immune to malaria (21.7%), felt chemoprophylaxis was not necessary because malaria was a mild disease like a cold (13.0%), and no health insurance and no money to obtain chemoprophylaxis medicine (4.4%). In general, one reason for poor adherence rates among VFRs is that they stay longer in endemic countries than those who travel for other reasons making it difficult for continuous chemoprophylaxis while abroad.[80] Not only does it become inconvenient to take the medication for an extended period of time, but VFR travelers usually cannot obtain enough chemoprophylaxis before they travel to last through their longer travel time, and therefore, they may run out of medication while still abroad.[81, 82] One reason that did not come up in this study, but has been reported in other studies was that the side effects of the drugs were the reason for not taking or adhering to chemoprophylaxis.[80]

Using personal protective measures to avoid mosquito bites is an effective means of reducing the risk of malaria.[83] Recommending using anti-mosquito measures is an essential message for travelers along with chemoprophylaxis use. This study found that patients reported doctors did not routinely advise their patients to also use anti-mosquito measures to prevent malaria. Only a small percentage of the sub-sample reported their doctors advised them to use barriers to avoid mosquito bites (16.7%), take precaution with food and water (16.7%), and to wash children's hands well and regularly (8.3%). However, like chemoprophylaxis use, the vast majority of VFRs do not use personal protection for malaria when they travel home either due to their culture, beliefs or lack access to preventive items in the places where they stay (no bed nets, air conditioners, or door and window screens). Travelers would need to have cues to action and self-efficacy to assist them in taking and adhering to chemoprophylaxis and using personal anti-mosquito measures such as insect repellant to protect them from mosquito bites.[76-78]

The findings of this study on use of chemoprophylaxis and other malaria preventive measures were consistent with previous studies.[45, 50, 52, 61, 84] A 1995 study in Canada Toronto's Pearson's International Airport focusing on South Asian travelers departing to India interviewed travelers with a 35-question survey to determine what preventive measures they were planning to use for and during their travel.[52] Of the 307 travelers on 14 flights who completed the survey, they were mostly VFRs (87%), most knew about malaria but believed they were not at risk for malaria (41%) and did not know about risk of malaria in India (23%). The remaining travelers in the airport study knew there was a definite risk of them getting malaria (27%) and 9% thought the risk was only seasonal. Only 54% of travelers sought pre-travel medical advice and 70% of those received it from their family doctor. Chemoprophylaxis was used by 31% of the travelers to India and less than10% planned to do at least two preventive measures such as using bed nets, insect repellant, wearing long sleeves or pants, or restricting outdoor activity in the evening. Among the Indian travelers, the reasons for not taking chemoprophylaxis mirrored this present study in that travelers did not believe they were at risk (34%), planned to get chemoprophylaxis drugs in India (26%), unaware chemoprophylaxis was needed (17%), thought they were immune (14%), had been "vaccinated" against malaria (2%) though there was no vaccine available, thought drugs were ineffective (3%), worried about the side effects (1%), and chemoprophylaxis drugs too expensive (0.5%). Though this study had comparable results, it differed from the present study in that all travelers were interviewed regardless of their malaria status.

In the US, a study was conducted in Nigerian immigrants residing in Houston, Texas, to understand their travel health practices and to identify factors that affected their adherence to CDC's guidelines for the prevention of hepatitis A, typhoid, and malaria during travel abroad had similar results.[53] The Texas study utilized a mixed methods approach where qualitative

focus groups were used and quantitative one-on-one semi-structured interviews with travelers and semi-structured interviews with key informant physicians and pharmacists serving the Nigerian community.[53] In general, the results of this Texas Nigerians study found that the participants believed they were at risk for malaria but were not worried about the health impact of getting malaria. Two themes that came up in the Nigerian study and arose in the present NYC study was distrust of providers and the perception that US doctors were incompetent in pre-travel advising patients on risk of travel related illness and in the diagnosis and treatment of malaria once travelers return.[53]

4.2 Limitation

This study has several limitations. A major limitation is that the study focused on NYC residents who have been diagnosed with malaria. This study did not examine the characteristics, beliefs or behaviors of NYC residents who traveled to malaria endemic countries but did not return with a malaria diagnosis. Without this comparison group, this study can only imply what knowledge and beliefs put the population of this study at risk for malaria and what behaviors travelers did or did not do that enabled their malaria infection. What behaviors would have prevented travelers from getting malaria infection cannot be obtained from this study.

Another limitation is that the surveillance survey instrument used is a CDC standardized form for surveillance case investigation and certain data of interest are not collected such as income, health insurance status, highest education attained. or reason chemoprophylaxis was not taken. The questionnaire only asks the reason why all doses were not taken for those cases that stated they took chemoprophylaxis, but it does not ask why they never took any chemoprophylaxis to those who did not take chemoprophylaxis. With the majority of people

(84%) in this study not taking chemoprophylaxis, not asking why they did not take it is an important gap in knowledge. Though this question was asked in the open-ended supplemental survey, only a sub-sample of the population diagnosed in 2011 (n=32) was interviewed with this instrument. Other limitation is that data may be incomplete or inaccurate due to self-report and recall bias. When interviews cannot be conducted, a medical chart review is performed. Since 78% of cases were hospitalized and doctor caring for these patients in the hospital are usually not the patient's primary care provider, data on travel history and chemoprophylaxis drugs taken if any may not be complete or accurately documented in the chart. This would account for the fact that in more than one-fourth of the cases (26.8%) the name of the chemoprophylaxis drug was unknown Some respondents may also be misclassified as VFRs when they were actually immigrants/refugees coming to the US for the first time to visit friends and relatives. This would have overestimated the number of VFRs in the study. This study also has the limitations of any cross sectional study. Since it was conducted in only one city it may not be generalizable to the US and the small sample size for 2011 sub-sample (n=32) of VFRs may not be generalizable to all VFRs.

4.3 Strengths

Strengths of this study are that it is population-based and representative of all New Yorkers diagnosed with malaria. Another strength is that all malaria cases diagnosed in NYC are reported to DOHMH since there is both healthcare provider and laboratory reporting mandated for malaria. In addition, this study was conducted in NYC, the largest city in the US with a diverse urban population, therefore, the results should be representative of other urban cities in the US.[6, 19] NYC also was the ideal setting for this research because it has the most malaria cases

diagnosed annually in the US with approximately 200 cases a year. Data from both the routine malaria case surveillance form, a validated survey instrument, and the supplemental questionnaire was collected by trained and experienced epidemiologists in a standardized manner with protocols for quality assurance. Another important strength of this study is that it used the supplemental questionnaire included open-ended questions. By using an open-ended supplemental interview tool, this study not only described the characteristics of those diagnosed with imported malaria but identified individual and structural barriers that explain why travelers do not take or adhere to chemoprophylaxis. In addition, few questions were asked on both questionnaires and worded in different ways to validate the responses. Finally, this study was the first to use both a large quantitative sample of surveillance data and an in-depth open-ended interview of a small sample of imported malaria cases in such a population and the findings have substantial public health implications for prevention of imported malaria in the US.

CHAPTER 5

POLICY IMPLICATIONS AND RECOMMENDATIONS

5.1 Introduction

The findings of this study were most informative regarding travelers' perception of malaria risk, its severity, and insightful on why people diagnosed with malaria did or did not take chemoprophylaxis or use other preventive measures. These findings along with the results of the socio-demographic characteristics of those NYC residents that returned from travel infected with malaria have substantial implications for malaria prevention outreach and intervention programs with all travelers to malaria endemic countries and primary care providers. This chapter will first discuss the policy implications of this research study to eliminate structural barriers of access to pre-travel care and chemoprophylaxis for malaria prevention. Next recommendations will be suggested to reduce the population level barrier of access to trained providers knowledgeable of travel medicine and decrease individual level barriers placing travelers at risk for malaria such as not taking and adhering to chemoprophylaxis. Lastly, recommendations will be suggested for future malaria research studies.

