

SCIENTIFIC NOTE

STATUS OF VECTOR CONTROL CAPABILITIES AND CAPACITIES IN FLORIDA AND TEXAS, AND ITS POTENTIAL PUBLIC HEALTH CONSEQUENCES

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ABSTRACT. It has been reported that roughly 80% of vector control organizations throughout the southern USA lack critical capabilities to properly address potential vector populations and vector-borne diseases within their jurisdictions. This study further investigated current vector control capabilities and capacity within the states of Florida and Texas. It was reported that only 26% of jurisdictions in Florida and 14% in Texas reported that they were “fully capable.” Both states are among the top 4 states relative to the number of human cases of mosquito-borne diseases, and both states have had local transmission of Zika virus. Respondents from Florida indicated that 88% of jurisdictions have vector control capabilities to some degree, with 65% of those reporting they had sufficient capabilities. Respondents from Texas indicated that 89% of jurisdictions have vector control capabilities to some degree, with 67% of those reporting they had sufficient capabilities. As the prioritization of resource commitment for vector control capabilities varies throughout the USA, it is imperative that each state evaluates their specific needs and current capabilities and capacity to best ensure the public health needs of their constituents.

KEY WORDS Florida, funding, mosquito surveillance, Texas, vector-borne diseases, vector control

A 2017 report by the National Association of County and City Health Officials (NACCHO) brought attention to the fact that about 80% of vector control organizations throughout the southern USA lack the critical surveillance, preventative, and control capabilities to effectively address vector-borne disease challenges within their jurisdictions (NACCHO 2016, 2017). This is especially alarming considering the US Centers for Disease Control and Prevention recently reported the number of vector-borne disease cases have more than tripled during the past 15-plus years. Additionally, 9 new vector-borne pathogens have been identified or introduced into the USA during that same time period (CDC 2018, Rosenberg et al. 2018). Having adequate capabilities to properly survey for both potential vector populations and vector-borne diseases within a jurisdiction is an important function for properly assessing the risks to public health, while the lack of adequate control capabilities is known to potentially result in substantial increased incidence of human illness (Tomerini et al. 2011, CDC 2013, Kilpatrick and Pape 2013).

The NACCHO report (NACCHO 2016, 2017) specifically states that only 26% (10/39) of Florida vector control jurisdictions, and 14% (3/22) within Texas were considered “fully capable” of providing sufficient vector control operations. In an effort to

further investigate the current status of statewide vector control capabilities within Florida and Texas, we developed and distributed a survey that addressed several relevant issues, including funding, surveillance and treatment activities, disease screening, and communication between public health authorities and vector control entities. The states of Florida and Texas were selected for evaluation because: 1) both states are ranked among the top 4 states with the number of mosquito-borne human disease cases in the continental USA (CDC 2018); 2) both states have recently had local transmission of emerging and resurgent mosquito-borne pathogens (i.e., chikungunya, dengue, and Zika viruses [Deckard et al. 2016, Likos et al. 2016]); and 3) both states manage and oversee their vector control operations differently, which allows for a comparison. For example, Florida has a state law that governs and regulates mosquito control (Florida Statute Chapter 388, Administration Code: 5E/13) and typically operates at the county level, while in Texas, statewide governance of vector control is relatively nonexistent and typically operates at the city and/or county level.

The current survey was initially distributed to representatives from 70 city and/or county vector control entities throughout the state of Florida, with a response rate of 45.7% (32/70), and to 191 city and/or county vector control entities throughout the state of Texas, with a response rate of 37.2% (71/191). Vector control entities were selected based on having identifiable contact information to send the survey link and participation invitation to. The overall survey response rate was 39.5% (103/261) (Fig. 1). Though low, it is similar to other survey-based studies in the field (Del Rosario et al. 2014). These city/county vector control entity representatives had

