Arthropod-Borne Diseases Research, Education and Training at the Biosecurity Research Institute

Background

The growing public health problems associated with mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are currently receiving a great deal of attention and causing great fear to individuals and the general public. The vectors, such as mosquitoes and ticks, that spread these diseases can rapidly infect entire regions of our nation. To control the spread of disease, it is important to monitor and take appropriate measures to control or eliminate the hazards. Lack of funding for training and research in arthropod-borne diseases is creating a void that is making it difficult to respond to the threat of increased vector-borne diseases and address the public's concerns in a timely manner.

Description

The Biosecurity Research Institute (BRI) at Pat Roberts Hall is equipped and capable of meeting the challenge of expanding education, training and research on arthropod-borne diseases. This state-of-the-art Arthropod Containment Level 3 (ACL-3) Laboratory and supporting mosquito rearing room allows researchers to investigate interactions between infectious disease agents and insect vectors. This specialized space for infected insect maintenance has controlled access, downdraft air curtains and screening. The insectary contains a 4-foot biosafety cabinet and specialized equipment to enable feeding, inoculation and transmission studies.

Laboratory space of 31,000 square feet in the BRI supports diverse and multidisciplinary research and training opportunities, with the capability for research on vector-borne and foreign animal diseases in both large animal and small animal models. Within the BRI, two core facilities in Molecular Virology and Applied Immunology support education and research. The BRI is the first nonfederal facility to be approved for the tick-borne select agent African swine fever virus (ASFV). Recent acquisitions of ASFV and classical swine fever virus (CSFV), have enabled research that has led to testing of promising new vaccines for CSF and innovative molecular genetic studies to improve our understanding of ASF in swine.

Arthropod-borne viruses that have been studied at the BRI include Zika (ZIKV), bluetongue, chikungunya, Japanese encephalitis (JEV), Rift Valley fever virus (RVFV) and yellow fever. Recent mosquito experiments with JEV, a priority pathogen for study at the National Bio and Agro -defense Facility (NBAF), are the first such studies to be conducted in the U.S. since the 1940s. This virus is closely related to West Nile virus that has probably infected more than 2 million people and caused more than 1,900 deaths since 1999. Our experiments with JEV demonstrated susceptibility of North American mosquitoes that could be effective vectors in the event this virus is introduced into the U.S. Research with the ZIKV that has infected more than 4,000 people in the U.S., investigated mosquito transmission, and also supported collaborative studies to evaluate new vaccines for Zika.

Experiments at the BRI with RVFV in livestock is the first such work in the U.S. for more than 20 years. A USDA-funded U.S.-U.K. collaboration is studying genetically engineered vaccines of mosquito-borne RVFV, Cache Valley, Schmallenberg, Akabani and Kairi viruses.

With interdisciplinary biosecurity research programs, agrosecurity initiatives and the development of collaborative research, the BRI is the platform for transitioning work currently conducted at the Plum Island Animal Diseases Center (PIADC) to the NBAF which is being constructed adjacent to the BRI.

Relevance

The threat of arthropod-borne diseases to U.S. citizens and agriculture is constant, especially with so many of these being zoonotic, infecting both wildlife and people. U.S. vulnerability has been demonstrated by the introduction and establishment of West Nile virus, and numerous travel-related cases of chikungunya and Zika viruses. It is vitally important to develop new programs that will provide comprehensive training in both basic and applied aspects of vector biology/medical entomology, arbovirology, and the epidemiology of arthropod-borne diseases.

Providing education and training to graduate students and postdoctoral fellows will help create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks. Working with some viruses can only be performed in high containment and the BRI is equipped and ready to undertake this research.

Public health professionals are an additional sector that will benefit from training at the BRI. By increasing their knowledge of arthropods and the diseases they vector, they are better equipped to work with the public they serve. They are a vital link in working with the public to increase and map surveillance of the insects and ticks, as well as reporting data so that the response to outbreaks can be swift and effective.

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