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## World Hepatitis Day — July 28, 2016

World Hepatitis Day, recognized on July 28, was established by the World Health Organization (WHO) to raise awareness and promote understanding of viral hepatitis, the seventh leading cause of death worldwide (*1*). Together, hepatitis B and hepatitis C are responsible for most of the 1.4 million annual deaths attributed to viral hepatitis (*1*). In April 2016, the 69th World Health Assembly adopted a Global Viral Hepatitis Strategy that aims to eliminate hepatitis B and hepatitis C as public health threats by 2030 (*1*). The strategy includes prevention and treatment targets that, when met, will save millions of lives.

This issue of MMWR features a report revealing the growing risk for perinatal transmission of hepatitis C virus (HCV) in the United States, a risk most pronounced in areas where HCV incidence is increasing among young adults and women of childbearing age. Vaccination-based strategies are highly effective in preventing perinatal hepatitis B virus transmission (*2*). The report highlights that, in the absence of a vaccine for HCV, there is an immediate need to improve risk screening, scale up HCV testing among persons at risk, including children born to HCV-infected mothers, as recommended by CDC and the United States Preventive Services Task Force, and improve case reporting, particularly among women who are pregnant or planning pregnancy. Additional information and resources are available at http://www.cdc.gov/hepatitis.

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# Increased Hepatitis C Virus (HCV) Detection in Women of Childbearing Age and Potential Risk for Vertical Transmission — United States and Kentucky, 2011–2014

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Hepatitis C virus (HCV) infection is a leading cause of liver-related morbidity and mortality (*1*). Transmission of HCV is primarily via parenteral blood exposure, and HCV can be transmitted vertically from mother to child. Vertical transmission occurs in 5.8% (95% confidence interval = 4.2%–7.8%) of infants born to women who are infected only with HCV and in up to twice as many infants born to women who are also infected with human immunodeficiency virus (HIV) (*2*) or who have high HCV viral loads (*3*,*4*); there is currently no recommended intervention to prevent transmission of infection from mother to child (*3*). Increased reported incidence of HCV infection among persons aged ≤30 years (*5*,*6*) with similar

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increases among women and men in this age group (*6*), raises concern about increases in the number of pregnant women with HCV infection, and in the number of infants who could be exposed to HCV at birth. Data from one large commercial laboratory and birth certificate data were used to investigate trends in HCV detection among women of childbearing age,* HCV testing among children aged ≤2 years, and the proportions of infants born to HCV-infected women nationally and in Kentucky, the state with the highest incidence of acute HCV infection during 2011–2014 (*6*). During 2011–2014, commercial laboratory data indicated that national rates of HCV detection (antibody or RNA positivity†) among women of childbearing age increased 22%, and HCV testing (antibody or RNA) among children aged ≤2 years increased 14%; birth certificate data indicated that the proportion of infants born to HCV-infected mothers increased 68%, from 0.19% to 0.32%. During the same time in Kentucky, the HCV detection rate among women of childbearing age increased >200%, HCV testing among children aged ≤2 years increased 151%, and the proportion of infants born to HCV-infected women increased 124%, from 0.71% to 1.59%. Increases in the rate of HCV detection among women of childbearing age suggest a potential risk for vertical transmission of HCV. These findings highlight the importance of following current CDC recommendations to identify, counsel, and test persons at risk for HCV infection (*1*,*7*), including pregnant women, as well as consider developing public health policies for routine HCV testing of pregnant women, and expanding current policies for testing and monitoring children born to HCV-infected women. Expansion of HCV reporting and surveillance requirements will enhance case identification and prevention strategies.

In the United States, incidence of HCV infection has been increasing in young persons, including women of childbearing age, particularly in rural areas such as Appalachia (*5*,*6*). Although acute HCV infection, as defined by the Council of State and Territorial Epidemiologists,§ is a notifiable condition and reportable to the health department in almost all states,¶ persons with acute HCV infection account for a small fraction of persons with newly diagnosed HCV infection; most new diagnoses are among persons with HCV infection of unknown duration. Because reporting of all cases of HCV infection is not mandated in many states, a substantial proportion of HCV-infected women of childbearing age, including pregnant women, are likely not reported in routine state-based surveillance systems. Commercial laboratory data and birth certificate data provide additional sources of information to supplement HCV surveillance data.

* Childbearing age among women is defined as 15–44 years.

† Quest Diagnostics detects antibody to HCV by an immunoassay, HCV RNA quantitatively by real-time polymerase chain reaction, and HCV RNA qualitatively by transcription mediated amplification.

§ Council of State and Territorial Epidemiologists. Hepatitis C, acute. https://wwwn.cdc.gov/nndss/conditions/hepatitis-c-acute.

¶ CDC. State reporting requirements for viral hepatitis. http://www.cdc.gov/hepatitis/featuredtopics/statereportingrequirements.htm.

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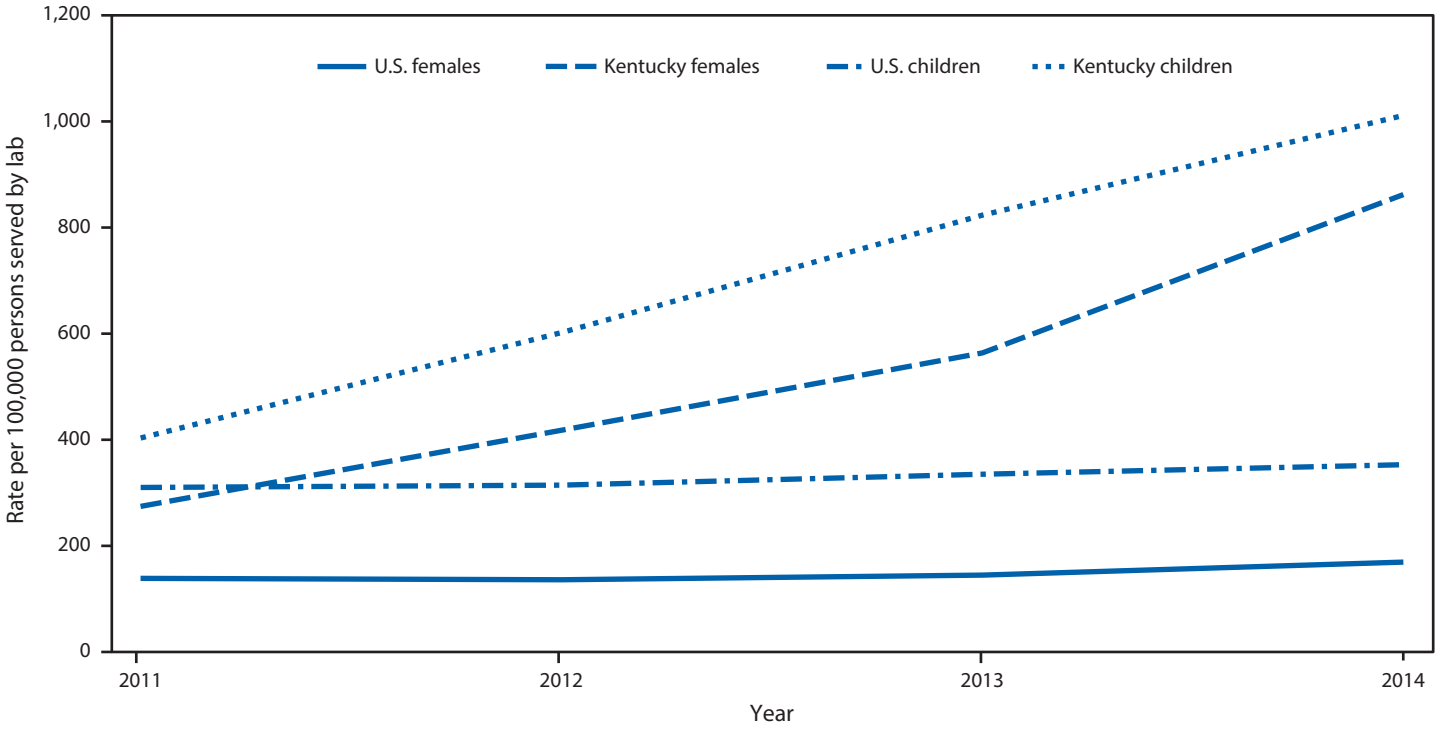
To evaluate HCV infection among women of childbearing age and the potential for mother-to-child transmission of HCV, trends in HCV detection (defined as HCV antibody or RNA positivity) in women of childbearing age and HCV testing (antibody or RNA) among children aged ≤2 years from 2011–2014 were assessed nationally and for Kentucky using commercial laboratory data from Quest Diagnostics (Quest). Detection of HCV infection among infants was not evaluated because 1) the exact infant dates of birth to allow discrimination between maternal and infant HCV antibody were not available, and 2) very few infants had RNA testing to detect current HCV infection. Trends in proportions of infants born to HCV-infected women were assessed using birth certificate data from the National Center for Health Statistics. Maternal HCV infection status on birth certificates is obtained from the prenatal record, labor and delivery admission form, admission history and physical examination, or delivery record; maternal HCV diagnosis is recorded on the birth certificate if HCV infection is present at pregnancy diagnosis or if HCV infection is confirmed during pregnancy with a positive test for HCV (*8*). Demographic characteristics of HCV antibody-positive pregnant women reported to the Kentucky Department for Public Health (KDPH) during 2011–2014 were also examined. These data were collected as part of routine acute HCV surveillance, and during December 2013–December 2014, were enhanced by a KDPH request for voluntary reporting of all cases of HCV infection identified among pregnant women and infants.

