



Short communication

State by state implementation of Zika virus testing guidance in the United States in 2017 and 2018

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ABSTRACT

In 2015 and 2016, outbreaks of the Zika virus began occurring in the Americas and the Caribbean. Following the introduction of this new threat, the United States' Centers for Disease Control and Prevention (CDC) issued testing guidance for the nation's state public health laboratories. We collected and analyzed testing guidance for all fifty states and the District of Columbia for both 2017 and 2018. In both years, state testing guidance was consistent for men and non-pregnant women, but there was notable variation in guidance for pregnant women. In addition, there were changes between the two years as testing algorithms shifted toward guidance that recommended testing in more limited circumstances. States adopted large, or complete, portions of CDC testing guidance, but were not required to conform completely, 33% of states had identical guidance in 2017 and 49% in 2018. Some of these trends, such as specifying that testing be contingent on travel, or sexual contact with an individual who has recently traveled, to an area where the Zika virus was circulating, presents a potential deficiency in the United States surveillance capacity. Understanding variations in state testing guidance enables public health professionals to better understand ongoing surveillance. This analysis provides insight into the testing practices for the various states across the country. Better understanding of how states approach Zika testing, and how that testing changes over time, will increase the public health community's ability to interpret future Zika case counts.

1. Introduction

After Zika virus was identified in the Western Hemisphere in May 2015, (Zanluca et al., 2015) it rapidly expanded throughout Latin America and the Caribbean. Although symptoms are often mild, infection can result in Guillain-Barré syndrome in adults and Congenital Zika Syndrome which leads to severe neurologic problems in fetuses whose mothers were infected during pregnancy. (Cao-Lormeau et al., 2016; Adibi et al., 2016; Johnansson et al., 2016) Given the novelty of the disease within the region and the severity of health outcomes in children infected during pregnancy, the World Health Organization declared the 2015–16 outbreak a Public Health Emergency of International Concern. (WHO statement on the first meeting of the International Health Regulations, 2005) Zika virus can be transmitted via the bite of an infected mosquito, sexual transmission, blood transfusion, and from mother to child during pregnancy. (Musso et al., 2015; Fauci and Morens, 2016) Most US Zika cases have been in individuals with travel history to Zika-affected countries; however, cases due to local mosquito-borne transmission have been reported in Florida and

Texas (Zika virus: Statistics and maps [Internet], 2019).

In response to the rise in Zika virus incidence, the US Centers for Disease Control and Prevention (CDC) issued guidance for Zika virus testing (CDC Recommendations for Subsequent Zika IgM Antibody Testing [Internet], 2019). This guidance recommended testing based on individual exposure status and other risk-modifying conditions. However, states were free to adopt differing testing recommendations. Between 2017 and 2018, CDC issued Zika testing guidance changed to reflect a number of considerations including the best allocation of state public health resources, the reduced burden of the Zika virus in the Americas, the potential cross-reactivity with Dengue virus, and the impact of false positives on individuals, especially pregnant women.

Understanding approaches to Zika virus testing is needed to help interpret national and state-based case counts and to gauge the risk of local transmission. Surveillance for Zika infections in the US may be limited by state testing approaches (Russell et al., 2017). Grubaugh et al found that that the true number of Zika infections in Florida was likely larger than detected and that local transmission of Zika may have occurred several months before it was detected by public health

Abbreviations: CDC, Centers for Disease Control and Prevention; US, United States; DC, Washington District of Columbia

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surveillance (Grubaugh et al., 2017).

We analyzed Zika testing guidance from all fifty US states and DC for 2017 and 2018 to understand similarities and differences in local surveillance approaches and to determine how those approaches changed over time. We present a summary and comparison of approaches from these two years, and their potential role in interpretation of Zika case counts.

2. Materials and methods

2.1. Data collection

Our data collection process occurred in two distinct windows of 2017 and 2018. The first data collection period ran from April to June 2017. Researchers obtained Zika virus testing algorithms, flow charts, or policies for US states and the District of Columbia from health department websites (N = 36) and conducted phone/email outreach to representatives from state health departments that did not post testing algorithms online (N = 15). The research team also obtained CDC's Zika testing policy to capture current recommendations at the time of data collection. (Exposure, Testing & Risks [Internet], 2017) All aspects of the first data collection effort was completed within the original data collection period. We then repeated this process from May to July 2018 to identify updates in state testing algorithms. The initial search in 2018 yielded 34 state testing policies; the remaining 17 were identified through outreach to health departments. In 2018 three cases required continued outreach beyond August due to lack of response from health department representatives. Researchers also located an updated CDC Zika testing policy to represent existing policy recommendations during the second data collection period (Zika Testing Guidance [Internet], 2018).

