Zika and Public Health: Understanding the Epidemiology and Information Environment

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Because Zika is a newly emerging infectious disease with little previous information known about it, there are many epidemiologic and clinical questions. The complexity of providing care to those who are at risk for infection or are already infected with Zika in this evidence-scarce environment cannot be understated. In this article, we provide an overview of the Zika virus (ZIKV) in the context of public health and pediatric health care. A broad public health focus is used to provide relevant information for addressing important questions about the epidemic and to facilitate communication with patients, parents, and caregivers within the current information environment. We explore issues regarding the epidemiology of the virus (including why ZIKV outbreaks are occurring), what has changed since the sporadic case reports before the outbreaks, why the true incidence is difficult to estimate, why attack rates vary by population and geography, and why the association between Zika and congenital Zika syndrome and Guillain-Barré syndrome have only come to light recently. Additionally, challenges related to the current information environment, traditional and informal information sources about the ZIKV, and examples of Zika public health communication campaigns are discussed. Importantly, we review the existing findings regarding the US population’s Zika-related knowledge, attitudes, beliefs, and behavior by highlighting variations and gaps. We conclude by identifying related research questions that remain critical.
In late 2015, reports of microcephaly and other birth defects in children of mothers with Zika virus (ZIKV) infection during pregnancy began to emerge in Brazil. On the basis of the suspected association among microcephaly cases and other neurologic disorders, in February 2016, Brazil declared a national public health emergency, and the World Health Organization declared the ZIKV outbreak a public health event of international concern in accordance with the International Health Regulations (2005). This rapid chain of events garnered widespread, international attention, and it soon became apparent that ZIKV was spreading throughout much of South and Central America and parts of the United States.

The scientific community quickly mobilized international collaborative efforts to understand the mechanisms of disease transfer, validate the causal link between infection and the full range of adverse health outcomes, and develop strategies to slow or eliminate disease transmission (eg, vaccine and diagnostic development, mosquito control, and public awareness campaigns). These efforts resulted in a remarkably rapid advance of knowledge. A brief PubMed search conducted at the end of February 2017 found <200 articles on some aspect of ZIKV published before 2016 compared with >2700 articles in the ensuing months.

The public health event of international concern designation ended in November 2016 because Zika was determined to be a long-term public health problem and required a corresponding response strategy. However, concern about its impact remains unabated, and there is an urgent need to understand the consequences for infants and families and develop effective treatments and diagnostics, vaccines, and vector-control strategies. In this article, we summarize Zika’s epidemiology, public health implications, communication considerations, the US population’s Zika-related knowledge, attitudes, and practices; we conclude by identifying related research questions.

Epidemiology

History of Zika Infection

Zika is considered an emerging disease because it is a known infectious disease that is spreading to new geographic areas and populations. ZIKV was first identified in 1947, when it was found in isolates collected from a rhesus macaque monkey; the following year, it was identified in isolates collected from a pool of *Aedes africanus* mosquitoes. Both occurred in the Zika Forest region of Uganda. There was documented evidence in 1952 that ZIKV could infect humans. Before 2007, only 14 cases of Zika-related illness (fever) were reported in humans, although it had been widely identified virologically and immunologically in Africa and Asia.

Alarmingly, in 2007, an outbreak of ZIKV affecting ∼5005 of the 6892 (73%) residents (based on a serologic study and modeling) in the state of Yap, Federated States of Micronesia, was reported. Subsequent human outbreaks occurred in French Polynesia and on other Pacific islands in 2013 and 2015. When Zika landed on continental shores in 2014, an explosion of cases occurred in Brazil and elsewhere in the Americas.

Why are Zika outbreaks occurring? What has changed since the sporadic case reports before the outbreak in Yap in 2007? These are good questions that are still not entirely resolved. One explanation is that the local transmission of ZIKV in rural areas of Africa involved forest-dwelling *Aedes* mosquitoes and a sylvatic transmission cycle between mosquitoes and nonhuman primates, with only occasional transmission occurring between mosquitoes and humans. The number of human cases remained small and localized. In the Yap 2007 and subsequent outbreaks, the primary mosquito vectors have been the suburban–urban dwelling *Aedes aegypti*, *Aedes albopictus*, *Aedes hensilli*, and *Aedes polynesiensis*. In the Americas, the primary vectors have been *A aegypti* and *A albopictus*, whose habitats have been expanding significantly in this region during the last 3 decades.