The annual HCV detection rate among women of childbearing age tested by Quest was calculated as cases of HCV detection per 100,000 women of childbearing age served by the laboratory (i.e., women of childbearing age who received a laboratory test for any reason). Quest data were also used to calculate the annual HCV testing rate per 100,000 children aged ≤2 years served by Quest. The proportion of infants born to HCV-infected mothers was calculated using birth certificate data.

During 2011–2014, the national rate of HCV detection among women of childbearing age served by Quest increased 22%, from 139 to 169 per 100,000, and the rate of HCV testing among children aged ≤2 years served by Quest increased 14%, from 310 to 353 per 100,000 (Figure 1). During this time, the proportion of infants born to HCV-infected women nationally increased 68%, from one in 536 (0.19%) to one

**FIGURE 1. Hepatitis C virus (HCV) detection rate among females aged 15–44 years and HCV testing rate among children aged ≤2 years — United States and Kentucky, 2011–2014***




**Source:** Quest Diagnostics laboratory data.

* HCV detection rates were calculated as number of females aged 15–44 years who received a positive HCV antibody and/or RNA result per 100,000 females aged 15–44 years served by Quest Diagnostics (i.e., received a laboratory test for any reason) by area of residence. HCV testing rates among children were calculated as number of children aged ≤2 years who received a test for HCV antibody and/or RNA per 100,000 children aged ≤2 years served by Quest Diagnostics by area of residence.

in 308 (0.32%) (Figure 2). During the same time, the rate of HCV detection among women of childbearing age in Kentucky increased 213%, from 275 to 862 per 100,000, and the rate of HCV testing among children aged ≤2 years increased 151%, from 403 to 1,011 per 100,000 (Figure 1). In addition, the proportion of infants born to HCV-infected women increased 124%, from one in 142 (0.71%) to one in 63 (1.59%) (Figure 2). During 2011–2014, HCV case reporting to KDPH identified 777 pregnant women with HCV antibody positivity; 527 (68%) were aged 20–29 years, 218 (28%) were aged 30–39 years, 653 (84%) were non-Hispanic white, and 293 (38%) reported past or current injection drug use.

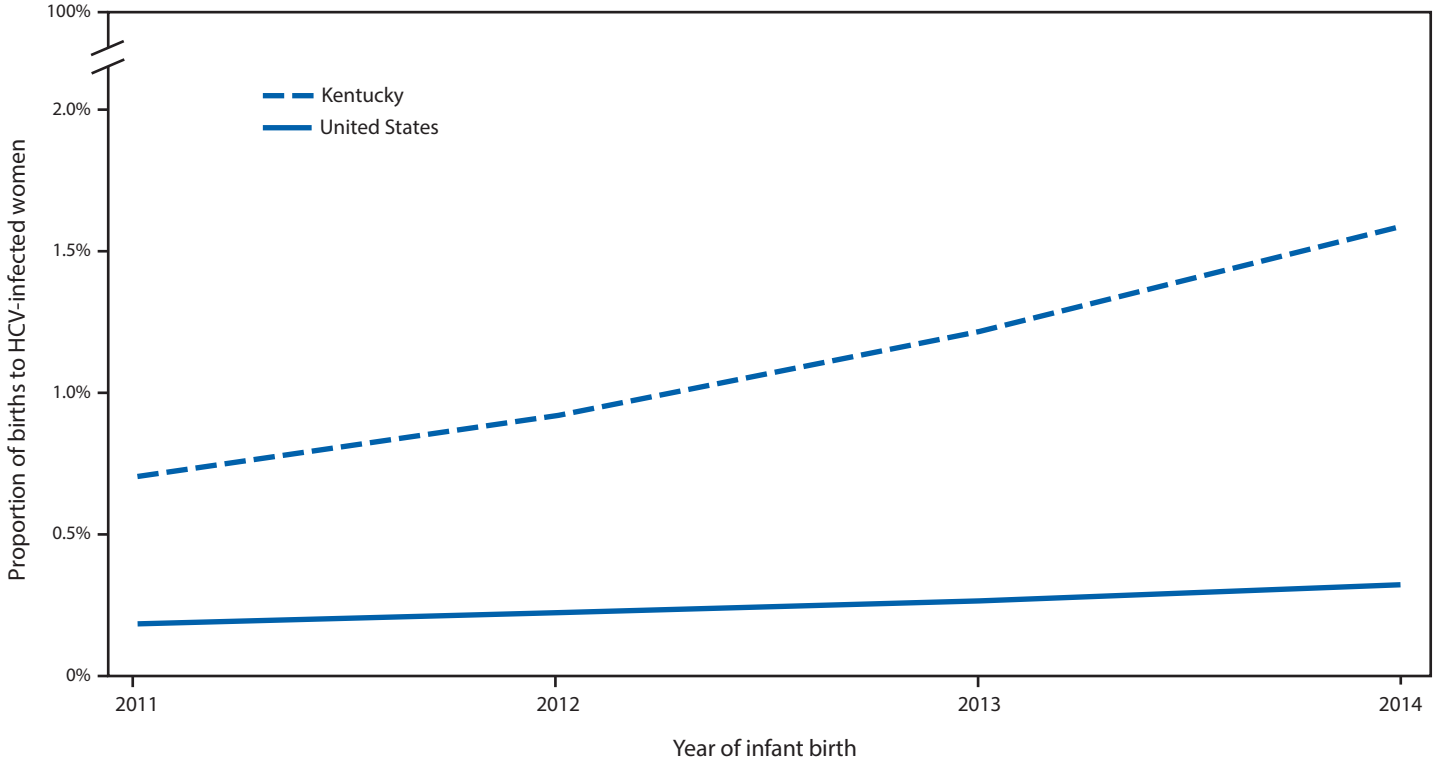
## Discussion

The national increases in HCV detection among women of childbearing age, HCV testing among infants, and the proportion of infants born to HCV-infected mothers suggest increased risk for mother-to-child transmission of HCV. This risk might be higher in certain areas of the United States, as illustrated by the findings in this report for Kentucky, which might be related to increasing illicit injection drug use (*5*). KDPH surveillance data for pregnant women are also consistent with demographic patterns of HCV incidence overall in Kentucky and nationally (*6*).

