COUNCIL OF STATE AND TERRITORIAL EPIDEMIOLOGISTS

2017 Vector-Borne Disease Surveillance Capacity Assessment Report

Table of Contents

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Executive Summary

In 2018, the Council of State and Territorial Epidemiologists (CSTE) began assessing current surveillance, prevention, and control capacity for vector-borne diseases in state and select local health departments for the year 2017. Prior vector-borne disease capacity assessments were conducted in 2004 and 2012. The 2017 assessment had four objectives: (1) assess current state and local health department capacity to conduct surveillance for vector-borne diseases, (2) compare staffing and capacity for vector-borne diseases in 2012 and 2017, (3) determine how state and large city/county health departments are currently funding, staffing, and conducting vector-borne surveillance and control activities, and (4) document health department staffing needs to achieve full vector-borne disease surveillance capacity. While the 2012 assessment mainly focused on West Nile Virus, the current assessment was adapted to include tick-borne diseases and additional arboviruses such as Zika and chikungunya. The expanded focus of this assessment on other vector-borne diseases highlighted gaps in funding and capacities at the state and territorial level. CSTE strongly recommends additional federal funding investments to preserve and enhance the current public health infrastructure for vector-borne disease surveillance programs at state, tribal, local and territorial health agencies to more effectively detect, surveil, and respond to current and emerging vector-borne disease outbreaks and threats.

Introduction

The emergence of West Nile Virus (WNV) in New York City in 1999 had substantial implications on the impact of vector-borne diseases in the United States, though documentation of vector-borne diseases has occurred in the US since the 17th century.[1,2] By 2005, WNV was considered endemic in the contiguous United States and is still reported in 2019 as the primary cause of domestically acquired arthropod-borne viral (arboviral) disease on the US mainland.[3,4] In 2017, 48 states and the District of Columbia reported 2,291 domestic arboviral cases, of which 92% were WNV. Of WNV cases, 68% were classified as neuroinvasive disease and 7% of cases resulted in death. This was a noteworthy increase from the yearly average reported from 2005 to 2012 (1,137 neuroinvasive disease WNV cases, 110 deaths).[5] Additionally, other arboviruses such as Jamestown Canyon virus and Powassan virus recorded higher incidence in 2017 than in any previous year.[4]

The geographic expansion of domestic vectors and rise of novel species capable of transmitting pathogens of human consequence remain a major public health concern. *Aedes* mosquitos are expanding their range and novel species, such as the Asian long-horned tick, *Haemaphysalis longicornis*, have the potential to increase disease incidence as many novel vectors may be competent hosts for viral, bacterial, and parasitic pathogens. Locally acquired cases of two newly introduced mosquito-borne viruses, chikungunya and Zika, have been reported within the United States and its territories (Puerto Rico, US Virgin Islands, American Samoa, Guam, Mariana Islands and American Samoa) since the 2012 Vector-borne Diseases Capacity Assessment conducted by The Council of State and Territorial Epidemiologists (CSTE). The 2016 Zika outbreak was striking, with nearly 5,000 cases reported in the continental US and over 35,000 cases reported in Puerto Rico. Additionally, tick-borne disease incidence levels continue to rise in the US and US territories with the average yearly case count from 2009 to 2012 increasing from 39,613 (range: 34,890 – 42,649), to 47,080 cases per year from 2013 to 2016 (range: 43,654 – 49,825).[6]

Vector-borne diseases can cause severe outbreaks affecting large numbers of individuals in a short interval and they can also cause smaller outbreaks with high mortality rates. While dangerous uncontrolled, these outbreaks can be mitigated through proper control and prevention measures. Both individual and population prevention activities are dependent on data collected through surveillance systems such as ArboNET. When WNV first arose in 1999, federal funding was unavailable to directly support state or local mosquito-borne disease surveillance; therefore no nationally coordinated arboviral surveillance system existed to help with the response. Since then, federal funding for surveillance and prevention activities has been made available annually through Centers for Disease Control and Prevention (CDC) Epidemiology and Laboratory Capacity (ELC) cooperative agreements for emerging infectious diseases. Thus, in the 2004 Vector-borne Diseases Capacity Assessment, the CSTE found WNV surveillance and control programs were well developed in health departments that received specific ELC funding.

Federal funding reached a high in 2004 and then decreased from 2006 to 2012. CSTE performed another assessment in 2012 and found that although some WNV surveillance remained, surveillance capacity overall had decreased since the 2004 assessment. The 2012 assessment also revealed that most states had little to no capacity for surveillance of other arboviruses, which became more apparent during the response to the 2016 Zika outbreak, requiring a drastic increase in federal funding. In addition to providing funding for state and local jurisdictions, CDC invested over $50 million in the creation of five Centers of Excellence on vector-borne diseases in 2015-2016 with the goal of building collaboration between universities, state and local health departments and vector control agencies, training public health entomologists, conducting research, and providing regional support.[7,8] Despite the progress made, ELC funding decreased for the 2018 fiscal year.[9]

In 2018, CSTE assessed current surveillance, prevention, and control capacity for vector-borne diseases in state and select local health departments for 2017. The assessment had four objectives: (1) assess current state and local health department capacity to conduct surveillance for vector-borne diseases, (2) compare staffing and capacity for vector-borne diseases in 2012 and 2017, (3) determine how state and city/county health departments are currently funding, staffing, and conducting vector-borne surveillance and control activities, and (4) document health department staffing needs to achieve full vector-borne surveillance capacity. While the 2012 assessment mainly focused on WNV, the current assessment was adapted to include tick-borne diseases and additional arboviruses such as Zika and chikungunya.

Methods

In May 2018, CSTE established a workgroup to develop the vector-borne disease capacity assessment tools for state and local health departments.

The workgroup included representatives from CSTE's national office, CSTE membership, CDC's Division of Vector-Borne Diseases (DVBD), Association of State and Territorial Health Officials (ASTHO), National Association of County and City Health Officials (NACCHO), Association of Public Health Laboratories (APHL), National Environmental Health Association (NEHA), American Medical Certification Association (AMCA), National Association of State Public Health Veterinarians (NASPHV), and the Regional Centers of Excellence in Vector-Borne Diseases. The 2012 assessment tools were edited to reflect national changes in vector-borne disease burden. The 2012 assessment primarily focused on WNV and other mosquito-borne viruses, and included questions related to staffing, mosquito-borne disease surveillance, prevention activities, funding, and laboratory diagnostic services. The new assessment was expanded to include tick-borne diseases and tick surveillance. Questions no longer relevant in the updated assessment were eliminated and new questions were added to reflect current vector-borne disease surveillance, prevention, and control standards. Several questions were added in the funding section to reflect changes in funding between 2012 and 2017. The local assessment tool differed slightly from the state tool and included additional questions to reflect local health departments' primary role in vector-borne disease surveillance and control. Respondents were instructed to answer questions based on program activities in 2017.

The assessment tools were completed in September of 2018 and piloted during October in five state and three local health departments. A few questions were reworded for clarity based on feedback. In December, a fillable Word document of the state assessment was emailed to state and territorial epidemiologists in all 50 state health departments, Washington, D.C., and US territories, in addition to a link to an electronic questionnaire via Qualtrics. Respondents were given a month to complete the assessment. The local assessment questionnaire was sent to 29 local health departments, which were selected in consultation with NACCHO. The majority (n=26) of these health departments had also received the 2012 assessment. The local health department contact was either the health officer or city/county epidemiologist. To increase response rates, the window for data collection was extended to three months.

While many responses were collected via the electronic link, responses that were received through the fillable word document were entered in Qualtrics for consistency and analysis. Data from the state and local health department assessments were analyzed separately. State respondents were grouped into categories—and data analyzed separately for each—based on (a) state population (quartiles) and (b) geographic region (five different regions). Capacity for selected surveillance activities in 2012 was compared between states reporting a need for additional surveillance staff and those not reporting such a need.

Due to the low response rate of the local assessment, no major inference or comparison could be made. The data were aggregated and displayed in tables. Additionally, due to the varying locations and size of the local health departments that responded, the collected data could not accurately be compared to the information collected in 2012. However, the information collected was used to reinforce the results discovered within the state assessment.

Responses to some questions were left blank. For questions relating to staffing, CSTE assumed blank responses indicated a lack of staff in the given response category. Thus, responses from all states were counted. For all other questions, a blank response was assumed to be a missing response and states with no response were not counted.

Differences of at least ten percentage points among comparison groups are highlighted in the results. The chi-square test for trend was used to assess the statistical significance of observed trends based on state population, recent state funding levels and recent state WNV burden (as all categorizations were ordered). Only statistically significant trend associations are reported. Data analysis was performed using Microsoft Excel and Epi Info Version 7.

Additionally, staff compared responses from the 2012 Assessment to highlight relevant trends and growths within the vector-borne disease capacity. While not every question was comparable, similar questions were highlighted in tables found in the appendix.

Results

Staffing

A combined total of fifty-four states and territories (50 states and 4 territories) responded to a series of questions regarding the number of staff employed at the state health departments, the number of contracted employees, the number of additional staff needed to reach full capacity and the division of work duties relating to mosquito and/or tick-borne diseases. In 2017, there were a total of 206 full-time employee (FTE) positions at the state and territorial level fully dedicated to vector-borne diseases. The average number of full-time state health department employees with a masters or doctorate level degree in epidemiology was less than one (0.83), while the average number of the full-time state health department employees with a related science degree (e.g., entomology or virology) was 1.24. Approximately 46% of states and territories had at least one FTE with a PhD, DrPH, MSPH, and/or MPH in epidemiology dedicated to vector-borne diseases in their jurisdiction. In addition to the 206 FTEs reported across the state health departments, there were an additional 30 full-time contractors dedicated solely to vector-borne diseases based at state health departments.

The average number of contractors with a masters or doctoral degree in epidemiology was 0.09. When reviewing staffing by regions, a majority (89%) of Northeastern states had at least one full-time employee working on vector-borne diseases, with a PhD, DrPH, MSPH or MPH in epidemiology. Southern and Western states on the other hand had lower percentages of FTEs with a PhD, DrPH, MSPH, or MPH in epidemiology with 71% and 69%, respectively.

The total number of full-time state employees not funded by the ELC or Public Health Emergency Preparedness (PHEP) cooperative agreements with a masters or doctoral degree in epidemiology was 14, with an average of 0.26 FTE per state and territory. Overall, only 11% of state and territories had at least one FTE not funded through federal programs that was solely dedicated to vector-borne diseases. Furthermore, the number of full-time vector-borne disease contractors not funded by the ELC or PHEP cooperative agreements with a masters or doctoral degree was also low, with only 2 full-time contracted employees reported and an average of 0.04 across jurisdictions.

Figure 1 Percentage of States/Territories with At Least One Full-Time Employee by Training Type, 2017.