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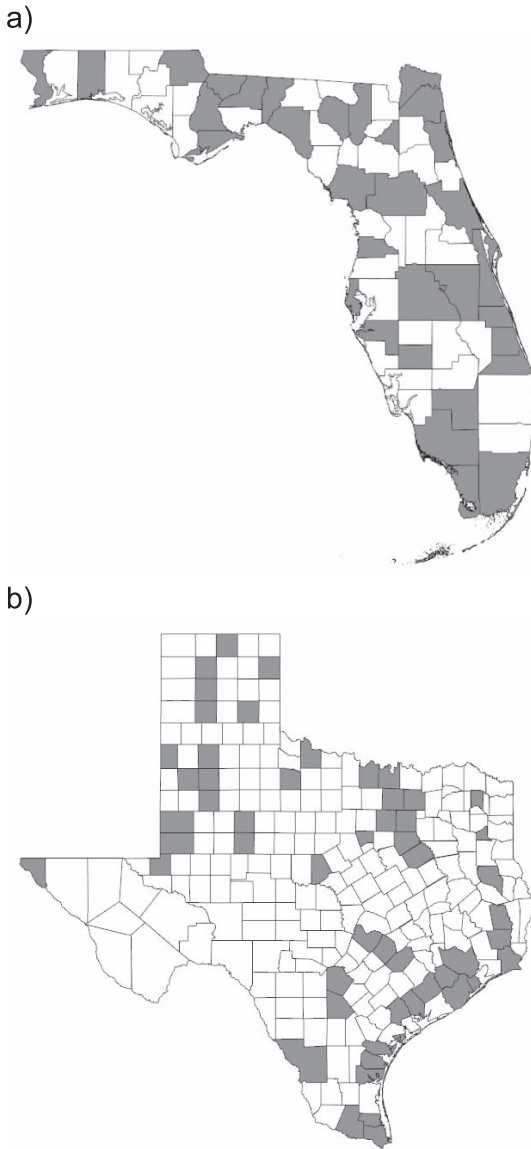


Fig. 1. Survey responses were received from jurisdictions in the following counties throughout the states of (a) Florida and (b) Texas.

firsthand knowledge regarding the operational capabilities and capacity of their respective local vector control jurisdiction, including the annual budgets allocated for vector control. Reminder emails were periodically sent to survey recipients throughout the duration of this project to encourage survey participation.

The average estimated city/county population for entities from the states of Florida and Texas, provided by respondents through the survey, was 320,289 (range 10,000–2,700,000) people and 204,164 (range 20–5,000,000) people, respectively.

In an effort to determine the operating per capita funding for vector surveillance and control, survey participants were asked to provide an estimate of their total yearly budget for their jurisdiction (Del Rosario et al. 2014). Florida jurisdictions had an average budget for vector control of \$3,186,189 (range \$32,000–19,500,000) per year, while Texas jurisdictions reported an average annual budget for vector control of \$293,560 (range \$0–7,000,000). Comparing statewide per capita budgets, \$9.15 was spent for mosquito control in Florida and \$1.12 was spent in Texas. When comparing the average per capita expenditures by individual jurisdictions, Florida spent \$15.56 and Texas spent \$2.05 per individual.

Respondents from both Florida and Texas reported that their city/county did not have any vector control capabilities, 12.5% (4/32) and 11.3% (8/71), respectively. Outsourcing of adulticide application by these jurisdictions were reported by 25% (1/4) of Florida respondents and 13% (1/8) of Texas respondents. Interestingly, none of these jurisdictions from Florida and 12.5% (1/8) from Texas reported that they outsourced larval control operations.

All jurisdictions from Florida and Texas conduct in-house adult treatment (Table 1). All Florida jurisdictions conducted adult surveillance prior to treatment, while only 69.8% (44/63) of Texas jurisdictions conducted any adult surveillance prior to treatment. This shows a lack of informed decision-making prior to pesticide application by Texas jurisdictions or perhaps is an indication of the funding discrepancies between the two states that prevents them from conducting such surveillance. However, of the Texas jurisdictions that do not conduct surveillance prior to pesticide application, 72.2% (13/18) considered themselves as having sufficient capabilities and 52.6% (10/19) consider their jurisdiction as having adequate funding. This was surprising and perhaps indicates a lack of understanding by these jurisdictions regarding the importance of making informed decisions prior to pesticide application. Vector control entities often consider a variety of factors in determining when to apply pesticides, including surveillance trap counts, positive mosquito pools, sentinel chicken seroconversion, or reported human cases. An emphasis on appropriate surveillance information prior to pesticide application or other control methods needs to be addressed.