Many opportunities to improve identification and monitoring of HCV infection among women of childbearing age and infants exist. CDC recommends HCV testing for persons with a history of injection drug use and others at risk, including persons infected with HIV and persons with recognized exposures (e.g., health care workers after needle sticks or mucosal exposure to HCV-positive blood) (*1*,*7*). It is important that providers assess women of childbearing age, particularly pregnant women, for HCV risk and test accordingly. CDC also recommends HCV testing of children born to HCV-infected women (*1*,*7*). Several organizations have published guidelines on HCV testing of children,** but harmonization is needed to ensure that all women who are pregnant or planning pregnancy

** American Association for the Study of Liver Disease. HCV testing and linkage to care. http://www.hcvguidelines.org/full-report/hcv-testing-and-linkage-care. American Academy of Pediatrics. Hepatitis C. http://redbook.solutions.aap.org/chapter.aspx?sectionid=88187160&bookid=1484. North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. Diagnosis and management of hepatitis C infection in infants, children, and adolescents. http://www.naspghan.org/content/63/en/Clinical-Guidelines-and-Position-Statements.

**FIGURE 2. Proportion* of infants born to hepatitis C virus (HCV)-infected women† — United States and Kentucky, 2011–2014**




* Proportion calculated annually as infants born to HCV-infected women divided by total infants born.
† HCV infection status of mother is determined by notation on infant's birth certificate. Birth categorization is based on mother's place of residence.

**Summary**

What is already known about this topic?

Illicit injection drug use is a risk factor for hepatitis C virus (HCV) infection; recent increases in injection drug use and increases in incidence of HCV infection among young persons have been observed in the United States.

What is added by this report?

During 2011–2014, increased rates of HCV detection (antibody or RNA positivity) among women of childbearing age and HCV testing (antibody or RNA) among children aged ≤2 years were observed both nationally and for Kentucky (22% and 14%, nationally; >200% and 151%, Kentucky). During the same period, birth certificate data showed the proportion of infants born to HCV-infected mothers increased 68% nationally and 124% in Kentucky.

What are the implications for public health practice?

Increased HCV testing of pregnant women, harmonized testing guidelines for children born to HCV-infected women, and adoption of a standardized perinatal HCV case definition might improve early identification of infants born to HCV-infected women and subsequent linkage of the mother and infant to care and treatment to prevent HCV-related sequelae.

and all infants born to HCV-infected women are appropriately tested and linked to care if they are infected.

The potential for mother-to-child transmission of HCV has prompted some jurisdictions to consider changes in HCV case identification strategies and reporting policies. For example, the Philadelphia Department of Public Health recently demonstrated improved identification of infants born to HCV-infected mothers by cross-matching maternal information (including mother's name and date of birth) on birth certificates to women in HCV surveillance registries (*9*). In 2015, Kentucky mandated reporting of all HCV-infected pregnant women and children through age 60 months, as well as all infants born to all HCV-infected women.†† Development of national reporting criteria to include a case definition for perinatal HCV infection could standardize reporting across states. Reporting pregnancy status as part of HCV laboratory-based surveillance would also facilitate case identification. Improved surveillance can inform HCV screening and testing recommendations for pregnant women. Furthermore, there is an opportunity to detect HCV infection through routine HCV testing of infants identified as having perinatal exposure to illicit drugs, or neonatal abstinence syndrome, and their mothers; this could enhance HCV case identification as suggested by the large proportion of HCV antibody-positive pregnant women in Kentucky who report injecting illicit drugs.

†† Kentucky Reportable Disease Regulations: 902 Ky. Admin. Regs. 2:020.

The findings in this report are subject to at least four limitations. First, incomplete information on pregnancy status on case report forms used for surveillance in Kentucky and maternal HCV infection status on birth certificates might underestimate rates of infants born to HCV-infected mothers. Second, identifying cases of HCV-infected persons, including pregnant women, relies on completeness of reporting; therefore, the data from KDPH are likely underestimates. Third, laboratory data were limited to a single commercial laboratory and thus might not represent the United States and Kentucky populations. Finally, HCV-infected mothers cannot be linked to their children using laboratory data, and information on children's age in the laboratory data are limited, making it difficult to determine whether children are appropriately tested and have current infection; thus, HCV detection rates among children aged ≤2 years were not included in this report.

These findings underscore the importance of providing primary prevention services (*7*) and following current recommendations to identify persons at risk for HCV infection and test accordingly; doing so among pregnant women would improve early identification of HCV-infected infants and linkage of the mother and infant to care and treatment. Furthermore, identifying HCV-infected women of childbearing age before pregnancy, with linkage to care, treatment, and cure, would avoid HCV infection during pregnancy and prevent mother-to-child transmission. Expanding current and developing new public health policies to increase HCV detection among women of childbearing age (especially pregnant women) and infants should be considered; however, additional data are needed to better assess HCV prevalence among pregnant women and their infants and investigate options for perinatal prevention, care, and treatment.

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# Projected Zika Virus Importation and Subsequent Ongoing Transmission after Travel to the 2016 Olympic and Paralympic Games — Country-Specific Assessment, July 2016

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*On July 13, 2016, this report was posted as an* MMWR *Early Release on the* MMWR *website (http://www.cdc.gov/mmwr).*

Zika virus belongs to the genus *Flavivirus* of the family Flaviviridae; it is transmitted to humans primarily through the bite of an infected *Aedes* species mosquito (e.g., *Ae. aegypti* and *Ae. albopictus*) (*1*). Zika virus has been identified as a cause of congenital microcephaly and other serious brain defects (*2*). As of June 30, 2016, CDC had issued travel notices for 49 countries and U.S. territories across much of the Western hemisphere (*3*), including Brazil, where the 2016 Olympic and Paralympic Games (Games of the XXXI Olympiad, also known as Rio 2016; Games) will be hosted in Rio de Janeiro in August and September 2016. During the Games, mosquito-borne Zika virus transmission is expected to be low because August and September are winter months in Brazil, when cooler and drier weather typically reduces mosquito populations (*4*). CDC conducted a risk assessment to predict those countries susceptible to ongoing Zika virus transmission resulting from introduction by a single traveler to the Games. Whereas all countries are at risk for travel-associated importation of Zika virus, CDC estimated that 19 countries currently not reporting Zika outbreaks have the environmental conditions and population susceptibility to sustain mosquito-borne transmission of Zika virus if a case were imported from infection at the Games. For 15 of these 19 countries, travel to Rio de Janeiro during the Games is not estimated to increase substantially the level of risk above that incurred by the usual aviation travel baseline for these countries. The remaining four countries, Chad, Djibouti, Eritrea, and Yemen, are unique in that they do not have a substantial number of travelers to any country with local Zika virus transmission, except for anticipated travel to the Games. These four countries will be represented by a projected, combined total of 19 athletes (plus a projected delegation of about 60 persons), a tiny fraction of the 350,000–500,000 visitors expected at the Games.* Overall travel volume to the Games represents a very small fraction (<0.25%) of the total estimated 2015 travel volume to Zika-affected countries,† highlighting the unlikely scenario that Zika importation would be solely attributable to travel to the Games. To prevent Zika virus infection and its complications among athletes and visitors to the Games and importation of Zika virus into countries that could sustain local transmission, pregnant women should not travel to the Games, mosquito bites should be avoided while traveling and for 3 weeks after returning home, and measures should be taken to prevent sexual transmission (Box).

