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Addressing the Global Zika Epidemic Locally

An Interprofessional Model of Universal Screening at One Center

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ABSTRACT

Escalating evidence for the fetal impact of Zika virus infection required a change in care by all prenatal providers. This article describes an effective model of rapid implementation of universal prenatal screening at one hospital and its network of community health centers for a large and diverse immigrant population exploring the challenges, experiences, and lessons learned. Implementation of national recommendations required a workflow change, challenging a system with a heterogeneity of settings and providers. Using a physician clinical champion and advanced practice nurses in the roles of logistical coordinator and liaison to the network, Zika screening was embedded into prenatal intake visits at both the hospital and community health centers. Challenges addressed include varied medical record systems, acceptance by patients, providers, and community health center leadership, as well as culturally appropriate outreach to diverse ethnic and linguistic communities. In 6 months, the prenatal screening rates increased from 20% to 88%, which resulted in the identification of more than 300 pregnant patients at risk of exposure to Zika virus. This model offers key lessons for emergency preparedness in heterogeneous, safety net hospital settings.

Key Words: community health centers, delivery of healthcare, emigrants and immigrants, prenatal diagnosis, Zika virus infection

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Questions about the impact of the Zika virus on fetal development were raised in early 2015 when microcephaly was identified in a cohort of newborns in Brazil and tied to a new mosquito-borne viral fever.[1,2] A year later, there was increased awareness of the Zika virus in the United States news media and by early 2016, it was declared a public health crisis by the Centers for Disease Control and Prevention (CDC) and the World Health Organization.[3] The urgent need to identify possible Zika infection in pregnant populations prompted the CDC to release the first guidelines calling for screening all pregnant populations for travel history and risk factors for exposure to Zika virus.[4] In March 2016, The American Congress of Obstetricians and Gynecologists and the Society for Maternal Fetal Medicine issued recommendations that all pregnant women be screened for exposure risk to Zika virus.[5] A timely response to these recommendations and guidelines required changes in practice to implement universal prenatal Zika screening, identification, and follow-up of a select cohort of patients. This article describes one model of rapid implementation of universal screening and management of the Zika virus at a safety net hospital and its collaborating health centers, defined by the identification of 3 key individual roles, and the focus on conducting the screening during the initial prenatal visit, and explores the challenges of this model.

BACKGROUND

Boston has an immigrant population of 27%, with a significant proportion of these immigrants originating from the Caribbean, Central and South America, and Cape Verde: all areas affected by endemic Zika.[6,7] One of the major hospitals in the city is Boston Medical Center, a 496-bed nonprofit academic medical center

that performs approximately 2800 deliveries a year. It is also New England's largest safety net hospital, a designated facility that primarily cares for underinsured, low-income, and low-resource populations. Pregnant patients receive outpatient prenatal care in a hospital-based clinic as well as from a network of 9 affiliated community health centers (CHCs). All sites provide primary healthcare to immigrant populations at historically high risk for health disparities. As such, the patients of Boston Medical Center were disproportionately vulnerable to impact by the global Zika epidemic.

In this system, practice protocols in obstetrics and gynecology in part stem from the central academic center and are disseminated to the CHCs. Fifty-four percent of the women who deliver at the hospital receive prenatal care at the CHCs. The academic center provides maternal fetal medicine services and ultrasonography for all patients. Prenatal care in this system is provided by a mix of hospital-employed certified nurse midwives (CNMs) (approximately 50%), nurse practitioners (NPs) (25%) employed by each clinical site, and hospital- or CHC-employed obstetricians and family medicine physicians. In addition, each CHC has a different leadership structure with respect to women's health. Thus, any new intervention must be adapted to a range of care models and medical homes. This article reviews the experience, barriers, facilitators, and impact of implementing evolving screening and testing guidelines for an emerging disease in a model that links an academic hospital to nested CHCs.

METHODS

A modified Plan-Do-Study-Act (PDSA) cycle framework was used to respond to the call for practice change, modeled on the discrete stages of implementation described by Damschroder et al: planning, engagement, execution, and evaluation.[8,9] The challenge in a public health emergency is that change must be effected rapidly; hence, the initial planning phase of implementation needed to be truncated. To that end, interventions were focused on identifying key personnel who could facilitate broad provider engagement and set a high bar of 90% patient screening for Zika by delivery.

