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Disparities in Hospital-Reported Breast Milk Use in Neonatal Intensive Care Units — United States, 2015

Ellen O. Boundy, ScD[1,2]; Cria G. Perrine, PhD[2]; Jennifer M. Nelson, MD[2]; Heather C. Hamner, PhD[2]

Breast milk is the recommended nutrition for infants. For preterm infants, when mother's milk is not available, pasteurized donor milk is recommended (*1*). Non-Hispanic black mothers are at increased risk for having a preterm birth and for not breastfeeding (*2*,*3*); however, it is not known whether demographic disparities exist in the use of breast milk in neonatal intensive care units (NICUs). Data from CDC's 2015 Maternity Practices in Infant Nutrition and Care (mPINC) survey, which does not collect patient-level demographics, were linked to the 2011–2015 U.S. Census Bureau's American Community Survey (ACS)* to examine use of breast milk in NICUs based on demographic makeup of the hospital's postal code area. Among U.S. hospitals with a NICU, the use of mother's own milk and donor milk were examined by the percentage of non-Hispanic black (black) residents in the hospital postal code area, categorized as being above or below the national average (12.3%). In postal codes with >12.3% black residents, 48.9% of hospitals reported using mothers' own milk in ≥75% of infants in the NICU, and 38.0% reported not using donor milk, compared with 63.8% and 29.6% of hospitals, respectively, in postal codes with ≤12.3% black residents. Further investigation is needed to understand variations in breast milk use in NICUs. Targeted efforts to increase breast milk use in hospitals located in postal codes where the percentage of black mothers is above the national average might help ensure more equitable access to breast milk for preterm and other high-risk infants.

The American Academy of Pediatrics (AAP) recommends that infants receive breast milk. In addition to the nutritional benefits of breast milk, consumption of breast milk by preterm infants is associated with lower rates of sepsis and necrotizing enterocolitis, and a number of other improved health outcomes (*1*). When mother's own milk is contraindicated or insufficient, pasteurized donor milk is recommended (*4*). Black mothers are at increased risk for preterm birth and delivering a low birthweight infant and have lower rates of breastfeeding initiation and duration than do white and Hispanic mothers (*2*,*3*). Mothers of infants in the NICU often face challenges with breastfeeding because of their infants' health conditions as well as being separated from their infants. The use of donor breast milk for high-risk infants is increasing, but access continues to be limited as hospital demand outpaces milk bank supply (*4*,*5*). Little is known about disparities in the use of breast milk for infants hospitalized in NICUs.

CDC's mPINC survey is a census of facilities providing maternity care in the United States and territories (*6*). The survey is completed by the person or persons who are most knowledgeable about the facility's practices related to infant nutrition. Information collected included facility characteristics, including hospital type; whether the facility is a teaching hospital; size (births per year); and neonatal care unit level (classified as level III or IV based on their ability to provide

* https://www.census.gov/programs-surveys/acs/.

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risk-appropriate subspecialty intensive care). Hospitals with a NICU report the approximate percentage of infants in the NICU routinely receiving mother's own breast milk and banked donor breast milk. Because patient-level demographics are not collected as part of the mPINC, neighborhood-level data were obtained from the ACS to explore potential racial disparities. ACS is an ongoing survey of demographic, social, and housing characteristics, with postal code–level race data reported in 5-year estimates. Data from the 2015 mPINC were linked to 2011–2015 ACS data by hospital postal code. In 2015, the mPINC response rate was 82%, and included 2,582 participating facilities. Among 654 hospitals with a NICU, 602 (92.0%) had postal code–level race data available in ACS, including 576 (95.7%) and 568 (94.4%) that had data on mother's own milk use and donor milk use, respectively. Hospitals were categorized as being in a postal code where the percentage of black residents was >12.3% (the national average) or ≤12.3%. No accepted cut-points exist for the prevalence of infants in the NICU receiving breast milk; therefore, receipt of breast milk was grouped into four categories at 25% intervals to illustrate the distribution of use across hospitals.

Because data were skewed, the median prevalence and interquartile range (IQR) of infants routinely receiving mother's own and donor milk was calculated across hospitals, with stratification by the percentage of black residents in the hospital postal code above or below the national average. Chi-square, Fisher's Exact, and, for continuous variables, Wilcoxon Rank-Sum tests were performed using statistical software.

Among 602 hospitals with NICUs, 222 (36.9%) were located in postal codes where the percentage of black residents exceeded the national average (Table 1). Overall, 145 of 580 (25.0%) hospitals were teaching hospitals, and 86 of 579 (14.9%) were government-run; in postal codes with higher percentages of black residents, the percentage of teaching hospitals (32.4%) and of government-run hospitals (20.5%) was higher than in postal codes with lower percentages of black residents (20.6% and 11.5%, respectively). NICU level and facility size were similar in hospitals in postal codes with high and low percentages of black residents.

Across all hospitals, the median estimated prevalence of infants in NICUs receiving mother's own milk was 75.0% (IQR = 60.0%–86.0%); the percentage was higher in NICUs in postal codes with lower percentages of black residents (80.0%) than in those in postal codes with higher percentages of black residents (72.0%) ($p<0.01$) (Table 2). The median prevalence of infants receiving banked donor breast milk across all NICUs was 10.0% (IQR = 0%–20.0%); the percentage was higher in NICUs in postal codes with lower percentages of black residents (10.0%) than in NICUs in postal codes with higher percentages of black residents (5.0%) ($p = 0.04$) (Table 2).

Less than half (48.9%) of hospitals in postal codes with higher percentages of black residents reported that ≥75% of infants in the NICU received mother's own breast milk, compared with 63.8% of NICUs in postal codes with lower percentages of black residents (Figure). Similarly, 38.0% of hospitals in postal codes with higher percentages of black

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TABLE 1. Characteristics of hospitals with a neonatal intensive care unit, by racial composition of hospital postal code area — United States, 2015

Hospital characteristic	All hospitals (n = 602), no. (%)*	Percentage of non-Hispanic black residents in hospital postal code area, no. (%)		p-value†
		≤12.3% (n = 380)	>12.3% (n = 222)	
Neonatal intensive care unit level§				0.24
III	525 (87.2)	336 (88.4)	189 (85.1)	
IV	77 (12.8)	44 (11.6)	33 (14.9)	
Hospital type¶				0.01
Government	86 (14.9)	42 (11.5)	44 (20.5)	
Nonprofit	406 (70.1)	264 (72.5)	142 (66.0)	
Private	87 (15.0)	58 (15.9)	29 (13.5)	
Teaching hospital				<0.01
Yes	145 (25.0)	75 (20.6)	70 (32.4)	
No	435 (75.0)	289 (79.4)	146 (67.6)	
Facility size (no. of births in past year)				0.45
1–499	9 (1.5)	6 (1.6)	3 (1.4)	
500–999	38 (6.3)	28 (7.4)	10 (4.5)	
1000–1999	166 (27.6)	106 (27.9)	60 (27.0)	
2000–4999	344 (57.1)	216 (56.8)	128 (57.7)	
≥5000	45 (7.5)	24 (6.3)	21 (9.5)	

* Total number does not sum to 602 for hospital type and teaching status because of missing values (n = 22).
† Chi-square test or Fisher's Exact test if one or more cells with expected count <5.
§ Level III indicates facilities with capability to care for infants born before 32 weeks' gestational age and weighing <1500 g and infants born at all gestational ages and birthweights with critical illnesses, with availability of a range of pediatric subspecialists; level IV indicates regional neonatal intensive care units with all level III capabilities, plus availability of pediatric surgical subspecialists.
¶ Military hospital data excluded in stratification by hospital type because of the small number of facilities, but are included in all other analyses.

TABLE 2. Percentage of infants routinely receiving mother's own breast milk and banked donor breast milk in neonatal intensive care units, by racial composition of hospital postal code area — United States, 2015

Source of breast milk	No.	Median (interquartile range), (%)	Range, %	p-value*
Mother's own breast milk				
Total (all hospitals)	576	75.0 (60.0–86.0)	0–100	<0.01
Percentage of non-Hispanic black residents in hospital postal code area				
Low†	359	80.0 (65.0–90.0)	0–100	
High	217	72.0 (60.0–85.0)	2.0–100	
Banked donor breast milk				
Total (all hospitals)	568	10.0 (0–20.0)	0–100	0.04
Percentage of non-Hispanic black residents in hospital postal code area				
Low	352	10.0 (0–20.0)	0–100	
High	216	5.0 (0–20.0)	0–100	

* Wilcoxon Rank-Sum test.
† Low: ≤12.3% (national average); high: >12.3%.

residents reported that no infants in the NICU received donor breast milk, and 5.1% reported that at least half of infants in the NICU received donor breast milk, compared with 29.6% and 11.4%, respectively, of NICUs in postal codes with lower percentages of black residents (Figure).

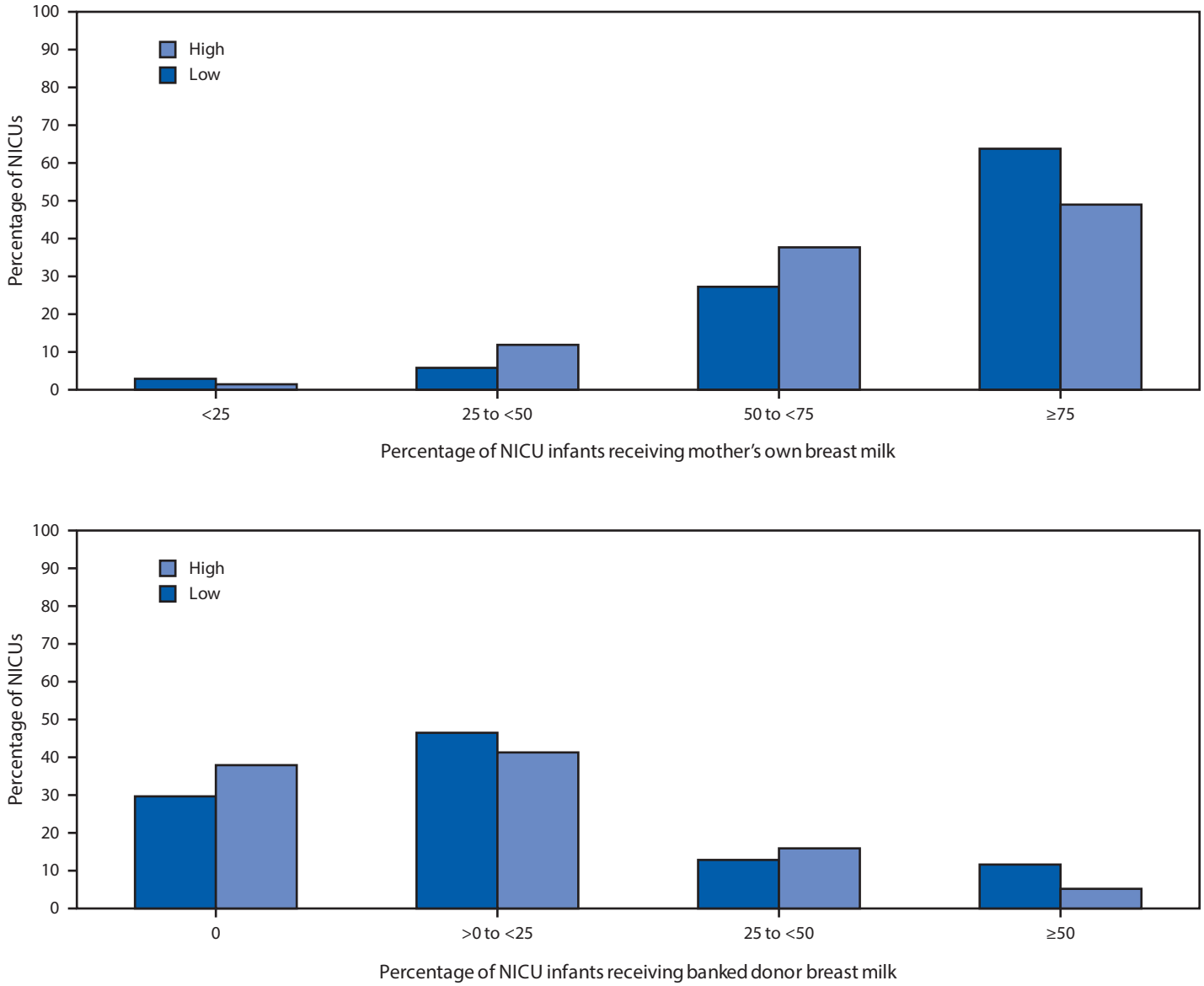
Discussion

The use of both mother's own and donor breast milk in NICUs was lower in hospitals located in postal codes with higher percentages of black residents than those in areas with lower percentages of black residents. This suggests that disparities exist in the provision of breast milk for high-risk infants by community or hospital characteristics despite breastfeeding being the optimal form of nutrition in their first days of life (*1*).

Differences in breast milk use in NICUs by racial composition of the surrounding community might be related to a range of factors, similar to those that have been found to affect breastfeeding rates overall. These include variations in health care personnel support, hospital policies and practices, mothers' knowledge and access to information, and community-level support for breastfeeding (*7*,*8*). Donor milk use might also be affected by hospital proximity to milk banks, state regulations and hospital policies related to the provision of donor milk, and insurance reimbursement (*4*). There are currently 23 nonprofit milk banks accredited by the Human Milk Banking Association of North America, 10 of which are located in postal codes with a percentage of black residents >12.3%, as well as other commercial for-profit milk banks across the United States.†

† https://www.hmbana.org.

FIGURE. Percentage of infants in neonatal intensive care units (NICUs) receiving mother's own breast milk or banked donor breast milk, by racial composition of hospital postal code area* — United States, 2015



* Percentage of non-Hispanic black residents in hospital postal code area. Low: ≤12.3% (national average); high: >12.3%.

