

Harris County Public Health Uses Global Health Innovations to Prevent Infectious Mosquito-borne Diseases in Harris County



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Introduction

Harris County – the largest county in Texas – includes the city of Houston, and is the third most populous county (~4.7 million residents)

in the United States. Harris County Public Health (HCPH) protects the health and well-being of its residents utilizing both local and global health innovations. Under the leadership of its Executive Director, Dr. Umair A. Shah, HCPH is continually looking for novel ways to improve its public health activities regardless of where they may originate. In this regard, HCPH is committed to adapting and adopting even global solutions to local problems and this commitment stems in part from Dr. Shah's global experiences working at the WHO, responding to disasters in Haiti and Kashmir, as well as his recognition of the importance of learning from each other. Understanding how the global public health landscape is intimately connected to local public health problems is critical to building a resilient community through innovation.

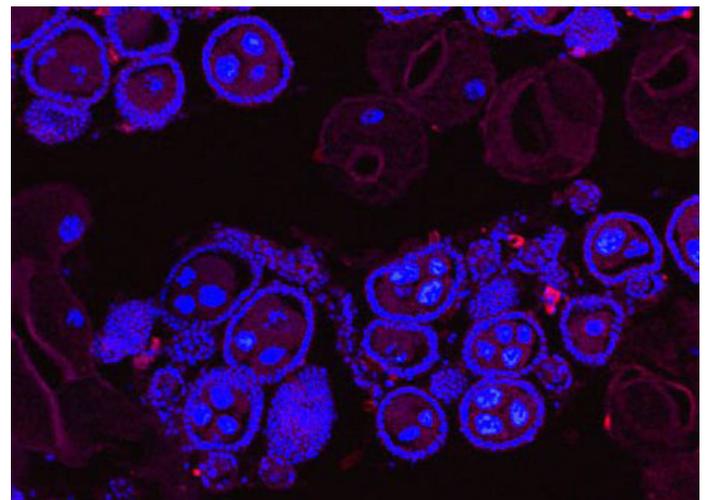
Given the recent introduction and outbreaks of emerging mosquito borne diseases such as Zika coupled with increased insecticide resistance in mosquitoes, HCPH looked globally for innovative ideas and alternative methods to improve its vector surveillance and control services. Harris County is home to 56 mosquito species, including vectors of Zika, Chikungunya, Dengue, West Nile virus, Saint Louis Encephalitis, etc. Some of the vectors such as *Aedes aegypti* and *Ae. albopictus* found in Harris County are cosmopolitan and also important



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vectors of yellow fever, dengue, chikungunya and zika worldwide but primarily in tropical and subtropical countries. Due to the increased public health risk in part due to increased globalization (trade and travel), HCPH wants to position itself to be at the forefront and be better equipped to protect the residents of Harris County in cases of introduction of new vector borne diseases or outbreak of already existing diseases.

Two examples of innovative "global to local" projects currently underway at HCPH include a *Wolbachia* incompatible mosquito control technique and Microsoft Research (MR) "Smart Trap" technology. These projects were initiated from of HCPH's constant program evaluation of its vector control approaches and constant communications and discussions with collaborators to find novel ways to improve our vector surveillance and control operations to protect the residents of Harris County from emerging or existing vector borne diseases. HCPH is one of the premier local public health agencies in the nation, and it is well positioned to leverage



collaborations and connections with numerous partners including members of academia, industry and government both locally and internationally for global public health solutions to local as well as global health issues.



Wolbachia and its use for vector and disease control strategies

HCPH is currently limited to only two classes of insecticides. As such it was imperative to find alternative strategies to manage mosquito populations that do not rely on insecticides. These strategies must accomplish two things: 1) control mosquito populations without increasing insecticidal selection pressure on mosquito vector populations; and 2) control mosquito populations that are already resistant to insecticides.

Wolbachia is an endosymbiotic bacteria genus present in many insects, but absent from some medically important mosquito vectors, including *Aedes aegypti*. *Wolbachia* causes a phenomenon called cytoplasmic incompatibility, i.e., when a *Wolbachia*-infected male mosquito mates with an uninfected female, she can no longer produce viable offspring. The infection of *Wolbachia* can also provide resistance to virus replication (e.g., Dengue virus in *Ae. aegypti*) and thus reduces disease transmission to humans.