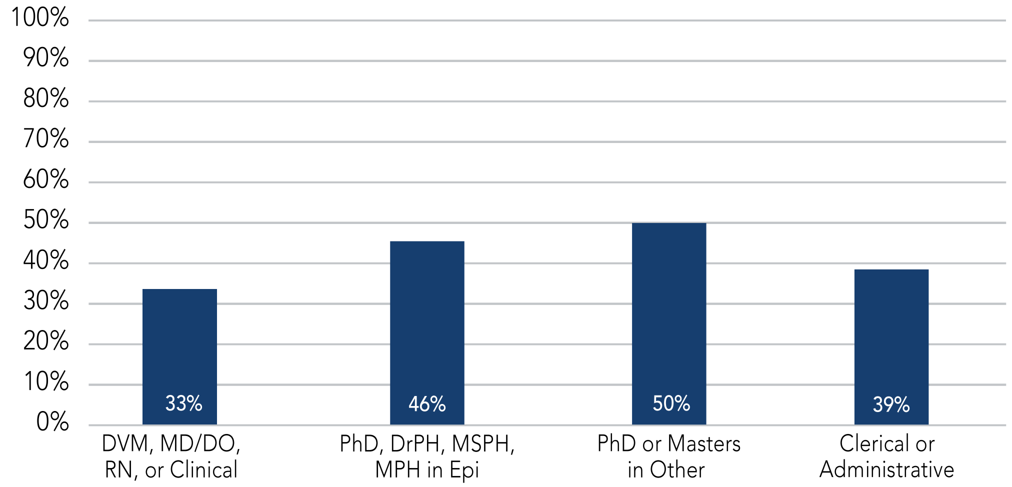
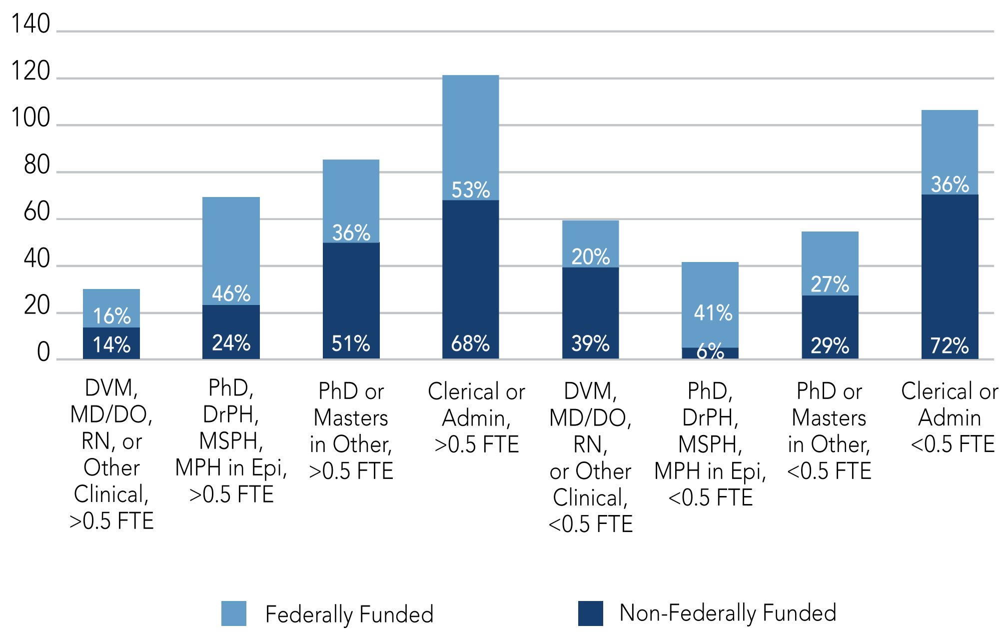


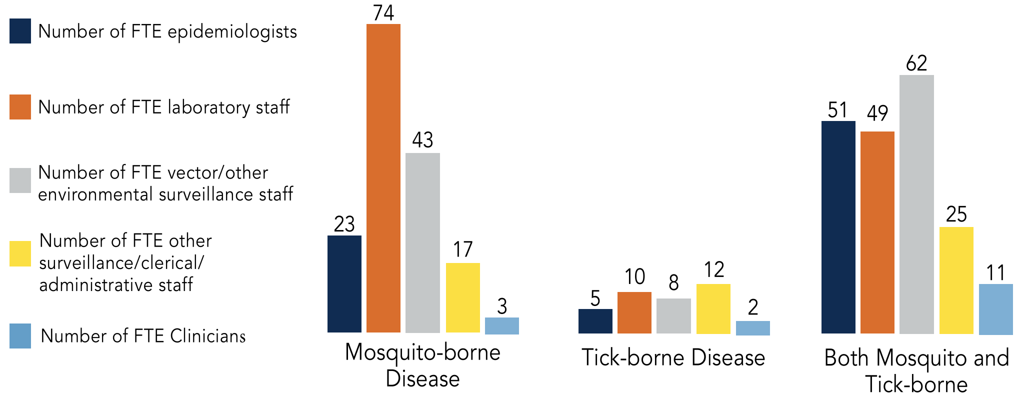
Figure 2 Total Number of State/Territorial Staff by Funding Source and Dedicated Vector-borne Full-Time Employee Status, 2017.



FTE: Full-Time Employee

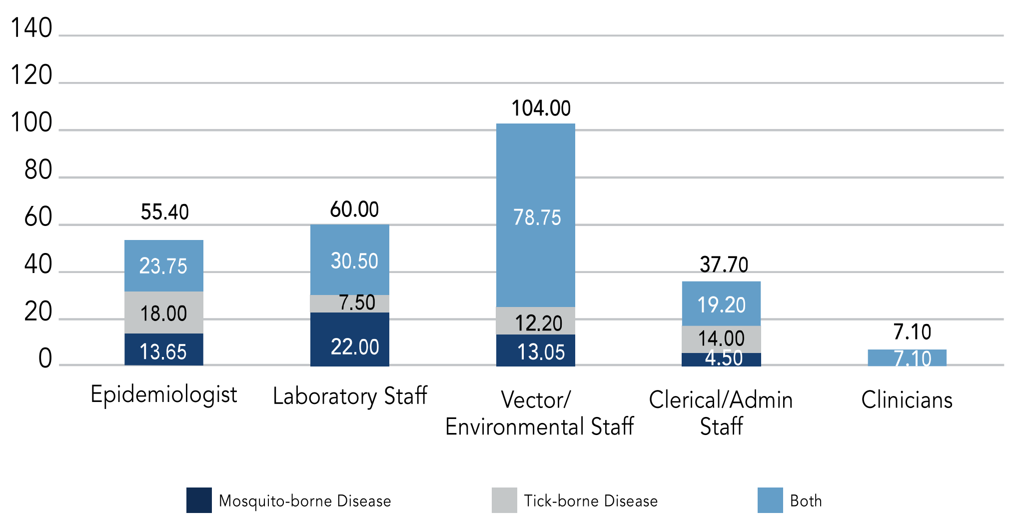
Most vector-borne disease staff split their time between mosquito- and tick-borne diseases (Figure 3). However, many laboratory staff continue to work solely on mosquito-borne diseases. Additionally, the number of staff working solely on tick-borne disease is significantly lower in comparison to the number of staff working on only mosquito-borne disease. On average, each state/territory has approximately 1 full-time epidemiologist, laboratory staff and vector/other surveillance staff member dedicated to working on both mosquito-borne and tick-borne diseases.

Figure 3 Total Number of Full-Time Vector-borne Disease Staff Reported by 54 States and Territories.



In order to reach full epidemiology and laboratory vector-borne disease capacity, states and territories reported needing approximately 55 full-time epidemiologists, 60 laboratory staff, and 104 additional vector or environmental staff dedicated to working on vector-borne diseases (Figure 4). The percentage of states and territories reporting access to medical entomologists and wildlife biology experts within their agency was low, with only 43% and 13% reporting direct access, respectively. A majority of states and territories, however, did report having a designated state public health veterinarian in their agency (78%).

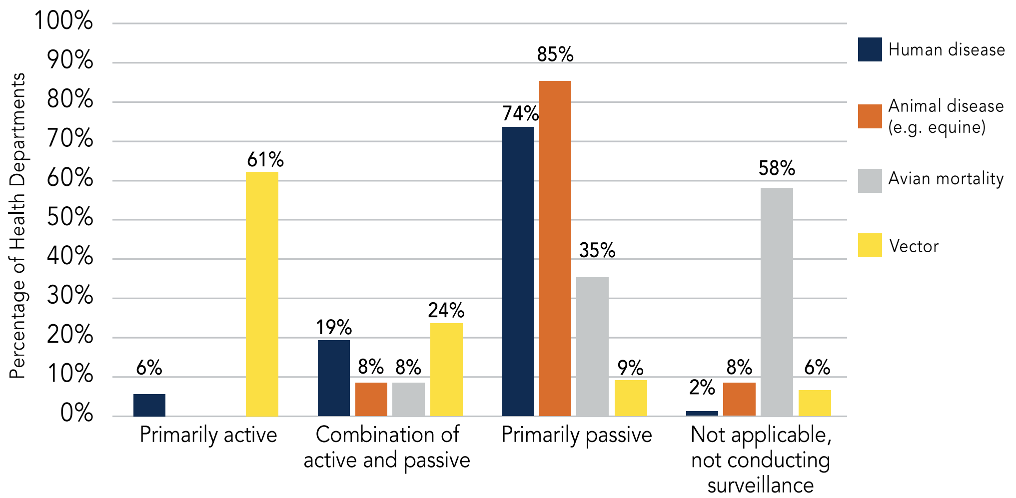
Figure 4 Total Number of Anticipated Additional Full-Time Vector-borne Staff Needed by State/Territorial Health Departments, 2017.



Surveillance Activities

Overall, the majority of states and territories report conducting surveillance for human disease (98%), animal disease (91%), and vectors (93%). Human and animal surveillance were conducted nearly year-round on average (11.4 months and 10.7 months, respectively) while avian and vector surveillance were performed during shorter durations (7.8 months and 6.9 months, respectively). States largely utilized passive surveillance for human (74%) and animal disease (85%). A small majority of states and territories reported reaching out to infectious disease specialists (63%) and emergency departments (54%) to encourage reporting. On the other hand, less than half of the states and territories reported reaching out to neurologists (38%) critical care specialists (37%), and urgent care/outpatient facilities (44%) to encourage reporting of meningitis and encephalitis. Most states required reporting of hospitalized encephalitis and meningitis cases of unknown etiology (64% and 58%, respectively). 98% of states and territories require in-state laboratories to report CSF and/or serologic specimens that are positive for arboviral infection but only 56% required commercial lab reporting of some or all arboviral infections. All respondents reported using the national case definition for arboviral neuroinvasive disease but only 85% reported having a system in place for reporting cases in susceptible animals (Appendix Table 24).

Figure 5 Type of Surveillance Utilized by State and Territorial Health Departments for Vector-borne Diseases.



Approximately 98% of states and territories reported conducting mosquito surveillance, with 61% of states utilizing active surveillance, most frequently utilizing their state health agency resources (79%), city/county health departments (57%), and universities or academic institutions (51%). Adult mosquito surveillance was reported more than larval mosquito surveillance (71% and 51%, respectively). All jurisdictions conducting mosquito surveillance reported identifying mosquitos but due to lack of capacity, only 47% of respondents were able to calculate minimum infection rates with collected data.

Of those jurisdictions collecting and identifying mosquitoes to species, 56% reported state health agencies contributed to collection and identification, 42% reported contributions from universities or academic institutions, and 40% reported contributions from city/county health departments and local mosquito control districts. Most states and territories (70%) conducted arboviral testing on mosquito pools through the state public health laboratory or another state-funded laboratory, with testing capacity primarily for WNV (89%), St. Louis Encephalitis virus (SLEV) (57%), and Zika (56%) (Appendix Table 41 & 42). Only 44% of states and territories monitored for pesticide resistance in mosquitoes. Of those that did monitor, only 35% conducted resistance testing within the state health department, as many states/territories collaborated with universities (48%) and local mosquito control districts (43%) to monitor resistance. The average percentage of human population in the state or territory covered by these mosquito surveillance activities was 64%.

