Updated Estimates of Neural Tube Defects Prevented by Mandatory Folic Acid Fortification — United States, 1995–2011

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In 1992, the U.S. Public Health Service recommended that all women capable of becoming pregnant consume 400 µg of folic acid daily to prevent neural tube defects (NTDs) (1).

NTDs are major birth defects of the brain and spine that occur early in pregnancy as a result of improper closure of the embryonic neural tube, which can lead to death or varying

Continuing Education examination available at http://www.cdc.gov/mmwr/cme/conted_info.html#weekly.

National Birth Defects Prevention Month and Folic Acid Awareness Week — January 2015

Birth defects affect one in 33 newborns in the United States (1). This year, National Birth Defects Prevention Month focuses on “Making Healthy Choices to Prevent Birth Defects — Make a PACT for Prevention: Plan ahead, Avoid harmful substances, Choose a healthy lifestyle, and Talk to your doctor.”

Health care providers should encourage women to plan for pregnancy; avoid harmful substances, like tobacco (2) and alcohol (3); and choose a healthy lifestyle, like eating a healthy diet (4), to increase their chances of a healthy pregnancy. Health care providers should also discuss with women any medications they might be taking, both prescription and over-the-counter, to ensure they are taking only what is necessary. More information is available at http://www.cdc.gov/ncbddd/birthdefects/prevention.html.

January 4–10, 2015, is National Folic Acid Awareness Week. CDC urges all women of childbearing age who can become pregnant to get 400 µg of folic acid every day to help reduce the risk for neural tube defects (major birth defects of the brain and spine). Health care providers should encourage women to consume folic acid in fortified foods or supplements, or a combination of the two, in addition to a diet rich in folate. More information about folic acid is available at http://www.cdc.gov/folicacid.

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January 4–10, 2015, is National Folic Acid Awareness Week. CDC urges all women of childbearing age who can become pregnant to get 400 µg of folic acid every day to help reduce the risk for neural tube defects (major birth defects of the brain and spine). Health care providers should encourage women to consume folic acid in fortified foods or supplements, or a combination of the two, in addition to a diet rich in folate. More information about folic acid is available at http://www.cdc.gov/folicacid.
degrees of disability. The two most common NTDs are anencephaly and spina bifida. Beginning in 1998, the United States mandated fortification of enriched cereal grain products with 140 μg of folic acid per 100 g (2). Immediately after mandatory fortification, the birth prevalence of NTD cases declined. Fortification was estimated to avert approximately 1,100 NTD-affected pregnancies annually (2,3). To provide updated estimates of the birth prevalence of NTDs in the period after introduction of mandatory folic acid fortification (i.e., the post-fortification period), data from 19 population-based birth defects surveillance programs in the United States, covering the years 1999–2011, were examined. After the initial decrease, NTD birth prevalence during the post-fortification period has remained relatively stable. The number of births occurring annually without NTDs that would otherwise have been affected is approximately 1,326 (95% confidence interval = 1,122–1,531). Mandatory folic acid fortification remains an effective public health intervention. There remain opportunities for prevention among women with lower folic acid intakes, especially among Hispanic women, to further reduce the prevalence of NTDs in the United States.

In August 2014, a total of 19 population-based birth defects surveillance programs in the United States reported to CDC the number of cases of spina bifida (International Classification of Diseases, 9th Revision, Clinical Modification codes 741.0 and 741.9) and anencephaly (codes 740.0–740.1) among deliveries occurring during 1995–2011 among non-Hispanic whites, non-Hispanic blacks, and Hispanics, as well as all racial/ethnic groups combined. Surveillance programs were grouped by whether they systematically conducted prenatal ascertainment to capture diagnosed cases (eight sites: Arkansas, Georgia, Iowa, New York, Oklahoma, Puerto Rico, South Carolina, and Utah) or did not (11 sites: Arizona, California, Colorado, Illinois, Kentucky, Maryland, New Jersey, North Carolina, Texas, West Virginia, and Wisconsin). Programs with prenatal ascertainment monitored birth defects among live births, stillbirths, and elective terminations, and included collection of information from prenatal sources, such as prenatal diagnostic facilities.

The birth prevalences of spina bifida, anencephaly, and both NTDs combined were estimated as the total number of cases divided by the total number of live births during the pre-fortification (1995–1996) and post-fortification periods (1999–2011). These prevalence estimates were multiplied by the average number of live births in the United States for the selected periods to estimate the annual number of NTD cases nationwide. Prevalence estimates were also calculated by type of surveillance program (i.e., programs with prenatal ascertainment and programs without prenatal ascertainment) and maternal race/ethnicity (i.e., non-Hispanic white, non-Hispanic black, and Hispanic). The estimated annual number of NTDs prevented was calculated as the difference between the estimated annual number during the pre-fortification period and the estimated annual number during the post-fortification period using prevalence estimates from programs with prenatal ascertainment.

A decline in NTDs was observed for all three of the racial/ethnic groups examined between the pre-fortification and
post-fortification periods (Figure). The post-fortification prevalence has remained relatively stable. During the observed periods, Hispanics consistently had a higher prevalence of NTDs compared with the other racial/ethnic groups, whereas non-Hispanic blacks generally had the lowest prevalence.

The birth prevalences of anencephaly and spina bifida during the pre-fortification (1995–1996) and post-fortification periods (biennial from 1999–2008, last 3 years of available data from 2009–2011, and all years from 1999–2011) for programs with and without prenatal ascertainment were estimated. Overall, a 28% reduction in prevalence was observed for anencephaly and spina bifida using data from all participating programs; a greater reduction (35%) was observed among programs with prenatal ascertainment than for programs without prenatal ascertainment (21%) (Table). The prevalence reported for anencephaly from programs with prenatal ascertainment was consistently higher across all racial/ethnic groups than for programs without prenatal ascertainment, whereas the difference in the observed prevalence of spina bifida was not as pronounced between the two types of programs. Based on data from programs that collect prenatal ascertainment information, an updated estimate of the number of births occurring annually without NTDs that would otherwise have been affected is 1,326 (95% confidence interval = 1,122–1,531).

**FIGURE. Prevalence of neural tube defects (NTDs) (anencephaly and spina bifida) before and after mandatory folic acid fortification, by maternal race/ethnicity — 19 population-based birth defects surveillance programs,* United States, 1995–2011**

* Contributing programs are based in Arkansas, Arizona, California, Colorado, Georgia, Illinois, Iowa, Kentucky, Maryland, New Jersey, New York, North Carolina, Oklahoma, Puerto Rico, South Carolina, Texas, Utah, West Virginia, and Wisconsin.

† 95% confidence interval.

**Discussion**

The birth prevalence of NTDs during the post-fortification period has remained relatively stable since the initial reductions observed during 1999–2000, immediately after mandatory folic acid fortification in the United States. The updated estimate of approximately 1,300 NTD-affected births averted annually during the post-fortification period is slightly higher than the previously published estimate (3). Factors that could have helped contribute to the difference include a gradual increase in the number of annual live births in the United States during the post-fortification period and data variations caused by differences in surveillance methodology. The lifetime direct costs for a child with spina bifida are estimated at $560,000, and for anencephaly (a uniformly fatal condition), the estimate is $5,415 (4); multiplying these costs by the NTD case estimates translates to an annual saving in total direct costs of approximately $508 million for the NTD-affected births that were prevented.

The reduction in NTD cases during the post-fortification period inversely mirrors the increase in serum and red blood cell (RBC) folate concentrations among women of childbearing age in the general population. Fortification led to a decrease in the prevalence of serum folate deficiency from 30% to <1%,
and a decrease in the prevalence of RBC folate deficiency from 6% to no measureable deficiency (5). A recent study modeled the dose-response relationship between RBC folate concentrations in women of childbearing age and risk for NTDs. It showed that RBC folate concentrations >1,000 nmol/L were sufficient to substantially attenuate the risk for NTDs at a population level (5). A recent study modeled the dose-response relationship between RBC folate concentrations in women of childbearing age and risk for NTDs. It showed that RBC folate concentrations >1,000 nmol/L were sufficient to substantially attenuate the risk for NTDs at a population level (5).

Although a reduction in the birth prevalence of NTDs has been observed for all three of the racial/ethnic groups examined, the prevalence among Hispanics is consistently greater than that among other racial/ethnic groups. Possible reasons could include differences in folic acid consumption and genetic factors affecting the metabolism of folic acid. Fewer Hispanic women (17%) than non-Hispanic white women (30%) report consuming ≥400 μg of folic acid per day through fortified food or supplements (8). A common genetic polymorphism in Hispanics, the methylenetetrahydrofolate reductase T allele, has been associated with relatively lower plasma folate and RBC folate concentrations compared with those without this polymorphism (9). Persons with this polymorphism have more genetic susceptibility to a folate insufficiency. To target Hispanics who might need additional folic acid intake to prevent NTDs, one strategy under consideration in the United States is to fortify corn masa flour with folic acid at the same

TABLE. Prevalence (per 10,000 live births) and estimated average annual number of spina bifida and anencephaly cases, by period and prenatal ascertainment status — 19 population-based birth defects surveillance programs, United States, 1995–1996 and 1999–2011*

| Type of case / Prenatal ascertainment status | Pre-fortification | Post-fortification | Difference in estimated annual cases between pre- and post-fortification |
|---------------------------------------------|-------------------|--------------------|-----------------------------------------------------------------------|
| Anencephaly                                 |                   |                    |                                                                       |
| Programs with prenatal ascertainment†      |                   |                    |                                                                       |
| Prevalence                                  | 4.2               | 2.9                | 1.3                                                                  |
| Estimated annual cases                      | 1,628             | 1,231              | 397                                                                  |
| (95% CI)                                    | (1,440–1,816)     | (1,059–1,394)      | (298–547)                                                            |
| Programs without prenatal ascertainment     |                   |                    |                                                                       |
| Prevalence                                  | 2.3               | 1.8                | 0.5                                                                  |
| Estimated annual cases                      | 913               | 701                | 212                                                                  |
| (95% CI)                                    | (827–1,000)       | (708–849)          | (298–547)                                                            |
| Spina bifida                                |                   |                    |                                                                       |
| Programs with prenatal ascertainment†      |                   |                    |                                                                       |
| Prevalence                                  | 6.5               | 4.0                | 2.5                                                                  |
| Estimated annual cases                      | 2,549             | 1,678              | 871                                                                  |
| (95% CI)                                    | (2,314–2,785)     | (1,433–1,802)      | (871)                                                                |
| Programs without prenatal ascertainment     |                   |                    |                                                                       |
| Prevalence                                  | 4.3               | 3.4                | 0.9                                                                  |
| Estimated annual cases                      | 1,685             | 1,455              | 230                                                                  |
| (95% CI)                                    | (1,568–1,803)     | (1,310–1,501)      | (230)                                                                |
| Anencephaly and spina bifida                |                   |                    |                                                                       |
| Programs with prenatal ascertainment†      |                   |                    |                                                                       |
| Prevalence                                  | 10.7              | 7.2                | 3.5                                                                  |
| Estimated annual cases                      | 4,177             | 2,604              | 1,573                                                                |
| (95% CI)                                    | (3,876–4,479)     | (2,364–2,797)      | (1,573)                                                               |
| Programs without prenatal ascertainment     |                   |                    |                                                                       |
| Prevalence                                  | 6.7               | 5.5                | 1.2                                                                  |
| Estimated annual cases                      | 2,599             | 2,203              | 396                                                                  |
| (95% CI)                                    | (2,453–2,745)     | (2,06–2,452)       | (396)                                                                |
| Average annual live births§                 | 3,895,542         | 4,027,860          | 132,318                                                              |

Abbreviation: CI = confidence interval.
* Estimated annual number of cases for the specified period is calculated by multiplying the prevalence by the average number of U.S. annual live births. Data during the optional fortification period (1997–1998) are not presented.
† States with prenatal ascertainment (n = 8): Arkansas, Georgia, Iowa, New York, Oklahoma, Puerto Rico, South Carolina, and Utah.
‡ States without prenatal ascertainment (n = 11): Arizona, California, Colorado, Illinois, Kentucky, Maryland, New Jersey, North Carolina, Texas, West Virginia, and Wisconsin.
§ Data available at http://wonder.cdc.gov.
level as enriched cereal grain products. Implementation of corn masa flour fortification would likely prevent an additional 40 cases of NTDs annually (10).