The effects of the 2015–2016 El Niño climate phenomenon may also have contributed to the explosive outbreak because the transmission risk at that time was at its highest since 1950; during El Niño, the temperatures favored high *A aegypti* and *A albopictus* biting rates, and lower mosquito mortality and extrinsic incubation periods. Another reason could be that the strain of ZIKV associated with the outbreaks in French Polynesia, the Pacific, and the Americas may be more virulent.

Prevalence and Risk Factors

As of February 2017, the penultimate World Health Organization Zika situation report indicated that people from 59 countries (48 of them in North and South America) have been reportedly infected with ZIKV, and new countries are continuously being identified. Importantly, our current understanding is that ∼20% of ZIKV-infected individuals show signs of illness. Nonetheless, this estimate is based on a retrospective study on Yap and has not been widely corroborated. Therefore, because of global variations in disease-reporting practices and the low number of infected individuals who are symptomatic, the true incidence of Zika infection is challenging to estimate.

There have been ∼3000 cases of Zika-related microcephaly or other central nervous system defects reported from 29 countries (as of...
February 2017); most of these cases (2366) were reported in Brazil. In the United States and District of Columbia, there have been 2143 completed pregnancies for women reported to have Zika infection during pregnancy as of December 19, 2017. Of these, 102 live-born infants had birth defects (as reported to the US Zika Pregnancy Registry), and 9 pregnancy losses had birth defects. The types of birth defects included in these numbers are those that are apparent around the time of birth with ZIKV infection and do not include those that might develop in the future because of ZIKV infection; they include “microcephaly, calcium deposits in the brain indicating possible brain damage, excess fluid in the brain cavities and surrounding the brain, absent or poorly formed brain structures, abnormal eye development, or other problems resulting from damage to [the] brain that affects nerves, muscles and bones, such as clubfoot or inflexible joints, and confirmed hearing loss.” Additionally, Guillain-Barré syndrome (GBS) has been associated with ZIKV infection and was first identified in French Polynesia when 42 patients developed GBS during the ZIKV outbreak. The reason that the ZIKV attack rate has been so high since the 2007 Yap outbreak is not yet understood. The Yap outbreak had a ZIKV attack rate (based on the number of people presenting with ZIKV to a health care facility) of 14.6 per 1000 residents (range of 3.6–21.5, depending on the municipality). Serological evidence combined with modeling showed that 75% of the population had been infected. For the corresponding household survey, 1 in 5 people were estimated to show clinical signs of illness. In the Yap outbreak, women were more likely to present to a health care facility, whereas the serologic survey showed that more men were infected. In Brazil, the 2015 documented attack rate was 4.4 in the northeastern state of Bahia, although in some cities, it was >25 per 1000 inhabitants. Serologic surveys done before the Yap outbreak indicated that the rate of infection in African populations was less than that seen in Yap and varied geographically. For example, studies in Uganda in 1953 indicated that 6.1% of the population had antibodies, and in Nigeria from 1971 to 1975, 38% of individuals had ZIKV antibodies. Because Zika is a flavivirus and cross-reacts with other flaviviruses, such as dengue fever, calculating the incidence of the infection is difficult. In the Americas, the transmission of both ZIKV and dengue fever have occurred simultaneously in the same locations.

Who is at risk for Zika infection and illness? Given our current understanding, most people in the world (ie, anyone without previous exposure to ZIKV) are susceptible to infection. Residents of areas with active local transmission of ZIKV from mosquitoes to humans are at an increased risk of infection, as are people with sexual partners who are infected. Aside from the Yap study, there is little known about why some people become ill from Zika whereas most people do not. Similarly, there is little understanding about the unique risk factors for developing GBS.

Why has the association between Zika and congenital Zika syndrome (CZS) and GBS only come to light recently? The newly recognized association of CZS and GBS is likely due to the higher attack rates in the outbreaks with high numbers of people infected. The number of cases seen before 2007 was so small that any adverse health effects may have gone undetected. Alternatively, there could be something unique about this strain of Zika that makes it more virulent.

