

## Health Care, Family, and Community Factors Associated with Mental, Behavioral, and Developmental Disorders in Early Childhood — United States, 2011–2012

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Sociodemographic, health care, family, and community attributes have been associated with increased risk for mental, behavioral, and developmental disorders (MBDDs) in children (1,2). For example, poverty has been shown to have adverse effects on cognitive, socio-emotional, and physical development (1). A safe place to play is needed for gross motor development, and accessible health care is needed for preventive and illness health care (3). Positive parenting and quality preschool interventions have been shown to be associated with prosocial skills, better educational outcomes, and fewer health risk behaviors over time (2). Protective factors for MBDDs are often shared (4) and conditions often co-occur; therefore, CDC considered MBDDs together to facilitate the identification of factors that could inform collaborative, multidisciplinary prevention strategies. To identify specific factors associated with MBDDs among U.S. children aged 2–8 years, parent-reported data from the most recent (2011–2012) National Survey of Children's Health (NSCH) were analyzed. Factors associated with having any MBDD included inadequate insurance, lacking a medical home, fair or poor parental mental health, difficulties getting by on the family's income, employment difficulties because of child care issues, living in a neighborhood lacking support, living in a neighborhood lacking amenities (e.g., sidewalks, park, recreation center, and library), and living in a neighborhood in poor condition. In a multivariate analysis, fair or poor parental mental health and lacking a medical home were significantly associated with having an MBDD. There was significant variation in the prevalence of these and the other factors by state, suggesting that programs and policies might use collaborative efforts to focus on specific factors. Addressing identified factors might prevent the onset of MBDDs and improve outcomes among children who have one or more of these disorders.

NSCH is a cross-sectional, nationally representative, random-digit-dialed telephone survey that collects information about U.S. children aged <18 years. The survey includes indicators of child health and well-being, access to quality health care, family characteristics, and school and neighborhood environment.\* Participating parents or guardians completed interviews about one randomly selected child (N = 95,677) per household. The interview completion rates were 54.1%

\* <http://www.cdc.gov/nchs/slait/nsch.htm> and [ftp://ftp.cdc.gov/pub/Health\\_Statistics/NCHS/slait/nsch\\_2011\\_2012/01\\_Frequently\\_asked\\_questions/NSCH\\_2011\\_2012\\_FAQs.pdf](ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/slait/nsch_2011_2012/01_Frequently_asked_questions/NSCH_2011_2012_FAQs.pdf).

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and 41.2% for landline and cell phone samples, respectively; the overall response rate was 23.0%.<sup>†</sup> Data were weighted to account for unequal probability of selection of each household and child and for nonresponse. Weighted estimates reflect the population of noninstitutionalized children in the United States and within each state.

Parents were asked, “Has a doctor or other health care provider ever told you that [child] had [specified disorder]?” A child was considered to have an MBDD if the parent or guardian reported any of the following: attention-deficit/hyperactivity disorder (ADHD), depression, anxiety problems, behavioral or conduct problems such as oppositional defiant disorder or conduct disorder, Tourette syndrome, autism spectrum disorder, learning disability, intellectual disability, developmental delay, or speech or other language problems.

Analyses were restricted to the 35,121 U.S. children aged 2–8 years (defined by Healthy People 2020 as “early childhood”) with data for sex and each disorder. Weighted prevalence estimates of having any MBDD, and the associations with sociodemographic, health care, family, and community factors were calculated using statistical software to account for the complex sampling. Given previously documented

<sup>†</sup>The response rate is the percentage of households that completed interviews among all eligible households, including those that were not successfully contacted. The cooperation rate is the percentage of households that completed interviews among all eligible households that were contacted. NSCH attempts to minimize nonresponse bias by incorporating nonresponse adjustments in the development of the sampling weights.

associations between health care, family, and community factors, an exploratory regression model was also fit to determine which of the health care, family, or community factors that were independently associated with any MBDD remained significant after adjusting for the others. Sociodemographic factors were not included in the model.

Overall, among U.S. children aged 2–8 years, 15.4% had at least one diagnosed MBDD, by parent report (Table 1). Sociodemographic factors associated with report of having an MBDD included male sex, older age (aged 4–5 or 6–8 years compared with 2–3 years), being non-Hispanic white, and living in a household with a higher poverty level (i.e., <200% of federal poverty level) or where English was the primary language spoken.

Specific factors most strongly associated with MBDDs in early childhood were fair or poor parental mental health, difficulty getting by on the family’s income, child care problems (among parents of children aged 2–3 years), and lacking a medical home. Factors with the highest prevalence among children with MBDDs included lacking a medical home, living in a neighborhood lacking amenities, difficulty getting by on family income, and living in a neighborhood in poor condition. When adjusted for the other significant health care, family, and community factors, an exploratory multivariate model showed that only lacking a medical home and fair or poor parental mental health remained significantly associated with having an MBDD (Table 2).

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**TABLE 1. Prevalence of ever having any mental, behavioral, or developmental disorder (MBDD)\* by parent report, among children aged 2–8 years, by selected characteristics — National Survey of Children's Health, United States, 2011–2012**

Characteristic	Any MBDD prevalence (95% CI)	Prevalence ratio (95% CI)	p value
<b>Overall</b>	<b>15.4 (14.6–16.2)</b>	—	—
<b>Sex</b>			
Male	19.5 (18.3–20.8)	1.8 (1.6–2.0)	<0.001
Female	11.0 (10.1–12.0)	Referent	—
<b>Age group (yrs)</b>			
2–3	9.2 (8.1–10.5)	Referent	—
4–5	14.6 (13.2–16.1)	1.6 (1.3–1.9)	<0.001
6–8	19.7 (18.4–21.0)	2.1 (1.8–2.5)	<0.001
<b>Race/Ethnicity</b>			
White, non-Hispanic	16.8 (15.9–17.9)	Referent	—
Black, non-Hispanic	15.0 (12.9–17.4)	0.9 (0.8–1.0)	0.158
Hispanic	13.5 (11.7–15.6)	0.8 (0.7–0.9)	0.006
Other, non-Hispanic <sup>†</sup>	14.1 (12.1–16.4)	0.8 (0.7–1.0)	0.030
<b>Federal poverty level<sup>§</sup></b>			
<100%	18.7 (16.8–20.8)	1.5 (1.3–1.7)	<0.001
100%–199%	16.4 (14.7–18.2)	1.3 (1.1–1.5)	<0.001
200%–399%	14.2 (12.8–15.8)	1.1 (1.0–1.3)	0.081
≥400%	12.5 (11.3–13.9)	Referent	—
<b>Highest education level in household<sup>¶</sup></b>			
Less than high school	14.0 (12.0–16.2)	0.9 (0.8–1.1)	0.267
High school graduate	16.3 (14.8–17.8)	1.1 (0.9–1.2)	0.331
More than high school	15.3 (14.3–16.5)	Referent	—
<b>Primary household language</b>			
English	16.3 (15.5–17.2)	1.5 (1.2–1.8)	<0.001
Any other language	10.9 (9.0–13.2)	Referent	—

**Abbreviation:** CI = confidence interval.

\* Including parent report of whether they were ever told by a health care professional that the child had attention-deficit/hyperactivity disorder (ADHD), depression, anxiety problems, behavioral or conduct problems such as oppositional defiant disorder or conduct disorder, Tourette syndrome, autism spectrum disorder, learning disability, intellectual disability, developmental delay, or speech or other language problems.

<sup>†</sup> Includes American Indian/Alaska Native, Native Hawaiian or Other Pacific Islander, and Asian.

<sup>§</sup> Federal poverty level is based on family income and family size and composition using federal poverty thresholds that are updated annually by the U.S. Census Bureau using the change in the average annual consumer price index for all urban consumers. Imputed income was used for 9.3% of children aged 2–8 years without reported household income.

<sup>¶</sup> Based on the education of adult parents or respondents.

The prevalence of MBDDs and health care, family, and community factors among U.S. children aged 2–8 years varied by state (supplemental table at <http://stacks.cdc.gov/view/cdc/38108>). Prevalence of having any disorder varied from 10.6% in California to 21.5% in Arkansas and Kentucky. More than 90% of children received preventive care (i.e., parent or guardian reported that in the past 12 months, the child saw a health care provider for preventive medical care such as a physical exam or well-child checkup at least once) in each state.

Among health care factors, inadequate insurance was highest in South Carolina (26.5%), and lacking a medical home was highest in Arizona (52.2%); Vermont had the lowest prevalence of both inadequate insurance (14.7%) and lacking a medical home (27%).

The prevalences of difficulty getting by on the family's income and child care problems were both highest in Arizona (34.9% and 21.8%, respectively); income difficulties were lowest in North Dakota (18.5%), whereas child care problems were lowest in Nevada (2.6%<sup>§</sup>). Fair or poor parental mental health prevalence was highest in the District of Columbia (19.1%) and lowest in Kansas (6.9%).

The District of Columbia had the highest prevalence of living in a neighborhood in poor condition (46.2%) but the lowest prevalence of living in a neighborhood without all of the reported amenities (26.7%); the lowest prevalence of living in a neighborhood in poor condition was 20% in Maryland, whereas the highest prevalence of living in a neighborhood without all of the reported amenities was 67.5% in Mississippi (67.5%). Finally, reported prevalence of lack of neighborhood support was highest in Arizona (32.9%) and lowest in North Dakota (7.9%).

## Discussion

Mental, behavioral, and developmental disorders identified in childhood often persist into adulthood and are associated with increased risk for poorer school outcomes and employment opportunities, other adverse health conditions, earlier mortality, and considerable costs for persons with the disorders, their families, and society (2). Children are more likely to outgrow speech or language problems or certain developmental delays than other MBDDs, particularly if they receive early intervention. In other disorders such as Tourette syndrome, some children might outgrow the condition by late adolescence but remain at increased risk for other disorders that are more likely to persist, including ADHD and obsessive-compulsive disorder. MBDDs can substantially affect health care, families, and communities. Children with MBDDs often require more health and therapy services than children without MBDDs. Families might face stress associated with the disorder itself or financial stress associated with treatment of the disorder. Communities might need to provide additional services and support for both children and families and might face lower productivity if the parent or guardian is unable to work (2). Thus, efforts to prevent the onset of MBDDs and to improve their identification and treatment in early childhood might improve health and well-being throughout the lifespan, with the potential to translate into cost savings and overall population health improvements (2).

The data in this report included a number of sociodemographic factors associated with MBDDs, including poverty and living in a primarily English-speaking household. Household

<sup>§</sup> Relative standard error for Nevada = 38%; this estimate should be interpreted with caution.

TABLE 2. Prevalence of ever having any mental, behavioral, or developmental disorder (MBDD)\* by parent report, among children aged 2–8 years, by health care, family, and community factors — National Survey of Children's Health, United States, 2011–2012

Type of factor	Any MBDD % (95% CI) <sup>†</sup>	No MBDD % (95% CI)	Any MBDD/ No MBDD prevalence ratio (95% CI)	p value	Any MBDD/ No MBDD adjusted prevalence ratio <sup>†</sup> (95% CI)	p value
<b>Health care</b>						
Inadequate insurance for optimal health <sup>§</sup>	26.3 (24.0–28.8)	20.4 (19.3–21.4)	1.3 (1.2–1.4)	<0.001	1.3 (0.9–2.1)	0.168
No preventive medical care, last 12 months <sup>¶</sup>	3.4 (2.6–4.4)	3.1 (2.7–3.6)	1.1 (0.8–1.4)	0.628	Not included	—
Lacks a medical home <sup>**</sup>	56.8 (54.1–59.5)	41.9 (40.6–43.2)	1.4 (1.3–1.4)	<0.001	2.1 (1.5–3.1)	<0.001
<b>Family</b>						
Fair or poor maternal mental health <sup>††</sup>	12.7 (10.9–14.7)	6.7 (6.0–7.6)	1.9 (1.6–2.3)	<0.001	Not included	—
Fair or poor paternal mental health <sup>††</sup>	7.4 (5.9–9.1)	3.8 (3.3–4.5)	1.9 (1.5–2.5)	<0.001	Not included	—
At least one parent with fair or poor mental health <sup>††</sup>	19.6 (17.2–22.3)	9.9 (9.0–10.9)	2.0 (1.7–2.3)	<0.001	1.8 (1.1–2.9)	0.019
Difficult to get by on family's income <sup>§§</sup>	35.5 (32.8–38.3)	24.0 (22.9–25.2)	1.5 (1.4–1.6)	<0.001	1.1 (0.7–1.6)	0.760
Parent lacks emotional support <sup>¶¶</sup>	11.8 (10.2–13.7)	11.3 (10.4–12.3)	1.0 (0.9–1.2)	0.616	Not included	—
Child care problems (children aged 2–3 years only) <sup>***</sup>	19.5 (14.9–25.3)	12.9 (11.4–14.5)	1.5 (1.1–2.0)	0.007	Not included	—
<b>Community</b>						
Neighborhood without amenities <sup>†††</sup>	45.5 (42.6–48.3)	42.2 (40.9–43.5)	1.1 (1.0–1.2)	0.040	1.0 (0.7–1.4)	0.889
Neighborhood in poor condition <sup>§§§</sup>	34.5 (31.8–37.2)	27.6 (26.4–28.7)	1.3 (1.1–1.4)	<0.001	1.1 (0.8–1.7)	0.560
Lack of support in neighborhood <sup>¶¶¶</sup>	24.3 (22.1–26.8)	18.5 (17.5–19.6)	1.3 (1.2–1.5)	<0.001	1.3 (0.9–1.9)	0.223
Neighborhood perceived to lack safety <sup>****</sup>	15.5 (13.7–17.5)	14.5 (13.5–15.5)	1.1 (0.9–1.2)	0.339	Not included	—

**Abbreviation:** CI = confidence interval.

\* Including parent report of whether they were ever told by a health care professional that the child had attention-deficit/hyperactivity disorder (ADHD), depression, anxiety problems, behavioral or conduct problems such as oppositional defiant disorder or conduct disorder, Tourette syndrome, autism spectrum disorder, learning disability, intellectual disability, developmental delay, or speech or other language problems.