The findings in this report are subject to at least one limitation. The prevalence data used in this study might not be generalizable to the entire United States, but only to the extent that NTD prevalence in other states/territories not examined could differ from NTD prevalence in the states/territories represented in this analysis.

The initial decline in NTD prevalence reported immediately after mandatory folic acid fortification has been maintained after more than a decade since implementation. Mandatory folic acid fortification remains an effective public health policy intervention.

What is already known on this topic?
A decline in the prevalence of neural tube defects (NTDs) was reported during the period immediately after mandatory folic acid fortification in the United States, which translated to approximately 1,000 births occurring annually without anencephaly or spina bifida that would otherwise have been affected.

What is added by this report?
The prevalence of NTDs during the post-fortification period has remained relatively stable since the initial reduction observed immediately after mandatory folic acid fortification in the United States. Using the observed prevalence estimates of NTDs during 1999–2011, an updated estimate of the number of births occurring annually without NTDs that would otherwise have been affected is 1,300.

What are the implications for public health practice?
Current fortification efforts should be maintained to prevent folic acid–sensitive NTDs from occurring. There are still opportunities for prevention among women with lower folic acid intakes, especially among Hispanic women, to further reduce the prevalence of NTDs in the United States.

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Neural tube defects (NTDs) include anomalies of the brain (anencephaly and encephalocele) and spine (spina bifida). Even with ongoing mandatory folic acid fortification of enriched cereal grain products, the U.S. Preventive Services Task Force recommends that women of childbearing potential consume a daily supplement containing 400–800 µg of folic acid (1). Women with a prior NTD-affected pregnancy have an increased risk for having another NTD-affected pregnancy, and if they are planning another pregnancy, the recommendation is that they consume high-dosage folic acid supplements (4.0 mg/day) beginning ≥4 weeks before conception and continuing through the first 12 weeks of pregnancy (2). To learn whether folic acid supplementation (from multivitamins or single-ingredient supplements) was commonly used during pregnancy by women with a previous NTD-affected pregnancy, supplement use was assessed among a convenience sample of women with a previous NTD-affected pregnancy who participated in the National Birth Defects Prevention Study (NBDPS), a case-control study of major birth defects in the United States. Characteristics of women who previously had an NTD-affected pregnancy and whose index pregnancy (pregnancy included in NBDPS) was either affected by an NTD (N = 17) (i.e., recurrence-cases) or resulted in a live-born infant without a major birth defect (N = 10) (i.e., recurrence-controls) were assessed. Taking a supplement that included folic acid was more common among recurrence-control mothers (80%) than recurrence-case mothers (35%). The recommendation that women should take folic acid supplements just before and during early pregnancy is not being followed by many women and offers an opportunity for NTD prevention, especially among women who are at a higher risk because they have had a previous pregnancy affected by an NTD.

Before folic acid fortification in the United States, the NTD recurrence risk was estimated to be about 2%–5% (3). Randomized controlled trials among women with a previous NTD-affected pregnancy demonstrated that a high-dosage folic acid supplement taken periconceptionally reduces the risk for recurrence up to 100% depending on background prevalence (2). Because a high dosage of folic acid (4.0 mg per day) recommended for women with a previous NTD-affected pregnancy exceeds the content of typical prenatal or other multivitamins (typically 400 µg–800 µg of folic acid), women at high risk might be prescribed dietary supplements with folic acid dosages >1.0 mg (4).

NBDPS is a multicenter case-control study conducted to assess risk factors for selected major birth defects. Cases were ascertained through population-based surveillance programs in 10 states (Arkansas, California, Georgia, Iowa, Massachusetts, New Jersey, New York, North Carolina, Texas, and Utah) and included live births, fetal deaths (in all sites except New Jersey), and pregnancy terminations (in all sites except Massachusetts and New Jersey) affected by at least one of the included major birth defects; cases with recognized syndromes or single-gene disorders were excluded. NBDPS includes only one eligible pregnancy per mother. Controls were live births with no major birth defects selected from the same geographically defined regions, identified through hospital logs or birth certificates. Pregnancies with an estimated date of delivery from October 1, 1997, through December 31, 2009, were included, and computer-assisted telephone interviews were conducted with women 6 weeks–24 months after their estimated date of delivery. Interview topics included pregnancy history, family history of birth defects, maternal health and medication use during pregnancy, and demographics.

The descriptive analysis was limited to mothers who reported a previous NTD-affected pregnancy during the interview. Recurrence-case mothers were those whose index pregnancy was affected by encephalocele, anencephaly, or spina bifida. Recurrence-control mothers were those who had a previous NTD-affected pregnancy, whose index pregnancy was included in NBDPS as a control. Although NBDPS is a population-based study, this sample of mothers with a previous NTD-affected pregnancy should be considered a convenience sample because the only mothers eligible to be included were those who did not participate in NBDPS with a previous NTD-affected pregnancy because the birth occurred before the study began, was outside the study area, or was not ascertained, or because the mother did not participate.

Frequencies of several maternal characteristics and pregnancy exposures among cases and controls were considered: year of estimated date of delivery, clinical characteristics of the index birth and previous NTD-affected pregnancy, maternal age,
race/ethnicity, education, pre-pregnancy body mass index, vitamin and medication use, diabetes, and pregnancy intention. NBDPS does not collect information on folic acid dosage, and therefore the only indicator of whether a mother might have taken high-dosage folic acid supplement was reported use of a single-ingredient folic acid supplement, in which case it is possible that she took the recommended amount.

A previous NTD-affected pregnancy was reported by 27 mothers (Table). Of these, 17 had index pregnancies that were also NTD-affected (recurrence-cases), and 10 had index pregnancies that resulted in a live-born infant without a major birth defect (recurrence-controls). Six recurrence-case mothers (35%) reported taking either a single-ingredient folic acid supplement or a prenatal or multivitamin in the 3 months before conception, compared with eight recurrence-control mothers (80%). Reported use of a single-ingredient folic acid supplement was more common among recurrence-control mothers, 70% (seven of 10), compared with 18% (three of 17) of recurrence-case mothers.

Over one third of recurrence-case mothers were Hispanic (six of 17), whereas only one of the 10 recurrence-control mothers was Hispanic. No Hispanic or non-Hispanic black case mothers reported using a supplement with folic acid, whereas 83% of non-Hispanic white case mothers and 88% of non-Hispanic white control mothers did.

Intending to become pregnant at the time of conception was reported by most case (10 of 17) and control (eight of 10) mothers. However, only half of case mothers intending pregnancy (five of 10) took a folic acid supplement during the preconception period. Single-ingredient folic acid supplement

### TABLE: Convenience sample of women with a previous pregnancy affected by a neural tube defect (NTD) — National Birth Defects Prevention Study, 1997–2009

| Case/Control | Previous pregnancy NTD | Index pregnancy NTD | Single-ingredient folic acid vitamin use* | Prenatal or multivitamin use* | Maternal race/ethnicity† | BMI category‡ | Medication summary B1–P2§ | Pregnancy intent summary ¶ |
|--------------|------------------------|---------------------|--------------------------------------|-----------------------------|-------------------------|-------------|--------------------------|--------------------------|
| 1            | Case                   | SB                  | Yes No                                | White                       | Overweight              | Opioid (morphine B2–B1, acetaminophen/hydrocodone B1); Abx (cephalexin B1 and P2–P5) | Did not care |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 2            | Case                   | AN                  | Yes No                                | White                       | Obese                   | Ace-inhibitor (lisinopril B3–P1); diabetes oral medication (NOS B1–P1, metformin B3–P1) | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 3            | Case                   | SB                  | Yes No                                | Other                       | Normal weight           | Abx (antibiotic NOS B1) | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 4            | Case                   | SB                  | No Yes                                | White                       | Overweight              | Opioid (acetaminophen/propoxyphene B3–P3) | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 5            | Case                   | SB                  | No Yes                                | White                       | Obese                   | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 6            | Case                   | SB                  | No Yes                                | White                       | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 7            | Case                   | SB                  | No No                                 | Hispanic                    | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 8            | Case                   | SB                  | No No                                 | Hispanic                    | Obese                   | Got pregnant while consistently using contraception |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 9            | Case                   | EN                  | No No                                 | Hispanic                    | Overweight              | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 10           | Case                   | SB                  | No No                                 | Hispanic                    | Obese                   | Wanted to wait until later |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 11           | Case                   | AN                  | No No                                 | Hispanic                    | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 12           | Case                   | SB                  | No No                                 | Hispanic                    | Obese                   | Wanted to wait until later |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 13           | Case                   | SB                  | No No                                 | Black                      | Overweight              | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 14           | Case                   | SB                  | No No                                 | Black                      | Obese                   | Did not want to become pregnant at all |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 15           | Case                   | SB                  | No No                                 | Black                      | Overweight              | Abx (amoxicillin/clavulanate P2) | Did not want to become pregnant at all |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 16           | Case                   | AN                  | No No                                 | Hispanic                    | Obese                   | Wanted to wait until later |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 17           | Case                   | EN                  | No No                                 | Other                       | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 18           | Control                | AN                  | Yes Yes                               | White                       | Normal weight           | Abx (ciprofloxacin B1) | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 19           | Control                | SB                  | Yes Yes                               | White                       | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 20           | Control                | U                   | Yes Yes                               | White                       | Overweight              | Wanted to wait until later |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 21           | Control                | AN                  | Yes Yes                               | White                       | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 22           | Control                | CO                  | Yes Yes                               | White                       | Normal weight           | Opioid (cough syrup with codeine NOS P2) | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 23           | Control                | EN                  | Yes No                                | White                       | Normal weight           | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 24           | Control                | AN                  | Yes No                                | White                       | Normal weight           | Stopped using contraception to get pregnant |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 25           | Control                | SB                  | No Yes                                | Hispanic                    | Missing                 | Wanted to be pregnant then |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 26           | Control                | AN and SB           | No No                                 | White                       | Overweight              | Got pregnant while consistently using contraception |
|              |                        |                     |                                      |                             |                         |                         |                          |                          |
| 27           | Control                | SB                  | No No                                 | Other                       | Underweight             | Abx (cephalexin B1–P7) | Wanted to be pregnant then |

**Abbreviations:** BMI = body mass index; SB = spina bifida; AN = anencephaly; EN = encephalocele; U = unknown phenotype; CO = control; B3, B2, B1 = 3rd, 2nd, 1st month before pregnancy; P3, P2, P1...P9 = 1st, 2nd, 3rd...9th month of pregnancy; Abx = antibiotic; NOS = not otherwise specified.

* B3–B1 self-reported use.

† Mothers of white, black, or other race are all non-Hispanic.

‡ Units in kg/m² where underweight = <18.5; normal weight = 18.5–24.9; overweight = 25.0–29.9; and obese ≥30.0.

¶ B1–P2 self-reported use.
Discussion

Taking a folic acid supplement (single vitamin or as part of a multivitamin) was reported by a low percentage of NBDPS recurrence-case mothers. Although the sample was small, the results are consistent with a protective effect of folic acid against recurrent NTDs, because recurrence-control mothers more often reported preconception use of folic acid supplements than recurrence-case mothers. Preventing the recurrence of NTDs by managing maternal risk factors before conception, including folic acid intake and obesity, presents important opportunities for public health.

A racial/ethnic disparity in preconception use of a high-dosage folic acid supplement has been observed previously; a Texas-based study of 195 mothers at high risk for NTD recurrence revealed a significant difference in folic acid–containing supplement use between non-Hispanic white (64.7%) and Hispanic (16.5%) mothers, even though recall of receiving postpartum advice did not vary (5). However, mothers who recalled receiving advice were more likely to take supplements than those who did not (5). Importantly, active outreach to mothers with a previous NTD-affected pregnancy has been shown to increase folic acid supplement use among mothers in South Carolina and along the Texas-Mexico border (6,7).