Engagement: Individual roles

Three essential roles drove process change and implementation of universal screening for Zika: a clinician champion, a testing coordinator, and a CHC liaison. The clinician champion took the lead on coordination of the department's clinical response and was a clinical resource for questions and concerns in a rapidly changing information landscape, staying up to date with any new information and recommendations. Although in this setting a maternal fetal medicine physician was the designated clinician champion, this role could be accomplished by an individual willing to commit himself or herself to owning and driving through a process change, and who holds clinical respect and credibility.[10]

An NP assumed the role of coordinator for testing and data collection. Essential to the success of this role was a history of strong relationships with colleagues as well as a willingness to be an educational resource to all staff. A portion of this person's clinical time was protected by the department for administrative tasks such as reviewing all referrals, coordinating testing, informing patients of all normal and abnormal results, and maintaining a secure database of affected patients, exposures, and results. The clinical coordinator collaborated with the clinician champion to design, adapt, and implement a laboratory testing workflow and was available and used as a clinical resource for other providers.

The third key individual was the hospital's CHC liaison, a CNM, whose responsibilities include maintaining communication both within and outside the medical center and disseminating and reinforcing care protocols and algorithms. This function relied on a previously established communication network and was essential for universal dissemination of practice change. The liaison collaborated with the clinician champion to ensure that the workflow for screening and referrals was applicable to the CHCs with their varied written medical records and electronic medical record (EMR) systems and laboratory capabilities and facilitated needed adaptations. In the early months of the epidemic, this liaison also reached out to staff at each CHC to broker the clinic's response to patients' concerns and promote utilization of CDC screening guidelines.

Execution: Improve awareness and change workflow

In the initial PDSA cycle, all providers were asked to screen patients individually at each prenatal visit, in line with the recommendations of The American Congress of Obstetricians and Gynecologists and the Society for Maternal Fetal Medicine. Motivation to change workflow for prenatal providers from different disciplines and departments will not happen without education. These efforts were launched by the clinician champion. Outreach to hospital-based providers was conducted through regular announcements and updates at department faculty and staff meetings with follow-up e-mail updates regarding newly affected countries and recommendations. Highlighting the importance of utilizing multiple channels for communication and education in emergency preparedness, education about

the Zika virus was incorporated into interdisciplinary grand rounds, brown bag lunch talks, as well as targeted seminars for obstetric ultrasound providers. In addition, the clinician champion created a "tool kit" for dissemination to prenatal providers in the CHCs. This tool kit consisted of a brief online presentation, multilingual patient handouts, signage to post on computer monitors to remind providers to screen for Zika, and a clinical note template that could be either inserted into a paper record or cut and pasted into an electronic record. The CHC liaison ensured dissemination to all hospital-affiliated prenatal providers.

Simultaneous to provider outreach were efforts to educate and empower patients on risk factors for and possible fetal effects of Zika virus infection, including appropriate precautions if travel to endemic areas was necessary. The majority of pregnant patients at risk for Zika exposure during pregnancy screened spoke Spanish, Haitian Creole, or Cape Verdean Creole as a first language. However, few written materials were available for patient education and those that existed were written at an advanced reading level. Early in the outbreak, popular and social media were rife with myths and misinformation about the impact of Zika infection and the "real" etiology of the resultant microcephaly.[11,12] It was, therefore, crucial to adapt informational materials from state and national organizations that were originally written in English, Spanish, and Brazilian Portuguese,[13] to a reading level and languages that were more appropriate for all patients. To accomplish this, both the marketing and interpreter services departments at the academic medical center worked with the clinician champion to create low literacy pamphlets on Zika and pregnancy in all 4 major languages of affected groups: English, Spanish, Haitian Creole, and Cape Verdean Creole.

In addition to written materials, video-based education was created in order to capitalize on the ubiquity of mobile technology and high social media use.[14] Four staff CNMs, native speakers in the 4 key languages listed previously, filmed brief videos featuring direct messaging about Zika virus and pregnancy as well as specific relevant services offered by the tertiary care hospital and affiliated CHCs (see Table 1). These videos were posted on the hospital Web site, the hospital YouTube site, and disseminated to clinic staff of all levels to post on personal social media feeds. To facilitate the best possible clinical care, educational interventions had to disentangle myth from reality. The goal of this multipronged approach was to provide accurate, accessible information and undo potential harm from misinformation.