The findings in this report are subject to at least five limitations. First, neighborhood demographics were used as a proxy for the racial makeup of the hospital's patient population. It was assumed that women tend to use hospitals in their postal code of residence, which is not always the case. If a significant proportion of mothers choose to seek care or are transferred to hospitals in postal codes of a different racial makeup than their own, then it is possible that our results might be biased. However, there was no statistical difference in the level of care provided by NICUs by percentage of black residents. In addition, the sample was limited to level III and IV NICUs, which provide care for high-risk patients, thereby attempting to reduce this potential bias. Second, the reported percentage of infants receiving breast milk might be inaccurate, but this is not likely to differ by racial make-up of the hospital community. Third, although AAP recommends that all infants receive mother's own milk unless it is unavailable or contraindicated (*1*), the percentage of high-risk infants who should receive donor milk is unknown, making interpretation of these results challenging. Fourth, mPINC does not capture data on NICUs in hospitals that do not perform deliveries, such as some children's hospitals. Finally, nonresponse bias was also possible.

Summary

What is already known about this topic?

Breast milk is the recommended nutrition for infants, and is particularly beneficial for preterm infants. Non-Hispanic black mothers are at increased risk for preterm birth, and also have lower breastfeeding rates. Some data suggest there might be limited access to donor milk, which is recommended for preterm and other high-risk infants when mother's milk is unavailable.

What is added by this report?

Data from the 2015 Maternity Practices in Infant Nutrition and Care (mPINC) survey of all U.S. maternity facilities, linked with postal code–level race data from the U.S. Census, found that hospitals in areas with higher percentages of black residents reported lower percentages of infants in the neonatal intensive care unit (NICU) routinely receiving mother's own breast milk (median = 72.0%) or banked donor breast milk (median = 5.0%) than did hospitals in areas with lower percentages of black residents (median = 80.0% and 10.0%, respectively).

What are the implications for public health practice?

Targeted interventions among hospitals in areas serving a higher proportion of non-Hispanic black residents might help ensure more equitable access to breast milk for all high-risk infants. Further investigation is needed to understand factors affecting variations in breast milk use in NICUs.

AAP recommends breast milk as the primary source of nutrition for infants, and supports equal access to donor breast milk based on medical necessity for all high-risk infants when mother's milk is unavailable (*1*,*4*). The 2011 Surgeon General's Call to Action to Support Breastfeeding recommends that stakeholders "identify and address obstacles to greater availability of safe banked donor milk for fragile infants" (*9*). Interventions aimed at increasing the use of breast milk in NICUs among hospitals serving higher percentage black patient populations might help reduce some of the disparities observed in this analysis. Health care providers can play a role in facilitating initiation of breastfeeding or breast milk expression after birth. Hospitals can ensure that policies and staff member training are in place to support provision of breast milk specific to high-risk infants. Safe and equitable access to milk from donor banks is also a factor in ensuring that all high-risk infants receive optimal nutrition. Understanding policies and practices at hospitals with higher breast milk use in the NICU might help inform interventions to increase its use in other facilities. Further investigation into cultural and community practices and preferences related to breast milk might also help in understanding differences in its use.

Conflict of Interest

No conflicts of interest were reported.

[1]Epidemic Intelligence Service, CDC; [2]Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC.

Corresponding author: Ellen O. Boundy, lwz9@cdc.gov, 770-488-4438.

References

1. American Academy of Pediatrics. Policy statement: breastfeeding and the use of human milk. Pediatrics 2012;129:e827–41. https://doi.org/10.1542/peds.2011-3552
2. Hamilton BE, Martin JA, Osterman MJK. Births: preliminary data for 2015. Natl Vital Stat Rep 2016;65:1–15.
3. Allen JA, Li R, Scanlon KS, et al. Progress in increasing breastfeeding and reducing racial/ethnic differences—United States, 2000–2008 births. MMWR Morb Mortal Wkly Rep 2013;62:77–80.
4. Committee on Nutrition, Section on Breastfeeding, Committee on Fetus and Newborn. Donor human milk for the high-risk infant: preparation, safety, and usage options in the United States. Pediatrics 2017;139:e20163440. https://doi.org/10.1542/peds.2016-3440
5. Updegrove KH. Donor human milk banking: growth, challenges, and the role of HMBANA. Breastfeed Med 2013;8:435–7. https://doi.org/10.1089/bfm.2013.0079
6. CDC. Maternity Practices in Infant Nutrition and Care (mPINC) survey. Atlanta, GA: US Department of Health and Human Services, CDC; 2015. https://www.cdc.gov/breastfeeding/data/mpinc/
7. Lind JN, Perrine CG, Li R, Scanlon KS, Grummer-Strawn LM. Racial disparities in access to maternity care practices that support breastfeeding—United States, 2011. MMWR Morb Mortal Wkly Rep 2014;63:725–8.
8. Jones KM, Power ML, Queenan JT, Schulkin J. Racial and ethnic disparities in breastfeeding. Breastfeed Med 2015;10:186–96. https://doi.org/10.1089/bfm.2014.0152
9. US Department of Health and Human Services. The Surgeon General's call to action to support breastfeeding. Washington, DC: US Department of Health and Human Services, Office of the Surgeon General, 2011. https://www.ncbi.nlm.nih.gov/books/NBK52682/

Update: Influenza Activity — United States, October 1–November 25, 2017

Vivien G. Dugan, PhD[1]; Lenee Blanton, MPH[1]; Anwar Isa Abd Elal[1]; Noreen Alabi, MPH[1]; John Barnes, PhD[1]; Lynnette Brammer, MPH[1]; Erin Burns, MA[1]; Charisse N. Cummings, MPH[1]; Todd Davis, PhD[1]; Brendan Flannery, PhD[1]; Alicia M. Fry, MD[1]; Shikha Garg, MD[1]; Rebecca Garten, PhD[1]; Larisa Gubareva, PhD[1]; Yunho Jang, PhD[1]; Krista Kniss, MPH[1]; Natalie Kramer[1]; Stephen Lindstrom, PhD[1]; Desiree Mustaquim, MPH[1]; Alissa O'Halloran, MSPH[1]; Sonja J. Olsen, PhD[1]; Wendy Sessions, MPH[1]; Calli Taylor, MPH[1]; Susan Trock, DVM[1]; Xiyan Xu, MD[1]; David E. Wentworth, PhD[1]; Jacqueline Katz, PhD[1]; Daniel Jernigan, MD[1]

Influenza activity in the United States was low during October 2017, but has been increasing since the beginning of November. Influenza A viruses have been most commonly identified, with influenza A(H3N2) viruses predominating. Several influenza activity indicators were higher than is typically seen for this time of year. The majority of influenza viruses characterized during this period were genetically or antigenically similar to the 2017–18 Northern Hemisphere cell-grown vaccine reference viruses. These data indicate that currently circulating viruses have not undergone significant antigenic drift; however, circulating A(H3N2) viruses are antigenically less similar to egg-grown A(H3N2) viruses used for producing the majority of influenza vaccines in the United States. It is difficult to predict which influenza viruses will predominate in the 2017–18 influenza season; however, in recent past seasons in which A(H3N2) viruses predominated, hospitalizations and deaths were more common, and the effectiveness of the vaccine was lower. Annual influenza vaccination is recommended for all persons aged ≥6 months who do not have contraindications. Multiple influenza vaccines are approved and recommended for use during the 2017–18 season, and vaccination should continue to be offered as long as influenza viruses are circulating and unexpired vaccine is available. This report summarizes U.S. influenza activity* during October 1–November 25, 2017 (surveillance weeks 40–47).†

Viral Surveillance

U.S. World Health Organization (WHO) and National Respiratory and Enteric Virus Surveillance System laboratories, which include both public health and clinical laboratories throughout the United States, contribute to virologic surveillance for influenza. During October 1–November 25, 2017, clinical laboratories tested 135,202 specimens for influenza virus; 5,070 (3.7%) specimens tested positive for influenza virus (Figure 1), including 3,723 (73.4%) that tested positive for influenza A viruses and 1,347 (26.6%) that tested positive for influenza B viruses.

Public health laboratories tested 8,777 specimens during October 1–November 25, 2017, and 1,969 (22.4%) were positive for influenza, including 1,714 (87%) influenza A and 255 (13%) influenza B viruses (Figure 2). Among the 1,696 influenza A viruses subtyped, 1,527 (90%) were influenza A(H3N2) viruses, and 169 (10%) were influenza A(H1N1)pdm09 viruses. Influenza B virus lineage information was available for 170 (66.1%) tested influenza B viruses; 159 (93.5%) belonged to the B/Yamagata lineage and 11 (6.5%) to the B/Victoria lineage.

Data on age were available for 1,737 influenza-positive patients tested by public health laboratories. Overall, 163 (9.4%) persons were aged 0–4 years, 475 (27.3%) were aged 5–24 years, 576 (33.2%) were aged 25–64 years, and 523 (30.1%) were aged ≥65 years. Influenza A(H3N2) viruses were predominant among all age groups, accounting for 69.9% of viruses identified among persons aged 0–4 years and 87.8% of viruses reported among persons aged ≥65 years. The largest proportion of reported influenza B viruses occurred in persons aged 5–24 years; influenza B viruses accounted for 16.6% of the viruses reported for that age group.

Novel Influenza A Viruses

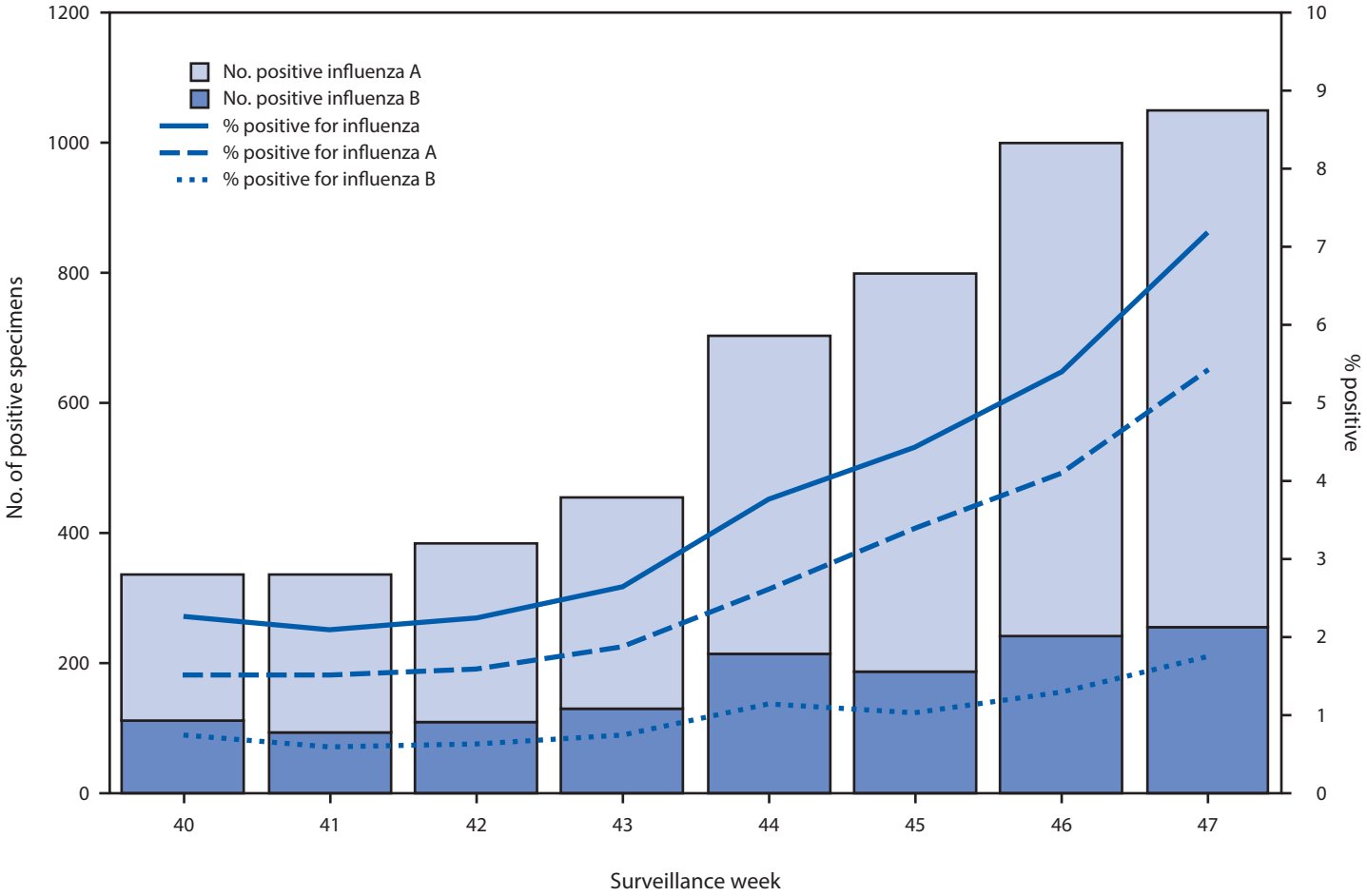
Five human infections with novel influenza A viruses were reported to CDC by five states (one each in Colorado, Iowa, Michigan, Nebraska, and Ohio) during October 1–November 25, 2017. All of these were variant§ virus infections (human infections with influenza viruses that normally circulate in swine). Two infections were caused by influenza A(H3N2)v viruses, two by influenza A(H1N2)v

* The CDC influenza surveillance system collects five categories of information from eight data sources: 1) viral surveillance (U.S. World Health Organization collaborating laboratories, the National Respiratory and Enteric Virus Surveillance System, and novel influenza A virus case reporting); 2) outpatient illness surveillance (U.S. Outpatient Influenza-Like Illness Surveillance Network); 3) mortality (National Center for Health Statistics Mortality Surveillance System and influenza-associated pediatric mortality reports); 4) hospitalizations (FluSurv-NET, which includes the Emerging Infections Program and surveillance in three additional states); and 5) summary of the geographic spread of influenza (state and territorial epidemiologist reports). https://www.cdc.gov/flu/weekly/fluactivitysurv.htm.

† Data as of December 1, 2017.

§ Influenza viruses that circulate in swine are called swine influenza viruses when isolated from swine but are called variant influenza viruses when isolated from humans. Seasonal influenza viruses that circulate worldwide in the human population have important antigenic and genetic differences from influenza viruses circulating in swine.

