

### Mosquitoes and Disease: Is There a Reemerging Problem?

Before the completion of the Panama Canal, one of the greatest obstacles to its construction was that of disease. Mosquito-borne malaria and yellow fever were the greatest setback to the project. Between 1882 and 1888, when the French attempted to build a canal through Panama, about 22,000 workers died at the canal zone from disease (Panama Canal). In 1904, when the United States took over the construction of the canal, an American doctor, William Gorgas was asked to investigate this problem. Knowing that *Anopheles* mosquitoes carried malaria and *Stegomyia* carried yellow fever from one infected individual to another, Gorgas decided to eradicate these mosquitoes in the canal area (McCullough). To do so, he covered all standing or slow moving water with screens, oil or kerosene to destroy eggs and larvae. He also put those infected with the diseases into quarantine. After much work, the canal zone was free from these two mosquito-borne diseases.

When such an accomplishment could be made against two such dreadful diseases, one would think that it would be possible for mosquito-borne diseases to be eliminated throughout the world. Mosquitoes, however, are still a problem in the spread of multiple diseases. Mosquitoes cause great human suffering; over one million people die each year from malaria alone (Cann). Mosquitoes are the vectors, or carriers, of both protozoan and filarial diseases as well as viruses. Many of these diseases such as malaria and yellow fever, previously thought to be under control in the world, are reemerging in full force.

There is a reemerging problem concerning mosquitoes and disease. It has been shown through history that it is not possible to completely eradicate the world's

population of mosquitoes, but that through constant effort, they may be controlled and disease kept in check. Without destroying all mosquitoes on the face of the earth, therefore, it is impossible to completely end the problem of mosquito-borne disease. Eliminating all mosquitoes, however, is not a good solution to the problem of mosquitoes and the diseases of which they are vectors. It is known that due to the food chain, one species depends upon another for survival. Bird and animal species around the globe depend on mosquitoes as a food source and in the process of attempting to completely destroy mosquitoes, the survival of other species is endangered. As hard as it is to admit, there is a purpose for mosquitoes, so since they cannot be eradicated, they must simply be controlled.

There are many mosquito-borne diseases that appear to be reemerging. Some examples of such diseases are malaria, dengue fever, and yellow fever. In the recent past, it had appeared that these diseases were going to be easily wiped out, but now it is obvious that this is not the case. Resistance of mosquitoes to pesticides, resistance of these diseases to medicines, population growth and laxness in mosquito control are some of the reasons contributing to this problem concerning mosquitoes and disease.

Malaria is one mosquito-borne disease which appears to be reemerging. As previously stated, progress was made in reducing the number of cases of malaria in Panama during the construction of the Panama Canal. As time passed, however, between 1992 and 1997 the incidents of malaria in the world quadrupled. Areas in the United States and Europe have had cases when there have been few in past decades (Shell). Throughout the less developed parts of the world, malaria is causing even more problems. "The disease has had a soaring revival in Asia, Africa, and Latin America in

the past twenty years, even though public health experts had done everything in their power to wipe it out and thought they had won the battle" (Pines 42). Malaria is also the third largest killer among infectious diseases caused by microbes after tuberculosis and measles (Hall 22).

Since malaria is such a widespread disease which impedes economic development, and nearly forty percent of the world's population lives in an area where malaria is endemic (Shell), it is important that the disease be controlled. One good way to do this is to protect people from mosquitoes. There are many options as to how to go about this. "Roll Back Malaria Initiative," is carrying out many programs in an attempt to halve the incidents of malaria in the world by 2010 ("Mosquito Nets Provided..."). One of their programs is the distribution of insecticide-treated mosquito bed nets to households in Kikimi, a region in the Democratic Republic of Congo. In places where malaria is not endemic and only beginning to reemerge, avoiding mosquito bites and reducing amounts of standing water can help to stop the spread of disease. The World Health Organization began a campaign against malaria right after World War II, with the availability of DDT seeming the perfect tool for this job. One place where this campaign appeared to be successful was in Sri Lanka. In 1946, there had been three million cases of malaria there, but by 1964, only twenty-nine cases were reported. Unfortunately, that year, the campaign was deemed successful and mosquito control through spraying was stopped. Four years later, Sri Lanka's problem of malaria had returned to half a million cases and it reached 1.5 million by 1970 (Pines 43). This is only one example of the reemergence of malaria, but it teaches a valuable lesson: an effort to control and

eliminate a disease must not become lax. Vigilant control of mosquito populations will help to prevent the spread of any mosquito-borne disease.