5.2 Policy implications

Programs are needed to facilitate travelers, especially immigrants, access to pre-travel medical advice. In general, present travel clinics that cater to the tourist population should be able to accept private health insurance plans as well as state sponsored Medicaid for pre-travel medical visit. This visit should include risk assessment, vaccinations, and prescriptions for chemoprophylaxis. Health insurance drug plans should pay for costs of chemoprophylaxis drugs

and allow enough medication to be given before departure to cover the longer duration of stay in country of origin for VFR travelers.

NYC Department of Health and Mental Hygiene should prioritize malaria prevention in NYC immigrant groups to improve the health of its traveling populations and decrease the medical costs associated with treatment and hospitalization in NYC from malaria. DOHMH should set up and provide public travel medicine clinics accepting all health insurances and providing free travel medicine care for the uninsured. These programs should offer free or reduced cost vaccinations, chemoprophylaxis and other travel related illness services that travelers may need. This would be an ideal intervention, if DOHMH resources were not limited as they are now.

NYC DOHMH and the New York State (NYS) Department of Health should lobby the NYS legislature to mandate and support continued medical education (CME) training programs in travel medicine for all primary care providers. This training should include educating providers on the special issues of travel medicine regarding cultural beliefs of immigrant populations. Topics should include conducting a travel risk assessments, providing pre-travel medical advice, and prescribing the appropriate chemoprophylaxis drug based patients' medical history, convenience of dosage type, and country of travel. Providers also should be trained in the diagnosis and treatment of travel related illnesses. DOHMH should add malaria prevention and chemoprophylaxis to their Public Health Detailing program which provides health education to primary care providers in the community on prescribing appropriate medications for selected health issues.[67, 68] Through academic detailing, DOHMH health educators would visit free standing clinics and private doctor offices to have a one on one discussion regarding issues of chemoprophylaxis advice for their traveling patients.[67, 68]

Request to fund these initiatives should be proposed to Exxon Mobile, the Melinda and Bill Gates Foundation, and pharmaceutical companies. The Melinda and Bill Gates Foundation provides funding for malaria prevention initiatives to tax exempt organizations and Exxon-Mobile funds global malaria prevention through their Roll Back Malaria program. Though these two foundations support prevention and eradication of malaria in malaria endemic countries abroad, proposal should be written to request funding for programs to prevention imported malaria in the US. These programs could then supply bed nets and insect repellants to travelers before travel. Funding can also be used for public health messaging to get recommendations out to the traveling public at large. Just as DOHMH does for smoking cessation, a public health campaign can be launched to recommend chemoprophylaxis use when traveling to malaria endemic regions. This campaign should include TV and radio commercials, internet ads, distributing malaria prevention materials to travel agencies, schools, medical offices, and community organizations.

5.3 Recommendations

Decreasing the number of malaria cases in NYC residents in subsequent years will require a two-component outreach approach targeting both the medical provider community and NYC residents who travel to malaria endemic countries, especially immigrant VFRs. Both interventions should be evaluated to assess the effectiveness of the program.

For providers:

Outreach to NYC providers is recommended to convey the importance of travel risk assessment of providers' patients during routine well care visits for adults and children.[85] A

hospital in the Bronx utilizes its outpatient pediatric clinic to conduct travel risk assessment for their pediatric patients and their families during general health care visits.[63, 64] Primary care providers should utilize this model to increase opportunities to discuss travel health care with the parents of their patients. Besides traveling immigrants, providers should specifically target children and pregnant women. Pediatricians and Obstetrics/Gynecology (OB/GYN) providers should conduct a travel risk assessment as part of the routine checkup during their patient's annual pediatric and OB/GYN visit. This present study had significant findings for these two populations that are the most vulnerable to malaria and its complications. This study found children 17 and younger were more likely to take chemoprophylaxis (22.2%) than adults (13.3%). However among those that took at least some chemoprophylaxis, children 17 and younger only 20.3% adhered to full regimen compared to 38.2% of adults. Among women diagnosed with malaria that were of child bearing age 18-39, at least 20.6% were pregnant at time of malaria diagnosis. Though chemoprophylaxis is not only safe in pregnancy, but highly recommended, 88.9% of the pregnant women did not take any chemoprophylaxis, and 8.3% did not adhere to the full regimen. These findings in children and women are noteworthy for primary care providers as well as public health professionals for the planning and implementation of prevention program initiatives.

As discussed earlier, clinicians require education and training on the need to encourage use of malaria prophylaxis and need further information on the appropriate diagnostic and treatment guidelines for malaria.[57] If training programs are not available through DOHMH, NYS Department of Health, or CDC, providers should do their own research and gather information topics of travel medicine and chemoprophylaxis in order to stay abreast of current recommendations in order to better serve their patients. Though there is little data and no

published recommendations on providing pre-travel medical advice to VFR[65], there are online resources available to providers to educate themselves on providing pre-travel medical advice, especially on the Centers for Disease Control and Prevention malaria website (Appendix M).[19]

Providers should inform patients on the risk and severity of malaria and instruct them on how to take the medication in a way to cue them not to forget. They should give their patients helpful tips, like taking a weekly dose every Monday and think of it as "Malaria Monday", to remind them to take their pill every Monday have been given by providers to their patients. By conducting a travel risk assessment, providers can determine what chemoprophylaxis drug is best for the patient based on their medical history and more convenient for each patient, whether weekly or a daily dose. Having the appropriate medication and informed of any possible side effects in advance, will give a patient the self-efficacy their need to believe they can adhere to the chemoprophylaxis regimen.

For travelers:

Studies have shown that chemoprophylaxis use and adherence are the primary prevention methods for imported malaria in travelers.[45, 52, 80-82] As this and other studies have shown, taking chemoprophylaxis does not guarantee a traveler will not be infected with malaria, but just taking some chemoprophylaxis can prevent a more severe or fatal case of malaria.[1, 19] Of the four fatal cases of malaria 2004-2010, none of these cases took any chemoprophylaxis. Travelers' must realize that malaria is not just a mild disease like getting a cold.

All travelers should research the country of travel and seek pre-travel medical advice before travel to have their risk for travel related disease or injury assessed and to get medical advice on how to reduce their risk for the country of travel to prevent all travel-related illnesses.[7]

If country of travel is identified as having any risk of malaria transmission, travelers should obtain, take, and adhere to chemoprophylaxis regimen prescribed by their provider. Besides taking chemoprophylaxis, travelers should take personal anti-mosquito measures to avoid mosquito bites including using insect repellants, sleeping under a bed nets, wearing long sleeves and pants in the evening, and avoiding rural areas where mosquitoes s breed.

5.4 Future research

Individuals who reside in NYC, travel home to visit friends and relatives, and return with malaria represent missed opportunities for disease prevention. Further researching this public health issue would contribute to our understanding of the barriers to prevention and aid in the development of future programs to prevent malaria infection in travelers residing in NYC. To implement effective outreach programs targeting the populations and behaviors at greatest risk, more research is also needed.

Investigating malaria prevention in travelers would benefit from both a large quantitative sample and truly qualitative study. Conducting a study utilizing in depth one on one interviews and focus groups would fill the gap in knowledge. A mixed methods malaria research study in NYC could answer three important research questions that would fill the gap in knowledge of malaria prevention: 1) Does failing to take any chemoprophylaxis, or adhering to the regimen place travelers at higher risk for malaria?, 2) What are the predictors or barriers to failing to take or adhere to chemoprophylaxis?, and 3) What are the key components of an effective malaria prevention program for immigrants? Studies have investigated the characteristics of travelers infected with malaria, chemoprophylaxis use, and why people do not take or adhere to it. But research on best practices for malaria prevention in immigrants is still lacking.

