Opinion

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The history of malaria in the United States: how it spread, how it was treated, and public responses

Volume 2 Issue 3 - 2016

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Received: March 10, 2016 | **Published:** April 28, 2016

Opinion

Perspiring, coughing, and aching, he falls to the ground in a pool of vomit. He feels nauseated and is sweating profusely. He feels his life slowly seep away from his body. His family surrounds him during his last moments. A few minutes later, the jaundiced man is on the floor; no sign of life remains in him. Every member of his remaining family bursts into tears. This was the second one this week. This is malaria.

Situations like the one described above were not uncommon in the history of the United States. In fact, this debilitating disease has been prevalent in the United States since the seventeenth century, and cases have been documented since the time of the ancient Egyptians (c. 1550 BC). The map below shows the current distribution of malaria around the world. As shown, the areas plagued most by malaria are sub-Saharan Africa, South Asia, and North-Central South America, in that order (Figure 1).

Although the transmission of malaria has greatly diminished over the past few centuries (only 1,500 cases per year in the United States, with the vast majority coming from travelers and immigrants from sub-Saharan Africa and South Asia), malaria was an immense problem throughout much of the history of the United States.

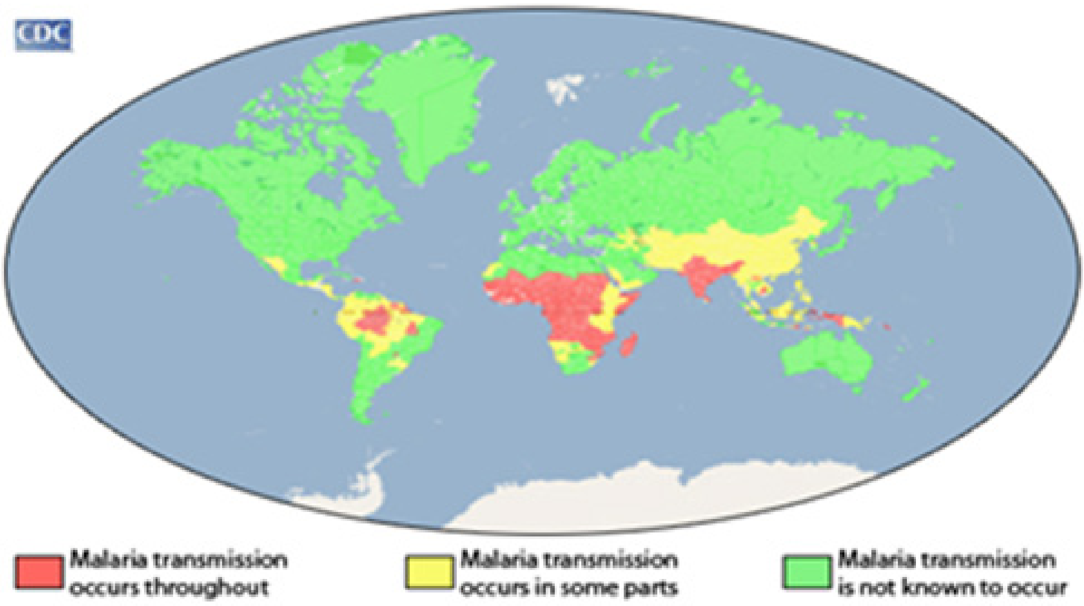

Figure 1 Occurrence of malaria transmission.

Before embarking on our analysis of the effect that malaria has had on American society, we must gain a rudimentary idea of malaria itself. Malaria is a mosquito-borne infectious disease of various organisms in the Animalia kingdom that is caused by parasitic protozoans belonging to the genus Plasmodium. There are four main species of Plasmodium that infect humans: vivax, falciparum, malaria, and ovale. The former two are the most common and will be the primary focus of this study. Out of the four strains of malarial parasites, falciparum is the most severe, often leading to death while the other three remain relatively mild.