Prepregnancy obesity has been associated with NTD risk, and obesity was more common among recurrence-case mothers than recurrence-control mothers (8). The data do not allow for the identification of causative factors for these recurrent NTD cases, but it is of note that two of three recurrence-case mothers who reported taking a single-ingredient folic acid supplement reported other NTD risk factors, specifically obesity, prepregnancy diabetes, and opioid medication use (8,9).

The findings in this report are subject to at least two limitations. First, because of small numbers and the study's design, no statistical tests were performed, and recurrence risk could not be estimated. Second, for study years 1997–2005, the family history question did not distinguish between older and younger siblings, making it theoretically possible that some cases were classified as recurrent that were actually the first NTD-affected pregnancy for that mother. However, most NTD-affected siblings are older because the interview was performed as soon as possible after the estimated date of delivery of the pregnancy, on average 9 months.

This study suggests that awareness of the importance of folic acid supplement use in preconception and early pregnancy should be increased among women with a previous NTD-affected pregnancy. Barriers to implementing NTD recurrence prevention recommendations need to be identified and overcome. Communication of the importance of this preventive action by health care providers to women of childbearing age, especially those at high risk for another NTD-affected pregnancy, should be improved. Active outreach programs have been shown to be cost-effective in preventing NTD recurrences and might be considered (10).

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Early Estimates of Seasonal Influenza Vaccine Effectiveness — United States, January 2015

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In the United States, annual vaccination against seasonal influenza is recommended for all persons aged ≥6 months (1). Each season since 2004–05, CDC has estimated the effectiveness of seasonal influenza vaccine in preventing medically attended acute respiratory illness (ARI) associated with laboratory-confirmed influenza. This season, early estimates of influenza vaccine effectiveness are possible because of widespread, early circulation of influenza viruses. By January 3, 2015, 46 states were experiencing widespread flu activity, with predominance of influenza A (H3N2) viruses (2). This report presents an initial estimate of seasonal influenza vaccine effectiveness at preventing laboratory-confirmed influenza virus infection associated with medically attended ARI based on data from 2,321 children and adults enrolled in the U.S. Influenza Vaccine Effectiveness Network (Flu VE) during November 10, 2014–January 2, 2015. During this period, overall vaccine effectiveness (VE) (adjusted for study site, age, sex, race/ethnicity, self-rated health, and days from illness onset to enrollment) against laboratory-confirmed influenza associated with medically attended ARI was 23% (95% confidence interval [CI] = 8%–36%). Most influenza infections were due to A (H3N2) viruses. This interim VE estimate is relatively low compared with previous seasons when circulating viruses and vaccine viruses were well-matched and likely reflects the fact that more than two-thirds of circulating A (H3N2) viruses are antigenically and genetically different (drifted) from the A (H3N2) vaccine component of 2014–15 Northern Hemisphere seasonal influenza vaccines (2). These early, low VE estimates underscore the need for ongoing influenza prevention and treatment measures. CDC continues to recommend influenza vaccination because the vaccine can still prevent some infections with the currently circulating A (H3N2) viruses as well as other viruses that might circulate later in the season, including influenza B viruses. Even when VE is reduced, vaccination still prevents some illness and serious influenza-related complications, including thousands of hospitalizations and deaths (3). Persons aged ≥6 months who have not yet been vaccinated this season should be vaccinated, including persons who might already have been ill with influenza this season.

CDC always recommends antiviral medications as an adjunct to vaccination, and their potential public health benefit is magnified in the context of reduced vaccine effectiveness. All hospitalized patients and all outpatients at high risk for serious complications from influenza should be treated as soon as possible with a neuraminidase inhibitor medication if influenza is suspected. A CDC health update from January 9, 2015, regarding treatment with antiviral medications is available at http://emergency.cdc.gov/han/han00375.asp. Physicians should not wait for confirmatory influenza laboratory testing, and the decision to use an antiviral medication should not be influenced by patient vaccination status (4). Clinicians should be aware that influenza activity is widespread and influenza should be considered as a possible diagnosis in all patients with acute respiratory illness.

Flu VE methods have been published previously (5). Patients aged ≥6 months were enrolled when seeking outpatient medical care for an ARI with cough at study sites in Michigan, Pennsylvania, Texas, Washington, and Wisconsin.* Study enrollment began once laboratory-confirmed cases of influenza were identified through local surveillance. Trained study staff members reviewed appointment schedules and chief complaints to identify patients with ARI. Patients were eligible for enrollment if they 1) were aged ≥6 months on September 1, 2014, and thus eligible for vaccination; 2) reported an ARI with cough and onset ≤7 days earlier; and 3) had not yet been treated for enrollment if they 1) were aged ≥6 months on September 1, 2014, and thus eligible for vaccination; 2) reported an ARI with cough and onset ≤7 days earlier; and 3) had not yet been treated with influenza antiviral medication (e.g., oseltamivir) during this illness. Consenting participants completed an enrollment interview. Nasal and oropharyngeal swabs were collected from each patient and placed together in a single cryovial with viral

* The U.S. Flu VE Network sites and the dates enrollment began were as follows: the University of Michigan School of Public Health (the University of Michigan School of Public Health, partnered with the University of Michigan Health System, Ann Arbor, and the Henry Ford Health System, Detroit, Michigan) (November 10, 2014); Baylor Scott and White Health, Texas A&M University Health Sciences Center College of Medicine (Temple, Texas) (November 13, 2014); Group Health Cooperative (Seattle, Washington) (December 1, 2014); the University of Pittsburgh Schools of the Health Sciences and UPMC (Pittsburgh, Pennsylvania) (November 24, 2014); and the Marshfield Clinic Research Foundation (Marshfield, Wisconsin) (December 8, 2014).
transport medium. Only nasal swabs were collected for patients aged <2 years. Specimens were tested at Flu VE laboratories using CDC’s real-time reverse transcription–polymerase chain reaction (rRT-PCR) protocol for detection and identification of influenza viruses.

Participants were considered vaccinated if they received ≥1 dose of any seasonal influenza vaccine ≥14 days before illness onset, according to medical records and registries (at the Wisconsin site) or medical records and self-report (at the Michigan, Pennsylvania, Texas, and Washington sites). Vaccine effectiveness was estimated as 100% x (1 - odds ratio [ratio of odds of being vaccinated among outpatients with influenza-positive test results to the odds of being vaccinated among outpatients with influenza-negative test results]); odds ratios were estimated using logistic regression. Estimates were adjusted for study site, age, sex, race/ethnicity, self-rated health, and days from illness onset to enrollment. These early interim VE estimates for the 2014–15 season were based on patients enrolled through January 2, 2015.

Of the 2,321 children and adults with ARI enrolled at the five study sites, 950 (41%) tested positive for influenza virus by rRT-PCR; 916 (96%) of these viruses were influenza A, and 35 (4%) were influenza B (Table 1). The proportion of patients with influenza differed by study site, age, race/ethnicity, and interval from onset to enrollment (Table 1). The proportion vaccinated ranged from 46% to 66% across sites and also differed by age, sex, race/ethnicity, and self-rated health status.

The proportion vaccinated with 2014–15 seasonal influenza vaccine was 49% among patients with influenza compared with 56% among influenza-negative controls (Table 2). After adjusting for study site, age, sex, race/ethnicity, self-rated health, and days from illness onset to enrollment, VE against medically attended ARI attributable to influenza A and B virus infections was 23% (CI = 8%–36%).

Among the 916 infections with influenza A viruses, 842 (92%) viruses were subtyped; 100% of those were influenza A (H3N2) viruses (Table 1). Overall, 24 influenza A (H3N2) viruses from patients enrolled in Flu VE were characterized; eight (33%) were antigenically similar to A/Texas/50/2012, and 16 (67%) were antigenically drifted. The drifted viruses had reduced titers with antiserum produced against A/Texas/50/2012, and were similar to the A/Switzerland/9715293/2013 (H3N2) virus. The adjusted VE for all ages against medically attended ARI caused by influenza A (H3N2) virus infection was 22% (CI = 5%–35%). The adjusted, age-stratified VE point estimates were 26% for persons aged 6 months–17 years, 12% for persons aged 18–49 years, and 14% for persons aged ≥50 years (Table 2). Statistically significant VE was observed only among persons aged 6 months–17 years.

**Discussion**

The early onset of the 2014–15 influenza season offered an opportunity to provide an early VE estimate. Overall, the estimate suggests that the 2014–15 influenza vaccine has low effectiveness against circulating influenza A (H3N2) viruses. These early findings are consistent with laboratory data demonstrating that most influenza A (H3N2) viruses circulating in the community are antigenically and genetically different from A/Texas/50/2012, the A (H3N2) component of the 2014–15 Northern Hemisphere influenza vaccine. The predominant A (H3N2) viruses detected during surveillance during the 2014–15 season have been similar to the A/Switzerland/9715293/2013 (H3N2) virus, the H3N2 virus selected for the 2015 Southern Hemisphere influenza vaccine. The drifted viruses had reduced titers with antiserum produced against A/Texas/50/2012, and 16 (67%) were influenza B (Table 1). The proportion of patients enrolled through January 2, 2015.

Of the 2,321 children and adults with ARI enrolled at the five study sites, 950 (41%) tested positive for influenza virus by rRT-PCR; 916 (96%) of these viruses were influenza A, and 35 (4%) were influenza B (Table 1). The proportion of patients with influenza differed by study site, age, race/ethnicity, and interval from onset to enrollment (Table 1). The proportion vaccinated ranged from 46% to 66% across sites and also differed by age, sex, race/ethnicity, and self-rated health status.

The proportion vaccinated with 2014–15 seasonal influenza vaccine was 49% among patients with influenza compared with 56% among influenza-negative controls (Table 2). After adjusting for study site, age, sex, race/ethnicity, self-rated health, and days from illness onset to enrollment, VE against medically attended ARI attributable to influenza A and B virus infections was 23% (CI = 8%–36%).

Among the 916 infections with influenza A viruses, 842 (92%) viruses were subtyped; 100% of those were influenza A (H3N2) viruses (Table 1). Overall, 24 influenza A (H3N2) viruses from patients enrolled in Flu VE were characterized; eight (33%) were antigenically similar to A/Texas/50/2012, and 16 (67%) were antigenically drifted. The drifted viruses had reduced titers with antiserum produced against A/Texas/50/2012, and were similar to the A/Switzerland/9715293/2013 (H3N2) virus. The adjusted VE for all ages against medically attended ARI caused by influenza A (H3N2) virus infection was 22% (CI = 5%–35%). The adjusted, age-stratified VE point estimates were 26% for persons aged 6 months–17 years, 12% for persons aged 18–49 years, and 14% for persons aged ≥50 years (Table 2). Statistically significant VE was observed only among persons aged 6 months–17 years.

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The proportion vaccinated with 2014–15 seasonal influenza vaccine was 49% among patients with influenza compared with 56% among influenza-negative controls (Table 2). After adjusting for study site, age, sex, race/ethnicity, self-rated health, and days from illness onset to enrollment, VE against medically attended ARI attributable to influenza A and B virus infections was 23% (CI = 8%–36%).

Among the 916 infections with influenza A viruses, 842 (92%) viruses were subtyped; 100% of those were influenza A (H3N2) viruses (Table 1). Overall, 24 influenza A (H3N2) viruses from patients enrolled in Flu VE were characterized; eight (33%) were antigenically similar to A/Texas/50/2012, and 16 (67%) were antigenically drifted. The drifted viruses had reduced titers with antiserum produced against A/Texas/50/2012, and were similar to the A/Switzerland/9715293/2013 (H3N2) virus. The adjusted VE for all ages against medically attended ARI caused by influenza A (H3N2) virus infection was 22% (CI = 5%–35%). The adjusted, age-stratified VE point estimates were 26% for persons aged 6 months–17 years, 12% for persons aged 18–49 years, and 14% for persons aged ≥50 years (Table 2). Statistically significant VE was observed only among persons aged 6 months–17 years.