Confirmatory Zika serology was offered according to the standards set by the CDC. Pregnant women were referred to the testing coordinator who was responsible for calling the local department of public health (DPH) with each case and awaiting the response of an epidemiologist before arranging phlebotomy. All patients with positive Zika serology had ultrasound surveillance every 3 to 4 weeks and complete neonatal evaluation at delivery as per CDC recommendations at that time.[5] Given barriers to care and resultant delayed presentation to care that disproportionately affect women who immigrate during pregnancy, the Boston Medical Center opted to broaden the use of ultrasonography for Zika exposure.[15] Additional ultrasound evaluation was performed at 28 and 34 weeks in all pregnant women with Zika exposure risk based on screening questions, who were unable to present for serologic testing or whose negative IgM did not rule out early exposure.

Evaluation: Assessing efficacy of universal screening

While anecdotal reporting of provider frustration with difficulty in screening every patient at every visit prompted an early informal assessment at 3 months, review was planned for 6 months. To evaluate the efficacy of the implemented screening tools, systematic retrospective chart reviews were executed at the 6-month mark abstracting data on the 3 screening questions: (1) Have you been outside the US during pregnancy? (2) Where were you? (3) When were you last there? If there was no risk for Zika exposure based on the response to these questions, the protocol recommended documentation of counseling about Zika risk using a scripted phrase offered to providers through the electronic health record.

Table 1. **Video education about Zika virus and pregnancy**

Language	Link to video
English	https://www.youtube.com/watch?v=gfTzBr2gYfc
Spanish	https://www.youtube.com/watch?v=S8yXLiB_ivQ
Haitian Creole	https://www.youtube.com/watch?v=3Egq_8OWz48
Cape Verdean Creole	https://www.youtube.com/watch?v=K-sd_aGOWb8

RESULTS

PDSA cycle 1: Optimized interventions and tools developed

Practice change restricted to selected providers

The initial recommendation to screen at every prenatal visit for travel histories concerning for possible exposure to Zika proved difficult to implement. The main barrier to this workflow was the expectation that dozens of prenatal care providers at 10 different sites could change the workflow of each visit and maintain this process change over time. In response to provider concerns, and reflection and evaluation by the clinician champion and clinical coordinator, the protocol changed. The effort to change the daily practice of multiple providers at multiple sites was untenable. Therefore, the intervention needed to be less complex and involve a default change affecting multiple patient flows at the same time.[16] Thereafter, the focus of implementation efforts to universal screening for travel or sexual exposure to Zika exposure was narrowed to happening at the prenatal intake visit. A select subset of NPs and CNMs performing all intakes for the academic medical center was called upon to embrace practice change. This approach built upon prior precedents in prenatal care, that is, similar to efforts to improve screening for human immunodeficiency virus, where screening was performed using algorithms at a prenatal intake visit.[17] With this change, a more limited group of providers evaluated women at their first presentation to care, used established electronic health record–based algorithms, and had appropriate time and tools for screening, thus promoting default engagement in implementation.[18]

This targeted intervention rapidly resulted in broader groups of prenatal providers having Zika screening documented on the problem list by their first official prenatal visit. The model was subsequently extended to the CHCs. In addition to including Zika screening in the prenatal intake flow, each CHC was asked by the CHC liaison to nominate 1-point person to coordinate screening documentation, and referrals for Zika virus testing as well as to track Zika referrals and lead response efforts at their health center. All of the designees are nurses, nurse midwives, or nurse practitioners, in keeping with a decentralized model that prioritizes local ownership. This model of information tracking made it possible to perform internal quality assurance, ensuring appropriate ultrasound surveillance, and awareness of context for any abnormal neonatal findings.

Another barrier to implementing recommended testing was skepticism from both providers and patients about the significance of the virus. Anecdotally, some prenatal providers felt that if there was no intervention for Zika exposure, there was no benefit to screening, only a perpetuation of fear. Ongoing provider education with dissemination of literature as it became available continued, however, shifting the moment of screening to the prenatal intake capitalized on a group of providers with complete buy-in.

Streamlining communication with state department of public health

In the beginning of screening for Zika virus exposure, the process of waiting for a call back from a state epidemiologist with serum screening results was onerous. However, by limiting communication between the hospital and the DPH to a single NP, the Zika coordinator, a track record of quality control, data collection and communication were established. A tailored request form was developed and accepted by the DPH with an expectation that we would perform an internal review of every requisition before submission. In exchange, the hospital was allowed to bypass the time-consuming case-by-case communication to DPH. This simplified and accelerated the process of getting patients tested.