† A regression model was fit to determine which of the health care, family, and community factors that were independently associated with MBDD remained significant after adjusting for the others. Child care problems were not included because these were limited to children aged 2–3 years. Having at least one parent with fair or poor mental health was included in the model rather than individual paternal and maternal mental health indicators.

§ Based on a negative response to one of four variables included in the following five questions: 1) whether the child has current health insurance coverage; 2) whether the coverage is sufficient to meet the child's needs; 3) whether the family pays out-of-pocket expenses, and if yes, 4) whether these expenses are usually or always reasonable; and 5) whether insurance allows the child to see needed health care providers.

¶ Based on a response of "none" to the question, "During the past 12 months, how many times did [child name] see a doctor, nurse, or other health care provider for preventive medical care such as a physical exam or well-child checkup?"

\*\* Based on five component variables (personal doctor or nurse, usual source for sick and well care, family-centered care, problems getting needed referrals, and effective care coordination when needed) drawn from 19 survey items. To have a medical home, children must have a personal doctor or nurse, usual source of care, and family-centered care; children needing referrals or care coordination must also have those criteria met.

†† Based on responses of "fair or poor" (i.e., compared with excellent, very good, or good) to questions about maternal and paternal mental health. Maternal question: "In general, what is the status of [child name's [mother's/your] mental and emotional health?" Paternal question: "In general, what is the status of [child name's [father's/your] mental and emotional health?"

§§ Based on responses of "very often" or "somewhat often" (i.e., compared with rarely or never) to "Since [the child] was born, how often has it been very hard to get by on your family's income, for example, it was hard to cover the basics like food or housing?"

¶¶ Based on responses of "no" to "Is there someone that you can turn to for day-to-day emotional help with [parenthood/raising children]?"

\*\*\* Regarding children aged 2–3 years, based on responses of "yes" to "During the past 12 months, did you or anyone in the family have to quit a job, not take a job, or greatly change your job because of problems with child care for [the child]?"

††† Based on responses of "no" to at least one of the following statements: "Please tell me if the following places and things are available to children in your neighborhood, even if [the child] does not actually use them": 1) sidewalks or walking paths; 2) a park or playground area; 3) a recreation center, community center, or boys' or girls' club; 4) a library or bookmobile.

§§§ Based on responses of "yes" to any of the following three questions: "In your neighborhood, is there litter or garbage on the street or sidewalk? How about poorly kept or rundown housing? How about vandalism such as broken windows or graffiti?"

¶¶¶ Based on responses of "definitely agree, somewhat agree, somewhat disagree, or definitely disagree" were scored for the following four statements about their neighborhood or community: "People in this neighborhood help each other out; we watch out for each other's children in this neighborhood; there are people I can count on in this neighborhood; if my child were outside playing and got hurt or scared, there are adults nearby who I trust to help my child." Responses were scored 1–4 and an average score was calculated; averages less than 2.25 indicated a "lack of support."

\*\*\*\* Based on responses of "never" or "sometimes" (i.e., compared with usually or always) to the question, "How often do you feel [the child] is safe in your community or neighborhood?"

language might be reflective of increased access to health care (and thus increased likelihood of being diagnosed) or the level of acculturation, a factor that has been associated with risk behaviors and poorer health outcomes in some domains (5). The identified health care, family, and community factors associated with child MBDDs in this report have each previously been documented to be associated with poverty (6). Each significant factor might reflect the effect of insufficient parental

and community resources to support optimal child development and might contribute to chronic stress. Chronic stress in early childhood can impact lifelong health. A chronically activated physiologic stress response impacts the sympathetic nervous system, metabolism, and the brain, resulting in increased risk for high blood pressure, obesity, inflammatory diseases, and mental and behavioral disorders (1). The prevalences of both poverty and MBDDs have been increasing among U.S.

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

Sociodemographic factors and environmental influences in early childhood have been demonstrated to have significant impact on development, mental health, and overall health throughout the lifespan.

**What is added by this report?**

This report provides recent national data documenting significant associations of early childhood mental, behavioral, and developmental disorders (MBDDs) with sociodemographic, health care, family, and community factors. There was substantial variation in state estimates of these factors and early childhood MBDDs. The factors most strongly associated with MBDDs were fair or poor parental mental health, difficulty getting by on the family's income, child care problems (among parents of children aged 2–3 years), and lacking a medical home.

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

These data support the Institute of Medicine recommendation that resources directed toward improving health care and supporting families and communities are needed to promote healthy development among all young children. Collaborative, multidisciplinary strategies including public health and pediatric clinical partners might have the greatest impact given the broad types of factors associated with early childhood MBDDs and the large number of agencies working to support optimal child development.

children,<sup>¶</sup> underscoring the need for public health strategies to prevent and treat MBDDs (7).

The factors most strongly associated with MBDDs in early childhood were lacking a medical home, fair or poor parental mental health, and difficulty getting by on the family's income. These and the other factors varied widely by state and might inform state-level decisions regarding allocation of resources to improve early childhood health at the population level. Strategies that address socioeconomic (e.g., poverty) and community (e.g., neighborhood condition) factors form the foundation of the health impact pyramid framework where interventions have the greatest public health impact (8), including demonstrated impacts into adulthood, and are likely to be cost-effective (2,9,10). Further analyses are needed to identify which factors might be the most effective targets to promote children's health.

Because a large percentage of children were reported to receive preventive care, pediatric clinical settings might be one venue for identifying and possibly delivering services to children and families in need. For example, the American Academy of Pediatrics has published policy statements on screening for postpartum depression (e.g., one way to address poor maternal mental health), the medical home, recognizing

<sup>¶</sup>[http://nccp.org/publications/pub\\_1099.html](http://nccp.org/publications/pub_1099.html).

social determinants of health, and partnering with public health to address child health from a population perspective (3). Increased awareness of the association of these factors with MBDDs by agencies serving children, (e.g., health departments, schools, and community organizations) might improve referrals and stimulate partnerships to address early childhood health within established community settings (3).

The findings in this report are subject to at least five limitations. First, the presence of MBDDs was based on parent report and might be subject to recall error or bias. Second, children with undiagnosed disorders were not included, and therefore, state estimates of these disorders might vary both by presence of disorders and likelihood of identification. Similarly, state data on health care, family, and community factors might be influenced by prevalence of MBDDs. Third, the cross-sectional nature of the data and reliance on parent report prevented drawing conclusions about the direction of the associations or about causality. Fourth, although the data were weighted for nonresponse, bias related to nonresponse might remain given the low response rate. Finally, a wide range of disorders were included and might be differentially related to health care, family, and community factors, and also likely vary in the extent to which they can be prevented.

These data support the Institute of Medicine recommendation that resources directed toward improving health care and supporting families and communities are needed to prevent mental, emotional, and behavioral disorders, and promote healthy development among all young children (2). Such investments would require substantial collaboration across public health, pediatric, and other agencies responsible for providing services to children, but could yield widespread benefits for early childhood and lifelong health (8).

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# Evaluation of a National Call Center and a Local Alerts System for Detection of New Cases of Ebola Virus Disease — Guinea, 2014–2015

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The epidemic of Ebola virus disease (Ebola) in West Africa began in Guinea in late 2013 (1), and on August 8, 2014, the World Health Organization (WHO) declared the epidemic a Public Health Emergency of International Concern (2). Guinea was declared Ebola-free on December 29, 2015, and is under a 90 day period of enhanced surveillance, following 3,351 confirmed and 453 probable cases of Ebola and 2,536 deaths (3). Passive surveillance for Ebola in Guinea has been conducted principally through the use of a telephone alert system. Community members and health facilities report deaths and suspected Ebola cases to local alert numbers operated by prefecture health departments or to a national toll-free call center. The national call center additionally functions as a source of public health information by responding to questions from the public about Ebola. To evaluate the sensitivity of the two systems and compare the sensitivity of the national call center with the local alerts system, the CDC country team performed probabilistic record linkage of the combined prefecture alerts database, as well as the national call center database, with the national viral hemorrhagic fever (VHF) database; the VHF database contains records of all known confirmed Ebola cases. Among 17,309 alert calls analyzed from the national call center, 71 were linked to 1,838 confirmed Ebola cases in the VHF database, yielding a sensitivity of 3.9%. The sensitivity of the national call center was highest in the capital city of Conakry (11.4%) and lower in other prefectures. In comparison, the local alerts system had a sensitivity of 51.1%. Local public health infrastructure plays an important role in surveillance in an epidemic setting.

Passive surveillance for Ebola in Guinea consists of telephone calls from health centers and community members (alert calls) to report community deaths and symptomatic patients. Early in the response, all alerts were reported directly to local prefectures\* and were investigated by a prefecture health department surveillance team to determine whether the patient met the suspected Ebola case definition, or whether the reported death occurred in a person who was at high risk for Ebola (4). In November 2014, the Government of Guinea, with funding from the CDC Foundation, established the national toll-free call center as a single point of contact to

facilitate alert reporting but kept the local alert lines in place. Calls to the national call center are received by operators who enter alert information into a database before routing the call to a dispatch team who informs the local prefecture. Prefectures are therefore notified of all alerts regardless of the source of the call and investigate all alerts originating within the prefecture. Clinical specimens are collected from suspected cases and community deaths for Ebola testing.

The VHF database contains data on all persons who were tested for Ebola and all known, confirmed Ebola cases. Neither the national call center database nor the local alerts system contains identifiers shared with the VHF database. To compare the sensitivity of the national call center and local alerts system to detect new Ebola cases using the VHF database, probabilistic record linkage (a method that calculates the probability that two records refer to the same entity) was used to determine whether confirmed Ebola cases in the VHF database were linked to local or national alert calls.

During November 5, 2014–August 31, 2015, a total of 185,437 unique calls to the national call center, including 22,660 (12%) alert calls, were analyzed; the other 162,777 (88%) calls were primarily requests for public health information. Among the alert calls, 5,351 (24%) were excluded because identifier data were missing, leaving 17,309 for analysis. These call center records were linked to 19,074 records in the VHF database for the same time period (excluding 311 records with missing identifiers) to measure call center sensitivity for detecting confirmed cases.

Fields in the databases for the local prefecture alerts system were standardized nationwide beginning April 1, 2015. To calculate the sensitivity of the local alerts system, records of 8,667 calls received during April 1, 2015–August 31, 2015, from four prefectures with active Ebola cases during that time period (Conakry, Coyah, Dubréka, and Forécariyah) were merged into a data set for linkage with 9,454 VHF records from the same prefectures and time period.