The severity and timing of influenza activity during the 2014–15 season has so far been similar to the moderately severe 2012–13 season, the last season when influenza A (H3N2) viruses predominated. Rates of influenza-associated hospitalization so far this season are similar to rates during 2012–13, with highest hospitalization rates among persons aged ≥65 years (2). CDC surveillance through January 3, 2015, shows that the percentage of patient visits to doctors for influenza-like-illness (ILI) this season was almost the same as at the peak of the 2012–13 season (2). For the past 13 seasons, influenza seasons have ranged in duration, with an average of 13 weeks of increased IILI activity. This season, as of the week ending January 3, 2015, influenza activity has been elevated for 7 consecutive weeks, suggesting that the current influenza season might continue for several weeks. Influenza activity might continue to increase, especially in parts of the country that have seen more recent increases in activity and parts of the country that have yet to experience significant influenza activity.

†Influenza vaccination coverage estimates for the 2014–15 season are available at http://www.cdc.gov/flu/fluvaxview/index.htm.
These early VE estimates underscore the need for additional influenza prevention and treatment measures, especially among persons aged ≥65 years, young children, and other persons at higher risk for serious influenza associated complications. Influenza antiviral medications should be used as recommended for treatment in patients, regardless of their vaccination status. Antiviral treatment can reduce the duration of illness and reduce complications associated with influenza. Antiviral treatment should be used for any patient with suspected or confirmed influenza who is hospitalized, has severe or progressive illness, or is at high risk for complications from influenza, even if the illness seems mild. Persons at high risk include young children (especially children aged <2 years), pregnant women, persons with chronic medical conditions like asthma, diabetes, or heart disease, and adults aged ≥65 years.

Ideally, antiviral treatment should be initiated within 48 hours of symptom onset, when treatment is most effective. However, antiviral treatment initiated later than 48 hours after illness onset can still be beneficial for some patients. Observational studies of hospitalized patients suggest some benefit when treatment was initiated up to 4 or 5 days after symptom onset. Also, a randomized placebo-controlled study suggested clinical benefit when oseltamivir was initiated 72 hours after illness onset among febrile children with uncomplicated influenza (6). Clinical judgment, on the basis of the patient’s disease severity and progression, age, underlying medical conditions, likelihood of influenza, and time since onset of symptoms, is important when making antiviral treatment decisions for outpatients. The decision to initiate antiviral treatment should not be delayed pending laboratory confirmation of influenza, especially if performed by insensitive assays, such as rapid influenza diagnostic tests. Health care providers should advise patients at high risk to call promptly if they get symptoms of influenza. Also, clinicians should have a high index of suspicion for influenza while influenza activity is widespread. Alternative strategies, such as health care provider–operated telephone triage, might enable patients at high risk to discuss symptoms over the phone and facilitate early initiation of treatment.

Although antigenic match influences vaccine effectiveness, randomized studies of influenza vaccines have reported variable vaccine efficacy during seasons when antigenically drifted viruses predominated. Since October 1, 2014, drifted influenza A (H3N2) viruses have accounted for an increasing proportion of antigenically characterized A (H3N2) isolates relative to A/Texas/2012-like viruses. Drifted A (H3N2) viruses were first identified in a small proportion of surveillance specimens in late March 2014, after the World Health Organization had selected the strains for inclusion in the 2014–15 Northern Hemisphere vaccine. These antigenically drifted viruses were detected with increasing frequency from July to September 2014, when they had become common among A (H3N2) viruses in the United States and abroad. As of January 3, 2015, 68% of A (H3N2) viruses isolated in the United States since October 1, 2014, were antigenically or genetically different from the A (H3N2) vaccine virus component; characterization of a limited number of A (H3N2) viruses from US Flu VE network enrollees had similar findings. Modeling conducted by CDC suggested that a VE of only 10% in older adults could prevent approximately 13,000 hospitalizations.
influenza-associated hospitalizations in adults aged ≥65 years in the United States during a moderately severe influenza season such as the 2012–13 influenza season (3). Vaccination is particularly important for persons at high risk for serious influenza-related complications and their close contacts.

The findings in this report are subject to at least four limitations. First, these early VE estimates are imprecise for persons aged ≥18 years, limiting ability to detect statistically significant protection against influenza illness resulting in visits to health care providers; larger numbers of enrollees are required to detect significant protection when VE is low. Second, the VE estimates in this report are limited to outpatient medical visits, rather than more severe illness outcomes, such as hospitalization or death; studies are being conducted during the 2014–15 season to estimate VE against more severe illness outcomes. Third, vaccination status included self-report at four of five sites, and dates of vaccination and vaccine formulation were available only for persons with documented vaccination.

**TABLE 1. Selected characteristics of enrolled patients with medically attended acute respiratory illness, by influenza test result status and seasonal influenza vaccination status — U.S. Influenza Vaccine Effectiveness Network, United States, November 10, 2014–January 2, 2015**

| Characteristic | Test result status | Vaccination status |
|---------------|-------------------|--------------------|
|               | Influenza positive | Influenza negative | **p value†** | Vaccinated* | Total (%) | **p value‡** |
|               | No. (%)            | No. (%)            |            | No. (%)     |            |            |
| Overall       | 950 (41)           | 1,371 (59)         | <0.001     | 1,236       | 2,321 (53) | <0.001     |
| Study site    |                   |                    |            |             |            |            |
| Michigan      | 202 (41)           | 286 (59)           |            | 258         | 488 (53)   |            |
| Pennsylvania  | 239 (52)           | 222 (48)           |            | 210         | 461 (46)   |            |
| Texas         | 210 (41)           | 297 (59)           |            | 252         | 507 (50)   |            |
| Washington    | 114 (24)           | 361 (76)           |            | 313         | 475 (66)   |            |
| Wisconsin     | 185 (47)           | 205 (53)           |            | 203         | 390 (52)   |            |
| Sex           |                   |                    | 0.63       | 0.01        |            |            |
| Male          | 402 (40)           | 594 (60)           |            | 499         | 996 (50)   |            |
| Female        | 548 (41)           | 777 (59)           |            | 737         | 1325 (56)  |            |
| Age group (yrs) |                |                    | <0.001     | <0.001      |            |            |
| 6 mos–8       | 225 (35)           | 413 (65)           |            | 302         | 638 (47)   |            |
| 9–17          | 185 (52)           | 170 (48)           |            | 142         | 355 (40)   |            |
| 18–49         | 268 (40)           | 400 (60)           |            | 307         | 668 (46)   |            |
| 50–64         | 136 (38)           | 223 (62)           |            | 240         | 359 (67)   |            |
| ≥65           | 136 (45)           | 165 (55)           |            | 245         | 301 (81)   |            |
| Race/Ethnicity§ |                |                    | 0.02       | <0.001      |            |            |
| White         | 713 (41)           | 1021 (59)          |            | 970         | 1734 (56)  |            |
| Black         | 89 (50)            | 90 (50)            |            | 61          | 179 (34)   |            |
| Other race    | 78 (37)            | 132 (63)           |            | 107         | 210 (51)   |            |
| Hispanic      | 66 (35)            | 123 (65)           |            | 95          | 189 (50)   |            |
| Self-rated health status¶ | |                    | 0.17       | 0.01        |            |            |
| Fair or poor  | 43 (38)            | 70 (62)            |            | 66          | 113 (58)   |            |
| Good          | 184 (37)           | 312 (63)           |            | 281         | 496 (57)   |            |
| Very good     | 328 (41)           | 474 (59)           |            | 442         | 802 (55)   |            |
| Excellent     | 388 (43)           | 514 (57)           |            | 443         | 902 (49)   |            |
| Illness onset to enrollment (days) | |                    | <0.001     | 0.15        |            |            |
| <3            | 451 (56)           | 354 (44)           |            | 420         | 805 (52)   |            |
| 3–4           | 330 (37)           | 553 (63)           |            | 458         | 883 (52)   |            |
| 5–7           | 169 (27)           | 464 (73)           |            | 358         | 633 (57)   |            |
| Influenza test result | |                    |            |            |            |            |
| Negative      | 1,371              |                    |            | 771         | 1,371 (56) |            |
| Influenza B positive** | 35 | | 17 | 35 | (49) | |
| Influenza A positive** | 916 | | 448 | 916 | (49) | |
| A (H1N1)pdm09 0 | 0 | | 0 | 0 | (0) | |
| A (H3N2) 842 | | 407 | 842 | (48) | |
| A subtype pending 74 | | 41 | 74 | (55) | |

* Defined as having received ≥1 dose of vaccine ≥14 days before illness onset. A total of 92 participants who received the vaccine ≤13 days before illness onset were excluded from the study sample.
† The chi-square statistic was used to assess differences between the numbers of persons with influenza-negative and influenza-positive test results, in the distribution of enrolled patient and illness characteristics, and in differences between groups in the percentage vaccinated.
§ Enrollees were categorized into one of four mutually exclusive racial/ethnic populations: white, black, other race, and Hispanic. Persons identified as Hispanic might be of any race. Persons identified as white, black, or other race are non-Hispanic. The overall prevalences calculated included data from all racial/ethnic groups, not just the four included in this analysis. Race/ethnicity data were missing for nine enrollees.
¶ Data on self-rated health status were missing for eight enrollees.
** One patient had coinfection with influenza A (H3N2) and influenza B, making the sum 951, or one greater than the total number of influenza positives.
TABLE 2. Number and percentage receiving 2014–15 seasonal influenza vaccine among 2,321 outpatients with acute respiratory illness and cough, by influenza test result status, age group, and vaccine effectiveness* against all influenza A and B and against virus type A (H3N2) — U.S. Influenza Vaccine Effectiveness Network, United States, November 10, 2014–January 2, 2015

| Influenza type/Age group | Influenza positive | Influenza negative | Vaccine effectiveness |
|-------------------------|--------------------|--------------------|----------------------|
|                         | No. vaccinated     | Total sample (%)   | No. vaccinated       | Total sample (%) | (%) (95% CI) | (%) (95% CI) |
| Influenza A and B       |                    |                    |                      |                    |              |              |
| Overall                 | 465                | 950 (49)           | 771                  | 1,371 (56)        | (25) (12–37) | (23) (8–36) |
| Age group (yrs)         |                    |                    |                      |                    |              |              |
| 6 mos–17                | 159                | 410 (39)           | 285                  | 583 (49)          | (34) (14–49) | (24) (0–43) |
| 18–49                   | 114                | 268 (43)           | 193                  | 400 (48)          | (21) (8–42)  | (16) (18–41) |
| ≥50                     | 192                | 272 (71)           | 293                  | 388 (76)          | (22) (10–45) | (23) (14–47) |
| Influenza A (H3N2)     | 407                | 841 (48)           | 771                  | 1,371 (56)        | (27) (13–39) | (22) (5–35) |
| Overall                 |                    |                    |                      |                    |              |              |
| Age group (yrs)         |                    |                    |                      |                    |              |              |
| 6 mos–17                | 143                | 375 (38)           | 285                  | 583 (49)          | (35) (16–50) | (26) (2–45) |
| 18–49                   | 100                | 235 (43)           | 193                  | 400 (48)          | (21) (10–43) | (12) (26–39) |
| ≥50                     | 164                | 231 (71)           | 293                  | 388 (76)          | (21) (15–45) | (14) (31–43) |

Abbreviation: CI = confidence interval.

* Vaccine effectiveness was estimated as 100% x (1 - odds ratio [ratio of odds of being vaccinated among outpatients with influenza-positive test results to the odds of being vaccinated among outpatients with influenza-negative test results]); odds ratios were estimated using logistic regression.

obtained from medical records or immunization registries; complete vaccination data are needed to verify vaccination status and estimate VE for different vaccine formulations. Finally, future interim estimates and end-of-season VE estimates could differ from current estimates as additional patient data become available or if there is a change in circulating viruses late in the season.

Although influenza vaccines are the best tool for prevention of influenza currently available, more effective vaccines are needed. Other practices that can help decrease the spread of influenza include respiratory hygiene, cough etiquette, social distancing (e.g., staying home from work and school when ill or staying away from persons who are ill) and hand washing. Antiviral medications are an important adjunct in the treatment and control of influenza for the 2014–15 season and should be used as recommended, regardless of patient vaccination status.