To assess the country-specific risk for importation and sustained, local mosquito-borne transmission of Zika virus from travel to the Games, CDC constructed a stepwise model. The model began with the 206 countries and numbers of athletes planning to participate in the Games, as of June 30, 2016 (*5*). Each country was assessed on five criteria: 1) no active CDC travel notice (as of June 30, 2016) reporting local Zika virus transmission (*3*); 2) modeled probability of *Ae. aegypti* presence, drawn from a data set of 20,000 observed occurrences during 1960–2014 (*6*) and fitted to climate norms for the months of August and September when travelers would return to their home country; 3) predicted dengue epidemic potential (*7*), such that the environmental and population conditions could support mosquito-borne disease spread from a single point of introduction; 4) lack of historic Zika virus circulation as evidenced by historic serosurveys, Zika virus detection, or exported Zika virus disease cases to exclude any country in which Zika virus might already be endemic (*8*); and 5) ranking countries by the estimated aviation travel passenger-journeys during August 2016 from Rio de Janeiro. Combined, the first four criteria estimate susceptibility to ongoing Zika transmission from introduction by a single traveler to the Games or to any other country with ongoing Zika virus transmission during August–September. The fifth criterion considers the probability that ongoing transmission could be the result of travel to the Games alone. In a stepwise manner, CDC successively excluded countries that did not meet the preceding criteria (Table 1).

* According to the Brazilian Tourism Board (Embratur), approximately 350,000–500,000 international visitors are expected at the Games (http://www.embratur.gov.br/piembratur-new/opencms/salaImprensa/noticias/arquivos/Embratur_aposta_que_Rio_2016_sera_a_melhor_Olimpiada.html).

† Calculated as a proportion using estimated foreign visitors to the Games (500,000 visitors) and the aviation travel for 2015 from all countries in the world to the 49 countries and U.S. territories with CDC Travel Notices, including journeys among countries with Zika transmission and domestic aviation journeys within Zika-affected countries (243,589,737 journeys).

**BOX. CDC prevention recommendations for athletes and visitors to Rio de Janeiro, and other areas where Zika virus is circulating**

- Pregnant women should not travel to any area where Zika virus transmission is ongoing.
- Travelers should take protective measures, including use of insect repellent, to prevent mosquito bites both during travel and for 3 weeks after returning to their home country. Such measures include wearing long-sleeved shirts and long pants; staying in places with air conditioning and window and door screens to keep mosquitoes outside; sleeping under a mosquito bed net, and using insect repellents with active ingredients (e.g., DEET).
- Travelers should prevent possible sexual transmission while at the 2016 Olympic and Paralympic Games and after returning home by correctly using condoms every time they have sex or by abstaining from sex. Males should use condoms for at least 8 weeks after travel or, if symptomatic for Zika virus infection, for 6 months from the start of symptoms.
- After returning from a country with Zika virus transmission, men with pregnant partners should use condoms or not have sex for the duration of the pregnancy.
- Couples who want to try to get pregnant after attending the Olympic and Paralympic Games should wait at least 8 weeks, and 6 months if the male partner has symptomatic Zika virus infection.

Research based on the previous four summer Olympics has indicated that travel during the Olympics typically does not exceed baseline travel volume patterns to the host city (Kamran Khan, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Canada, personal communication, June 2016). Therefore, for most countries, the number of passenger-journeys from Rio de Janeiro during August 2016 was assumed to be approximately the same as the number of journeys occurring during August 2015. Modeled data were used to estimate the number of passenger-journeys originating from Rio de Janeiro during August 2015.[§] For countries without documented passenger-journeys from Rio de Janeiro in August 2015, the estimated Olympic delegation size[¶] was used as a proxy for travel volume during August 2016.[**] Delegation size was determined by viewing video footage of the Parade of Nations from the London 2012 Olympics Opening Ceremony and comparing the number of persons observed with the known number of athletes; this is likely an underestimation given that some delegates might not participate in the parade (*5*). Finally, CDC calculated the estimated aviation travel from Rio de Janeiro during August 2016 as the proportion of each country's total travel to all Zika-affected countries during 2015.[††] For example, there were 36,923,504 passenger-journeys to the United States from all Zika-affected countries and U.S. territories in 2015 and 38,798 journeys from Rio de Janeiro during August 2015; thus, the proportion of estimated U.S. travel from Rio de Janeiro for the Games, relative to that of all Zika-affected countries is 0.11%. CDC assumed that any country whose estimated proportion of travel to Rio de Janeiro among all travel to Zika transmission areas exceeded 5% was at risk for ongoing transmission of Zika attributable to the Games.

Among the 206 countries competing in the Games, 39 have CDC travel notices indicating ongoing Zika virus outbreaks or epidemics (Table 1). Among the remaining 167 countries, 148 were not considered to be at risk for the following reasons: 74 did not have a predicted presence of *Ae. aegypti* in August–September, 51 did not also have a predicted high dengue epidemic potential, and 23 also had evidence of previous Zika virus transmission. Thus, 19 countries currently not reporting Zika outbreaks that are participating in the Games met all the risk criteria for susceptibility to ongoing Zika transmission from introduction by a single traveler to the Olympics. For 15 of these countries, estimated aviation travel from Rio de Janeiro in August 2016 compared with total aviation travel from all countries with local Zika virus transmission in 2015 was 0.01%–3.25% (Table 2). Four countries (Chad, Djibouti, Eritrea, and Yemen) were estimated to have >19% of travel from Rio de Janeiro in August 2016 compared with the overall aviation travel from all countries with local Zika transmission.

## Discussion

This risk assessment reflects an unlikely scenario, given that it will be winter in Rio de Janeiro during the Games and mosquito-borne transmission of Zika virus is predicted to be low. Nineteen countries participating in the Games have no evidence of ongoing or previous Zika virus transmission but do have the environmental and population conditions that could support ongoing mosquito-borne Zika virus transmission after introduction from a single traveler after the Games. For 15 of the countries, travel to Rio de Janeiro during the Games is not estimated to increase substantially the level of risk above that incurred by the usual aviation travel baseline for these countries. Chad, Djibouti, Eritrea, and Yemen have

[§] https://www.diio.net.

[¶] Delegation is defined as athletes and other official attendees from a country, such as coaches, referees, officials, etc.

[**] https://www.rio2016.com/en/athletes.

[††] For countries lacking total aviation travel from Rio de Janeiro in August 2015, estimated size of delegation was added to the aviation travel from all Zika-affected countries in 2015.

