OBSTETRICS

Infant outcomes among women with Zika virus infection during pregnancy: results of a large prenatal Zika screening program

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BACKGROUND: Zika virus infection during pregnancy is a known cause of congenital microcephaly and other neurologic morbidities.

OBJECTIVE: We present the results of a large-scale prenatal screening program in place at a single-center health care system since March 14, 2016. Our aims were to report the baseline prevalence of travel-associated Zika infection in our pregnant population, determine travel characteristics of women with evidence of Zika infection, and evaluate maternal and neonatal outcomes compared to women without evidence of Zika infection.

STUDY DESIGN: This is a prospective, observational study of prenatal Zika virus screening in our health care system. We screened all pregnant women for recent travel to a Zika-affected area, and the serum was tested for those considered at risk for infection. We compared maternal demographic and travel characteristics and perinatal outcomes among women with positive and negative Zika virus tests during pregnancy. Comprehensive neurologic evaluation was performed on all infants delivered of women with evidence of possible Zika virus infection during pregnancy. Head circumference percentiles by gestational age were compared for infants delivered of women with positive and negative Zika virus test results.

RESULTS: From March 14 through Oct. 1, 2016, a total of 14,161 pregnant women were screened for travel to a Zika-affected country. A total of 610 (4.3%) women reported travel, and test results were available in 547. Of these, evidence of possible Zika virus infection was found in 29 (5.3%). In our population, the prevalence of asymptomatic or symptomatic Zika virus infection among pregnant women was 2/1000. Women with evidence of Zika virus infection were more likely to have traveled from Central or South America (97% vs 12%, $P < .001$). There were 391 deliveries available for analysis. There was no significant difference in obstetric or neonatal morbidities among women with or without evidence of possible Zika virus infection. Additionally, there was no difference in mean head circumference of infants born to women with positive vs negative Zika virus testing. No microcephalic infants born to women with Zika infection were identified, although 1 infant with hydranencephaly was born to a woman with unconfirmed possible Zika disease. Long-term outcomes for infants exposed to maternal Zika infection during pregnancy are yet unknown.

CONCLUSION: Based on a large-scale prenatal Zika screening program in an area with a predominantly Hispanic population, we identified that 4% were at risk from reported travel with only 2/1000 infected. Women traveling from heavily affected areas were most at risk for infection. Neonatal head circumference percentiles among infants born to women with evidence of possible Zika virus infection during pregnancy were not reduced when compared to infants born to women without infection.

Key words: neonatal head circumference, population-based screening, pregnancy, travel history, Zika virus infection

Introduction

Zika virus has emerged in the last year as the first major teratogenic arbovirus responsible for an epidemic of congenital microcephaly in the Western Hemisphere.[1-4] Surveys of local Zika virus transmission in countries such as Brazil, Columbia, and Puerto Rico have provided estimates of cumulative incidences in the general population, as well as among pregnant women.[5-8] Attempts to quantify the number of Zika virus infections in both pregnant and nonpregnant women in an affected population, however, have been hampered by the apparent lack of clinical symptoms in approximately 80% of infections, and the inherent limitations of currently available diagnostic tests.[9] In February 2016, in an effort to increase detection of Zika virus infection in asymptomatic pregnant women, the Centers for Disease Control and Prevention (CDC) recommended testing all pregnant women who traveled to a Zika-affected area.[10] The ongoing effort to screen and counsel pregnant women was complicated by the fact that the epidemic continued to spread north throughout early 2016. In July 2016, local Zika virus transmission in the United States was determined in a cluster of confirmed cases in Miami-Dade County, Florida.[11] In November 2016, the CDC began to investigate the first suspected locally transmitted cases of Zika virus disease in Brownsville, TX.[12] With locally transmitted disease now reported in the United States, states with high travel volume such as California, Florida, New York, and Texas remain at continued risk for both travel-associated and locally transmitted Zika virus infections.

We now report our experience with a large-scale, prenatal Zika screening program in Dallas, TX. This epidemiologic study was intended to establish the baseline risk for travel-associated

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maternal Zika virus infection, to evaluate the travel characteristics of at-risk women with evidence of Zika infection, and to describe the outcomes among neonates exposed to maternal Zika virus infection in our predominantly Hispanic pregnant population.