Variables in all data sets (first name, surname, age, sex, village, sous-prefecture, and prefecture) were standardized to string variables with Soundex transformation of proper names. Soundex is a phonetic algorithm for indexing names by sound and has been used to perform accurate record linkage while preserving patient confidentiality (5). The data sets were matched by means of a probabilistic record linkage

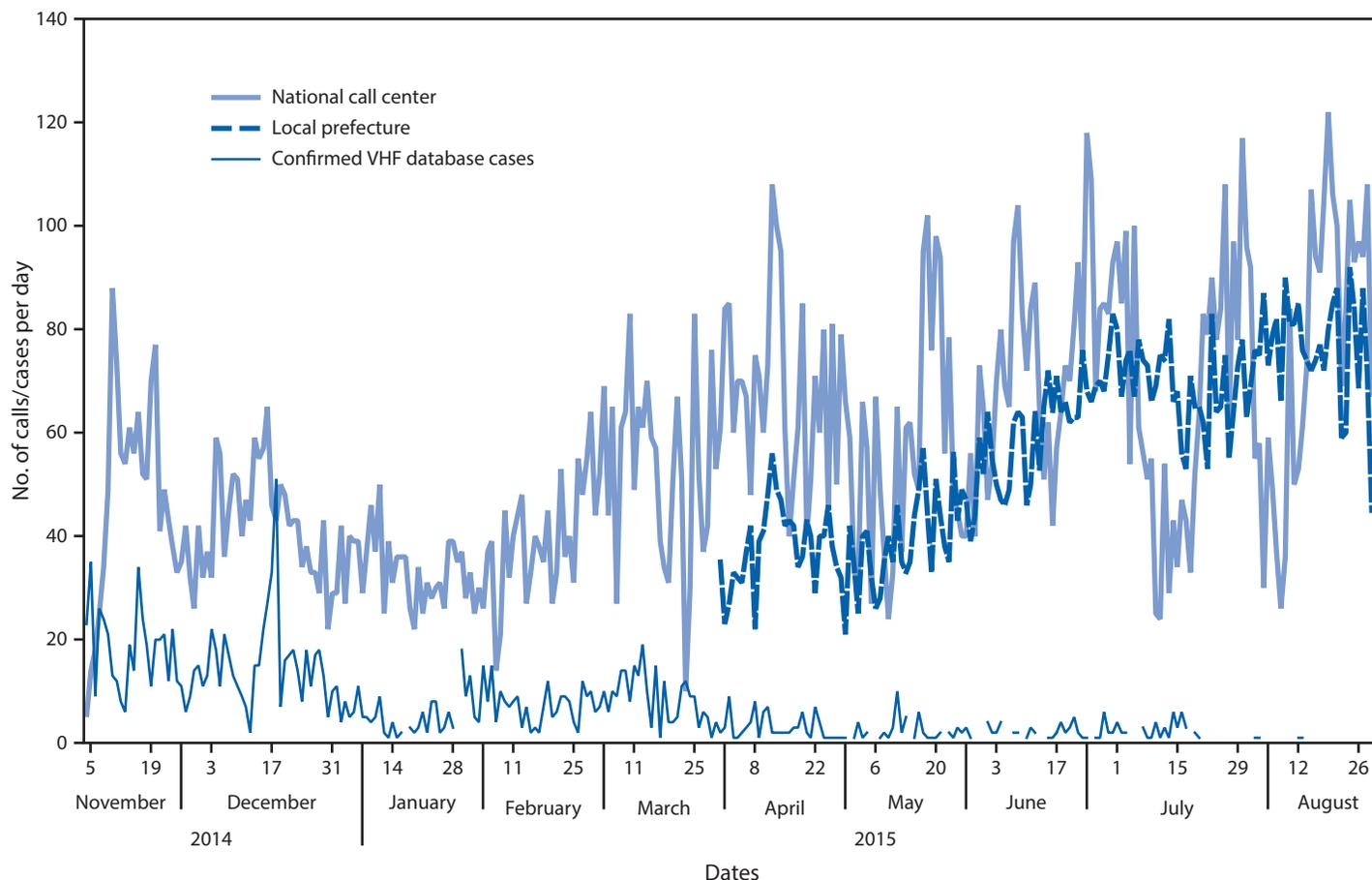
\*Guinea is divided into 34 prefectures; each prefecture has a public health department. Prefectures are further divided into sous-prefectures, except in the case of the capital city of Conakry, which is divided into five communes.

algorithm (6) using statistical software. Probabilistic record linkage uses a measure of the similarity between string variables (Levenshtein distance) to find matches between data sets using identifiers that might be spelled slightly differently when shared unique identifiers do not exist. Validation of matches was performed by drawing a random sample of 200 matched pairs and manually confirming actual matches. The manual confirmation process generated a receiver operating characteristic (ROC) curve, which plotted the sensitivity and specificity of actual matching for each match probability score produced by the algorithm. A match probability score of 0.80 was defined as the cutoff value on the ROC curve with equal sensitivity and specificity for actual matches (75%). For each system, sensitivity was calculated as the proportion of confirmed cases in the VHF database with a match found within either the national call center database or within the prefecture alerts database. Validation of the sensitivity estimate from the national call center-VHF linkage was performed by: 1) drawing two additional random subsamples of 200 confirmed cases from the VHF database; and 2) manually

confirming the matches identified by the probabilistic record linkage algorithm to determine the proportion of confirmed cases identified as a result of their being reported to the national call center. Sensitivity of the local alerts system was determined by manual confirmation of matches for all confirmed cases in the VHF from the same prefectures and time period.

During the study period, the number of daily alert calls to the national call center remained stable, the number of local alerts increased, and the number of confirmed Ebola cases declined (Figure). Linkage resulted in 1,778 matches between the national call center and VHF databases, 71 of which were confirmed cases. During the same period, there were 1,838 confirmed Ebola cases, with a resulting sensitivity (proportion of confirmed cases in the national call center database) of 3.9% for the call center (Table 1). Two random subsamples of 200 confirmed cases in the VHF database were drawn for validation purposes, with matches manually verified. Both subsamples contained 12 exact matches between databases, with a sensitivity estimate of 6.0%.

**FIGURE.** Calls reporting community deaths and suspected Ebola virus disease (Ebola) cases from the national call center and local prefectures compared with confirmed Ebola cases in the viral hemorrhagic fever (VHF) database — Guinea, November 5, 2014–August 31, 2015



**TABLE 1. Sensitivity of calls to the national call center and to local prefectures — Guinea, November 2014–August 2015**

Source	Cases detected/ confirmed VHF database cases	Sensitivity % (95% CI)
<b>National call center* (n = 17,309 alerts)</b>	<b>71/1,838</b>	<b>3.9 (3.0–4.9)</b>
Validation subsample 1	12/200	6.0 (3.1–10.3)
Validation subsample 2	12/200	6.0 (3.1–10.3)
<b>Alert database (active prefectures)<sup>†,§</sup> (n = 8,667 alerts)</b>	<b>120/221</b>	<b>54.3 (47.8–70.0)</b>
Local source (n = 7,038 alerts)	113/221	51.1 (44.3–57.9)
National source (n = 1,629 alerts)	7/221	3.2 (1.3–6.4)

**Abbreviations:** CI = confidence interval; VHF = viral hemorrhagic fever.

\* November 2014–August 2015.

<sup>†</sup> Active prefectures (Dubréka, Conakry, Coyah, and Forécariah) are those with active Ebola cases during the period since the prefecture alert databases were standardized on April 1, 2015; data before this date are incomplete and inconsistent across prefectures.

<sup>§</sup> April 2015–August 2015.

Linkage between the local alerts database and VHF database identified 5,006 matches, 120 of which were confirmed cases. Among these, 113 originated locally and seven were first reported to the national call center. There were 221 confirmed cases in the VHF database in the same prefectures and time frame, resulting in a sensitivity estimate of 51.1% for local alert calls and 3.2% for the national call center.

Sensitivity estimates were calculated by prefecture (Table 2). Sensitivity of the national call center was highest in Conakry (11.4%) and lower in other prefectures; there were 13 prefectures with confirmed Ebola cases where the sensitivity of the call center was <1%. Analysis of the local alerts database indicated varying patterns of sensitivity of local alerts; sensitivity was highest in Dubréka (79.3%) and lowest in Conakry (30.2%). Analysis of the local alerts database also demonstrated that sensitivity of the national call center was lower than the local alerts system in each of the active prefectures<sup>†</sup> studied (Table 2).

## Discussion

Sensitive surveillance mechanisms are critical for detecting outbreaks early and reducing transmission in an epidemic setting (7). In Guinea, passive surveillance detected approximately half of cases in active prefectures during the study period; the remainder were detected either by Ebola treatment units or through tracing contacts of known cases. The majority of calls that resulted in identification of confirmed cases of Ebola originated from calls to local prefectures. The sensitivity of both the national call center and local alerts systems varied by prefecture; however, for all prefectures studied, local alerts were more sensitive than the call center.

<sup>†</sup> Active prefectures (Dubréka, Conakry, Coyah, and Forécariah) are those with active Ebola cases during the period since the prefecture alerts databases were standardized (on April 1, 2015); data before this date are incomplete and inconsistent across prefectures.

## Summary

### What is already known about this topic?

Little is known about the sensitivity of call centers for Ebola case-finding in an epidemic setting.

### What is added by this report?

During the Ebola epidemic in Guinea, approximately half of cases were reported as alert calls. The sensitivity of passive surveillance systems can be compared using probabilistic record linkage. Calls to prefecture health departments were more sensitive for case detection than those to a national call center in all prefectures studied.

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

Although the national call center provided public health information for a high volume of calls, its low sensitivity for Ebola case detection limits its utility as a surveillance system. Prefecture health departments play a key role in surveillance and should be supported.

The findings in this report are subject to at least three limitations. First, data quality issues in the call center database resulted in a high volume of calls being excluded from analysis, which might have resulted in a lower or higher sensitivity estimate. Second, the local alerts databases were standardized later in the response than the national call center database, and at a time when few prefectures had active Ebola cases. Finally, mismatches resulting from the probabilistic record linkage of the national call center database with the VHF might have affected the accuracy of sensitivity estimates; based on the ROC curve, the sensitivity and specificity of matching was known to be 75%. Despite these limitations, the sensitivity estimates for the national call center were nearly identical using two validation steps. Random subsamples with manual validation of the national call center sensitivity matches provided internal validation of the matching procedure. Estimates from the local alerts database provided external validation of those estimates generated from the national call center database.

Given the high call volume recorded in Guinea and the low sensitivity for identification of cases, the national call center was likely to have been more valuable in providing public health information than in case detection. Although nationwide call centers were established in response to the Ebola epidemic in Guinea, Liberia, and Sierra Leone, the sensitivity of those call centers for Ebola detection has not yet been studied. In Sierra Leone, a study of the nationwide call center found that alert calls resulted in same- or next-day field responses to 81% of deaths but only 45% of possible cases, highlighting the need to scale up local response services (8). These findings underscore the limited sensitivity of the national call center in Guinea and the importance of local public health infrastructure for Ebola surveillance.

TABLE 2. Sensitivity estimates by prefecture for national call center alerts and local alerts in 12 prefectures\*—Guinea, November 2014–August 2015

Prefecture	Alert source				
	National call center database <sup>†</sup>		Local database <sup>§</sup> (active prefectures <sup>¶</sup> )		
	Confirmed VHF database cases	National call center matches [sensitivity (%)]	Confirmed VHF database cases	Local prefecture matches [sensitivity (%)]	National call center matches [sensitivity (%)]
Boké	32	1 (3.1)	NA	NA	NA
Conakry	343	39 (11.4)	53	16 (30.2)	6 (11.3)
Coyah	184	3 (1.6)	8	5 (62.5)	0 (0.0)
Dubréka	122	1 (0.8)	29	23 (79.3)	0 (0.0)
Forécariah	411	13 (3.2)	131	69 (52.7)	1 (0.8)
Kankan	29	1 (3.5)	NA	NA	NA
Kerouane	67	1 (1.5)	NA	NA	NA
Kindia	69	4 (5.8)	NA	NA	NA
Kissidougou	94	1 (1.1)	NA	NA	NA
Macenta	133	5 (3.8)	NA	NA	NA
N'Zérékoré	101	1 (1.0)	NA	NA	NA
Telimele	17	1 (5.9)	NA	NA	NA

**Abbreviations:** NA = not applicable; VHF = viral hemorrhagic fever.

\* Twelve prefectures in which at least one alert call to the national call center was linked to a confirmed VHF case. Of the remaining prefectures, 11 had no confirmed VHF cases during the study period and 11 had at least one confirmed case, but no alert calls from the national call center were linked to VHF records (sensitivity = 0%).

<sup>†</sup> November 5, 2014–August 31, 2015.

<sup>§</sup> April 1, 2015–August 31, 2015.

<sup>¶</sup> Active prefectures are those with active Ebola cases during the period since the prefecture alert databases were standardized in Dubréka, Conakry, Coyah, and Forécariah prefectures on April 1, 2015; data before this date are incomplete and inconsistent across prefectures.

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## Update: Providing Quality Family Planning Services — Recommendations from CDC and the U.S. Office of Population Affairs, 2015

Loretta Gavin, PhD<sup>1</sup>; Karen Pazol, PhD<sup>2</sup>

In 2014, CDC published *Providing Quality Family Planning Services: Recommendations of CDC and the U.S. Office of Population Affairs (QFP)*, which describes the scope of services that should be offered in a family planning visit, and how to provide those services (e.g., periodicity of screening, which persons are considered to be at risk, etc.). The sections in *QFP* include Contraceptive Services, Pregnancy Testing and Counseling, Clients Who Want to Become Pregnant, Basic Infertility Services, Preconception Health Services, Sexually Transmitted Disease Services, Related Preventive Health Services, and Screening Services for Which Evidence Does Not Support Screening.

CDC and the Office of Population Affairs (OPA) developed *QFP* recommendations by conducting an extensive review of published evidence, seeking expert opinion, and synthesizing existing clinical recommendations from CDC, agencies such as the U.S. Preventive Services Task Force (USPSTF), and professional medical associations such as the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics.

The scope of preventive services related to reproductive health is constantly evolving as new scientific findings are published, and clinical recommendations are modified accordingly. Being knowledgeable about the most current recommendations is an important step toward providing the highest quality care to patients.

This report summarizes updated recommendations released from the time *QFP* was issued in April 2014 through the end of 2015. Recommendations are based on newly published findings or revisions in recommended best practices. Updates that have implications for clinical practice are highlighted (Box). In addition, an updated reference list is provided for guidelines published in 2014 and 2015 that did not result in any change in recommended practices for family planning providers.