In addition to human and mosquito surveillance, 41% of states and territories utilized dead bird reporting in their mosquito-borne disease surveillance systems. Of those states utilizing dead bird surveillance, 91% of specimens were submitted for arboviral testing (40% in state health laboratories, 32% in other state agency laboratories, and 28% in other contracted laboratories). Only 9 states (17%) reported utilizing sentinel chicken surveillance, and of these, all utilized it for WNV, 89% for SLEV, and 56% for Eastern Equine Encephalitis virus (EEEV).

For tick-borne diseases, 89% of states and territories conducted tick-borne disease surveillance, 98% of which was reported as passive surveillance for human disease and 46% of those states/territories also reported conducting tick surveillance (Appendix Tables 48 & 49). The average percentage of human population per state or territory covered by these tick surveillance activities was 39%. For tick identification, 60% of respondents conducting surveillance for tickborne diseases reported receiving no reports with tick species identified; only 19% received identification reports from universities and academic institutions, 10% received reports from state health vector-borne disease programs, and 6% from a state health laboratory (Appendix Table 50).

Federal funding is imperative for the surveillance of pesticide resistance in mosquitoes as 57% of states reported the source of funding for pesticide resistance surveillance to be federally funded. Funding continues to be a barrier for the surveillance of mosquitoes and ticks as 38% of states and territories reported they would have conducted mosquito pesticide resistance testing, had federal funds been available, and 29% said they would have conducted testing had state funds been available. Furthermore, 44% of states and territories would have conducted tick pesticide resistance testing had federal funds been available and 23% if state funds were available.

Control and Prevention

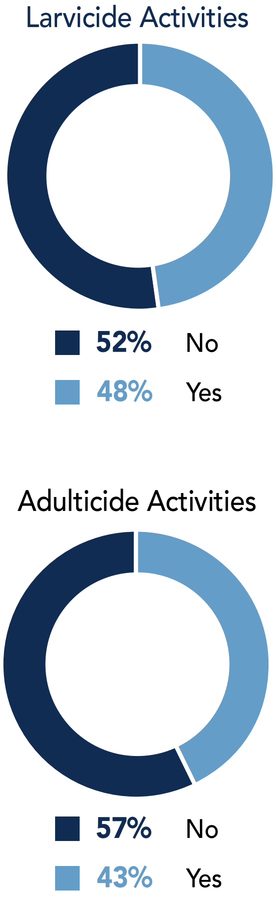
Approximately 94% of state and territorial vector-borne disease programs issued public notifications about local transmission risk and/or possible vector control activities through their state or territorial health agency and 63% issued notifications through local health agencies. The most reported methods of providing disease prevention included press releases via electronic and printed media (94%), agency website home page displays (83%), passive distribution of informational brochures (81%), and social media postings (78%). Only 21% of states and territories reported having sufficient resources to perform needed prevention and outreach activities. The most common resources that would help ensure adequate capacity included additional staff (90%), staff training (57%), educational and reference materials for providers (57%), and educational materials for the public (50%).

Figure 6 States and Territories Reporting Sufficient Resources to Perform Needed Prevention and Outreach Activities.

When asked about the presence of *Aedes* mosquitoes, 79% of states and territories had records of *Aedes aegypti, Aedes albopictus*, or both being present in their jurisdiction in the past 5 years. Of those jurisdictions that did have record of Aedes being present, 86% reported having a written Zika, chikungunya, and/or dengue surveillance and control plan should those diseases be detected in their area.

When it comes to mosquito control efforts, 48% of the respondents financially supported or conducted larviciding for the prevention of mosquito-borne diseases in 2017. Of those states supporting or conducting larviciding, 54% of states reported larviciding conducted by city/county health departments, and 42% reported larviciding conducted by local mosquito control districts or similar organizations. Only 38% of states reported the state health agency conducted larvicide activities. The main financing of larvicide activities came from federal funding (42%), followed by local funding (38%). Approximately 58% of states/territories reported any local jurisdiction conducting larviciding with its own funding. Forty-one percent of states reported they would have conducted or supported larviciding activities in local jurisdictions if federal funds were available and 26% if state funds were available.

Figure 7 Number of States Supporting or Conducting Larviciding and Adulticiding for Mosquito Control and Prevention.



In 2017, 35% of states and territories did not have a formal plan for mosquito-borne disease control that included adulticiding to control mosquito populations and mosquito-borne diseases. Only 37% reported having an emergency fund or funding mechanism for mosquito-borne disease outbreak control. Of those jurisdictions reporting funding or a mechanism, only 7 used it to fund adulticiding. Furthermore, under half (43%) of states and territories supported or conducted adulticiding activities in 2017. Of those that did support and conduct adulticide activities, the majority was performed by local mosquito control districts or similar organizations (30%) or another state agency (22%). The funding for these activities primarily came from state funds (35%) and federal funds (22%). Of the 30 jurisdictions that reported they did not conduct these activities, 14 cited never having a serious outbreak threat as the reason why (47%), as well as 16 reporting it was due to other reasons (53%), including performing larviciding instead and a lack of funding. However, 63% of states reported local jurisdictions conducted adulticiding with their own funding in 2017. Forty percent of states and territories would have conducted or financially supported adulticiding activities in local jurisdictions if they had sufficient federal funding and 23% if they had sufficient state funds.

Laboratory

For state public health laboratory capacity to test non-viral tick-borne disease, 74% of states reported capability to test for tularemia, but 18% of states reported having no capacity to test for these diseases at all (Figure 8). This is in stark contrast to state public health laboratory capacity to test for arboviruses, with only 6% of jurisdictions reporting no testing was performed. Approximately 60% of all cerebrospinal fluid (CSF) specimens tested for WNV were also routinely tested for one or more other arboviruses such as SLEV, EEEV, and La Crosse virus.

Figure 8 Capacity to Test for Non-Viral Tick-borne Diseases

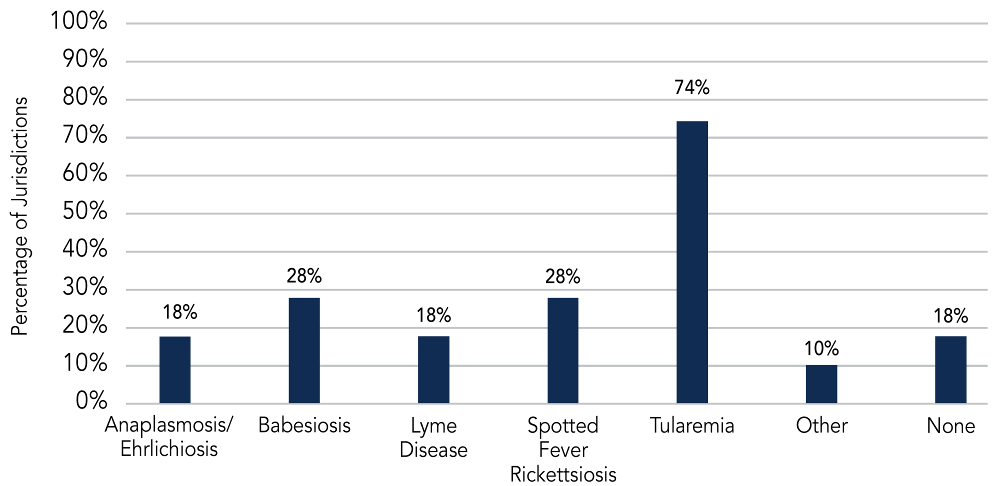
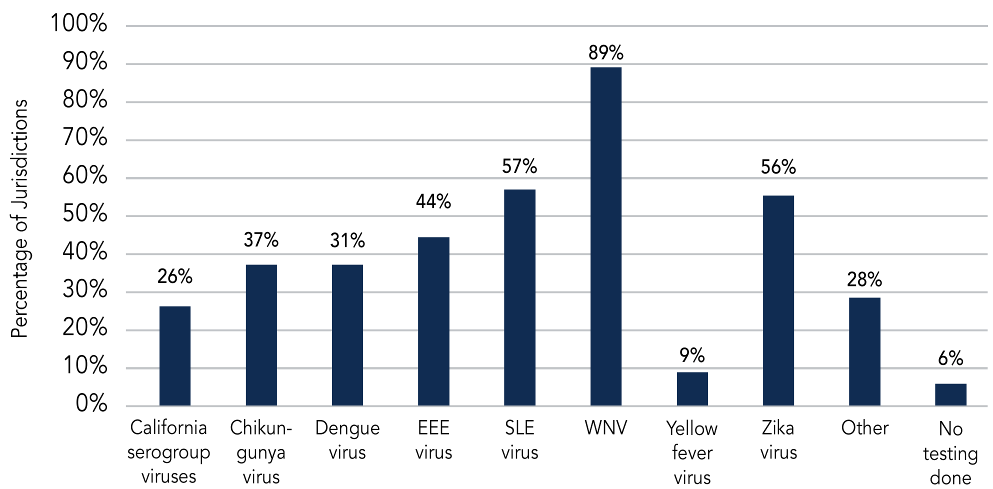


Figure 9 Capacity to Test for Arboviruses



More than three-quarters (76%) of states and territories reported needing additional full-time laboratory staff and 71% needed additional laboratory resources such as equipment, reagents, etc. in order to adequately test for mosquito-borne diseases, both endemic and emerging, in their jurisdiction. Furthermore, 86% of states and territories needed additional full-time staff and 80% needed additional lab resources to adequately test for tick-borne diseases in their state/territory. An average of 1.4 FTE was needed per jurisdiction to adequately test for mosquito-borne diseases while approximately 1 FTE was needed per jurisdiction to adequately test for tick-borne diseases.

Funding

States and territories were asked to provide characterization of funding for three different time periods, general federal funding (ELC, the Emerging Infections Program [EIP], PHEP) trends from 2013-2016, Zika supplemental funding trends from 2016-2017, and post-Zika supplemental funding trends in 2017. For mosquito-borne disease activities 2013-2016, a small majority (56%) of states and territories reported mostly level federal funding and 26% reported decreased funding. For 2016-2017 (Zika supplemental funding), 91% of states reported federal funding for mosquito-borne disease activities increased with the supplemental funding. In 2017, post-Zika supplemental funding, 59% of states and territories reported federal funding had generally decreased, followed by 22% reporting it remained level. For tick-borne disease funding from 2013-2016, 39% of states reported not receiving federal funds during this period, 31% reported federal funding increased, and 28% reported it remained the same.

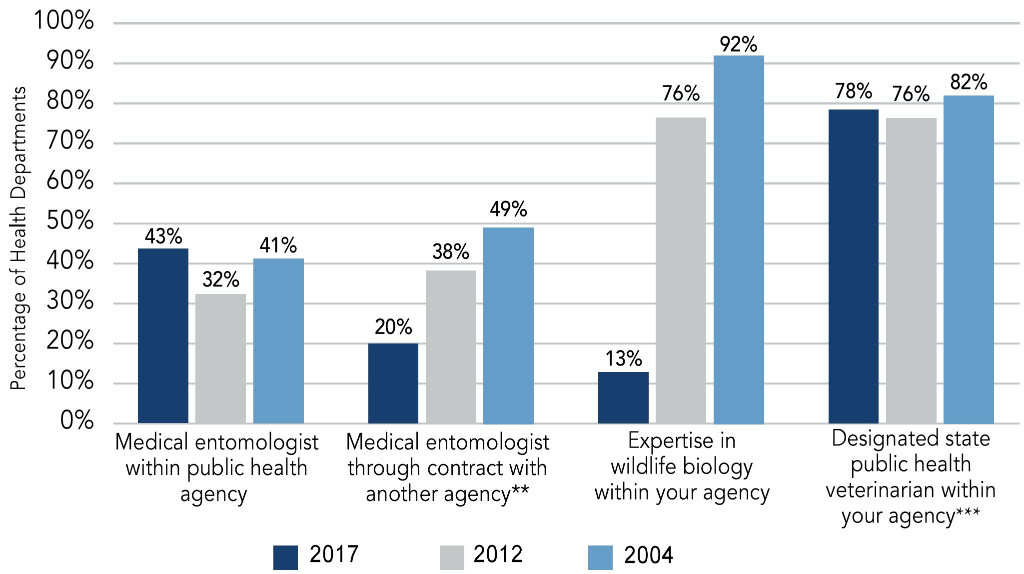
For those states that received Zika funding in 2016, the majority of states and territories utilized it for pregnancy registries (94%), human surveillance for mosquito-borne diseases (86%), mosquito surveillance (82%), and prevention activities for mosquito-borne diseases (82%). When asked to describe the extent to which federal funding impacted agency capacity for vector-borne diseases, 43% of states and territories felt the general funding from 2013-2016 had a high impact on their mosquito-borne disease capacity and 30% felt it had a substantial impact. The same results were received in regard to the Zika supplemental funding in 2016. For tick-borne disease capacity, results varied, with 26% of states and territories reporting that funding had a high impact on agency capacity from 2013-2017, while 26% reported not having surveillance (not applicable).