**TABLE 1. Iterative analytic process for estimating risk for Zika virus importation and subsequent ongoing transmission after the 2016 Olympic and Paralympic Games — 206 participating countries, 2016**

| | Analytic criteria | No. countries | |
|---|---|---|---|
| | | Not meeting criteria | Remaining in iterative analysis* |
| 1 | Without CDC Zika travel notice† | 39 | 167 |
| 2 | *Aedes aegypti* in August–September§ | 74 | 93 |
| 3 | Predicted high dengue epidemic potential¶ | 51 | 42 |
| 4 | No evidence of past Zika virus transmission** | 23 | 19 |
| 5 | Proportion of travel attributable to Games out of all travel to Zika transmission areas ≥5%†† | 15 | 4 |

**Abbreviation:** Olympic and Paralympic Games (Games) = Games of the XXXI Olympiad, Rio 2016.

* For each step of the analysis, countries were removed iteratively. Thus, for example, among the 206 countries participating in the Games, 39 countries did not meet criteria 1 and were removed, leaving 167 countries; for criteria 2, 93 countries met both criteria 1 and 2 (167–74 = 93).

† Forty-nine countries and U.S. territories currently have Zika travel notices (https://wwwnc.cdc.gov/travel/page/zika-travel-information). Some areas with notices are not competing in the Games (as of June 30, 2016), including Anguilla, Bonaire, Curacao, Guadeloupe, Guiana, Martinique, New Caledonia, Saint Barthelemy, Saint Martin, and Sint Maarten.

§ https://elifesciences.org/content/4/e08347.

¶ http://www.nature.com/nature/journal/v496/n7446/full/nature12060.html.

** http://cmr.asm.org/content/29/3/487.abstract.

†† https://www.diio.net.

**TABLE 2. Participating countries currently not reporting Zika outbreaks (n = 19) that met risk criteria for Zika virus importation and subsequent ongoing transmission attributed to travel to the Olympic and Paralympic Games, ranked by aviation travel volume* from Rio de Janeiro, Brazil — August 2016**

| Country | Total aviation travel from Rio de Janeiro in August 2015 (no. passenger-journeys) | No. of athletes for 2016 Games† | Estimated size of Olympic delegation for countries without aviation travel from Rio de Janeiro in August 2015 (no. persons) | Aviation travel from all Zika-affected countries in 2015§ No. passengers (% travel attributable to Rio de Janeiro¶) |
|---|---|---|---|---|
| Angola | 2,841 | 21 | NA | 87,549 (3.25) |
| China | 1,201 | 379 | NA | 308,238 (0.39) |
| Hong Kong** | 229 | 32 | NA | 108,215 (0.21) |
| Sao Tome and Principe | 104 | 2 | NA | 4,732 (2.20) |
| Oman | 70 | 3 | NA | 2,300 (3.04) |
| Saudi Arabia | 46 | 8 | NA | 7,688 (0.60) |
| Congo | 22 | 6 | NA | 2,023 (1.09) |
| Myanmar | 15 | 1 | NA | 733 (2.05) |
| Antigua and Barbuda | 10 | 3 | NA | 61,312 (0.02) |
| Cayman Islands | 10 | 3 | NA | 66,859 (0.01) |
| Ghana | 10 | 6 | NA | 2,498 (0.40) |
| Rwanda | 1 | 5 | — | 281 (0.36) |
| Eritrea | 0 | 9 | 27 | 27 (100) |
| Yemen | 0 | 4†† | 12 | 13 (92) |
| Djibouti | 0 | 4 | 12 | 62 (19.35) |
| The Gambia | 0 | 3 | 9 | 1,198 (0.75) |
| Chad | 0 | 2†† | 6 | 19(31.6) |
| Mauritania | 0 | 2†† | 6 | 201 (2.99) |
| Sudan | 0 | 1 | 3 | 153 (1.96) |

**Abbreviation:** NA = not applicable because countries had aviation travel to Rio de Janeiro; Olympic and Paralympic Games = Games of the XXXI Olympiad, Rio 2016.

* https://www.diio.net.

† http://www.sports-reference.com/olympics.

§ For countries without total aviation travel from Rio de Janeiro in August, 2015, estimated size of delegation was added to aviation travel from all Zika-affected countries in 2015.

¶ Calculated as aviation from Rio de Janeiro in August 2015 divided by aviation travel from all Zika-affected countries in 2015. For countries with no documented aviation passenger-journeys in August 2015, the estimated Olympic delegation size was substituted as the numerator in place of passenger-journeys.

** Hong Kong is a separate member of the International Olympic Committee and competes independently during the Olympics.

†† Chad, Mauritania, and Yemen had not qualified athletes for the 2016 Games as of June 30, 2016. Numbers from 2012 Olympics are used for athlete and delegation.

an additional, unique factor: apart from projected travel to the Games, these countries do not have substantial travel to any country with local Zika virus transmission. With the exception of these four countries, the Games do not pose a unique or substantive risk for mosquito-borne transmission of Zika virus in excess of that posed by non-Games travel.

To create a model based on "worst-case scenarios," CDC identified five assumptions. First, CDC assumed that Zika transmission would be ongoing during the winter months of August and September in Rio de Janeiro. Historically, winter months are low season for mosquito-borne disease transmission in Rio de Janeiro (*4*). Second, it was assumed that preventive measures, such as wearing long sleeves and pants or using insect repellent, would not be used or would be ineffective, and that all visitors would have an equal risk for exposure to Zika virus. Third, visitors who were infected were assumed to be viremic upon return from the Games. Fourth, infected visitors were assumed to return immediately to their home country with no extended stays in other countries. Fifth, it was assumed that visitors would not employ precautions to prevent mosquito bites upon return to their home country.

The findings in this report are subject to at least five limitations. First, the aviation travel data set comprised modeled estimates of passenger-journeys from 2015, not actual counts of travelers, and aviation travel data might have changed in 2016. Second, delegation sizes were estimated using a simple formula based on the projected numbers of athletes. However, the planned participating countries and numbers of athletes reflect data available as of June 30, 2016 (*5*) when Olympic qualifying events were ongoing and the numbers of athletes had not been finalized. Chad, Mauritania, and Yemen had not completed qualifications, so the number of athletes from the 2012 London Games was used to estimate the number of athletes for the 2016 Rio de Janeiro Games. Third, analyses were completed considering only the primary Zika virus vector, *Ae. Aegypti,* and not *Ae. Albopictus,* which is less commonly associated with transmission; however, this did not affect the results, because none of the countries where *Ae. albopictus* but not *Ae. aegypti* is present met all four risk criteria. Fourth, assessment included all estimated passenger-journeys from Rio de Janeiro in August 2016, although many of these passenger journeys might be unrelated to the Olympics. Finally, the analysis does not estimate actual risk, which would be expected to be related to travel volume (and therefore low for countries with low travel volume), but instead estimates proportionate changes in risk that could occur because of travel during the Games.