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**Box. Updated Recommendations That Might Have Implications for Clinical Practice, by Section Heading — *Providing Quality Family Planning Services: Recommendations from CDC and the U.S. Office of Population Affairs (QFP)*, 2015**

### Preconception Health Services

Blood pressure

- The 2015 U.S. Preventive Services Task Force (USPSTF) recommendation reaffirms the 2007 recommendation to screen routinely for high blood pressure in adults (grade A\*).
- The 2015 statement explains how to perform office blood pressure measurement and emphasizes the need to confirm a diagnosis of hypertension outside of the clinical setting. The 2015 statement recommends optimal screening intervals for diagnosing hypertension in adults, such as annual screening for persons at increased risk (i.e., African American, high normal blood pressure, obese or overweight, aged >40 years) and every 3–5 years in persons at low risk (adults aged 18–39 years with no risk factors).

**Source:** USPSTF. Screening for high blood pressure in adults. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2015. <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/high-blood-pressure-in-adults-screening>.

Diabetes

- The 2008 USPSTF statement recommended screening for diabetes in asymptomatic adults with hypertension (defined as sustained blood pressure of >135/80mm Hg).
- The 2015 updated statement recommends screening for diabetes in adults aged 40–70 years who are overweight or obese, and referring patients with abnormal glucose levels to intensive behavioral counseling interventions to promote a healthful diet and physical activity (grade B<sup>†</sup>).

**Source:** USPSTF. Screening for abnormal blood glucose and type 2 diabetes mellitus. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2015. <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/screening-for-abnormal-blood-glucose-and-type-2-diabetes>.

\* A USPSTF grade A recommendation indicates there is high certainty that the net benefit is substantial. <http://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>.

<sup>†</sup> A USPSTF grade B recommendation indicates there is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial. <http://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>.

**Box. (Continued) Updated Recommendations That Might Have Implications for Clinical Practice, by Section Heading — Providing Quality Family Planning Services: Recommendations from CDC and the U.S. Office of Population Affairs (QFP), 2015**

### Sexually Transmitted Disease (STD) Services

#### STD Treatment

- The 2015 CDC STD treatment guidelines changed the age for screening sexually active young females for chlamydia from  $\leq 25$  years to  $< 25$  years. CDC and USPSTF recommendations are now aligned with regard to this age cutoff.
- Persons with HIV infection should be tested at least annually for hepatitis C.
- Transgender clients should be assessed for their STD- and HIV-related risks on the basis of current anatomy and sexual behaviors.
- There are alternative treatment options for several STDs, including gonorrhea and genital warts.

**Source:** Workowski KA, Bolan GA, CDC. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep* 2015;64(No. RR-03).

#### Human Immunodeficiency Virus (HIV) Prevention for adults and adolescents with HIV

- The new CDC guidelines provide additional information about how to care for patients with HIV, which go beyond the level of care provided by most family planning service providers in primary care settings.
- The guidelines do not suggest any change from the original *QFP* recommendations with regard to screening for HIV.
- Family planning providers should be aware of these guidelines because they might help inform the referrals that they provide for HIV-positive clients.

**Source:** CDC, Health Resources and Services Administration; National Institutes of Health. Recommendations for HIV prevention with adults and adolescents with HIV in the United States, 2014. Atlanta, GA: CDC; 2014. <http://stacks.cdc.gov/view/cdc/26062>.

**Box. (Continued) Updated Recommendations That Might Have Implications for Clinical Practice, by Section Heading — Providing Quality Family Planning Services: Recommendations from CDC and the U.S. Office of Population Affairs (QFP), 2015**

### Screening Services for Which Evidence Does Not Support Screening

#### Gonorrhea

- The previous USPSTF recommendation (2005) for gonorrhea recommended against routine screening for gonorrhea infection in men and women who are at low risk of infection (grade D<sup>§</sup>).
- The revised recommendation (2014) notes that evidence is insufficient (grade I<sup>¶</sup>) for screening for chlamydia and gonorrhea among men.
- Given this change in recommendations, gonorrhea screening for men is no longer a list of services for which evidence does not support screening, as was noted in Appendix F of *QFP*. However, because *QFP* recommends following CDC's STD Treatment Guidelines 2015, which recommend screening of males at risk, no change for practice is suggested.

**Source:** USPSTF. Screening for chlamydia and gonorrhea. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2014. <http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/chlamydia-and-gonorrhea-screening>.

<sup>§</sup> A USPSTF grade D recommendation indicates moderate or high certainty exists that the services have no net benefit or that the harms outweigh the benefits. <http://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>.

<sup>¶</sup> A USPSTF grade I recommendation indicates that the current evidence is insufficient to assess the balance of benefits and harms of the service (i.e., evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined). <http://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>.

**Box. (Continued) Updated Recommendations That Might Have Implications for Clinical Practice, by Section Heading — Providing Quality Family Planning Services: Recommendations from CDC and the U.S. Office of Population Affairs (QFP), 2015**

### Screening Services for Which Evidence Does Not Support Screening (*Continued*)

#### Hepatitis B

- The previous USPSTF recommendation (2004) recommended against screening for chronic hepatitis B virus (HBV) infection in asymptomatic persons in the general population (grade D).
- The new recommendation (2014) advises screening among high risk populations, which include persons from countries with a high prevalence of HBV infection, HIV-positive persons, injection drug users, household contacts of persons with HBV infection, and men who have sex with men (grade B).
- Although USPSTF did not reaffirm the grade D recommendation for the general population, it made this comment: “The prevalence of HBV infection is low in the general U.S. population and most infected persons do not develop complications. Therefore, screening is not recommended in those who are not at increased risk.” Hence, the revised HBV screening recommendations do not suggest any change from the original *QFP* recommendation for populations at low risk.

**Source:** USPSTF. Screening for hepatitis B infection in nonpregnant adolescents and adults. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2014. <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/hepatitis-b-virus-infection-screening-2014>.

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## Vital Signs: Preventing Antibiotic-Resistant Infections in Hospitals — United States, 2014

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### Abstract

**Background:** Health care–associated antibiotic-resistant (AR) infections increase patient morbidity and mortality and might be impossible to successfully treat with any antibiotic. CDC assessed health care–associated infections (HAI), including *Clostridium difficile* infections (CDI), and the role of six AR bacteria of highest concern nationwide in several types of health care facilities.

**Methods:** During 2014, approximately 4,000 short-term acute care hospitals, 501 long-term acute care hospitals, and 1,135 inpatient rehabilitation facilities in all 50 states reported data on specific infections to the National Healthcare Safety Network. National standardized infection ratios and their percentage reduction from a baseline year for each HAI type, by facility type, were calculated. The proportions of AR pathogens and HAIs caused by any of six resistant bacteria highlighted by CDC in 2013 as urgent or serious threats were determined.

**Results:** In 2014, the reductions in incidence in short-term acute care hospitals and long-term acute care hospitals were 50% and 9%, respectively, for central line-associated bloodstream infection; 0% (short-term acute care hospitals), 11% (long-term acute care hospitals), and 14% (inpatient rehabilitation facilities) for catheter-associated urinary tract infection; 17% (short-term acute care hospitals) for surgical site infection, and 8% (short-term acute care hospitals) for CDI. Combining HAIs other than CDI across all settings, 47.9% of *Staphylococcus aureus* isolates were methicillin resistant, 29.5% of enterococci were vancomycin-resistant, 17.8% of Enterobacteriaceae were extended-spectrum beta-lactamase phenotype, 3.6% of Enterobacteriaceae were carbapenem resistant, 15.9% of *Pseudomonas aeruginosa* isolates were multidrug resistant, and 52.6% of *Acinetobacter* species were multidrug resistant. The likelihood of HAIs caused by any of the six resistant bacteria ranged from 12% in inpatient rehabilitation facilities to 29% in long-term acute care hospitals.

**Conclusions:** Although there has been considerable progress in preventing some HAIs, many remaining infections could be prevented with implementation of existing recommended practices. Depending upon the setting, more than one in four of HAIs excluding CDI are caused by AR bacteria.

**Implications for Public Health Practice:** Physicians, nurses, and health care leaders need to consistently and comprehensively follow all recommendations to prevent catheter- and procedure-related infections and reduce the impact of AR bacteria through antimicrobial stewardship and measures to prevent spread.

### Introduction

Antibiotic-resistant (AR) bacteria are a worldwide public health threat. A 2013 CDC report outlined the top 18 urgent, serious, and concerning AR threats in the United States (1). Among the 15 urgent and serious threats, seven are bacteria predominately acquired during health care. *Clostridium difficile* is included among these; although *C. difficile* is not drug-resistant, the infections it causes and its spread are exacerbated by inappropriate antibiotic use and inadequate infection control, similar to the six other AR bacteria. Preventing health care–associated infections (HAIs) provides immediate benefit in reducing the impact of antibiotic resistance on human

health. When combined with antibiotic stewardship and steps to prevent transmission as outlined in the National Action Plan to Combat Antibiotic Resistant Bacteria (2), preventing HAIs is critical to reducing the public health threat of AR bacteria.

More than half of hospitalized patients are receiving antibiotics on any given day (3), and about one in 25 have one or more HAIs (4). During 2011 an estimated 722,000 HAIs occurred in U.S acute care hospitals, and approximately 75,000 patients with HAIs died during hospitalization (4). More than half of these HAIs include *C. difficile* infections (CDIs), urinary tract infections, bloodstream infections, or surgical site infections (SSIs). The HAI National Action Plan (5) calls for CDC to monitor progress toward established goals through

the National Healthcare Safety Network (NHSN). This report describes progress toward reducing HAIs in the United States and describes the frequency of six AR bacteria of urgent or serious public health concern among reported HAIs in 2014.

## Methods

HAI data on central line-associated bloodstream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), surgical site infections (SSIs), and laboratory-identified CDI events for 2014 were reported to NHSN from hospitals in all 50 states, the District of Columbia, and Puerto Rico, using standard NHSN definitions (6–8). Data are presented separately for acute care hospitals (including critical access hospitals), long-term acute care hospitals, and inpatient rehabilitation facilities, because reporting timelines and type of HAIs reported varied among the different settings.

Standardized infection ratios (SIRs), a statistic used to track HAIs over time, were used to compare the observed number of infections reported during 2014 with the predicted number of infections, based on national aggregate data reported during a historical baseline time period. SIRs for different infections were adjusted for key risk factors (9–11). Baseline time periods among short-term acute care hospitals were 2006–2008 for CLABSIs and SSIs, 2009 for CAUTIs, and 2010–2011 for CDIs. Among long-term acute care hospitals and inpatient rehabilitation facilities the baseline time period was 2013 for both CLABSIs and CAUTIs. The SSI data include 10 procedures that approximate procedures included in the Centers for Medicare and Medicaid Services Surgical Care Improvement Project and were performed during 2014 (10).

Pathogen and susceptibility data are provided by the facility's designated clinical microbiology laboratory. No more than three pathogens per HAI could be reported. Susceptibility results for each pathogen were reported as "susceptible," "intermediate," "resistant," or "not tested" (12). The six AR phenotypes included the urgent threat of carbapenem-resistant Enterobacteriaceae, along with the serious threats of methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, extended-spectrum beta-lactamase phenotype Enterobacteriaceae, multidrug-resistant (MDR) *P. aeruginosa*, and MDR *Acinetobacter* species. The criteria used to define each phenotype approximated interim standard definitions for defining multidrug resistance as used in the CDC AR Threat Report (1), along with updated criteria for carbapenem-resistant Enterobacteriaceae (13).

A pooled mean percentage of resistant pathogens, based on the sum of pathogens that tested resistant, divided by the sum of pathogens tested, was calculated for each threat pathogen by HAI type and facility type. In addition, the likelihood that an HAI was associated with any of the six antibiotic-resistant

threat pathogens was calculated as the sum of HAIs with any resistant phenotype divided by the sum of HAIs reported (regardless of whether another pathogen or, in the case of SSI, no pathogen was reported).

