

Mosquitoes as a Potential Host for Emerging Infectious Disease

Justin Middleton

The history of civilization is molded by the advent of infectious diseases. The Black Death, Small Pox, Influenza and AIDS define different eras of humanity and reflect the culture of these times. Now, in the modern age, new and reemerging diseases are poised to take hold in our society. It seems that a perfect set of conditions and catalysts are driving the world to see a former nuisance as a sinister threat. In a warming world dominated by globalization and fraught with poverty, the mosquito is one of the greatest dangers to worldwide health.

Historically, the mosquito, as a vector of infectious diseases, has wreaked havoc on mankind. Malaria, one of the largest causes of childhood mortality in the world, has killed millions of people a year for centuries. Yellow fever devastated Europe after the fall of Rome, soldiers on expeditions in the Caribbean and workers building the Panama Canal. Mosquitoes are also vectors for diseases ranging from heartworms to West Nile virus to elephantiasis. There is indubitable precedence for the mosquito being a health risk. The improved technology and medical sciences in the modern era continually prove to be useful in controlling mosquito-borne disease and mosquito populations. Unfortunately, natural and man-related factors allow for the presence of emerging and reemerging diseases that are easily spread by mosquitoes.

In exploring the potential catalysts of dangerous mosquito-borne diseases, there are two differentiating groups. Some factors act as a propellant for the breeding and spread of mosquitoes, while others pertain to our susceptibility to the ailments themselves.

Perhaps the greatest threat associated with the breeding patterns of the mosquito is the progressive rise in temperatures as a result of global warming and climate change. There is a recent and noticeable weather trend that is coupled to global warming: high temperature and drought, followed by large amounts of precipitation. This trend is extremely conducive to the growth of larval mosquitoes, as these infantile pests require moisture and heat to hatch from their eggs. The consequences of this particular meteorological tendency are a reality in North America, with the emergence of West Nile Virus. Over a time period in which eleven of thirteen years were the hottest globally on record, West Nile infiltrated the eastern portion of the U.S., eventually affecting the entire country. At the same time, University of Oregon researchers identified a non-pest mosquito, the pitcher plant mosquito, as actively evolving its breeding patterns in order to adjust to climate change. Though this species feeds mainly on nectar, the obvious implication is that pest mosquitoes could adapt to a longer breeding season and a larger range of acceptable habitats in the northern regions of North America.

Though climate change in itself is a challenge, when coupled with globalization, the two become an immense threat. The phenomenon of globalization involves an incredible amount of intermingling of people of different countries and cultures. Along with this is the reliance on trade and business among nations. The precedent for the transfer of mosquito-borne disease from international trade to the United States took place in the form of the Yellow Fever epidemic of 1878. Across the country, 120,000 people were infected and many thousands died. The virus was imported from Africa through mosquitoes breeding in water barrels. By 2015, North America will be receiving

72 million shipping containers a year. Trade with China and other emerging nations will take up a bulk of this number, creating unlimited opportunities for new species of mosquitoes and new diseases to infiltrate our ports. Another shipping concern relates to the used tire trade. Anyone familiar with mosquito breeding habits knows how often larval mosquitoes will proliferate in water-filled tires. Currently, there are millions of used tires – complete with water and larva – traded between dozens of countries each year. The result of this is found in Houston, Texas, where a rapidly growing population of *Aedes albopictus* – a known vector of dengue fever – has been appearing in used tires originating from Asia. This is only one known instance of global trade affecting mosquito populations, but the immense amount of materials and containers traded throughout the world ensures a present danger. Beyond trade, there is the mere movement of people that is cause for concern. During the recent SARS and avian flu outbreaks, the United States saw a renewed anxiety about airline travel bringing these foreign ailments into the country. There are theories that hypothesize this is how West Nile was introduced to America. Millions of people involved with business and tourism have the potential to come into contact with deadly mosquito-borne disease in other countries every year, and bring contagions back home. Travel restrictions, vaccinations and public awareness will help curb this danger. Thus, in the same way that our ports and airports are heavily inspected for terrorist and illegal activity, regulatory actions need to be created and enforced to protect citizens' health and security.