Global travel has resulted in spread of Zika virus across much of the Western Hemisphere (*9*). Substantial and continuous travel has occurred between most of the countries participating in the Games and the 49 countries or U.S. territories with CDC Zika Travel Notices. Global connectivity creates a pervasive risk for importation of Zika virus by travelers from areas with local transmission. These findings support implementation of public health interventions that increase ongoing readiness and response capabilities to prevent Zika virus transmission, including educating travelers regarding prevention of infection and transmission. CDC recommends that pregnant women not travel to any area with ongoing Zika virus transmission. Pregnant women with male partners who travel to Zika transmission areas should correctly use condoms every time they have sex or abstain from sex during pregnancy. Athletes and visitors to Rio de Janeiro and other Zika transmission areas should follow precautions to prevent exposure to the virus. Specifically, all delegation members and visitors should take rigorous steps to reduce the likelihood of mosquito bites (e.g. use insect repellent) both during the Games and within the three weeks after they return to their home country from an area with ongoing Zika transmission (Box). Efforts to enhance global health security to prevent, detect, and respond to Zika virus, as well as other emerging infections, require a sustained international commitment at all levels of government, the private sector, and civil society.

**Summary**

**What is already known about this topic?**

High travel volume globally has disseminated Zika virus broadly across much of the Region of the Americas since May 2015, highlighting the major role of globalization in rapidly spreading this emerging virus.

**What is added by this report?**

All countries are at risk for travel-associated importation of Zika virus. CDC identified 19 countries currently not reporting Zika outbreaks but with environmental conditions and population susceptibility that could sustain mosquito-borne transmission of Zika virus during August–September. Among these, Chad, Djibouti, Eritrea, and Yemen have risk uniquely attributable to their travel related to the 2016 Olympic and Paralympic Games (Games), because these four countries do not have substantial non-Games travel to any countries with local Zika virus transmission.

**What are the implications for public health practice?**

With the exception of four countries, attendance at the Games does not pose a unique or substantive risk for mosquito-borne transmission of Zika virus in excess of that posed by non-Games travel. Efforts to enhance global health security to prevent, detect, and respond to Zika virus, as well as other emerging infections, require a sustained international commitment at all levels of government, the private sector, and civil society.

## Acknowledgments

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# Suspected Female-to-Male Sexual Transmission of Zika Virus — New York City, 2016

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*On July 15, 2016, this report was posted as an* MMWR *Early Release on the* MMWR *website (http://www.cdc.gov/mmwr).*

A routine investigation by the New York City (NYC) Department of Health and Mental Hygiene (DOHMH) identified a nonpregnant woman in her twenties who reported she had engaged in a single event of condomless vaginal intercourse with a male partner the day she returned to NYC (day 0) from travel to an area with ongoing Zika virus transmission. She had headache and abdominal cramping while in the airport awaiting return to NYC. The following day (day 1) she developed fever, fatigue, a maculopapular rash, myalgia, arthralgia, back pain, swelling of the extremities, and numbness and tingling in her hands and feet. In addition, on day 1, the woman began menses that she described as heavier than usual. On day 3 she visited her primary care provider who obtained blood and urine specimens. Zika virus RNA was detected in both serum and urine by real-time reverse transcription–polymerase chain reaction (rRT-PCR) performed at the DOHMH Public Health Laboratory using a test based on an assay developed at CDC (*1*). The results of serum testing for anti-Zika virus immunoglobulin M (IgM) antibody performed by the New York State Department of Health Wadsworth Center laboratory was negative using the CDC Zika IgM antibody capture enzyme-linked immunosorbent assay (Zika MAC-ELISA) (*2*).

Seven days after sexual intercourse (day 6), the woman's male partner, also in his twenties, developed fever, a maculopapular rash, joint pain, and conjunctivitis. On day 9, three days after the onset of his symptoms, the man sought care from the same primary care provider who had diagnosed Zika virus infection in his female partner. The provider suspected sexual transmission of Zika virus and contacted DOHMH to seek testing for the male partner. That same day, day 9, urine and serum specimens were collected from the man. Zika virus RNA was detected in urine but not serum by rRT-PCR testing at the DOHMH Public Health Laboratory. Zika virus IgM antibodies were not detectable by the CDC Zika MAC-ELISA assay performed at the New York State Department of Health Wadsworth Center. The CDC Arbovirus Disease Branch confirmed all rRT-PCR results for urine and serum specimens from both partners.

During an interview with DOHMH on day 17, the man confirmed that he had not traveled outside the United States during the year before his illness. He also confirmed a single encounter of condomless vaginal intercourse with his female partner (the patient) after her return to NYC and reported that he did not engage in oral or anal intercourse with her. The man reported that he noticed no blood on his uncircumcised penis immediately after intercourse that could have been associated either with vaginal bleeding or with any open lesions on his genitals. He also reported that he did not have any other recent sexual partners or receive a mosquito bite within the week preceding his illness.

Independent follow-up interviews with the woman and man corroborated the exposure and illness history. The patients were consistent in describing illness onset, symptoms, sexual history, and the woman's travel. This information also was consistent with the initial report from the primary care provider.

The timing and sequence of events support female-to-male Zika virus transmission through condomless vaginal intercourse. The woman likely was viremic at the time of sexual intercourse because her serum, collected 3 days later, had evidence of Zika virus RNA by rRT-PCR. Virus present in either vaginal fluids or menstrual blood might have been transmitted during exposure to her male partner's urethral mucosa or undetected abrasions on his penis. Recent reports document detection of Zika virus in the female genital tract, including vaginal fluid. A study on nonhuman primates found Zika virus RNA detected in the vaginal fluid of three nonpregnant females up to 7 days after subcutaneous inoculation (*3*), and Zika virus RNA was detected in specimens from a woman's cervical mucous, genital swab, and endocervical swab collected 3 days after illness onset, using an unspecified RT-PCR test (*4*). Further studies are needed to determine the characteristics of Zika virus shedding in the genital tract and vaginal fluid of humans.

This case represents the first reported occurrence of female-to-male sexual transmission of Zika virus. Current guidance to prevent sexual transmission of Zika virus is based on the assumption that transmission occurs from a male partner to a receptive partner (*5*,*6*). Ongoing surveillance is needed to determine the risk for transmission of Zika virus infection from a female to her sexual partners. Providers should report to their local or state health department any patients with illnesses compatible with Zika virus disease who do not have a history

of travel to an area with ongoing Zika virus transmission, but who had a sexual exposure to a partner who did travel.

Persons who want to reduce the risk for sexual transmission of Zika virus should abstain from sex or correctly and consistently use condoms for vaginal, anal, and oral sex, as recommended in the current CDC guidance (*5*). Guidance on prevention of sexual transmission of Zika virus, including other methods of barrier protection, will be updated as additional information becomes available (http://www.cdc.gov/zika).