Dengue fever (DF) is a viral disease causing such symptoms as headaches, bone, joint, or muscular pain, or a rash and is carried by mosquitoes. A more dangerous form of this disease is called dengue haemorrhagic fever (DHF) and can even lead to hypovolaemic shock which can be fatal. In the nineteenth century, dengue epidemics were reported throughout the world. Before 1970, only nine countries worldwide had had epidemics of dengue, but the number increased by four times that amount by 1995 ("Dengue and Dengue..."). Over the past forty years, cases of both DF and DHF have been increasing steadily as well as spreading to new areas (Dengue). In the United States, risk of dengue fever outbreaks is increasing as many travelers from tropical areas are carrying the disease into the country. This is a problem in the transmission of the disease in this country because two species of mosquito, *Ae. aegyptj* and *Aedes. albopjctus* exist in the United States and are able to be vectors of dengue fever ("Dengue Fever" CDC). If a mosquito of one of these species were to bite an infected person, the disease could be spread to others through bites of the now virus carrying mosquito.

Four reasons exist as to why there is such an emergence of dengue fever. One reason is that in most countries where dengue fever is endemic, there is no effective mosquito control program. Secondly, increased population and urbanization has lent to the increase of dengue. This is because an increasing population often results in inadequate water, sewer, and waste management systems, allowing a greater *Ae. aegyptj* population and increasing the likelihood of diseases such as dengue fever, carried by this species of mosquito. This also contributes to the problem of new disease strains

developing through the many mosquitoes available in which the virus can mutate. A third reason for the emergence of dengue is rising numbers of people traveling by airplane to dengue endemic areas and carrying the disease from place to place with them. Lastly, many countries are losing good public health systems. So, rather than working to prevent disease epidemics, many countries are only worrying about epidemics when they occur ("Dengue Fever" CDC).

Heartworm, a serious disease in dogs, is spread from one dog to another through the bite of a mosquito carrying young worms which are known as microfilariae. As larvae grow to maturity, they enter the dog's bloodstream and live in its pulmonary arteries and the right side of its heart. Heartworm disease is spreading through the United States where it was once limited to the south and southeast (Heartworm Disease Animal Clinic). Where many mosquitoes are present, the likelihood of heartworm transmission is greater. Thousands of dogs in Michigan are diagnosed with heartworm each year. In 1999, however, there were over 1,500 dogs in Wayne and Oakland Counties alone found to have heartworm disease ("Heartworm Disease May be Fatal..."). Due to unchecked mosquito populations, heartworm is becoming more prevalent in Michigan.

Yellow fever, a viral mosquito-borne disease, has such symptoms as fever, chills, jaundice, and internal bleeding. It is called yellow fever because of the jaundice that affects some who are ill with the disease. Since there is no specific drug to treat yellow fever, it is important to prevent this disease. There is an effective vaccine to prevent yellow fever, but there has been a dramatic reemergence of yellow fever in both Africa and South America in the past twenty years (Yellow Fever Facts). Tropical areas of Asia, Africa and South America are areas of greatest risk for yellow fever. This is

because the intermediate hosts of the disease and mosquitoes of the species that carries the virus are endemic to these areas. Every year, there are an estimated 200,000 cases of yellow fever, resulting in 30,000 deaths ("Yellow Fever"). Deforestation and urbanization are increasing human contact with mosquitoes and this virus and world travel could help to spread the disease. In the past, efforts have been made to eradicate the disease through vaccination and mosquito control. The yellow fever vaccine is very safe, effective, and long lasting. The mosquito control programs in South America were able to successfully eradicate mosquito habitats, but over the past thirty years, the programs lapsed, allowing mosquito populations to increase. Since 80% of a population must be immune to yellow fever to prevent an epidemic, and very few countries have succeeded in this, there is a large group of people in Africa and South America susceptible to an epidemic ("Yellow Fever"). The numbers of epidemics and cases of the disease in various countries have risen. Since yellow fever is a reemerging mosquito-borne disease, steps must be taken to control it.

