Zika Virus Pandemic: Vector Control

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ABSTRACT

Objective: The objective is to understand the progression of the volatile pandemic of Zika virus occurring around Central America, South America, North America, Central Africa, Southeast Asia and the Caribbean and to communicate guidelines aimed at potentially infected individuals and health care providers for the support and care of individuals potentially infected with Zika virus. The negative health impacts of Zika virus affect both adults and infants therefore methods to remain safe during outbreaks should be implemented to prevent severe brain abnormalities and diminished function.

Materials and Methods: A literature review was used to reevaluate data from nine well-cited articles on the impact of Zika virus, followed by an analysis of the Zika virus and its epidemiologic features, clinical management, laboratory testing, prevention and treatment to support providers in the assessment and diagnosis of individuals potentially carrying Zika virus.

Results: The published literature demonstrates how Zika virus developed into a worldwide pandemic in the span of a single year following the 2015 outbreak in Brazil. Health care practitioners and organizations must work together in outbreak prevention, vaccine discovery and treatment of individuals throughout outbreaks of Zika virus. The biological difficulties in diagnosing and treating Zika virus necessitate the implementation of suitable risk communication procedures. Zika virus pandemic response plans for populations were not sufficient, and national policies must characterize access to services and treatment.

Conclusion: Health impairments and impacts associated with the Zika virus infection, including brain abnormalities, neural tube defects and eye disease are not entirely understood and may be better understood through sustained research, as Zika virus remains a long-term issue. The magnitude of risk of the Zika virus on public health is unknown, and pregnancy outcomes and evaluation of vaccines and therapeutics support the importance of screening and prevention measures.

KEY WORDS: Zika virus, infants, healthcare providers, long-term, risk communication

INTRODUCTION

The arthropod-borne virus (arbovirus) Zika is a single-stranded positive RNA virus (10,794-nt genome).[1] The Zika virus is dispersed by the bite of an infected Aedes species mosquito (*Ae. aegypti, Ae. albopictus, Ae. africanus, Ae. luteocephalus, and Ae. hensilli*). Zika virus is of the genus flavivirus and family Flaviviridae, related to the flaviviruses of the West Nile virus, yellow fever and dengue virus.[8]

Zika virus was discovered in Uganda in 1947 by means of a mosquito and primate investigation of Zika transmission that was limited to areas throughout Asia and Africa.[3] Zika virus was first reported in humans in 1952.[3] Zika virus is spread by mosquitoes, mother-to-child transmission, blood transfusions and sexual intercourse, initiating slight sickness with maculopapular rash, blindness, muscle pain (myalgia), joint pain (arthralgia), fever and pink eye (conjunctivitis). Symptomatic individuals generally present with mild symptoms lasting from a few days to a week. Approximately 80% of carriers remain asymptomatic.[4]

All age groups are vulnerable to infection with Zika virus. Zika virus has been discovered in numerous body fluids such as semen, saliva, blood, placenta, fetal tissue, cerebrospinal fluid, serum samples and amniotic fluid, demonstrating the risk of both sexual and mother-to-child transmission. Zika virus has the capability of crossing the placental barrier as well as the blood brain barrier (BBB), causing birth defects if the virus is transmitted from a pregnant woman to her fetus.[7] Zika virus infection at any trimester of pregnancy presents risk to the fetus. The virus can have long-term health consequences. Following a Zika infection, infants who are born appearing normal and healthy may develop abnormally small heads—a condition called microcephaly—and develop further brain damage after a few months. Microcephaly results in damage and shrinking of the brains of developing fetuses, causing the skull to either collapse or develop gradually. Zika virus causes additional destruction to the brains and bodies of infants, such as severe reflux, epilepsy, difficulty feeding and stiffened limbs (hypertonia). Ultrasonographies conducted during gestation have also revealed microcephaly along with calcifications in the fetal brain and placenta.[6] Fetal tissue, cerebrospinal fluid and serum samples, as well as placenta and amniotic fluid of infected mothers, have been found to be Zika virus-positive.[10]

Zika virus is associated with neurological conditions such as Guillain-Barré syndrome, a disorder causing rare, temporary paralysis in adults that causes the immune system to attack nerves of the peripheral nervous system. According to the World Health Organization (WHO), Guillain-Barré syndrome affects one in every 100,000 individuals and may be fatal. Mosquitoes pose disease hazards, such as in Zika virus, and cause psychological stress and mental health issues in virus outbreaks.