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# Notes from the Field

## *Rickettsia parkeri* Rickettsiosis — Georgia, 2012–2014

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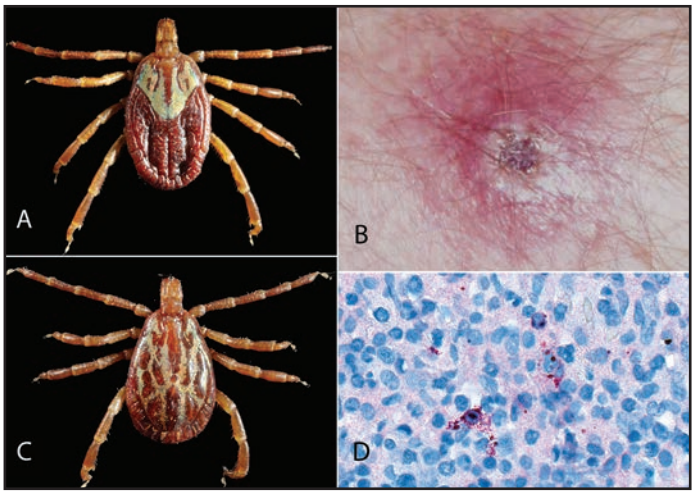
During 2012–2014, five cases of *Rickettsia parkeri* rickettsiosis were identified by a single urgent care practice in Georgia, located approximately 40 miles southwest of Atlanta. Symptom onset occurred during June–October, and all patients had a known tick bite. Patients ranged in age from 27 to 72 years (median = 53 years), and all were male. The most commonly reported initial signs were erythema (n = 3) and swelling (n = 2) at the site of the bite. Two patients reported fever and a third patient reported a rash and lymphadenopathy without fever. Other symptoms included myalgia (n = 3), chills (n = 3), fatigue (n = 2), arthralgia (n = 2), and headache (n = 2). Eschar biopsy specimens were collected from each patient using a 4-mm or 5-mm punch and placed in 10% neutral buffered formalin or sterile saline. These specimens were tested by immunohistochemical (IHC) stains, quantitative polymerase chain reaction (qPCR) assays, or cell culture isolation to determine if there was evidence of infection with a *Rickettsia* species (*1*). IHC evidence of spotted fever group rickettsiae was found in the eschar biopsy specimens in all five cases. In four cases, the biopsy specimens were also positive for *R. parkeri* by qPCR. The fifth case (specimen positive only by IHC testing) was considered a probable *R. parkeri* case based on clinical signs and symptoms. *R. parkeri* was grown in cell culture from one specimen from which isolation was attempted. All patients were treated with oral doxycycline (100 mg twice daily) for a minimum of 10 days, and all recovered.

*R. parkeri*, recently recognized as a pathogen of humans, is transmitted by *Amblyomma maculatum* (Gulf Coast) ticks (Figure). The disease in humans is most commonly characterized by a necrotic, ulcerated, or scabbed lesion at the tick bite site, known as an inoculation eschar (Figure), which is generally followed by the patient experiencing some combination of fever, headache, malaise, and a sparse maculopapular or vesiculopustular rash (*1*). The first confirmed human infection with *R. parkeri* was described in 2004; through June 2016, a total of 39 cases, predominantly from the southeastern United States, have been documented in the scientific literature or confirmed by laboratory assays at CDC (*2*,*3*). The incidence of *R. parkeri* rickettsiosis in the United States is unknown. Serological assays currently used to diagnose spotted fever group rickettsial infections lack species-specificity, and there is considerable cross-reactivity among pathogens. It is likely that some, or possibly many, of the approximately 13,500 noncharacterized cases of spotted fever group rickettsioses reported in the United States during 2008–2012 were caused by *R. parkeri* (*4*).

**FIGURE. Female (A) and male (C) Gulf Coast ticks (*Amblyomma maculatum*); (B) necrotic, ulcerated or scabbed lesion at the tick bite site, known as an inoculation eschar; and (D) immunohistochemical stain indicating the presence of a spotted fever group *Rickettsia* species in the tissue**




The identification of five cases of *R. parkeri* rickettsiosis from one medical practice during a 3-year interval suggests that this disease is underrecognized in Georgia. During 2012–2014, a total of 335 cases of spotted fever group rickettsiosis were reported in Georgia, including 38 from the health district where the urgent care practice is located.* Four cases of *R. parkeri* rickettsiosis recently were diagnosed by one clinician in southern Mississippi (*5*), indicating that the disease might be more common throughout the range of *A. maculatum* than currently realized.

The recognized range of *A. maculatum* has increased considerably during the past 70 years and now includes most states in the southeastern United States (*1*). Clinicians should suspect *R. parkeri* rickettsiosis in patients who have febrile illnesses after being bitten by a tick, particularly in patients with an eschar at the bite site. Eschar biopsy samples are the most versatile diagnostic specimen and can be tested by IHC stains,

* Data from the State Electronic Notifiable Disease Surveillance System, Georgia Department of Public Health Epidemiology Section (https://dph.georgia.gov/epidemiology).

qPCR assays, or cell culture isolation techniques; alternatively, a sterile swab of the eschar can be tested using qPCR and is less invasive than a biopsy (*6*). These tests are not widely available but can be performed at CDC and some academic hospitals (*3*). Because different spotted fever rickettsioses vary greatly in severity, species-specific diagnoses provide more accurate determinations of hospitalization and case-fatality rates associated with each disease. Doxycycline is the recommended treatment for all patients with a tickborne rickettsial infection, including *R. parkeri* rickettsiosis (*3*). Infection with *R. parkeri* rickettsiosis and other tickborne rickettsial diseases can be minimized by avoiding contact with ticks and by promptly removing attached or crawling ticks after exposures to tick-infested habitats. Persons should use Environmental Protection Agency–approved repellent products and check themselves, their children, and their pets after spending time in tick-infested habitats (*3*).

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# Announcement

## Release of CDC's 2016 Model Aquatic Health Code, Second Edition and Revised Hyperchlorination and Fecal Incident Response Recommendations

The 2016 Model Aquatic Health Code (MAHC), Second Edition was released on July 15, 2016 (http://www.cdc.gov/mahc/editions/current.html). MAHC is national guidance that can be voluntarily adopted by state and local jurisdictions to minimize the risk for illness and injury at public aquatic facilities through facility design, construction, operation, maintenance, and management.

The 2016 MAHC reflects input from state and local public health colleagues, aquatics professionals, and other stakeholders who joined the Council for the Model Aquatic Health Code (CMAHC*; http://www.cmahc.org). CMAHC collects, assesses, and relays input on MAHC revisions to CDC for consideration.

In October 2015, the first CMAHC biennial conference was held to review 159 proposed MAHC revisions. During November 21–December 20, 2015, CMAHC members voted and approved 92 (58%) revisions, including new or revised recommendations related to disinfection and water quality; lifeguarding and bather supervision; risk management and safety; and ventilation and air quality. In January 2016, the CMAHC director informed CDC of the voting results. The MAHC is updated every 2 years through this CMAHC–CDC revision process to ensure that the MAHC remains current and takes into account the latest scientific data and aquatics sector innovations.

An important change in the 2016 MAHC recommends that when hyperchlorinating to inactivate *Cryptosporidium* (the leading cause of aquatic facility–associated disease outbreaks) and in response to diarrheal incidents in the water (high-risk *Cryptosporidium* contamination events), concentrations of chlorine stabilizer† not exceed 15 ppm (*1*). Previous recommendations for hyperchlorinating and responding to diarrheal incidents in the presence of chlorine stabilizer permitted cyanuric acid concentrations of up to 50 ppm (*2*). Current CDC hyperchlorination and fecal incident response recommendations are aligned with the MAHC and are available at http://www.cdc.gov/healthywater/swimming/aquatics-professionals/fecalresponse.html.

* Information on how to become a CMAHC member is available at http://www.cmahc.org/membership.php.

† Chlorine stabilizers include compounds such as cyanuric acid, dichlor, and trichlor.