Most jurisdictions reported no significant changes in surveillance activities due to funding levels from 2013-2016 for mosquito-borne diseases and 2013-2017 for tick-borne disease. The changes reported from 2013-2016 included elimination of dead bird surveillance (15%), increased mosquito surveillance (33%), increased testing of human specimens for arboviruses (25%), increased mosquito pesticide resistance testing (24%), increased tick surveillance (17%), and increased testing of ticks for tick-borne pathogens (15%). Only 11% of states and territories increased testing of endemic arboviruses in mosquito pools during 2013-2016. From 2016-2017, however, 57% of states/territories increased mosquito surveillance, 63% increased testing of human specimens for arboviruses, and 33% increased pesticide resistance testing in mosquitoes. During this time period, 43% of states increased testing of endemic arboviruses in mosquito pools. States and territories were asked to describe their current funding of both mosquito-borne and tick-borne disease programs. In 2017, 98% of states utilized federal funding and 58% utilized state funding for their mosquito-borne program and activities. For tick-borne disease programs and activities, 62% of states/territories utilized federal funding, and 44% utilized state funds.

Discussion

Vector-borne diseases pose a significant health burden in the United States. An estimated 300,000 Lyme Disease cases occur annually, and nearly 2,300 WNV cases were reported in 2017. Since the 2012 Assessment conducted by CSTE, exotic arboviral diseases have been locally acquired, emerging diseases and novel vectors have appeared, and arboviruses such as Jamestown Canyon, Eastern Equine Encephalitis and Powassan viruses have reached new peaks in incidence. In order to detect and respond to vector-borne diseases, strong surveillance systems and adequate staffing must be present in state and local health departments. This 2017 Vector-borne Disease Capacity Assessment was performed to: (1) assess current state and local health department capacity to conduct vector-borne diseases surveillance, (2) compare staffing and capacity for vector-borne diseases in 2012 and 2017, (3) determine how state and large city/county health departments are currently funding, staffing, and conducting vector-borne surveillance and control activities, and (4) document health department staffing needs to achieve full vector-borne surveillance capacity. The 2017 Assessment included both mosquito-borne and tick-borne disease for the first time, as previous assessments focused on mosquito-borne only. Compared to 2012, which focused solely on WNV surveillance staff, staffing has increased across degree areas for both state employees and contractors. State employees with a DVM, MD/DO, RN, or other clinical degrees that are fully dedicated to vector-borne diseases (1.0 FTE) increased 475%, going from 4 in 2012 to 23 in 2017. A 63% increase was also observed in state employees with a PhD, DrPH, MSPH, or MPH degree in epidemiology who are fully dedicated to vector-borne diseases between 2012 and 2017. A 116% increase was present for fully dedicated state employees with a PhD or masters degree in a related science, and a 147% increase in clerical/administrative staff between the two assessment periods. It is important to note that while the addition of tick-borne diseases to the 2017 Assessment likely contributed to these increases, it is unlikely that this addition alone resulted in the significant change observed. While staffing has increased at least to levels observed in 2004 following initial WNV funding, states still feel there is need for more funding and a stronger workforce. The large difference in the total amount of funded vector-borne disease FTEs and those who are not funded by ELC or PHEP highlights the importance these agreements have on sustaining the workforce. Access to experts in wildlife biology and medical entomology within state health agencies has increased since the 2012 Assessment. However, when asked about contracted entomologists and wildlife biologists there were significant decreases within the states and territories. As seen in Figure 10, only 13% of states had access to expertise in wildlife biology within their agency, decreasing approximately 60%. In 2017, the question regarding contracted entomologists was expanded to include not only contracted entomologists through other state agencies but also academic institutions. Even with the addition, the number of medical entomologists contracted by the state decreased nearly 20%. However, a higher percentage of states now have a designated state public health veterinarian. These results are promising in that the workforce is heading in the right direction to meet current and future demands, however, there are gaps that still need to be addressed in staffing and access to wildlife biology, entomology, and veterinary expertise. Through proper collaboration with SMEs in other public health agencies, states and territories can better detect new pathogens and emerging trends.

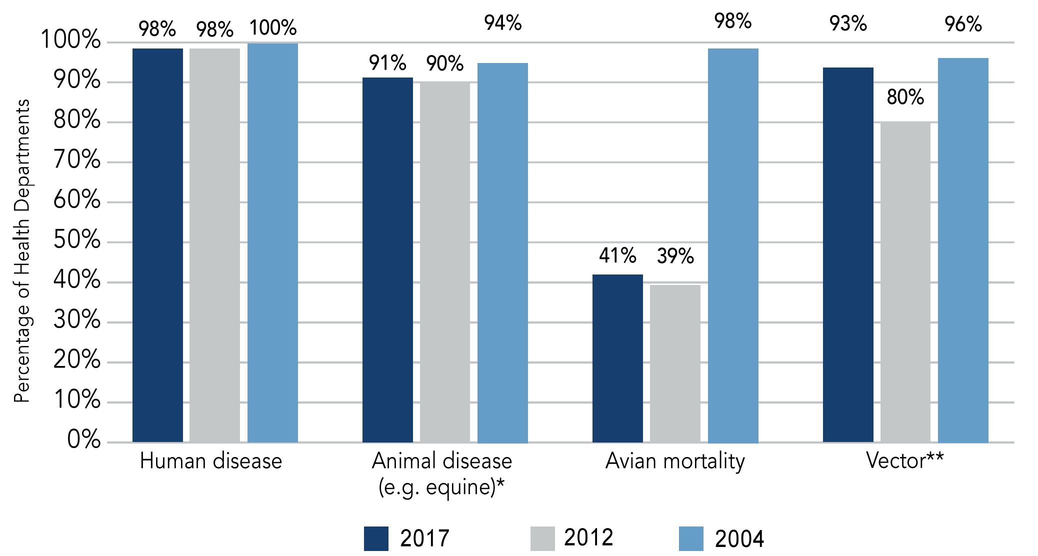
Figure 10 Access to Specialists by State and Territorial Health Departments



** This includes data for formal channels and informal agreements/ with academic institutes.
***This includes within agency, contract, and informal arrangements.

The percentage of states and territories conducting human vector-borne disease surveillance and avian surveillance has remained the same since the 2012 Assessment (Figure 11). Vector-borne disease surveillance, expanded in 2017 to include both mosquito- and tick-borne diseases, increased by 13%. Additionally, previous assessments had examined only equine disease, but the most recent iteration expanded from surveillance in horses to include other species therefore changing the name to animal disease. The percentage of states conducting animal surveillance remained the same since the 2012 Assessment. The percentage of states having an active component to surveillance for human, animal, and avian surveillance remained the same since 2012, with states primarily conducting passive surveillance for human and animal disease and active surveillance for vectors. The percentage of states reaching out to neurologists, critical care specialists, and emergency departments to encourage reporting and suggesting a high index of suspicion for arboviral meningitis/encephalitis has continued to decrease, while the percentage of states reaching out to infectious disease specialists has increased since 2012.

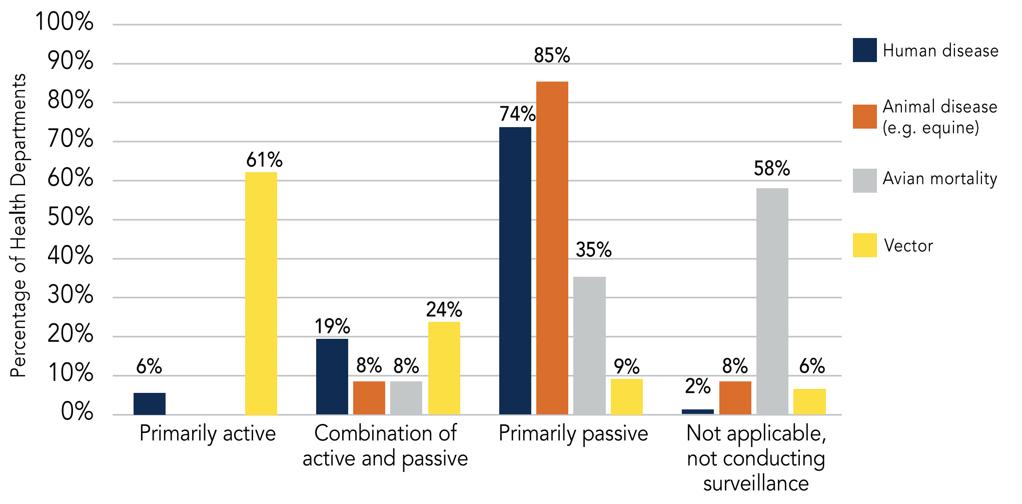
Figure 11 Surveillance Conducted by State and Territorial Health Departments



*Surveillance for equine disease was expanded to animal diseases in 2017

**Surveillance for vector-borne disease was expanded to include both mosquito and tick-borne diseases in 2017

Figure 12 Type of Surveillance Used in State and Territorial Health Departments



Both states and territories requiring reporting of hospitalized encephalitis cases of unknown etiology, suspected as being arboviral disease, have increased from 48% in 2012 to 64% in 2017. Additionally, states requiring reporting of hospitalized meningitis cases of unknown etiology, suspected arboviral disease, have also slightly increased from 50% in 2012 to 58% in 2017. The percentage of states requiring confirmation of commercial lab-positive specimens by the public health laboratory or another reference laboratory have also increased from 36% in 2012 to 56% in 2017. However, the requirement of in-state laboratories to report CSF and/or serologic specimens positive for arboviral infection has appeared to slightly decrease, with 98% of states requiring reporting in 2017 compared to the 100% reported in 2012. A standardized case definition for arboviral neuroinvasive disease is now utilized across all states (CDC/CSTE NNDSS definition), a notable increase from the 88% of states reported in 2012 (CDC/CSTE NPHSS definition).

For mosquito surveillance activities, the percentage of states reporting that most local jurisdictions conduct adult surveillance increased 37% since the 2012 Assessment and the percentage of states reporting larval surveillance increased 33%. The median percentage of the population living in areas covered by mosquito surveillance activity has increased from 2012 levels (50%) to cover a median of 69% of the population. Number of trap nights for mosquito collection has also increased to a median of 1,996 nights since 2012 (1,071 nights) but has not returned to 2004 levels (2,602 nights). However, despite these large increases in mosquito surveillance, only a small increase in the percentage of states that calculate minimal mosquito infection rates or receive such data was observed.