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American Indian/Alaska Native (AI/AN) populations experience substantial disparities in the incidence of multiple diseases compared with other racial/ethnic groups in the United States. A major goal of Healthy People 2020 is to eliminate health disparities, monitor disease trends, and identify population groups and diseases for targeted interventions (1). High rates of certain infectious diseases continue to be a major problem facing AI/AN populations (2). During 1990–2011, incidence rates for some infectious diseases declined among AI/AN populations, but disparities remain and AI/AN populations are still disproportionately affected (2,3). To describe disparities in selected notifiable diseases among AI/ANs, CDC analyzed data from the National Notifiable Diseases Surveillance System (NNDSS) for 2007–2011, the most recent 5 years for which data are available. The results of this analysis of 26 infectious diseases indicate that incidence rates of 14 diseases were higher for AI/ANs than for whites. Interventions are needed to address and reduce disparities in chlamydia, gonorrhea, West Nile virus, spotted fever rickettsiosis, and other infections among AI/ANs.

NNDSS is a public health surveillance system that collects data on nationally notifiable diseases in the United States and its territories (3). CDC maintains the system, in collaboration with the Council of State and Territorial Epidemiologists, which determines nationally notifiable diseases and approves use of national surveillance case definitions. Each year, state epidemiologists, other Council of State and Territorial Epidemiologists members, and CDC staff members collaborate in determining for which diseases universal national case reporting yields important data and therefore should remain on the list of nationally notifiable diseases. For this study, CDC examined diseases that were notifiable during the study period and for which a minimum of 20 cases was recorded for AI/ANs. Human immunodeficiency virus/acquired immunodeficiency syndrome was excluded from the analysis because of changes in the case definition and surveillance beginning in 2009 such that data from earlier years cannot be combined with later data. Data were abstracted from a series of published annual Summary of Notifiable Diseases reports for sexually transmitted diseases, arboviral diseases, and tuberculosis because these diseases are not directly reported to the surveillance system. Neuroinvasive and non-neuroinvasive West Nile virus disease reports were combined in a single category as West Nile disease reports. Incidence rates for Asians/Pacific Islanders are not presented in this report because, with the exception of tuberculosis and acute viral hepatitis B, for which the rates are higher among Asians/Pacific Islanders, lower incidence rates were recorded for multiple diseases (e.g., shigellosis, salmonellosis, mumps, Lyme disease, and syphilis) compared with whites (3). However, Asians/Pacific Islanders and persons of “other race” category were included in the total counts for each disease. A person’s race in the surveillance system is based on self-reporting, regardless of ethnicity. Incidence rates were not calculated by ethnicity (i.e., Hispanic or non-Hispanic) for this report.

For 26 notifiable diseases examined for 2007–2011, a total of 12,420,236 cases were recorded (Table). Among 20 diseases for which >10,000 cases were reported nationally, incidence was higher in nine (45%) diseases for AI/ANs. Missing data on race ranged from 0.3% for Chlamydia trachomatis infection and 0.8% for tuberculosis to 42% for giardiasis. Race information was complete for >70% of cases for 22 of the 26 diseases. The four with incomplete data for ≥30% of cases during this period were botulism, foodborne; ehrlichiosis, total; giardiasis; and Lyme disease. Among the 22 diseases for which >70% of records had complete race information, rates were higher in 12 (55%) among AI/ANs.

Of the 12 diseases with race information for >70% of records and for which rates were higher among AI/ANs than among whites, the largest difference was for hantavirus pulmonary syndrome, which was reported 15 times more often among AI/ANs than among whites; however, only 20 cases were reported among AI/ANs of a total of 112 cases reported during 2007–2011. The second largest difference was for tularemia, which was reported 6.8 times as often among AI/ANs. There were 47 cases among AI/ANs out of a total of 626. Among more commonly reported diseases, incidence rates were 4.2 times higher among AI/ANs than whites for spotted fever rickettsiosis, 2.5 times higher for Chlamydia trachomatis infections, 2.4 times higher for gonorrhea, 2.1 times higher for West Nile virus, 1.9 times higher for tuberculosis, 1.8 times higher for shigellosis, 1.6 times higher for acute hepatitis C, 1.3 times higher for invasive pneumococcal infection in children aged <5 years, 1.3 times higher for Haemophilus influenzae type b infection, and 1.2 times higher for invasive pneumococcal infection at all ages (Table).
Of the 10 diseases with race information for >70% of records for which rates were lower among AI/ANs than among whites, the largest difference was for chickenpox (varicella) which was reported 2.6 times as often among whites as among AI/ANs. The second largest difference was for cryptosporidiosis, which was reported 2.2 times as often among whites. Lyme disease was reported 3.0 times more often among whites, but 39% of records did not include race.

**Discussion**

The findings in this report document disparities in the reported incidence of selected notifiable infectious diseases among AI/ANs compared with whites. When compared with whites, AI/AN incidence rates were higher for 14 of 26 diseases. Race information was complete for >70% of cases for 22 of 26 (85%) diseases in this study, compared with a previous analysis (4) in which complete information on race was recorded for >70% of cases for only 23 of 42 diseases (55%).

NNDSS has improved in coding the race variable, allowing better characterization of disease burden. It is not possible to determine if this improvement in coding is a result of several reporting jurisdictions now using the National Electronic Diseases Surveillance System (NEDSS) or a NEDSS-based compatible systems (3). With implementation of NEDSS or NEDSS-based systems, providers can rapidly transfer clinical and laboratory-based data electronically to health departments, thereby reducing the number and proportions of missing data elements. However, additional improvements might be possible when jurisdictions ascertain the value of efforts to increase the completeness of race information because laws and regulations that require public health reporting are under the purview of each reporting authority (3). The relatively low proportion of missing race data for syphilis infections and tuberculosis disease likely reflects federal and local support for more complete follow up of these cases to ensure that treatment is given and contacts are identified and treated for infection.

### TABLE. Number and incidence rate per 100,000 population for 26 selected notifiable diseases, by American Indian/Alaska Native (AI/AN), black, or white race — United States, 2007–2011

| Disease                          | AI/ANs | Rate | No. Rate | No. | Rate | No. Rate | No. | Rate | No. Rate | Rate ratio: AI/ANs compared with whites | % with no race identified |
|----------------------------------|--------|------|----------|-----|------|----------|-----|------|----------|----------------------------------------|--------------------------|
| Botulism, foodborne              | 26     | 0.12 | 28       | 0.03| 339  | 0.03     | 672 | 0.04| 4.38     | 35.42                                  |                          |
| Chickenpox (varicella)           | 503    | 2.45 | 7,086    | 8.54| 7,877| 6.45     | 110,634 | 7.22| 106,344 | 17.82                                  |                          |
| Chlamydia trachomatis            | 77,092 | 374.93 | 2,189,748 | 2,639.03 | 1,841,172 | 150.74 | 6,283,761 | 409.90 | 2.49 | 0.30                                  |                          |
| Cryptosporidiosis                | 223    | 1.08 | 3,202    | 3.86| 29,010| 2.38     | 45,721 | 2.98| 0.46     | 25.63                                  |                          |
| Ehrlichiosis, total              | 219    | 1.07 | 167      | 0.20| 7,250| 0.59     | 12,348 | 0.81| 1.79     | 36.46                                  |                          |
| Gonorrhea                        | 12,764 | 62.08 | 894,198  | 1,077.66 | 7,877 | 6.45     | 110,634 | 7.22| 1.33     | 21.96                                  |                          |
| Giardiasis                       | 385    | 1.87 | 6,875    | 8.29| 38,506| 3.15     | 93,164 | 6.08| 0.59     | 41.55                                  |                          |
| Haemophilus influenzae           | 206    | 1.00 | 1,822    | 2.20| 9,340 | 0.76     | 14,990 | 0.98| 1.31     | 20.69                                  |                          |
| Hantavirus pulmonary syndrome    | 20     | 0.10 | 1        | 0.00| 77    | 0.01     | 112    | 0.01| 15.43    | 10.71                                  |                          |
| Hepatitis A, viral acute         | 66     | 0.32 | 677      | 0.82| 5,607 | 0.46     | 10,544 | 0.69| 0.70     | 28.15                                  |                          |
| Hepatitis B, viral acute         | 144    | 0.70 | 3,532    | 4.26| 9,433 | 0.77     | 184,114 | 12.01| 0.91     | 2.22                                  |                          |
| Hepatitis C, viral acute         | 88     | 0.43 | 261      | 0.31| 3,220 | 0.26     | 45,533 | 0.30| 1.62     | 19.33                                  |                          |
| Legionellosis                    | 42     | 0.20 | 2,890    | 3.48| 10,590| 0.87     | 16,870 | 1.10| 0.24     | 16.87                                  |                          |
| Lyme disease                     | 476    | 2.31 | 1,649    | 1.99| 85,721| 7.02     | 160,209 | 10.45| 0.33     | 38.68                                  |                          |
| Meningococcal disease            | 48     | 0.23 | 707      | 0.85| 2,899 | 0.24     | 4,776 | 0.31| 0.98     | 18.91                                  |                          |
| Pertussis                        | 788    | 3.83 | 3,709    | 4.47| 57,644| 4.72     | 85,723 | 5.59| 0.81     | 23.48                                  |                          |
| Salmonellosis                    | 1,783  | 8.67 | 21,647   | 26.09| 142,495| 11.67    | 252,169 | 16.45| 0.74     | 28.99                                  |                          |
| Shiga toxin–producing Escherichia coli | 161 | 0.78 | 1,020    | 1.23| 16,749| 1.37     | 26,058 | 1.70| 0.57     | 27.09                                  |                          |
| Shigellosis                      | 1,115  | 5.42 | 17,822   | 21.48| 37,309| 3.05     | 85,172 | 5.56| 1.78     | 28.71                                  |                          |
| Spotted fever rickettsiosis      | 519    | 2.52 | 434      | 0.52| 7,325 | 0.60     | 11,108 | 0.72| 4.21     | 23.17                                  |                          |
| Streptococcus pneumoniae, invasive (all ages) | 575 | 2.80 | 8,652    | 10.67| 28,766| 2.36     | 49,548 | 3.23| 1.19     | 20.76                                  |                          |
| Streptococcus pneumoniae, invasive (age <5 years) | 297 | 20.02 | 2,249    | 48.85| 9,214 | 15.03    | 16,102 | 19.94| 1.33     | 21.96                                  |                          |
| Syphilis, primary and secondary  | 367    | 1.78 | 31,469   | 37.93| 28,046| 2.30     | 66,707 | 4.35| 0.78     | 4.00                                  |                          |
| Tuberculosis                     | 813    | 3.95 | 15,167   | 18.28| 25,944| 2.12     | 59,458 | 3.88| 1.86     | 0.77                                  |                          |
| Tularemia                        | 47     | 0.23 | 15       | 0.02| 413   | 0.03     | 626    | 0.04| 6.76     | 21.73                                  |                          |
| West Nile virus disease          | 184    | 0.89 | 348      | 0.42| 5,142 | 0.42     | 6,418 | 0.42| 2.13     | 25.33                                  |                          |
| **Total**                        | 98,767 | —    | 3,215,027 | — | 2,793,116 | — | 12,420,236 | — | — | — |
American Indian and Alaska Native (AI/AN) populations experience health disparities in infectious diseases. Although rates of infectious diseases have decreased among AI/AN populations, health disparities continue to exist for notifiable infectious diseases.

What is added by this report?

Analysis of National Notifiable Diseases Surveillance System data from 2007–2011 indicates that among 26 diseases examined, race data were included for >70% of records for 22 diseases. Among the 26, incidence rates were higher among AI/ANs than whites for 14 diseases, including chlamydia, gonorrhea, West Nile virus infection, and spotted fever rickettsiosis.

What are the implications for public health practice?

Jurisdictions with concentrated populations of AI/ANs might choose to routinely analyze their surveillance data and address concerns specific to this population. State and local health departments with large segments of AI/ANs have opportunities to develop efficient intervention efforts and programs tailored to this population.

