Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 66 / No. 27
July 14, 2017

# Measles Outbreak — Minnesota April–May 2017

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On April 10, 2017, the Minnesota Department of Health (MDH) was notified about a suspected measles case. The patient was a hospitalized child aged 25 months who was evaluated for fever and rash, with onset on April 8. The child had no history of receipt of measles-mumps-rubella (MMR) vaccine and no travel history or known exposure to measles. On April 11, MDH received a report of a second hospitalized, unvaccinated child, aged 34 months, with an acute febrile rash illness with onset on April 10. The second patient's sibling, aged 19 months, who had also not received MMR vaccine, had similar symptoms, with rash onset on March 30. Real-time reverse transcription–polymerase chain reaction (rRT-PCR) testing of nasopharyngeal swab or throat specimens performed at MDH confirmed measles in the first two patients on April 11, and in the third patient on April 13; subsequent genotyping identified genotype B3 virus in all three patients, who attended the same child care center. MDH instituted outbreak investigation and response activities in collaboration with local health departments, health care facilities, child care facilities, and schools in affected settings. Because the outbreak occurred in a community with low MMR vaccination coverage, measles spread rapidly, resulting in thousands of exposures in child care centers, schools, and health care facilities. By May 31, 2017, a total of 65 confirmed measles cases had been reported to MDH (Figure 1); transmission is ongoing.

## Investigation and Results

After receiving notification of the first case on April 10, MDH and the Hennepin County Human Services and Public Health Department began an investigation. The Council of State and Territorial Epidemiologists and CDC case definition* was used to identify confirmed cases of measles in Minnesota (*1*). A health alert was issued April 12, which notified health care providers of the two measles cases in Hennepin County and provided recommendations concerning laboratory testing for measles and strategies to minimize transmission in health care settings. Emphasis was placed on recommendations for all children aged ≥12 months to receive a first dose of MMR. Providers identified patients with suspected measles based on clinical findings and reported suspected cases to MDH. Testing with rRT-PCR was performed at MDH on nasopharyngeal or throat swabs and urine specimens. Among persons testing positive by rRT-PCR who had received vaccine ≤21 days before the test, genotyping was performed to distinguish wild-type measles virus

* An acute illness in a Minnesota resident during January 1, 2017–May 12, 2017, characterized by generalized, maculopapular rash lasting ≥3 days with a temperature ≥101°F (≥38.3°C) and cough, coryza, or conjunctivitis. A confirmed case is an acute febrile rash illness with isolation of measles virus from a clinical specimen; or detection of measles-virus specific nucleic acid from a clinical specimen using polymerase chain reaction; or immunoglobulin G seroconversion or a significant rise in measles immunoglobulin G antibody using an evaluated and validated method; or a positive serologic test for measles immunoglobulin M antibody; or direct epidemiologic linkage to a case confirmed by one of these methods.