BACKGROUND

The Centers for Disease Control and Prevention (CDC) has reported over 4,200 cases of Zika in the United States alone, primarily carried by travelers. Following the arrival of Zika virus in Brazil in 2015, it promptly spread throughout the Americas.[9] By the end of 2015, roughly 440,000 to 1.3 million cases of Zika infection had been recorded around Brazil.5 Upon analysis of locations where Zika virus may have dispersed via individuals infected through the Brazilian outbreak, it was discovered that 9.9 million travelers departing from Brazil were traveling to the most popular destinations of North and South America, of which the United States was the most popular.[2] The virus gradually spread via mosquitoes throughout regions where 60 percent of US the population (about 200 million) reside during warmer months. According to WHO, 69 countries and territories reported cases of vector-borne Zika virus transmission as of 2015. By February 29, 2016, birth defects related to Zika virus have been observed in 31 countries, with more than 2,100 cases of nervous system malformations in Brazil alone.[5] Following the extensive Zika virus epidemic in the United States, as well as the rise in the number of cases of microcephaly and other neurological disorders such as Guillain-Barré syndrome, WHO announced Zika virus a public health emergency of international concern on February 1, 2016.

Currently, WHO defines Zika virus as a considerable and persistent public health threat but no longer an emergency. On November 18, 2016, the United Nations health agency rescinded a nine-month state of emergency and arranged for long-term response efforts to mosquito-borne Zika virus. WHO reports that emergency procedures have led the world into a vital and organized response, yet the virus continues to spread. The CDC worked in slowing the spread of Zika virus, discovering and reporting cases, educating healthcare providers to recognize the virus, testing samples, providing laboratories with diagnostic tests, public education and offering travel advisories to areas at risk for Zika transmission. The WHO Emergency Committee believes that Zika virus and related complications remain a significant, enduring public health challenge requiring intense action but no longer represent a Public Health Emergency of International Concern (PHEIC), as defined under the International Health Regulations (IHR). More than 60 global and local partners are aiding in controlling and preventing the spread of Zika virus and offering public education. The WHO reports that numerous factors of Zika virus and correlated outcomes are not yet understood, and further research is needed to properly comprehend its long-term effects.

The international public health response remains centered on preventing infection, specifically in pregnant women, and offering prompt recommendations to lower the risk of non-vector transmission of Zika virus. Cases of Zika virus will aid in creating a diagnosis based on epidemiological features and clinical foundations as well as laboratory testing validation.[1] Additional research on the ecologic, etiologic and host contributors of virus regulation and emergence is necessary to combat the effects of arboviruses such as Zika virus around the world. Enhanced public health approaches are essential to maintain control and establish a vaccine for Zika virus. Providers of healthcare should work toward understanding Zika virus to effectively evaluate and manage children and adults with potential Zika virus infections. The National Institutes of Health (NIH), public partners and private sectors' continued research on Zika virus, innovative treatment methods and prevention procedures is critical. The CDC, the Council of State, and Territorial

Epidemiologists and other partners are supporting the continued surveillance on Zika virus to offer additional direction and provide approaches for assessing and reporting cases as well as to follow the results of pregnant women and infants infected with Zika virus.

The National Institute of Allergy and Infectious Diseases (NIAID) is aiding in the conduction of research to improve understanding of the effects of Zika virus, as well as developing progress diagnostic tests to promptly diagnose the virus and enhance effective therapeutics testing.[2] The NIH and NIAID researchers are creating vaccine contenders to aid in prevention of Zika virus infection in individuals. The CDC provides health care providers with provisional guidelines for facilitating diagnoses and mitigating the risk of local transmission in order to support individuals with potential Zika virus infection. The clinical characteristics of Zika virus infection may be similar to common pediatric illnesses and thus may be difficult to diagnose in infants and children. Furthermore, healthcare providers for patients with potential sexual exposure to Zika virus must follow the CDC's interim guidelines, which require that all pregnant women be asked about possible exposure before and during pregnancy, and tested for symptoms of Zika virus.