Materials and Methods

This was a prospective, observational study of Zika virus screening in our health care system from March 14 through Oct. 1, 2016. Parkland Hospital serves the medically indigent women of Dallas County through an administratively and medically integrated public health care system. Pregnant women are routinely assigned to a Parkland neighborhood clinic for antenatal and postpartum care. Using an electronic health record–associated best practice alert (BPA) implemented at 11 different Parkland prenatal clinics, we screened all pregnant women receiving prenatal care for travel to an area with active Zika transmission. The BPA is an electronic reminder triggered within the medical record at the initiation of prenatal care, which prompted the provider to ask a series of 3 cascading questions. These questions referred to a list of areas considered to have local Zika transmission by the CDC, and the list was updated periodically to reflect the evolving epidemic.[13] At the time of this publication, no local transmission of Zika virus had been confirmed in the Dallas area.[13] For each woman reporting travel, a detailed travel history and review of compatible symptoms were recorded in the subsequent BPA questions.

Laboratory evaluation

Serum testing with the Food and Drug Administration–approved Zika IgM antibody capture enzyme-linked immunosorbent assay and/or real-time reverse transcription (rRT)-polymerase chain reaction (PCR) was performed for all women with positive travel screens who met extant CDC criteria. Laboratory testing was performed by the Dallas County Health and Human Services (DCHHS) and the CDC. Testing was based on the time interval between last exposure (ie, last date of travel) or symptom onset and the date of screening.[10,14] Serum IgM was performed by DCHHS for specimens collected >2 weeks after travel in asymptomatic and symptomatic pregnant women, up to 9 months after return from travel. Presumptive positive or equivocal serum IgM specimens were forwarded by DCHHS to the CDC for confirmatory plaque reduction neutralization (PRNT) testing.[15] Serum rRT-PCR for Zika virus RNA was performed by DCHHS on any specimen collected within 4 weeks of symptom onset or within 6 weeks of return from travel.[16] Serum screening alone was implemented at our institution prior to the development of CDC guidelines regarding urine testing.[17] In August 2016, following release of the interim guidance for urine testing and evaluation of pregnant women, we implemented rRT-PCR testing of subsequent urine specimens for pregnant women with presumptive positive or equivocal serum IgM.

Ultrasound evaluation

Detailed fetal anatomic survey was performed for all at-risk women, with assessment for specific findings such as intracranial calcifications, microcephaly, ventriculomegaly, abnormal corpus callosum, cortical abnormalities, and cerebellar hypoplasia.[18] Additional ultrasounds were performed for fetal growth assessment in women with either positive or unknown IgM results as recommended by the American Congress of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine.[19] Women with negative Zika virus IgM results received routine prenatal care. Women with presumptive positive or equivocal serum IgM results or with abnormal fetal ultrasound findings suggestive of intrauterine infection were referred to a dedicated maternal-fetal medicine clinic. The clinic is staffed by fellows and faculty from the University of Texas Southwestern Medical Center with expertise in infectious disease affecting pregnancy. When intrauterine infection was suspected, further evaluation was conducted, including amniocentesis when indicated. Women received comprehensive counseling regarding laboratory testing, ultrasound results, the need for evaluation at the time of delivery, and the plan for postnatal follow-up in this clinic.