FIGURE 1. Number* and percentage of respiratory specimens testing positive for influenza reported by clinical laboratories, by influenza virus type and surveillance week — United States, October 1–November 25, 2017†

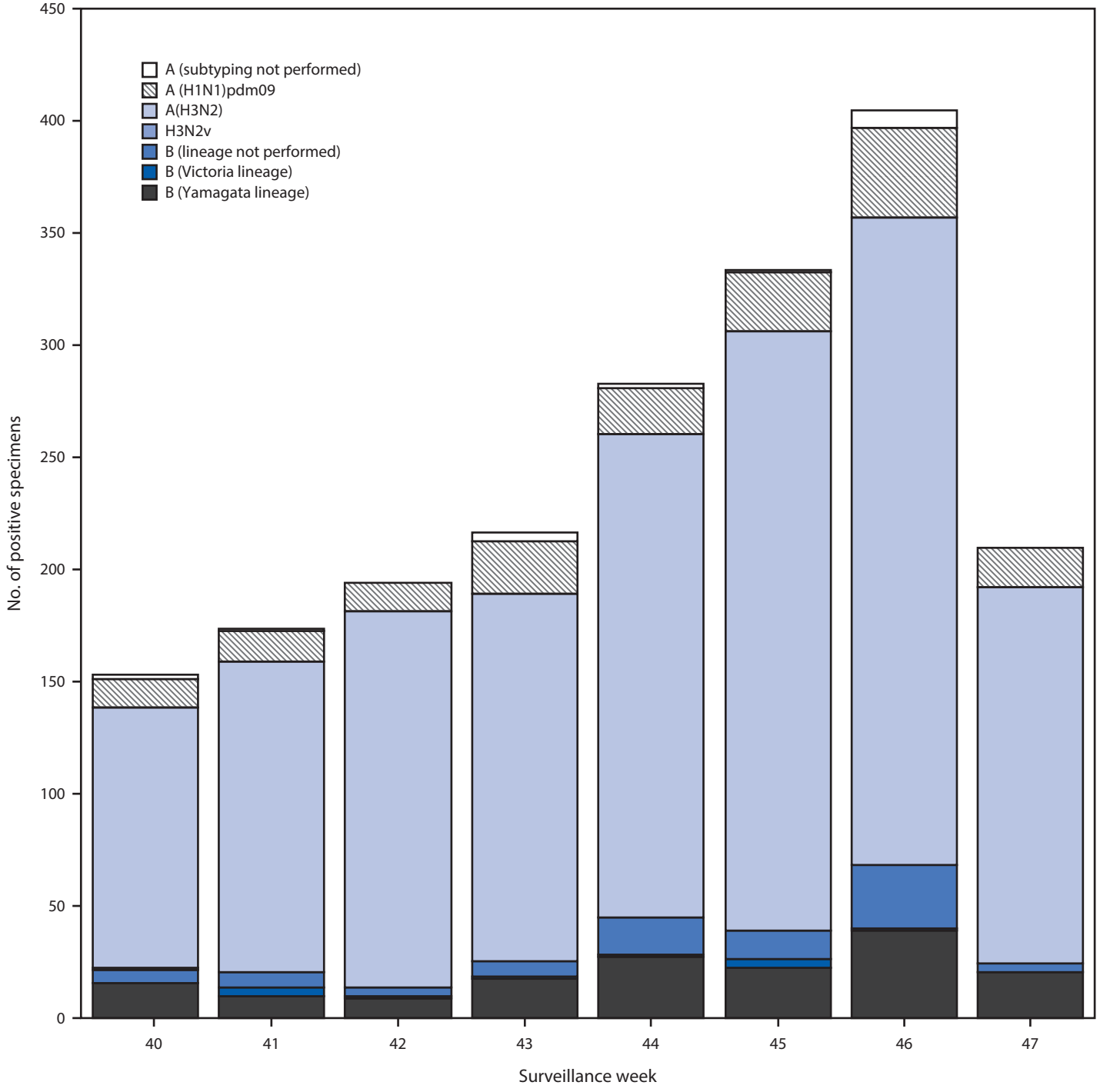


* Specimens from 5,070 (3.7%) of 135,202 persons tested positive during October 1–November 25, 2017.
† As of December 1, 2017.

viruses, and one by an influenza A(H1N1)v virus. The patient from Colorado reported exposure to swine at an agricultural event during the week preceding illness onset. The patient from Iowa had direct contact with swine during the week preceding illness onset. The patient from Michigan was a close contact of a person with laboratory-confirmed A(H3N2)v virus infection that had been reported earlier this year. Although that patient also reported exposure to swine, it occurred more than a week before illness onset, which is outside the typical incubation period. It is possible that this infection resulted from limited human-to-human transmission. The patient from Nebraska reported no contact with swine during the week preceding illness onset; however, a household member did report exposure to swine. The patient from Ohio reported exposure to swine at an agricultural fair during the week preceding illness onset. Two of the five patients were children aged <18 years, one patient was an adult aged 18–44 years, and two patients were adults aged ≥45 years. Two of the patients were hospitalized, and all have fully recovered from their illness. No ongoing human-to-human transmission was identified.

The A(H3N2)v viruses detected in Michigan and Nebraska had a hemagglutinin (HA) gene segment derived from a seasonal human H3N2 virus that was likely introduced into swine by reverse zoonosis (i.e., humans infecting swine) in 2010. These viruses were closely related to H3N2 viruses known to circulate in the U.S. swine population (*1*), as well as to variant virus infections detected in Delaware, Maryland, Michigan, North Dakota, Ohio, and Pennsylvania during May–September 2017 (*2*). The A(H1N2)v viruses detected in Colorado and Ohio had HA gene segments from the delta sublineage of the classical swine H1 HA lineage (*3*). The HA and neuraminidase (NA) gene segments of this virus were closely related to 2016/2017 H1N2 influenza viruses known to circulate in the U.S. swine population and have been sporadically detected in other A(H1N2)v virus infections. The A(H1N1)v virus detected in Iowa had HA and NA gene segments derived

FIGURE 2. Number* of respiratory specimens testing positive for influenza reported by public health laboratories, by influenza virus type, subtype/lineage, and surveillance week — United States, October 1–November 25, 2017†



* N = 1,970.
† As of December 1, 2017.

from the seasonal human H1N1pdm09 virus that was likely introduced into swine by a recent reverse zoonosis. This virus was closely related to H1N1 influenza viruses currently circulating in the U.S. swine population.

Antigenic and Genetic Characterization of Influenza Viruses

In the United States, public health laboratories participating in influenza surveillance as WHO collaborating laboratories are asked to submit a subset of influenza-positive respiratory specimens to CDC for virus characterization according to specific guidelines (*4*). CDC characterizes influenza viruses through one or more laboratory tests, including genomic sequencing, antigenic characterization by hemagglutination inhibition (HI), or neutralization assays. Circulating viruses that have been isolated and propagated in mammalian cell culture are evaluated for antigenic similarity with cell culture–propagated reference viruses representing the recommended vaccine components of the Northern Hemisphere 2017–18 vaccine (*5*). This process establishes whether antigenic drift from the vaccine reference viruses has occurred.

All influenza-positive surveillance specimens submitted for surveillance and received by CDC are sequenced by next generation sequencing (NGS), using previously described genomic enrichment practices (*6*–*8*) adapted by CDC. The genomic data from the NGS pipeline are analyzed to determine the genetic identity of circulating viruses and submitted to public databases (GenBank or GISAID EpiFlu). Data obtained from antigenic characterization are important in the assessment of the similarity between reference vaccine viruses and circulating viruses. In vitro antigenic characterization data generated through HI assays or virus neutralization assays are used to assess whether genetic changes in circulating viruses affect antigenicity, which subsequently might affect vaccine effectiveness.

Since the 2014–15 season, many influenza A(H3N2) viruses lack sufficient hemagglutination titers for antigenic characterization using HI assays. Therefore, a subset of influenza A(H3N2) viruses are selected for antigenic characterization using the virus neutralization focus reduction assay to assess the ability of various antisera to neutralize infectivity of the test viruses. CDC has antigenically or genetically characterized 277 influenza viruses collected and submitted by U.S. laboratories since October 1, 2017, including 38 influenza A(H1N1)pdm09 viruses, 187 influenza A(H3N2) viruses, and 52 influenza B viruses.

Phylogenetic analysis of the HA gene segments from 38 A(H1N1)pdm09 viruses collected since October 1, 2017, showed that all belonged to subclade 6B.1 (Figure 3). Thirteen A(H1N1)pdm09 viruses were analyzed using HI assays with ferret antisera, and all of these viruses were antigenically similar to the cell culture–propagated 6B.1 virus A/Michigan/45/2015, the reference virus representing the A(H1N1)pdm09 vaccine virus for the 2017–18 Northern Hemisphere influenza season.

One hundred and eighty-seven influenza A(H3N2) viruses collected since October 1, 2017, were sequenced, and phylogenetic analysis of the HA gene segments illustrated that multiple clades/subclades were cocirculating (Figure 3). The HA gene segments belonged to clade 3C.2a or subclade 3C.2a1, with 3C.2a predominating (Figure 3). Sixty-four influenza A(H3N2) viruses were antigenically characterized, and 63 (98.4%) were well-inhibited (reacting at titers that were within fourfold of the homologous virus titer) by ferret antisera raised against A/Michigan/15/2014 (3C.2a), a cell-propagated A/Hong Kong/4801/2014–like reference virus representing the A(H3N2) component of the 2017–18 Northern Hemisphere influenza vaccines. Although considerable genetic diversity has been observed among H3N2 viruses, there has been no evidence of significant antigenic drift in the limited number of H3N2 viruses tested from this season. A smaller number, 45 (70.3%) of viruses tested, were well-inhibited by antiserum raised against egg-propagated A/Hong Kong/4801/2014 reference virus representing the A(H3N2) vaccine component. This is likely because of egg-adaptive amino acid changes in the HA of the egg-propagated virus.

Two influenza B/Victoria-lineage viruses were sequenced and phylogenetically analyzed, and the HA gene segment of both viruses belonged to genetic clade V1A, the same genetic clade as the vaccine reference virus, B/Brisbane/60/2008. However, the HA gene segment of one virus has a 6-nucleotide deletion (encoding amino acids 162 and 163) and viruses like this, abbreviated as V1A-2Del, were previously reported (*2*). This V1A-2Del virus was poorly inhibited (reacting at titers that were eightfold or more reduced compared with the homologous virus titer) with antisera raised to cell culture–propagated B/Brisbane/60/2008, the reference virus representing the B/Victoria lineage component of 2017–18 Northern Hemisphere vaccines.

Phylogenetic analysis of 50 influenza B/Yamagata-lineage viruses show that the HA gene segments belonged to clade Y3 (Figure 3). Fourteen B/Yamagata lineage viruses were antigenically characterized, and all were antigenically similar to the cell culture–propagated B/Phuket/3073/2013, the reference virus representing the B/Yamagata-lineage component of quadrivalent vaccines for the 2017–18 Northern Hemisphere influenza season.

Antiviral Resistance of Influenza Viruses

The WHO Collaborating Center for Surveillance, Epidemiology, and Control of Influenza at CDC tested 291 influenza virus specimens (41 influenza A(H1N1)pdm09, 200 influenza A(H3N2), and 50 influenza B viruses) collected in the United States since October 1, 2017, for resistance to the influenza NA inhibitor antiviral medications oseltamivir, zanamivir, and peramivir, drugs currently approved for use against seasonal influenza. All 291 influenza viruses tested were sensitive to all three antiviral medications. High levels of resistance to the adamantanes (amantadine and rimantadine) persist among influenza A(H1N1)pdm09 and influenza A(H3N2) viruses. Adamantane drugs are not recommended for use against influenza at this time.

Outpatient Illness Surveillance

During October 1–November 25, 2017, the weekly percentage of outpatient visits for influenza-like illness[¶] (ILI) to heath care providers participating in the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet) ranged from 1.3% to 2.3%. During the week ending November 25, 2.3% of patient visits reported through ILINet were for ILI, which is above the national baseline[**] level of 2.2% (Figure 4). The increase in the percentage of patient visits for ILI during the week ending November 25 (surveillance week 47) might be influenced in part by a reduction in routine health care visits during the holidays, as has occurred in previous seasons. During the week ending November 25, four of 10 U.S. Department of Health and Human Services regions[††] (Regions 1, 4, 6, and 7) reported a percentage of outpatient visits for ILI at or above their region-specific baseline levels.

ILINet data are used to produce a weekly jurisdiction-level measure of ILI activity,[§§] ranging from minimal to high. For the week ending November 25, three states (Louisiana, Mississippi, and South Carolina) experienced high ILI activity; one state (Georgia) experienced moderate ILI activity; 10 states (Alabama, Alaska, Arizona, Hawaii, Massachusetts, Nebraska, Oklahoma, South Dakota, Texas, and Virginia) experienced low ILI activity; the District of Columbia, New York City, and 36 states (Arkansas, California, Colorado, Connecticut, Delaware, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming) experienced minimal ILI activity; and Puerto Rico had insufficient data to calculate an ILI activity level.

Geographic Spread of Influenza Activity

Influenza activity levels reported by state and territorial epidemiologists indicate the geographic spread of influenza viruses. For the week ending November 25 (surveillance week 47), four states (Georgia, Louisiana, Massachusetts, and Oklahoma) reported widespread activity.[¶¶] Guam and 10 states (Arkansas, Connecticut, Kentucky, Maine, Mississippi, New Hampshire, North Dakota, Oregon, South Carolina, and Washington) reported regional activity. Puerto Rico and 24 states (Alabama, Alaska, Arizona, California, Colorado, Florida, Hawaii, Illinois, Kansas, Maryland, Minnesota, Missouri, Nebraska, New Jersey, New Mexico, New York, Ohio, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Wisconsin, and Wyoming) reported local activity. The District of Columbia, the U.S. Virgin Islands, and 12 states (Delaware,

[¶] Defined as a fever (temperature ≥100°F [≥37.8°C], oral or equivalent) and cough or sore throat, without a known cause other than influenza.

[**] The national and regional baselines are the mean percentage of visits for ILI during noninfluenza weeks for the previous three seasons plus two standard deviations. Noninfluenza weeks are defined as periods of ≥2 consecutive weeks in which each week accounted for <2% of the season's total number of specimens that tested positive for influenza in public health laboratories. National and regional percentages of patient visits for ILI are weighted based on state population. Use of the national baseline for regional data is not appropriate.

[††] The 10 regions include the following jurisdictions. *Region 1*: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2*: New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands; *Region 3*: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4*: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee; *Region 5*: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6*: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7*: Iowa, Kansas, Missouri, and Nebraska; *Region 8*: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9*: Arizona, California, Hawaii, Nevada, American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Marshall Islands, and Republic of Palau; *Region 10*: Alaska, Idaho, Oregon, and Washington.

