

CDC DIVISION OF VECTOR-BORNE DISEASES

DVBD Priority Diseases

Dengue hemorrhagic fever
Ehrlichiosis & Anaplasmosis
Lyme disease
Plague
Q fever
Rocky Mountain Spotted Fever
Tularemia
West Nile and other mosquito borne viruses

KEY DVBD FUNCTIONS

- **Lead agency** for prevention and response to viral and bacterial vector-borne disease.
- Coordinates **nationwide disease surveillance**. Identifies and responds to changes in disease patterns.
- Serves as national **diagnostic reference laboratory**, supporting state laboratory networks to quickly identify the cause of outbreaks.
- Responds to vector-borne disease outbreaks with **science-based guidance** and leadership for control.
- As CDC's only major infectious disease laboratory outside of Atlanta, provides emergency **continuity-of-operations**; tests for all major infectious bioterrorism agents.

PROMOTING HEALTH AND QUALITY OF LIFE BY PREVENTING AND CONTROLLING VECTOR-BORNE DISEASES

Some of the world's most destructive diseases are vector-borne—that is they are transmitted to humans by ticks, mosquitoes or fleas. DVBD is one of the **world's foremost centers of research** for preventing and controlling vector-borne viruses and bacteria.

Vector-borne diseases are among the most complex of all infectious diseases to prevent and control.

Not only is it difficult to predict the habits of the vectors, but most vector-borne agents can infect animals as well. The rapid, unstoppable spread of **West Nile virus (WNV)** across the US is an example of the problem. Another emerging infection, **Lyme disease**, has resulted in over 20,000 annual reported human cases in the US in recent years. **Dengue fever** causes thousands of cases of illness in US territories and US travelers, and millions of cases worldwide. *Yersinia pestis*, which causes the ancient disease known as **plague**, continues to cause focal outbreaks in the US, and is a significant health threat in Africa and Asia. Looking forward, we are preparing for the potential introduction of **chikungunya** and **Rift Valley fever** viruses. Tickborne rickettsial diseases, such as **Rocky Mountain spotted fever (RMSF)**, **ehrlichiosis**, and **anaplasmosis** are responsible for over 4,000 cases each year, including some with fatal outcome.

DVBD combines specialized **epidemiology, ecology and laboratory expertise** to respond to the challenges presented by vector-borne infectious diseases. We support state and local health departments, work with partners in industry and other federal agencies and answer the call for expertise from international partners during epidemics. We are more cognizant than ever of the potential risks presented by globalization and climate change. The world is an increasingly smaller place, and **the U.S. is at greater risk than ever from vector-borne disease**. It is DVBD's challenge to mitigate that risk.



BIOTERRORISM: DEFENDING THE NATION

Of the pathogens judged most likely to be used as biological weapons, eight (**tularemia, plague, Venezuelan, western, and eastern equine encephalitis viruses, Q fever, RMSF, and epidemic typhus**) are DVBD's responsibility—more than any other division within CDC.

DVBD has created **emergency response** plans for these agents, including having teams at the ready to respond to field investigations. Our laboratorians are prepared for and capable of testing for all major infectious bioterrorism agents, and have the experience which allows us to respond rapidly and accurately to emergencies and to identify the source of the pathogen.

DVBD also has an active **research program**, working to develop more rapid and accurate diagnostic reagents that can be used by national and international laboratories, as well as conducting research to improve our knowledge of effective drugs and interventions.

DVBD WORKS WITH STATES



Field investigation of tularemia outbreak, 2008

DVBD provides **diagnostic and reference** services for all state health departments. DVBD laboratories test samples for vector-borne diseases that are uncommon in the US that require special testing equipment. State public health laboratories also rely on DVBD for special laboratory materials.

DVBD's **technical assistance and disease investigation** includes collaboration with Colorado and New Mexico in the investigations of plague, investigation of tularemia outbreaks in Utah and Missouri, work with Native American tribes in several states and investigations of fevers of unknown origin in Arkansas.

DVBD **coordinates surveillance** with all states through **ArboNET**, the computerized national surveillance system it developed for tracking West Nile virus. ArboNet address states' needs for tracking West Nile virus (WNV). This electronic data sharing allows all partners to make decisions about mosquito control or outbreak preparation and response.

In 2010, DVBD provided funds valued at \$13 million to **48** states, 1 territorial and 5 major city health departments to support activities for WNV and other medically important arboviruses. Another \$48,000 was provided to 12 states to support enhanced surveillance for Lyme disease and ticks.

As a Division of CDC, DVBD blends world-class scientific research in vector-borne disease with operational response to vector-borne disease epidemics and bioterrorism.

DVBD INTERNATIONAL

DVBD supports two types of international projects:

- **Outbreak response**— Short-term assistance in the suppression of epidemics.

Recent examples include the response to outbreaks of yellow fever in **Sudan, Peru, and Paraguay**; Rift Valley fever in **Kenya**; Zika virus in the Pacific island of **Yap**, and chikungunya in the **Indian Ocean** region.