Although it has proven to be quite difficult to determine the origins of malaria (because malaria leaves no mark on bones), historians have found evidence of the disease in Chinese medical parchments from as early as 3000 BCE. Due to recent biological innovations in the past century, the processes behind the spread of malaria and various genetic adaptations to it have been determined more accurately. Recent studies confirm the great antiquity of the disease and the likely transmission of the malaria parasite from monkeys to humans. Since the highest density of Simian monkeys is in South Asia, it is likely that malaria may have moved into humans in Thailand or India.[1] Also, the prevalence of genetic traits for the resistance to malaria serves as evidence that the disease prevailed in the human population long enough for traits to be amplified by natural selection. For example, sickle cell anemia is a disease which, as many scientists believe, developed as a resistance to malaria. In sickle cell anemia, due to a lack of hemoglobin, red blood cells are modified into the shape of a sickle. Because malaria specifically affects normal red blood cells, one with sickle cell anemia has fewer normal red blood cells for malaria to affect. Hence, it is rare for one with sickle cell anemia to also contract malaria. This shows that malaria was around long enough for the human population to develop genetic resistances against it, like sickle cell anemia.

Malaria is defined as a "febrile disease arising as a reaction of the body to invasion by parasites of the genus Plasmodium".[2] This disease is caused by the anopheles mosquito; however, although these mosquitos are relatively common in certain regions, the passing of malaria from the mosquito to the human can be a complicated process. In order for the transmission to occur successfully, the anopheles mosquito must be infected by a human host, who, in turn must be infected by another anopheles, with the circular transmission dependent on both. It is important to note that only the female mosquito bites in order to get blood to develop her eggs; the male, on the other hand, simply "spends his time sipping nectar and looking for sex".[3] Once the blood is sucked from the malaria patient, it travels to the insect's gut, from which it travels to the mosquito's salivary glands. From here, it is injected into another human when the mosquito takes its next meal. The blood then travels to its host's liver, where it multiplies, attacks red blood cells, changes and multiplies again, and emerges ready to be picked up by the next feeding mosquito. This incubation period, in most cases, varies from 7 to 30days, with the shorter periods coming from the falciparum strain of malaria and the longer periods coming from the vivax strain of malaria. Although most individuals will acquire immunity to malaria once contracting it, these immunities tend to be species and strain specific--reason malaria has been so debilitating throughout the course of American history.

In order to begin to understand the intensity with which malaria affected its victims, one must first understand the physiological symptoms associated with malaria. The normal malaria attack cycle lasts for approximately 6-10 hours. It consists of primary three stages--a cold stage, hot stage, and a sweating stage. During the cold stage, the patient may experience sensations of coldness and shivering. The hot stage is characteristic of fevers, headaches, and vomiting. In cases with young children, seizures may occur as well. Finally, during the sweating stage, the individual's temperature returns back to normal. Tiredness is often experienced shortly after the sweating stage (CDC: "Disease").[4]

The two most common types of malaria, and the ones that this study will concentrate most on, are vivax and falciparum, both of which became prevalent in the United States. Vivax is classified as a vernal fever--a fever that appears in the spring, while falciparum is an aestivoautumnal fever--one that appears in the summer and fall. The cycle of the tertian fever vivax repeats every 48hours. This strain of malaria is generally tolerant of cold; historians believe that it reached the New World from the Europeans. The malignant tertian fever of falciparum was formerly limited to the tropics; historians believe that it probably reached the New World from the Africans in the middle passage.

Now that we have a concrete background to work from, we shall embark on our study of the effects malaria has had on society, specifically during the American Revolution, Civil War, and WWI. We will analyze the perception of the etiology of malaria, public health responses to malaria, prevention techniques, public reactions, and the use of malaria as a war tactic.

American revolution: 1765-1783

During the American Revolution, medical knowledge of malaria was quite limited; thus, the treatments that were provided often did not work. However, in the late eighteenth century, scientists made observations about the disease and its transmission patterns that would later prove to be crucial in medical advancements for the treatment of malaria.

Public health reactions and treatments of malaria were mostly based off of the public's perception of what caused malaria--thus, many of them were ineffective, perhaps even adversely affecting the patient. Because it was believed that malaria was caused by "bad air", hence the name mal-aria (bad-air), most public health actions focused on avoiding or purifying bad air. For example, people were advised to avoid swamps at all costs and get fresh air often. They were also advised to burn frankincense (to improve immune system function) and to avoid wearing dead peoples' clothes.