The majority of testing on mosquito pools was performed by a state or state-funded lab, similar to 2012. Utilization of local health departments and local mosquito districts for mosquito pool testing has apparently decreased since 2012. Two of the most commonly tested for viruses were included for the first time on the 2017 Assessment (WNV and Zika), both showing a majority of states testing (89% and 56%, respectively). The number and percentage of states not performing any testing on mosquito pools has decreased from 24% in 2012 to only 6% in 2017. In addition, the monitoring of pesticide resistance has increased since 2012, with only 56% of states reporting no monitoring in 2017, compared to the 67% observed in 2012. Utilization of sentinel chicken surveillance for WNV, SLEV, and EEEV has also increased since 2012, though the percentage and number of states remains low. Additionally, the percentage of states maintaining dead bird databases has increased since 2012, with most of those states submitting these specimens for WNV testing. The strategies for collection and testing vary but show no considerable changes since 2012.

Tick-borne diseases were included for the first time on the 2017 Assessment. The majority (89%) of states reported conducting surveillance for tick-borne disease, 98% of which was passive surveillance. While this is a large percentage of states, it is still lower than human disease surveillance for mosquito-borne diseases (98%). Surveillance for the vector is also lower for ticks than mosquitoes (46% and 93%, respectively). Furthermore, the median percentage of the population covered by tick surveillance (15%) is lower than the percentage of the population covered by mosquito surveillance activities (69%) and no states reported conducting pesticide resistance monitoring in ticks.

Overall, the percentage of states performing various prevention activities has increased since 2012 but is still lower than observed in 2004. Press releases to electronic and printed media remain the primary activity. Public service announcements and town, community, and neighborhood meetings increased since 2012, while message modification for lower literacy and non-English speaking audiences only increased 2%, remaining lower than 2004 (71%). Social media, assessed for the first time in 2017, appears to be an important method of prevention messaging for states, with 78% of states utilizing those outlets.

Though increases in some of these prevention activities have been observed, 79% of states felt there were not enough resources to perform prevention and outreach activities as needed.

In 2004, federal funding for vector-borne diseases through the CDC ELC program had reached a new high and CSTE recommended ELC funding be continued for surveillance and control, with flexibility to use the funds to address vector-borne diseases more broadly. Despite this recommendation, from 2006 through 2012 federal funding through ELC decreased each year, reaching a low of $9,340,637 in 2012. CSTE discovered that year that surveillance capacity overall had decreased since the 2004 assessment and the ability to conduct surveillance for other arboviruses was intermittent, with most states having little to no capacity. The impact of funding deficits on vector-borne diseases manifested throughout 2016 when ELC funding had to be drastically increased to respond to the outbreak of Zika. In the years of 2016 and 2017, a combined total of 180 million was awarded to state and territorial public health agencies in Zika supplemental awards to strengthen epidemiological surveillance and investigation, improve mosquito control and monitoring, and bolster laboratory capacity by ELC. Despite the progress made in response to Zika, it appears total ELC funding decreased from approximately $302 million for fiscal year 2017 to approximately $217 million for fiscal year 2018, with an unspecified amount going directly to Zika or vector-borne diseases response. States agreed in the current assessment that general funds for mosquito-borne diseases from 2013-2016 either remained the same or decreased, then rapidly increased in response to Zika. However, since the Zika response, federal funding for mosquito-borne diseases has started to decrease again. In addition, some states report increases in funding for tick-borne disease or maintenance of funding levels, while 39% report receiving no federal funding at all for tick-borne activities.

Conclusion

Since 2012, the capacity for mosquito-borne disease surveillance has remained the same with increases only in other vector surveillance activities for state and territorial health agencies. Additionally, capacity to conduct surveillance for vector-borne diseases continues to vary widely with some jurisdictions having high-level capacity and others having little to no surveillance activity. Laboratory capacity to test for vector-borne diseases remains low for diseases other than WNV. Prevention activities have increased since 2012 but still remain lower than 2004 levels. Most state and territorial health agencies still need additional support and resources to attain full capacity for surveillance. Funding cuts and future fiscal uncertainty, along with the continued focus on disease specific funding, continue to raise apprehensions about the sustainability of capacity for vector-borne diseases surveillance; mosquito and tick detection, testing, and control; insecticide resistance monitoring; supportive laboratory services; and prevention messaging, given they were primarily advanced with federal funding. ELC funding has supported surveillance for 25 arboviral diseases, in addition to the management of surveillance data through ArboNET and TickNET.

Based on these findings, CSTE strongly recommends the continuation and expansion of federal funding to preserve the public health infrastructure for vector-borne disease surveillance and to enhance state, tribal, local, and territorial jurisdictional capacities to more effectively detect, surveil and respond to current and emerging vector-borne disease outbreaks and threats. Capacity in jurisdictions with little to no surveillance activity needs enhancement particularly for tick-borne diseases. This includes increasing testing capacity in public health laboratories to routinely test for vector-borne diseases. Sufficient funding through the ELC and PHEP cooperative agreements is needed to ensure not only the maintenance of the current infrastructure in place, but also the enhancement of vector-borne disease surveillance capacity at state, tribal, local, and territorial levels.

Appendix 1: References

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9. CDC. FY 2018 ELC Awards by Grantee. Available at: https://www.cdc.gov/ncezid/dpei/elc/history/elc-awards-by-grantee-2018.html. Accessed June 20, 2019.

Appendix 2: Assessment

2017 State/Territorial Assessment Tables

Table 1. Total Number of State/ Territories Full- Time Employee				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or masters degree in related sciences *(e.g entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 FTE	23	44	67	72
0.5-0.99 FTE	7	26	20	49
< 0.50 FTE	59	47	56	108

Table 2. Average Number State/ Territories Full-Time Employee				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 .0 FTE	0.43	0.83	1.24	1.33
0.5-0.99 FTE	0.12	0.48	0.37	0.91
<0.50 FTE	1.09	0.89	1.04	2.04

Table 3. Percentage of States/Territories with at Least One Full-Time Employee				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
Respondent percent	33%	46%	50%	39%

Table 4. Total Number of Contractors based in State Health Department				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 FTE	3	5	10	12
0.5-0.99 FTE	0	6	26	27
< 0.50 FTE	5	4	15	55

Table 5. Average Number of Contractors Based in State/ Territories Health Department

	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 .0 FTE	0.06	0.09	0.19	0.22
0.5-0.99 FTE	0	0.11	0.48	0.50
<0.50 FTE	0.09	0.07	0.28	1.02

Table 6. Total Number of State Employees Not Funded by ELC or PHEP

	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 FTE	11	14	37	41
0.5-0.99 FTE	3	10	14	27
< 0.50 FTE	39	6	29	72

Table 7. Average Number State Employees Not Funded by ELC or PHEP

	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 .0 FTE	0.20	0.26	0.68	0.77
0.5-0.99 FTE	0.06	0.19	0.26	0.50
<0.50 FTE	0.72	0.11	0.54	1.33

Table 8. Percentage of States/Territories with at Least One Non-ELC or PHEP Funded Full-Time Employee

	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
Respondent percent	17%	11%	20%	15%

Table 9. Total Number of Contractors Not Funded by ELC or PHEP				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 FTE	0	2	5	1
0.5-0.99 FTE	0	1	12	6
< 0.50 FTE	5	1	3	19

Table 10. Average Number of Contractors Based in State Health Department				
	# with DVM, MD/DO, RN or other clinical degrees	# with PhD, DrPH, MSPH, MPH degrees in epidemiology	# with PhD or master's degree in related sciences *(e.g. entomologist, virologist)*	# of all other clerical, administrative, and programmatic staff
1 .0 FTE	0	0.04	0.09	0.02
0.5-0.99 FTE	0	0 02	0.22	0.11
<0.50 FTE	0.09	0.02	0.06	0.35

Table 11. Total Number of FTE Vector-Borne Disease Surveillance Staff from all Funding Sources					
	Number of FTE epidemiologists	Number of FTE laboratory staff	Number of FTE vector/other environmental surveillance staff	Number of FTE other surveillance/ clerical/ administrative staff	Number of FTE clinicians
Mosquito-borne Disease	22.62	74.10	43.40	17.40	3.25
Tick-borne Diseases	4.97	9.80	8.40	12.25	2.00
Both Mosquito and Tick-borne	51.10	48.91	61.85	24.82	10.55

Table 12. Average Number of FTE Vector-Borne Disease Surveillance Staff from all Funding Sources					
	Number of FTE epidemiologists	Number of FTE laboratory staff	Number of FTE vector/other environmental surveillance staff	Number of FTE other surveillance/ clerical/ administrative staff	Number of FTE clinicians
Mosquito-borne Disease	0.44	1.37	0.80	0.32	0.06
Tick-borne Diseases	0.10	0.18	0.16	0.23	0.04
Both Mosquito and Tick-borne	0.95	0.91	1.15	0.46	0.20

Table 13. Total Number of Additional FTE Staff Persons Needed to Achieve Full Epidemiology and Laboratory Capacity

	Number of FTE epidemiologists	Number of FTE laboratory staff	Number of FTE vector/other environmental surveillance staff	Number of FTE other surveillance/ clerical/ administrative staff	Number of FTE clinicians
Mosquito-borne Disease	13.65	22.00	13.05	4.50	0
Tick-borne Diseases	18.00	7.50	12.20	14.00	0
Both Mosquito and Tick-borne	23.75	30.50	78.75	19.20	7.10

Table 14. Average Number of Additional FTE Staff Persons Needed to Achieve Full Epidemiology and Laboratory Capacity

	Number of FTE epidemiologists	Number of FTE laboratory staff	Number of FTE vector/other environmental surveillance staff	Number of FTE other surveillance/ clerical/ administrative staff	Number of FTE clinicians
Mosquito-borne Disease	0.25	0.41	0.24	0.08	0
Tick-borne Diseases	0.33	0.14	0.23	0.26	0
Both Mosquito and Tick-borne	0.44	0.56	1.46	0.36	0.13

Table 15. Adequate Access to Medical (i.e., public health) Entomologist(s)

	N =54	%
within the state public health agency.	23	43%
through a contract or other formal arrangement with an academic institution or other state agency.	11	20%
through other informal arrangements/agreements with an academic institution or other state agency with regulatory authority.	24	44%
does not have access.	9	13%

Table 16. Adequate Access to Expertise in Wildlife Biology

	N =54	%
within the state public health agency.	7	13%
through a contract or other formal arrangement with an academic institution or other state agency.	6	11%
through other informal arrangements/agreements with an academic institution or other state agency with regulatory authority.	40	74%
does not have access.	6	11%

Table 17. Existence of Designated Public Health Veterinarian

	N =54	%
Yes	42	78%
No	12	22%

Table 18. Type and Duration of Mosquito-borne Disease Surveillance

Type of Surveillance	Conduct state-level surveillance?		If yes, for how many months each year?
	Yes	No	Average Number of Months
Human disease (N=54)	53 (98%)	1 (2%)	11.43
Animal disease (e.g. equine) (N=53)	48 (91%)	5 (9%)	10.70
Avian mortality (N=51)	21 (41%)	30 (59%)	7.83
Vector (N=54)	50 (93%)	4 (7%)	6.88

Table 19. Type of Surveillance Used in State and Territorial Health Departments for Vector-borne Diseases