[§§] Activity levels are based on the percentage of outpatient visits in a jurisdiction attributed to ILI and are compared with the average percentage of ILI visits that occur during weeks with little or no influenza virus circulation. Activity levels range from minimal, corresponding to ILI activity from outpatient clinics at or below the average, to high, corresponding to ILI activity from outpatient clinics much higher than the average. Because the clinical definition of ILI is nonspecific, not all ILI is caused by influenza; however, when combined with laboratory data, the information on ILI activity provides a clearer picture of influenza activity in the United States.

[¶¶] Levels of activity are 1) no activity; 2) sporadic: isolated laboratory-confirmed influenza cases or a laboratory-confirmed outbreak in one institution, with no increase in activity; 3) local: increased ILI, or two or more institutional outbreaks (ILI or laboratory-confirmed influenza) in one region of the state, with recent laboratory evidence of influenza in that region; virus activity no greater than sporadic in other regions; 4) regional: increased ILI activity or institutional outbreaks (ILI or laboratory-confirmed influenza) in two or more outbreaks, but less than half of the regions in the state with recent laboratory evidence of influenza in those regions; and 5) widespread: increased ILI activity or institutional outbreaks (ILI or laboratory-confirmed influenza) in at least half the regions in the state, with recent laboratory evidence of influenza in the state.

Idaho, Indiana, Iowa, Michigan, Montana, Nevada, North Carolina, Rhode Island, Vermont, Virginia, and West Virginia) reported sporadic activity.

Influenza-Associated Hospitalizations

CDC monitors hospitalizations associated with laboratory-confirmed influenza infections in adults and children through the Influenza Hospitalization Surveillance Network (FluSurv-NET),*** which covers approximately 27 million persons (9% of the U.S. population). During October 1, 2017–November 25, 2017, a total of 566 laboratory-confirmed influenza-related hospitalizations were reported, with a cumulative incidence for all age groups of 2.0 per 100,000 population. The hospitalization rate was highest among persons aged ≥65 years, who accounted for approximately 50% of reported influenza-associated hospitalizations.

The cumulative influenza hospitalization rates per 100,000 population during October 1, 2017–November 25, 2017, for persons aged 0–4 years, 5–17 years, 18–49 years, 50–64 years, and ≥65 years were 1.6, 0.6, 0.8, 2.4, and 7.3, respectively. Among all hospitalizations, 484 (85.5%) were associated with influenza A virus infections, 80 (14.1%) with influenza B virus infections, and two (0.4%) with influenza A virus and influenza B virus coinfections. Among the 146 patients for whom influenza A subtype information was available, 127 (87.0%) were infected with influenza A(H3N2) viruses, and 19 (13.0%) were infected with influenza A(H1N1)pdm09 viruses.

Pneumonia and Influenza-Associated Mortality

CDC tracks pneumonia and influenza (P&I)–attributed deaths through the National Center for Health Statistics (NCHS) Mortality Reporting System. The percentages of deaths attributed to P&I are released 2 weeks after the week of death to allow for collection of sufficient data to produce a stable P&I mortality percentage. Based on data from NCHS available on November 30, 2017, 5.7% of all U.S. deaths occurring during the week ending November 11, 2017, (surveillance week 45) were attributed to P&I. This percentage is below the epidemic threshold††† of 6.5% for week 45. Since October 1, the weekly percentage of deaths attributed to P&I has ranged from 5.7% to 6.2% and has not exceeded the epidemic threshold for this season. P&I percentages for recent weeks might be artificially low because of a backlog of records requiring manual processing, and the percentage of deaths caused by P&I is higher among manually coded death certificates than among machine-coded death certificates. The percentage of deaths caused by P&I will likely increase as more data become available.

Influenza-Associated Pediatric Mortality

As of November 25, 2017 (surveillance week 47), five laboratory-confirmed influenza-associated pediatric deaths occurring during the 2017–18 season were reported to CDC. Two deaths were associated with an influenza A(H1N1)pdm09 virus infection, two were associated with an influenza A(H3) virus infection, and one was associated with an influenza A virus for which no subtyping was performed. Since influenza-associated pediatric mortality became a nationally notifiable condition in 2004, the number of influenza-associated pediatric deaths per season has ranged from 37 to 171, excluding the 2009 pandemic, when 358 pediatric deaths were reported to CDC during April 15, 2009–October 2, 2010.

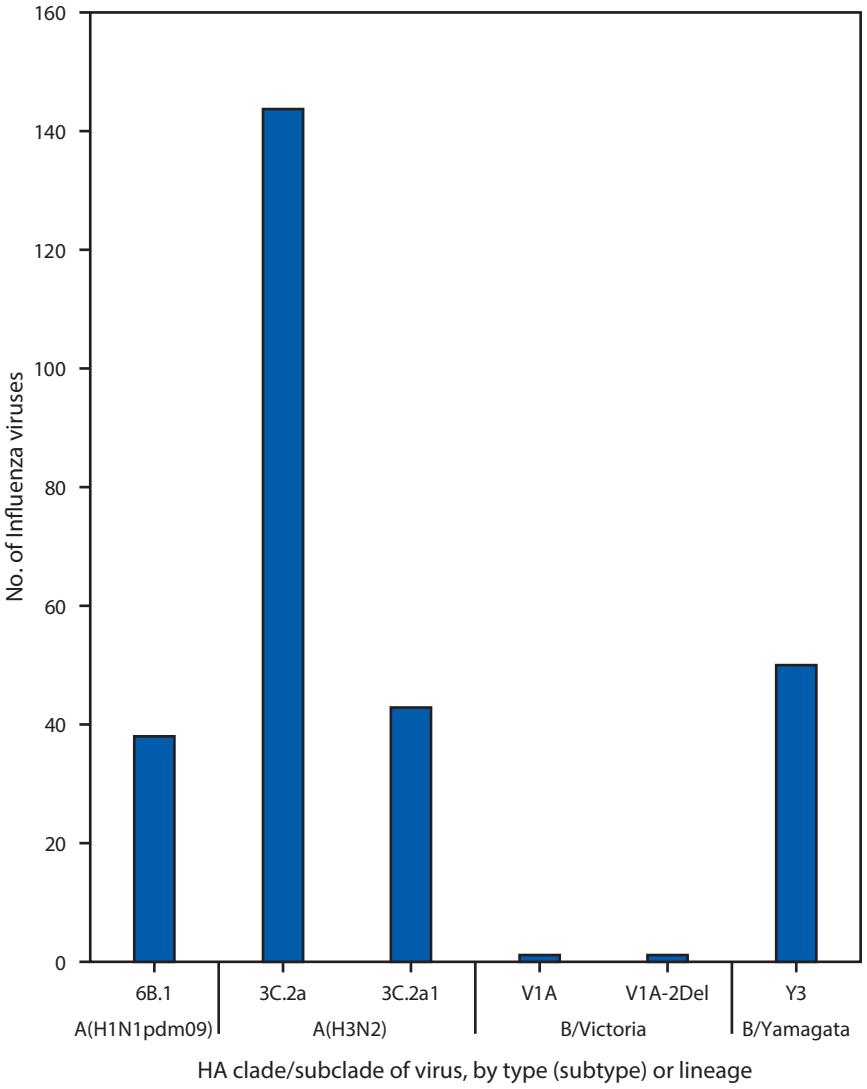
Discussion

Influenza activity in the United States for the 2017–18 season was low during October but has been increasing since early November. The timing of influenza activity often varies; however, peak influenza activity in the United States most commonly occurs during December–February, and substantial influenza activity can be observed through May. It is difficult to predict when influenza activity will peak for the current season; however, influenza activity will increase in the coming weeks. During October 1–November 25, 2017, A(H3N2) viruses were most commonly reported, but A(H1N1)pdm09 and influenza B viruses also were reported. The majority of influenza viruses collected in the United States since October 1, 2017, were characterized antigenically or genetically as

*** FluSurv-NET conducts population-based surveillance for laboratory-confirmed, influenza-associated hospitalizations in children and adolescents aged <18 years (since the 2003–04 influenza season) and adults aged ≥18 years (since the 2005–06 influenza season). The FluSurv-NET covers approximately 70 counties in the 10 Emerging Infections Program states (California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee) and additional Influenza Hospitalization Surveillance Project (IHSP) states. IHSP began during the 2009–10 season to enhance surveillance during the 2009 H1N1 pandemic. IHSP sites included Idaho, Iowa, Michigan, Oklahoma, and South Dakota during the 2009–10 season; Idaho, Michigan, Ohio, Oklahoma, Rhode Island, and Utah during the 2010–11 season; Michigan, Ohio, Rhode Island, and Utah during the 2011–12 season; Iowa, Michigan, Ohio, Rhode Island, and Utah during the 2012–13 season; and Michigan, Ohio, and Utah during the 2013–14, 2014–15, 2015–16, 2016–17, and 2017–18 seasons. Cumulative unadjusted incidence rates are calculated using CDC's National Center for Health Statistics population estimates for the counties included in the surveillance catchment area. Laboratory confirmation is dependent on clinician-ordered influenza testing, and testing for influenza often is underutilized because of the poor reliability of rapid test results and greater reliance on clinical diagnosis for influenza. Therefore, cases identified as part of influenza hospitalization surveillance likely are an underestimation of the actual number of persons hospitalized with influenza.

††† The seasonal baseline proportion of P&I deaths is projected using a robust regression procedure, in which a periodic regression model is applied to the observed percentage of deaths from P&I that were reported by the National Center for Health Statistics Mortality Surveillance System during the preceding 5 years. The epidemic threshold is set at 1.645 standard deviations above the seasonal baseline.

FIGURE 3. Genetic characterization of U.S. viruses collected during October 1, 2017–November 25, 2017*



Abbreviation: HA = hemagglutinin.
* As of December 1, 2017.

being similar to the cell-grown reference viruses representing the 2017–18 Northern Hemisphere influenza vaccine viruses, indicating that significant antigenic drift has not occurred at this time. However, some currently circulating A(H3N2) viruses are less similar to egg-adapted viruses used for production of the majority of U.S. influenza vaccines.

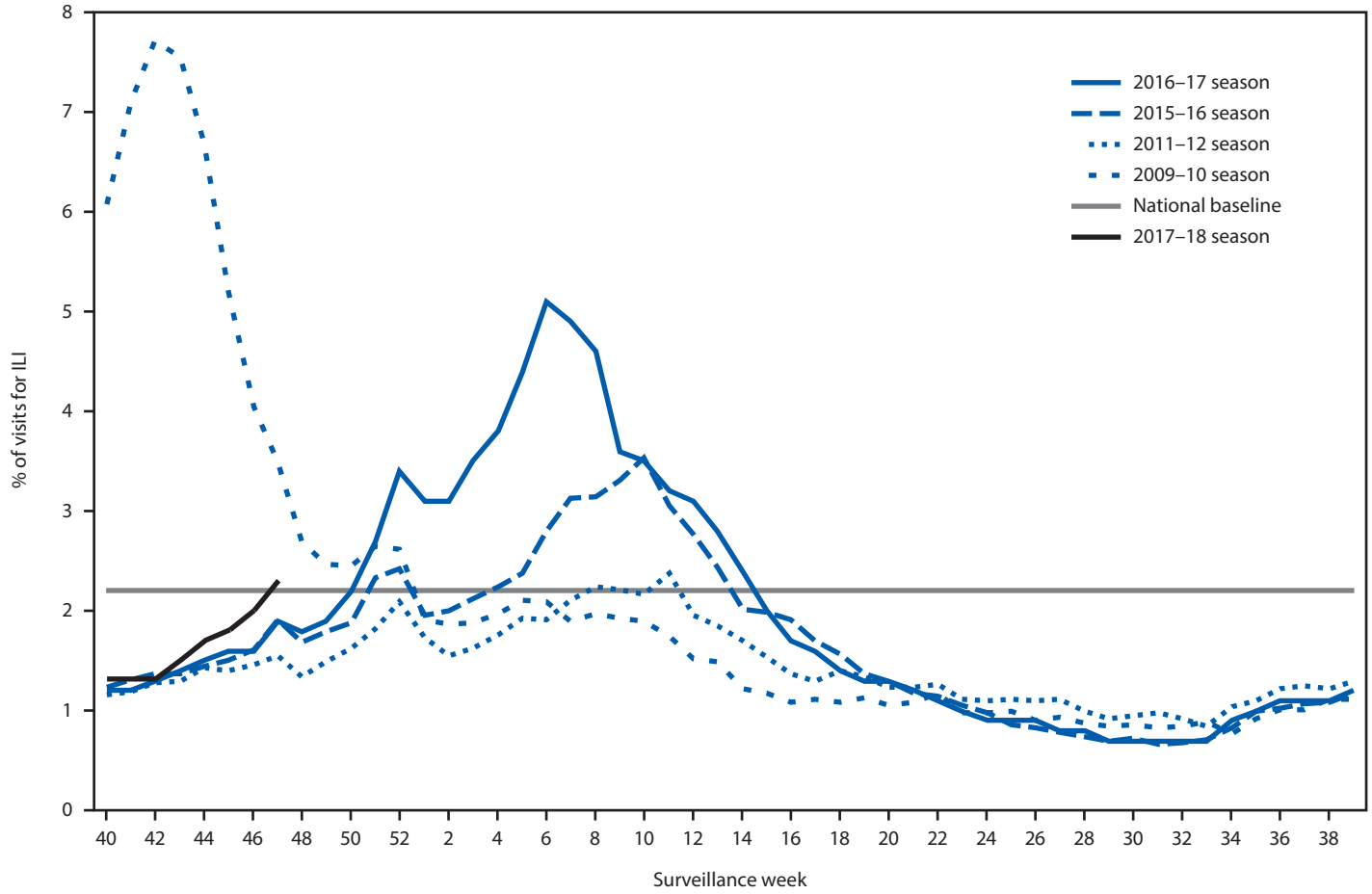
Although influenza vaccine effectiveness can range widely from season to season, influenza vaccination is the most effective currently available method to prevent influenza and its complications. However, less than half of the U.S. population has been vaccinated in recent influenza seasons. Even with influenza vaccine effectiveness in the range of 30% to 60%, influenza vaccination prevents millions of infections and medical visits and tens of thousands of influenza-associated hospitalizations each year in the United States.[§§§] Health care providers should recommend influenza vaccine now and throughout the influenza season to all unvaccinated persons aged ≥6 months who do not have contraindications. Children aged 6 months–8 years who had not previously received a total of ≥2 doses of any trivalent or quadrivalent influenza vaccine (doses do not have to be received in the same influenza season) before July 1, 2017, require 2 doses for the 2017–18 season. The interval between the 2 doses should be at least 4 weeks (*5*).