Because it was not actually known what caused malaria, most treatments were not very useful; however, there was one treatment that was so successful that it would be the primary form of treatment for centuries to come--quinine. Although physicians attempted curing their patients in a multitude of different ways including making their patients eat spiders, drink their own urine, draining large amounts of their blood, and even tying one's head to a tree trunk and yanking their hair out (as to leave the disease on the tree with their hair), none of them were as successful as quinine.

Even before the birth of the United States as a nation, it was already plagued by the disease now known as malaria. But in America's early history, did malaria truly have such an adverse effect as one would expect? Perhaps, it was malaria that greatly helped the United States win the American Revolution. As environmental historian J.R. McNeill once wrote, "Those tiny amazons [mosquitos] conducted covert biological warfare against the British army".[5] Although many examples of this exist, perhaps the clearest example can be seen in the devastation of Cornwallis's army in the late eighteenth century.

In 1779, British commander Henry Clinton developed what he called the "southern strategy"--one in which he planned to send his forces to occupy South Carolina. By doing this, he presumed would put him in a militaristically advantageous position. However, one thing he overlooked was the presence of malaria. As German natural historian Johann David Shoepf wrote in the early 1780s, "Carolina was in the spring a paradise, in the summer a hell, and in the autumn a hospital".

As a result, as was the norm in the South, Carolina became infested with malaria--a disease which broke out every spring, especially among new arrivals from Europe who lacked protection against the parasite. The rice-growing in the South further aggravated the problem, providing ample habitat for the mosquitoes to thrive. Most of the white colonists in the United States had already survived malaria in their adolescence and had thus built up resistance against the parasite. Also, much of the black slave population had a degree of genetic immunity to protect them from malaria (related to prevalence of sickle-cell). Hence, in reality, European soldiers were virtually the only ones without some acquired immunity to malaria, making the U.S. South the worst place to attack and enter the United States.

After the British captured Charleston in the June of 1780 (the height of the mosquito season), they marched inland, slowly becoming debilitated by the ravenous mosquitoes. By the time the British encountered the first American army, the majority of the army, including Cornwallis, was plagued by malarial fevers. Because the only efficient treatment (quinine) was monopolized by the Spanish, who cut off trade with the British to support the French and the American forces, the consequences of malaria were further aggravated for Cornwallis's army.

By that winter, most of Cornwallis's men had recovered from the plague, and he decided to "preserve the troops from the fatal sickness, which so nearly ruined the Army last autumn".[6] However, Clinton demanded that he march back to the coast and receive the reinforcements that would be sent his way. Cornwallis was forced back to Yorktown, a fort which lay between two mosquito-infested swamps on the Chesapeake Bay. After Washington surrounded him with French and American troops, Cornwallis and his disease-diminished army surrendered three weeks thereafter. As explained by McNeill, "mosquitoes helped the Americans snatch victory from the jaws of stalemate and win the Revolutionary War, without which there would be no United States of America. Remember that when they bite you next Fourth of July".

Civil war: 1861-1865

It was not until after the conclusion of the Civil War that society found that a single-celled sporozoan of the Plasmodium genus caused malaria. It was discovered to be a parasite in 1880, by Alphonse Laveran, a French army surgeon in Algeria. Moreover, its transmission by the mosquito would not be demonstrated for a few decades (1897).

For these reasons, Americans' understanding of malaria, although more advanced than what was known during the Revolution, was still rudimentary. At the time of the Civil War, physicians and public health reformers knew only that "malaria is some mysterious poison in the atmosphere, and it is confined strictly to certain localities. It seems to favor valleys rather more than mountains" (Scientific American: "The Civil War and Malaria"). They also observed that malaria was not attracted to newly formed countries, pointing to Campagna as an example and that the "inhabitants of paved cities are almost entirely exempt from attacks of malaria" (Scientific American: "The Civil War and Malaria").[7]