## Results

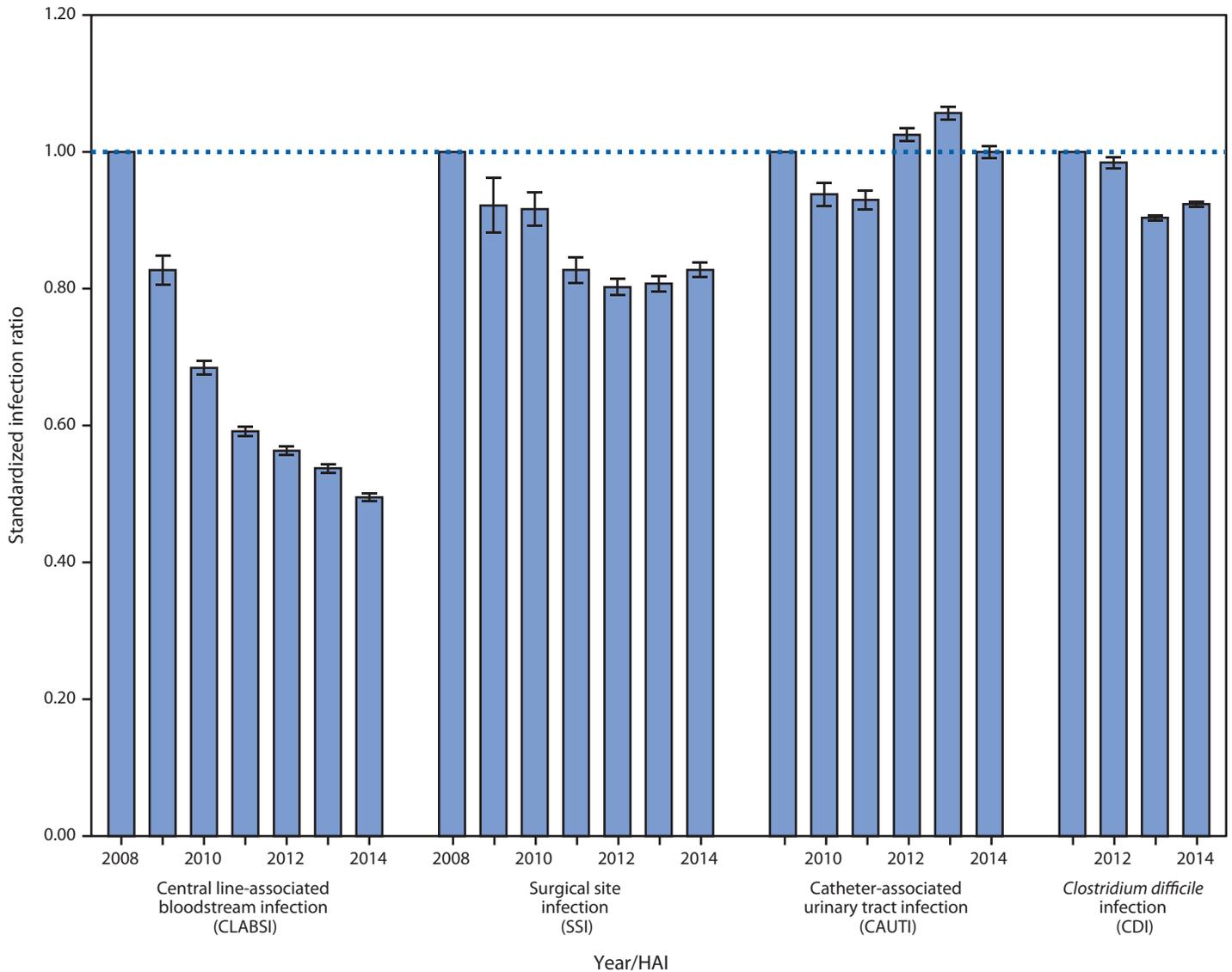
In 2014, approximately 4,000 acute care hospitals (3,655 reported CLABSI data, 3,791 reported data on CAUTI, 3,994 reported CDI, and 3,618 reported SSI), 501 long-term acute care hospitals, and 1,135 inpatient rehabilitation facilities contributed data. Within acute care hospitals, 17,758 CLABSIs, 35,760 CAUTIs, 101,074 hospital-onset CDIs, and 15,927 SSIs from selected procedures were reported. The corresponding SIRs (and 95% confidence intervals) were 0.495 (0.488–0.502) for CLABSI, 1.00 (0.990–1.010) for CAUTI, 0.924 (0.918–0.929) for CDI, and 0.827 (0.815–0.840) for SSI, corresponding to percentage decreases compared with the historical baseline assessment ranging from 0% (CAUTI) to 50% (CLABSI) (Figure). The percentage change from 2013 to 2014 was –8% for CLABSI, –5% CAUTI, +4% for CDI, and +2% for SSI.

Among long-term acute care hospitals, 2,928 CLABSIs and 4,467 CAUTIs were reported; after risk adjustment, the SIRs were 0.909 (0.876–0.942) for CLABSI and 0.893 (0.867–0.920) for CAUTI, corresponding to 9% and 11% decreases, respectively, compared with baseline. Within inpatient rehabilitation facilities, 1,449 CAUTIs were reported, for an SIR of 0.856 (0.813–0.901) or a 14% reduction compared with baseline.

Combining HAIs across all settings, 47.9% of *S. aureus* infections were resistant to methicillin, 29.5% of enterococci were resistant to vancomycin, 17.8% of Enterobacteriaceae were extended-spectrum beta-lactamase phenotype, 3.6% of Enterobacteriaceae were carbapenem-resistant, 15.9% of *P. aeruginosa*, and 52.6% of *Acinetobacter* species were MDR. Notably, the percentage resistance varied by facility type and was consistently higher in long-term acute care hospitals (Table).

During 2014, the likelihood of any of the six AR threat bacteria varied by HAI type and facility type. Overall, among short-term acute care hospitals, 14% of all HAIs were caused by one of the six AR threat bacteria, including 18% of CLABSIs (3,348 of 18,373), 15% of SSIs (2,583 of 17,512), 10% of CAUTIs (3,601 of 34,621). Among long-term acute care hospitals, 28% of CLABSIs (808 of 2,873) and 29% of CAUTIs (1,251 of 4,293) were caused by one of these organisms, and among inpatient rehabilitation facilities, 12% of CAUTIs (164 of 1,349) were caused by one of these six bacteria. Pooled over all facility types, 14.9% of the 79,021 HAIs reported were associated with one of the AR threat pathogens.

FIGURE. Standardized infection ratios (SIRs) with 95% confidence intervals for health care–associated infections (HAIs) reported from acute care hospitals as a measure of prevention progress compared with the baseline year,\* by HAI type and year — National Healthcare Safety Network, United States, 2008–2014†,§



\* First year with calculated SIR value, 1.00. Baseline periods were 2006–2008 for CLABSI and SSI, 2009 for CAUTI, and 2010–2011 for CDI. Data were calculated using the latest year of the baseline period.

† SSI data are inclusive of the 10 selected procedures that approximate the procedures included in the Centers for Medicare & Medicaid Services Surgical Care Improvement Project and were performed during 2014.

§ Device-associated infections include both intensive care unit (ICU) and non-ICU locations. [http://www.cdc.gov/hai/surveillance/nhsn\\_nationalreports.html](http://www.cdc.gov/hai/surveillance/nhsn_nationalreports.html).

## Conclusions and Comment

In the United States, approximately 2 million persons become ill every year with AR infections, and approximately 23,000 die. This report is the first to combine national data on AR bacteria threats with progress on HAI prevention. In 2014, the incidence of CLABSI in acute care hospitals reached the 2013 goal established by the HAI Action Plan (5), decreasing

50% during 2008–2014. This is important given the high morbidity, mortality, and excess costs associated with CLABSIs (14,15), which are partially related to the frequency with which methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and extended-spectrum beta-lactamase phenotype Enterobacteriaceae cause these infections (Table). In addition, CAUTIs in acute care hospitals decreased overall by 5% during 2013–2014 and, although not quantified in

**TABLE. Pooled mean percentage of tested isolates of six urgent or serious antibiotic-resistant threat pathogens that were antibiotic-resistant, by type of health care facility and type of health care–associated infection reported — National Healthcare Safety Network, United States, 2008–2014\***

Facility type/Antibiotic-resistant threat pathogen	Health care–associated infection type							
	CLABSI		CAUTI		SSI		Combined	
	No. tested	%R	No. tested	%R	No. tested	%R	No. tested	%R
<b>Short-term acute care hospital</b>								
Methicillin resistant <i>Staphylococcus aureus</i>	2,556	47.3	629	49.1	3,212	44.4	6,397	46.0
Vancomycin-resistant enterococci	3,079	44.6	4,690	21.7	3,427	18.3	11,196	27.0
ESBL-phenotype Enterobacteriaceae	2,804	21.1	11,146	16	4,184	12.6	18,134	16.0
Carbapenem-resistant Enterobacteriaceae	3,199	4.9	10,530	2.8	4,441	1.3	18,170	2.8
Multidrug-resistant <i>Pseudomonas aeruginosa</i>	810	15.7	3,392	13.9	1,061	6.5	5,263	12.6
Multidrug-resistant <i>Acinetobacter</i> spp.	369	36.6	171	63.2	63	47.6	603	45.3
<b>Long-term acute care hospital</b>								
Methicillin-resistant <i>Staphylococcus aureus</i>	345	75.7	50	82			395	76.5
Vancomycin-resistant enterococci	708	42.5	642	62.1			1,350	51.9
ESBL-phenotype Enterobacteriaceae	401	39.7	1,324	38.2			1,725	38.6
Carbapenem-resistant Enterobacteriaceae	480	14.6	1,328	11.1			1,808	12.0
Multidrug-resistant <i>Pseudomonas aeruginosa</i>	138	31.9	934	32.9			1,072	32.7
Multidrug-resistant <i>Acinetobacter</i> spp.	90	73.3	80	87.5			170	80.0
<b>Inpatient rehabilitation facility</b>								
Methicillin-resistant <i>Staphylococcus aureus</i>			46	58.7			46	58.7
Vancomycin-resistant enterococci			190	22.6			190	22.6
ESBL-phenotype Enterobacteriaceae			633	10.7			633	10.7
Carbapenem-resistant Enterobacteriaceae			634	1.9			634	1.9
Multidrug-resistant <i>Pseudomonas aeruginosa</i>			218	12.8			218	12.8
Multidrug-resistant <i>Acinetobacter</i> spp.			14	—†			14	—†

**Abbreviations:** %R = % resistant to antibiotics; CAUTI = catheter-associated urinary tract infection; CLABSI = central line-associated bloodstream infection; ESBL = extended-spectrum beta-lactamase; SSI = surgical site infection.

\* Empty cells indicate no reporting occurred for that HAI type.

† Insufficient data; fewer than 20 isolates tested for resistance.

this report, declined 24% in non-intensive care unit (ICU) settings since baseline.\* In long-term acute care hospitals, both CLABSIs and CAUTIs have decreased as have CAUTIs in inpatient rehabilitation facilities. The importance of preventing CAUTIs in all settings is highlighted by the frequency with which vancomycin-resistant enterococci, extended-spectrum beta-lactamase phenotype Enterobacteriaceae, and (especially in long-term acute care hospitals) carbapenem-resistant Enterobacteriaceae, cause these infections (Table). Collaboration across the U.S. Department of Health and Human Services (HHS), including CDC, the Office of the Assistant Secretary of Health, the Centers for Medicare and Medicaid Services, and the Agency for Health Research and Quality has been important in achieving this success. For example, Centers for Medicare and Medicaid Services reporting and payment incentives have led to greater transparency and accountability, and their Hospital Engagement and Quality Innovation Networks have promoted best practices.

*C. difficile* has been recently recognized as the most common HAI pathogen in acute care hospitals (4). In 2011, it caused an overall total of 453,000 infections, and 29,000 patients died

within 30 days of diagnosis (16); 94% of all CDIs are related to various precedent or concurrent health care exposures (17). The CDI SIR in acute care hospitals decreased only 8% overall during 2011–2014, and more concerning, increased 4% during 2013–2014. More work is needed to ensure that patients are safe from *C. difficile* and AR bacteria.

Controlling AR threats is linked to preventing the occurrence of HAIs, reducing selective pressure by improving overall antibiotic stewardship, and preventing the spread of AR bacteria within and between facilities. Preventing catheter- and procedure-related infections can be accomplished by always following recommended indications and guidelines for insertion, maintenance, and removal of vascular and bladder catheters. CDC and its partners are implementing new HHS-proposed HAI targets for December 2020, using 2015 NHSN data as its new baseline. A key strategy for reaching these goals is the Targeted Assessment for Prevention strategy to identify gaps in infection control in facilities with a disproportionate number of HAIs (18). In addition to reducing the need for antibiotics used in treatment, preventing HAIs prevents complications of infection, including sepsis, a major cause of death

\* <http://www.cdc.gov/hai/progress-report/index.html>.

### Key Points

- Antibiotic-resistant (AR) bacteria can make infections impossible to treat, especially given the extensive resistance frequently encountered in health care facilities. Of 18 AR bacteria identified by CDC as public health threats, six, in addition to *Clostridium difficile*, cause health care–associated infections (HAIs).
- Three common HAIs associated with catheters placed in a vein or the bladder and procedures (operations) include: central-line associated blood stream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), and surgical site infections (SSIs).
- Preventing these HAIs is an important strategy for reducing the impact of AR bacteria on human health, including the prevention of sepsis and death. Considerable progress has been made for some but not all HAIs. Compared with baseline historic data from 5–8 years earlier, CLABSIs decreased by 50% and SSIs by 17% in 2014. Whereas CAUTIs appear unchanged from baseline, there have been recent decreases. *C. difficile* infections in hospitals decreased 8% during 2011–2014.
- In 2014, the chance that an HAI was caused by one of the six AR threat bacteria was one in seven in short-term acute care hospitals but higher in other health care settings such as long-term acute care hospitals where it was one in four.
- Physicians, nurses, and health care leaders, working together with the help of CDC, other federal agencies, and other partners, need to consistently combine strategies to prevent catheter- and procedure-related HAIs, prevent the spread of AR bacteria, and improve antibiotic use, thereby preventing further patient harm caused by AR HAIs.
- Additional information available at <http://www.cdc.gov/vitalsigns>.