BEHAVIOR AND EVALUATION PLAN

Presently there is no particular antiviral treatment or vaccine against Zika virus infections. The creation and administration of a vaccine may be prohibitively expensive. In addition,the process of stockpiling of vaccine may be too gradual to prevent unexpected outbreaks of Zika virus.[3] Currently, accessible treatments center on treating symptoms rather than targeting the virus itself, and as of October 5, 2017, vaccines remain under development through phase two clinical trials by the NIH. Treatment of Zika virus is aided by a good support system and may consist of ample fluids, rest and symptomatic treatment, such as the utilization of antipyretics (reducing fever) and analgesics (relieving pain).

Zika virus testing is organized by local, regional and state health departments and is controlled by the CDC. Zika virus testing has been proven effective in preventing the further spread of Zika virus. Testing of Zika virus is executed in the United States by the CDC and state health department laboratories, which are increasing laboratory diagnostic testing to more areas. There were no commercially accessible and cleared diagnostic tests for Zika virus infection by the US Food and Drug Administration (FDA), until authorization of reverse transcription–polymerase chain reaction (RT-PCR) on May 13, 2016. Health care providers may utilize the new emergency use authorization (EUA), initiating the first commercially available diagnostic testing to improve health systems capabilities, prevent the spread of Zika virus infection and avoid long-term consequences such as severe neurological impairment.

Detection of Zika virus infection is guided through RT-PCR testing and must be implemented on serum specimens gathered during the first week of illness.[4] In the fetal brain tissue on RT-PCR assay, Zika virus was discovered reliably through electron microscopy. Testing of anti-Zika virus immunoglobulin M (IgM) and neutralizing antibody must be performed on specimens gathered four days or later following the initiation of illness and endured at a minimum of 12 weeks.[2] Yet, serologic assays may be positive due to cross-reacting antibodies counter to associated flaviviruses, such as dengue and yellow fever. Virus-specific cross-neutralization testing may be used to distinguish amongst cross-reacting antibodies in chief flavivirus infections. Neutralizing antibodies may generate cross-reactive outcomes in individuals formerly infected or vaccinated against a related flavivirus. Thus, following positive IgM results, plaque reduction neutralization tests (PRNT) should be conducted to differentiate an infection of Zika virus in particular from other flaviviruses.

Prevention of Zika virus may be possible by means of vigorous vector control of mosquitoes. This solution, however, may prove difficult due to logistics, expenses, opposition by the public, issues caused by inner city crowding and weak sanitation procedures. The chief method to counter the spread of Zika virus is education of individuals on prevention techniques through, for example, fact sheets published by the CDC, including tips on air-conditioning, house screens and elimination of household and yard debris. During disasters such as heavy rains and floods, large amounts of new mosquito breeding sites are created in standing water and debris. Disasters generate a rise in insect populations, which increases contact between humans and vector species. The Aedes genus of mosquitoes, which reside in and nearby human households, are difficult to eliminate and capable of reproducing in little water.[5] Prevention techniques of

Zika virus consist of disposing of water-holding canisters, which offer mosquito-breeding locations, that may frequently be unavailable to impoverished inhabitants of overcrowded urban settings where outbreaks affect the population most intensely.

Preventing Zika virus may be possible by avoiding areas of local transmission through mosquito bites and delaying travel to areas containing enduring virus transmission. Individuals must be educated on prevention procedures, such as dressing in long sleeves and pants, utilizing permethrin-treated clothing and gear, and using insect repellents when outdoors. The majority of Environmental Protection Agency (EPA)-registered repellents, such as N,N-diethyl-m-toluamide (DEET), may be applied to children older than two months. If utilized as directed on the product label, insect repellents such as DEET are safe for pregnant and lactating women.[4]

Knowledge regarding the spread and impact of Zika virus on population health necessitates collaboration between public health officials, clinicians and high-quality reference laboratories. Procedures for both the prevention and control of Zika virus should entail promotion of insect repellent usage and interventions to decrease the amount of possible mosquito vectors. Officials responsible for the public health surveillance of Zika virus should be alert to potential spread of the infection and remain aware of distinguishing diagnostic differences between Zika virus and dengue. Further investigation regarding the impact of Zika virus on the public health of populations, including infected pregnant women and newborns, should be studied as data on the health impact of infection are limited. Future studies will offer improved insight into the role of Zika virus infection in irregular brain development and indicators for detection.

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