To determine why NYC residents do not take chemoprophylaxis, the barriers to adhering to their regimen, and the decision making process that led these travelers to decide not to take or adhere to the prevention, the study would benefit from adding a qualitative method such as focus group for an in-depth exploration of immigrants and travelers' attitudes, perceptions and behaviors. With focus groups, the study could ascertain how participants feel about issues of pre-travel medical advice and if and why they seek it before travel. Focus groups of immigrants and community health educators could also explore ideas for implementing a malaria prevention program, focusing on what type of messages participants would be amenable to, how best to present those messages, and in what venues. Having key informants in the group would identify best practices and venues to reach hard to find immigrant populations. Focus groups of healthcare providers, as done in the Texas study, could also identify issues that impact immigrants such as providers attitudes on access to appropriate care for travelers, providers' beliefs on immigrant health, and providers' knowledge and confidence in their travel medicine.[53]

For these reasons, a mixed methods approach would be the ideal research design for malaria prevention research in NYC. A study that includes data analysis of surveillance survey data, supplementary in-depth surveys, focus groups of primary care providers that care for immigrants, focus groups of NYC residents who travel abroad regardless of their malaria status, and focus groups of health educators and key informants in the community. The Texas study and the DOHMH study are two examples of the effectiveness of using a mixed method approach with focus groups and survey methods to investigate and develop malaria prevention approaches. However, there is still a gap in knowledge that future research could address. The Texas study was limited to one city, Houston, and conducted only in the Nigerian community so not generalizable to the general population of immigrants in the US. The NYC DOHMH study was

conducted several years ago and only one focus group was conducted. Other limitations of the DOHMH study is that the focus group participants were not immigrants who travel, but the employees and key leaders from one community based organization that worked as Health Educators. This was not a diverse focus group therefore findings could not be generalized to the larger NYC immigrant population.

Cost analysis research should also be conducted to evaluate the cost of providing free chemoprophylaxis compared to the cost of treatment and hospitalization for those travelers who return to NYC with malaria. These data can be used for proposal to request funding for malaria prevention programs in NYC residents.

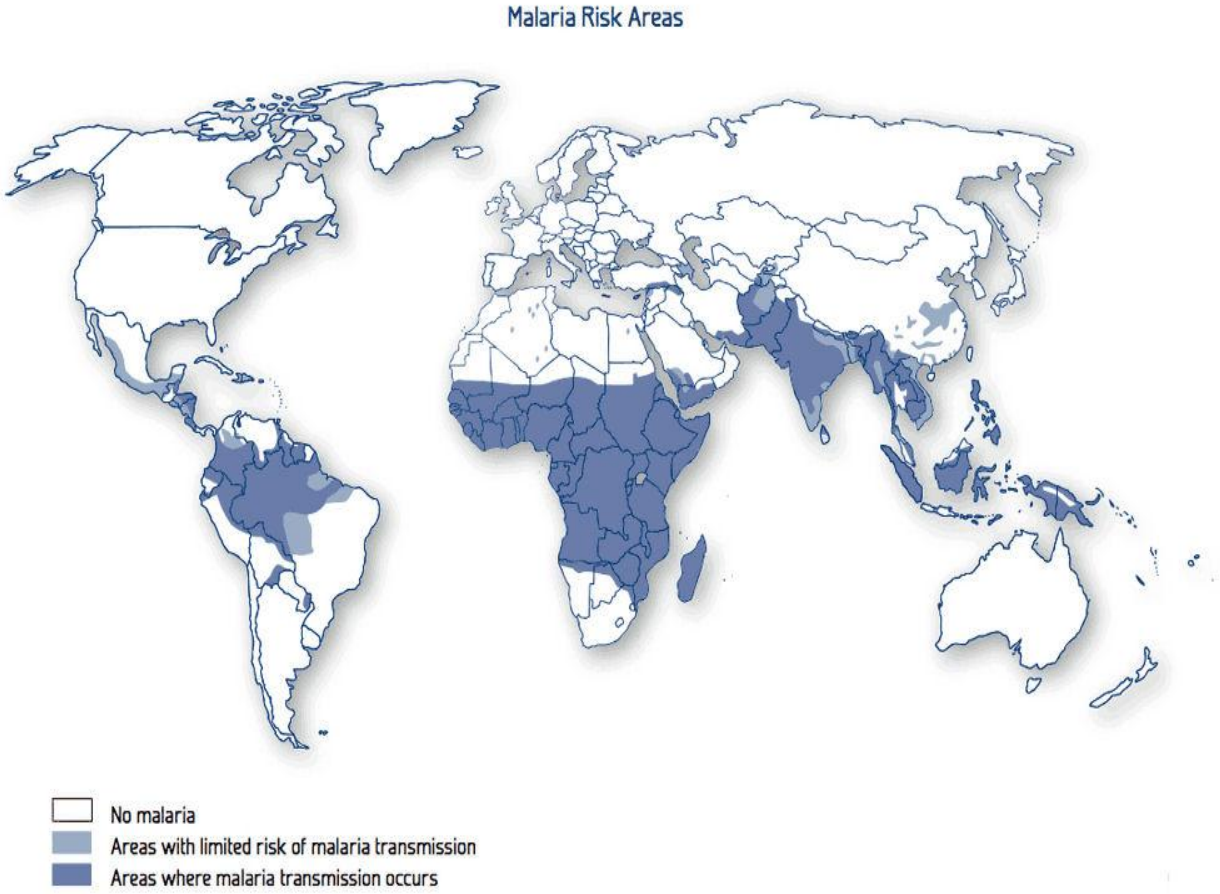
5.5 Study significance

Though the burden of malaria morbidity and mortality is not as high as some other infectious or chronic diseases, this study's findings are important to public health because malaria in travelers is a preventable disease and efforts should be made to eliminate imported malaria into NYC and the US.[25] Moreover, this study contributes to our knowledge on issues around chemoprophylaxis use and adherence not only for malaria but also for common diseases. As stated previously, non-adherence to medication is a major public health issue in the US.[44] Of all medication related hospital admissions in the US, non-adherence to medication accounts for 33-66% of those admissions which is responsible for approximately $100 billion in direct healthcare cost.[41,-44] Thus, this study's findings could be applied to infectious diseases such as HIV and chronic diseases such as diabetes, hypertension and asthma where studies have shown that individuals have difficulty adhering to their recommended drug regimens.[44]