In conjunction with HAI prevention is implementation of hospital antibiotic stewardship programs (19). This is accomplished by always obtaining cultures when starting necessary antibiotics and, especially in septic patients, doing so promptly, using culture results to reassess the continued need for antibiotics, discontinuing antibiotics that are no longer needed or to which AR has developed, and using the appropriate drug at the proper dose and administration frequency. Antibiotic exposure is well recognized as the most important modifiable risk factor for CDI, and antibiotic stewardship is potentially

the most effective CDI prevention strategy (17,19). The emergence and spread of the hypervirulent, fluoroquinolone-resistant, ribotype 027 strain of *C. difficile* in North America and Europe was facilitated by increased use of fluoroquinolones (20). Reducing unnecessary use of this antibiotic class has been instrumental in facilities where control of this strain has been achieved (21,22). What is less widely recognized is the role that disruption of the human microbiome has on increasing patients' risk for acquiring AR strains of other HAI pathogens (23) and, once colonized, developing infection (24). Genes that confer resistance can be carried on the same plasmid or chromosome as genes that increase bacterial virulence, leading to the emergence of highly adapted AR HAI pathogens (25). CDC summarizes core elements of successful stewardship programs, which can help assure the prompt initiation of necessary antibiotics and reduce unnecessary antibiotic use, thereby reducing the risk of CDI and AR infections, improving individual patient outcomes, and saving health care dollars (19).

In conjunction with HAI prevention and antibiotic stewardship, the third necessary strategy is the prevention of cross transmission. To achieve this, physicians, nurses, and health care leaders need to improve hand hygiene, room cleaning, and use of personal protective equipment, and be aware of HAI outbreaks caused by AR bacteria in their hospital or region. In the case of *C. difficile*, which is unique among the AR threat bacteria in forming spores, special environmental measures might also be needed to prevent transmission (17). Because AR strains might be more virulent than other strains and thereby more likely to colonize and infect patients already receiving antibiotics, interrupting transmission of these strains reduces both the number of HAIs and the likelihood that an HAI is caused by an AR threat. To assist clinicians, health care leaders, and state and local public health authorities to learn when well-adapted resistant strains are emerging and spreading in a region, CDC is working with partners to build networks to better detect and respond to AR threats and to make antibiotic resistance data from health care facilities more readily accessible through a new HAI Antibiotic Resistance Patient Safety Atlas.<sup>†</sup>

Over one of every four HAIs reported from long-term acute care hospitals were caused by AR bacteria. Moreover, limited data suggest CDI incidence in long-term acute care hospitals might be several fold higher than in short-term acute care hospitals (26,27). One contributing factor is patient transfer from intensive care units of acute care hospitals where their microbiomes have been disrupted by exposure to antibiotics and where they have been colonized with AR threat bacteria (28). Long-term acute care hospitals are facilities that can transmit or amplify antibiotic resistance within a community

<sup>†</sup> <http://www.cdc.gov/hai/surveillance/ar-patient-safety-atlas.html>.

of interconnected health care facilities (29). It is critical for interconnected health care facilities to work together for early detection and response to emerging AR threats; coordinated prevention initiatives have the biggest impact on a community or region overall (30). Through sharing of information, practical expertise, and regional leadership, coordinated activity can have a larger impact on preventing transmission and infections with antibiotic-resistant bacteria than hospitals working alone.

The findings in this report are subject to at least two limitations. First, infections included in SIR calculations were a subset of all the infections evaluated for AR. The latter included infection events reported from any type of SSI, and infections occurring in locations regardless of eligibility to calculate a SIR. Second, the reported resistance relied on the manual reporting of the facility staff, based on reports provided by the clinical laboratory, and might contain inaccurate test results, data entry errors, and some incomplete information. Despite these limitations, these data provide important information on the status of HAI infection prevention in the United States in 2014 and the persistent challenge of preventing the spread of AR bacteria in a variety of inpatient health care settings. Preventing HAIs and the spread of antibiotic resistance is possible if physicians, nurses, and health care leaders consistently and comprehensively follow all recommendations to prevent HAIs, including prevention of catheter- and procedure-related infections, antimicrobial stewardship, and implementation of measures to prevent spread.

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## Increase in Reported Prevalence of Microcephaly in Infants Born to Women Living in Areas with Confirmed Zika Virus Transmission During the First Trimester of Pregnancy — Brazil, 2015

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Widespread transmission of Zika virus by *Aedes* mosquitoes has been recognized in Brazil since late 2014, and in October 2015, an increase in the number of reported cases of microcephaly was reported to the Brazil Ministry of Health.\* By January 2016, a total of 3,530 suspected microcephaly cases had been reported, many of which occurred in infants born to women who lived in or had visited areas where Zika virus transmission was occurring. Microcephaly surveillance was enhanced in late 2015 by implementing a more sensitive case definition. Based on the peak number of reported cases of microcephaly, and assuming an average estimated pregnancy duration of 38 weeks in Brazil (1), the first trimester of pregnancy coincided with reports of cases of febrile rash illness compatible with Zika virus disease in pregnant women in Bahia, Paraíba, and Pernambuco states, supporting an association between Zika virus infection during early pregnancy and the occurrence of microcephaly. Pregnant women in areas where Zika virus transmission is occurring should take steps to avoid mosquito bites. Additional studies are needed to further elucidate the relationship between Zika virus infection in pregnancy and microcephaly.

Since late 2014, clusters of febrile rash illness have been reported from the Northeast region of Brazil (2,3). These cases were attributed to Zika virus, a flavivirus transmitted by *Aedes* mosquitoes, when the first cases confirmed by reverse transcription–polymerase chain reaction (RT-PCR) were reported in Bahia and Rio Grande do Norte states in April 2015 (4,5). As of January 2016, transmission had been confirmed in 22 of Brazil's 26 states and the federal district, and in all five regions of the country.†

In Brazil, all recognized congenital anomalies are registered in the Live Birth Information System (Sistema de Informações sobre Nascidos Vivos [SINASC]), which collects information on all live births nationwide and is estimated to have >95%

coverage. In SINASC, microcephaly is defined as a head circumference  $\geq 3$  standard deviations (SDs) below the mean for age and sex.§ According to the World Health Organization (WHO) Multicenter Growth Reference Study, this corresponds to a head circumference of 30.3 cm for full-term females (gestational age = 259–293 days [approximately 37–42 weeks]) and 30.7 cm for full-term males during the first week of life (6).

During 2000–2014, an average of 157.3 (SD = 17.7) cases of microcephaly were registered in SINASC each year.¶ On October 22, 2015, the Secretary of Health of Pernambuco state (in the Northeast region) informed the Brazil Ministry of Health (MoH) of a marked increase in the number of infants born with microcephaly in the state, where 26 cases had been reported since August 2015.\*\* By late October, the Northeast region states of Paraíba and Rio Grande do Norte also were reporting an increase in cases of microcephaly. On October 29, 2015, MoH reported the event to the Pan American Health Organization as a potential Public Health Emergency of International Concern. On November 19, 2015, an ad hoc microcephaly surveillance system was established by MoH for identification of cases of microcephaly both prospectively, and through a retrospective review of hospital records going back to January 1, 2015. Initially, the case definition for the ad hoc system included all full-term infants with a head circumference  $\leq 33$  cm. Toward the end of 2015, the MoH defined microcephaly as a head circumference  $\leq 32$  cm in any full-term newborn; this case definition is currently used nationwide.

The MoH and Secretaries of Health from the affected states led a joint investigation to characterize and identify the etiology of the outbreak, with the support of national research institutes. This report presents temporal and geospatial evidence linking preceding Zika virus transmission with the increased prevalence of microcephaly in Brazil. Among Brazil's 26 states and the

\* <http://portalsaude.saude.gov.br/index.php/cidadao/principal/agencia-saude/20805-ministerio-da-saude/divulga-boletim-epidemiologico>.

† [http://portalsaude.saude.gov.br/images/pdf/2016/fevereiro/04/2016-004—Dengue-SE3.pdf](http://portalsaude.saude.gov.br/images/pdf/2016/fevereiro/04/2016-004-Dengue-SE3.pdf).

§ Castilla EE, Orioli IM, Luquetti DV, Dutra MG. Manual de Preenchimento e de Codificação de Anomalias Congênicas no Campo 34 da DN (SINASC). ECLAMC: Estudo Colaborativo Latino Americano de Malformações Congênicas. INaGeMP no IOC; Rio de Janeiro; 2010.

¶ <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinasc/cnv/nvuf.def>.

\*\* <http://www2.aids.gov.br/cgi/tabcgi.exe?caumul/anoma.def>.

federal capital district, the 19 jurisdictions that reported prospectively and retrospectively identified cases of microcephaly through the ad hoc microcephaly surveillance system during November 19, 2015–January 7, 2016 are included in this analysis. Two analyses were conducted. The first compared the number of cases of microcephaly identified through the ad hoc microcephaly surveillance system during January 1, 2015–January 7, 2016, with the mean number of cases reported to SINASC during 2000–2014 in those 19 jurisdictions, and compared the prevalence of microcephaly in states with documentation of laboratory-confirmed Zika virus transmission with the prevalence in states without confirmed Zika virus transmission. The second analysis examined the timing of peak occurrence of microcephaly cases in the three states with the highest reported prevalence of infants with microcephaly, relative to laboratory confirmation of Zika virus transmission in those states, to estimate the time during pregnancy when exposure to Zika virus might have occurred.

Because the SINASC case definition of microcephaly (head circumference  $\geq 3$  SDs below the mean for age and sex) was more restrictive than that of the ad hoc microcephaly surveillance system ( $\leq 32$  cm in any full-term infant), the SINASC criteria were applied to cases reported to the ad hoc system for these analyses. Therefore, only cases reported to the ad hoc surveillance system with a head circumference  $\geq 3$  SDs below the mean for age and sex were included.

The annual mean number of cases of microcephaly among full-term newborns reported to SINASC during 2000–2014 was calculated and compared with the number of cases of microcephaly that occurred during January 1, 2015–January 7, 2016, and identified through the ad hoc microcephaly surveillance system. The excess number of microcephaly cases was calculated as the number of SDs above the mean number of cases reported during 2000–2014.<sup>††</sup> Denominator data for estimation of state-level 2015 microcephaly birth prevalence were obtained by averaging the total number of live births from the SINASC 2009–2013 annual series (the most recent data available).<sup>§§</sup> Exact binomial (F-inverse) 95% confidence intervals (CIs) for birth prevalence of microcephaly were calculated for states that did and did not report laboratory-confirmed Zika virus transmission. These two rates were compared with a Pearson's chi-square test for heterogeneity.

To identify potential periods of maternal exposure to Zika virus during pregnancy, assuming an average gestation of 38 weeks (1), weekly counts of cases of microcephaly reported in 2015 in Bahia, Paraíba, and Pernambuco, the three states with the largest increases above the 2000–2014 mean, were reviewed. The beginning of the first trimester of pregnancy was estimated by counting back

## Summary

### What is already known about this topic?

An outbreak of Zika virus disease, caused by a flavivirus transmitted by *Aedes* mosquitoes, occurred in Brazil in early 2015. An increase in the prevalence of infants born with microcephaly has been reported in Brazil since October 2015, in association with clusters of febrile rash illness in pregnant women.

### What is added by this report?

The birth prevalence of microcephaly in Brazil increased sharply during 2015–2016. The largest increase occurred in the Northeast region, where Zika virus transmission was first reported in Brazil. This analysis of 574 cases of microcephaly, detected through a newly established ad hoc microcephaly surveillance system, identified temporal and geospatial evidence linking the occurrence of febrile rash illness consistent with Zika virus disease during the first trimester of pregnancy with the increased birth prevalence of microcephaly. The prevalence of microcephaly in 15 states with laboratory-confirmed Zika virus transmission (2.8 cases per 10,000 live births) significantly exceeded that in four states without confirmed Zika virus transmission (0.6 per 10,000).

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

The suggested link between maternal exposure to Zika virus infection during the first trimester of pregnancy and the increased birth prevalence of microcephaly provide additional evidence for congenital infection with Zika virus. Ongoing surveillance is needed to identify additional cases and to fully elucidate the clinical spectrum of illness. Pregnant women should protect themselves from mosquito bites by wearing protective clothing, applying insect repellents, and when indoors, ensuring that rooms are protected with screens or mosquito nets.

38 weeks from the week during which the peak number of cases of microcephaly were reported in each of the three states. The earliest reports of laboratory confirmation of Zika virus transmission in the three states were used as a proxy for the beginning of Zika virus transmission. All statistical significance levels were set at  $p < 0.05$ .

A total of 574 cases of microcephaly that occurred during January 1, 2015–January 7, 2016, were prospectively and retrospectively identified and registered in the ad hoc microcephaly surveillance system from 19 states. Among these, 58.5% (336) were in females; this excess of female cases has been reported previously (7). The average head circumference of these infants was 29.0 cm (SD = 1.4 cm). During 2000–2014, the mean annual reported number of cases of microcephaly reported to SINASC was 157.3 (SD = 17.7), and by region, ranged from 13.0 in the Center-West to 65.2 in the Southeast (Table). During 2015–2016, 12 states reported microcephaly cases in excess of 3 SDs above the historical 2000–2014 average, including Bahia, Paraíba, and Pernambuco, each of which reported cases in excess of 20 SDs above the historical average (Figure 1).