For the 2017–18 season, manufacturers projected they would supply the United States with 151 million–166 million doses of injectable influenza vaccine. As of November 24, 2017, approximately 148.2 million doses of vaccine had already been distributed. Influenza vaccination coverage estimates for this season show coverage similar to the same time last season among the general population. Survey data collected through early November 2017 indicate that 38.6% of all persons aged ≥6 months reported receiving flu vaccination (compared with 39.8% at this time last season). This leaves approximately 3 out of 5 persons in the United States unprotected against influenza. These estimates are reported on the CDC website (https://www.cdc.gov/flu/fluvaxview/).

The majority of influenza viruses collected this season, although small in number, have been antigenically and genetically characterized as being similar to the cell-grown reference viruses representing the 2017–18 Northern Hemisphere influenza vaccine viruses. The lack of significant antigenic drift observed for recently circulating influenza viruses further suggests that vaccination with the Northern Hemisphere influenza vaccine should offer similar protection as past seasons when cell-grown reference vaccine viruses were most similar to circulating viruses. Vaccine effectiveness can vary between influenza seasons and by virus type or subtype. Studies have shown reduced vaccine effectiveness against A(H3N2) viruses (30–40%), in the absence of significant antigenic drift, when compared with A(H1N1) and influenza B viruses (*9*). This reduction in effectiveness might result, in part, from the egg propagation of influenza A(H3N2) vaccine virus components

[§§§] Estimated influenza illnesses, medical visits, hospitalizations, and deaths averted by vaccination in the United States. https://www.cdc.gov/flu/about/disease/2015-16.htm.

FIGURE 4. Percentage of outpatient visits for influenza-like illness (ILI)* reported to CDC, by surveillance week — U.S. Outpatient Influenza-Like Illness Surveillance Network, 2017–18 influenza season and selected previous influenza seasons†



* Defined as fever (temperature of ≥100°F [≥37.8°C], oral or equivalent) and cough or sore throat, without a known cause other than influenza.
† As of December 1, 2017.

required for most influenza vaccine products licensed in the United States. For example, egg adaptation of current A(H3N2) viruses typically results in a loss of N-linked glycosylation motif at residues 158-160 of the HA protein, which is within an important antibody epitope (site B). Other factors that might also contribute to the reduced effectiveness against A(H3N2) viruses include the naturally occurring, high level of genetic diversity and rapid evolutionary rate of this particular subtype and modification of the immune response to vaccine because of prior infection or vaccination. Vaccine effectiveness studies are needed to ascertain the level of protection that influenza vaccination provides to the population, but these data will not be available until later in the season.

Influenza antiviral medications are an important adjunct to vaccination in the treatment and prevention of influenza. Treatment with influenza antiviral medications as close to the onset of illness as possible is recommended for patients with confirmed or suspected influenza who have severe, complicated, or progressive illness; who require hospitalization; or who are at high risk for influenza complications. Antiviral treatment should be initiated as soon as possible for patients who are at high risk for complications or who are severely ill with suspected influenza infection, even if rapid antigen-detection influenza diagnostic test results are negative (*10*).

Influenza surveillance reports for the United States are posted online weekly (https://www.cdc.gov/flu/weekly). Additional information regarding influenza viruses, influenza surveillance, influenza vaccine, influenza antiviral medications, and novel influenza A infections in humans is available online (https://www.cdc.gov/flu).

Summary

What is already known about this topic?

CDC collects, compiles, and analyzes data on influenza activity year-round in the United States. Timing of influenza activity and predominant circulating influenza viruses varies by season.

What is added by this report?

Influenza activity remained low in the United States during October 2017, but has been increasing since November. As of November 25, influenza A(H3N2) viruses were the most commonly identified viruses. The majority of influenza viruses collected in the United States since October 1, 2017, were characterized antigenically or genetically as being similar to the cell-grown reference viruses representing the 2017–18 Northern Hemisphere influenza vaccine viruses. All influenza viruses tested to date have been sensitive to the antiviral drugs oseltamivir, zanamivir, and peramivir.

What are the implications for public health practice?

In the United States, annual influenza vaccination can reduce the likelihood of becoming ill with influenza and transmitting the virus to others and is recommended for all persons aged ≥6 months. Annual influenza vaccination offers optimal protection regardless of whether the vaccine composition has changed since the previous season. Although vaccination is the best method for preventing and reducing the impact of influenza, antiviral medications are an important adjunct. Early treatment with influenza antiviral medications is recommended for patients with confirmed or suspected influenza (either seasonal influenza or novel influenza virus infection) who have severe, complicated, or progressive illness; who require hospitalization; or who are at high risk for influenza-related complications.

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Conflict of Interest

Jacqueline M. Katz, reports U.S. Patent 6,196,175 (issued January 2, 2001) for "Preparation and use of recombinant influenza A virus M2 construct vaccine" and U.S. Patent 8,163,545 (issued April 26, 2012) for "An effective vaccine against pandemic strains of influenza viruses." No other conflicts of interest were reported.

[1]Influenza Division, National Center for Immunization and Respiratory Diseases, CDC.

Corresponding author: Vivien Dugan, vdugan@cdc.gov, 404-718-6220.

References

1. Bowman AS, Walia RR, Nolting JM, et al. Influenza A/H3N2 virus in swine at agricultural fairs and transmission to humans, Michigan and Ohio, USA, 2016. Emerg Infect Dis 2017;23:1551–5. https://doi.org/10.3201/eid2309.170847
2. Blanton L, Wentworth DE, Alabi N, et al. Update: influenza activity—United States and worldwide, May 21–September 23, 2017. MMWR Morb Mortal Wkly Rep 2017;66:1043–51. https://doi.org/10.15585/mmwr.mm6639a3
3. Anderson TK, Macken CA, Lewis NS, et al. A phylogeny-based global nomenclature system and automated annotation tool for H1 hemagglutinin genes from swine influenza A viruses. MSphere 2016;1:e00275–16. https://doi.org/10.1128/mSphere.00275-16
4. Association of Public Health Laboratories. Influenza virologic surveillance right size roadmap. 1st ed. Silver Spring, MD: Association of Public Health Laboratories; 2013. https://www.aphl.org/AboutAPHL/publications/Documents/ID_July2013_Influenza-Virologic-Surveillance-Right-Size-Roadmap.pdf
5. Grohskopf LA, Sokolow LZ, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2017–18 influenza season. MMWR Recomm Rep 2017;66(No. RR-2). https://doi.org/10.15585/mmwr.rr6602a1
6. Zhou B, Donnelly ME, Scholes DT, et al. Single-reaction genomic amplification accelerates sequencing and vaccine production for classical and swine origin human influenza a viruses. J Virol 2009;83:10309–13. https://doi.org/10.1128/JVI.01109-09
7. Zhou B, Wentworth DE. Influenza A virus molecular virology techniques. Methods Mol Biol 2012;865:175–92. https://doi.org/10.1007/978-1-61779-621-0_11
8. Zhou B, Lin X, Wang W, et al. Universal influenza B virus genomic amplification facilitates sequencing, diagnostics, and reverse genetics. J Clin Microbiol 2014;52:1330–7. https://doi.org/10.1128/JCM.03265-13
9. Belongia EA, Simpson MD, King JP, et al. Variable influenza vaccine effectiveness by subtype: a systematic review and meta-analysis of test-negative design studies. Lancet Infect Dis 2016;16:942–51. https://doi.org/10.1016/S1473-3099(16)00129-8
10. Fiore AE, Fry A, Shay D, Gubareva L, Bresee JS, Uyeki TM. Antiviral agents for the treatment and chemoprophylaxis of influenza—recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2011;60(No. RR-1).

Progress Toward Global Eradication of Dracunculiasis, January 2016–June 2017

Donald R. Hopkins, MD[1]; Ernesto Ruiz-Tiben, PhD[1]; Mark L. Eberhard, PhD[2]; Sharon L. Roy, MD[2]; Adam J. Weiss, MPH[1]

Dracunculiasis (Guinea worm disease) is caused by *Dracunculus medinensis*, a parasitic worm. Approximately 1 year after a person acquires infection from contaminated drinking water, the worm emerges through the skin, usually on a lower limb (*1*). Pain and secondary bacterial infection can cause temporary or permanent disability that disrupts work and schooling. The campaign to eradicate dracunculiasis worldwide began in 1980 at CDC. In 1986, the World Health Assembly called for dracunculiasis elimination,* and the global Guinea Worm Eradication Program, led by the Carter Center and supported by the World Health Organization (WHO), United Nations Children's Fund, CDC, and other partners, began assisting ministries of health in countries with endemic dracunculiasis. In 1986, an estimated 3.5 million cases occurred each year in 20 countries in Africa and Asia (*2*). Since then, although the goal of eradicating dracunculiasis has not been achieved, considerable progress has been made. Compared with the 1986 estimate, the annual number of reported cases in 2016 has declined by >99%, and cases are confined to three countries with endemic disease. This report updates published (*3*–*4*) and unpublished surveillance data reported by ministries of health and describes progress toward dracunculiasis eradication during January 2016–June 2017. In 2016, a total of 25 cases were reported from three countries (Chad [16], South Sudan [six], Ethiopia [three]), compared with 22 cases reported from the same three countries and Mali in 2015 (Table 1). The 14% increase in cases from 2015 to 2016 was offset by the 25% reduction in number of countries with indigenous cases. During the first 6 months of 2017, the overall number of cases declined to eight, all in Chad, from 10 cases in three countries (Chad [four], South Sudan [four] and Ethiopia [two]) during the same period of 2016. Continued active surveillance, aggressive detection, and appropriate management of cases are essential eradication program components; however, epidemiologic challenges, civil unrest, and insecurity pose potential barriers to eradication.

Because the life cycle of *D. medinensis* is complex, its transmission can be interrupted using multiple strategies (*1*). Dracunculiasis can be prevented by the following four main interventions: 1) educating residents in communities where the disease is endemic, particularly persons from whom worms are emerging, to avoid immersing affected body parts in sources of drinking water; 2) filtering potentially contaminated drinking water through a cloth filter or pipe filters to remove copepods (small crustaceans that host *D. medinensis* larvae); 3) treating potentially contaminated surface water with the organophosphate insecticide temephos (Abate) to kill the copepods; and 4) providing safe drinking water from bore-hole or protected hand-dug wells (*5*). Containment† of transmission is achieved through four complementary measures: 1) voluntary isolation and education of each patient to prevent contamination of drinking water sources, 2) provision of first aid to prevent secondary infections, 3) manual extraction of the worm, and 4) application of occlusive bandages. No vaccine or medicine to prevent or treat Guinea worm disease currently exists.

D. medinensis has an approximately 1-year incubation period (range = 10–14 months) after infection (*5*). A case of dracunculiasis is defined as an infection occurring in a person exhibiting a skin lesion or lesions with emergence of one or more worms that are laboratory-confirmed at CDC as *D. medinensis*. Each infected person is counted as a case only once during a calendar year. Because certain patients have multiple Guinea worms emerge, more laboratory-confirmed specimens than cases might be reported in any given period.

Countries enter the WHO precertification stage of eradication after 1 full year with no reported indigenous§ cases. An imported case is an infection resulting from ingestion of contaminated water from a source, identified through patient interviews and epidemiologic investigation, in a place other than in the community where the patient is detected and the case reported (i.e., another country or village within the same country). Since 2012, no known internationally imported cases have been reported.

* http://www.who.int/neglected_diseases/mediacentre/WHA_39.21_Eng.pdf.

† Transmission from a patient with dracunculiasis is contained only if all of the following conditions are met for each emerged worm: 1) the infected patient is identified ≤24 hours after worm emergence; 2) the patient has not entered any water source because the worm emerged; 3) a village volunteer or other health care provider has managed the patient properly, by cleaning and bandaging the lesion until the worm has been fully removed manually and by providing health education to discourage the patient from contaminating any water source (if two or more emerging worms are present, transmission is not contained until the last worm is removed); 4) the containment process, including verification of dracunculiasis, is validated by a Guinea Worm Eradication Program supervisor within 7 days of emergence of the worm; and 5) temephos is used to treat potentially contaminated surface water if any uncertainty about contamination of these sources of drinking water exists, or if such a source of drinking water is known to have been contaminated.

§ An indigenous case of dracunculiasis is defined as an infection consisting of a skin lesion or lesions with emergence of one or more Guinea worms in a person who had no history of travel outside their residential locality during the preceding year.

TABLE 1. Number of reported indigenous human dracunculiasis cases, by country — worldwide, January 2015–June 2017

Country	Cases by period: Jan–Dec 2015 No.	Jan–Dec 2016 No. (% contained)	% Change Jan–Dec 2015 to Jan–Dec 2016	Jan–Jun, 2016* No.	Jan–Jun, 2017 No. (% contained)	% Change Jan–Jun 2016 to Jan–Jun 2017
Chad	9	16 (56)	78	4	8 (75)	100
Ethiopia	3	3 (67)	0	2	0 (—)	-100
Mali†	5	0 (—)	-100	0	0 (—)	0
South Sudan	5	6 (50)	20	4	0 (—)	-100
Total	**22**	**25 (56)**	**14**	**10**	**8 (75)**	**-20**

* No international importations were reported during the 18-month period January 2016–June 2017.
† Civil unrest and insecurity continued to constrain program operations in regions with endemic dracunculiasis (Gao, Kidal, Mopti, and Timbuktu) during 2016–2017.