There were primarily three types of malaria identified by physicians during the Civil War--"dumb ague," "ordinary fever and ague," and "bilious fever." Dumb ague was the mildest of the three types of diseases. It was the same as fever and ague, but the fever instead is not preceded by a chill or followed by perspiration. Every 1-3days, usually at the same hour each day, the patient experienced a moderate attack of fever, usually lasting 1-2hours. For the rest of the time, the patient felt almost normal. Ordinary fever and ague was the most common form of malarial disease. For over an hour, the patient shivered and shook with cold, the time of which was somewhat unpredictable. After the chills subsided, it was often succeeded by a violent, burning fever, usually which lasted 3-4hours. This was followed, in the more severe forms, by a copious perspiration. Bilious fever was the most severe and infamous form of malaria. The paroxysms of fever became so prolonged as to extend from one to the other. However, it still preserved its periodical character: some hours of the day were more violent than others. This fever was also known as remittent fever.

During the Civil War, there were two main treatments for malaria: quinine (Jesuit's Bark) and arsenic. Quinine originated from Don Inigo Lopez do Recalde do Loyola (afterwards called Saint Ignatius do Loyola) and his journeys to the Andes. It was, at first, sent to Europe as something that could banish all diseases--an "elixir of life." However, although this was not the case, it was soon found to be extremely effective in treating intermittent and malarious diseases. In fact, the effects of this treatment were more marked and constant than any other remedy for any disease. It was also used in the Civil War as a means of preventing the contraction of malaria. It was often added into coffee or whiskey to reduce bitter taste and convince soldiers to drink it. Arsenic was sold in the form of "Sappington's pill". Dr. Beaumont of St. Louis analyzed the pill and determined that all of its beneficial medicinal properties were derived from the arsenic that it contained. Arsenic was a metallic poison that remains in the system and, once accumulated, killed the individual. For this reason, the Sappington's pill became increasingly avoided and, as in the American Revolution, quinine was viewed as the most effective treatment for malaria.

Long before the war began, both Northern and Southern soldiers feared the malaria that came with the "sickly season" (the summer and fall)--especially along coasts and wetlands of South.[8] Once the war broke out, shattered infrastructure, the close quartering of men, and compromised sanitary conditions only extended the reach of the disease.

For the first two years of the war, the Confederacy hoped that yellow fever and malaria would save cities like New Orleans from Union forces. When the South was about to be defeated, the South even launched a "biological warfare" strategy on Washington, D.C.[8] Also, because they realized that the Union's operations further south would be significantly scaled back during "sickly season", they sent extra troops from the deep South to more vulnerable regions like Richmond. Hence, even into 1863, the Confederate army, although badly outnumbered, stayed in the battle because of the help it received from the "mosquito soldiers".[8] Note that Southern whites often developed acquired resistance to malaria, from surviving repeated attacks. African slaves in the South often had genetic traits that provided protection against the disease. However, Yankees did not have any protection against this disease. The tide turned towards Union when Grant, undeterred by the scourge of malaria, rushed his army past the Confederate Army at Vicksburg in the middle of the sickly season with the assistance of an ample supply of quinine. Grant's victory at Vicksburg divided the South along the Mississippi River, restricting the Confederacy's ability to supply its soldiers with provisions (including medicine). Vicksburg was a turning point in the war because after it fell, the mosquitos began adversely impacting, rather than benefitting, the Confederacy.[8]

In June 1861, reformers had persuaded Lincoln to create a Sanitary Commission to investigate conditions among Union forces. The commission pressured civilian and military authorities to improve sanitation and educate officers and enlisted men about the spread of infectious diseases (esp. malaria) and the need for personal and public hygiene.[9] The sanitary movement continued to have an impact after the war. New York and Chicago established the first municipal boards of health in 1866 and 1867, while Massachusetts created the first effective state board of health in 1869. These efforts also extended into south Southern cities occupied by the North, most prominently Memphis, Charleston, and New Orleans.

By 1879, there were at least 50 "reasonably efficient" municipal health departments.[10] In 1872, a new national health organization was formed--the American Public Health Association (APHA)--to advance sanitary science and promote organizations and measures for the practical application of public hygiene.[11] Ten reform leaders were present at its first meeting in Cincinnati in 1873, but this number grew quite rapidly. Around 400 members attended the 1880 meeting in New Orleans; just a year later, 700 gathered in Savannah.