<sup>††</sup> Microcephaly case excess = (reported no. cases during 2015–2016 - mean no. cases 2000–2014) / standard deviation above 2000–2014.

<sup>§§</sup> <http://tabnet.datasus.gov.br>.

During January 1, 2015–January 7, 2016, Zika virus transmission was laboratory-confirmed by real time quantitative RT-PCR in 15 of the 19 states included in this analysis; among these 15 states, the overall microcephaly birth prevalence was 2.80 (CI = 1.86–4.05) per 10,000 live births, compared with 0.60 (CI = 0.22–1.31) in the four states without laboratory-confirmed Zika virus transmission ( $p < 0.001$ ). The overall microcephaly birth prevalence in the 12 states reporting microcephaly cases  $>3$  SDs above the historical 2000–2014 mean was 4.61 per 10,000 live births (CI = 4.19–5.05). The two states with the highest prevalence rates were Pernambuco (14.62; CI = 12.33–17.17) and Paraíba (10.82; CI = 8.86–13.04).

Pernambuco state reported the largest increase in number of reported cases of microcephaly. During epidemiologic weeks 18–39 (corresponding to mid-May–early October) 2015, Pernambuco reported 0–4 cases of microcephaly per week (Figure 2). The number of cases increased substantially during epidemiologic weeks 42–43 (late October), reaching a peak of 27 cases per week during epidemiologic week 46 (mid-November). Assuming an average full-term pregnancy of 38 weeks, the first trimester of pregnancy of mothers of infants with microcephaly born during epidemiologic week 46 occurred during epidemiologic weeks 8–20 (late February–mid May) of 2015. An outbreak of rash illness clinically compatible with Zika virus disease was reported in Pernambuco in December 2014, with laboratory confirmation of Zika virus disease in epidemiologic week 20 of 2015. The estimated first trimester of pregnancy of the mothers of the infants with microcephaly in Pernambuco coincided with occurrence of the rash illness outbreak.

Paraíba and Bahia states reported an abrupt increase in the number of infants born with microcephaly in epidemiologic weeks 45 and 47, respectively, and both states reported similar occurrences of a rash illness clinically compatible with Zika

virus infection during May 2015 (Figure 2). In Bahia and Paraíba states, cases of microcephaly reported in infants born through epidemiologic week 42 in 2015 (when the first cases in Pernambuco were reported to MoH), were identified retrospectively through the ad hoc microcephaly surveillance system.

## Discussion

Congenital anomalies, including microcephaly, have a complex and multifactorial etiology and can be caused by infections during pregnancy as well as chromosomal disorders, exposures to environmental toxins, and metabolic diseases.<sup>¶¶</sup> The temporal relationship between outbreaks of Zika virus disease and increases in reported prevalence of microcephaly in Brazil, as well as the significant increase in birth prevalence of microcephaly in states with laboratory-confirmed Zika virus transmission, suggest a relationship between these two epidemiologic events. The reported occurrence of the 2015–2016 microcephaly cases, especially in Pernambuco, highlight the temporal relationship between preceding Zika virus transmission and the abrupt increase in birth prevalence of microcephaly.

This hypothesis is strengthened by recent virologic evidence. On November 17, 2015, the Flavivirus Laboratory of the Oswaldo Cruz Institute (Rio de Janeiro, Brazil) reported the detection of Zika virus RNA by real time RT-PCR in amniotic fluid samples collected from two pregnant women from Paraíba state whose fetuses were found to have microcephaly and cerebral calcifications by fetal ultrasound, and who reported symptoms compatible with Zika virus disease at 18 and 19 weeks' gestational age.<sup>\*\*\*</sup> On November 18, 2015, the Evandro Chagas Institute (Pará, Brazil) reported that Zika virus RNA was identified in blood and tissue samples of a neonate with microcephaly who died shortly

¶¶ [http://www.who.int/nutrition/publications/birthdefects\\_manual/en/](http://www.who.int/nutrition/publications/birthdefects_manual/en/).

\*\*\* <https://agencia.fiocruz.br/fiocruz-identifica-v%C3%ADrus-zika-em-dois-casos-de-microcefalia>.

**TABLE. Average annual number of full-term infants reported with microcephaly\* during 2000–2014 compared with 2015, prevalence of microcephaly in 2015, and number of states reporting confirmed transmission of Zika virus,† by region — 19 states, Brazil, 2015**

Region	2000–2014			2015				
	No. states	Average annual no. cases	SD	Total no. cases	No. SDs above mean	Average no. live births <sup>§</sup>	Microcephaly prevalence at birth <sup>¶</sup>	No. states reporting confirmed transmission of Zika virus
North	2	14.1	4.7	11	-0.7	310,508	0.4	2
Northeast	9	43.5	5.6	471	76.3	842,270	5.6	8
Southeast	3	65.2	6.8	58	-1.1	1,137,408	0.5	2
South	1	21.5	6.2	3	-3.0	376,599	0.1	0
Center-West	4	13.0	5.1	31	3.5	226,500	1.4	3
<b>Total</b>	<b>19</b>	<b>157.3</b>	<b>17.7</b>	<b>574</b>	<b>23.6</b>	<b>2,893,285</b>	<b>2.0</b>	<b>15</b>

**Abbreviation:** SD = standard deviation.

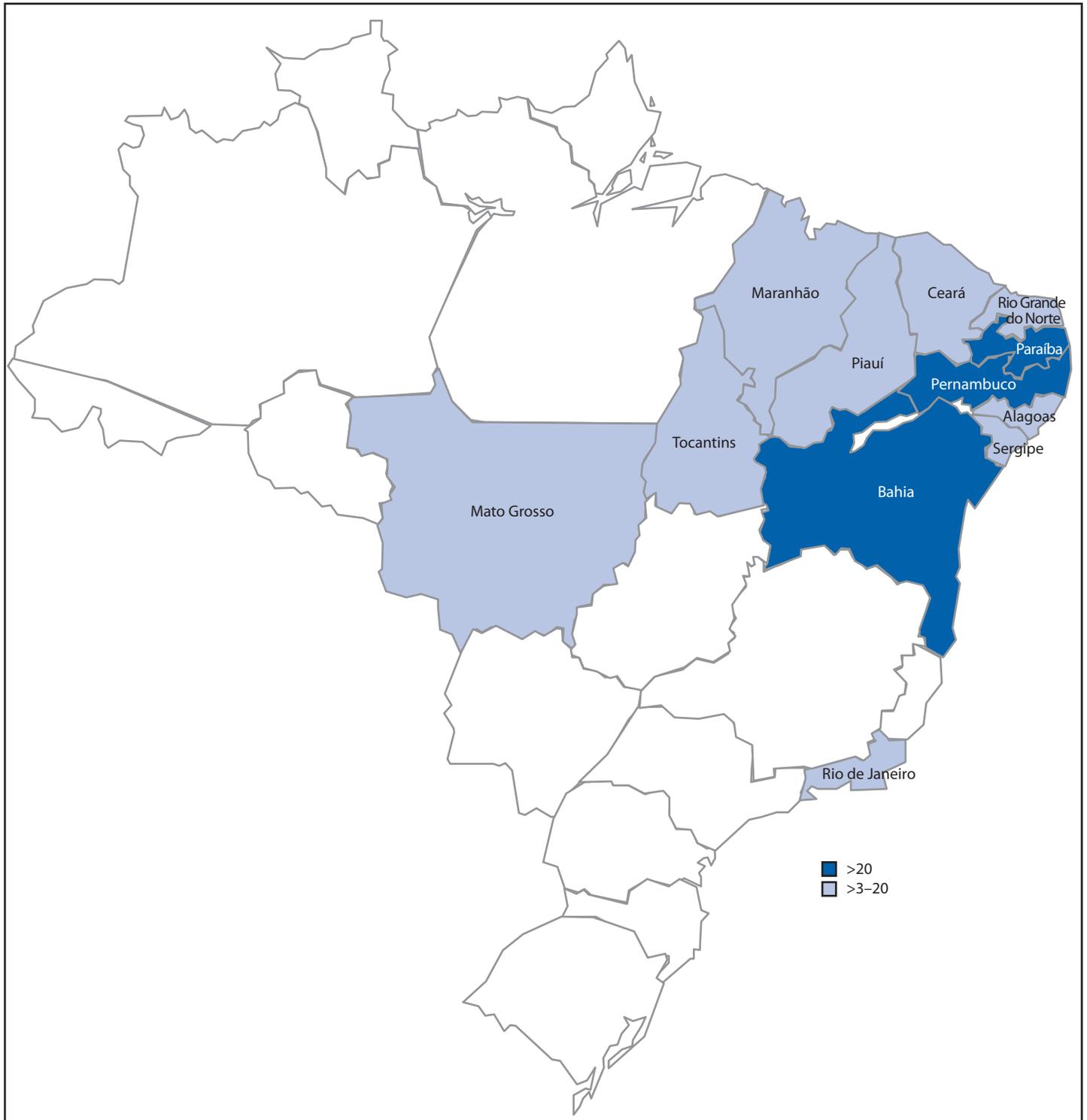
\* Defined as head circumference  $\geq 3$  SDs below the mean for age and sex.

† Confirmed by real time reverse transcription–polymerase chain reaction.

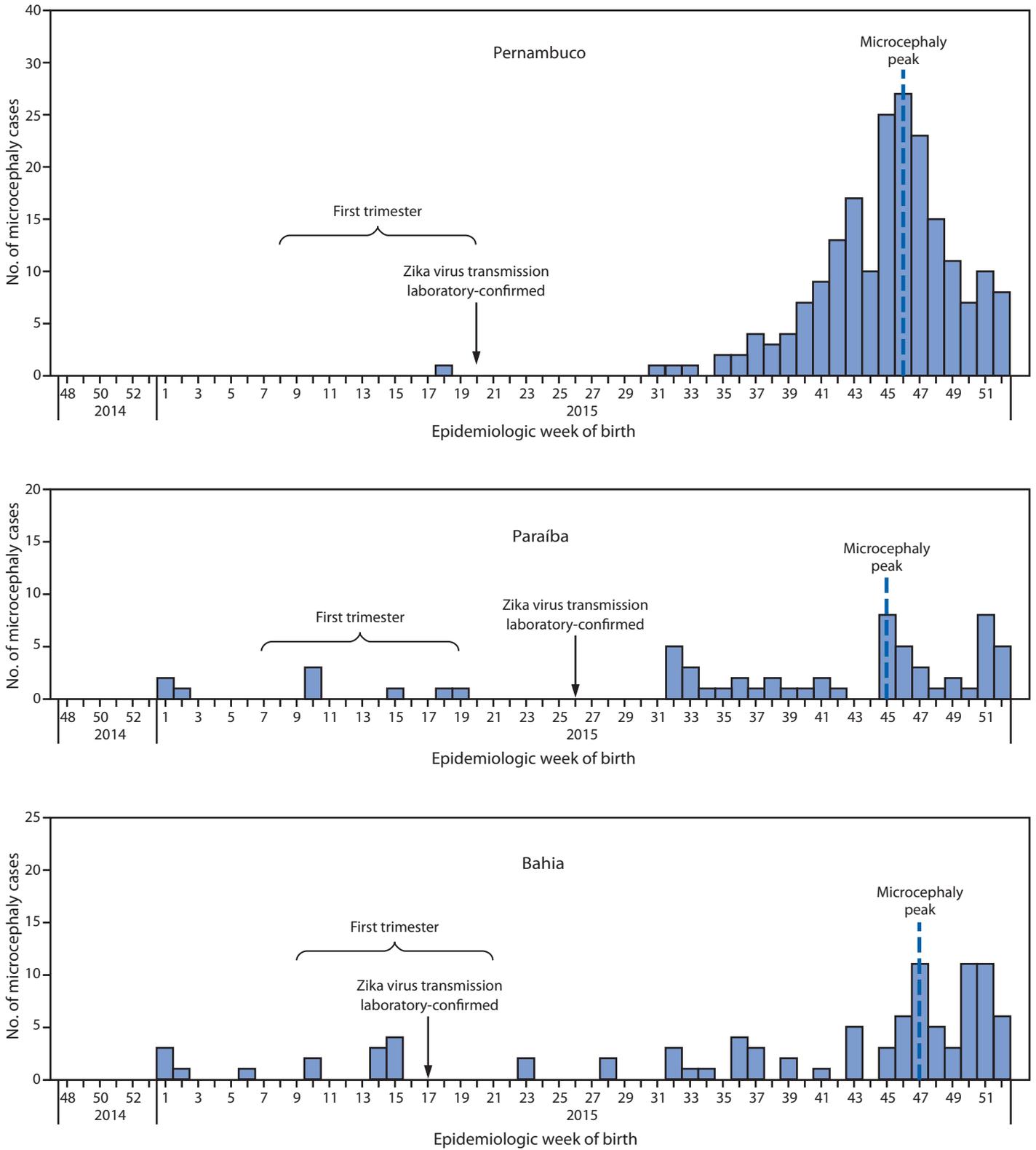
§ From Brazil's Live Birth Information System, 2009–2013 annual series.