2.2. Analysis

We classified patient groups contained in each state's testing algorithm using a coding matrix. The final version of the coding matrix covered three groups of individuals; men, non-pregnant women, and pregnant women. Each group were then assessed for eight testing categories that encompassed each combination of one of two routes of exposure, travel history and sexual contact, and if the patient was or was not symptomatic (i.e. asymptomatic men with no sexual contact). Each state Zika testing algorithm included the language to describe symptomatic individuals as people with at least two of the following symptoms: rash, fever, arthralgias and conjunctivitis. For each patient group in the coding instrument, we assigned a value of one if a state's algorithm had recommended testing at a state public health laboratory, or zero if the algorithm did not include the patient group. At least two research team members reviewed coding decisions to ensure reliability. Using Stata 15.1 we utilized one-way tables to visualize the distribution of testing recommendations for each category by year and chi-square tests to identify statistically significant changes in testing guidance. (<https://www.stata.com>)

3. Results

3.1. CDC guidance and state adherence

Degree of adherence with CDC Zika testing guidance is a primary source of variation across state Zika testing policies. In 2017, one third of states offered Zika testing policies that matched CDC guidelines, in 2018 this number increased to just under half (Fig. 1). In 2017, one state (TX) offered additional guidance to specifically address the potential for local transmission in their region. The 2018 CDC guidance agreed with 83% of the codes from the year prior, with new guidance that did not recommend testing for asymptomatic pregnant women or symptomatic pregnant women without a route of exposure.

3.2. State Zika testing Guidance, 2017

In 2017, most states shared similar Zika virus testing guidance. Almost every state recommended testing for symptomatic individuals with a history of exposure (i.e. travel or sexual contact with a traveler from an area with active Zika transmission); most did not recommend testing for asymptomatic men and non-pregnant women (Table 1). Variation in state testing guidance was tied to guidance for pregnant women. In 2017, fewer than half of states recommended that symptomatic pregnant women with no travel history (43%) and no sexual contact (41%) undergo Zika testing. The remaining states only recommended testing for pregnant women with known exposures.

3.3. State Zika testing Guidance, 2018

In 2018, most states recommended Zika testing for all symptomatic individuals with travel history (96%) or sexual contact (92%). Additionally, each state abstained from recommending testing for asymptomatic men and non-pregnant females, except for one state that recommended testing for non-pregnant females with potential sexual contact. The variation seen in 2017 regarding states' testing guidance for symptomatic pregnant women changed in 2018. Six percent of states recommend testing for symptomatic pregnant women without a history of travel and 8% for symptomatic pregnant women without potential sexual contact. In 2018, differences were seen in testing guidance for asymptomatic pregnant women with a history of exposure. Almost half of states recommended testing for pregnant women with no travel history (45%) or no sexual contact (39%), showing wide variability across testing guidance for pregnant women and a decrease of 55% from 2017.

3.4. Changes in Zika testing guidance

Despite having relative uniformity across categories, there were notable shifts in state Zika testing guidance between years (Table 1). In 2017, all 50 states and DC followed guidance that recommended testing for some asymptomatic individuals; in 2018, this number dropped to twenty-three states (45%). In 2017, testing was widely recommended for asymptomatic pregnant women with travel history (100%) and potential sexual contact (96%); these numbers dropped to twenty-two (44%) and twenty-five (51%) states in the following year.