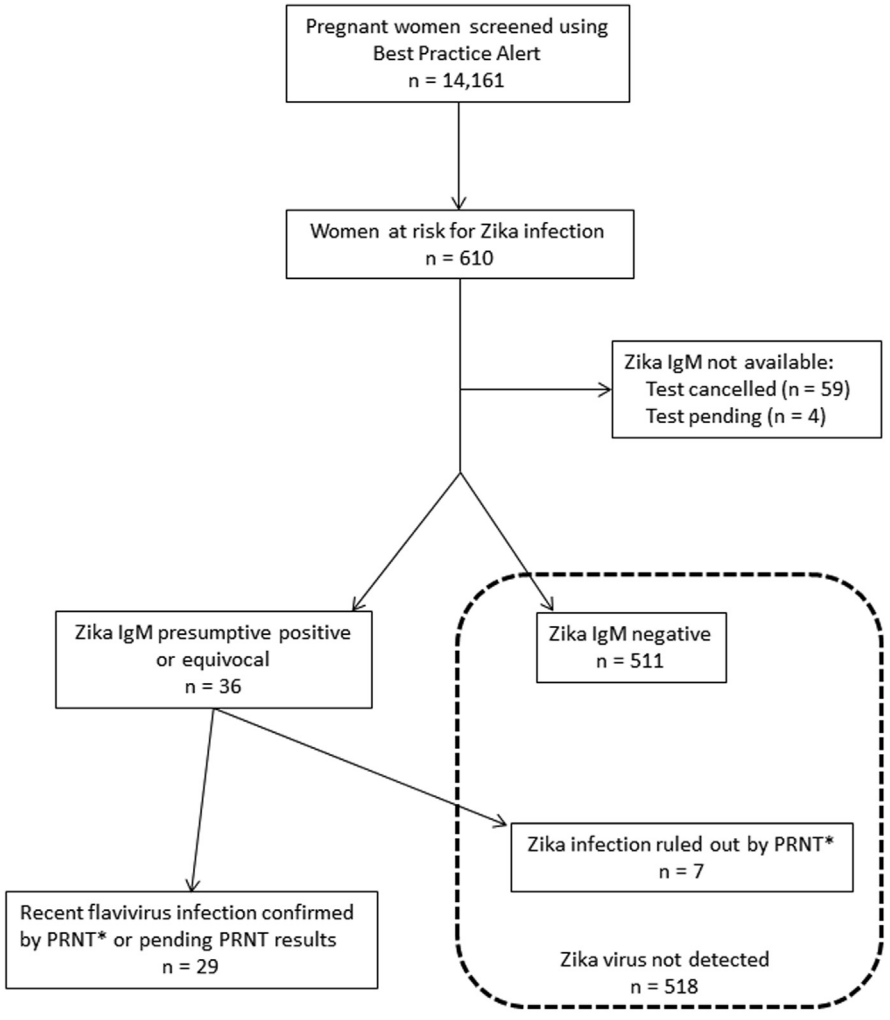
Infant evaluation

At the time of delivery, maternal and neonatal specimens were sent to the local health department for women with known or suspected recent Zika infection, and for those at risk for Zika infection without prior screening results. Placental and umbilical cord tissue samples were sent to CDC for rRT-PCR testing for Zika virus RNA.[10] Umbilical cord blood was routinely sampled at delivery until late July 2016, when the CDC guidelines for evaluation of infants at risk for congenital Zika infection changed to recommend infant serum collected within the first 2 days after birth.[20,21]

The scope of neonatal evaluation evolved during the study period. Initially, the CDC recommended testing only infants born with microcephaly or intracranial calcifications, or those born to mothers with positive or inconclusive Zika testing results. For these infants, PCR and serologic testing of umbilical cord blood or infant serum collected within 2 days of birth was recommended.[22] Routine care was recommended for infants with normal prenatal imaging and postnatal physical examinations born to at-risk mothers for whom Zika virus testing was not performed.[21] In July 2016, Zika testing on umbilical cord blood was no longer recommended by the CDC.[10] This change was implemented in our hospital the same month. In August 2016, CDC recommended that for infants with normal prenatal imaging and postnatal physical examinations born to at-risk women not previously tested, evaluation should begin with maternal Zika testing, with subsequent infant testing if maternal results were positive or indeterminate.[20]

Comprehensive physical exam and standard newborn hearing screen

FIGURE 1
Flow diagram of prenatal Zika screening at Parkland Hospital



*PRNT = Plaque reduction neutralization test

Flow diagram of pregnant women screened for Zika virus infection at Parkland Hospital from March 14 through Oct. 1, 2016.

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using auditory brainstem response testing were routinely performed on all infants soon after birth regardless of Zika results. Head circumference and gestational age-specific head circumference percentile for each infant was assessed using the gender-specific growth curves developed and validated by Olsen et al[23] and currently in use at Parkland Hospital. Microcephaly was defined as head circumference <3rd percentile for gestational age.

Additional neonatal evaluation for possible congenital Zika virus infection was performed on a case-by-case basis according to evolving CDC guidelines, including urine testing, head ultrasound, and complete ophthalmologic assessment.[20] For infants with abnormal findings, evaluation was conducted for other intrauterine infections, such as cytomegalovirus (CMV), toxoplasmosis, syphilis, or rubella virus, as appropriate.