¶ Cases of microcephaly per 10,000 live births.

FIGURE 1. Locations of nine states with reported cases of microcephaly in 2015 exceeding 3 standard deviations and three states exceeding 20 standard deviations above the mean number of cases reported annually during 2000–2014 — Brazil, January 1, 2015–January 7, 2016



**FIGURE 2. Number of reported cases of microcephaly\* in full-term† newborns following laboratory-confirmed Zika virus transmission§ — Pernambuco, Paraíba, and Bahia states, Brazil, 2015**



\* Defined as head circumference  $\geq 3$  standard deviations below the mean for age and sex.

† The beginning of the first trimester indicator is estimated as 38 weeks preceding the peak period of reported cases of microcephaly.

§ Confirmed by real time reverse transcription–polymerase chain reaction.

after birth.<sup>†††</sup> In addition, on January 12, 2016, MoH reported RT-PCR–confirmed Zika virus infection in two stillborn infants with central nervous system malformations and two neonates with microcephaly who died during the first hours of life, as determined by investigation by the Federal University of Rio Grande do Norte (Natal, Brazil), in collaboration with CDC.

The findings in this report are subject to at least four limitations. First, this is an ecologic analysis, with only limited laboratory evidence of Zika virus infection for the pregnancy outcomes described. Second, data were obtained from an ad hoc surveillance system established by MoH after the first cases possibly linked to maternal Zika virus disease were identified. The enhanced awareness regarding this event might have resulted in an increased ascertainment and reporting of cases, including identification of false positives. Third, microcephaly was probably underascertained in Brazil before this event, so the increases might not be as large as suggested by these findings; however, they are substantial increases compared with cases of microcephaly reported during 2000–2014, and in some states, such as Paraíba and Pernambuco, exceed the rate of 5.1 per 10,000 births in Brazil during 1995–2008, estimated by the Latin American Collaborative Study of Congenital Malformations (8). Finally, this study was limited to analysis of the temporal and geospatial association between the increased prevalence of microcephaly in Brazil and earlier Zika virus transmission, and other possible causes of microcephaly were not evaluated in this analysis.

The sudden and marked increase in birth prevalence of microcephaly in multiple states in Brazil temporally associated with documented widespread transmission of Zika virus provides additional evidence for the role of Zika virus infection during the first trimester of pregnancy; Zika virus has been demonstrated to cross the placenta, has been associated with congenital infection, and has been recovered in neural tissue (9,10). There is an urgent need for additional research to confirm the link between Zika virus infection and microcephaly through prospective and retrospective analytic studies,

<sup>†††</sup> <http://www.iec.gov.br/index.php/destaque/index/762>.

as well as to determine the critical Zika virus exposure period during pregnancy with respect to possible fetal infection and microcephaly. Pregnant women should protect themselves from mosquito bites by wearing long sleeves and long pants, applying insect repellent, and when spending time indoors, ensure that rooms are protected by screens or mosquito nets.

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<sup>1</sup>Ministry of Health, Brasília, Brazil; <sup>2</sup>Pan American Health Organization, Brazil.

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## Notes from the Field

### Lymphocytic Choriomeningitis Virus Meningoencephalitis from a Household Rodent Infestation — Minnesota, 2015

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On April 20, 2015, a female aged 15 years sought care at her pediatrician's office after 5 days of fever, myalgia, left parietal headache, and photophobia. A rapid influenza assay was negative, and erythrocyte sedimentation rate and total white blood cell count were normal. She improved with symptomatic care at home, but returned to her pediatrician's office on April 28, reporting recurrence of her headache and photophobia and new onset of a stiff neck. She was admitted to the hospital, where she was febrile to 102.9°F (39.4°C) and had meningismus. Computed tomography scan of her head was normal, and a cerebrospinal fluid (CSF) analysis showed a markedly elevated white blood cell count with 68% lymphocytes, low glucose, and a negative Gram stain. She was treated empirically for both bacterial and herpes simplex virus meningitis. The patient's hospital course was notable for hypotension (blood pressure 81/50), irritability, and pancreatitis with a peak lipase of 8,627 U/L. CSF cultures yielded no growth, and CSF polymerase chain reaction (PCR) testing for herpes simplex virus was negative. Nucleic acid amplification testing, acid-fast bacilli stain, and acid-fast bacilli cultures of CSF were negative for *Mycobacterium tuberculosis*. Results of investigations for human immunodeficiency virus, syphilis, Lyme disease, human herpesvirus 6 and 7, and species of *Babesia*, *Toxoplasma*, *Histoplasma*, *Cryptococcus*, *Blastomyces*, and *Brucella* were negative. She recovered and was discharged on hospital day 11 with no apparent sequelae.

The case was reported to the Minnesota Department of Health's Unexplained Critical Illnesses and Deaths Project,\* which provides testing for cases that appear likely to have infectious etiologies although usual laboratory assays do not identify an etiologic agent; specimens collected during the hospitalization were submitted. Serum collected on hospital day 4 was reported to be positive for lymphocytic choriomeningitis virus (LCMV) antibody by immunofluorescence assay at a commercial reference laboratory (Table). CDC's Viral Special Pathogens Branch was consulted because of the uncommon diagnosis and to determine whether this illness represented acute infection. Serologic testing by enzyme-linked immunosorbent assay at CDC showed an immunoglobulin M titer of >1/6,400, consistent with recent infection (Table).

\* <http://www.health.state.mn.us/divs/idepc/dtopics/unexplained/index.html>.

The Minnesota Department of Health initiated an investigation to identify the source of infection, determine whether additional persons were at risk, and develop recommendations to prevent additional cases. A recently ill family member tested negative for LCMV antibody. No pregnant women resided in the duplex apartment. The family had reported a rat infestation to the treating medical team during hospitalization; subsequent home inspection by a Minnesota Department of Health investigator revealed mouse droppings in the kitchen pantry. The fecal pellets tested positive for LCMV (1) by PCR, implicating the mouse infestation as the likely source of the patient's infection. A 2006 case report from Michigan identified household rodents as the source of a human LCMV infection, which was confirmed through necropsy, serology, and tissue testing of trapped mice; fecal pellet testing in that case was negative for LCMV (2). This is the first report to identify LCMV-infected mice through fecal pellet testing.

The family was referred for integrated pest management services through the U.S. Department of Housing and Urban Development Healthy Homes program. The city housing inspector performed an urban rodent survey, and the property owner complied with orders to have professional exterminators treat the apartment within 30 days. Both households in the duplex were provided with educational materials concerning prevention of rodent reinfestation.

In the United States, an etiologic agent is identified in <50% of meningoencephalitis cases (3); some undiagnosed cases might be caused by LCMV. LCMV is a virus of the *Arenaviridae* family; its primary host is the house mouse, *Mus musculus*. The disease burden in humans is unknown; an estimated 5% of U.S. house mice carry LCMV (4). Human infection occurs by inhalation of aerosolized urine and droppings of infected rodents (5). The virus is a fetal teratogen, and transplacental vertical transmission with severe effects on infants has been described (6); infection after solid organ transplant (7–9) also have been reported.

This investigation suggests fecal pellet testing as a possible first step in an environmental LCMV investigation when rodent trapping and conducting necropsy for diagnostics are difficult or impractical. Public health action around home rodent infestation might be warranted when LCMV infections in households are detected. Collaboration among clinicians, public health investigators, and local housing authorities can facilitate integrated pest management to decrease the risk for LCMV infection.

**TABLE. Laboratory findings associated with lymphocytic choriomeningitis virus (LCMV) infection in a patient with meningoencephalitis, by specimen collection date — Minnesota, April–August 2015**

Clinical specimen/Laboratory test	Reference range	Collection date				
		April 28	May 2	May 4	May 21	August 6
<b>Cerebrospinal fluid</b>						
White blood cells/ $\mu$ L	0–10	1,287	—	688	—	—
Red blood cells/ $\mu$ L	0–10	108	—	1,186	—	—
Lymphocytes (%)	<70	68	—	89	—	—
Glucose (mg/dL)	45–80	36	—	26	—	—
Protein (mg/dL)	15–40	94	—	150	—	—
<b>Serum</b>						
LCMV IgM antibodies (IFA)*	<1:10	—	1:40	—	1:20	—
LCMV IgG antibodies (IFA)*	<1:10	—	1:1,280	—	1:2,560	—
LCMV IgM antibodies (ELISA <sup>†</sup> )	<1/100	—	$\geq$ 1/6,400	—	$\geq$ 1/6,400	$\geq$ 1/6,400
LCMV IgG antibodies (ELISA <sup>†</sup> )	<1/100	—	<1/100	—	<1/100	$\geq$ 1/400

**Abbreviations:** ELISA = enzyme-linked immunosorbent assay; IFA = immunofluorescence assay; IgG = immunoglobulin G; IgM = immunoglobulin M.

\* Commercial reference laboratory.

<sup>†</sup> CDC Viral Special Pathogens Branch laboratory.

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## Errata

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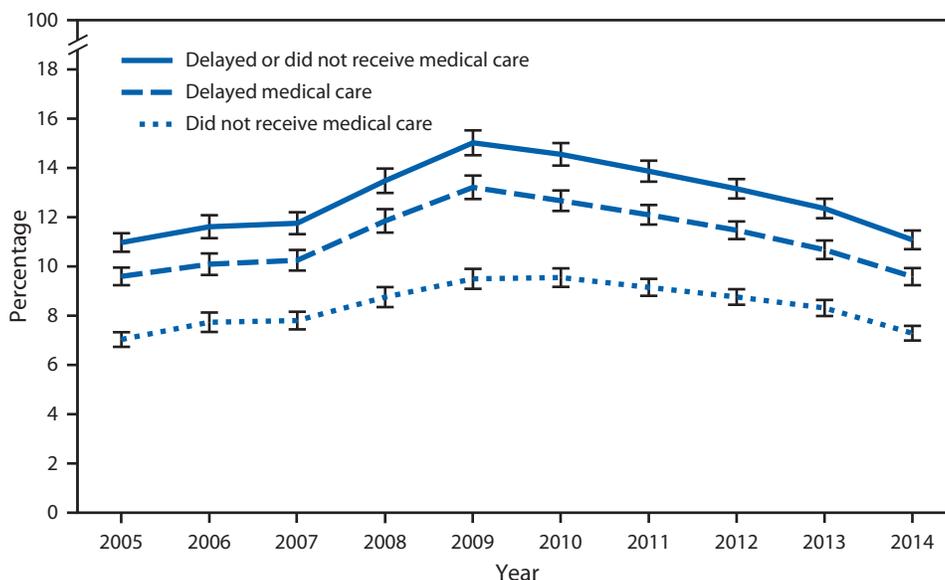
In the report, “Notes from the Field: Administration Error Involving a Meningococcal Conjugate Vaccine — United States, March 1, 2010–September 22, 2015,” on page 162, the end of the first paragraph should contain an additional sentence as follows: **“However, because serogroup A meningococcal disease is rare in the United States, patients only receiving the liquid MenCYW-135 component of Menveo might not need revaccination, unless international travel is anticipated (especially travel to Africa) (3,6).”**

On page 162, in the list of references, an additional reference should be added as follows: **“6. MacNeil JR, Meyer SA. Meningococcal disease. In: Brunette GW, ed. Health information for international travel 2016. New York, NY: Oxford University Press; 2016.”**

## QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

### Percentage\* of Adults Aged 18–64 Years Who Delayed or Did Not Receive Medical Care During the Past 12 Months Because of Cost,<sup>†</sup> by Year — National Health Interview Survey,<sup>§</sup> United States, 2005–2014



\* With 95% confidence intervals indicated with error bars.

<sup>†</sup> Based on responses to the following survey questions: “During the past 12 months, has medical care been delayed for [person] because of worry about the cost?” and “During the past 12 months, was there any time when [person] needed medical care, but did not get it because [person] couldn’t afford it?” Both questions excluded dental care. Respondents were asked to answer regarding themselves and other family members living in the same household.

<sup>§</sup> Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population and are derived from the National Health Interview Survey Family Core component.

From 2005 to 2014, the percentage of adults aged 18–64 years who delayed or did not receive medical care because of cost increased from 11.0% (20.2 million) in 2005 to 15.1% (28.7 million) in 2009, and then decreased to 11.2% (21.7 million) in 2014. During the same period, the percentage of adults aged 18–64 years who delayed medical care because of cost increased from 9.7% (17.6 million) in 2005 to 13.3% (25.2 million) in 2009, and then decreased to 9.6% (18.8 million) in 2014. In addition, the percentage of adults aged 18–64 years who did not receive medical care because of cost increased from 7.1% (12.9 million) in 2005 to 9.6% in 2009 and 2010, and then decreased to 7.3% (14.3 million) in 2014.

**Source:** National Health Interview Survey, 2005–2014 data. <http://www.cdc.gov/nchs/nhis.htm>.

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