Utilization of the EMR

Utilization of the electronic medical record was essential in the standardization and systematization of screening. Prior work has demonstrated that automation of clinical text improves adherence to new guidelines, including prenatal screening.[19,20] The maternal fetal medicine clinician champion drafted and disseminated separate "smart phrases," automated piece of text, available within the EMR with a keyboard shortcut, for Zika screening and shared them internally using the EMR and externally by paper or electronic copy to clinics that did not share the same EMR. Table 2 provides the text of the smart phrases that were available to prenatal providers.

One smart phrase articulated the appropriate counseling to reduce travel and sexual risk for those patients with no exposure risk and a second included a more comprehensive body of information about the consequences of Zika exposure with the relevant information that needed to be collected for the serum screen. These smart phrases not only standardized documentation but also served as a reference for the providers to standardize the counseling provided. The hospital relied on problem-based charting, and at the prenatal intake, each patient had either negative Zika screen language added to his or her "supervision of normal pregnancy" problem or "Zika exposure in pregnancy" added to the patient's problem list with its associated text.

The director of Women's Health at one health center, who was a CNM, had an innovative solution to implement universal Zika virus screening. The

Table 2. **Automated text for Zika exposure and Zika prevention**

Results to verbal screening for exposure risk	Smart phrase text
Positive screen	Due date: . . . Country of travel: . . . Dates of travel: . . . Estimated gestational age at time spent in Zika-affected area: . . . Specific sites of travel in country: . . . Recollection of insect/mosquito bite: . . . Known history of dengue, yellow fever, Chikayunga, or West Nile infection? . . . Known prior vaccination to any of these infections? . . . Yes/No to the following symptoms during or within 2 wk of time in affected country: Yes/No acute onset fever . . . Yes/No maculopapular rash . . . Yes/No arthralgia . . . Yes/No conjunctivitis . . . The patient was counseled that Zika virus is transmitted to a person primarily via mosquitoes. Zika can also be transmitted through unprotected sexual intercourse. For this reason, if her partner has recently been in an affected area, she should consider using condoms to reduce the risk of transmission. Infection is asymptomatic in the majority of people (80%). Symptomatic disease in the remainder is usually mild and transient. Zika virus infection in pregnant women, however, has been associated with birth defects (mainly microcephaly and intracranial calcifications) and perhaps fetal loss. It is not known what fraction of Zika virus infections in pregnancy lead to microcephaly and/or fetal loss. It is also not known how long after Zika virus exposure any change is seen in the fetus on ultrasound. All women with exposure to a Zika-affected area during their pregnancy should be followed with additional ultrasounds. We will do ultrasounds assessing growth with specific attention to the fetal head at 22, 28 and 34 weeks gestational age. This is coordinated with the antenatal testing unit.
Negative screen	The patient was screened for travel during pregnancy and has not traveled/has traveled to . . . which is not considered endemic to Zika. She was advised to avoid travel to Zika-affected areas during pregnancy and if she is going to travel, she should take precautions to avoid mosquito bites. Finally, she was counseled that it may be possible to acquire Zika through sexual transmission. Therefore, if her male partner has been to a Zika affected area recently, it is recommended she use condoms for the remainder of her pregnancy.

information technology team was asked to make verbal screening for travel or sexual Zika exposure risk an obligatory prenatal laboratory result; the provider had to indicate a negative or positive result in order for the visit to be closed in the EMR. This creative use of the EMR effectively ensured documentation of guideline adherence. This health center also successfully reproduced the hospital's model to centralize logistical management of the cohort of patients at risk for Zika infection by an NP. Ultimately, direct Zika PCR (Polymerase Chain Reaction) and IgM testing with the DPH was rolled out at this CHC, eliminating the step of testing through the central hospital and thereby improving accessibility for their patients. Figure 1 illustrates the key components of the model developed to institute near universal screening of Zika virus exposure.