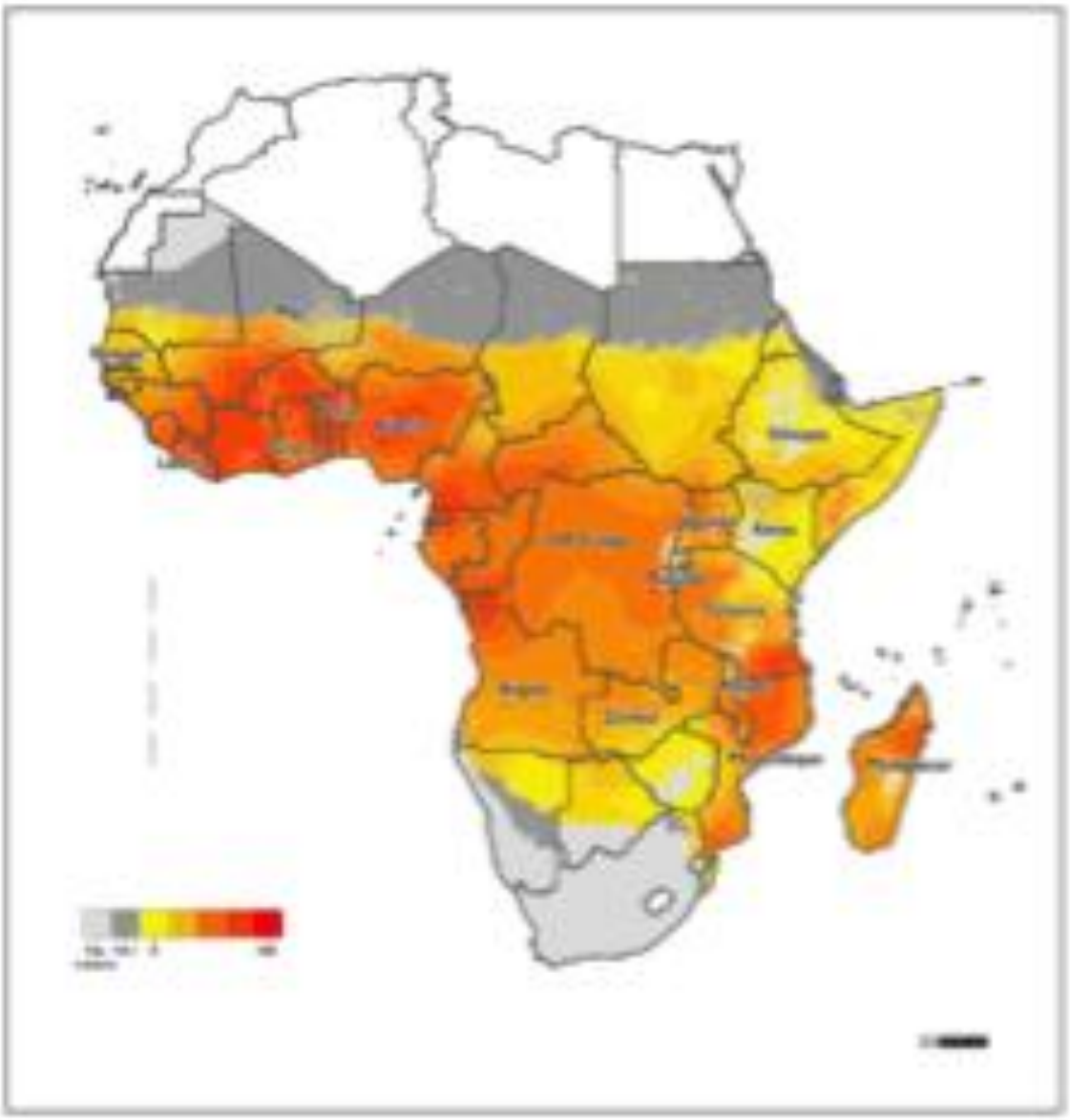
The World Health Organization (WHO) states that non adherence is the primary reason for suboptimal clinical benefits from medications for HIV, diabetes, hypertension and asthma.[44] Like malaria, there are barriers on multiple levels making it difficult for patients to adhere to the medication regimen for these diseases and WHO suggests that interventions to increase adherence should have several components including individual, community, and structural level interventions. [44] Findings from this study on the reasons why travelers diagnosed with malaria did not take or adhere to their chemoprophylaxis can be applied to studies focusing on treatment management programs for diabetes, hypertension and asthma to increase adherence to medication. This study found that prevention programs should a) focus on individual level barriers such as patients' knowledge of the disease and what behaviors put them at risk, and b) stress the severity of the disease and how non-adherence may lead to complications such as a stroke in uncontrolled hypertension or loss of an extremity for uncontrolled diabetes. Programs need to increase individuals' access to healthcare providers trained and experienced in issues of the disease of interest and aware of the social and cultural barriers that may interfere with adherence to medication(s). Not only do people need to be able to obtain the necessary medication, but they also need support to realize the benefits of adherence outweigh the cost of taking the medication.[76-78] This study showed that unless patients are knowledgeable, have access to care and medication, and the self-efficacy needed to overcome the barriers for taking the necessary steps to prevent disease, they would not take and adhere to any medication and would be at risk for disease and poor health.[76-78]

APPENDICES

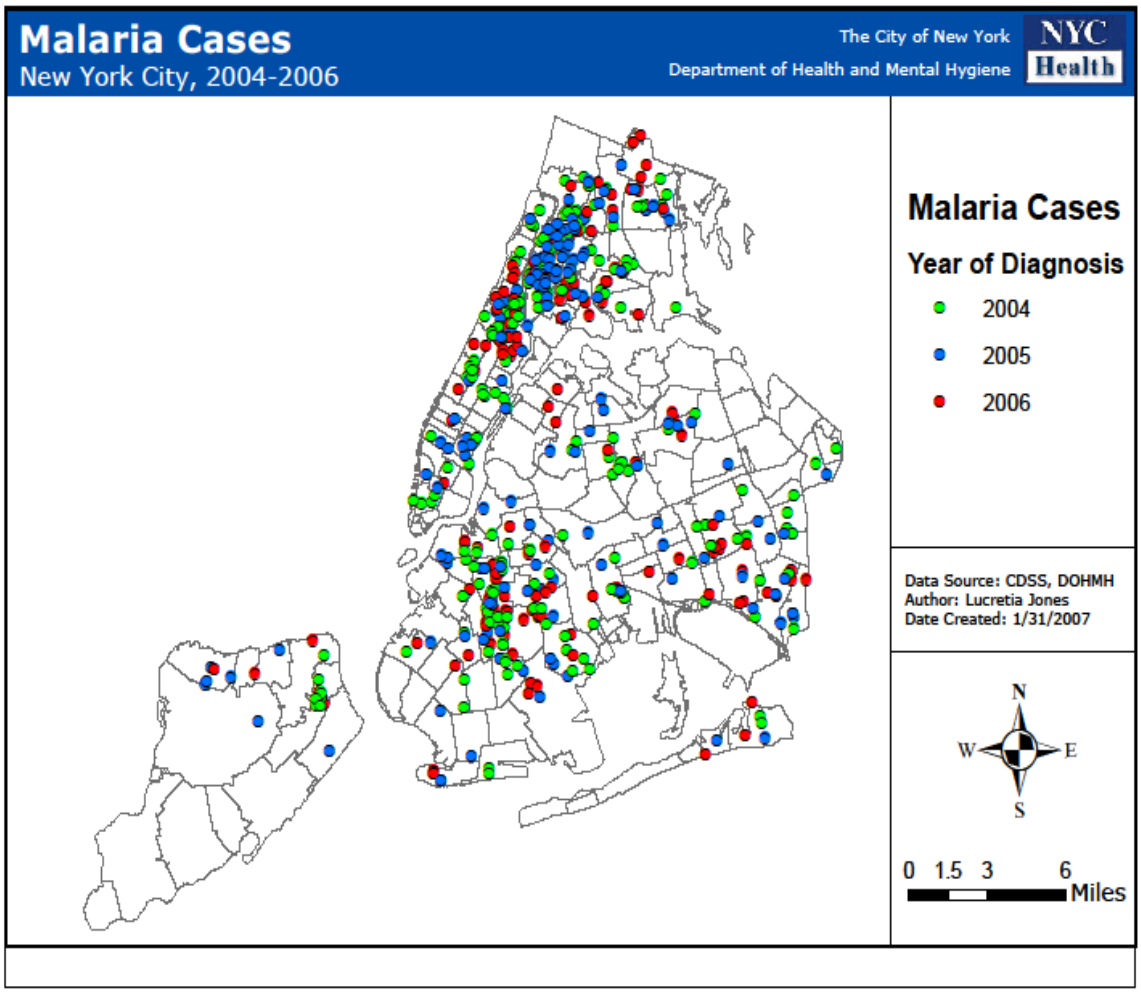
Appendix A
Malaria distribution worldwide