**Routes of Transmission**

The known routes of transmission include being bitten by an infected mosquito, congenital infection, through sex from a ZIKV-infected person, through blood transfusion, and through laboratory and health care settings. Notably, this is the first time an arbovirus has been documented spreading through sexual contact, and it is the only arbovirus to be isolated from human semen. There have been reported cases of ZIKV infection through sex even when the ZIKV-infected person is not showing clinical signs or symptoms of illness. In humans, ZIKV has been isolated from blood, urine, semen, vaginal secretions, saliva, spinal fluid, amniotic fluid, and breast milk. Nevertheless, there are no reports of infants being infected through breastfeeding to date. ZIKV is most persistent in semen, followed by serum and urine. Studies with individual travelers indicate that ZIKV RNA has been found in semen 6 months after infection. However, our knowledge about transmission remains limited. There has been at least 1 case in the United States in which the route of transmission was not determined even after extensive investigation.

Multiple *Aedes* mosquito species are believed to be involved in the transmission of ZIKV to humans. ZIKV has been isolated from *A aegypti, A albopictus, A africanus, Aedes luteocephalus, Aedes furcifer,* and *Aedes vittatus.* The primary vector implicated in the Brazil epidemic is *A aegypti.* Two mosquito species can carry ZIKV in the United States. The Centers for Disease Control and Prevention (CDC) estimate that *A albopictus* can be present in 40 states and *A aegypti* in 26. Most of these states are in the southern swath of the United States and extend into the Northeast. The places with the most records of county-level collection of *A aegypti* are southern California, Arizona, Texas, Louisiana, and Florida; for *A albopictus*, they are in the Southeast, South Central, and Mid-Atlantic.
regions. Therefore, the potential for transmission is theoretically possible in many parts of the United States if an Aedes mosquito is present and bites a ZIKV-infected person and then bites a nonimmune person. This scenario is considered local transmission, and, to date, local transmission has occurred in Florida and Texas.

Clinical Signs and Symptoms of Zika Infection

Of those infected with ZIKV, ~20% have shown signs of illness, including fever, a maculopapular rash, arthralgia, and conjunctivitis. Diagnosing ZIKV can only be confirmed through laboratory tests on blood or other body fluids, such as urine or semen. A causal link has been established between in utero ZIKV infection and CZS. CZS reflects the spectrum of symptoms observed in affected infants. Early reports focused on findings of microcephaly. However, we now know that CZS has variable presentation, severity, and prognosis. A recent review concluded that CZS differs from other congenital infections because of 5 distinct features: (1) severe microcephaly with a partially collapsed skull, (2) thin cerebral cortices with subcortical calcifications, (3) macular scarring and focal pigmentary retinal mottling, (4) congenital contractures, and (5) marked early hypertonia and symptoms of extrapyramidal involvement.

Only a subset of infants who were exposed to prenatal Zika infection have obvious abnormalities at birth. Others have less obvious impairments that only become evident over time. ZIKV replication in infant brains can continue after birth. A recent study of 13 infants with prenatal Zika infection without microcephaly at birth showed that all had brain abnormalities consistent with CZS. Surprisingly, head growth decelerated after birth, and by 5 months of age, 11 had microcephaly. Moreover, a recent article reported ocular and neurologic findings in the absence of microcephaly in a 6-day-old infant.

GBS has also been associated with ZIKV infection. In French Polynesia, 42 patients developed GBS during the ZIKV outbreak. Most (88%) of the case patients developed neurologic symptoms a mean of 6 days after becoming infected. Of note, neurophysiological studies of these patients suggested acute motor axonal neuropathy rather than acute demyelinating inflammatory polyradiculoneuropathy.

Prevention

No vaccine against Zika currently exists. ZIKV infection can only be prevented by taking personal measures against sexual transmission and infection from mosquito bites and through efforts to prevent ZIKV-infected mosquitoes from thriving in the surrounding environment. In areas where local transmission of ZIKV is a risk, personal protection includes minimizing the risk of mosquito bites when in the community and at home. Covering the skin with clothing and, when that is not feasible, the use of mosquito repellent are advised. Other practical ways to minimize the risk of infection are to use window screens, sleep under a mosquito net, and eliminate standing water in and around the home, thereby removing mosquito breeding habitats. Additionally, local governments may have programs to reduce the mosquito population by spraying insecticide or larvicide over population centers and other communities. All sexually active people, including teenagers, should be counseled about the danger of ZIKV transmission through sexual contact. People should be aware of the risk of having sex with someone who lives in an area with ZIKV transmission or who has traveled to an area with local transmission. Current CDC guidelines are to use a condom for at least 6 months if a male sexual partner is at risk for having had ZIKV and at least 8 weeks if the female partner is at risk. Studies are underway that will better inform our understanding of sexual transmission.

