

Preventing the Bite Day and Night: Harris County Public Health's Comprehensive Approach to Vector-Borne Disease Management



Harris County Public Health (HCPH) Mosquito & Vector Control Division (MVCD) provides mosquito and vector control public health services to Harris County, TX, the third most populous county in the United States. Spread over 1,778 square miles, Harris County contains 4.7 million residents, including the residents of Houston, the fourth largest city in the nation.

The mission of MVCD is to protect the health and well-being of all Harris County residents from mosquito-borne diseases by integrating surveillance, control, education, research, and technology. This has been the primary mission of MVCD since its inception in 1965 following an outbreak of St. Louis encephalitis that reached epidemic proportions in 1964. Over the last 53 years, MVCD has established a comprehensive integrated vector management approach, making it a leader in emerging infectious disease (EID) and vector-borne disease surveillance, control, preparedness, and response. Prior to 2016, MVCD activities focused primarily on mosquitoes; however, MVCD added a vector surveillance component in 2016 to include other vectors of public health importance (e.g., kissing bugs, ticks).

Responsiveness and Innovation

Vector-borne diseases and EIDs are not limited by country borders. Many diseases thought to no longer threaten the United States are resurfacing, while new ones are emerging. According to the Texas Department of State Health Services (DSHS), 14 vector-borne diseases were reported in Texas in the past five years; nine of these diseases were EIDs, with West Nile virus (WNV) contributing 74% of all arboviral diseases reported.¹

In 1984, MVCD established an in-house virology laboratory that continues to play a vital role in detecting EIDs today through the testing and analysis of field-collected mosquitoes. The methodologies integrated into the virology laboratory test program not only screen for and target infectious pathogens that are endemic to this region, namely WNV, but also incorporate the latest in testing technology, thereby enhancing MVCD's capability to detect EIDs such as chikungunya, dengue, and Zika. Having a laboratory capable of testing for arboviruses on site shortens the time between virus identification and deployment of appropriate

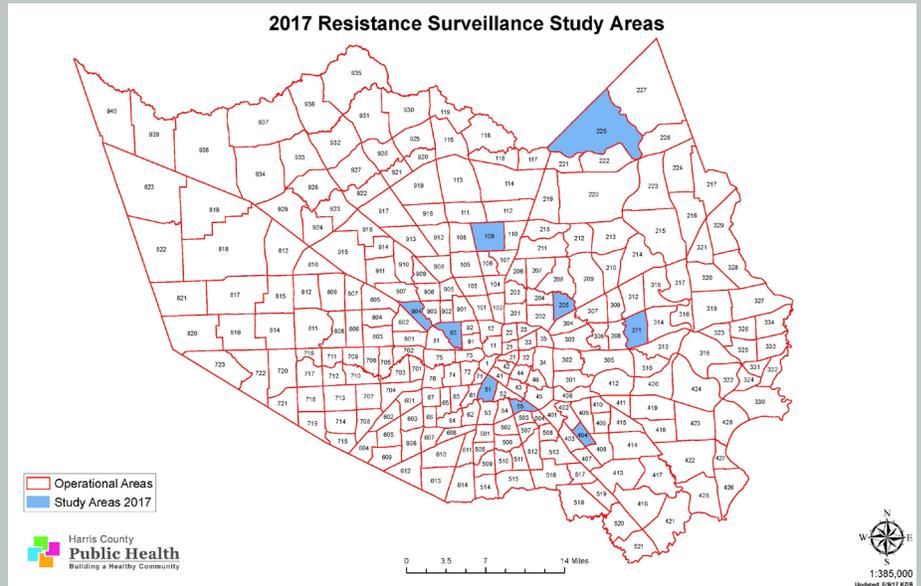


control measures. In addition, MVCD is testing new technologies to increase efficiency in the avian surveillance program. MVCD is the first organization in the United States to utilize Loop-Mediated Isothermal Amplification technology to test for WNV in avian blood samples.²

In 2004, after WNV emerged in Texas, the MVCD testing and evaluation program began evaluating potential pesticide resistance in wild WNV-carrying mosquitoes, i.e., *Culex quinquefasciatus*, from various areas in Harris County. In 2017, two additional mosquito species were added to the program: the yellow fever mosquito, *Aedes aegypti*, and the Asian Tiger mosquito, *Aedes albopictus*. The Asian Tiger mosquito is a known vector of multiple EIDs in the Americas including yellow fever, dengue fever, chikungunya, and Zika. Incorporating insecticide resistance testing and evaluation as part of the comprehensive vector management program has proven invaluable in determining both efficacy of insecticides tested and resistance in vector mosquito populations to current insecticides. To date, vigilant monitoring has not revealed any emerging patterns of insecticide resistance.