Physicians did much to support this sanitation movement, with nearly all of the early presidents of the APHA also being prominent members of the American Medical Association (AMA). Individuals lacking formal medical training were also quite important in the APHA, and many broadly representative civic organizations took an interest in public health. According to historian John Duffy, by the 1870s, the public health movement was strongly supported by leading businesspeople who recognized that a reputation for an unhealthy environment restricted the growth of the community (134). As stated by J.E. Reeves in an 1883 medical journal article, "sanitary science is a segment of [the] political economy, and should receive encouragement by the State as a wealth-creating factor riches, indeed, to the whole people far above that of any other earthly value" (415).

Federal progress was also made on the public health front. In the early 1870s, members of the APHA discussed the idea of creating an overarching federal health agency and promoted bills to create a national quarantine system. The catalyst which propelled the reluctant Congress into action was a devastating yellow fever epidemic in 1878. A new bill was created that gave the Marine Hospital Service (MHS), an organization originally created in 1798 to provide hospital care for sick seamen, the responsibility for administering a National Quarantine Act.

However, in 1879, the MHS lost its authority over the national quarantine system. It was in this year that Congress, backed by the APHA, passed a bill to establish a National Board of Health. It was this board that was entrusted with authority over the national quarantine system. The bill was not passed however, without a slew of amendments that restricted its function greatly. Some of these restrictions include limiting the board to a lifespan of only four years and requiring the national board to follow states' regulations, without letting it make any rules of its own. Moreover, the board faced great political opposition from organizations like the MHS; it was also firmly opposed by the states. All of these combined to undermine the board's ability to produce any useful results. Eventually, with no further outbreaks of yellow fever (or any other epidemics), the National Board of Health went extinct in 1883. Once again, the responsibility for the national quarantine system and public health was given back to the MHS.

Soon after the MHS regained control of the national quarantine system, the United States realized the birth of a new public health threat, one caused by the multitude of new immigrants. During the late nineteenth and early twentieth centuries, the U.S. was experiencing exponential industrial growth and a booming economy. Naturally, this attracted a great many number of immigrants (24million), mostly comprised of those from Eastern and Southern Europe; however, these immigrants also brought with them a multitude of infectious diseases.[12]

This wave of immigration (1880-1920) also coincided with outbreaks of cholera in Russia and Eastern Europe--it was these outbreaks that served as motivation for the National Quarantine Act of 1893. According to this act, the surgeon general and the MHS were responsible for preventing "admission of idiots, insane persons, persons likely to become a public charge, [and] persons suffering from a loathsome or a dangerous contagious disease".[13] To do this, the MHS took over many of the state and local quarantine systems, including the Ellis Island facility in NY Harbor, a place in which roughly two-thirds of all immigrants entered.[14] Due to its expanded role, the MHS was renamed the United States Public Health Service (PHS) in 1912. The 1890s saw the birth of a new movement--one which would last until the early 1920s. This movement is generally referred to as progressivism. Medically, it was characterized by a change in perceptions toward immigrants. When the first large waves of immigrants came to the United States in the 1880s, many Americans perceived them as a great threat--bringing with them many infectious diseases foreign to the nation. However, progressivism changed this perception, causing Americans to view the immigrants more as people in need of help, realizing that their situations were quite similar to those faced by older generations of Americans.[15]

Now, instead of dismissing the immigrants, Americans began campaigning for improved housing conditions, infectious disease control, school hygiene, etc. With regards to politics, the reformers served as a middle ground between the entrepreneurial capitalists and the contemporary socialists. It was for this reason that these reform groups were quite successful and reform movements passed with relative ease.

During World War I and II, inconsistent supplies of cinchona bark and quinine prompted substantial funding into research and development of other drugs and vaccines. American military organizations conducting such research initiatives include the Navy Medical Research Center, Walter Reed Army Institute of Research, and the U.S. Army Medical Research Institute of Infectious Diseases of the United States Armed Forces.