Considerations for Traveling

In addition to known, sustained transmission in countries such as Brazil, the ZIKV outbreak is spreading to new countries. Updated information on countries with confirmed local ZIKV transmission can be found on the CDC Web site and the European Centre for Disease Prevention and Control Web site. If traveling to an area with local transmission, women of childbearing age, who are planning to get pregnant, or who are already pregnant should take extra precautions to prevent infection. When advising parents, it is important for them to understand that there is little known about long-term sequelae for young children who are infected with ZIKV postnatally. Postnatal infection is currently being studied, and 1 case series was described as having 158 confirmed or probable ZIKV infections in US children <18 years of age.

INFORMATION ENVIRONMENT

It is incumbent on pediatric health care providers to familiarize themselves with the evolving set of evidence-based information regarding ZIKV and implications for providing care. The intersection of ZIKV and its consequences with direct primary care cover the range of activities that characterize comprehensive approaches, including prevention and anticipatory guidance, acute care, chronic care, and community-level advocacy. A clear understanding of the existing knowledge, attitudes, beliefs, and behaviors in a population is essential.
Sources of Information

The amount of scientific information published on ZIKV has increased substantially over the last 3 years. This information has clarified a number of issues about the current epidemic and raised important questions for further investigation in the areas of diagnosis, epidemiology, neurologic consequences, vaccine development, and prevention strategies. In addition to the basic scientific literature, numerous formal sources of evidence-based information have emerged. Perhaps the most accessible publications are the Morbidity and Mortality Weekly Reports (MMWR) released by the CDC. These reports provide research-based updates regarding the status of the epidemic and relevant guidelines for direct-care providers and public health authorities. Topics covered in the MMWR include, for example, broad-based public health system response plans for addressing ZIKV, specific documentation of surveillance efforts on topics such as GBS as a result of ZIKV, guidelines for the prevention of the sexual transmission of ZIKV, and information on the public’s awareness, beliefs, and actions in relation to ZIKV in the US Virgin Islands. These sources of information are of substantial benefit to the scientific and professional health care community but likely have a limited direct impact on the general public.

To enhance the public’s direct knowledge of ZIKV-related information, the translation of these research findings for the popular audience can be done through organized and comprehensive community health campaigns or less-formal interactions with health care providers. For example, the CDC Foundation funded a campaign in Puerto Rico in mid-2016 to enhance the knowledge and influence the behavior of pregnant women regarding ZIKV. Formative research conducted during the design stages of the campaign unearthed important contextual factors that altered the campaign’s original focus on pregnant women to include the broader context of family and social support. In addition, campaign messages were crafted to address the influences of social media and barriers to receptivity that are caused by broad negativity toward the US government. The campaign was successfully implemented through multiple communication channels in the community, including health care clinics, as noted in a comprehensive process evaluation, but campaign outcome results remain pending.

In addition to formal sources of information, there are numerous informal sources that influence health knowledge, attitudes, and behavior. In the era of social media, Web-based platforms can have a significant impact on knowledge acquisition and behavior. Social media channels, such as Facebook, Twitter, Instagram, and YouTube, are frequently used to access information about ZIKV by the public, although the accuracy and reliability of this information vary considerably. To illustrate this, researchers in a recent study focused on ZIKV tracked Associated Press releases, Google searches, and Twitter posts in the United States, Guatemala, and Brazil over 60 days. They found that formal press releases likely influence users to seek further information online. The study result confirms the importance of taking a broad perspective on considering information channels when evaluating and attempting to influence existing knowledge and attitudes in health care settings. Moreover, broader implications exist beyond individual interactions in health care settings, and as noted in the example of the campaign in Puerto Rico, a broader view should also be considered when designing comprehensive, community-level communication campaigns. To further emphasize this issue, a recent study in which researchers evaluated Twitter posts in early 2016 documented a significant rise in pseudoscientific claims regarding the potential for a ZIKV vaccine. These claims may be fueling negative opinions that could be difficult to change when an effective vaccine does become available.