In symmetry with the rapid virology testing and treatment time, MVCD partnered with Microsoft Corporation in 2016 to develop a mosquito trap that saves time and resources in mosquito and vector surveillance. This innovative trap, part of Microsoft's Project Premonition, attempts to speciate mosquitoes as they fly into its separate chambers. The trap eliminates precious time in the virus

TESTING FOR INSECTICIDE RESISTANCE



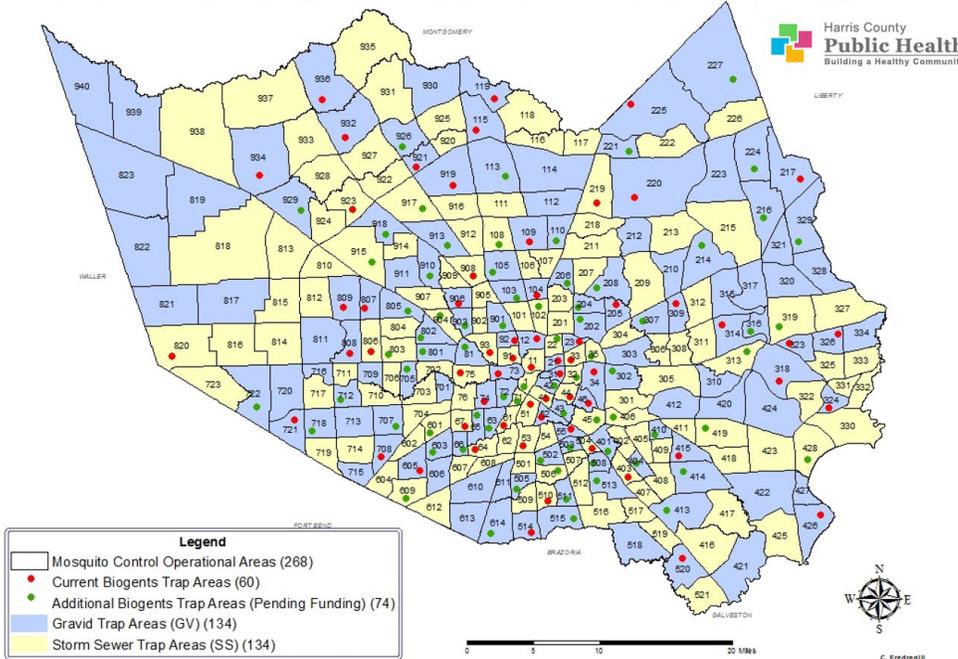
identification process as it only traps certain species of public health importance, and the sorting process, which takes the most time, is significantly reduced. The trap is still undergoing product design improvements and development, but with the eventual maturation of this new technology, the entire EID detection and notification system can be adapted further to protect Harris County residents.

Following Hurricane Harvey, MVCD was heavily involved in mosquito and vector control response. Successful activities included conducting landing mosquito rate counts throughout Harris County and Houston; coordinating aerial adulticide treatment with the Texas DSHS and the Department of Defense; scheduling and conducting truck Ultra Low Volume adulticiding spray missions; conducting mosquito inspections and surveillance; arboviral testing; and coordinating mosquito education and outreach.