INSIDE



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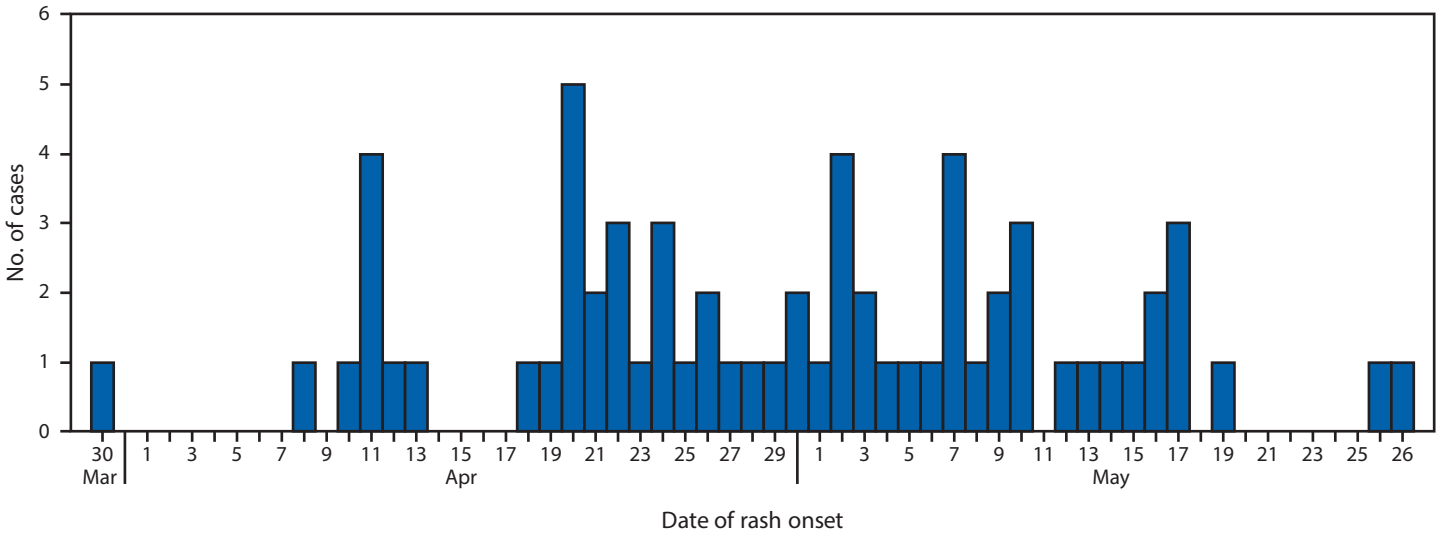
**FIGURE 1. Number of measles cases (N = 65) by date of rash onset — Minnesota, March 30–May 27, 2017**




(genotype B3 virus) from the vaccine virus (genotype A virus). Patients (or their parents or guardians) with confirmed measles were interviewed by local public health officials to confirm symptoms, onset date, and exposure history for the 21 days before rash onset and identify contacts during their infectious period (4 days before through 4 days after rash onset). Contacts were defined as persons who had any contact with patients during their infectious period.

Among the 65 confirmed cases, the median patient age was 21 months (range = 3 months–49 years). Patients were residents of Hennepin, Ramsey, LeSueur, and Crow Wing counties. During April 10–May 31, confirmed measles patients were identified in five schools, 12 child care centers, three health care facilities, and numerous households; an estimated 8,250 persons were potentially exposed to measles in these settings. Rash onset dates ranged from March 30–May 27, 2017. Sixty-two (95%) cases were identified in unvaccinated persons, including 50 (77%) in children aged ≥12 months (i.e., age-eligible for MMR vaccination). U.S.-born children of Somali descent (Somali children) accounted for 55 (85%) of the cases. Among the three patients

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

**Suggested citation:** [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2017;66:[inclusive page numbers].

with a history of measles vaccination, all had received 2 MMR doses before illness onset. As of May 31, 20 (31%) patients had been hospitalized, primarily for treatment of dehydration or pneumonia; no deaths had been reported.

## Public Health Response

Rosters and attendance records were obtained from child care centers and schools where persons might have been exposed to measles, and the vaccination status of each attendee was verified through the Minnesota Immunization Information Connection, a system that stores electronic immunization records (http://www.health.state.mn.us/miic). Health care facilities similarly identified contacts who were exposed to measles patients and followed up with susceptible (i.e., unvaccinated, pregnant, or immunocompromised) exposed persons. In accordance with the Advisory Committee on Immunization Practices 2013 guidelines (*2*), postexposure prophylaxis (PEP) with MMR or immune globulin was recommended for susceptible, exposed persons. Persons who received PEP with MMR within 72 hours of exposure or with immune globulin within 6 days of exposure were placed on a 21-day self-monitoring symptom watch for development of fever or rash, but could continue attending child care and school. Susceptible exposed persons who did not receive PEP according to recommendations were excluded from child care centers or school, and MDH recommended that they avoid public gatherings for 21 days, including having visitors who were susceptible to measles virus. By May 31, at least 154 persons had received PEP (26 MMR doses and 128 courses of immune globulin), and 586 susceptible exposed persons who did not receive recommended PEP were excluded from child care centers or school and advised to receive MMR vaccination to protect against future measles illness.