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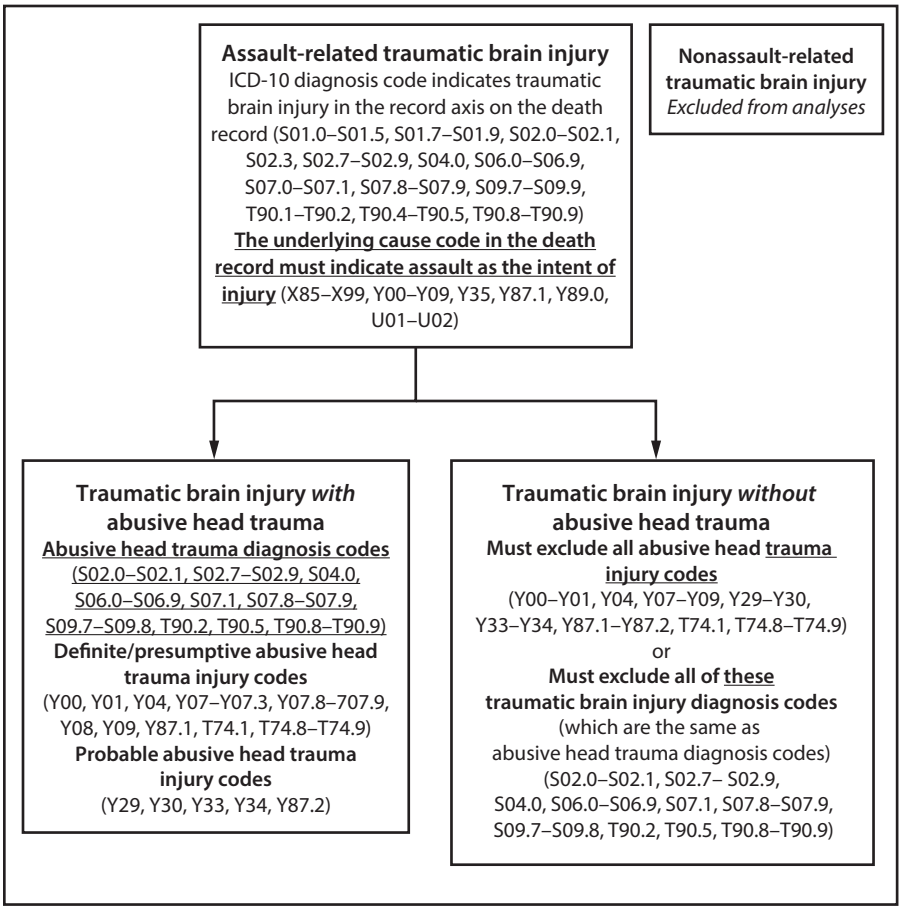
# Errata

## Vol. 65, No. 20

In the *MMWR* report, "Fatal Abusive Head Trauma Among Children Aged <5 Years — United States, 1999–2014," multiple errors occurred in the figure on page 507 (corrected text is noted by underline). The top box should have read, "The underlying cause code in the death record must indicate assault as the intent of injury." The bottom left box should have read, "Abusive head trauma diagnosis codes (S02.0–S02.1, S02.7–S02.9, S04.0, S06.0–S06.9, S07.1, S07.8–S07.9, S09.7–S09.8, T90.2, T90.5, T90.8–T90.9)." The bottom right box should have read, "Must exclude all abusive head trauma injury codes," and "Must exclude all of these traumatic brain injury diagnosis codes."

**FIGURE. Classification of fatal assault-related traumatic brain injury* with and without abusive head trauma† among children aged <5 years — United States, 1999–2014**




**Abbreviation:** ICD = *International Classification of Diseases*.

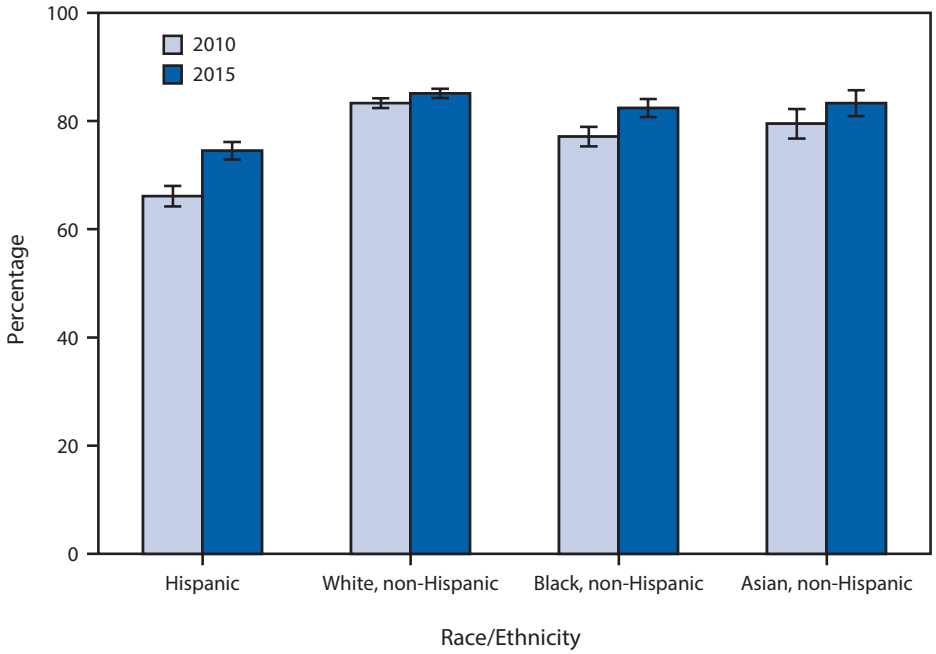
* Fatal traumatic brain injury is defined as a death caused by a bump, blow, or jolt to the head, or by a penetrating injury that disrupts normal brain function, and includes intentional gunshot wounds and stab wounds. These deaths can be classified as assault-related or nonassault-related.

† Fatal abusive head trauma is defined as a death caused by an injury to the skull or intracranial contents of an infant or child aged <5 years attributable to inflicted blunt impact and/or violent shaking, and excludes deaths from injuries resulting from neglectful supervision and deaths from gunshot or stab wounds and penetrating trauma.

# QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Percentage* of Adults Aged 18–64 Years With a Usual Place for Medical Care,† by Race/Ethnicity§ — National Health Interview Survey, 2010 and 2015¶




* With 95% confidence intervals indicated with error bars.
† Based on a question in the "Sample Adult" section that asked, "Is there a place that you usually go to when you are sick or need advice about your health?" Adults who indicated that the emergency department was their usual place for care were considered not to have a usual place of health care.
§ Categories shown are for non-Hispanic respondents who selected one racial group; respondents had the option to select more than one racial group. Hispanic origin refers to persons who are of Hispanic ethnicity and might be of any race or combination of races. Only selected groups shown in graph.
¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Adult component.

From 2010 to 2015, there was an increase in the percentage of Hispanic adults (66.1% to 74.5%), non-Hispanic white adults (83.3% to 85.1%), non-Hispanic black adults (77.1% to 82.4%), and non-Hispanic Asian adults (79.5% to 83.3%) aged 18–64 years who had a usual place to go for medical care. In 2010, non-Hispanic white adults aged 18–64 years were the most likely to have usual place to go for medical care, but there was no significant difference between non-Hispanic white and non-Hispanic Asian adults in 2015. In both 2010 and 2015, Hispanic adults aged 18–64 years were the least likely to have a usual place to go for medical care.

**Source:** National Health Interview Survey, 2010 and 2015. http://www.cdc.gov/nchs/nhis.htm.

**Reported by:** Michael E. Martinez, MPH, MHSA, bmd7@cdc.gov, 301-458-4758; Brian W. Ward.

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