Patients with recurring exposure risk

Despite verbalizing understanding of counseling to avoid Zika exposure, some patients inevitably had to travel during pregnancy. Many had partners who continued to go back and forth to Zika-endemic areas. In addition to recommendations regarding mosquito bite prevention during travel, written and graphic materials on risk reduction were provided from the CDC Web site and advised barrier protection to prevent sexual transmission of Zika virus from partners who had new travel exposure. Retesting was offered after return or in the third trimester in the case of continued sexual exposure. In addition, in the summer of 2016, the local state DPH assembled "Zika prevention kits" including bug repellent, mosquito nets, and incentive items such as a passport pouch and toiletry bag for dissemination to lower-resource patients embarking on necessary travel.

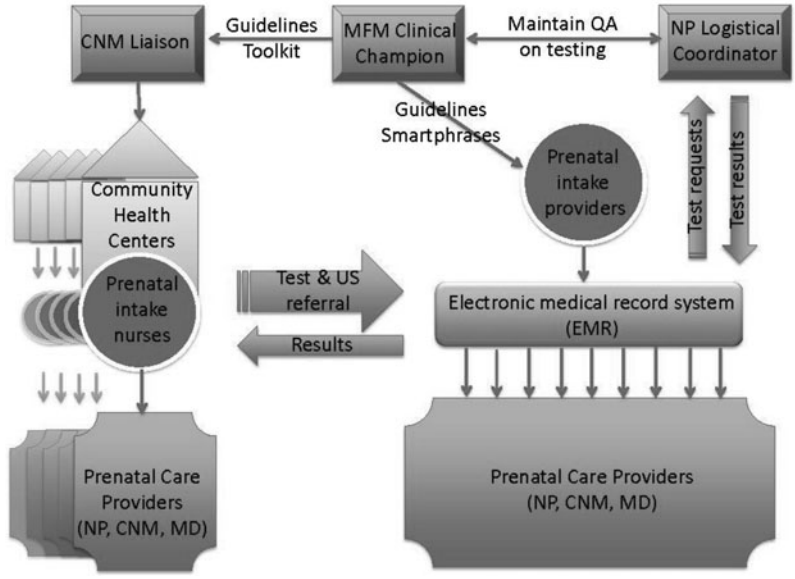

Figure 1. Model for Zika virus screening. CNM indicates certified nurse midwife; MD, medical doctor; MFM, maternal fetal medicine specialist; NP, nurse practitioner; QA, quality assurance; US, ultrasound.

Revisions of screening questions

While the CDC recommended asking pregnant women about "travel during pregnancy," this was not an effective screening question for the immigrant patients. Many individuals had not traveled recreationally but were living in areas affected by Zika and migrating to the United States midpregnancy. After much discussion and reflection, the question "have you spent any time outside the US during your pregnancy?" was adopted. This allowed us to capture women who had shifted geography during gestation.

PDSA cycle 2: Prenatal Zika screening rates

The preliminary evaluation prompted a second iteration of the PDSA cycle improving the screening process with a narrower range of providers, better electronic tools, and tailored language. This flexibility allowed changes to be adapted more quickly and earlier during the screening rollout and proved to be highly effective. Chart review was completed on 50 charts after 6 months to assess the adherence to recommended screening. The adherence rate, as noted in Figure 2, rose from 20% among patients delivering in March 2016 to 88% by the August 2016, approaching the target of 90%.

The greatest upward tick in the rate of screening occurred in May 2016 when hospital-based nurse practitioners and CNMs began to incorporate questions regarding time spent in a Zika-affected region into the flow of routine queries asked at the prenatal intake visit. This embedded the information into the problem list within the EMR and carried forward into future notes for both the assigned primary provider and the obstetric ultrasound unit.

Between February 2016 and February 2017, Zika exposure risk was identified in more than 300 pregnant patients. Among those eligible for serology testing, 12% ultimately tested positive. Furthermore, this institution, which delivers only 3% of the babies in Massachusetts, has identified more than 30% of the United States Pregnancy Zika Registry cases in Massachusetts.

DISCUSSION

Despite some formidable challenges, rapid implementation of universal screening in response to the global

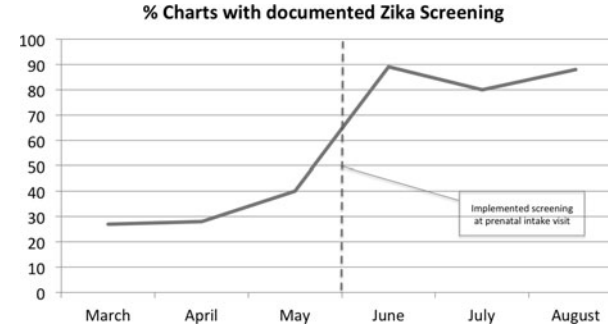

Figure 2. Results of chart review of first 6 months of 2016.