On April 18, as the outbreak continued, MDH recommended an accelerated MMR schedule; to provide additional protection, a second dose of MMR vaccine was recommended for children who had received a first dose >28 days previously.† These recommendations were initially for all children living in Hennepin County and for all Minnesota Somali children regardless of county of residence, because MMR coverage rates among Somali children in Hennepin County have declined since 2007. In 2014, coverage with the first dose of MMR among Somali children in Hennepin County was 35.6% (Figure 2). In response to the rapid increase in the number of reported cases, on May 4, 2017, MDH recommended an accelerated vaccination schedule for all children aged ≥12 months residing in all counties where a measles case had been reported during the previous 42 days; MDH further recommended that health care providers throughout the state consider using an accelerated schedule.

Previously established culturally appropriate community outreach approaches (e.g., working with community and spiritual leaders, interpreters, health care providers, and community members) (*3*) were intensified during the outbreak. Using existing partnerships, state and local public health officials worked with MDH Somali public health advisors, Somali medical professionals, faith leaders, elected officials, and other community leaders to disseminate educational materials, attend community events, and create opportunities for open dialogue and education about measles and concerns about MMR vaccine. Child care centers and schools were provided talking points and informational sheets on measles and MMR vaccine, and posters with key messages were distributed in mosques and shopping malls popular with the Somali community. Community outreach focused on oral communication, which is preferred by this community, including radio and television messaging and telephone call-in lines that permit approximately 500 persons at a time to listen to a health professional.

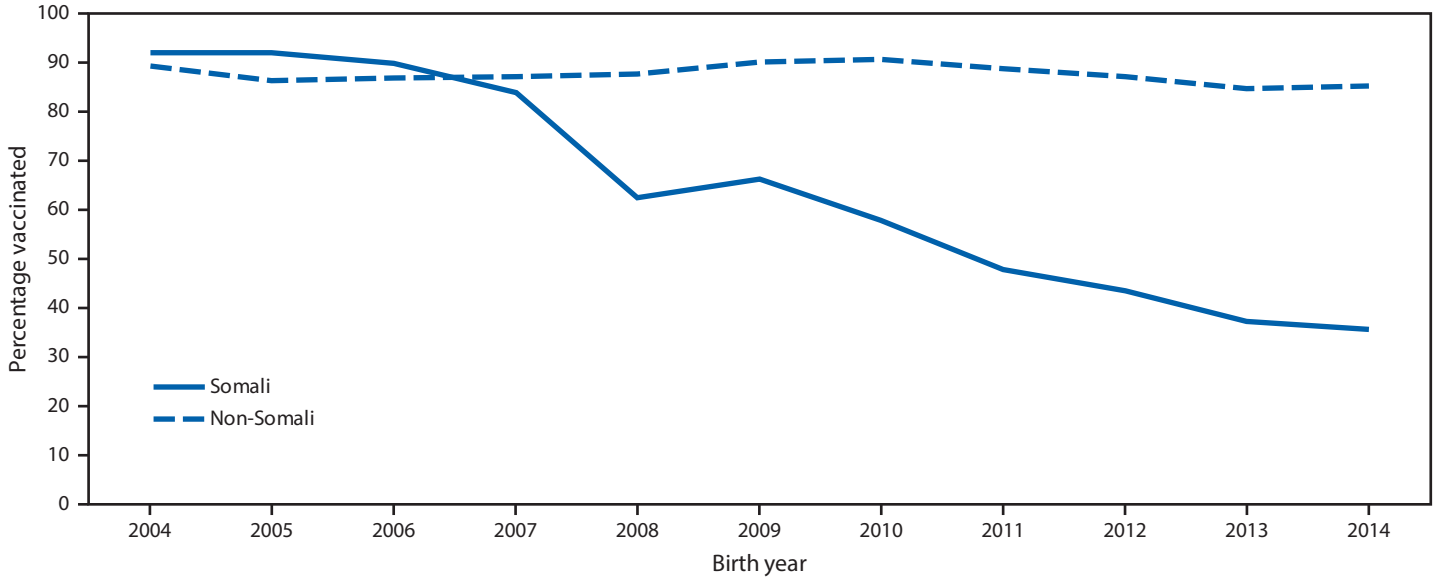
Outreach to encourage vaccination was increased during the outbreak. By the second week of May, the average number of MMR vaccine doses administered per week in Minnesota had increased from 2,700 doses before the outbreak to 9,964, as reported by the Minnesota Immunization Information Connection.