Appendix B
Malaria distribution in Africa



Appendix C
NYC malaria cases by zip code, 2004-2010



Appendix D

Considerations when choosing a drug for malaria prophylaxis

DRUG	REASONS TO CONSIDER USE OF THIS DRUG	REASONS TO CONSIDER AVOIDING USE OF THIS DRUG
Atovaquone-proguanil	• Good for last-minute travelers because the drug is started 1–2 days before travel • Some people prefer to take a daily medicine • Good choice for shorter trips because you have to take the medicine for only 7 days after traveling rather than 4 weeks • Well tolerated—side effects uncommon • Pediatric tablets are available and may be more convenient	• Cannot be used by women who are pregnant or breastfeeding a child that weighs <5 kg • Cannot be taken by people with severe renal impairment • Tends to be more expensive than some of the other options (especially for long trips) • Some people (including children) would rather not take a medicine every day
Chloroquine	• Some people would rather take medicine weekly • Good choice for long trips because it is taken only weekly • Some people are already taking hydroxychloroquine chronically for rheumatologic conditions; in those instances, they may not have to take an additional medicine • Can be used in all trimesters of pregnancy	• Cannot be used in areas with chloroquine or mefloquine resistance • May exacerbate psoriasis • Some people would rather not take a weekly medication • For short trips, some people would rather not take medication for 4 weeks after travel • Not a good choice for last-minute travelers, because drug needs to be started 1–2 weeks before travel
Doxycycline	• Some people prefer to take a daily medicine • Good for last-minute travelers because the drug is started 1–2 days before travel • Tends to be the least expensive antimalarial • People who are already taking doxycycline chronically to prevent acne do not have to take an additional medicine • Doxycycline also can prevent some additional infections (such as rickettsial infections and leptospirosis), so it may be preferred by people planning to hike, camp, and swim in fresh water	• Cannot be used by pregnant women and children aged <8 years • Some people would rather not take a medicine every day • For short trips, some people would rather not take medication for 4 weeks after travel • Women prone to getting vaginal yeast infections when taking antibiotics may prefer taking a different medicine • People may want to avoid the increased risk of sun sensitivity • Some people are concerned about the potential of getting an upset stomach from doxycycline
	• Some people would rather take	• Cannot be used in areas with

DRUG	REASONS TO CONSIDER USE OF THIS DRUG	REASONS TO CONSIDER AVOIDING USE OF THIS DRUG
	medicine weekly	mefloquine resistance
Mefloquine	• Good choice for long trips because it is taken only weekly • Can be used during pregnancy	• Cannot be used in patients with certain psychiatric conditions • Cannot be used in patients with a seizure disorder • Not recommended for people with cardiac conduction abnormalities • Not a good choice for last-minute travelers because drug needs to be started at least 2 weeks before travel • Some people would rather not take a weekly medication • For short trips, some people would rather not take medication for 4 weeks after travel
Primaquine	• It is the most effective medicine for preventing *P. vivax*, so it is a good choice for travel to places with more than 90% *P. vivax* • Good choice for shorter trips because you only have to take the medicine for 7 days after traveling rather than 4 weeks • Good for last-minute travelers because the drug is started 1–2 days before travel • Some people prefer to take a daily medicine	• Cannot be used in patients with glucose-6-phosphate dehydrogenase (G6PD) deficiency • Cannot be used in patients who have not been tested for G6PD deficiency • There are costs and delays associated with getting a G6PD test; however, it only has to be done once. Once a normal G6PD level is verified and documented, the test does not have to be repeated the next time primaquine is considered • Cannot be used by pregnant women • Cannot be used by women who are breastfeeding, unless the infant has also been tested for G6PD deficiency • Some people (including children) would rather not take a medicine every day • Some people are concerned about the potential of getting an upset stomach from primaquine

Appendix D (continued)

CDC recommendations on dosage of drugs for prophylaxis for malaria

DRUG	USAGE	ADULT DOSE	PEDIATRIC DOSE	COMMENTS
Atovaquone-proguanil	Prophylaxis in all areas	Adult tablets contain 250 mg atovaquone and 100 mg proguanil hydrochloride. 1 adult tablet orally, daily	Pediatric tablets contain 62.5 mg atovaquone and 25 mg proguanil hydrochloride. 5–8 kg: 1/2 pediatric tablet daily > 8–10 kg: 3/4 pediatric tablet daily > 10–20 kg: 1 pediatric tablet daily > 20–30 kg: 2 pediatric tablets daily > 30–40 kg: 3 pediatric tablets daily > 40 kg: 1 adult tablet daily	Begin 1–2 days before travel to malarious areas. Take daily at the same time each day while in the malarious area and for 7 days after leaving such areas. Contraindicated in people with severe renal impairment (creatinine clearance <30 mL/min). Atovaquone-proguanil should be taken with food or a milky drink. Not recommended for prophylaxis for children weighing <5 kg, pregnant women, and women breastfeeding infants weighing <5 kg. Partial tablet doses may need to be prepared by a pharmacist and dispensed in individual capsules, as described in the text.
Chloroquine phosphate	Prophylaxis only in areas with chloroquine-sensitive malaria	300 mg base (500 mg salt) orally, once/week	5 mg/kg base (8.3 mg/kg salt) orally, once/week, up to maximum adult dose of 300 mg base	Begin 1–2 weeks before travel to malarious areas. Take weekly on the same day of the week while in the malarious area and for 4 weeks after leaving such areas. May exacerbate psoriasis.
Doxycycline	Prophylaxis in all areas	100 mg orally, daily	≥8 years of age: 2.2 mg/kg up to adult dose of 100 mg/day	Begin 1–2 days before travel to malarious areas. Take daily at the same time each day while in the malarious area and for 4 weeks after leaving such areas. Contraindicated in children <8 years of age and pregnant women.
Hydroxychloro-quine sulfate	An alternative to chloroquine for prophylaxis only in areas with chloroquine-	310 mg base (400 mg salt) orally, once/week	5 mg/kg base (6.5 mg/kg salt) orally, once/week, up to maximum adult dose of 310 mg	Begin 1–2 weeks before travel to malarious areas. Take weekly on the same day of the week while in the malarious area and for 4 weeks after

DRUG	USAGE	ADULT DOSE	PEDIATRIC DOSE	COMMENTS
	sensitive malaria		base	leaving such areas.
Mefloquine	Prophylaxis in areas with mefloquine-sensitive malaria	228 mg base (250 mg salt) orally, once/week	≤9 kg: 4.6 mg/kg base (5 mg/kg salt) orally, once/week > 9-19 kg: 1/4 tablet once/week > 19-30 kg: 1/2 tablet once/week > 30-45 kg: 3/4 tablet once/week > 45 kg: 1 tablet once/week	Begin ≥2 weeks before travel to malarious areas. Take weekly on the same day of the week while in the malarious area and for 4 weeks after leaving such areas. Contraindicated in people allergic to mefloquine or related compounds (quinine, quinidine) and in people with active depression, a recent history of depression, generalized anxiety disorder, psychosis, schizophrenia, other major psychiatric disorders, or seizures. Use with caution in persons with psychiatric disturbances or a previous history of depression. Not recommended for persons with cardiac conduction abnormalities.
Primaquine[1]	Prophylaxis for short-duration travel to areas with principally *P.vivax*	30 mg base (52.6 mg salt) orally, daily	0.5 mg/kg base (0.8 mg/kg salt) up to adult dose orally, daily	Begin 1–2 days before travel to malarious areas. Take daily at the same time each day while in the malarious area and for 7 days after leaving such areas. Contraindicated in people with G6PD deficiency. Also contraindicated during pregnancy and lactation, unless the infant being breastfed has a documented normal G6PD level.
	Used for presumptive antirelapse therapy (terminal prophylaxis) to decrease the risk for relapses of *P. vivax* and *P. ovale*	30 mg base (52.6 mg salt) orally, daily for 14 days after departure from the malarious area	0.5 mg/kg base (0.8 mg/kg salt) up to adult dose orally, daily for 14 days after departure from the malarious area	Indicated for people who have had prolonged exposure to *P. vivax*, *P. ovale*, or both. Contraindicated in people with G6PD deficiency. Also contraindicated during pregnancy and lactation, unless the infant being breastfed has a documented normal G6PD level.