	Primarily Active	Combination of active and passive	Primarily Passive	Not applicable, not conducting surveillance
Human disease (N=54)	3 (6%)	10 (19%)	40 (74%)	1 (2%)
Animal disease (e.g. equine) (N=53)	-	4 (8%)	45 (85%)	4 (8%)
Avian mortality (N=52)	-	4 (8%)	18 (35%)	30 (58%)
Vector (N=54)	33 (61%)	13 (24%)	5 (9%)	3 (6%)

Table 20. Use of Sentinel Chicken Surveillance

	N =54	%
Yes	9	17%
No	45	83%

Table 21. Breakdown of Use of Sentinel Chicken Surveillance for Specified Viruses:

Virus	N = 9	%
WNV	9	100%
EEEV	5	56%
SLEV	8	89%
WEEV	4	44%
Other (HJV)	1	11%

Table 22. Use of Specialists for Reporting Suspicion for Arboviral Meningitis/ Encephalitis

	Yes n (%)		No n (%)	
Neurologists (N=52)	20	38%	32	62%
Critical care specialists (N=52)	19	37%	33	63%
Urgent care/outpatient facilities (N=52)	23	44%	29	56%
Infectious disease specialists (N=51)	32	63%	19	37%
Emergency departments (N=52)	28	54%	24	46%

Table 23. Hospitalization Reporting Requirements

	Yes n (%)		No n (%)	
Hospitalized encephalitis cases of unknown etiology (suspect cases of arboviral disease)? (N=53)	34	64%	19	36%
Hospitalized meningitis cases of unknown etiology (suspect cases of arboviral disease)? (N=53)	31	58%	22	42%

Table 24. In-state Laboratory Reporting Requirement for CSF and/or Serologic Specimens Positive for Arboviral Infection

	N = 52	%
Required	51	98%
Not required	1	2%

Table 25. Lab Positive Specimens Reporting Requirements for Arboviral Infection Confirmation (N=52)

	N = 52	%
Yes	17	33%
Yes, but only specific diseases[1]	12	23%
No requirement	23	44%

[1]Specific diseases included: Zika, West Nile, Chikungunya, and Dengue

Table 26. Case Definition Use for Reported Cases of Arboviral Neuroinvasive Disease

	N = 53	%
CDC NNDSS case definition used exclusively	53	100%
Modified case definition specific to my jurisdiction	0	-

For *veterinary* mosquito-borne disease surveillance in 2017:

Table 27. Existence of System for Reporting Cases of Neurologic Disease in Animals to the State Health Dept from Veterinarians, Veterinary Diagnostic Labs or other Agency Labs		
	N = 54	%
Yes	46	85%
No	6	11%
Unknown	2	4%

Table 28. Use of Dead Bird Reporting		
	N = 54	%
Yes	22	41%
No	32	59%

Table 29. Submission of Avian Specimens for Diagnostic Testing for Arbovirus		
	N = 22	%
Yes	20	91%
No	2	9%

Table 30. Number of Avian Specimens Tested in 2017		
	N = 22	%
Unknown	4	18%
Specified number	18	82%

Table 31. Location of Testing for Avian Specimens		
	N = 25	%
State lab	10	40%
Other state agency lab	8	32%
Other lab contracted by state	7	28%

Table 32. Strategies Used for Collecting and Testing Dead Birds				
	Yes n (%)		No n (%)	
Collect or test all dead birds in an area all season long	5	15%	29	85%
Collect or test all in an area until the first tests positive	3	9%	30	91%
Collect or test all of specified species (e.g. corvids) in an area all season long	5	15%	28	85%
Collect or test all of specified species in an area until the first test positive	5	16%	27	84%
Other	13	68%	6	32%

For mosquito-based arboviral surveillance in 2017:

Table 33. Collection of Mosquito Surveillance Information for Jurisdiction

	N = 54	%
Yes	53	98%
No	1	2%

Table 34. Contributing Agencies to Mosquito Surveillance Information (Check all that apply)

	N = 53	%
State health agency	42	79%
Other state agency	15	28%
City/county health departments	30	57%
Local MCDs or similar organizations	23	43%
Universities or academic institutions	27	51%
Other local city/county agencies	12	23%
Other	9	17%

MCDs: Mosquito control districts

Table 35. Percentage of Human Population in Jurisdictions Living in Area Covered by Mosquito Surveillance

	Percentage
Average	64%
Median	69%
Range	12% - 100%
Don't know	17%

Table 36. Conducting of Adult and Larval Mosquito Surveillance within Local Jurisdictions

	Yes		No	
Adult mosquito surveillance (N=48)	34	71%	14	29%
Larval mosquito surveillance (N=45)	23	51%	22	49%

Table 37. Number of Trap-nights Collected for Adult Mosquitoes

	Number of Trap Nights N = 27
Average	5,397
Median	1,996
Range	54 – 45,674

Table 38. Identification of Trapped Mosquitoes

	N = 52	%
Yes	52	100%
No	0	0%

Table 39. Contributors to Species Identification on Mosquito Populations

	N = 52	%
State health agency	29	56%
Other state health agency	11	21%
City/county health departments	21	40%
Local MCD or similar organization	21	40%
Universities or academic institutions	22	42%
Other local city/county agencies	9	17%
Other	10	19%

MCDs: Mosquito control districts

Table 40. Use of Minimum Infection Rate Calculation

	N = 53	%
Yes	25	47%
No, we don't the capacity	20	38%
No, we have not found it to be useful	7	13%
Don't know	1	2%

Table 41. Laboratories Performing Testing for Arboviruses on Mosquito Pools Collected

	N = 53	%
State public health laboratory or other state-funded laboratory	37	70%
Local health department laboratory	9	17%
University or academic institution	15	28%
Local MCD (if different from county health dept)	15	28%
Other	2	4%
Mosquito surveillance done, but no testing done on mosquito pools	4	8%

MCDs: Mosquito control districts

Table 42. Testing Capacity for Specified Viruses

	N = 54	%
California serogroup viruses	14	26%
Chikungunya virus	20	37%
Dengue viruses	17	31%
EEE virus	24	44%
SLE virus	31	57%
WNV	48	89%
Yellow fever virus	5	9%
Zika virus	30	56%
Other	15	28%
Not applicable (no testing done)	3	6%

Table 43. Monitoring Pesticide Resistance in Mosquitoes in Health Department

	N = 52	%
Yes	23	44%
No	29	56%

Table 44. Agencies that Monitor for Pesticide Resistance in Mosquitoes

	N = 23	%
State health department	8	35%
Other state agency (Dept of EP)	1	4%
City/county health departments	3	13%
Local MCDs or similar organizations	10	43%
University or academic institution	11	48%

MCDs: Mosquito control districts

Table 45. Funding Source for Pesticide Resistance Testing in Mosquitoes

	N = 23	%
Federal funds	13	57%
State funds	2	9%
Combination of federal and state funds	2	9%
Local funds	6	26%
Unknown source of funds	0	0%

Table 46. Support for Pesticide Resistance Testing in Mosquitoes if Additional Funding Available

	N = 52	%
Yes, if federal funds available	20	38%
Yes, if state funds available	15	29%
Yes if local funds available	9	17%
No, our jurisdiction would not conduct resistance testing	2	4%
No, MCDs or other similar organization conduct resistance testing	3	6%
Not applicable, no outbreak threat in our state	2	4%
Unknown	1	2%

MCDs: Mosquito control districts

Table 47. Number of States and Territories with Tick-borne Disease Surveillance

	N = 54	%
Yes	48	89%
No	6	11%

Table 48. Number of States and Territories by Type and Duration of Tick-borne Disease Surveillance					
Type of Surveillance	Conduct state- level surveillance?		If yes, for how many months each year?		
	Yes	No	Average Number of Months	Median number of months	Range (number of months)
Passive surveillance for human disease (N=48)	47 (98%)		11.8	12	4-12
Active surveillance for human disease (N=47)	2 (4%)		7.25	8.5	0-12
Tick surveillance (mapping of species distribution) (N=48)	22 (46%)		7.86	8	0-12
Tick testing (for human pathogens) (N=48)	15 (31%)		8.07	9	0-12

Table 49. Percentage of the Human Population Covered by Any Type of Tick Surveillance (either for tick species or pathogen testing) (N=48)	
Average percentage	39%
Median percentage	15%
Range percentage	0% - 100%
Don't know	N=20

Table 50. Tick Identification Reports		
	N = 48	%
Receive reports from state health laboratory	3	6%
Receive reports from state health VBD program	5	10%
Receive reports from city/county laboratories	1	2%
Receive reports from city/county VBD programs	2	4%
Receive reports from universities or academic institutions	9	19%
Other	6	13%
No reports received	29	60%

Table 51. Monitoring for Pesticide Resistance in Ticks		
	N = 47	%
Yes	0	-
No	47	100%

Table 52. Pesticide Resistance Testing in Ticks if Funding Available in 2017		
	N = 47	%
Yes, if Federal funds available	20	44%
Yes, if State funds available	11	23%
Yes, if local funds available	7	15%
No, our jurisdiction would not conduct resistance testing	15	32%
No, MCDs or other similar organization conduct resistance testing	3	6%
Not applicable, no outbreak threat in our state	3	6%
Unknown	6	13%

MCDs: Mosquito control districts

Table 53. State Issued Vector-Borne Disease Program Notifications About Local Transmission Risk & Vector-Control Activities		
	N = 54	%
Yes, through state health agency	51	94%
Yes, through local health agencies	34	63%
No	2	4%
No risk of transmission in 2017 in our state	0	0%

Table 54. Vector-borne Disease Prevention Information and Notification		
	N = 54	%
Press releases to electronic and printed media	51	94%
Public service announcements on television or radio	25	46%
Passive distribution of informational brochures	44	81%
Active distribution of informational brochures	28	52%
Town, community, or neighborhood meetings	22	41%
Posting information on the home page of your agency's website	45	83%
Social media outlets (Facebook, Twitter, etc)	42	78%
Door-to-door outreach in selected locations	11	20%
Participation in community clean-ups	8	15%
Modification of messages for lower literacy and non-English speaking audiences	26	48%
Other	3	6%

Table 55. Existence of Sufficient Resources for Prevention and Outreach Activities		
	N = 53	%
Yes	11	21%
No	42	79%

Table 56. ResourcesNeeded to Ensure Adequate Capacity

	n	%
Educational materials for the public	21	50%
Educational and reference materials for providers	24	57%
Educational and reference materials for local health departments	19	45%
Additional staff	38	90%
Staff training	24	57%
Additional resources	13	31%

The following tables summarize questions pertaining to state investments in larviciding mosquitoes to prevent amplification of mosquito-borne diseases .

Table 57. States Conducting Larviciding for Prevention of Mosquito-borne Diseases in 2017

	N = 54	%
Yes	26	48%
No	28	52%

Table 58. Agency/Organization Conducting Larviciding for Prevention

	N = 26	%
State health agency	10	38%
Other State agency	5	19%
City/county health departments	14	54%
Local MCDs or similar organization	11	42%
Other local city/county agencies	9	35%
Other	2	8%

MCDs: Mosquito control districts

Table 59. Source of Financial Support for Larviciding for Prevention

	N = 26	%
Federal funding	11	42%
State funding	9	35%
Combined federal and state funding	6	23%
Local funding	10	38%
Other	1	4%

Table 60. Willingness to Conduct Larviciding Activities if Sufficient Fund Available

	N = 47	%
Yes, if Federal funds available	11	41%
Yes, if State funds available	7	26%
Yes, if local funds available	3	11%
No, our state does not conduct larviciding	3	11%
No, MCDs or other similar organization conduct larviciding	9	33%
Not applicable, no outbreak threat in our state	2	7%
Unknown	3	11%

MCDs: Mosquito control districts

Table 61. Local Jurisdiction Conduct Larviciding in 2017 with its Own Funding

	N = 53	%
Yes	31	58%
No	11	21%
Unknown	11	21%

The following tables summarize questions pertaining to state investments in adulticiding arbovirus-infected mosquitoes.