Additionally, initiatives were founded such as Malaria Control in War Areas (MCWA), established in 1942, and its successor, the Communicable Disease Center (now known as the Centers for Disease Control and Prevention, or CDC) established in 1946. According to the CDC, MCWA "was established to control malaria around military training bases in the southern United States and its territories, where malaria was still problematic."

The only specific treatment given was quinine--it was either given by mouth, intramuscular, or intravenous injections (Miller: "Management of Malaria).[16] Mosquito nets (18 meshes to the linear inch) and mosquito repellants (oil of cassia, oil of bergamot, etc.) were also used when feasible. Administration of quinine was given in 6-grain doses of the sulphate, bisulphate, or biliydrochloride daily with double dose once a week. When tablets were used, they were always cracked before being swallowed. Doses under 6 grains were not always efficient; the 6-grain dose was taken either in an equal morning and evening dose or in a single evening dose.

The camps were often abound in drainage channels and ditches while military positions were not uncommonly traversed by small streams. In these cases, the use of an oil drip as shown below was recommended: Before the quinine could be administered, the liver was first "put in good working order." To do this, a preliminary dose of calomel followed by saline was advised. During benign infections, doctors usually waited until the sweating stage begins before giving the drugs. Then, 10 grains by mouth, and then 5 grains 3-4times daily for a week were administered.

The latter doses were often given in the following manners:

i. R/Quinin. sulphate. grs.

Acid..citric. ... grs. 10

Sacchar. lact. q. s.

Ft. pulv.

ii. R/Amnion. carb. grs. 3

Potas. bicarb. grs. 10

Syrupi simpliis or Syrupi aurantii ad i Dram

Aq., aurantii ad i oz.

Citation: Bukkuri A. The history of malaria in the United States: how it spread, how it was treated, and public responses. *MOJ Anat Physiol.* 2016;2(3):82–87. DOI: 10.15406/mojap.2016.02.00048

Dissolve 1 in 2 and drink during effervescence. This mixture was also valuable during convalescence or after an attack of malaria. It was noted that quinine should be taken in gradually lessening doses for a period of three months. Otherwise, in many cases, the infection would persist even though the peripheral blood showed no sign of parasites. Sometimes, the following simpler, but less efficient formula was used:

R/Quinin. sulph. 5grains,

Dilute sulphuric acid 5minims,

Syrup of oranges 1drachme,

Distilled water ad iounce.

In ordinary cases, where there was gastric disturbance or when the drug appeared to be failing, intramuscular injections were used. The syringe and needle were carefully sterilized by boiling and by rinsing thereafter with 1 in 20 carbolic acid, with great care being taken that not much of the lotion is left behind. Doctors often painted a patch of skin in the gluteal region an inch or two below the middle of the iliac crest with tincture of iodine and injected the contents of one of the ampoules, vials or sterilettes in which sterilized quinine solutions suitable for injection were issued, after wiping off quinine solution on the needle with a pledget of wool soaked in 1 in 20 carbolic. Doctors would often inject half of the 15 grains in one spot and half in the other. Much care had to be taken in order to avoid the line of the sciatic nerve. The deltoid was often another alternative site.

If the solution had to be made on the spot, doctors would use filtered water. They would dissolve 15g of the bi-hydrochloride or other suitable salt in 10 c.c. of the filtered water and bring the solution thrice to the boiling point to ensure sterility. If the solution was already made up in a bottle, it was poured into a spoon which was been lying in 1 in 20 carbolic. Before this was done, the neck and mouth of the bottle were to be swabbed with the carbolic solution. Then, the quinine was drawn into the syringe from the spoon. With due precautions there was no danger of tetanus or septicity. The local discomfort was trifling and soon subsided; the effect is usually rapid and satisfactory.

In pernicious infections and comatose cases the intravenous route was undoubtedly the preferred option. The dose never exceeded 10 grains of the hydrochloride or bi-hydrochloride, and the total quantity given in 24hours did not exceed 30 grains. Five grains every four hours or 10grains every eight hours was injected. The strength of the solution was not be less than 1 in 300 and normal saline (0.75per cent.) had to be employed. A quantity of sodium bromide equal to that of the sodium chloride used was added for treatment of cerebral cases.