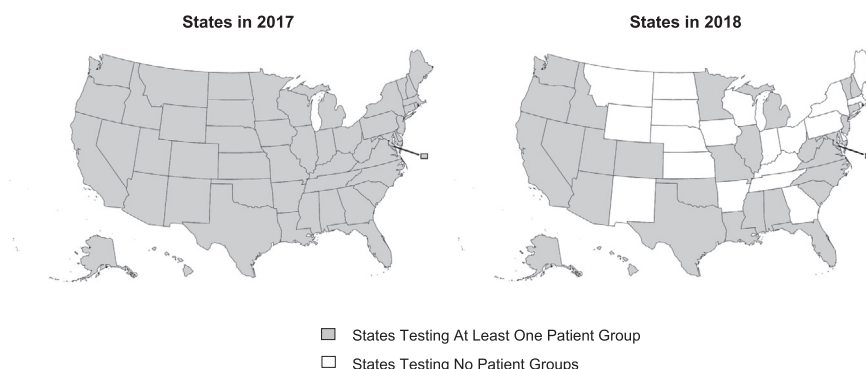
Changes were also seen regarding testing contingent on exposure. In 2017, 29% of states used travel history to Zika-affected areas as an exclusive criterion for Zika testing, a number that increased to 39% in 2018. Overall, there was a statistically significant increase (30%) in the number of states requiring a history of travel or sexual contact for Zika testing.

4. Discussion

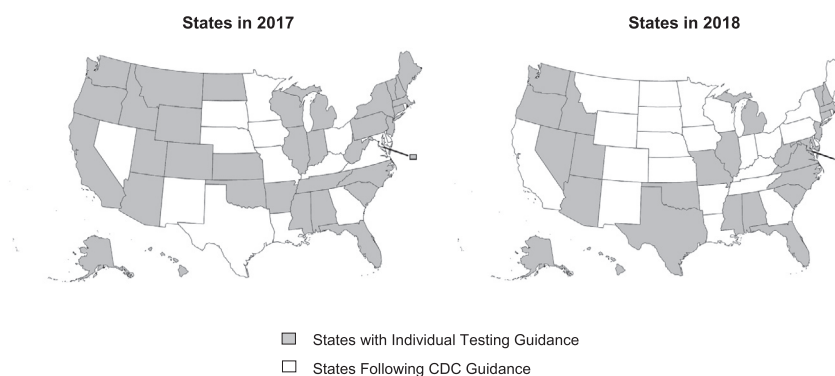
Zika testing contingent on travel-related exposure and symptom expression can influence how public health professionals interpret case numbers. Unidentified cases can impact efforts to track the spread of disease and can lead to misrepresentative case counts, delay detection of local outbreaks, and endanger populations in at-risk areas. Additionally, at-risk individuals may have more of a challenge gauging their risk of Zika virus exposure.

The CDC estimated that 30 states and DC have a "likely" or "very likely" chance of hosting *Aedes aegypti* or *Aedes albopictus*, the mosquito species known to carry Zika virus (Potential Ranges in the US [Internet], 2019). Though these ranges are estimates and are not a direct proxy for disease spread, the potential for local transmission in these areas should be highlighted in testing guidance. However, we found that in 2017 and 2018 that several states recommended testing only for individuals with a history of travel or sexual contact with a Zika case, thus limiting detection of local transmission. Moreover, there

States Testing at Least One Zika Patient Group that is Asymptomatic or Without a Definite Route of Exposure (Travel History or Sexual Exposure): Comparison Between U.S. States, 2017 and 2018



States Following Testing Guidance that Differs from CDC Testing Guidance: Comparison Between U.S. States, 2017 and 2018



Map template courtesy of simplemaps.com^{xviii}

Fig. 1. It presents two sets of maps of all 50 United States and Washington DC. The first set of maps depicts the number of states with Zika testing guidance that recommended testing at state public health laboratories for at least one patient group without a definite route of exposure for both 2017 and 2018. The second set of maps shows the number of states with Zika testing guidance that differed from the current guidance of the US Centers for Disease Control and Prevention for both 2017 and 2018.

was minimal recommended testing for asymptomatic, non-pregnant female and male populations. Although resource limitations may require testing approaches that focus on those with the greatest likelihood of adverse outcomes, limited population testing raises the chances that cases are overlooked.

The decrease in Zika activity between 2017 and 2018 was an influential factor in state and national Zika testing guidance. Although we recognize the burden of expanded testing, potentially lower likelihood of providers requesting tests for patients without an exposure history, and the potential harmful effects of false positives ([Exposures, Testing and Risks with Zika Virus \[Internet\], 2020](#)), we believe that Zika testing is a critical part of the US disease surveillance system. A robust disease testing system designed to detect and monitor local transmission is an important component of Zika surveillance, in addition to environmental scans of mosquito breeding pools and programs like the AABB Zika Virus Biovigilance Network ([Zika Virus Biovigilance Network \[Internet\], 2020](#)). Additionally, understanding variations in state guidance is a critical component in a public health professional's ability to interpret emerging case counts of the Zika virus ([Free United States SVG Map \[Internet\], 2020](#)).