Table 62. Existence of Plan for Mosquito-borne Disease Control with Threshold (e g , level of vector mosquito abundance or minimum infection rate) Resulting a Adulticiding Recommendation

	N = 54	%
Yes – have a threshold that does not require concurrent human cases	16	30%
Yes – have a threshold that requires concurrent human cases	6	11%
No – have a plan but there is no specific threshold	13	24%
No – do not have a formal plan that includes adulticiding to control mosquito-borne diseases	19	35%

Table 63. Existence of Emergency Fund for Mosquito-borne Disease Outbreak Control

	N = 54	%
Yes	20	37%
No	34	63%

Table 64. Use of Emergency Funds to Pay for Adulticiding

	N = 19	%
Yes	7	37%
No	12	63%

For the following mosquito borne diseases: WEE, EEE, Zika, WNV, SLE

Table 65. States Conducting Larviciding for Prevention of Mosquito-borne Diseases in 2017	N = 53	%
Yes	23	43%
No	30	57%

Table 66. Organization/Agencies Conducting Larviciding	N = 23	%
State health agency	2	9%
Other state agency	5	22%
City/county health departments	3	13%
Local MCDs or similar organizations	7	30%
Other local city/county agencies	4	17%
Other	2	9%

MCDs: Mosquito control districts

Table 67. Source of Financial Support for Larviciding for Prevention	N = 23	%
Federal funds	5	22%
State funds	8	35%
Combined federal and state funding (Please enter the percentage of funding for both)	3	13%
Local funds	4	17%
Other	3	13%

Table 68. Reasons to Not Conduct Larviciding	N = 30	%
Never had serious outbreak threat	14	47%
Had outbreak threat that reached adulticiding threshold but no funding to support adulticiding	2	7%
Had outbreak threat that reached adulticiding threshold but no public support of spraying	1	3%
Other	16	53%

Other reasons provided: focused on larviciding, abatement performed by local jurisdictions, and a lack of funding.

Table 69. Willingness to Conduct Larviciding Activities if Sufficient Fund Available

	N = 30	%
Yes, if Federal funds available	12	40%
Yes, if State funds available	7	23%
Yes, if local funds available	5	17%
No, our jurisdiction would not conduct adulticiding	3	10%
No, MCDs or other similar organizations conduct adulticiding	5	17%
Not applicable, no outbreak threat in our state	7	23%
Unknown	4	13%

MCDs: Mosquito control districts

Table 70. Adulticiding Conducted by Local Jurisdiction with its Own Funding

	%	N = 54
Yes	63%	34
No	24%	13
Unknown	13%	7

Table 71. Historical Record of *Aedes aegypti* or *Aedes albopictus* Mosquitoes in Last 5 Years

	N = 54	%
Yes, *Aedes aegypti* only	4	7%
Yes, *Aedes albopictus* only	22	41%
Yes, both *A. aegypti* and *A. albopictus*	17	31%
None found in our state at this time	10	19%
Unknown to the state health department at this time.	1	12%

Table 72. Existence of Written Zika, Chikungunya, and/or Dengue Surveillance and Control Plan, if Detected (Plan of Action)

	N = 43	%
Yes	37	86%
No	6	14%

Table 73. Threat of *Aedes aegypti* and *Aedes albopictus* within Jurisdiction

	N = 43	%
Aedes are spreading and pose a significant public health threat	10	23%
Aedes are spreading but do not yet pose a significant threat	8	19%
Aedes are stable yet pose a significant threat	7	16%
Aedes are stable and do not pose a significant threat	9	21%
Aedes are only intermittently found and do not pose a significant public health threat	9	21%

Table 74. General Funding Trends, 2013–2016 (excluding Zika supplemental funding)		
	N = 54	%
Federal funding for mosquito-borne disease activities generally increased	8	15%
Federal funding for mosquito-borne disease activities generally remained the same	30	56%
Federal funding for mosquito-borne disease activities generally decreased	14	26%
Federal funding for mosquito-borne disease activities was eliminated sometime during this period	0	0%
Our state did not receive federal funding for mosquito-borne disease activities during this period	2	4%

Table 75. Zika Supplemental Funding Trends, 2016–2017		
	N = 54	%
Federal funding for mosquito-borne disease activities generally increased with supplemental funding	49	91%
Federal funding for mosquito-borne disease activities generally remained the same with supplemental funding	1	2%
Federal funding for mosquito-borne disease activities generally decreased with supplemental funding	1	2%
Our state applied for but did not receive supplemental funding for mosquito-borne disease activities	2	4%
Our state did not apply for supplemental funding for mosquito-borne disease activities	1	2%

Table 76. Post-Zika Supplemental Funding Trends, 2017		
	N = 54	%
Federal funding for mosquito-borne disease activities generally increased	7	13%
Federal funding for mosquito-borne disease activities generally remained the same	12	22%
Federal funding for mosquito-borne disease activities generally decreased	32	59%
Federal funding for mosquito-borne disease activities was eliminated sometime during this period	2	4%
Our state did not receive federal funding for mosquito-borne disease activities during this period	1	2%

Table 77. General Tick-borne Disease Funding Trends, 2013–2016

	N = 54	%
Federal funding for tick-borne disease activities generally increased	17	31%
Federal funding for tick-borne disease activities generally remained the same	15	28%
Federal funding for tick-borne disease activities generally decreased	0	0%
Federal funding for tick-borne disease activities was eliminated sometime during this period	1	2%
Our state did not receive federal funding for tick-borne disease activities during this period	21	39%

Table 78. Vector-borne Activities Funded by Zika Supplemental Funding in 2016-2017

	N = 51	%
Mosquito surveillance	42	82%
Human surveillance for mosquito-borne diseases	44	86%
Animal surveillance for mosquito-borne diseases	9	18%
Larvicide mosquito control	22	43%
Adult mosquito control	17	33%
Resistance testing for mosquitoes	18	35%
Prevention activities for mosquito-borne diseases	42	82%
Pregnancy registry	48	94%
Other	5	10%

Table 79. General Federal Funding

	Highly (made it possible)	Substantially	Some	A little	Have a system but no influence	Not applicable (no surveillance)
Mosquito-borne Disease Program Capacity (2013-2016) N=54	23 (43)	16 (30)	9 (17)	3 (6)	2 (4)	1 (2)
Tick-borne Disease Program Capacity (2013-2017) N=53	14 (26)	4 (8)	6 (11)	7 (13)	8 (5)	14 (26)

Table 80. Zika Supplemental Funding -Mosquito Borne Disease Program Funding

	N = 54	%
Highly (made it possible)	22	43%
Substantially	16	31%
Some	10	20%
A little	2	4%
Have a system but no influence	1	2%
Not applicable (no surveillance)	0	0%

Table 81. Changes in Federal Funding Regarding Specific Vector-borne Disease Surveillance Activities during 2013–2016 for Mosquito-borne Diseases and 2013–2017 for Tick-borne Diseases

	Increased	Reduced but still maintain some	Eliminated	No significant changes	Does not apply
Dead bird surveillance (N=54)	2 (4)	6 (11)	8 (15)	12 (22)	26(48)
Mosquito surveillance (include identification) (N=54)	18 (33)	10 (19)	1 (2)	22 (41)	3 (6)
Testing human specimens for arboviruses (N=53)	13 (25)	7 (13)	2 (1)	29 (55)	3 (6)
Mosquito pesticide resistance testing (N=54)	13 (24)	1 (2)	2 (1)	4 (8)	35 (65)
Tick surveillance (N=54)	9 (17)	2 (4)	2 (1)	6 (11)	36 (67)
Testing ticks for tick-borne pathogens (N=54)	8 (15)	1 (2)	2 (1)	4 (7)	40 (74)
Testing human specimens for tick-borne pathogens (N=54)	2 (4)	0 (0)	2 (4)	23 (43)	27 (50)
Tick pesticide resistance testing (N=54)	0 (0)	0 (0)	2 (1)	3 (6)	50 (93)

Table 82. Changes in General Federal Funding Regarding Specific Mosquito-borne Disease Surveillance Activities during 2013–2016: Testing Mosquito Pools for Endemic Arboviruses

	N = 53	%
Increase in testing mosquito pools	11	21%
Reduced (but still maintain some) testing of mosquito pools	8	15%
Eliminated testing of mosquito pools	2	4%
No significant changes	24	45%
Increase in testing turnaround time between trap date and test results	3	6%
Decrease in testing turnaround time between trap date and test results	6	11%
Do not test mosquito pools for arboviruses	8	15%

Table 83. Changes in Zika Supplemental Funding Regarding Specific Mosquito-borne Disease Surveillance Activities during 2016–2017

	Increased	Reduced but still maintain some	Eliminated	No significant changes	Does not apply
Mosquito surveillance (include identification)	29 (57)	3 (6)	1 (2)	12 (24)	6 (12)
Testing human specimens for arboviruses	32 (63)	3 (6)	0 (0)	9 (18)	7 (14)
Mosquito pesticide resistance testing	17 (33)	0 (0)	0 (0)	4 (8)	30 (59)

Table 84. Changes in Zika Supplemental Funding Regarding Specific Mosquito-borne Disease Surveillance Activities during 2016–2017: Testing Mosquito Pools for Endemic Arboviruses

Answer	N = 51	%
Increase in testing mosquito pools	22	43%
Reduced (but still maintain some) testing of mosquito pools	2	4%
Eliminated testing of mosquito pools	1	2%
No significant changes	18	35%
Increase in testing turnaround time between trap date and test results	2	4%
Decrease in testing turnaround time between trap date and test results	9	18%
Do not test mosquito pools for arboviruses	8	16%

Table 85. Mix of all Federal, State and In-kind Support for Mosquito-borne Program and Activities

	N = 52	%
Federal funding	51	98%
State funding	30	58%
In-kind support	5	10%
Other support	7	13%
No mosquito-borne program in our state	1	2%

Table 86. Mix of All Federal, State and In-kind Support for Tick-borne Program and Activities

	N = 52	%
Federal funding	32	62%
State funding	23	44%
In-kind support	7	13%
Other support	4	8%
No tick-borne program in our state	11	21%

Table 87. Lab Capacity for Non-viralTick-borne Disease		
	N = 50	%
Anaplasmosis/ ehrlichiosis	9	18%
Babesiosis	14	28%
Lyme disease	9	18%
Spotted fever rickettsiosis	14	28%
Tularemia	37	74%
Other (specify)	5	10%
None	9	18%

Table 88. Testing of CSF Specimens for WNV in the State Public Health Laboratory Routinely Tested for One or More Other Arboviruses		
	N = 52	%
Yes (in state lab)	22	42%
Yes (in other lab)	2	4%
Yes (forwarded to CDC)	7	13%
No	21	40%

Table 89. CSF Specimens Tested for Additional Viruses		
Answer	N = 31	%
EEEV	17	55%
SLEV	26	84%
WEEV	6	19%
LaCrosse	12	39%
Powassan	5	16%
Dengue	4	13%
Chikungunya	4	13%
Jamestown Canyon	6	19%
Colorado Tick Fever	1	3%
Other (specify)	3	10%

Table 90. Additional Capacities Needed in Laboratory and/ or Staff to Test for Emerging and Endemic Mosquito-borne Diseases		
Answer	N = 53	%
Yes	40	75%
No	13	25%