- **Research and development**— Long-term, multidisciplinary projects with the aim of improving diagnosis and control of diseases at their source.

Recent activities include:

Africa: Although rare in the US, **plague** is a significant endemic disease in Africa. In *Uganda*, DVBD, with support from USAID, is conducting the largest multidisciplinary study of plague in the world. This study will provide the knowledge to better predict, diagnose, prevent and treat plague anywhere. For example, in 2010, DVBD and its Ugandan partners will begin the first trial to test the efficacy of the readily available, inexpensive antibiotic ciprofloxacin (Cipro™) in the treatment of plague—the results of which may influence the US National Stockpile of drugs kept in reserve for bioterrorism. Another highlight is rapid, inexpensive bedside diagnostic tests (“dipsticks”) being developed at DVBD, with the goal of transferring this technology to Africa where it will have broader application to other diseases as well.

Asia: **Japanese encephalitis (JE)**, a mosquito-borne disease, is one of the leading causes of viral encephalitis in Asia. JE is a continuing health threat to children in these areas with tens of thousands of cases reported each year. Beginning In 2007, DVBD helped initiate local disease monitoring programs, provided training, and established a laboratory network that will allow better vaccine coverage for children in *China, India* and *Bangladesh*.

Latin America: DVBD is working with local partners to assess the disease burden from **West Nile virus, dengue, and other arboviruses** in *Guatemala, Panama, and Mexico*. Some of these viruses are transported by migrating birds throughout the Americas.



Dr. Ingrid Weber examines a child in Uganda.

INNOVATIVE RESEARCH TO PREDICT, PREVENT & CONTROL DISEASE

Disease prediction is key in prevention and control. Data on the number and location of human cases, the vector quantity and type, ecological and climate patterns as well as infection rates in hosts animals and vectors can give a picture of when, where and how a disease is spreading or declining. This and other data can help predict future outbreaks, identify unique disease cycles, as well as frame research, preparedness and prevention plans.

To that end, DVBD's ongoing surveillance identified 28,921 human cases of **Lyme** disease in 2008, the most common vector-borne disease in the United States. DVBD developed and manages the internet-based ArboNet, the only surveillance system at CDC that tracks human cases of disease as well as reports of infection in vectors and hosts. ArboNet carefully tracked **West Nile virus** as it progressed across the US in less than a decade. With ArboNet, state health departments can view hot spots of vector activity or human cases in neighboring states and areas to better initiate prevention activities to reduce human risk.

Dengue fever causes thousands of cases of illness in US territories and travelers from the US. DVBD's ongoing surveillance in Puerto Rico tracks dengue epidemics, such as in 2007 when over 10,500 cases were identified. Understanding the disease patterns alerts public health officials to heighten mosquito control, alert the public to increase personal protection and allows health care facilities to manage a potential increase in patients.

DVBD **research** focuses on prevention and control strategies that can reach the targeted disease or vector at multiple levels while being mindful of **cost effective** delivery that is acceptable to the public, and cognizant of the world's ecology. Current research includes vaccine development, vector control, and public and health care provider education. At another level, novel approaches to control ticks, including evaluation of insecticides and repellents derived from **natural products** are being investigated.

DVBD will continued to develop more **refined surveillance** systems, develop human and animal **vaccines**, research novel approaches to **control vectors** and their ability to transmit disease, while increasing public and health care provider **education**. US citizens can feel secure in that their public health system is the most sophisticated in the world.

DVBD COMMERCIAL PARTNERS

DVBD scientists develop vaccines and novel products to prevent and diagnose vector-borne disease. Materials are created and tested for safety and effectiveness, and then licensed through technology transfer agreements.

- DVBD and **Inviragen** have developed a promising dengue vaccine, which is being prepared for human clinical trials.
- DVBD and **Ventria Bioscience** have developed genetically modified rice that produces a vaccine to immunize certain mice against the bacteria that cause Lyme disease .
- The first ever DNA vaccine to be licensed was developed at DVBD. Today it is available through **Wyeth/Fort Dodge Animal Health** for West Nile virus protection in horses.
- DVBD scientists pioneered the development of "bait boxes" to control the spread of Lyme disease from rodents to ticks by applying a tiny amount of pesticide to the rodent. The boxes, licensed to **Bayer Environmental Science**, have been hailed as an eco-friendly method of vector-borne disease control that can be used in residential settings.
- DVBD is collaborating with **Legacy BioDesign** in Loveland, Colorado to develop formulations for a natural tick control using oils from Alaska Yellow Cedar, as well as with **Genesis, Inc.** in Wellington, CO to develop antibiotic bait to control Lyme disease bacteria in rodent hosts.

DVBD is the focal point for national coordination of public health efforts for vector-borne diseases.





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DVBD's goal: reduce the threat and burden from
vector-borne diseases everywhere.

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