Field releases of *Wolbachia*-infected mosquitoes for disease prevention are currently being evaluated in different countries as well as the United States. For example,

a recent study demonstrated mass release of male *Ae. albopictus* mosquitoes super infected with *Wolbachia* and treated with low dose radiation resulted in a significant population reduction (94%) from two islands in Guangzhou, China (Zheng et al. 2019). Another project led by team in Australia released *Wolbachia* infected *Ae. aegypti* mosquitoes in 12 countries including in Australia, India, Vietnam, Indonesia, Sri Lanka, Fiji, New Caledonia, Mexico, Brazil and Columbia to reduce dengue transmission in those countries (<http://bit.ly/2MAXdN6>). During the Zika epidemic, billions of *Wolbachia* infected *Ae. aegypti* mosquitoes were released in Brazil to curb the spread of the disease (<http://bit.ly/31ATtzs>).

Learning from these global projects, HCPH is currently evaluating use of *Wolbachia* incompatible mosquito control strategy in collaboration with MosquitoMate, a private startup mosquito control company founded in partnership with University of Kentucky. The project involved weekly release of *Wolbachia* infected non-biting males of *Ae. aegypti* and *Ae. albopictus* in urban neighborhoods of Harris county. The target mosquito species include *Ae. aegypti* and *Ae. albopictus* both of which have co-occurred in Harris County for over three decades. The two species are known to vector yellow fever, Zika, Dengue and Chikungunya viruses and pose a public health risk to the residents of Harris County.



The impact of the *Wolbachia*-infected male releases on mosquito populations are being evaluated by MosquitoMate itself, and independently by the United States Centers for Disease Control and Prevention (CDC).

The goal is to leverage novel, environmentally friendly technologies to protect residents of Harris County from vector-borne diseases as efficiently and effectively as possible. The *Wolbachia* project does just that.

Incorporation of Smart Mosquito Trap Technologies

So too does the HCPH partnership with the global Microsoft Research (MR), known as Project Premonition. HCPH currently uses traditional surveillance tools for collecting vectors and detecting vector-borne pathogens.



The MR “Smart Trap” can identify and capture specific species of mosquitoes based on the frequency and oscillation of the wing-flapping of the individual mosquito. On the back-end, this initiative promises to yield a plethora of additional information (e.g., environmental data, time collected, etc.) to reduce the amount of time and resources to collect, test and identify diseases thus decreasing response time to control the vectors. Furthermore, it will facilitate detection of pathogens that are threat to global health including Zika and other novel and introduced pathogens in Harris County.

HCPH was the first public health agency in the nation to work with MR on the deployment of this technology. The

trap was first deployed in Grenada and then brought to Harris County. After learnings from Harris County and elsewhere, MR then deployed the trap for further piloting in sub-Saharan Africa. The global-domestic-global partnership demonstrates the bidirectional importance of learnings across the globe.

The Value and Challenges of Using a Global Strategy Locally

There were several challenges faced during the implementation of the *Wolbachia* project. This included obtaining appropriate regulatory permits from state, county and municipal jurisdictions in a timely manner and securing resident consent to conduct project evaluations on individual properties.

HCPH gained valuable experience in evaluating these novel global technologies for local implementation. The adoption of these global projects led to the establishment of close partnerships with global public health leaders and stakeholders while enabling HCPH to tap into international expertise and innovation in combating emerging diseases here in Harris County moving forward.

Conclusions

Although these projects are at the early stage of evaluation, they have shown great potential in improving HCPH vector surveillance and control capabilities. Once evaluation of these projects is completed, these new tools will enhance the HCPH vector surveillance and control toolbox. Thus far, HCPH has learned that robust coordination and communication with state and local (county, municipality) jurisdictions is imperative to successfully adopting new technologies that will improve the health of Harris County residents. Furthermore, community education and engagement are also critical for successful implementation of these novel surveillance and control tools. HCPH has been successful in establishing partnerships with global project leaders in adapting these technologies to improve the public health and well-being of Harris County residents.



References

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Global Health Featured on Podcast from Washington

Emily Yox, NACCHO's program analyst for global health, sits down with Dr. Umair Shah, former NACCHO president and executive director of Harris County Public Health in Texas, to discuss health department programs that were inspired by successful global health work. Dr. Shah discusses two mosquito and vector control interventions that were initially carried out in India, Brazil, and Australia before being adopted by Harris County to align with their specific needs.

Listen to the podcast here:

<http://bit.ly/2Pa6g9K>

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