In each affected country, a national dracunculiasis eradication program receives monthly reports regarding cases from each village under active surveillance. Reporting rates are calculated as the proportion of all villages under active surveillance reporting monthly (Table 2). Active surveillance is conducted in all villages with endemic dracunculiasis or that are at high risk for importation, with daily searches of households for persons with signs or symptoms of dracunculiasis, to ensure case detection within 24 hours of worm emergence and prompt patient management to prevent contamination of water sources. Villages where endemic transmission of dracunculiasis is interrupted (i.e., zero cases reported for ≥12 consecutive months) are kept under active surveillance for 3 consecutive years. WHO certifies a country free from dracunculiasis after that country maintains adequate nationwide surveillance for ≥3 consecutive years and demonstrates that no indigenous cases occurred during that period. As of January 2016, WHO had certified 198 countries, areas, and territories as free from dracunculiasis (*3*). Eight countries remain to be certified: four where dracunculiasis is currently endemic (Chad, Ethiopia, Mali, and South Sudan), two in the precertification stage (Kenya and Sudan), and two never known to have had endemic dracunculiasis since the global eradication program began in 1980 (Angola and the Democratic Republic of the Congo), which are in the process of completing the requirements for certification.

During January 2016–June 2017, CDC evaluated 118 worm specimens that emerged from humans, including 108 (91.5%) from the four countries with endemic dracunculiasis, two (1.7%) from Kenya, three (2.5%) from Benin (Kenya and Benin formerly had endemic dracunculiasis), four (3.4%) from the Democratic Republic of Congo, and one (1%) from Niger. Among the 118 human worm specimens submitted, 89 (75%) were from 2016 (37 [42%] were identified as *D. medinensis*) and 29 were from January to June 2017 (eight [28%] were identified as *D. medinensis*).

During 2016, 46 animal worm specimens were submitted, and 32 (70%) were identified as *D. medinensis*. The 32 *Dracunculus* specimens came from two baboons and 13 dogs from Ethiopia, 11 dogs from Mali, and five dogs and one domestic cat from Chad. During January–June 2017, 18 animal worm specimens were submitted and 14 were identified as *D. medinensis*. The 114 *Dracunculus* specimens came from four baboons and nine dogs from Ethiopia, and one dog from Chad.

Country Reports

Chad. After a decade with no reported cases, Chad reported 10 indigenous cases in 2010. After indigenous cases were confirmed during 3 consecutive years, dracunculiasis was declared to be endemic in 2012 (*6*,*7*). In 2016, Chad reported 16 cases (nine contained) in 12 villages, compared with nine cases (none contained) in 2015. During the first half of 2017, eight cases (six contained) were reported in eight villages. One of 12 villages that reported a case in 2016, and one of eight reporting a case during January–June 2017, had reported a case previously.

In 2012, Guinea worm infections were first reported in domestic dogs in Chad (*6*), and since then, more dogs than humans have been identified with emerging Guinea worms. This substantial number of nonhuman infections has not occurred in any other country during the eradication campaign. Worm specimens obtained from dogs were determined to be genetically indistinguishable from *D. medinensis* worms removed from humans in Chad (*6*). A majority of infections during the current outbreak have occurred in communities along the Chari River. The Carter Center has assisted the ministry of health in implementing active village-based surveillance for the disease in approximately 1,700 villages in the at-risk zone. The working hypothesis, on the basis of biologic, environmental, and epidemiologic investigations by CDC and the Carter Center, is that the cases in humans and infected dogs are associated with the domestic and commercial fishing industry along the Chari River and involve fish, frogs, or other aquatic hosts that serve as paratenic hosts (intermediate hosts in which no development of the parasite occurs). New infections are thought to occur when humans consume inadequately cooked paratenic hosts and when such hosts are

TABLE 2. Reported human dracunculiasis cases, surveillance, and status of local interventions in villages with endemic disease, by country — worldwide, 2016

Cases/Surveillance/Intervention status	Country				
	Chad*	Ethiopia	Mali†	South Sudan	Total
Reported cases					
No. indigenous, 2016	16	3	0	6	**25**
No. imported,§ 2016	0	0	0	0	**0**
% Contained¶ in 2016	56	67	0	50	**56**
% Change in indigenous cases in villages/localities under surveillance, same period 2015 and 2016	78	0	-100	20	**14**
Villages under active surveillance, 2016					
No. of villages	1,799	152	450	2,736	**5,137**
% Reporting monthly	100	89	100	99	**99**
No. reporting ≥1 case	8	3	0	5	**16**
No. reporting only imported** cases	0	0	0	0	**0**
No. reporting indigenous cases	8	3	0	5	**16**
Status of interventions in villages with endemic dracunculiasis, 2015–2016					
No. of villages with endemic dracunculiasis	20	5	3	9	**37**
% Reporting monthly††	100	100	100	100	**100**
% Filters in all households††	100	100	100	100	**100**
% Using temephos††	30	100	100	100	**60**
% ≥1 safe water source††	73	100	66	56	**62**
% Providing health education††	100	100	100	100	**100**

* Participants at the annual Chad Guinea Worm Eradication Program review meeting in November 2014 adopted "1+ case village" as a new description for villages in Chad affected by human cases of Guinea worm disease or dogs infected with Guinea worms and defined as "a village with one or more indigenous or imported cases of Guinea worm infections in humans, dogs, or cats in the current calendar year or previous year."

† Civil unrest and insecurity continued to constrain Guinea Worm Eradication Program operations (supervision, surveillance, and interventions in Gao, Kidal, and Timbuktu regions).

§ Imported from another country.

¶ Transmission from a patient with dracunculiasis is contained only if all of the following conditions are met for each emerged worm: 1) the infected patient is identified ≤24 hours after worm emergence; 2) the patient has not entered any water source because the worm emerged; 3) a village volunteer or other health care provider has managed the patient properly, by cleaning and bandaging the lesion until the worm has been fully removed manually and by providing health education to discourage the patient from contaminating any water source (if two or more emerging worms are present, transmission is not contained until the last worm is removed); 4) the containment process, including verification of dracunculiasis, is validated by a Guinea Worm Eradication Program supervisor within 7 days of emergence of the worm; and 5) temephos is used to treat potentially contaminated surface water if any uncertainty about contamination of these sources of drinking water exists, or if a such a source of drinking water is known to have been contaminated.

** Imported from another in-country village with endemic disease.

†† The denominator is the number of endemic villages/localities where the program applied interventions during 2015–2016.

consumed raw by dogs (*6*). Overall, 1,011 infected dogs (and 11 infected domestic cats) were reported during 2016, which was twice the number of infected dogs (503) reported in 2015. However, during January–June 2017, 537 infected dogs were reported, which is an 18% decrease from the 653 reported during the same period of 2016. This is the first such half-yearly reduction since infected dogs were first reported in 2012, and it reflects consecutive months of declining dog infections that began in November 2016 (*3*).

Beginning in October 2013, Chad's Guinea Worm Eradication Program urged villagers to cook their fish well, bury fish entrails, and prevent dogs from eating fish entrails. By June 2017, according to monthly sample surveys, this intervention was being implemented by approximately 81% of respondents in surveyed communities with populations at risk. In February 2014, health education measures began to persuade villagers to tether infected dogs until the worms emerged, to prevent contamination of water and infection of copepods. In February 2015, the program introduced a reward equivalent to US$20 for reporting and tethering an infected dog. Whereas 40%, 68%, and 68% of infected dogs were tethered in 2014, 2015, and 2016, respectively, 78% of 537 infected dogs reported during January–June 2017 were tethered.

Beginning before 2010, Chad has offered a cash reward equivalent to US$100 for reporting a human case of dracunculiasis. In areas under active surveillance, 69% of 383 residents surveyed during January–June 2017 knew of the cash reward for reporting a case of dracunculiasis, and 60% of 363 persons surveyed knew of the cash reward for reporting and tethering an infected dog.

As of June 2017, 68% of villages with endemic dracunculiasis had safe water (i.e., water sources free of copepods, such as rapidly flowing rivers, protected hand dug wells, and borehole wells). Temephos use is limited by the extremely large lagoons used for fishing and as sources of drinking water. Starting in August 2014, an innovative technique of applying temephos to smaller cordoned sections of the lagoons at entry points used by infected humans or dogs was introduced and used to protect 19, 29, 61, and 51 villages in 2014, 2015, 2016, and January–June 2017, respectively.

The Carter Center and WHO Collaborating Center for Dracunculiasis Eradication at CDC are supporting research to better understand the unusual epidemiology of the current outbreak of dracunculiasis in Chad, assess antihelminthic treatment of dogs to prevent maturation of worms, and study the food sources and movements of dogs in an area of Chad with endemic disease. In collaboration with researchers from the University of Georgia, this initiative has demonstrated that *D. medinensis* can use an amphibian (frog) (*8*) as a paratenic host in the laboratory (*8*) and has recovered, for the first time, a *Dracunculus* larva from a frog captured in the wild in Chad (*9*).

Ethiopia. In 2016, Ethiopia reported three cases of dracunculiasis (two contained), in two villages of the Gog district and one village of the Lare district of Gambella Region. This is the same number of cases that Ethiopia reported in 2015 and in 2014. (The origin of the third case, which was reported in September 2016, is unclear, because the patient entered Ethiopia from South Sudan approximately 1 year before emergence of his Guinea worm). Ethiopia also reported 14 infected domestic dogs and two infected baboons in 2016, compared with 13 infected dogs and one infected baboon in 2015, all in the same area of the Gog district. During January–June 2017, Ethiopia reported no human case, eight infected dogs, and four infected baboons. However, in the same area of the Gog district, there were two cases in humans, two infected dogs, and no infected baboons during the same period of 2016. The program applied temephos monthly to almost all water sources known to have been used by humans in the at-risk area throughout 2015, increased coverage threefold to include numerous smaller water sources in 2016, and is addressing additional gaps in identification of water sources related to a particular stream in the at-risk area in 2017. A cash reward, equivalent to US$20 for reporting an infected animal was introduced, and the ministry of health held three press conferences to publicize the eradication effort during 2016. There are 152 villages under active surveillance in three districts of Gambella Region. Ethiopia offers a cash reward equivalent to US$100 for reporting a case of dracunculiasis. Among 11,712 persons surveyed in the Gog district during January–June 2017, 82% were aware of the reward for reporting an infected person; 61% of 2,123 surveyed knew of the reward for reporting an infected animal.

Mali. In 2016, Mali reported no human cases of dracunculiasis for the first time since its eradication program began, compared with five cases reported from three villages in 2015. Mali reported one infected dog for the first time in 2015 and 11 infected dogs (eight contained) in 2016. Two infected dogs (one contained) were reported during January–June 2017, compared with one dog (contained), during the same period of 2016. All infected dogs were detected in the Tominian district of Segou Region, but many had been imported from other areas of Segou or adjacent Mopti Region, in which certain areas were inaccessible to the program because of insecurity. Mali has 455 villages under active surveillance. Mali offers a cash reward equivalent to US$100 for reporting a case of dracunculiasis and US$20 for reporting and tethering an infected dog. In areas under active surveillance, 79% of 23,943 persons surveyed in 2016 were aware of the cash reward for reporting a case. During January–June 2017, 80% of 2,190 persons surveyed were aware of the reward for reporting a case, and 88% of 819 persons surveyed were aware of the reward for reporting and tethering an infected dog.

South Sudan. South Sudan reported six cases of dracunculiasis (three contained) from four villages in 2016, all west of the Nile, compared with five cases (three contained) reported from five villages in 2015. The country reported no infected dogs in 2016, compared with one in 2015, which has been the only infected dog found in South Sudan to date. South Sudan has reported no cases during January–June 2017, compared with four cases (three contained) reported during the same period of 2016. South Sudan has 3,860 villages under active surveillance. In April 2014, South Sudan began offering a cash reward equivalent to approximately US$125 for reporting a case of dracunculiasis (*10*). The overall level of reward awareness among 495 persons queried in active surveillance areas in 2016 was 76%. In March 2017, the ministry of health doubled its cash reward for reporting a case of dracunculiasis to 10,000 South Sudanese pounds (approximately US$139) to adjust for inflation and introduced a cash reward (approximately US$20) for reporting and tethering an infected animal. Coverage with interventions in villages with endemic disease remains high (except for provision of safe sources of drinking water) (Table 2), despite increased insecurity having forced the evacuation of most expatriate staff members assisting the South Sudan Guinea Worm Eradication Program since early July 2016.

Discussion

The number of countries reporting endemic dracunculiasis decreased from four in 2015 to three in 2016, to only one country (Chad), which reported eight cases during January–June 2017. This compares with 10 cases reported by Chad, Ethiopia, and South Sudan during January–June 2016 and indicates that the goal of complete eradication of the disease is closer. The decrease in the number of infected dogs in Chad for the first time during January–June 2017 is another favorable milestone. Led by their ministers of health, Mali and Chad have launched enhanced national communication campaigns in March and July 2017, respectively, to increase awareness of rewards for reporting cases and knowledge of prevention

Summary

What is already known about this topic?

The number of new cases of dracunculiasis (Guinea worm disease) occurring worldwide has decreased from an estimated 3.5 million in 1986, when the World Health Assembly declared global elimination as a goal, to 25 in 2016.

What is added by this report?

The number of human dracunculiasis cases reported worldwide during 2016 increased to 25 cases in three countries in 2016 from 22 cases in four countries in 2015. However, during January–June 2017, the number of cases reported decreased from 10 cases in three countries during the same period in 2016, to eight, all in Chad. The number of infected domestic dogs doubled from 503 in 2015 to 1,011 in 2016, but declined to 537 during January–June 2017 compared with 653 during the same period of 2016. The emergence of infected dogs in Chad especially, and program disruptions caused by civil unrest and insecurity in Mali and South Sudan, are now the greatest challenges to interrupting transmission.

What are the implications for public health practice?

Although earlier target dates for global dracunculiasis eradication were missed, progress towards this goal has accelerated. However, rigorous implementation (including recent interventions to prevent transmission to and from dogs) must be maintained in Chad to ensure continued progress during 2017 and beyond.

messages; South Sudan and Ethiopia plan to launch similar campaigns later in 2017.

Political support for Guinea worm eradication remains strong in South Sudan and has improved recently in Chad, Ethiopia, and Mali. The health ministers of all four countries attended or were represented at the annual informal meeting of countries with current or former endemic dracunculiasis at the World Health Assembly in Geneva, Switzerland, in May 2016, and at the International Review Meeting for Guinea Worm Eradication Program Managers held at The Carter Center in March 2016. Mali's Minister of Health visited an area with endemic disease in June 2016, whereas South Sudan's Minster of Health and the regional Vice President of Gambella, Ethiopia, visited such areas in their countries in September 2016. In June 2017, Chad's National Assembly convened a special session for a briefing on that country's Guinea Worm Eradication Program. Insecurity remains a serious challenge to program activities, especially in Mali and South Sudan.