Appendix E

Reportable Diseases to NYC DOHMH
Bureau of Communicable Disease

AMEBIASIS
ANTHRAX
ARBOVIRAL INFECTION
BABESIOSIS
BOTULISM, FOODBORNE
BOTULISM, INFANT
BOTULISM, OTHER
BRUCELLOSIS
CAMPYLOBACTERIOSIS
CHOLERA
CRYPTOSPORIDIOSIS
CYCLOSPORA
DENGUE FEVER
E COLI O157
EHRLICHIOSIS, NOT OTHERWISE SPECIFIED
ENCEPHALITIS, PRIMARY
GROUP A STREP, INVASIVE
GROUP B STREP, INVASIVE
GIARDIASIS
GLANDERS
HEPATITIS DELTA
HEPATITIS A
HEPATITIS B
HEPATITIS C
HEPATITIS E VIRUS
HEPATITIS OTHER OR UNSPECIFIED
ANAPLASMOSIS, HUMAN GRANULOCYTIC
HAEMOPHILUS INFLUENZAE, INVASIVE
EHRLICHIOSIS, HUMAN MONOCYTIC
HANTAVIRUS INFECTION
HEMOLYTIC UREMIC SYNDROME
INFLUENZA
KAWASAKI
LYMPHOCYTIC CHORIOMENINGITIS VIRUS
LEGIONELLA
LEPTOSPIROSIS
LISTERIOSIS
LEPROSY
LYME DISEASE
MALARIA
VIRAL MENINGITIS
MELIOIDOSIS
NEISSERIA MENINGITIDIS
MENINGITIS, BACTERIAL, OTHER
MISCELLANEOUS
MONKEYPOX
METHICILLIN RESISTANT STAPH AUREUS
NOROVIRUS
NON SPECIFIC RICKETTSIAL AB
PEDIATRIC FLU DEATH
PLAGUE
STREPTOCOCCUS PNEUMONIAE
PSITTACOSIS
PARATYPHI
Q FEVER
RABIES, ANIMAL
RABIES, HUMAN
RICIN
RICKETTSIALPOX
ROCKY MOUNTAIN SPOTTED FEVER
ROTAVIRUS
RESPIRATORY SYNCYTIAL VIRUS
SALMONELLA
SARS
STAPH ENTEROTOXIN B
SHIGELLA
SHIGATOXIN PRODUCING E. COLI
SMALLPOX
TRACHOMA
TRICHINOSIS
TRANSMISSIBLE SPONGIFORM ENCEPH
TOXIC SHOCK SYNDROME
TULAREMIA
TYPHOID FEVER
VIRAL HEMORRHAGIC FEVER
NONCHOLERA VIBRIOS
VANCOMYCIN INTERMEDIATE STAPHYLOCOCCAL AUREUS
WEST NILE FEVER
WEST NILE VIRUS
YELLOW FEVER
YERSINIOSIS

Appendix F
CDC malaria case surveillance form (Aim 1 and 2)

MALARIA CASE SURVEILLANCE REPORT

Department of Health and Human Services, Centers for Disease Control and Prevention
Division of Parasitic Diseases (MS F-22), 4770 Buford Highway, N.E. Atlanta, Georgia 30341

Part I

State Case No: ..... CSID No..... Case No: .....

Patient name (last, first):

Date of symptom onset of this attack (mm/dd/yyyy): ____/ ____/ _____

Age: _____ yrs. mos. wks. days (*circle units*)
Date of Birth: ____/ ____/ _____
Is patient pregnant? ☐ Yes ☐ No
Height: ____ ft. and _____in. Weight:____ lbs.

Sex:
☐ Male
☐ Female
☐ Unknown

Physician name (last, first):

Telephone Number: ( ) _____ – _____

Ethnicity:
☐ Hispanic or Latino
☐ Not Hispanic or Latino

Race (select one or more):
☐ American Indian/Alaska Native
☐ Native Hawaiian/Other Pacific Islander
☐ Black or African American
☐ Asian ☐ White ☐ Unknown

Positive lab test result (*check all that apply*):
☐ Smear ☐PCR ☐RDT ☐ No test done/unknown

Species (check all that apply):
☐ Vivax ☐ Falciparum ☐Malariae ☐ Ovale ☐ Not Determined
☐ Other species (specify) _____

Parasitemia (%): _____

State/territory reporting this case: _____
County: _____

Patient admitted to hospital: ☐ Yes ☐ No ☐ Unknown

Hospital: _____

Date: ____/ ____/ _____ Hospital record No.: _____

Laboratory name:

Telephone Number: ( ) _____ – _____

Specimens being sent to CDC? ☐ Yes ☐ No ☐ Unknown

If yes: ☐ Smears ☐ Whole Blood ☐ Other: _____

Has the patient traveled or lived outside the U.S. during the past 2 years? ☐Yes ☐ No If yes, specify:

	1.	2.	3.
Country:	_____	_____	_____
Date returned/ arrived in U.S. (mm/dd/yyyy):	____/ ____/ _____	____/ ____/ _____	____/ ____/ _____
Duration in country yrs. mos. wks. days (*circle units*)	_____	_____	_____

Did patient reside in U.S. prior to most recent travel?
☐ Yes
☐ No, (specify country): _____
☐ Unknown

Principal reason for travel from/ to U.S. for most recent trip:
☐ Tourism ☐ Visiting friends/relatives ☐ Student/teacher
☐ Military ☐ Airline/ship crew ☐ Other: _____
☐ Business ☐ Missionary or dependent ☐ Unknown
☐ Peace Corps ☐ Refugee/immigrant

Was malaria chemoprophylaxis taken? ☐ Yes ☐ No ☐ Unknown
If yes, which drugs were taken? ☐ Chloroquine ☐ Mefloquine ☐ Doxycycline ☐ Primaquine ☐ Atovaquone/proguanil
☐ Other: _____ ☐ Unknown

Was chemoprophylaxis taken as prescribed?
☐ Yes, missed no doses
☐ No, missed doses
☐ Unknown

If doses were missed, what was the reason?
☐ Forgot
☐ Didn't think needed
☐ Had a side effect (specify): _____
☐ Was advised by others to stop
☐ Prematurely stopped taking once home
☐ Other (specify): _____
☐ Unknown

History of malaria in last 12 months (prior to this report)?
☐ Yes ☐ No ☐ Unknown
Date of previous illness: ____/ ____/ _____
If yes, species (check all that apply):
☐Vivax ☐ Falciparum ☐Malariae ☐ Ovale
☐Not Determined ☐ Other (specify) _____

Blood transfusion/organ transplant within last 12 months: ☐ Yes ☐ No ☐ Unknown If yes, date: ____/ ____/ _____

Clinical Complications: ☐ Cerebral malaria ☐ ARDS ☐ None ☐ Renal failure ☐ Severe anemia(Hb<7) ☐ Other : _____

Was illness fatal: ☐ Yes ☐ No ☐ Unknown
If yes, date of death : _____/____/_____

Therapy for this attack (check all that apply):
☐ Chloroquine ☐ Tetracycline ☐ Doxycycline ☐Mefloquine ☐ Exchange transfusion ☐ Artesunate ☐ Artemether/lumefantrine ☐ Unknown
☐ Primaquine ☐ Quinine ☐ Quinidine ☐Clindamycin ☐Atovaquone/proguanil ☐ Other (specify): _____

Person submitting report: Telephone No. :

Affiliation: Date Submitted: _____/_____/_____

For CDC Use Only. Classification ☐ Imported ☐ Induced ☐ Introduced ☐ Congenital ☐ Cryptic

CDC 54.1 11/2011 (Front) OMB 0920-0009

If sending specimens, please forward blood smears (thick and thin) with this report.