Beginning September 2016, infants born to women with evidence of Zika virus infection during pregnancy were assigned to follow-up after delivery with both a pediatric infectious disease specialist at Children's Medical Center Dallas, and a pediatric primary care provider. Developmental testing and infant follow-up was planned for these infants according to CDC guidelines.[20]

Delivery outcomes and statistical analysis

Demographics and perinatal outcomes of delivered women were linked to an existing obstetric database. The database contained maternal and infant outcomes for all women delivered at Parkland Hospital. Categorical and continuous variables were compared among women with positive and negative Zika results using χ^2 and Student t tests, respectively, and $P < .05$ was considered significant for all analyses. Statistical analysis was performed using software (SAS 9.3; SAS Institute Inc, Cary, NC). This study was approved by the institutional review board of the University of Texas Southwestern Medical Center.

Results

Between March 14 and Oct. 1, 2016, a total of 14,161 pregnant women were screened with the BPA (Figure 1). A total of 610 (4.3%) women reported travel to a Zika-affected country and were screened with serum testing. Of these, the majority (510 [84%]) of at-risk women were identified through the prenatal clinic BPA. An additional 100 (16%) women, including those not enrolled in prenatal care or those who traveled subsequent to initial screening, were identified through direct questioning on the labor and delivery or maternal inpatient units. Of the 610 Zika tests performed, 59 (10%) were not completed due to inconsistent travel history or extant CDC guidelines. Four (0.7%) serum tests were pending at the time of submission and were excluded from the analysis. Of the 547 women with resulted Zika tests, 511 (93%) had negative Zika virus IgM results, and 36 (7%) had preliminary

TABLE 1
Demographic characteristics of travel-positive women at risk for Zika infection

Characteristic	Probable Zika infection n = 29	Negative for Zika infection n = 518	*P* value
Age, y	25.9 ± 7	26.3 ± 6	.73
Race			.79
Hispanic	29 (100)	500 (96)	
African American	0 (0)	5 (1)	
Non-Hispanic white	0 (0)	5 (1)	
Unknown	0 (0)	8 (2)	

Data presented as n (%) or mean (SD) as appropriate.

PRNT, plaque reduction neutralization.

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evidence of possible Zika virus infection. Subsequently, Zika infection was excluded in 7 women with confirmatory PRNT testing performed at the CDC leaving a total of 29 women with evidence of possible Zika virus infection during pregnancy (Figure 1). Of these 29 women, only 5 reported symptoms of Zika virus disease whereas 24 (83%) were asymptomatic, which is consistent with previously published studies.[9] Symptoms reported among our 5 pregnant patients included: rash (4/5), fever (2/5), conjunctivitis (2/5), and arthralgia (2/5).

Demographic and travel characteristics

Selected demographic characteristics of women screened during the study period are presented in Table 1 according to Zika testing results. There were no significant differences in age or race among women with positive or negative Zika virus testing. Travel characteristics of women screened at our hospital during the study period are presented in Table 2. Women with evidence of Zika virus infection were more likely to have traveled from Central or South America compared to women with negative Zika testing (97% vs 12%, $P < .001$). Specifically, of the women with evidence of possible Zika infection, 16 (55%) traveled to El Salvador, 7 (24%) to Honduras, 3 (10%) to Guatemala, and 2 (7%) to Venezuela, compared with 1 (3%) who traveled to Mexico. There was no significant difference in the time interval between last exposure or symptom onset and screening among women with positive or negative Zika tests. Detailed exposure characteristics and case definitions of women with evidence of possible Zika infection are presented in detail in Table 3, classified according to the definitions adopted by the Council of State and Territorial Epidemiologists.[24] Among these women, 5 (17%) were exposed or had symptoms in the first trimester, 13 (45%) in the second trimester, and 11 (38%) in the third trimester.

TABLE 2
Travel characteristics of women at risk for Zika virus infection

Travel characteristic, n (%)	Probable Zika infection n = 29	Negative for Zika infection n = 518	*P* value
Country of travel			<.001
El Salvador	16 (55)	29 (6)	
Honduras	7 (24)	21 (4)	
Guatemala	3 (10)	4 (1)	
Venezuela	2 (7)	8 (2)	
Puerto Rico	0	3 (1)	
Mexico	1 (3)	436 (84)	
Other	0	17 (3)	
Interval between last exposure or symptom onset and screening			.55
<7 d	0	15 (3)	
7–14 d	2 (7)	51 (10)	
≥15 d	27 (93)	452 (87)	

PRNT, plaque reduction neutralization.