This study was subject to a number of limitations. Data collection methods may have omitted additional or updated guidelines given that

Zika testing guidelines often change over time. This limitation highlights a potential challenge for clinicians in accessing and remaining up-to-date with evolving guidance. Moreover, this study does not assess how closely healthcare providers adhere to state health department testing recommendations. Additionally, some changes between years may have been due to a shift in testing from state to commercial laboratories. Finally, a number of states implemented guidelines directly mirroring those set by the CDC, influencing the pervasive nature of certain testing recommendations.

5. Conclusions

Zika virus testing guidance varied between states and over time. Understanding Zika testing strategies employed by health departments is important for interpreting US Zika case counts and identifying vulnerabilities in surveillance systems. In 2017, states recommended testing patients who would be at greatest risk of severe outcomes (e.g. pregnant women with likelihood of exposure), but few employed testing strategies that would help identify the true prevalence of infection in the US or enable early detection of local transmission. Over the two years reviewed, state testing guidance decreased the number of conditions warranting Zika virus testing at state laboratories, a

Table 1

The number of states recommending testing for sub-sets of the U.S. population. The middle columns represent both 2017 and 2018, while the final column shows the change in the percentage of states recommending this testing between years.

Testing category	2017: number of states (%)	2018: number of states (%)	Net change (%)
Pregnant Women with Travel History ^a			
Reported symptoms	51/51 (100%)	51/51 (100%)	0%
No reported symptoms	51/51 (100%)	23/51 (45%)	-55%
Pregnant women with no travel history ^b			
Reported symptoms	22/51 (43%)	5/51 (10%)	-33%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Pregnant women with sexual contact			
Reported symptoms	49/51 (96%)	50/51 (98%)	+2%
No reported symptoms	48/51 (94%)	20/51 (39%)	-55%
Pregnant women with no sexual contact			
Reported symptoms	21/51 (41%)	4/51 (8%)	-33%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Men with travel history ^c			
Reported symptoms	50/51 (98%)	49/51 (96%)	-2%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Men with no travel history ^d			
Reported symptoms	4/51 (8%)	4/51 (8%)	0%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Men with sexual contact ^e			
Reported symptoms	43/51 (84%)	47/51 (92%)	+8%
No reported symptoms	1/51 (2%)	0/51 (0%)	-2%
Non-pregnant women with travel history ^f			
Reported symptoms	50/51 (98%)	49/51 (96%)	-2%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Non-pregnant women with no travel History ^g			
Reported symptoms	4/51 (8%)	3/51 (6%)	-2%
No reported symptoms	0/51 (0%)	0/51 (0%)	0%
Non-pregnant women with sexual contact ^h			
Reported symptoms	44/51 (86%)	47/51 (92%)	+6%
No reported symptoms	1/51 (2%)	1/51 (2%)	0%
Jurisdiction tests pregnant women only	2/51 (4%)	2/51 (4%)	0%
State conducts enhanced surveillance ⁱ	6/49 (12%)	1/43 (2%)	-10%
State tests possible sexual exposure	49/51 (96%)	50/51 (98%)	+2%
Test pregnant women with sexual exposure	49/51 (96%)	50/51 (98%)	+2%
Test men and/or non-pregnant women with sexual exposure	44/51 (86%)	47/51 (92%)	+6%
State tests only if history of exposure	23/51 (46%)	38/51 (76%)	+30%
State tests only if symptomatic	0/51 (0%)	28/51(56%)	+56%
State includes local transmission as a potential exposure route [*]	5/51 (10%)	5/51 (10%)	0%

potential cause for concern for future Zika seasons, should incidence of the infections increase. While potentially a strategic allocation of resources that reflect decreased risk, current testing algorithms may lead to surveillance gaps and undetected local transmission of Zika virus.

CRedit authorship contribution statement

Marc Trotochaud: Writing - original draft, Writing - review & editing, Investigation, Formal analysis, Visualization, Data curation. **Tara Kirk Sell:** Writing - review & editing, Writing - original draft, Supervision, Validation. **Sanjana J. Ravi:** Project administration, Investigation, Methodology, Data curation. **Carolina I. Andrada:** Investigation, Data curation. **Jennifer B. Nuzzo:** Conceptualization, Methodology, Validation, Writing - original draft, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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