In November 1990, the U.S. designated November as National American Indian Heritage Month. This proclamation calls for agencies and organizations to promote programs and activities that serve AI/ANs. Agencies and organizations have used NNDSS data to pursue Healthy People 2020 objectives (1), to understand infectious disease trends, to assess prevention efforts, and to identify subpopulations at higher risk for multiple infections (3). When a surveillance system is used to monitor health status, program planners can identify areas in need of additional resources and efforts. To improve the accuracy of self-reported AI/AN status in NNDSS, jurisdictions with high proportions of AI/ANs might conduct sensitivity analyses, comparing the numbers of case reported to their surveillance systems with the numbers found in statewide hospital discharge systems (5,6), Indian Health Service contract health provider systems, and Indian Health Service hospital data (5). These types of analyses can validate the higher incidence rates recorded for hantavirus pulmonary syndrome and tularemia within this population and allow epidemiologists to identify specific risk factors.

Among potentially vaccine-preventable diseases, incidence rates were lower among AI/ANs than among whites for varicella, acute hepatitis A, acute hepatitis B, meningococcal disease, and pertussis; rates were slightly higher for Haemophilus influenzae type b and invasive pneumococcal disease. These results suggest that, overall, the AI/AN population is receiving the full benefit of immunization programs.

The findings in this report are subject to at least four limitations. First, incidence rates are presented following the Summary of Notifiable Diseases format, which does not adjust the rates to control for differences in age, geography, and risk factors associated with the particular diseases (3). In addition, the format does not test the differences in rates for statistical significance nor explain the importance of the differences (3). Second, NNDSS is a passive surveillance system, and no attempt was made to confirm race categorization. Races might be misclassified on some records, and previous research has indicated that AI/ANs are disproportionately misclassified (5). Third, certain diseases might be underreported in NNDSS because of low priority by the state, lack of health care access of subpopulations, lack of resources for enhanced surveillance, unavailability of diagnostic tests, or many other reasons. Suboptimal reporting and completeness have been reported for several diseases of public health importance (7), but it is not known whether underreporting is equally distributed among racial groups. Finally, only national statistics are provided to highlight the diseases of AI/ANs. Certain states do not have high proportions of AI/ANs populations and might not have identified this group for targeting when addressing infectious diseases. Jurisdictions with concentrated populations of AI/ANs might analyze their surveillance data routinely and address concerns specific to this population.

Surveillance of notifiable diseases is essential for the prevention and control of infectious diseases. Health status assessments for AI/ANs often are hindered by a lack of complete and accurate data regarding race in surveillance systems (5). AI/ANs have lower socioeconomic status overall, and although those who live on reservations and tribal members have access to Indian Health Service hospital services, not all AI/ANs might have ready access to health care. State and local health departments with large segments of AI/AN populations have opportunities to develop efficient intervention efforts and programs tailored to this population (8).

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Improving Burial Practices and Cemetery Management During an Ebola Virus Disease Epidemic — Sierra Leone, 2014

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On January 13, 2015, this report was posted as an MMWR Early Release on the MMWR website (http://www.cdc.gov/mmwr).

As of January 3, 2015, Ebola virus disease (Ebola) has killed more than 2,500 persons in Sierra Leone since the epidemic began there in May 2014 (1). Ebola virus is transmitted principally by direct physical contact with an infected person or their body fluids during the later stages of illness or after death (2). Contact with the bodies and fluids of persons who have died of Ebola is especially common in West Africa, where family and community members often touch and wash the body of the deceased in preparation for funerals. These cultural practices have been a route of Ebola transmission (3). In September 2014, CDC, in collaboration with the Sierra Leone Ministry of Health and Sanitation (MOH), assessed burial practices, cemetery management, and adherence to practices recommended to reduce the risk for Ebola virus transmission. The assessment was conducted by directly observing burials and cemetery operations in three high-incidence districts. In addition, a community assessment was conducted to assess the acceptability to the population of safe, nontraditional burial practices and cemetery management intended to reduce the risk for Ebola virus transmission. This report summarizes the results of these assessments, which found that 1) there were not enough burial teams to manage the number of reported deaths, 2) Ebola surveillance, swab collection, and burial team responses to a dead body alert were not coordinated, 3) systematic procedures for testing and reporting of Ebola laboratory results for dead bodies were lacking, 4) cemetery space and management were inadequate, and 5) safe burial practices, as initially implemented, were not well accepted by communities. These findings were used to inform the development of a national standard operating procedure (SOP) for safe, dignified medical burials, released on October 1. A second, national-level, assessment was conducted during October 10–15 to assess burial team practices and training and resource needs for SOP implementation across all 14 districts in Sierra Leone. The national-level assessment confirmed that burial practices, challenges, and needs at the national level were similar to those found during the assessment conducted in the three districts. Recommendations based on the assessments included 1) district-level trainings on the components of the SOP and 2) rapid deployment across the 14 districts of additional trained burial teams supplied with adequate personal protective equipment (PPE), other equipment (e.g., chlorine, chlorine sprayers, body bags, and shovels), and vehicles. Although these assessments were conducted very early on in the response, during October–December national implementation of the SOP and recommendations might have made dignified burial safer and increased community support for these practices; an evaluation of this observation is planned.

During an Ebola epidemic, prevention and control measures include prompt and safe burial of the dead (2). A safe burial can be accomplished by a trained burial team using appropriate PPE, placing the body in a puncture- and leak-resistant plastic body bag, and burying the body in a grave at least 2 meters deep (4,5). Ideally, used burial team PPE should be incinerated or buried at a depth of at least 2 meters (4,5). During July and August, MOH-supported waste management and burial trainings were conducted for newly established burial teams. Burial teams that were added after these trainings were trained individually within their respective districts. The initial MOH protocol included the deployment of three different functional teams after a reported death. These teams were 1) a case investigation (Ebola surveillance) team to collect risk factor and contact information, 2) an oral swab–collection team for Ebola testing, and 3) an eight to 12-person burial team. In September, in response to growing evidence of substantial Ebola virus transmission associated with funeral attendance and contact with the bodies of Ebola victims, CDC and the MOH conducted assessments of burial practices in preparation for developing and disseminating guidance and the SOP.

Sierra Leone, in West Africa, is divided into 14 districts (Figure 1). The capital of Sierra Leone, Freetown (estimated population of 1 million), is in Western Urban District. In September 2014, five direct observational assessments were conducted in Western Urban, Western Rural, and Port Loko districts, areas with high Ebola incidence (Figure 1). Practices of burial teams, swab-collection teams, cemetery management teams, and cemeteries were directly observed and recorded. The observers conducted the direct observations without wearing PPE but remained at a safe distance of at least 3 meters away from the body at all times. In the two Western districts, the two cemeteries designated for Ebola victims were visited and assessed (King Tom for Western Urban and Waterloo for Western Rural). In Port Loko District, a cemetery designated for Ebola victims, as well as community burials
(burials conducted by burial teams using single graves dug by the community outside of an established cemetery) were evaluated. In addition, a community assessment of the acceptability of safe burial practices was conducted in Western Urban, Western Rural, and Port Loko districts. While the burial teams were removing the bodies, 15 short interviews were conducted with community counselors and family and community members that were near the homes where the person had died to learn the community and family perceptions of the cause of death, burial team procedures, and Ebola in the community.

On October 1, an SOP for safe, dignified medical burials was approved and released by the Sierra Leone National Emergency Operations Center (4). During October 10–15, a national-level rapid needs assessment was conducted to assess the national-level burial team practices and determine the training and resource needs for effective implementation of this SOP. In all, 12 of 14 MOH district burial team supervisors and one district medical officer were interviewed about trainings received, the process for coordinating supplies, and logistics for the daily activities of the burial teams, as well as burial team composition, practices, challenges, and needs (Table).

### Burial Team Assessments — September and October 2014

Before October 2014, the national safe burial system in Sierra Leone required substantial human resources and was logistically complicated, resulting in delays in collecting bodies. As observed during this study, after a death, it could take 1–5 days to pick up the body. The coordination of the case investigation, swab collection, and burial teams was inconsistent, and burial teams often arrived at the location of a deceased person and buried the body before a swab specimen was collected or a case investigation was completed. When a burial team was in a community, a community counselor or leader would directly inform the team of other deceased persons requiring pick-up, which the burial team would then collect. This would bypass the official reporting structure and further complicate the coordination of investigation and swab-collection teams. Burial team size varied from six to 12 persons.

Where security was a concern, a police escort sometimes accompanied the burial team.

Nationally, burial team supervisors received reports about dead bodies from many different sources and requested improved coordination and communication in their respective districts when receiving notification of a death. Notification occurred through various channels, including the district hotline or alert system, the district surveillance teams, and direct calls from community members. Whether a death was officially recorded depended on how it was reported. Deaths were not recorded if they were reported directly by community members rather than through the official alert system, leading to underreporting of deaths. For example, of the 12 bodies that were collected over a 1-day period by two Port Loko burial teams, five deaths were reported directly to the burial team supervisor by a community counselor while the burial teams were out picking up other bodies. Because these five deaths were not reported through the designated alert channels, they were not officially recorded, representing an undercount of 42% for that day for the two teams, although this is based on very small numbers.

The number of deaths to which the teams responded on a daily or weekly basis varied greatly (Table). The number of bodies that teams collected was typically higher in districts that had an Ebola treatment center or large holding facility, because the number of Ebola patients (and deaths) was higher in a facility than in the general community (Table and Figure 1). Burial teams collected as many as 10 bodies each day, which required each team member to don and doff up to 11 sets of PPE each day (the last set of PPE is donned when the burial team arrives at the cemetery) (Figure 2). This frequent change of PPE was required for safety, but could also provide occasions for breaches in infection prevention and control, specifically breaches in stringent procedures.
TABLE. Burial team supervisors’ assessments on burial team composition, practices, challenges, and needs, by district — Sierra Leone, October 1–10, 2014

| District       | No. of trained burial teams | No. of persons per team | No. of functional burial teams | How being alerted to a request for a body collection | Average body collection per day | Bodies collected within 24 hours | Cemetery or community burials | Swabs performed by laboratory technician | Challenges and needs                                                                 |
|----------------|----------------------------|-------------------------|--------------------------------|---------------------------------------------------|--------------------------------|---------------------------------|----------------------------------|------------------------------------------|----------------------------------------------------------------------------------------|
| Kambia         | 1                          | 8 (includes grave digger)| 1                              | Receiving calls from community and holding center | 1–2                              | Yes                             | Both                             | No swabs                                 | Would like 1–2 more teams and a coordinator                                      |
| Port Loko      | 7 (5 are emergency responder teams, district is split into 2 zones; 3 chieftoms per team) | 7 (only 2 supervisors) | 7                              | Through hotline                                | 15                              | Mostly, except when vehicle challenges occur | Cemetery for bodies collected from health facilities and community burials; district-level grave digger stays at cemetery | Just started October 1 | Just received WHO vehicles but might not be sufficient for rough roads; also only 3 of the teams are being paid regularly |
| Bombali        | 2 (3rd team being trained) | 11                      | 2                              | Getting called directly by community and by surveillance team | 10–15 | 80% | Cemetery 2–3 miles from Makeni and community | Swab team just started on October 2 | Getting support from WHO but still need strong vehicles |
| Koinadugu      | 1 (2nd team being trained) | Team 1 = 8 (includes grave digger) | 1                              | Called by surveillance team                     | 2 bodies total                   | Community                         | Yes; both bodies were swabbed and negative | Getting 2 more vehicles next week, waiting for 2nd team to start after training |
| Tonkolili      | 1                          | 8                       | 11 (disagreement on recognition of burial teams) | Most bodies are from holding center, not community | 3 (12 bodies buried in total)    | Not all                          | Cemetery                          | Not coordinated                          | Additional teams are working and being paid, but only one has been trained by MOH and it is the only one the supervisor recognizes; need vehicles and more compensation for cemetery land owners |
| Kono           | Cannot be reached           |                         |                                 |                                                   |                                 |                                 |                                  |                                          |                                                                                        |
| Kenema         | 4                          | 6 (no supervisor)        | 3                              | By holding center or surveillance team           | 6–7 from holding center, 4 from community; has decreased since treatment center moved | 1–3 days; road access challenges cause delays | All bodies from treatment center buried in Red Cross Cemetery; other cemetery full | Yes; either laboratory technician goes with or they bring body to mortuary, but do not wait for results | Need more vehicles and sometimes the surveillance team uses their sprayers for their surveillance team visits |
| Kailahun       | 2 IFRC                     | 8                       | 2                              | By DMO and MSF                                  | ≥200 bodies buried to date       | Cemetery                         | Technician just started IFRC burial teams | Yes | Improve communication and coordination between DMO and IFRC |
| Bo             | 4                          | 8                       | 4                              | Surveillance team                                | 4                              | 1–3 days                         | Cemetery                          | Yes | Doing OK since WHO sent vehicles; gaining community confidence with swabs |
| Pujehun        | 2, as per the DMO          | 8, includes a grave digger |                               | Getting 4–7 calls per day                       |                                 |                                 |                                  |                                                          | Would like more vehicles that can handle rough terrain, fuel, and refresher training |

See table footnotes on next page.
It also created a substantial volume of hazardous medical waste to be disposed of.