Surgeons were to note that before carrying out any serious operation on a man who has, or may have; suffered from malaria his blood should, where possible, be examined for signs of infection, and if there is evidence of it and time admits a course of quinine was to be given. Even when a blood examination could not be made, the advisability of administering quinine was considered, for an operation often lights up a latent malaria and the disease may very seriously, and sometimes with fatal result, appear in a patient after operation.

Chronic cases exhibited iron and arsenic. A useful prescription for such cases showing splenomegaly was as follows:

R/Quinin. hydrochlorid ... gr. 5 to gr. 7

Acidi arseniosi ... ... gr. 1/36 to 1/4 grain.

Pulv. ipecac. co.... ... gr. 3 to gr. 4

Hydrarg subchorid ... gr. 1/10 to gr.4

Fiat. pulv in cachets.

Sig. One at 11 am. and another at bedtime.

In Macedonia, British, French, and German armies were immobilized for 3years by malaria. On one occasion, when the French commanding general was ordered to attack, he replied: "Regret that my army is in hospital with malaria" (Srinivas: "Malaria in Wars and Victims).[17] Nearly 80 percent of 120,000 French troops in this area were hospitalized with malaria. In an average British strength of 124,000, there were 162,512 admissions to hospital for malaria during the years 1916 to 1918, in contrast to 23,762 killed, wounded, prisoner, and missing in action. In the spring of 1918, about 25,000 British soldiers were sent home from Macedonia with chronic malaria, and, apart from these evacuees, over 2,000,000 man-days were lost to the British Army in this area in 1918 because of malaria. Approximately 7.5/1,000 Americans quartered in the U.S. were infected with malaria in 1917.

Conclusion

Even with all of the technological and scientific developments that have transpired over the centuries in which malaria has plagued the world, society has still not eradicated malaria. Although the last case of malaria occurred in the United States in the early 1950s, there are still 106 countries in the world (containing approximately 3.4billion people) in which people are at a risk for contracting malaria. In 2013, the WHO reported an estimated 198million clinical episodes and 500,000 deaths caused by malaria worldwide. Recently, much effort has been taken into eradicating malaria--both politically in terms of new policies and movements, and scientifically in terms of vaccination and transmission reduction research. For example, as of 2012, the "Global Fund to Fight AIDS, Tuberculosis, and Malaria" has distributed over 230million insecticide-treated nets to prevent the mosquito-borne transmission of malaria. Also, the Clinton Foundation has attempted to manage demand and stabilize prices of artemisinin (a group of drugs that possess the most rapid action of all current drugs against Plasmodium falciparum malaria). Scientifically, efforts like the Malaria Atlas Project are focusing on analyzing climate information in hopes of accurately predicting the spread of malaria based on the availability of the habitat of malaria-carrying parasites.[18] Also, the MPAC (Malaria Policy Advisory Committee), part of the WHO, was formed in 2012 in order "to provide strategic advice and technical input to WHO on all aspects of malaria control and elimination." In November 2013, the MPAC officially set a goal to develop vaccines to curb malaria transmission, eventually hoping to eradicate malaria totally. Although their goal has not yet been achieved, they have made great strides towards it. Previously, malaria was quite common in the United States and areas of Southern Europe; however, now, malaria has been virtually eliminated from these regions, perhaps due to the booming growth of vector control programs and the improved treatments of infected individuals. A multitude of other factors outside of medicine also contributed to the decrease in malaria such as the draining of wetland breeding grounds for agriculture and other changes in water management practices, and advances in sanitation, including greater use of glass windows and screens in dwellings.[19–21] Although much effort has been put into the eradication of malaria and much progress has been made, work still remains to be completed in order to rid the world of the disease we know as malaria.

Acknowledgements

None.

Conflict of interest

Author declares that there is no conflict of interest.

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Citation: Bukkuri A. The history of malaria in the United States: how it spread, how it was treated, and public responses. *MOJ Anat Physiol.* 2016;2(3):82–87.
DOI: 10.15406/mojap.2016.02.00048