Chapter

Introductory Chapter: Vector-Borne Diseases

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1. Introduction

In the waning years of the nineteenth century, Theobald Smith convincingly proved that Texas cattle fever was caused by a protozoan parasite and, perhaps more importantly, was transmitted to cattle by a tick. This was the first definitive proof of vector-borne transmission by an arthropod [1]. Within a few years, scientists demonstrated transmission of human disease agents by vectors for a variety of diseases, from filariasis to malaria. Since then, vector-borne transmission has proven to be a major means of disease for dozens of diseases, some of great public health importance. **Table 1** provides a partial list of vector-borne diseases along with the disease agents and vectors for each. Malaria is probably the vector-borne disease with the largest impact on human health today, though historically typhus, bubonic plague, and yellow fever have been extremely important [2].

Despite extraordinary efforts to control or eliminate vector-borne diseases, they persist. Estimates of mortality due to malaria alone exceed 400,000 per year [3]. For the millions of survivors of malaria infection, the costs of disease and disability are enormous. And this reflects a recent improvement over previous years. Great effort has gone into reducing the incidence of malaria, reflecting the dedication of governments, nongovernmental organizations, charitable agencies, scientists, and medical workers. Despite significant success with reducing the rates of diseases like malaria, typhus, and yellow fever, vector-borne diseases persist. Of the 20 illnesses listed as neglected tropical diseases by the World Health Organization in 2020, 6 are primarily transmitted by vectors: American trypanosomiasis, African trypanosomiasis, dengue (and chikungunya), leishmaniasis, lymphatic filariasis, and onchocerciasis. Some of the others, like trachoma, may also exhibit a vector-borne element through the mechanical transmission of disease agents by filth flies. The vectors represent a wide spectrum of arthropod species, from the ticks and mites of *Arachnida* to the mosquitoes, true bugs, and lice of *Insecta*. The disease transmission cycles are as diverse as the range of vectors.

Although the disease transmission cycles of vector-borne diseases can be very complex, they do provide a unique opportunity for prevention or control. For non-vector-borne diseases, prevention can take a variety of forms including immunizations, sanitation, infection control, chemoprophylaxis, curative medicine, and others. For vector-borne disease, however, there is often the possibility of vector control as a means of interrupting the disease cycle. Some vector-borne diseases, such as yellow fever and Japanese encephalitis, can be effectively prevented by immunization, though maintenance of a cold chain to ensure vaccine viability may be necessary and can be difficult to maintain in remote environments. Other diseases such as malaria can be prevented through prophylactic use of drugs. But for many vector-borne diseases, there are no effective vaccines or chemoprophylactic measures. Also, there is no specific treatment for many of the diseases. For such

Disease	Agent	Vector
Babesiosis	Protozoan	Tick
Bartonellosis	Bacteria	Sand fly
Chikungunya	Virus	Mosquito
Crimean-Congo hemorrhagic fever	Virus	Tick
Dengue fever	Virus	Mosquito
Ehrlichiosis	Intracellular bacterium	Tick
Japanese encephalitis	Virus	Mosquito
Leishmaniasis	Protozoan	Sand fly
Louse-borne relapsing fever	Bacterium	Louse
Lyme disease	Bacterium	Tick
Lymphatic filariasis	Filarial worm	Mosquito
Malaria	Protozoan	Mosquito
Onchocerciasis	Filarial worm	Black fly
Plague	Bacterium	Flea
Q fever	Intracellular bacterium	Tick
Relapsing fever	Bacterium	Tick
Rickettsiosis	Intracellular bacterium	Tick, mite
Rift Valley fever	Virus	Mosquito
Rocky Mountain Spotted fever	Intracellular Bacterium	Tick
Sand Fly fever	Virus	Sand fly
Tick-borne encephalitis	Virus	Tick
Tularemia	Bacterium	Tick, deer fly
Typhus	Bacterium	Lice

[1]*This is a partial list, especially for the tick-borne viruses. Mechanical transmission by filth flies and cockroaches is not considered here, though several diseases such as shigellosis probably have vector-borne components of their transmission.*

Table 1.
Important vector-borne diseases, disease agents, and vectors.[1]

illnesses, vector control or protection of humans from exposure to the vector may be the most important means of risk reduction. Such is the case for diseases like dengue, chikungunya, and Zika. Though the vector provides another vulnerability to the disease transmission cycle, it also provides a mechanism for spreading the diseases. The resurgence of vector population like that of *Aedes aegypti* in Latin America has been linked to the resurgence of dengue [2]. Likewise, expansion of the range of invasive species like *Aedes albopictus* in the USA can present an increased risk of disease transmission in affected regions.

The current status of information regarding vector-borne disease prevention, control, and treatment demonstrates the need for more research and dissemination of the knowledge gathered from laboratory and field studies alike. Developments in molecular biology, genomics, pharmacology, field biology, and virology provide great potential for improvements in control of vector-borne disease. At the same time, it is necessary to acknowledge the continuing utility of older, field-proven methods such as interior residual sprays, which continue to provide effective and inexpensive disease control for millions of people [4]. The wide variety of

vector-borne diseases along with the fact that they can be attacked through a wide variety of methods makes the study of such diseases far ranging in subject and perspective.

Conflict of interest

The author declares no conflict of interest.

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