Table 91. Specified Capacities Needed in Laboratory and/ or Staff to Test for Emerging and Endemic Mosquito-borne Diseases

	N = 38	%
Additional staff FTE (estimate number of FTE)	29	76%
Additional staff training	17	45%
Additional lab equipment, reagents, etc.	27	71%
Other capacity needs	10	26%

Table 92. Additional Staff Breakdown (N=29)

Average number of staff FTE	1.39
Total number of Staff	30.5
Median number of Staff	1
Range:	0.5-5.5

Table 93. Additional Comments Regarding Training and Capacity Needs

Additional Staff Training	Other Capacity Needs
• PRNT training • Serology • PCR based technology training • Laboratory methods training including cutting edge technologies (e.g., sequencing, MIA • New P~protocols as developed • Testing protocol	• Mosquito pesticide resistance mechanisms • Limits mostly due to lack of staff (turnover) and an already large test menu • Protocols for other disease such as JCV or La Crosse • Bioinformatics • Testing protocols for tick-borne disease pathogens • Training, equipment, reagents, cost for validation • Adequate number of samples in order to keep the test running • We have no staff and no testing capability • Contract the testing out to outside vendor

Table 94. Additional Capacities Needed by Laboratory and Staff Need to Test for Emerging and Endemic Tick-borne Diseases

Answer	N = 52	%
Yes	36	69%
No	16	31%

Table 95. Specified Capacities Needed in Laboratory and/ or Staff to Test for Emerging and Endemic Tick-borne Diseases

Answer	N = 35	%
Additional staff FTE (estimate number of FTE)	30	86%
Additional staff training (examples)	22	63%
Additional lab equipment, reagents, etc	28	80%
Other capacity needs:	6	17%

Table 96. Additional Staffing Breakdown (N=30)	
Average number of Staff	0.96
Total number of Staff	22
Median number of Staff	1
Range:	0.5-2

Table 97. Additional Comments Regarding Training and Capacity Needs

Additional Staff Training	Other Capacity Needs
• Extraction techniques • Continue CDC Blood Borne parasitic training classes • Laboratory methods training including cutting edge technologies (e.g., sequencing and NGS) • Training on protocols • Testing protocol	• Testing for nonviral tick-borne pathogens (Lyme, tularemia, etc) • Testing protocols • Training, equipment, reagents, cost for validation • Adequate sample volume • Mainly to add Lyme, babesiosis, and anaplasmosis • Contract out the testing to outside vendor

Appendix 3: Comparable Tables

Table S1. Number of State-level WNV Surveillance Staff with Specified Levels of Training, Regardless of Funding Source: 2017, 2012 and 2004

Year	State Employees			Contracted Employees		
	1.0 FTE	0.5-0.99 FTE	<.5 FTE	1.0 FTE	0.5-0.99 FTE	<.5 FTE
Number of staff with DVM, MD/DO, RN or other clinical degrees						
2017	23	7	59	3	0	5
2012	4	9	44	0	0	0
2004	18	17	66	1	7	5
Number of staff with PhD, DrPH, MSPH, MPH degrees in epidemiology						
2017	44	26	47	5	6	4
2012	27	7	37	3	1	2
2004	26	18	19	3	2	2
Number of staff with PhD or master's degree in related sciences						
2017	67	20	56	10	26	15
2012	31	13	38	2	3	13
2004	46	17	36	6	7	21
Number of other staff in clerical, administrative or other programmatic categories						
2017	72	49	108	12	27	55
2012	49	33	125	12	12	36
2004	66	53	147	38	23	58

Table S2. Specialists Working for State Health Departments: 2017, 2012, and 2004

	2017		2012		2004	
	N	Yes (%)	N	Yes (%)	N	Yes (%)
Medical entomologist within public health agency	54	23 (43)	50	16 (32)	49	20 (41)
Medical entomologist through contract with another agency**	54	35 (64)	48	18 (38)	47	23 (49)
Expertise in wildlife biology within your agency	54	48 (89)	50	38 (76)	49	45 (92)
Designated state public health veterinarian within your agency***	54	42 (78)	50	38 (76)	49	40 (82)

** This includes data for formal channels and informal agreements/ with academic institutes

***This includes within agency, contract, and informal arrangements

Table S3. Number and Percentage of States with Selected Surveillance Systems for WNV: 2017, 2012 and 2004

	2017			2012			2004		
	N	Yes n (%)	Median	N	Yes n (%)	Median	N	Yes n (%)	Median
Human disease	54	53 (98)	12	50	49 (98)	12	49	49 (100)	12
Animal disease (e.g. equine)*	53	48 (91)	12	49	44 (90)	12	49	46 (94)	12
Avian mortality	51	21 (41)	7	49	19 (39)	7	49	48 (98)	7
Vector**	54	50 (93)	6	49	39 (80)	5	49	47 (96)	6

*Surveillance for equine disease was expanded to animal diseases in 2017
**Surveillance for vector-borne disease was expanded to include both mosquito and tick-borne diseases in 2017

Table S4. Human WNV Surveillance and Reporting in States: 2017, 2012 and 2004

	2017		2012		2004	
	N	Yes (%)	N	Yes (%)	N	Yes (%)
Did your agency specifically contact, by any method, the following specialists to encourage reporting and to suggest these specialists have a high index of suspicion for arboviral meningitis/ encephalitis?						
Neurologists	52	20 (38)	48	24 (50)	48	29 (60)
Critical care specialists	52	19 (37)	48	23 (48)	49	28 (57)
Infectious disease specialists	51	32 (63)	48	28 (58)	49	40 (82)
Emergency departments	52	28 (54)	49	28 (57)	-	-
Did your agency require reporting						
Of hospitalized encephalitis cases of unknown etiology (suspect cases of arboviral disease)?	53	34 (64)	50	24 (48)	49	31 (63)
Of hospitalized meningitis cases of unknown etiology (suspect cases of arboviral disease)?	53	31 (58)	50	25 (50)	49	27 (55)
CSF and/or serologic specimens positive for arboviral infection from in state laboratories?	52	51 (98)	49	49 (100)	48	32 (67)
Which case definition did your program use for reported cases of arboviral neuroinvasive disease (i.e. classifying cases as confirmed or probable)?						
Require confirmation of commercial lab-positive specimens by your public health laboratory or another reference laboratory?	52	29 (56)	50	18 (36)	46	37 (80)
National case definition used exclusively	53	53 (100)	-	-	-	-

Table S5. Avian WNV Surveillance and Reporting in States: 2017 and 2012				
Avian Surveillance	2017		2012	
	N	Yes (%)	N	Yes (%)
Maintain a database of dead bird sightings?	53	22 (41)	49	12 (24)
If state maintained a database of dead bird sightings				
Were specimens submitted for WNV testing?	22	20 (91)	12	11 (92)
How many specimens tested?				
What strategies did your agency use for collecting and testing dead birds?				
Collected all dead birds in an area all season	34	5 (15)	12	3 (25)
Tested all dead birds in an area all season	33	7 (21)	12	3 (25)
Collected all in an area until first tests positive	33	3 (9)	12	1 (8)
Tested all in an area until the first tests positive	31	4 (13)	12	1 (8)
Collected all of specified species all season long	33	5 (15)	12	4 (33)
Tested all of specified species all season long	31	7 (23)	12	3 (25)
Collected all of specific species until first tests positive	32	5 (16)	12	2 (17)
Tested all of specific species until first tests positive	31	6 (19)	12	3 (25)

Table S6. Mosquito Surveillance for WNV in States: 2017, 2012 and 2004											
2017				2012				2004			
N	Mdn	Range	Unk	N	Mdn	Range	Unk	N	Mdn	Range	Unk
What percentage of the population in your state lives in an area covered by mosquito surveillance?											
53	69	12-100	9 (17)	43	50	6-100	5 (12)	37	65	5-100	6 (16)
Number of trap nights mosquitoes collected											
27	1996	54-45674		43	1071	83-23704	22 (55)	32	2602	1-16840	14 (40)

2017			2012			2004		
N	Yes (%)	Unknown	N	Yes (%)	Unknown	N	Yes (%)	Unknown
Do most local jurisdictions with mosquito control within your state conduct adult surveillance?								
48	34 (71)	-	44	15 (34)	0	44	21 (48)	0
Do most local jurisdictions with mosquito control within your state conduct larval surveillance								
45	23 (51)	-	44	8 (18)	0	44	13 (30)	0
Does your agency calculate minimal mosquito infection rates or receive such data?								
53	25 (47)	1 (2)	44	18 (41)	0	44	25 (47)	1 (2)

Table S7. Laboratory Aspects of Arboviral Mosquito Surveillance in States: 2017, 2012

	2017		2012	
	N	Yes (%)	N	Yes (%)
What labs performed testing on mosquito pools collected in your state?				
State or state funded lab	53	37 (70)	46	40 (87)
Local health department	53	9 (17)	46	12 (26)
Local mosquito district	53	15 (28)	46	17 (37)
University or academic institution	53	15 (28)	-	-
Mosquito surveillance done, but no testing done on mosquito pools	53	4 (8)	46	4 (9)
For which viruses are mosquito pools routinely tested?				
California serogroup viruses	54	14 (26)	45	13 (29)
Chikungunya virus	54	20 (37)	-	-
Dengue viruses	54	17 (31)	-	-
EEE virus	54	24 (44)	45	22 (49)
SLE virus	54	31 (57)	45	24 (53)
WNV	54	48 (89)	-	-
Yellow fever virus	54	5 (9)	-	-
Zika virus	54	30 (56)	-	-
Other (specify)	54	15 (28)	45	13 (29)
Not applicable (no testing done)	54	3 (6)	45	11 (24)
Which agencies in your state monitor for pesticide resistance in mosquitos?				
State health department	23	8 (35)	49	3 (6)
Other state agency (Dept of EP)	23	1 (4)	-	-
City/county health departments	23	3 (13)	49	9 (18)
Local MCDs or similar organizations	23	10 (43)	-	-
University or academic institution	23	11 (48)	-	-
No monitoring done	29	29 (56)	49	33 (67)
Does your state (or local jurisdictions within your state) utilize sentinel chicken surveillance? If yes which viruses?				
WNV	9	9 (100)	5	5 (100)
EEEV	9	5 (56)	5	3 (60)
SLEV	9	8 (89)	5	3 (60)
WEEV	9	4 (44)	-	-
Other	9	1 (11)	5	0 (0)

MCDs: Mosquito control districts

Table S8. WNVEducational Prevention Activities in States: 2017, 2012 and 2004						
Mosquito Surveillance	2017		2012		2004	
	N	Yes (%)	N	Yes (%)	N	Yes (%)
Which of the following WNV prevention messages and activities did your program use and promote?						
Press releases to electronic and printed media	54	51 (94)	50	48 (96)	49	47 (96)
Public service announcements	54	25 (46)	50	20 (40)	49	31 (63)
Passive distribution of info brochures	54	44 (81)	50	40 (80)	49	44 (90)
Active distribution of info brochures	54	28 (52)	50	24 (48)	49	37 (76)
Town, community, neighborhood meetings	54	22 (41)	50	15 (30)	49	30 (61)
Posting info on the home page of your agency website	54	45 (83)	50	45 (90)	49	48 (98)
Social Media outlets (Facebook, Twitter, etc.)	54	42 (78)	-	-	-	-
Door-to-door outreach in selected locations	54	11 (20)	50	11(22)	49	11 (22)
Participation in community clean-ups	54	8 (15)	50	6 (12)	49	4 (8)
Modification of messages for lower literacy and non-English speaking audiences	54	26 (48)	50	23 (46)	49	35 (71)