A mosquito-borne disease especially important to residents of Michigan, as well as the rest of the continental United States, is West Nile virus. This disease is different because in most of the United States, it is emerging rather than reemerging and various strains are spreading throughout the rest of the world. The virus causes such symptoms in humans as fever, headache, and body aches. Severe infections can cause nausea and paralysis, and rarely, death. Sick and dying birds are a good indicator of the presence of West Nile virus in an area because they are the reservoir hosts of the disease. Infected birds pass the virus to mosquitoes who feed on them. Even though West Nile virus has existed in Africa, Europe, and Asia for hundreds of years, it was only discovered in the

United States in 1999 ("Zoos..." A6). West Nile virus has from that time been emerging in North America and is currently spreading west across the United States. It is expected to have reached the west coast within one or two years (Gibbs). Mid-Michigan was reached with West Nile virus this year as expected, but in great numbers. Before this year, there had been no documented cases of West Nile virus in humans in all of Michigan. By August 28, 2002, however, state health officials had confirmed eleven cases of West Nile virus as well as two deaths caused by the disease (Laitner). Without controlling the population of mosquitoes, diseases such as West Nile virus could continue to spread and create increased problems. Therefore, it is very important to reduce mosquito populations through constant control methods.

There are many scientists concerned with the prospect of global warming. If the earth's climate is truly warming, this could increase the risk of mosquito-borne diseases in areas where the disease formerly could not survive. In a recent study, researchers suggested that a warming climate could allow bacteria, insects, parasites, etc. that used to be restricted by seasonal temperatures, to begin to thrive in new territories ("Warming Climate..." AI4). If this is so, humans could be at more risk of mosquito-borne diseases such as malaria, dengue fever, and yellow fever. Some of the examples used in the study to prove this point, include the fact that there are epidemics of Rift Valley fever, a mosquito-borne disease, in northern Africa in unusually warm years. If the climate became warmer, these epidemics could become more frequent. Malaria and yellow fever could move into new areas due to milder winters allowing mosquitoes to survive out of season and spread to places formerly protected by cold weather ("Warming Climate..." AI4). Since a one or two degree temperature change can lead to disease outbreaks,

global warming is a concern for the possibility of outbreaks of mosquito-borne diseases. Whether global warming is occurring or not, there is still the problem of occasional cycles of warmer and colder winters. During unseasonably warm winters, mosquitoes would be able to move to new areas such as the mountains or into other new, normally cold areas, carrying disease with them. When winters are back to their normal temperatures, mosquitoes would be eradicated by the cold and diseases the mosquitoes brought there would be reduced.

Along with the reemergence of many mosquito-borne diseases is the problem of drugs failing when they formerly were effective treatments. The parasite which causes malaria, for example, is able to mutate so that it can resist drugs. In Asia and Latin America, 95% of the malaria parasites have become resistant to chloroquine, the cheapest and most potent of drugs used to combat malaria (Pines 43). There are not very many drugs used for malaria prevention and it has been necessary to use quinine, which has severe side effects and was used in the distant past, in areas where the malaria parasite has become resistant to chloroquine. This is a very serious problem since the parasites are able to pass on the resistance to other malaria parasites. Scientists are working very seriously to find a solution to contest the development of drug resistant parasites. Some possibilities include genetically engineering the parasite so that it is ineffective and dies before it can do any damage, producing an effective vaccine, or simply gaining an understanding of how the parasite resists drugs, then coming up with a way to prevent it (Pines 44).

Just as the malaria parasite mutates, the virus which causes dengue fever is able to undergo change. When many mosquitoes are present, new strains of the disease can

emerge ("Dengue Fever" CDC). Although no specific treatment is available for dengue fever, new strains make it harder to produce an effective vaccine. It is also possible for a person to become ill with dengue fever more than once since the person has immunity to only one strain.

There is an obvious problem with reemerging mosquito-borne diseases which must be faced. Individual precautions against mosquito-borne diseases may be taken through the use of bed nets and avoidance of bites, by wearing insect repellent, long sleeves and pants as well as trying to stay indoors during times of high mosquito activity. The control of mosquito populations has been shown through history to be effective as in Panama and Sri Lanka. In recent years, as surveillance has eased off, malaria and yellow fever are becoming more prevalent, and new diseases are emerging. The best solution for reduction of mosquito-borne diseases is through continual and consistent control of mosquito populations.

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