Public Knowledge, Attitudes, and Behaviors

Attempts have been made to broadly assess the public’s knowledge of and attitudes toward ZIKV. Three of the more methodologically rigorous studies provide important information about knowledge and attitudes among the US population.

A risk-perception study was conducted by New York University in which researchers surveyed 2464 individuals across multiple waves of data collection in mid-2016. A high level of general awareness (80%) was reported, although specific knowledge of aspects of ZIKV were variable. In addition, personal risk was perceived to be low (approximately one-third of the sample perceived low risk) as was the propensity to take personal preventive action and support more broad-based public health interventions, such as insecticide spraying. Support for public health interventions was strongly related to confidence in government and political ideology rather than risk perception.

To successfully implementing health care strategies and approaches with the highest potential for curbing this epidemic and its negative outcomes. Addressing public health care needs regarding ZIKV requires an understanding of the sources of information that are available to the public and the variables that influence people to acquire and act on this information.
An analysis of the results of multiple health tracking polls by the Kaiser Family Foundation provides additional information on US citizens’ knowledge.50 This random-digit–dialing survey poll is conducted periodically with ∼1200 respondents. Analyses of data from early to mid-2016 indicated that 92% of the population had at least some awareness of ZIKV, and 61% were following news about the virus regularly. Approximately two-thirds of the respondents were aware of US-based cases, and 59% of individuals were knowledgeable about the sexual transmission of the virus and the potential for microcephaly. A smaller percentage (13%) indicated that GBS was linked to ZIKV. Few individuals (2%) knew anyone personally who had been affected by ZIKV. Approximately half of the respondents indicated that cases in the United States were likely to increase during 2016 and 2017, but less than half indicated that the public health response had been adequate to combat the potential epidemic. Most reported that ZIKV was primarily a threat to pregnant women, and relatively low levels of personal prevention behaviors were reported. Responses varied by region; those living in the southern United States reported a greater adoption of preventive behaviors than respondents in other parts of the country. Despite the variability in risk perception and the self-reported low rates of adoption of prevention behaviors, most respondents supported more government funding for research, the use of vector control, and help for other countries that are addressing the epidemic.

A survey on ZIKV with 2379 US adults aged ≥18 years from a probability-based panel in August 2016 was conducted by the National Opinion Research Center for the March of Dimes.51 The study reported that 95% of the respondents had heard about ZIKV, and most were moderately concerned about the increasing rates of cases in the United States. Women who were pregnant or trying to get pregnant displayed the most concern. Most respondents were supportive of increased federal funding to control the spread of the virus. Less-than-optimal knowledge of the symptoms or effects linked to ZIKV was reported.

A portion of this survey was used to evaluate the respondents’ sources of information. Less trusted sources were the most frequently consulted for information, whereas more trusted sources were infrequently cited as sources of information. Television and radio were cited as the most frequent sources of information (85%), but a minority of respondents (39%) indicated that they trusted this information a great deal or more. Social media and blogs were the second-highest reported sources of information (26%), although few respondents (12%) trusted these sources a great deal or more. The CDC was used only by 16% as a resource for information, yet 75% indicated a great deal or more trust in this information source. Interestingly, only 3% had received information from their personal doctors, yet 67% indicated that they trusted this source a great deal or more. As would be suspected, changes in prevention behaviors were reported in response to ZIKV but at low levels.

Research conducted outside the United States has reported similar conclusions. General, overall awareness and knowledge about ZIKV is high, but specific information about signs and symptoms as well as preventive behaviors is variable and below the levels that are expected to drive health behavior change.52–54 In summary, public opinion surveys conducted with probability-based sampling indicate a high level of general knowledge and awareness of ZIKV and support for increased funding for government intervention. Specific knowledge of the effects and symptoms of infection is variable, although those who are pregnant or trying to become pregnant appear to be more knowledgeable. Although an increased level of personal preventive behavior was reported, it is unclear whether these behaviors are being practiced optimally to alter the path of the infection. Informal and less trusted sources of information are being relied on as knowledge sources, whereas more formal and trusted sources of information (including personal physicians) are much less likely to be accessed by the public.