Partnerships and Collaborations

Establishing and maintaining strong working relationships with internal and external partners provides MVCD with the foundation for all program components. These relationships have a direct link to MVCD objectives: (1) utilize Harris County and collaborative resources to support program components; (2) maintain and adapt program processes as new methodologies and technologies become available; and (3) enhance and streamline the notification system for vector-borne disease presence. Internal partners and collaborators are vital to keeping MVCD in alignment with One Health goals and HCPH initiatives, and they ensure MVCD is utilizing all pertinent data needed to make sound decisions regarding vector-borne disease detection and response. The HCPH program areas that have a direct correlation with EID/vector-borne disease investigation, detection, and response include epidemiology, communications, public health preparedness, veterinary public health, and environmental

Mosquito Traps by Type and Operational Area in Harris County, TX



**Biogents (BG)
Sentinel Trap
(*Aedes*)**

**Gravid Trap
(*Culex* &
Aedes)**

**CDC Storm
Sewer Trap
(*Culex*)**

**Microsoft
Smart Trap
(*Aedes*)**



public health. Working with these internal partners and collaborators broadens MVCD's knowledge base and enhances processes to make informed decisions to protect the health of the community.

External partners and collaborators are also key to achieving division goals completely, effectively, and efficiently. Some of these partners and collaborators include the University of Texas Medical Branch at Galveston, Baylor College of Medicine, Texas A&M University, University of Houston, Texas Mosquito Control Association, Microsoft Corporation, the American Mosquito Control Association, Walter Reed Army Institute of Research, MEVLABS, Inc, MosquitoMate, New Mexico State University, and Texas Tech University. Robust working relationships with these partnering and collaborating academic and research institutions, organizations, and associations allows MVCD to further its entomological reach to cover all areas of Harris County in the most efficient way possible, saving time and valuable resources.

Faced with the threat of Zika virus in Harris County, MVCD leveraged these partnerships and collaborations to increase mosquito surveillance, enhance testing capabilities, and increase community engagement activities. The partners' assistance with both monetary and knowledge-based resources was invaluable.

Working with HCPH internal partners, MVCD implemented an in-house One Health collaboration between disease control and clinical prevention, veterinary public health, environmental public health, and mosquito and vector control units. The goal of this collaboration was for all participating program areas to identify mosquito breeding sites and eliminate or treat them at the time

HCHP Collaborations

- University of Texas Medical Branch at Galveston is contributing to and enhancing avian arboviral surveillance and tick surveillance.
- Baylor College of Medicine is contributing to and enhancing mosquito and kissing bug surveillance.
- Microsoft is enhancing novel mosquito surveillance (e.g., Project Premonition).
- Walter Reed Army Institute of Research and MEVLABS, Inc. are contributing to and enhancing novel mosquito control approach.
- MosquitoMate is contributing to and enhancing novel mosquito control approaches (e.g., Wolbachia).
- New Mexico State University and the U.S. Department of Agriculture are contributing to and enhancing novel mosquito microbiome control interactions.
- Future collaboration with Oxitec will contribute to and enhance the sterile male insect technique of *Aedes* mosquito control.

of identification. MVCD provided regular meetings, education, and training opportunities (e.g., MVCD staff-led classroom and field trainings) to collaborative members. In addition to this in-house effort, MVCD included the City of Houston Community Development Department and the City of Houston Health Department Bureau of Public Health Preparedness in the One Health practice. This allowed MVCD to further reach into Harris County neighborhoods to identify mosquito breeding sites and educate residents and business owners on breeding site elimination and personal protective measures. MVCD provides training and outreach materials to these partners as needed.