A**ppendix G**
Supplemental questionnaire for sample of malaria cases: 2011 (Aim 2)

EVT Number: _____ **Date of Interview** _____/_____/____

Instructions: *Please read each question and allow person to respond freely.*

DO NOT READ OFF CHOICES. *Use choices only to clarify answers given.*

Hi, my name is _____ and I am calling from the New York City Department of Health.

We received a laboratory report indicating you have been diagnosed with malaria. I need to ask you a few questions about your possible illness. We are also trying to learn more about how to protect other people who are traveling by interviewing people who got malaria during their recent travel. I'd like to ask you some additional questions about pre travel health advice you may have received, your beliefs about malaria, as well as what helped you and could help other travelers.

This interview will take approximately 15 minutes to complete. If you prefer not to answer a specific question, you can refuse and I will go on to the next question.

Is it ok with you to proceed with my questions?

1. Did any children travel with you? □Yes □No □Don't know □Refused

   Number of children _____ Ages of children _____

2. Before you traveled, what did you believe was the health impact of getting malaria? ____

   _____
   _____
   _____

3. How worried were you about getting sick from traveling?_____

   _____
   _____
   _____

4. Did anyone else get malaria in your group? □Yes □No □Don't know □Refused

   Number of sick _____ Ages of sick _____

5. Did you get pre-travel medical advice? □Yes □No □Don't know □Refused

   If no, why not?_____

6. If yes, where_____

7. If yes, what advice was given _____

_____

8. Did you use anything to prevent you from getting malarias? (probe bed nets, repellant…)

□Yes □No □Don't know □Refused

9. Type of preventive measures used _____

_____

_____

10 Did you take any medicine to prevent you from getting malaria? (if No, skip to Q. 13)

□Yes Drug_____ □No □Don't know □Refused

11. Did you take all the medicine the way the doctor told you to take it?

□Yes □No □Don't know □Refused

12. What helped you take all your medicine as prescribed ?_____

_____

_____

13. What was the reason you didn't take any or didn't take all your medicine?_____

_____

14. Did you have any health insurance at travel? □Yes □No □Don't know □Refused

15. Did you have Medicaid at time of travel? □Yes □No □Don't know □Refused

16. Is money a reason people don't take medication? □Yes □No □Don't know □Refused

17. What can healthcare workers do to help other travelers take malaria medication?_____

_____

_____

18. What policies/services/messages do you think would help prevent malaria in other travelers?_____

_____

19. What is your belief now about the health impact of having malaria?_____

_____

_____

20. What advice would you give someone who is traveling to the country you went to?____

_____

21. Is there anything you would like to add about your experience with malaria or medicine to prevent it?

_____

22. Highest level of schooling: □some HS □HS grad □Some college □College grad □Graduate/Professional degree □Other □Don't know □Refused

Appendix H
Regions of travel for malaria cases 2004-2010

Travel Region	n (%)
West Africa	1030(77.1)
Caribbean	80(6.0)
South Asia	76(5.7)
Central Africa	32(2.4)
East Africa	31(2.3)
South America	24(1.8)
Central America and Mexico	14(1.1)
All other travel regions (15) combined	48(3.6)

Appendix I
Countries of travel for malaria cases 2004-2010

Country of Travel	N (%)
Nigeria	368(27.6)
Ghana	257(19.3)
Ivory Coast	90(6.7)
Guinea	75(5.6)
Haiti	68(5.1)
India	63(4.7)
Senegal	48(3.6)
Sierra Leone	41(3.1)
Mali	28(2.1)
Liberia	25(1.9)
Gambia	24(1.8)
Guyana	21(1.6)
All other countries worldwide (47) combined	222(16.6)

Appendix J
Reason for travel 2004-2010

Reason for Travel	N (%)
Visiting friends & relatives (VFR)	920(68.9)
Immigrant/refugee	107(8.0)
Tourism	78(5.8)
Business	48(3.6)
Teacher/student	29(2.2)
Missionary/dependent	9(0.7)
Peace Corps	1(0.1)
Airline/ship crew	1(0.1)

Appendix K

Comparison of characteristics of people diagnosed with malaria according to type of chemoprophylaxis use for those who took chemoprophylaxis: NYC, 2004-2010

	Daily Dose n=39	Weekly Dose n=117	Drug Unknown n=57	Overall P-value*	P-value: Daily vs. Unknown	P-value: Weekly vs. Unknown
	n (%)	n (%)	n (%)			
Age (years)				0.0003	0.05	0.71
0 – 17	5(12.8)	38(32.5)	21(36.8)			
18 – 39	25(64.1)	39(33.3)	12(21.1)			
40 -59	7(18.0)	33(28.2)	24(42.1)			
60 +	2(5.1)	7(6.0)	0(0)			
Gender				0.56	0.65	0.83
Female	14(35.9)	53(45.3)	23(40.4)			
Male	25(64.1)	64(54.7)	34(59.7)			
Race				<.0001	0.0003	0.64
Non-Hispanic Black	21(53.9)	98(83.8)	53(93.0)			
All other races/ethnicities	18(46.2)	19(16.2)	4(7.0)			
Residence				<.0001	0.001	0.21
Bronx	6(15.4)	40(34.2)	19(33.3)			
Brooklyn	5(12.8)	36(30.8)	11(19.3)			
Manhattan	24(61.5)	22(18.8)	12(21.1)			
Queens	2(5.1)	15(12.8)	12(21.1)			
Staten Island	2(5.1)	4(3.4)	3(5.3)			
Reason for Travel				0.005	0.01	0.33
VF R	16(41.0)	73(62.4)	42(73.7)			
All other reasons	23(59.0)	44(37.6)	15(26.3)			
Region of Travel				0.05	0.15	0.77
West Africa	26(66.7)	98(83.8)	48(84.2)			
All other regions	13(33.3)	19(16.2)	9(15.8)			
Countries of Travel				0.09	0.02	0.20
Nigeria	7(18.0)	42(35.9)	21(36.8)			
All other countries	32(82.1)	75(64.1)	36(63.2)			
Admitted to Hospital				0.68	0.37	0.89
Yes	30(76.9)	82(70.1)	42(73.7)			
No	9(23.1)	35(29.9)	15(26. 3)			

Appendix L
Results of open ended questions from supplemental interview of Aim 2 (n=32)

Q2. Before you traveled, what did you believe was the health impact of getting malaria?

Didn't know about malaria or their risk	8(25.0)
Knew about the illness and their risk, but didn't or couldn't take chemoprophylaxis	11(34.4)
Knew about the illness and their risk, so took chemoprophylaxis	13(40.6)

Q3. How worried were you about getting sick when traveling?

Not worried	28(87.5)
Worried	4(12.5)

Q6. Where did you get your pre-travel medical advice? (12 respondents)

Private medical doctor (PMD)	4(33.3)
Hospital clinic	6(50.0)
Freestanding clinic/Health Center	2(16.7)

Q7. What health advice did you receive? (12 respondents)

Take chemoprophylaxis as prescribed	12(100)
Avoid mosquitoes	2(16.7)
Be careful of the food and water	2(16.7)
Wash children's hands	1(8.3)

Q9. What preventive methods did you use?