Additional interventions, including increased use of temephos and trials of potential anthelminthic treatments for infected dogs are beginning or underway in Chad. In addition, scientists are researching aspects of the parasite's biology, life cycle, and molecular composition, and dog ecology. Furthermore, a case-control study of humans and dogs in households with and without infected dogs is planned in Chad for early 2018.

Conflict of Interest

No conflicts of interest were reported.

[1]The Carter Center, Atlanta, Georgia; [2]Division of Parasitic Diseases and Malaria, Center for Global Health, World Health Organization Collaborating Center for Research, Training, and Eradication of Dracunculiasis, CDC.

Corresponding author: Sharon L. Roy, slroy@cdc.gov, 404-718-4698.

References

1. Hopkins DR, Ruiz-Tiben E, Eberhard ML, Roy SL, Weiss AJ. Progress toward global eradication of dracunculiasis—January 2015–June 2016. MMWR Morb Mortal Wkly Rep 2016;65:1112–6. https://doi.org/10.15585/mmwr.mm6540a5
2. Watts SJ. Dracunculiasis in Africa in 1986: its geographic extent, incidence, and at-risk population. Am J Trop Med Hyg 1987;37:119–25. https://doi.org/10.4269/ajtmh.1987.37.119
3. World Health Organization. Dracunculiasis eradication: global surveillance summary, 2016. Wkly Epidemiol Rec 2017;92:269–86.
4. Hopkins DR, Ruiz-Tiben E, Weiss A, Withers PC Jr, Eberhard ML, Roy SL. Dracunculiasis eradication: and now, South Sudan. Am J Trop Med Hyg 2013;89:5–10. https://doi.org/10.4269/ajtmh.13-0090
5. Ruiz-Tiben E, Hopkins DR. Dracunculiasis (Guinea worm disease) eradication. Adv Parasitol 2006;61:275–309. https://doi.org/10.1016/S0065-308X(05)61007-X
6. Eberhard ML, Ruiz-Tiben E, Hopkins DR, et al. The peculiar epidemiology of dracunculiasis in Chad. Am J Trop Med Hyg 2014;90:61–70. https://doi.org/10.4269/ajtmh.13-0554
7. CDC. Renewed transmission of dracunculiasis—Chad, 2010. MMWR Morb Mortal Wkly Rep 2011;60:744–8.
8. Eberhard ML, Yabsley MJ, Zirimwabagabo H, et al. Possible role of fish and frogs as paratenic hosts of *Dracunculus medinensis*, Chad. Emerg Infect Dis 2016;22:1428–30. https://doi.org/10.3201/eid2208.160043
9. Eberhard ML, Cleveland CA, Zirimwabagabo H, Yabsley MJ, Ouakou PT, Ruiz-Tiben E. Guinea worm (*Dracunculus medinensis*) infection in a wild-caught frog, Chad. Emerg Infect Dis 2016;22:1961–2. https://doi.org/10.3201/eid2211.161332
10. World Health Organization. Meeting of the International Task Force for Disease Eradication, April 2015. Wkly Epidemiol Rec 2015;90:384–92.

Acute Malnutrition Among Children, Mortality, and Humanitarian Interventions in Conflict-Affected Regions — Nigeria, October 2016–March 2017

Eva Leidman, MSPH[1]; Erin Tromble, MD[1,2]; Adamu Yermina, DVM[3]; Robert Johnston, MPH, MSc[3]; Chris Isokpunwu, MBBS[4]; Adeyemi Adeniran[5]; Assaye Bulti, MSC[3]

A public health emergency was declared by the Nigerian Federal Ministry of Health in northeastern Nigeria in June 2016 and escalated by the United Nations to a Level 3 Emergency in August 2016, after confirmation of wild poliovirus and measles outbreaks and evidence that prevalence of acute malnutrition exceeded emergency thresholds in areas newly liberated from Boko Haram control (*1*,*2*). To monitor rates of mortality, acute malnutrition among children, infectious disease morbidity, and humanitarian interventions after the emergency declaration, a series of cross-sectional household surveys were conducted in fall 2016 and winter 2017 in the northeastern states of Borno and Yobe using a cluster methodology. All-cause mortality among all age groups (crude mortality) and among children aged <5 years (under-five mortality) were above emergency thresholds in 2017 and significantly increased from 2016, despite evidence of increased preventive public health interventions, including measles vaccination. Access to treatment for common childhood illnesses remained very low, as evidenced by reports of fewer than one in six children in areas outside Borno's capital receiving any care for diarrhea. The data from these surveys provide evidence of excessively high mortality (particularly among children), highlight the impact of ongoing violence, and underscore the need for humanitarian efforts to scale up access to treatment services in conflict-affected areas.

After the emergency declarations, the Nigerian National Bureau of Statistics, in coordination with the National Population Commission, the Federal Ministry of Health, United Nations Children's Fund, and CDC collaborated to conduct a series of two-stage cluster surveys to assess mortality, malnutrition, and access to and receipt of essential public health services. This report presents findings from the first two rounds of data collection (October 11–November 17, 2016, and February 13–March 29, 2017).

Enumeration areas from the national sampling frame were used as clusters for Yobe. Because of ongoing displacement in Borno, clusters there included both settled villages and camps of internally displaced persons. Within each state, local government areas were grouped into substate regions based on geography and conflict impact. Data were stratified by region (Borno: Southern, Central, and the Borno capital area comprising Maiduguri and Jere; Yobe: Central, Southern, and Northern). Clusters for each region were drawn independently, with probability of selection proportional to size. Within selected clusters, households were selected applying systematic random selection. Areas that were known to be inaccessible because of security concerns were excluded. Adjusting for nonresponse, a sample size of 1,800 households was calculated for each of the two states in the first round. In the second round, 1,860 households were included for Borno, and the Southern Yobe region was oversampled to allow for disaggregated analysis of areas with greater conflict, yielding a target sample of 2,480 households in Yobe. All age-eligible children were measured using standard anthropometric procedures (*3*). Nutritional status was classified using 2006 World Health Organization (WHO) growth standards (*4*). Pearson's chi-square test was used to determine significant differences ($p<0.05$) between rounds. This project was reviewed in accordance with CDC human subjects protection procedures and was determined to be nonresearch and not subject to review by an institutional review board.

The final sample in Borno comprised 1,719 households (including 1,557 children aged 0–59 months) in the first round and 1,729 households (1,813 children) in the second. In the first and second rounds in Yobe, 1,667 households (1,692 children) and 2,393 households (2,729 children), respectively, were selected. Among selected clusters, 13 (7.2%) in the first round and 15 (6.9%) in the second round were inaccessible or abandoned. Household response rates in the accessed clusters exceeded 96% in all regions in both rounds.

Prevalence of global acute malnutrition (weight-for-height z-scores less than -2 or bilateral pitting edema) among children aged 0–59 months was significantly higher in the first round than the second round in Maiduguri and Jere (13.0% compared with 6.4%) and in both Southern (10.7% compared with 7.8%) and Northern Yobe (14.3% compared with 8.6%). During the first round, prevalence of global acute malnutrition ranged from 8.9% to 14.3% by region and from 6.4% to 8.6% in the second round (Table 1). Crude and under-five mortality rates increased from the first to the second round in all regions. The increase in crude mortality was significant in two Borno regions (Southern and Central) and two Yobe regions (Southern and Northern) ($p<0.05$). The under-five mortality rate was approximately three times higher than the crude mortality rate in Southern Borno for both rounds and during the first round in Central Borno and Central and

Northern Yobe (Table 1). Crude and under-five mortality both exceeded the emergency thresholds of one and two deaths per 10,000 per day, respectively, in Central Borno as well as Central and Northern Yobe during the second round. The under-five morality rate in Southern Yobe also exceeded the emergency threshold.

Use of public health interventions was assessed using the following four indicators: 1) measles vaccination coverage, 2) receipt of one or more services through a public health outreach campaign, 3) receipt of anthelmintic prophylaxis in the 6 months preceding the survey, and 4) receipt of fortified cereals (Table 2). The proportion of children aged 12–59 months that had received at least 1 dose of a measles-containing vaccine, as determined by either vaccination card or parental recall, was <65% in all regions in the first round (range = 28.8%–63.5%). Measles vaccination coverage increased significantly in the second round in all regions except Southern Borno, with the greatest absolute increases in Central Borno (from 33.7% to 78.9%) and Northern Yobe (from 28.8% to 67.1%). No region attained the 95% vaccination coverage threshold necessary to establish herd immunity. The proportion of households reporting receipt of one or more of the maternal, neonatal, and child health services (such as vaccinations, nutritional screening, birth registration, and bed-net distributions) during a government sponsored public health outreach campaign was <10% in all regions except Southern Borno (11.9%) during the first round of surveys. The percentage of children aged 12–59 months who received anthelmintic prophylaxis during the 6 months preceding the survey was also <10% in all regions (range = 2.9%–6.2%) during the first round. Increases in the receipt of services through the outreach campaign (range = 11.7%–26.6%) and of anthelmintic prophylaxis use (range = 7.8%–21.1%) were significant in all regions during the second round of surveys. However, no increase was observed in the distributions of fortified cereals.

The prevalence of diarrhea among children aged <5 years during the preceding 2 weeks and receipt of appropriate treatment (oral rehydration solution or zinc) were analyzed as an indication of morbidity and access to primary care, respectively (Table 3). Prevalence of diarrhea was lower in Borno state regions (range = 14.1%–19.5%) than in Yobe state (range = 23.8%–31.5%) during the first round. In the second round, the prevalence of diarrhea did not change significantly in Yobe but increased significantly in all Borno regions. Among children with diarrhea, less than a third received oral rehydration solution, zinc, or both in either round, and <8% received the appropriate treatment. The proportion of children receiving treatment significantly declined in Southern Yobe and Central Yobe (for zinc only) between survey rounds.

Discussion

The prevalence of global acute malnutrition did not exceed the WHO emergency threshold of 15% in either survey (*5*); prevalence either improved (Maiduguri and Jere; Northern and Southern Yobe) or remained stable (Southern and Central Borno; Central Yobe) between rounds. Despite these findings, the crude mortality rate increased significantly in all but two of the surveyed regions (Southern Borno and Central Yobe). Although the study was not designed to detect significant changes in child mortality, an increase in the under-five mortality rate was observed in all regions. Increased mortality in the absence of concurrent increase in acute malnutrition suggests possible causes other than food insecurity, such as increased morbidity and mortality from common childhood illnesses.

The findings from these surveys provide evidence of increases in the use of selected public health interventions. Measles vaccination coverage approximately doubled in several regions of Borno and Yobe after a January 2017 campaign to vaccinate an estimated 4.7 million children, which was recommended after the first survey round. Both the percentage of households that received services during the government sponsored health campaign and the percentage of children who received anthelmintic prophylaxis increased significantly in all regions. Emphasis on active outreach through mobile clinics and household visits, particularly in the November–December 2016 public health campaigns, might have contributed to these increases. Yet receipt of all four public health interventions remains well below target levels, and there has been no improvement in the distribution of fortified cereal.

The percentage of children who received appropriate treatment for diarrhea, assessed as an indication of primary health care service use, was low overall. In both surveys, fewer than one in three children with diarrhea received any treatment, and the proportion of children who received treatment either failed to increase (Borno) or declined (Southern Yobe). Conflict-related destruction has resulted in the loss of two thirds of Borno health facilities (*6*). Southern Yobe, particularly in the local government areas of Gujba and Gulani, experienced increased violence in the months between survey rounds (*7*). Constrained population movement and loss of health care facilities might partially explain the poor access to recommended treatment.

The findings in this report are subject to at least two limitations. First, because of the active conflict, some areas were inaccessible to survey teams, and it is likely that health and nutritional outcomes are worse in these regions. Second, to prioritize rapid data collection, the emergency surveys were designed with relatively small sample sizes that result in estimates with relatively high standard errors (particularly

TABLE 1. Emergency survey prevalence of acute malnutrition among children and crude and under-five mortality rates, by region — Northeastern Nigeria, round 1 (October–November 2016) and round 2 (February–March 2017)

	Acute malnutrition, by weight-for-height, children aged 0–59 mos							
	Global acute malnutrition*		Severe acute malnutrition†		Crude mortality§		Under-five mortality¶	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
State/Region	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	Rate** (95% CI)	Rate** (95% CI)	Rate** (95% CI)	Rate** (95% CI)
Borno								
Southern Borno	8.9 (6.7–11.0)	6.4 (4.0–10.2)	1.1 (0.5–2.8)	0.8 (0.3–2.2)	0.26 (0.17–0.41)	0.56 (0.25–1.22)	0.97 (0.56–1.6)	1.96 (0.84–4.49)
Central Borno	11.6 (8.8–15.2)	7.8 (4.8–12.4)	0.6 (0.2–1.8)	1.2 (0.5–2.8)	0.55 (0.35–0.85)††	1.36§§ (0.83–2.20)††	1.69 (0.96–2.91)	2.60§§ (1.62–4.12)
Maiduguri and Jere	13.0 (10.2–16.4)††	6.4 (4.6–8.9)††	1.3 (0.6–2.9)	0.8 (0.3– 2.1)	0.30 (0.16–0.57)††	0.85 (0.53–1.36)††	0.78 (0.34–1.78)	1.45 (0.76–2.74)
Yobe								
Central Yobe	10.3 (7.3–14.2)	8.1 (5.8–11.3)	2.1 (1.1–4.2)	0.9 (0.5–1.8)	0.63 (0.39–1.01)	1.14§§ (0.81–1.61)	2.06§§ (1.24–3.38)	2.49§§ (1.61–3.82)
Southern Yobe	10.7 (8.3–13.6)††	7.8 (6.3–9.6)††	1.6 (0.8–3.0)	0.8 (0.4–1.6)	0.36 (0.24–0.54)††	0.91 (0.59–1.24)††	0.90 (0.56–1.67)	2.17§§ (1.13–3.21)
Northern Yobe	14.3 (10.6–18.9)††	8.6 (6.2–11.9)††	1.6 (0.7–3.9)	1.0 (0.5–2.0)	0.50 (0.36–0.68)††	1.02§§ (0.70–1.47)††	1.69 (0.96–2.91)	2.63§§ (1.54–4.43)

Abbreviation: CI = confidence interval.
* Weight-for-height z-scores less than -2 or bilateral pitting edema.
† Weight-for-height z-scores less than -3 or bilateral pitting edema.
§ Mortality rate among all age groups from all causes.
¶ Mortality rate among children aged 0–59 months.
** Rates reported as deaths per 10,000 population per day.
†† Statistically significant difference between round 1 and round 2.
§§ Rate exceeded emergency thresholds (1 per 10,000 per day for crude mortality and 2 per 10,000 per day for mortality among children aged <5 years).