Zika virus epidemic was successful. This model required a flexible and multidisciplinary approach to match an evolving epidemic. The use of a dedicated testing nurse coordinator to manage and ensure quality control for all referrals and the establishment of consistent screening at the initial prenatal visit were 2 key components of the successful screening intervention.

Choice of language and context for counseling are essential to patient engagement in decisions around testing. A common apprehension in working with vulnerable populations is that multiple layers of vulnerability—in this case, low health literacy, pregnancy, as well as immigration status—can interact leading to miscommunication.[21,22] Shared decision making strives to find the balance between the available medical information about a topic and the patient's personal system of beliefs and attitudes.[23] This process has been shown to improve outcomes and treatment adherence.[24] In light of the continued lack of therapy for in utero Zika exposure, the decision to engage in prenatal screening should be a shared process between patient and provider. Minimal modification in the language of the initial screening question enhanced clinicians' ability to identify women at risk. However, further research is needed to understand the ideal language and modes of counseling to engage vulnerable, affected populations in prevention of and testing for Zika virus in the United States.

While the network of CHCs improves access of patients at risk for Zika exposure to prenatal care, the varied structure of leadership in women's health at 9 CHCs in relation to the tertiary care hospital presented some challenges to implementation of best practice. Often small, women's health departments may not have a designated director with authority and support to mandate a change in practice and documentation guidelines. Thus, practice changes may depend on motivation, time, resources, and organization of individual providers and staff, as well as the presence of a champion with sustained effort and access to performance data over time. In an informal survey of CHC providers, challenges included remembering to screen, frustration with not being able to order the laboratory test directly, communication to the main hospital, and lack of time to fully answer questions. These challenges were heightened by the transition to a new EMR system as previously described.

The greatest successes were at sites with a designated clinical leader in women's health who held authority over clinical practice, underscoring the importance of designated key personnel. When an individual assumed the role of the Zika point person, the burden of communication about testing was lifted off of the provider group and the anxiety over counseling about risk without educational support was allayed.

With an eye to this and future public health crises, the key elements were narrowing the focus of practice change to a few strategic staff, both in leadership and patient contact, as well maximizing use of the EMR through "smart phrases" and creative tools, as noted in Table 3. However, the initial system clearly benefited from early critical evaluation and change. In the midst of this new epidemic, rapid cycling of PDSA allowed us to identify roadblocks and capitalize on effective interventions without delaying initiation of screening ultimately leading the state in identifying Zika exposure in pregnancy.

Table 3. **Recommendations for implementation of universal screening of Zika virus exposure in pregnant patients**

- Identify clinician champion
  - Individual should represent organizational norms, beliefs, and mission
- Identify logistical coordinator
  - Maintain quality assurance in testing requests
  - Leverage this to broker simpler communication with state department of public health
- Narrow range of personnel who need to change practice in order to reach the largest number of people
  - Maximizes efficacy of intervention
- Tailor communication to target population
  - Use written and video education to overcome linguistic and literacy barriers
  - Consider impact of word selection in standardized screening questions
- Optimize use of electronic medical record
  - Share preset language that collects key information and embeds reference information for counseling
  - Update the problem list in mother's chart so that it functions as a communication tool to delivery pediatric teams and prompts appropriate evaluation of the neonate
  - Consider making verbal screening a hard-stop in the internal flow of the prenatal visit to ensure compliance

Finally, this public health emergency disproportionately affects a multilingual, multicultural, immigrant population. Sensitivity to literacy, health system distrust, and historical disempowerment has to be at the forefront of an approach to implement public health guidelines and effective clinical care.

CONCLUSION

The Zika epidemic continues to challenge hospital systems with its widespread impact on a large immigrant population. Early leadership of advanced practice nurses both as a designated logistical coordinator and in systematic change of the prenatal intake visit expedited effective transformation of care and facilitated successful and rapid practice change in a critical moment in time. Ongoing organization, commitment, research, and community engagement are needed to sustain and build on these early efforts, as the Zika virus epidemic winds on with uncertain consequences.

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The authors and planners have disclosed that they have no financial relationships related to this article.

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