Took chemoprophylaxis	13(40.6)
Used mosquito bed nets	6(18.8)
Used insect repellant	2(6.3)
Used ceiling fan	1(3.1)
Used window screens	1)3.1)

Q12. What helped you take all your chemoprophylaxis as prescribed? (9 adherences)

Just remembered to take or give it to child	5(56.6)
Parents didn't know what helped because they didn't travel with the child	3(33.3)
Family member reminded them to take it	1(11.1)

Q13. What is the reason you didn't take any or didn't take all of your chemoprophylaxis? (multiple reasons given by some respondents)

Didn't know about malaria/chemoprophylaxis	7(21.9)
No time, had to travel at last minute	6(18.8)
Just forgot to take some doses	6(18.8)
Thought they were immune/wouldn't get sick	5(15.6)
Thought malaria is mild like a cold	3(9.4)
Ran out of medication, stayed abroad longer	2(6.3)
No health insurance and no money	1(3.1)

Q17. What can healthcare workers do to help other travelers take malaria medication?

Educate travelers/advertise medications	19(59.4)
Give them the medications to take	6(18.8)
Don't know	7(21.9)

Q18. What policies, services, or messages do you think would help prevent malaria in other travelers? (multiple reasons given by some respondents)

Policy: make it mandatory for all travelers to take chemoprophylaxis, and enforce it	4(12.5)
Services: give free chemoprophylaxis or make the medications more affordable	6(18.8)
Message: "Go to Dr. before travel, get and take chemoprophylaxis and avoid mosquitoes"	15(46.9)
Don't know	7(21.9)

Q19. What is your belief now about the health impact of having malaria?

Illness worse than they thought it would be	21(65.6)
Will use prevention next time they travel	3(9.4)
Financial burden, too sick for work, school, or other activities	2(6.3)
Other	6(18.8)

Q20. What advice would you give someone who is traveling to the country you went to?

Take chemoprophylaxis	24(75.0)
Use prevention measures against mosquitoes	11(34.4)
See your doctor before travel	5(15.6)

Q21. Is there anything you would like to add about your experience with malaria or the medicine to prevent it?

This final open-ended question allowed respondents to add anything else they about malaria, chemoprophylaxis, or what they thought should be done. Only half, (n=16), had a response to this question. Many

repeated their beliefs stated in previous questions: that malaria actually is a devastating disease, travelers should see their doctor before traveling, and travelers need to use other prevention against mosquitoes even if they are taking chemoprophylaxis. New themes emerged such as patients suggesting doctors needed training in advising patients who travel abroad, and in the diagnosis and treatment of malaria when they return sick. Someone stated that "malaria patients should not be treated as people with AIDS" and another commented that "I was nearly quarantined". Three responses were directed to the NYC DOHMH and respondents felt "the Health Dept. needs to do something about malaria". They suggested the Health Department should give to or help travelers get chemoprophylaxis, and "city health workers can go to the community to educate the people on how to prevent themselves and family from getting malaria

Appendix M

Centers for Disease Control and Prevention Malaria References and Resources online

MMWR

Malaria-related publications that have appeared in the Morbidity and Mortality Weekly Report.

Kid Stuff

Information and educational materials designed to teach children about malaria.

Fact Sheets, Brochures and Posters

Printable materials for educational and display purposes.

Test Your Knowledge

Case presentations and questions designed to teach health professionals about malaria.

Continuing Education

Accredited Continuing Education courses for Health Professionals.

External Links

Websites external to CDC that may be of interest.

Quick Links

- Red Pages – Malaria information by country
- Medicines for prevention (United States)
- Medicines for treatment (United States)
- Malaria travelers brochure
- Malaria Map Application
- Surveillance form
- FAQs
- Glossary
- Malaria Features

- Email page
- Print page

- Get email updates
- Subscribe to RSS
- Listen to audio/Podcast

Get email updates about Malaria

To receive email updates about this page, enter your email address:

What's this?

Contact Us:

Centers for Disease Control and Prevention
1600 Clifton Rd
MS A-06
Atlanta, GA 30333

- Health care providers needing assistance with diagnosis or management of suspected cases

of malaria should call the **CDC Malaria Hotline:** 770-488-7788 or 855-856-4713 toll-free
(M-F, 9am-5pm, eastern time).

Continuing Education

Accredited Continuing Education courses for Health Professionals.

Malaria 101 for the Health Care Provider

On this Page

Description

The Malaria 101 for the Health Care Provider course is a web-based training course designed to teach clinicians about the epidemiology, prevention, diagnosis, and treatment of malaria. Lesson 1 provides some background on malaria and discusses the epidemiology of malaria. Lesson 2 discusses the prevention of malaria in travelers. Lesson 3 reviews the diagnosis and treatment of malaria. After the lessons, three clinical scenarios will be presented.

Launch Course

Technical Requirements

To run this course your browser must support frames and Javascript.

Instructions for Completing Posttest & Evaluation Online

1. View the **Malaria 101 for the Health Care Provider** course online.
2. Once you completed the course, go to CDC Training and Continuing Education Online at

   www.cdc.gov/tceonline

   .

   a. If you have not registered as a participant, click on new participant to create a user ID and password; otherwise click on participant login and login.

   b. If you have registered in this system before, please use the same login name and password. This will ensure an accurate transcript.
3. Once you have logged in/registered, Click on search and keyword search for course**WB1901**.
4. Click on the course. The course information page will come up. Scroll down to register here. Click on the type of CE credit that you would like to receive and then submit. Three demographic questions will come up. Complete the questions and then submit.
5. From "Participant services," click on "evaluations and tests"
6. Answer the questions presented on posttest (all answers are in the course material).

   a. To receive continuing education credit, you must answer all of the questions.

   b. Some questions have more than one answer. Questions with more than one answer will instruct you to "indicate all that are correct."
7. Complete the course evaluation.
8. You will be able to immediately print your continuing education certificate from your personal transcript.

   a. A record of your completion will be located in the transcript and certificate section of your record.
9. If you have any questions or problems contact CDC Training and Continuing Education Online

   at: 1-800-41TRAIN or 404-639-1292 or **ce@cdc.gov**.

- **Origination Date: 10/24/2011**
- **Expiration Date: 10/24/2013**

Course Objectives

After completing this course you will be able to:

1. Describe malaria disease epidemiology, life cycle of *Plasmodium*, and risk factors for malaria.
2. Describe how to manage a patient during the pre-travel consultation to prevent malaria using CDC guidelines for malaria prophylaxis.
3. Describe how to diagnose and treat malaria using current CDC recommendations.

Target Audience

The Malaria 101 for the Health Care Provider is intended for the following clinicians who desire a basic introduction to malaria prevention, diagnosis, and management:

- Nurses
- Nurse practitioners
- Physician assistants
- Physicians

Prerequisites

There are no prerequisites for this course.

Accreditation Statements

Students completing the Malaria 101 for the Health Care Provider course can earn continuing education credits/contact hours in one of the following categories:

- **Continuing Medical Education (CME):**
  The Centers for Disease Control and Prevention is accredited by the Accreditation Council for Continuing Medical Education (ACCME®) to provide continuing medical education for physicians.

  The Centers for Disease Control and Prevention designates this enduring activity for a maximum of *1 AMA PRA Category 1 Credits*™. Physicians should only claim credit commensurate with the extent of their participation in the activity.
- **Continuing Education Designated for Non-Physicians:**
  Non-physicians will receive a certificate of participation.
- **Continuing Nursing Education (CNE):**
  The Centers for Disease Control and Prevention is accredited as a provider of Continuing Nursing Education by the American Nurses Credentialing Center's Commission on Accreditation. This activity provides 1 contact hours.
- **Continuing Education Units (CEU):**
  The CDC has been approved as an Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102. The CDC is authorized by IACET to offer *0.1* ANSI/IACET CEU's for this program.

  To obtain continuing education credit/contact hours, go to CDC/ATSDR *Training and Continuing Education Online* (www2a.cdc.gov/TCEOnline) after completing the content of this module and register for course **WB1901 (Malaria 101 for the Health Care Provider)**. You will be required to complete a posttest in order to obtain the credit or contact hours.
-

Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA

800-CDC-INFO (800-232-4636) TTY: (888) 232-6348 - cdcinfo@cdc.gov

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