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Perinatal outcomes

Of the 610 pregnant women tested for Zika during the study period, 447 deliveries were recorded; perinatal outcomes were available for 391 deliveries. These included 28 deliveries among women with evidence of possible Zika infection and 306 deliveries among women with negative Zika testing. Selected perinatal outcomes for at-risk women who delivered are presented in Table 4. There was no significant difference in gestational age at birth, birthweight, stillbirth, major malformation, chorioamnionitis, abruption, or preeclampsia among women with positive or negative Zika virus testing. In addition, there was no significant difference in umbilical cord blood pH, 5-minute Apgar score, neonatal seizures, culture-proven sepsis, mechanical ventilation, or neonatal death among women with positive or negative Zika virus testing.

TABLE 3
Exposure characteristics of women with laboratory evidence of possible Zika infection during pregnancy

Case	Country of travel	EGA at arrival to US, wk	Days from arrival to screening	Symptoms	EGA of symptoms, wk	Days from symptom onset to screening	CDC Zika infection case classification
1	El Salvador	5	138	No			Probable infection[a]
2	El Salvador	7	39	No			Probable infection
3	El Salvador	8	126	No			Probable infection
4	El Salvador	15	68	No			Probable infection
5	El Salvador	17	66	No			Probable infection
6	El Salvador	17	26	No			Probable infection
7	El Salvador	17	83	Yes	6	166	Probable disease
8	El Salvador	18	83	No			Probable infection
9	El Salvador	19	40	No			Probable infection
10	El Salvador	19	14	No			Probable infection
11	El Salvador	23	14	No			Probable infection
12	El Salvador	28	18	No			Confirmed infection
13	El Salvador	30	26	No			Probable infection
14	El Salvador	32	24	Yes	31	32	Probable disease
15	El Salvador	34	30	No			Probable infection
16	El Salvador	34	29	Yes	23	99	Probable disease
17	Honduras	23	59	Yes	2	204	Probable disease[b]
18	Honduras	25	17	No			Probable infection
19	Honduras	29	31	No			Probable infection
20	Honduras	32	21	Yes	28	24	Probable disease
21	Honduras	34	31	No			Probable infection
22	Honduras	34	16	No			Probable infection
23	Honduras	36	30	No			TBD
24	Guatemala	25	80	No			TBD
25	Guatemala	29	31	No			Probable infection
26	Guatemala	35	23	No			Probable infection
27	Venezuela	23	61	No			Probable infection
28	Venezuela	24	47	No			Confirmed infection
29	Mexico	21	78	No			Probable infection

Zika case classification according to Council of State and Territorial Epidemiologists and CDC.

CDC, Centers for Disease Control and Prevention; *EGA*, estimated gestational age in completed weeks; *TBD*, to be decided pending final plaque reduction neutralization results.

[a] Undelivered at time of analysis; [b] Fetal brain anomaly diagnosed.

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There were 57 deliveries among women whose Zika tests were not completed due to extant CDC guidelines; these were analyzed separately and we found no difference in perinatal outcomes.

Of the 28 infants born to women with evidence of Zika virus infection, 17 (61%) were evaluated after delivery with serum and urine Zika testing based on extant CDC guidelines. We identified 1 infant with lethal brain anomaly (hydranencephaly) and normal head circumference born to a woman with symptoms of Zika disease near the time of conception (case 17 in Table 3). Amniocentesis was performed and was negative for Zika, CMV, and toxoplasma. At delivery, placenta and umbilical cord samples were sent to the CDC for testing and results are pending. Serum and urine samples

TABLE 4
Perinatal outcomes of delivered women at risk for Zika virus infection during pregnancy

Outcome	Probable Zika infection n = 28	Negative for Zika infection n = 306	*P* value
Gestational age at delivery, wk	38.8 ± 1.7	38.8 ± 1.8	.99
Gestational age <37 wk	2 (7)	13 (4)	.48
Birthweight, g	3173 ± 446	3291 ± 514	.24
Birthweight <2500 g	2 (7)	16 (5)	.67
Stillbirth	0 (0)	1 (0)	.76
Major malformation	1 (4)	8 (3)	.76
Chorioamnionitis	5 (19)	36 (12)	.35
Abruption	0 (0)	4 (1)	.54
Preeclampsia with severe features	4 (15)	22 (7)	.18
5-min Apgar score <4	0 (0)	2 (1)	.67
pH <7.0 at birth	0 (0)	3 (1)	.60
Neonatal seizures	0 (0)	4 (1)	.54
Neonatal sepsis	0 (0)	2 (1)	.67
Mechanical ventilation <24 h of birth	0 (0)	3 (1)	.60
Neonatal death	0 (0)	0 (0)	NA

Data presented as n (%) or mean ± SD as appropriate.