During observations, burial teams performed most infection prevention and control practices well, including using PPE and chlorine for disinfection. However, one major concern was that after body removal, decontamination of homes was limited to spraying all surfaces with 0.5% hypochlorite solution (undiluted household bleach). Bedding and other potentially contaminated materials were not removed, despite a recommendation to dispose of them (4, 5).

During direct observation of burial teams over 3 days in the two Western districts, the homes of only two of 22 persons who had died had been visited by a case management team before the burial team arrived to remove the body. In addition, of 22 bodies collected by burial teams, a swab specimen was collected from only three. The burial team supervisor had to explain to these 19 families that they could either keep the body in a separate room and wait for a swab team to arrive and collect a specimen, then wait for the test result before learning...
if they could bury the body, or the burial team could remove the body without a test result. By the time the burial team arrived, often more than 24 hours had elapsed since the person had died. All 19 families chose not to wait for a swab specimen to be collected but to have the body removed for safe burial.

**Cemetery and Burial Practices Assessments — September and October 2014**

In Western Urban District, King Tom Cemetery was the only approved location for safe burials. By October 7, a total of 420 bodies had been buried there; during September to mid-October, 30–40 bodies were buried each day. At the time of the assessment, the cemetery was not fenced and pedestrian traffic through the cemetery was high. Unmarked graves were hand-dug (Figure 3), often not to the recommended depth, and were too few to accommodate all the bodies brought to the cemetery each day. More than one body was sometimes placed into a single grave (Figure 4). Because of the challenge of appropriately disposing of large volumes of used PPE, it was placed on top of bodies, nearly filling the graves. Thus, bodies and medical waste were often not buried as deep as 2 meters, the recommended safe depth (4,5). Cemetery managers did not allow family members in the cemetery, and family members were not able to observe their loved ones’ burial. Funerals for persons who had not been tested for Ebola were still being performed in the non-Ebola areas of the cemetery by burial agencies or mortuaries.

Safe burials in Western Rural and Port Loko districts included both cemetery and community burials. Both districts had a designated cemetery, which was an isolated open area of unfenced land where graves were dug. Families were not allowed to observe cemetery burials. Safe community burials were taking place with the approval of the chiefdom leader, which permitted the community of the person who had died to dig a grave in an area that was agreed upon by the family and the community. Then the burial team would place the body in the body bag and bury the body in the grave, usually while the community looked on.

Bodies were buried, not cremated. Districts with larger cities or towns were more likely to bury bodies in cemeteries (Table and Figure 1). Each day, burial teams collected all bodies reported to them before going to the cemetery. This often resulted in many bodies being placed together in the backs of trucks in unmarked body bags (Figure 2), which prevented individual identification and distressed the families.

**Community Assessment — September 2014**

Fifteen community and family interviews were conducted. An important concern among them was that family members were being buried in unmarked graves, often with multiple bodies in the same grave. These practices were considered undignified and unacceptable by the community. Safe community burials were more acceptable to community members than safe cemetery burials because families were more involved and procedures were more transparent. In addition, for 11 of 12 bodies collected by burial teams being observed in Western Urban District, the community counselors that were interviewed reported that the cause of death was unknown, and that there were no known suspected or confirmed Ebola cases in the community. During the interviews of community and family members, it was also learned that many were not aware of the risk for Ebola transmission from contact with an infectious dead body, many denied that Ebola was real, witchcraft was reported to be the cause of
**Recommendations and Development of Standard Operating Procedures**

Recommendations based on these findings from the September assessment included 1) developing multifunction burial teams that are trained to complete case investigation forms and collect swab specimens from dead bodies, and 2) conducting safe and dignified medical burials. To improve community acceptance of safe burials, increased community outreach and cemetery management were recommended, such as removing waste, adding fencing, and marking graves. These findings were used in developing the national SOP for safe, dignified medical burials. The SOP, with special consideration of burial practices consistent with a person’s religious faith, was developed and approved by the Sierra Leone Emergency Operations Center on October 1 (4). The primary purpose of the SOP was to provide operational guidance for the classification of deaths, proper burial in a safe and dignified manner, and the disposal of potentially contaminated materials from the household when the body was collected. The SOP included guidance that during the epidemic, in high-incidence areas, all deceased persons should be buried by the burial teams within 24 hours, irrespective of laboratory results. Because of limited laboratory capacity, the guidance recommends swabbing only bodies of suspected and probable Ebola victims and the bodies of persons who died from an unknown cause. Deaths clearly attributable to another cause or of previously confirmed Ebola victims did not need swab testing. The policy could be further refined to address the management of dead bodies in areas with less Ebola virus transmission.

As the epidemic continues, coordination of safe burial teams is important, and district-level coordination is needed in each of Sierra Leone’s 14 districts. To address the scale of the epidemic and ensure that each burial team collected a manageable number of bodies each day (judged to be five or fewer) and donned and doffed PPE a reasonable number of times per day, it was recommended that the number of burial teams in the country be increased to 120. Engagement with religious and traditional leaders to build important alliances within the community also was recommended to encourage community acceptance of safe, dignified medical burials.

Given the size of the ongoing epidemic, additional Ebola deaths are expected, and additional cemeteries for Ebola burials should be designated. In addition, as specified in the SOP, safe community burials by burial teams should be allowed, when space is available.

**National Response — October–December 2014**

In October, a major focus of national social mobilization efforts was the “Safe Burials Save Lives” campaign. The campaign spread the message that dead bodies needed to be handled with extreme caution and that safe burials prevent Ebola virus transmission. It promoted the SOP for safe, dignified medical burials. On October 18, 149 out of 150 Paramount Chiefs (nonpartisan members of Parliament in the government of Sierra Leone) and other traditional leaders met to discuss the need for safe burials and recognized the need to provide leadership to improve community acceptance of safe burials. Ongoing efforts to incorporate some traditions into safe burial practices continues, including the use of shrouds for Muslim families and the use of coffins for families that provide them (Figure 5). Additional safe and dignified burial practices have been implemented allowing the community and family to honor and respect the deceased; these practices include 1) allowing families to provide special clothing to the burial team to dress the deceased before they are placed inside the body bag, 2) allowing the families to come to the cemeteries to observe the burial, and allowing them to invite an imam or minister to pray with the families at a safe distance.
and 3) allowing, when possible, burial teams to conduct safe community burials close to the home of the deceased.

On October 19, with significant support from the government of the United Kingdom, a burial team command center was launched for Western Rural and Western Urban districts. This center, staffed by Republic of Sierra Leone Armed Forces troops, was responsible for coordinating the activities of all burial teams, including 1) dispatching teams, swab collection coordination, and managing cemeteries; 2) determining in real-time which burial team would respond to each reported death; and 3) ensuring that records related to each body were managed appropriately. Changes in burial team structures also were initiated to include a team of newly trained persons, with one person designated to fill out the case investigation form and another person trained to collect swab specimens. These additional persons were dispatched at the same time as the burial teams. All burial teams also were restructured to include at least one supervisor to coordinate with the identified community counselor or leader and family members, and supervise the activities of their burial team. By October 31, there were 70 trained burial teams, nationally. By the end of November, safe burial command centers were established in eight additional districts (Port Loko, Bombali, Moyamba, Kambia, Tonkolili, Kenema, Koinadugu, and Bo).

In response to the findings of inadequate Ebola cemetery management and in anticipation of future burial capacity needs in King Tom Cemetery in Freetown, major improvements of the cemetery were initiated. Improvements included removing waste, constructing a perimeter wall, marking and recording grave sites, and allowing families to visit the cemetery and observe safe burials. As of October 26, a total of 891 bodies had been buried in King Tom Cemetery.

**Discussion**

These preliminary assessments of burial practices in Sierra Leone found that 1) deaths were not always reported or not recorded when reported directly to the burial teams, 2) testing of bodies for Ebola was not always performed in situations where it was recommended, 3) decontamination of homes where Ebola deaths had occurred was often incomplete, and 4) not all bodies were collected by burial teams. Numerous examples of bodies being handled in an inappropriate and undignified manner were identified and included unmarked body bags being loaded into a truck, bodies being placed in unmarked graves, failure to respect or follow religious practices, and family members not being allowed to observe the burial of a loved one. By discouraging reporting and proper burial of bodies, these problems might have contributed to ongoing Ebola virus transmission in Sierra Leone. In response to these and other assessments, guidance and a safe and dignified burial SOP were developed and are being implemented across the country and have led to burying bodies in a safer, yet dignified, manner that allows many religious and cultural traditions to be honored. Ongoing efforts in Sierra Leone have addressed all of the recommendations in this report. It will be important to document these dramatic improvements.

The findings in this report are subject to at least two limitations. First, the findings of the assessment are based on relatively small sample sizes of direct observations and unstructured interviews of available family and community members. Second, the national level burial team supervisor assessment was conducted soon after the approval of the SOP and before the rapid scale-up of burial teams and command centers, which has since improved burial practices. Nonetheless, this is the first documentation of challenges faced by communities and authorities trying to make burials safe and dignified during the Ebola epidemic in Sierra Leone. There have been challenges to changing behaviors related to safe burials, with continuing reports of unsafe and secret burials leading to new Ebola outbreaks in Sierra Leone (6). Continuing to improve the dignity of safe burial process by treating all bodies with respect, observing customs and religious practices to the extent that they do not endanger the living, and allowing community involvement to occur at safe distances, as called for in the SOP, might increase the acceptability of safe burials. This would likely reduce Ebola virus transmission because deaths would be more likely to be reported and bodies more likely to be buried safely by burial teams.
An important lesson from the first large-scale Ebola epidemic is the need for plans to effectively and safely handle the bodies of persons who have died from Ebola, and to execute these plans in a dignified and respectful manner that honors the deceased, their families, and their communities. Rapidly scaling up of safe, dignified burial practices and focusing on increasing community acceptance of safe burials during an Ebola epidemic could interrupt transmission substantially (7). Since the time of these assessments, considerable improvements have been made in burials nationally.

Acknowledgments

Sierra Leone Ministry of Health and Sanitation. CDC Sierra Leone Ebola Response Team. Department for International Development, Government of the United Kingdom. International Federation of Red Cross and Red Crescent Societies. Sierra Leone Red Cross. Republic of Sierra Leone Armed Forces. GOAL. Concern Worldwide. Médecins Sans Frontières. World Health Organization.

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Use of a Nationwide Call Center for Ebola Response and Monitoring During a 3-Day House-to-House Campaign — Sierra Leone, September 2014

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On January 13, 2015, this report was posted as an MMWR Early Release on the MMWR website (http://www.cdc.gov/mmwr).

During May 23, 2014–January 10, 2015, Sierra Leone reported 7,777 confirmed cases of Ebola virus disease (Ebola) (I). In response to the epidemic, on August 5, Sierra Leone’s Emergency Operations Center established a toll-free, nationwide Ebola call center. The purpose of the call center is to encourage public reporting of possible Ebola cases and deaths to public health officials and to provide health education about Ebola to callers. This information also functions as an “alert” system for public health officials and supports surveillance efforts for the response. National call center dispatchers call district-level response teams composed of surveillance officers and burial teams to inform them of reported deaths and possible Ebola cases. Members of these response teams investigate cases and conduct follow-up actions such as transporting ill persons to Ebola treatment units or providing safe, dignified medical burials as resources permit. The call center continues to operate. This report describes calls received during a 3-day national campaign and reports the results of an assessment of the call center operation during the campaign.