Arboviral screening is a critical and informative surveillance tool used by vector control programs. Approximately 53.6% (15/28) of Florida jurisdictions and 61.4% (27/44) of Texas jurisdictions reported that arboviral screening of potential vector populations is being conducted. However, for both states, outsourcing these operations is more common than conducting such screening in-house (Table 1). Even though 88.0% (22/25) of Florida jurisdictions and 81.5% (22/27) of Texas jurisdictions reported that they notify public health entities (i.e., local or state

Table 1. Survey results from participants of vector control programs from the states of Florida and Texas.

Survey question	Survey response	
	Florida	Texas
Counties with mosquito control program	87.5% (28/32)	88.7% (63/71)
Counties with no mosquito control program	12.5% (4/32)	11.3% (8/71)
Average county population of respondents	320,289 (10,000–2,700,000)	204,164 (20–5,000,000)
Average county population of respondents with vector control	348,277 (10,000–2,700,000)	229,752 (2,000–5,000,000)
Average county population of respondents with no vector control	124,375 (14,500–350,000)	5,857 (20–15,000)
Average county budget	\$3,186,189 (32,000–19,500,000)	\$293,560 (0–7,000,000)
Average county per capita	\$15.56 (0.44–160)	\$2.04 (0–35)
State per capita	\$9.15	\$1.12
Larval surveillance	71.4% (20/28)	54.0% (34/63)
Adult surveillance	100% (28/28)	69.8% (44/63)
In-house arboviral testing	10.7% (3/28)	18.2% (8/44)
Outsource arboviral testing	46.4% (13/28)	54.6% (24/44)
Overall arboviral testing	53.6% (15 ¹ /28)	61.4% (27/44)
Notify public health entities	88.0% (22/25)	81.5% (22/27)
Get notified by public health entities	— ²	75.4% (46/61)
Larval treatment	85.7% (24/28)	86.9% (53/61)
Outsources larval treatment	0 (0/4)	12.5% (1/8)
Adult treatment	100% (28/28)	100% (63/63)
Monitor/treat nonmosquito vectors	0 (0/28)	1.6% (1/63)
Considered adequately funded	40.6% (13/32)	52.9% (37/70)
Have sufficient capabilities	64.5% (20/31)	67.1% (47/70)

¹ One county does both in-house testing and outsourcing for arboviral testing.
² Due to an error in the survey distribution for Florida participants, this variable was not collected.

health departments and hospitals) when positive results from in-house or outsourced arboviral screenings are obtained, only 75.4% (46/61) of Texas jurisdictions reported that they were notified by public health entities when human cases of arboviral diseases have been confirmed by healthcare professionals within their jurisdictions (Table 1).

Clearly there is room for improvement in both instances as the communication going both ways should be at 100%. Communication is critical for developing a consistent and reliable flow of such vital information between vector control jurisdictions and health departments at the local and state levels to ensure effective public health intervention (Naranjo et al. 2014, Espinal 2019). A delay in notifying vector control entities of active human infections may render emergency vector control measures essentially unsuccessful with respect to arresting the spread of human disease (Day and Shroyer 2009). Notification by a vector control jurisdiction to their local public health entities may alert physicians to consider arboviruses as a potential diagnosis at a time such diagnoses may not have typically been considered (Mostashari et al. 2001, Burakoff 2018).

Despite having relatively low response rates from both Florida and Texas, the information gained from this survey is very enlightening, especially considering that between 2004 and 2016, Florida had the 4th highest and Texas had the 3rd highest number of human mosquito-borne disease cases in the continental USA, behind California and New York, respectively (CDC 2018). The NACCHO report

(NACCHO 2016, 2017) indicated that only 26% of Florida jurisdictions and 14% of Texas jurisdictions were considered fully capable. Our findings conclude that overall, 64.5% (20/31) of Florida jurisdictions and 67.1% (47/70) of Texas jurisdictions reported sufficient capabilities, while 40.6% (13/32) and 52.9% (37/70) of jurisdictions, respectively, reported they were adequately funded. These results differed slightly from Moise and colleagues (Moise et al. 2020) as they indicated that all counties in the state of Florida had some form of mosquito control. For those in this study who did not report having sufficient capabilities and capacity, they indicated needing the following: 1) upgraded or additional equipment and infrastructure, 2) more personnel to better cover their jurisdictions, 3) training, 4) surveillance equipment and capabilities, 5) expansion of aerial programs, 6) additional personnel for resistance in testing, and 7) larval control capabilities. Jurisdictions reporting that they did not feel they were adequately funded listed the need for additional funding for the following: 1) hiring additional personnel, 2) establishing larval surveillance and larval control programs, 3) purchasing testing and application equipment, 4) conducting surveillance operations, 5) performing research and public education, 6) purchasing chemicals, permits, and vehicles. There were also responses stating that they “lack funding in every aspect of [their] program.”