PRNT, plaque reduction neutralization.

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from the infant were negative for Zika IgM and Zika RNA. The infant was discharged to comfort care and remains at home with the family. A second infant born to a mother who had symptomatic Zika virus disease at 6 weeks' gestation was found to have serologic evidence of probable congenital flavivirus infection based on PRNT testing. This infant had a normal head ultrasound at birth, and has had normal development documented through age 4 months of life. In a third infant, Zika virus exposure was confirmed by detection of Zika RNA in placenta and umbilical cord specimens at delivery; this infant had a normal neurologic evaluation after birth and was lost to follow-up soon after discharge.

Head ultrasounds were performed on 22 (79%) Zika-exposed infants with normal or unavailable antenatal imaging. In 1 infant, a hyperechoic focus was identified on initial postnatal head ultrasound, but subsequent magnetic resonance imaging was without abnormality. In all other infants with normal prenatal ultrasounds, neonatal head ultrasound was unremarkable and failed to identify any signs of possible congenital Zika virus infection. Standard auditory brainstem response hearing screen was performed in all nonanomalous Zika virus–exposed infants, and all passed. Ten (38%) infants had dilated ophthalmologic exams and no significant abnormalities were detected.

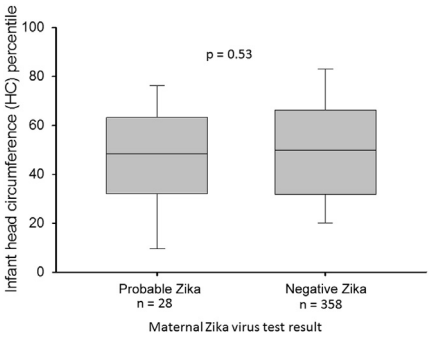
Head circumference percentiles

Head circumference measurements were available for 386 deliveries. Head circumference percentiles were compared among infants delivered to mothers with positive and negative Zika virus tests (Figure 2). There was no significant difference in the mean head circumference percentile among the groups ($P = .53$). Of the 28 neonates delivered of women with evidence of Zika virus infection, none were diagnosed with microcephaly. Among the 306 infants delivered of women with negative Zika virus testing, 4 (1.3%) were identified with head circumference <3rd percentile for gestational age according to the growth curve of Olsen et al.[23] In examining these cases in detail, 2 neonates were noted to be symmetrically small for gestational age at birth with concordant measurements of head circumference, length, and weight; CMV testing of these neonates was negative. The third neonate with microcephaly was diagnosed with Trisomy 21, and the fourth neonate had a confirmed diagnosis of congenital CMV prior to birth. Thus, no women with confirmed, probable, or suspected Zika virus infection delivered neonates with head circumference abnormalities; long-term outcomes for these infants is yet unknown. One infant with hydranencephaly and normal head circumference was born to a woman with probable Zika virus disease; however, we currently have no evidence confirming congenital Zika virus infection in this case.

Comment

In this report, we describe the results of a large-scale, hospital-based Zika virus screening program for pregnant women in a state with high travel volume from Zika-affected areas. First, we determined that 4.3% of pregnant women screened were at risk for travel-associated Zika infection, and only 2/1000 of the screened cohort had evidence of possible Zika infection. Second, we confirmed that most women with evidence of possible Zika infection during pregnancy were asymptomatic (83%), and found they were more likely to have traveled from Central or South America rather than Mexico. Lastly, we found no difference in neonatal morbidity among Zika virus-exposed infants compared to Zika-unexposed infants—specifically no differences in neonatal head circumferences were noted, although 1 lethal brain anomaly was identified that has not been confirmed to be due to congenital Zika virus infection.

FIGURE 2
Infant head circumference percentiles



Infant head circumference percentiles according to maternal Zika virus testing result. Data are shown as median (quartile 1, quartile 3).