The call center recorded all answered calls in a database. When the number of incoming calls exceeded the number of available lines, calls were not answered because there was no queue in which calls could be held for an available operator. Hence, unanswered calls were not recorded. The call center was staffed by 60 persons during two 12-hour shifts each day.

During September 19–21, the Sierra Leone government conducted a 3-day national campaign called “Ose-to-Ose Ebola Tok” (House-to-house Ebola talk), intended to provide education and galvanize support for the Ebola response. During the 3-day campaign, persons were required to stay in their homes, where they were visited by volunteer teams that provided Ebola education and sought to identify cases. More than 28,000 volunteers with knowledge of local resources and Ebola prevention information visited an estimated 75% of households nationwide during the 3-day campaign. Also, mass media and volunteers promoted using the call center to report possible cases of Ebola or to obtain more information.

An average of 1,100 calls per day was received during the 3-day campaign (Table); because of a computer malfunction on September 20, some data from that date were lost. Among the 3,299 callers during the 3-day period, 36% reported possible Ebola cases, 39% reported deaths, 9% asked for health information, 2% asked questions related to quarantine, and 23% reported other issues (e.g., questions or concerns regarding the campaign). More than one call could have reported the same death or possible case. During the campaign, 47% of reported calls came from the Western Urban and 15% came from the Western Rural district. Compared with day 1, on day 3 total call volume was 10% higher, and the number of calls reporting possible Ebola cases was 28% higher. The number of calls reporting deaths was 14% lower.

Each day during the campaign, call center dispatchers telephoned district-level response teams to notify them of reported deaths and possible cases. To determine whether calls received resulted in action by a district-level response team, the call center staff conducted a follow-up survey 1 week after the campaign. During September 26–27, the call center telephoned 191 households in Bombali, Port Loko, Western Urban, and Western Rural districts that had reported deaths (96) and possible cases (95) during September 19–21. The districts were selected by convenience and call center dispatchers recorded the number of days between the call and the response (i.e., when a burial or surveillance team visited the home).

From these four districts, among households that had reported a death, 44% reported receiving a response the same day; 37% reported a response the next day; 7% reported a response within 2–3 days of calling; and 12% reported receiving no response by a district team. Among households that reported possible cases, 31% reported receiving a response the same day; 14% reported a response the next day; 6% reported a response within 2-3 days of calling, and 50% reported there was no response from district teams.

The findings in this report are subject to at least three limitations. First, a computer malfunction resulted in incomplete data for September 20. Second, the data are not generalizable to other areas. Finally, the usefulness of call center data was limited in trying to understand why some district team responses were delayed or incomplete.

Sierra Leone’s 3-day national campaign was a highly publicized effort to raise Ebola awareness and educate the public about prevention, home care, and treatment options. The call center was used to answer questions from citizens and helped the government manage the outbreak response. In the follow-up survey, a response on the same or next day was received for 81% of reported
TABLE. Number of incoming calls, reported deaths, and reported possible Ebola patients, by district — nationwide Ebola call center, Sierra Leone, September 19–21, 2014

| District          | September 19 | September 20* | September 21 | Total |
|-------------------|--------------|---------------|--------------|-------|
| No. of incoming calls |              |               |              |       |
| Bombali           | 73           | 52            | 76           | 201   |
| Port Loko         | 96           | 44            | 101          | 241   |
| Western Rural     | 166          | 125           | 190          | 481   |
| Western Urban     | 503          | 389           | 663          | 1,555 |
| 11 other districts† | 355          | 188           | 278          | 821   |
| Total             | 1,193        | 798           | 1,308        | 3,299 |
| No. of reported deaths |          |               |              |       |
| Bombali           | 17           | 6             | 14           | 37    |
| Port Loko         | 14           | 7             | 31           | 52    |
| Western Rural     | 96           | 76            | 81           | 253   |
| Western Urban     | 220          | 203           | 250          | 673   |
| 11 other districts† | 163          | 53            | 65           | 281   |
| Total             | 510          | 345           | 441          | 1,296 |
| No. of reported possible Ebola cases |              |               |              |       |
| Bombali           | 34           | 26            | 39           | 99    |
| Port Loko         | 37           | 21            | 39           | 97    |
| Western Rural     | 37           | 31            | 63           | 131   |
| Western Urban     | 178          | 126           | 284          | 588   |
| 11 other districts† | 125          | 62            | 100          | 287   |
| Total             | 411          | 266           | 525          | 1,202 |

* Data for September 20 are incomplete because of a computer malfunction resulting in data loss.
† The 11 districts were Bo, Bonth, Bonth Island, Kailahun, Kambia, Kenema, Koinadugu, Moyamba, Pujehun, and Tonkolili.

Deaths but only 45% of possible cases. Because treatment and isolation of possible cases are essential to control the epidemic, this finding suggested an urgent need to scale-up response services. Since October, there have been increases in Ebola treatment units, burial teams, and coordinated call center response at the district level that have helped to improve response capacity. Call centers can be used to improve allocation of resources, provide the public with a credible source for assistance and information, monitor programs, and possibly to assist in decreasing rates of local transmission by facilitating prompt transfer of ill persons to hospitals or Ebola treatment units and providing prompt and safe burial of persons who have died in their homes.

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Outbreak of Diarrheal Illness Caused by *Shigella flexneri* — American Samoa, May–June 2014

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On May 9, 2014, a physician at hospital A in American Samoa noticed an abnormally high number of children presenting to the emergency department with bloody diarrhea. Based on preliminary testing of stool specimens, *Entamoeba histolytica* infection was suspected as a possible cause. *Shigella* was also suspected in a subset of samples. On May 22, the American Samoa Department of Health requested assistance from CDC with the outbreak investigation. The goals of the investigation were to establish the presence of an outbreak, characterize its epidemiology and etiology, and recommend control measures. The CDC field team reviewed the emergency department log book for cases of diarrheal illness during April 15–June 13, 2014. During this period, 280 cases of diarrheal illness were recorded, with a peak occurring on May 10. Twice as many cases occurred during this period in 2014 compared with the same period in 2011, the most recent year for which comparable surveillance data were available. Cases were widely distributed across the island. The highest number of cases occurred in children aged 0–9 years. Across age groups, cases were similarly distributed among males and females. These patterns are not consistent with the epidemiology of disease caused by *E. histolytica*, which tends to cause more cases in males of all ages.

Hypothesis-generating interviews with families of 13 patients did not reveal any common water, food, sewage, or event exposures. Eight participants reported having ill household contacts, with family contacts often becoming ill within 1–3 days after the participant’s illness onset. Six stool specimens were sent to CDC. All were negative for ameba, including *E. histolytica*, by multiple laboratory methods. All six specimens were also negative for *Cryptosporidium* and *Giardia* by a polymerase chain reaction test. However, an invasion plasmid antigen H (ipaH) gene sequence, a genetic marker of *Shigella*, was identified in four specimens. Additionally, seven *Shigella* isolates sent to the Hawaii Department of Health and CDC were identified as *Shigella flexneri* serotype 7 (proposed; also referred to as provisional 88-893 or 1c), and five shared an indistinguishable pulsed-field gel electrophoresis pattern.

*Shigella* causes an estimated 500,000 cases of shigellosis per year in the United States (1). Most persons infected with *Shigella* develop diarrhea (sometimes bloody), fever, and stomach cramps 1–2 days after they are exposed to the bacteria. The illness usually resolves in 5–7 days. Careful and frequent hand washing and strict adherence to standard food and water safety precautions are the best defense against shigellosis (2).

Together, epidemiologic and laboratory data suggest this was a shigellosis outbreak with person-to-person transmission. This investigation highlights the importance of building epidemiologic and laboratory capacity for enteric illnesses and enhancing basic hand hygiene and prevention strategies in U.S. territories.

Acknowledgments
Jonathan Yoder, MSW, MPH, Lihua Xiao, DVM, PhD, Sharon Roy, MD, Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC.

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Updates to the Overseas Immunization Program for United States–Bound Refugees

Refugees being resettled in the United States, unlike immigrants seeking residency, have not been subject to immunization requirements (1). Without immunization, refugee communities overseas and in the United States are vulnerable to outbreaks of vaccine-preventable diseases that can disrupt the resettlement process and require costly public health responses (2,3). CDC’s Division of Global Migration and Quarantine has regulatory authority to prevent communicable disease importation among the approximately 70,000 refugees resettled in the United States each year.

Historically, logistical challenges prevented overseas routine vaccination of refugees scheduled for resettlement in the United States. However, in December 2012, CDC began implementation of an overseas program that resulted in the routine vaccination of United States–bound refugees in six countries: Thailand and Nepal (initiated December 2012), Malaysia and Kenya (initiated September 2013), Ethiopia (initiated November 2013), and Uganda (initiated August 2014). Refugees vaccinated through this program began arriving in the United States in 2013. The program covers approximately 50% of refugees who arrive in the United States annually and likely will be expanded to include countries from which other refugees originate.

A collaboration with two other agencies (the U.S. State Department’s Bureau of Population, Refugees, and Migration and the International Organization for Migration), the overseas vaccination program is intended to reduce U.S. disease outbreaks by ensuring that refugees arrive in the United States protected against vaccine-preventable diseases. Depending on age and individual risk factors, refugees now receive 2 to 3 doses of the following vaccines while overseas: polio; measles, mumps, and rubella; hepatitis B; pneumococcal conjugate; and Haemophilus influenzae type B. Initial doses are given during the immigration medical examination 2–6 months before departure for the United States. These vaccines were selected after considering disease risk and the cost and availability of the vaccines in refugee camp settings.

Information on participating countries and current vaccine schedules is available at http://www.cdc.gov/immigrantrefugeehealth/guidelines/overseas/interventions/immunizations-schedules.html, or by contacting CDC at dgmqpdi@cdc.gov. Vaccines administered to refugees through this program are documented in the Division of Global Migration and Quarantine’s Electronic Disease Notification System and are accessible to clinics conducting postarrival refugee medical examinations (4). More information on the notification system is available by contacting the help desk at edn@cdc.gov.

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FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

**QuickStats**

**Rates* of Deaths from Drug Poisoning† and Drug Poisoning Involving Opioid Analgesics§ — United States, 1999–2013**

![Graph showing rates of drug poisoning and drug poisoning involving opioid analgesics from 1999 to 2013.](image)

* Per 100,000 population, age-adjusted to the 2000 U.S. standard population.
† Drug poisoning deaths can result from taking an overdose of a drug, being given the wrong drug, taking a drug in error, or taking a drug inadvertently. Drug poisoning deaths include all intents (i.e., unintentional, suicide, homicide, and undetermined intent).
§ Drug poisoning deaths are identified using the International Classification of Diseases, Tenth Revision (ICD-10) underlying cause of death codes X40–X44, X60–X64, X85, and Y10–Y14. Drug poisoning deaths involving opioid analgesics are the subset of drug poisoning deaths with a multiple cause of death code of T40.2–T40.4.

In 2013, a total of 43,982 deaths in the United States were attributed to drug poisoning, including 16,235 deaths (37%) involving opioid analgesics. From 1999 to 2013, the drug poisoning death rate more than doubled from 6.1 to 13.8 per 100,000 population, and the rate for drug poisoning deaths involving opioid analgesics nearly quadrupled from 1.4 to 5.1 per 100,000. For both drug poisoning and drug poisoning involving opioid analgesics, the death rate increased at a faster pace from 1999 to 2006 than from 2006 to 2013.

**Sources:** National Vital Statistics System mortality data. Available at http://www.cdc.gov/nchs/deaths.htm.
Chen LH, Hedegaard H, Warner M. Drug-poisoning deaths involving opioid analgesics: United States, 1999–2011. NCHS data brief no. 166.
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