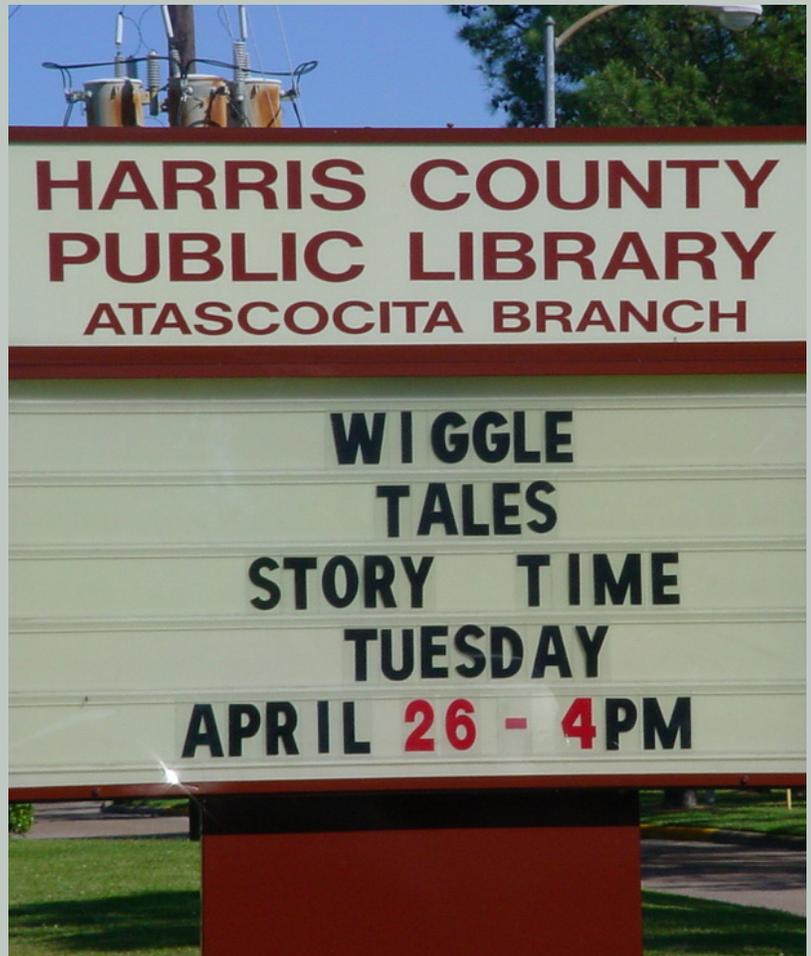
Communication and Community Engagement

MVCD disseminates ongoing prevention messages to county residents to alter their attitudes and beliefs toward vector-borne

diseases. Both community efforts to reduce vector populations and personal protective measures against these vectors and the pathogens they transmit are vital extensions to the work conducted by MVCD. Providing these messages and facilitating community involvement to motivate behavior change is even more critical when EIDs are detected in the community. MVCD notifies the public of EID detection through person-to-person communication, online communication, social media, and traditional media (e.g., radio, print, television).

MVCD's community outreach footprint is currently expanding with the addition of two mobile outreach vehicles, allowing MVCD personnel to engage the community in an innovative and interactive learning experience. The first of the two vehicles is the Skeeter School Bus, an extension of the Skeeter School outreach program,³ which targets elementary-age children. The program includes a teacher's edition with lessons and supplies for rearing mosquitoes in a closed container in the classroom to observe the mosquito life cycle as it occurs.

MVCD COMMUNITY ENGAGEMENT



The second is the Mobile Vector Unit (MVU), which is a museum-style interactive, exploratory unit that includes information panels; video screens with public health service announcements and an interactive quiz; microscopes with vector specimens; and mosquito “hatcheries” that enable the participants to see each stage of the mosquito life cycle up close. MVCD worked with the Houston Museum of Natural Science to complete this learning experience. Since MVU has been in operation, MVCD has observed a strong, positive impact in the communities the vehicle has visited.

In addition to these community outreach efforts, MVCD partners with the Texas Department of Agriculture (TDA) and Texas AgriLife Extension to provide state-required training to vector control professionals. As a TDA Recertification Sponsor, MVCD hosts the Annual Vector Control CEU Workshop for Certified Pesticide Applicators, which ensures that insecticide and pesticide applicators in communities are using best practices for integrated vector management. A significant commitment from stakeholders is imperative to this workshop’s success. Buy-in and input from these regional partners is an important factor in data collection and program implementation throughout Harris County neighborhoods. The return on investment is immeasurable as the participants receive state-required continuing education units and valuable resources in conducting day-to-day operations. The connections made through these workshops provide increased target audience access, increased information distribution capabilities, and expanded outreach of MVCD’s mosquito and vector control community education program.

Vector control is everyone’s concern. MVCD has a strong commitment to developing and implementing an effective and efficient vector and pathogen surveillance program to protect Harris County residents from vector-borne diseases. Utilizing a comprehensive vector-management practice program ensures that MVCD meets the community’s needs.

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MVCD COMMUNITY ENGAGEMENT



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