Survey participants were also given an opportunity to express their thoughts regarding any topics covered in the survey. These self-reported responses

are able to provide valuable opinions, views, and information from those who work firsthand in the field of mosquito control and have direct knowledge of the challenges and struggles faced in the field (Moise et al. 2021). A few select responses received include: “Need more public education programs regarding standing water.” “It is very difficult to educate the populace concerning vector breeding grounds.” “Better communications from other entities on outbreaks.” “We do not have a dedicated staff strictly for mosquito control.” “We were recently approved for Hurricane Crisis Cooperative funding which will help fund replacement of our equipment that is nearly 20 years old and not supported by the manufacturer. This funding could not have come at a better time as we were not receiving any local funding to support vector control.” The following 2 responses suggest that all vector control jurisdictions throughout the state may not be fully apprised on the statewide recommendations. “Texas does not have a best-practices for vector control. Other states like Mississippi have manuals on best practices. I do not even know if our methods are worth the funds...” “Need standardize vector control with integrated pest management for all jurisdictions.” One response suggested a solution for the lack of funding within their jurisdiction: “I would like to assess a \$1/month charge on every water account for 6 months (mosquito season) within city limits or initiate a mosquito control district to help raise funds for the program.” Although several jurisdictions indicated that they currently feel like they have sufficient capabilities, they clarified by stating, “... additional funding and resources would be required in case of widespread arbovirus outbreak.” These financial and other resource shortfalls are especially concerning when considering the risk for potential local outbreaks such as occurred with Zika virus in Florida and Texas in 2016 and 2017 (CDC 2019). Vector control entities need to be prepared to handle perennial demands for surveillance and treatment operations, as well as from any unexpected outbreak that may occur, or natural disasters.

The findings from this survey suggest a general need for improvement in vector control programs for both Florida and Texas. The disparities in annual funding made available and the lack of adequate surveillance and control capabilities and capacity is alarming. Based on free-response answers from survey participants, there is a clear need and want for collaboration among jurisdictions within both of the participating states.

An additional point of concern through this survey is that no jurisdictions from Florida, and only one jurisdiction (1/63) from Texas, reported that they conducted any nonmosquito vector surveillance (e.g., ticks and kissing bugs), and they do not offer any treatment efforts at this time. Despite Florida ranking 25th and Texas ranking 22nd regarding the number of tick-borne human disease cases in the USA, tick vectors of disease are known to be expanding in their

range, including through the state of Texas (Sonenshine 2018). This expansion of potential tick vectors of disease may lead to an increase in tick-borne diseases within these states as well. Chagas disease, caused by *Trypanosoma cruzi* Chagas, is vectored by triatomine insects or “kissing bugs,” and is increasingly concerning within the USA. Specifically, within the state of Texas, 7 of the 11 known triatomine species occur within the state and active transmission has been documented in reservoir hosts such as dogs (Bern et al. 2011, Hodo et al. 2019).

With the recent focus on vectors and vector-borne diseases in the USA, it is imperative that public health officials and other public officials have an understanding of the current capability and capacity status of their vector control programs, as well as their abilities to respond effectively and efficiently. The success of mosquito control programs is dependent on reliable sources of funding, continuity of staff, and long-term surveillance of potential vectors (Del Rosario et al. 2014). In recent years, the passing of congressional funding such as the Strengthening Mosquito Abatement for Safety and Health Act or the SMASH Act 2020, Zika response funding, and the establishment of regional Centers of Excellence, is welcome confirmation that these issues are valid, and that more research and funding is required for programs to properly support and protect the public health of their constituents. The prioritization of mosquito control varies throughout the USA (Hamer 2016), and it is imperative that each state evaluates their specific needs and current capabilities and capacity to ensure they are prepared to address arboviral infections, one of the most significant public health concerns that exists today (CDC 2020).

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