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Our findings of women with evidence of Zika infection during pregnancy are important adjuncts to the September 2016 CDC report describing travel-associated cases and add to the growing literature for this disease. In the recent CDC report, travel-associated Zika virus cases in the United States originated primarily from the Caribbean, whereas we now report that the majority of Zika-infected women in our Texas population traveled from either Central or South America.[25] We believe our first 2 findings are related in that the frequency of infection is, in part, a reflection of the relative origin of travelers to Texas compared to other states with higher travel volumes from Zika-affected areas. For example, most travelers to Texas originated in Northern Mexico and traveled by land, while those originating from the Caribbean islands were more likely to travel by air or sea to states such as Florida and New York; these states have relatively higher numbers of travel-associated Zika infections.[26] For the same reason, we did not screen for travel to elevations <2000 m above sea level, due to the impracticality in a large screening process where most of our patients travel by land to arrive in Texas. In 2016, Zika virus outbreaks described in Mexico were primarily localized to the Southern half of the country, thus travel history within specific regions of Mexico may be an important addition to our Zika screening in the future.[27] In our cohort, a majority of women with suspected Zika infection traveled from South Central or South America. No serious neonatal morbidity or altered neonatal head measurements have been identified as definitively caused by congenital Zika virus infection, however, long-term follow-up is critical to further elucidate what risks, if any, exist in this group of infants. We emphasize caution in making conclusions regarding fetal brain abnormalities without definitive evidence of congenital Zika virus infection.

There are limitations to our approach. In implementing a serum-only-based screening protocol, we may have been limited in our ability to confirm acute Zika virus infection during pregnancy. In May 2016, the CDC released interim guidelines for Zika virus testing to include urine specimens based on evidence that Zika virus RNA may be detectable for at least 2 weeks after onset of symptoms.[28,29] To evaluate the potential utility of adding urine specimens to our screening protocol, we evaluated the time frame from symptom onset or last exposure to screening date in all women tested. The window in which urine screening might be useful is between 7-14 days—after Zika virus RNA is no longer detected in serum but before development of antibodies to Zika virus. Among women with negative Zika IgM, 51 (10%) were screened within this window; these represent potential acute Zika virus infections that we may have missed. The prevalence of Zika virus infection in our population in 2016 was low, and we conclude that the addition of urine screening would have identified fewer confirmed Zika cases than would have been possible in a region with high Zika prevalence. If the prevalence of infection increases, the predictive value of adding urine screening should be considered, as rRT-PCR would add certainty in diagnosis and add precision in ascertainment of infant abnormalities caused by maternal Zika infection. Finally, our screening protocol is based on travel reported by the patient at the first prenatal visit. Failure to report subsequent travel could result in failure to send appropriate serum testing for Zika virus. Although we provided written information on Zika virus with appropriate travel warnings as recommended by the CDC, a woman who traveled after receiving the travel warnings would not have been rescreened unless she informed her health care provider. Likewise, women exposed only through sexual intercourse were not screened unless they notified the health care provider. The written information provided at the initial prenatal encounter included potential modes of transmission and recommendations to avoid sexual contact with a partner who had traveled to a Zika-affected area. Women who reported sexual contact with a partner who had traveled were screened appropriately. In our cohort, 2 women reported exposure through sexual contact with a partner who had traveled; these women were screened for Zika and both tested negative. As the epidemic evolves in the coming year, we expect to revisit additional screening modalities on a large scale.

This report describes a large, hospital-based prenatal screening program for travel-associated Zika virus infection during pregnancy in the United States. Knowledge of the baseline prevalence of symptomatic and asymptomatic Zika virus infection in pregnant travelers and the travel characteristics of at-risk women will be important as the global epidemic worsens. Success of our program required a coordinated, multidisciplinary effort among obstetricians, pediatricians, laboratory staff, and the DCHHS to ensure success in the complex, multistep screening process. We emphasize the importance of communication and team-based strategies across multiple health care systems as we strive to understand and prevent Zika virus infection in pregnant women in the future. At this time, elimination of Zika virus transmission still rests on prevention techniques, such as avoidance of travel, mosquito eradication, and avoidance of sexual intercourse among couples at risk. In states with high travel volume such as Texas, a systematic prenatal screening approach may improve

future detection of local Zika virus transmission. We look forward to future studies of screening, treatment, and prevention of this poorly understood but potentially devastating disease. ■

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