UNANSWERED QUESTIONS AND FUTURE DIRECTIONS

Because Zika is a newly emerging infectious disease with little previous information known about it, the need for various types of epidemiologic research is great. To guide public health recommendations, much more needs to be elucidated about the virus, its transmission, risk factors, and prevention measures that work. We need to understand all the modes of transmission and how risk differs by mode. At least 1 person has been infected by an unidentified route.20 Why do the attack rates vary by population and geography? We need to understand the differences between the Asian and African ZIKV strains and their unique epidemiologies. We need information about how the endemicity of ZIKV in localities affects the risk of infection to tourists. Little is known about the risk factors associated with developing signs and symptoms after infection. Similarly, we need robust evidence about the percentage of individuals who are infected and develop the disease. Uncovering the breadth of signs and symptoms and long-term sequelae in children and adults is critical.

Currently, there is no ZIKV vaccine for prevention. Without an effective
vaccine, proven measures to reduce risk are urgently needed. Innovative methods have been proposed for Aedes vector control, such as the use of genetically modified mosquitoes, Wolbachia-infected mosquitoes, new insecticides and larvicides, and various, novel delivery methods for each. Nonetheless, the long-term effectiveness of these vector-control efforts in reducing disease is not known. The cost, scalability, sustainability, reproducibility, and societal acceptability of the innovative approaches have not yet been established.

Public opinion data indicate that adults generally possess a foundation of information that can be built on either through communication campaigns conducted in health care settings or direct discussion with health care personnel. Obtaining further knowledge on the specific details of the ZIKV infection and exposure to communication strategies that are designed to enhance the level of personal prevention behaviors are useful goals for interventions in primary health care settings. More specifically, greater focus must be placed on messages that are designed to enhance decision-making on avoiding travel to endemic areas for pregnant women, sexual transmission protection, the use of mosquito repellents and clothing, and other broader vector-control efforts not just for ZIKV but also for other vector-borne infectious diseases, such as dengue fever and the chikungunya virus. Within pediatric health care settings, these are messages that can easily be directed toward parents and/or caregivers and adolescents. The public appears to have a high degree of trust in personal physicians as sources of information on ZIKV, although studies show that physicians are not sought out frequently for such information.

To date, however, the public opinion data collected provide little information about topics of importance to communicate with children and adolescents. We do not have specific information on the baseline knowledge, risk perceptions, and level of prevention behaviors in these groups that would enable us to determine how to tailor health-communication approaches. Combined with incomplete information in the scientific literature, we cannot be certain about the most effective interventions to implement for these groups within pediatric primary care.

Answers to many important questions could assist in developing approaches to curbing the epidemic, and more targeted research is needed on a range of issues. For example, is the ZIKV infection in normally developing children and adolescents relatively harmless? What is the range of potential neurologic sequelae for children who are born to mothers who were infected with Zika but did not show signs of microcephaly and other significant neurologic birth defects? What is the level of awareness and knowledge among adolescents, especially in relation to Zika transmission and sexual risk behaviors? Should personal prevention behaviors be encouraged at the same level of diligence with children and adolescents as with adults? How might parenting approaches be modified to enhance the adoption of personal prevention behaviors by children and adolescents? Answers to these and other questions will be crucial to building the evidence base to drive new approaches within pediatric primary care to directly advise patients and successfully encourage prevention behaviors.

With successful personal prevention efforts, public health vector control, and vaccine development in the near future, the societal impact of the ZIKV outbreak will eventually be contained. However, the long-term impact of microcephaly and other central nervous system impairments will continue to affect thousands of children, adults, and their families. Continuing specialized care of these children will require substantial resources from multiple sectors in the health care community as well as ongoing support for families. These latter issues represent another kind of Zika public health emergency that will extend far into the future.

**ABBREVIATIONS**

CDC: U.S. Centers for Disease Control and Prevention
CZS: congenital Zika syndrome
GBS: Guillain-Barré syndrome
ZIKV: Zika virus

**REFERENCES**


2. Roos RP. Zika virus-a public health emergency of international concern. *JAMA Neurol.* 2016;73(12):1395–1398


7. World Health Organization. Emergencies. One year into the Zika outbreak: how an obscure disease became a global health emergency. Available at: www.who.int/emergencies/zika-virus/articles/


47. Southwell BG, Dolina S, Jimenez-Magdaleno K, Squiers LB, Kelly BJ. Zika virus-related news coverage and online behavior; United States, Guatemala, and Brazil. Emerg Infect Dis. 2016;22(7):1320–1321


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