TABLE 2. Emergency survey coverage with measles vaccination, public health outreach campaigns, anthelmintic medication, and distribution of fortified cereals, by region — Northeastern Nigeria, round 1 (October–November 2016) and round 2 (February–March 2017)

	Measles vaccination coverage, by recall or vaccination card, among children aged 12–59 mos		Coverage with the preceding public health outreach campaign, among all households		6-month coverage of anthelmintic medication, among children aged 12–59 mos		Receipt of fortified cereals in the last 6 months, among all households	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
State/Region	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Borno								
Southern Borno	57.1 (41.7–71.3)*	76.9 (64.2–86.1)*	11.9 (5.7–23.1)	38.5 (28.2–49.9)	2.9 (1.2–6.9)	19.3 (11.9–29.8)	0.2 (0.0–1.2)*	0.5 (0.2–1.5)*
Central Borno	33.7 (22.7–46.7)	78.9 (66.1–87.7)	6.5 (3.0–13.6)	27.4 (17.2–40.7)	3.5 (1.2–9.6)	15.2 (7.9–27.1)	1.7 (0.4–6.8)*	1.7 (0.7–3.8)*
Maiduguri and Jere	63.5 (52.4–73.4)	83.9 (77.3–88.9)	8.7 (4.1–17.8)	29.5 (19.8–41.5)	4.7 (2.3–9.4)	17.2 (10.5–26.9)	1.5 (0.4–5.1)*	3.5 (1.2–10.0)*
Yobe								
Central Yobe	34.1 (24.4–45.3)	67.1 (52.4–79.1)	7.3 (3.3–15.3)	30.9 (20.1–44.2)	4.8 (1.6–13.4)	24.8 (14.3–39.4)	5.3 (1.7–15.2)	0.6 (0.3–1.6)
Southern Yobe	41.1 (28.4–55.0)	58.3 (48.4–67.5)	7.7 (3.8–14.9)	19.4 (13.4–27.2)	4.6 (2.2–9.6)	12.4 (7.8–18.9)	0.9 (0.3–2.8)*	1.5 (0.5–4.4)*
Northern Yobe	28.8 (18.1–42.6)	67.1 (50.3–80.5)	5.5 (2.2–12.9)	30.4 (19.6–43.9)	6.2 (2.3–15.5)	27.3 (16.4–41.8)	2.5 (0.8–7.1)*	0.7 (0.3–1.7)*

Abbreviation: CI = confidence interval.
* Difference between round 1 and round 2 was not statistically significant.

TABLE 3. Emergency survey prevalence of diarrhea during the preceding 2 weeks and access to recommended treatment among children aged 0–59 months, by region — Northeastern Nigeria, round 1 (October–November 2016) and round 2 (February–March 2017)

	Round 1				Round 2			
		Among children with diarrhea % (95% CI)				Among children with diarrhea % (95% CI)		
State/Region	Diarrhea prevalence % (95% CI)	ORS	Zinc	ORS and Zinc	Diarrhea prevalence % (95% CI)	ORS	Zinc	ORS and Zinc
Borno								
Southern Borno	14.1 (8.9–21.6)*	15.6 (7.6–29.2)	1.3 (0.2–7.4)	0	26.1 (21.4–31.5)*	16.6 (9.2–28.0)	4.3 (1.9–9.4)	1.8 (0.6–5.5)
Central Borno	19.5 (14.7–25.3)*	13.9 (8.3–22.2)	5.0 (2.1–11.1)	4.0 (1.5–10.0)	30.0 (23.9–37.0)*	15.9 (9.5–25.5)	3.8 (1.4–10.0)	2.5 (0.6–10.4)
Maiduguri and Jere	17.9 (12.1–25.7)*	26.1 (16.3–39.2)	4.5 (1.9–10.7)	2.3 (0.6–7.7)	31.7 (26.8–37.0)*	28.4 (19.3–39.8)	9.0 (4.7–16.5)	7.1 (3.8–13.0)
Yobe								
Central Yobe	23.8 (18.5–30.1)	15.2 (9.2–24.1)	9.4 (4.3–19.2)*	4.3 (1.7–10.8)	26.5 (20.4–33.7)	12.1 (7.2–19.5)	2.9 (1.2–6.7)*	2.9 (1.2–6.7)
Southern Yobe	31.5 (25.9–37.7)	26.7 (17.9–38.0)*	24.6 (15.0–37.6)*	5.9 (2.3–14.1)*	28.0 (23.0–33.6)	11.4 (7.7–16.6)*	3.3 (1.8–5.8)*	0.8 (0.3–2.6)*
Northern Yobe	30.7 (26.0–36.0)	14.5 (9.1–22.3)	7.5 (2.4–21.4)	0.6 (0.1–4.1)	26.3 (20.0–33.9)	16.1 (7.7–30.4)	3.6 (1.3–9.6)	1.8 (0.4–7.8)

Abbreviations: CI = confidence interval, ORS = oral rehydration solution.
* Statistically significant difference between round 1 and round 2.

Summary

What is already known about this topic?

A public health emergency was declared in northeastern Nigeria in June 2016, as rapid assessments conducted in areas newly liberated from Boko Haram control suggested rates of mortality and prevalence of acute malnutrition exceeded emergency levels. Outbreaks of polio and measles have been confirmed, and the Government of Nigeria has expressed concern in response to evidence of acute malnutrition in excess of emergency thresholds. Increased prevalence of acute malnutrition and high rates of mortality are often observed in complex humanitarian emergencies.

What is added by this report?

Results from population-representative surveys examining acute malnutrition and mortality conducted in accessible areas in Borno and Yobe states suggest that, although the coverage of major public health interventions, including measles vaccinations, has improved, it remain below targeted levels. All-cause mortality among all age groups (crude mortality) and among children aged <5 years (under-five mortality) was above emergency thresholds in regions of Borno and Yobe states during February–March 2017; this was an increase in the mortality observed during October–November 2016.

What are the implications for public health practice?

Increasing mortality rates suggest a need for enhanced efforts to improve receipt of ongoing lifesaving interventions, including treatment of common childhood illnesses in conflict-affected areas. Use of preventive services such as measles vaccination improved in the months after the emergency declaration; however, treatment services have not. Without efforts to scale up multisectoral interventions targeted at reducing malnutrition and morbidity among children throughout accessible regions of northeast Nigeria, limited impact on mortality can be expected.

for under-five mortality) and do not allow for disaggregated analysis of subpopulations, such as displaced persons.

The conflict in northeastern Nigeria, which has resulted in mass destruction of health facilities and limited access to treatment, has contributed to emergency levels of mortality throughout the affected region, particularly among children. Ongoing humanitarian activities in Nigeria prioritize interventions known to reduce maternal and child undernutrition and mortality (*8*). However, survey results indicate that substantial gaps in use of these important interventions remain. Until effective interventions are adequately used, they will have limited effect on large-scale mortality, particularly among vulnerable populations including children.

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Conflict of Interest

No conflicts of interest were reported.

[1]Division of Global Health Protection, Center for Global Health, CDC; [2]Epidemic Intelligence Service, CDC; [3]Nutrition Section, United Nations Children Fund, Abuja, Nigeria; [4]Nutrition Division, Federal Ministry of Health, Abuja, Nigeria; [5]Real Sector and Household Statistics, National Bureau of Statistics, Abuja, Nigeria.

Corresponding author: Eva Leidman, eleidman@cdc.gov, 404-498-2448.

References

1. World Health Organization. Health emergencies: WHO response in severe, large-scale emergencies. Director General's report no. EB 140/7. Geneva, Switzerland: World Health Organization; 2016. http://apps.who.int/gb/ebwha/pdf_files/EB140/B140_7-en.pdf
2. World Health Organization. Nigerian conflict: armed conflict in the North-East. Situation report #28. Geneva, Switzerland: World Health Organization; 2017. https://reliefweb.int/report/nigeria/nigerian-conflict-armed-conflict-northeast-situation-report-28-1-30-april-2017
3. United Nations Department of Technical Co-Operation for Development and Statistical Office. How to weigh and measure children: assessing the nutritional status of young children in household surveys. New York, NY: United Nations; 1986. https://unstats.un.org/unsd/publication/unint/dp_un_int_81_041_6E.pdf
4. World Health Organization. The WHO child growth standards: length/height-for-age, weight-for-age, weight-for-height and body mass index for- age: methods and development. Geneva, Switzerland: World Health Organization; 2006. http://www.who.int/childgrowth/standards
5. World Health Organization. The management of nutrition in major emergencies. Geneva, Switzerland: World Health Organization; 2000. http://www.who.int/nutrition/publications/emergencies/9241545208/en/
6. Borno State Ministry of Health; World Health Organization. Health Resource Availability Monitoring System: Borno State Nigeria. Maiduguri, Nigeria: Borno State Ministry of Health; 2017. http://www.who.int/hac/herams/north-eastern-Nigeria.pdf?ua=1
7. Famine Early Warning System Network. Nigeria food security outlook: October 2016 to May 2017: famine may be ongoing in inaccessible areas of the northeast. Washington, DC: United States Agency for International Development, FEWS NET; 2016. http://www.fews.net/west-africa/nigeria/food-security-outlook/december-2016
8. Bhutta ZA, Ahmed T, Black RE, et al.; Maternal and Child Undernutrition Study Group. What works? Interventions for maternal and child undernutrition and survival. Lancet 2008;371:417–40. https://doi.org/10.1016/S0140-6736(07)61693-6

Announcement

Community Preventive Services Task Force Recommendation for Interactive Digital Interventions to Improve Blood Pressure Self-Management

The Community Preventive Services Task Force (CPSTF) recommends interactive digital interventions for blood pressure self-management. "Cardiovascular Disease Prevention: Interactive Digital Interventions for Blood Pressure Self-Management" is available at https://www.thecommunityguide.org/findings/cardiovascular-disease-interactive-digital-interventions-blood-pressure-self-management.

Established in 1996 by the U.S. Department of Health and Human Services, the CPSTF is an independent, nonfederal panel of public health and prevention experts whose members are appointed by the director of CDC. The CPSTF provides information for a wide range of persons who make decisions about programs, services, and other interventions to improve population health. Although CDC provides administrative, scientific, and technical support for the CPSTF, the recommendations developed are those of the task force and do not undergo review or approval by CDC.

Erratum

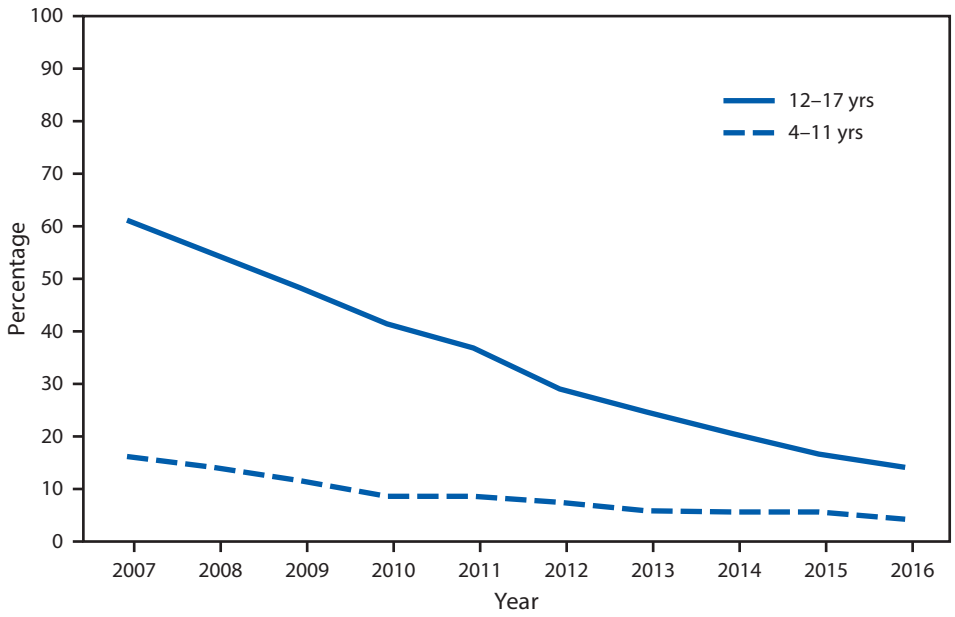
Vol. 66, No. 47

In the report "Synthetic Cannabinoid and Mitragynine Exposure of Law Enforcement Agents During the Raid of an Illegal Laboratory — Nevada, 2014," on page 1292, the following footnote should have been included with the Table: "***Any level above the lower limit of quantification (LLOQ) for the substance. The LLOQ for AB-PINACA, AB-PINACA OH, and AB-PINACA pent is 0.10 ng/mL; the LLOQ for mitragynine is 1.0 ng/mL.**" The online version is correct.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Children Aged 4–17 Years Who Had Ever Had Varicella (Chickenpox),* by Age Group — National Health Interview Survey, 2007–2016†



* Based on responses to the question "Has (child) ever had chickenpox?"
† 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 Sample Child component.

During 2007–2016, the percentage of children aged 4–17 years who had ever had chickenpox decreased among both younger children (aged 4–11 years) and older children (aged 12–17 years). Among younger children, the percentage of children who had ever had chickenpox declined by 73.9%, from 16.1% in 2007 to 4.2% in 2016. Among older children the percentage who had ever had chickenpox declined by 76.9%, from 61.4% in 2007 to 14.2% in 2016. During 2007–2016, older children were more likely than younger children to have ever had chickenpox.

Source: National Center for Health Statistics, National Health Interview Survey, 2007–2016. https://www.cdc.gov/nchs/nhis.htm.

Reported by: Cynthia Reuben, MA, CReuben@cdc.gov, 301-458-4458; Mary Ann Bush, MS.

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