The second range of issues creating the potential for a proliferation of emerging and reemerging mosquito-borne diseases is based upon our susceptibility to the diseases

themselves. The concurrence of these catalysts is the major source of concern, as this causes an exponentiation of consequences. Around the world, the highest growth in human population is found in poor, rural areas and developing nations. Generally, the areas are located in Asia, Latin America and Africa. These areas, specifically Africa, are ravaged by dengue and yellow fever, malaria and chikungunya. As these areas grow in population and use up more resources and land, conditions will become more cramped and dire, making the proliferation of these diseases less manageable. In the United States, there is the unique situation of a large aging population. Baby boomers are reaching their fifties and sixties, making them major targets for several types of viruses transmitted by mosquitoes in the U.S., including West Nile Virus, Eastern and Western Equine Encephalitis and other types of encephalitic and viral diseases. Seniors and children are usually the most susceptible to these diseases, and more likely to have a fatal case than the average person. This presents a serious possibility of a large-scale outbreak of one or several of these sicknesses in this enormous demographic.

Across the world, in Africa and South America, a dangerous product of human ingenuity is arising: drug resistance. The parasite that transmits malaria has mutated into several strains that do not respond to normal treatments, such as chloroquine, the cheapest and most widely used anti-malarial medicine. If these strains spread from isolated areas to larger population centers, the threat of epidemic would be imminent. Add to this the influence of globalization, and new areas unfamiliar with malaria are in serious danger. Though the majority of mosquito-borne diseases in the United States are viral, there is a danger in viruses adapting to the treatments physicians use to abate

symptoms and slow down disease progression. Scientists have long feared that the overabundance of antibacterial products, frequent use of antibiotics and self-medication will cause many common diseases to become drug resistant.

Since mosquito-borne diseases are not bacterial, it would seem that the issue of drug resistance would not be a problem related to mosquitoes. The last few decades have shown that philosophy to be irresponsible and shortsighted. After the eradication of small pox, the medical community largely believed infectious diseases were manageable and deserved little attention. Focus shifted to cancer, genetic diseases and congenital diseases. Indeed, this caused the worldwide population to be thoroughly surprised at the advent of AIDS, SARS, avian flu and other new infectious diseases with the pandemic potential. The rise of these maladies brings attention back to the fact that new infectious diseases, many the result of mutation of older afflictions, can and will develop. In the case of AIDS and avian flu, the disease evolved to become zoonotic. It is not a small stretch to believe that mosquitoes can become vectors for emerging diseases that previously did not affect humans, especially when factoring in the effects of climate change and globalization. The decreased ability of some to cope with bacteria due to drug resistance could also factor into this. The common problem is the adaptation of disease and the danger of ignorance toward this fact.

There are measures to counteract these issues. Mosquito control is certainly a first line of defense against mosquito-borne emerging diseases. Whether it is ultra-low volume adulticiding in urban areas or mosquito bed nets in impoverished, malaria-ridden sections of Africa, prevention, control and integrated pest management are key to abating

mosquito populations. As mosquito control agencies and government aid can only do so much, education of the public is a critical supplement. Awareness about mosquito breeding habits in standing water, their peak times of feeding and the diseases they carry may have the most effect in allaying future problems with emerging diseases. There also needs to be a significant awaking in the scientific community in the study of infectious disease. The world is constantly changing and becoming more complicated and different. Multiple factors converge to make the environment perfect for emerging diseases and new vectors. Giving attention to the threat of mosquito-borne disease would be an ideal starting point for this initiative. If anything is to be learned from history and our current knowledge about the world around us, it must be that new dangers will constantly be around to inflict humanity, and preparedness is the primary and necessary deterrent.

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