## Discussion

Minnesota law requires that children aged ≥2 months be vaccinated against certain diseases or file a medical or conscientious exemption to enroll in school, child care, or school-based early childhood programs. Before 2008, first-dose MMR vaccination coverage among Minnesota-born Somali children aged 2 years in Hennepin County exceeded 90%. However, MMR vaccination coverage rates declined among Minnesota's Somali-American community members starting with the 2008 birth-year cohort. The decline in vaccination coverage was in response to concerns about autism, the perceived increased rates of autism in the Somali-American community, and the misunderstanding that autism was related to MMR vaccine (*3,4*). Studies have consistently documented that there is not a relationship between vaccines and autism (*5,6*). The low vaccination rate resulted in a community highly susceptible to measles. Parental concerns were addressed by building trust with the community and identifying effective, culturally appropriate ways to address questions, concerns, and misinformation about MMR vaccine. In 2011, a smaller measles outbreak began in

† The Advisory Committee on Immunization Practices (ACIP) recommends MMR vaccine for prevention of measles, mumps, and rubella for persons aged ≥12 months. ACIP recommends 2 doses of MMR vaccine routinely for children, with the first dose administered at age 12 through 15 months and the second dose administered at age 4 through 6 years before school entry. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm.

**FIGURE 2. Percentage of children receiving measles-mumps-rubella vaccine at age 24 months among children of Somali and non-Somali descent, by birth year — Hennepin County, Minnesota, 2004–2014**




**Source:** Minnesota Immunization Information Connection, Minnesota Department of Health.


**Summary**

What is already known about this topic?

Measles was declared eliminated from the United States in 2000 but continues to circulate in many regions of the world and can be imported into the United States by travelers. Measles vaccine is highly effective, with 1 dose being 93% effective and 2 doses being 97% effective at preventing measles.

What is added by this report?

In a community with previously high vaccination coverage, concerns about autism, the perceived increased rates of autism in the Somali-American community, and the misunderstanding that autism was related to the measles-mumps-rubella (MMR) vaccine resulted in a decline in MMR vaccination coverage to a level low enough to sustain widespread measles transmission in the Somali-American community following introduction of the virus. Studies have consistently documented that there is not a relationship between vaccines and autism.

What are the implications for public health practice?

This outbreak demonstrates the challenge of combating misinformation about MMR vaccine and the importance of creating long-term, trusted relationships with communities to disseminate scientific information in a culturally appropriate and effective manner.


the Somali community in Hennepin County and resulted in 21 cases, including eight cases in persons of Somali descent (*4*,*7*). At that time, the 1-dose MMR vaccination coverage rate among Somali children aged 2 years in Hennepin County was 54%. The source of the 2011 outbreak was a Somali child aged 30 months who acquired measles while visiting Kenya (*7*). However, the source of the current outbreak is unknown, which suggests that additional cases have likely occurred that did not come to the attention of health care providers or public health departments.

Although indigenous measles transmission has been eliminated in the United States, the virus continues to circulate widely in many regions of the world, including Africa, Europe, and parts of Asia, and is often introduced into the United States by international travelers (*8*). High measles vaccination coverage rates across subpopulations within communities are necessary to prevent the spread of measles. The current Minnesota measles outbreak, with 31% (20 of 65) of cases requiring hospitalization, demonstrates the importance of addressing low vaccination coverage rates to ensure that children are adequately protected from a potentially serious vaccine-preventable disease (*3*).

## Acknowledgments


Andrew Murray, Carol Hooker, Erica Bagstad, Hennepin County Human Services and Public Health Department; Ruth Lynfield, Malini DeSilva, Richard Danila, Danushka Wanduragala, Kirk Smith, Ben Christianson, Ellen Laine, Hannah Friedlander, Sean Buuck, Austin Bell, Carmen Bernu, Erica Bye, Corinne Holtzman, Katherine Schleiss, Victor Cruz, Megan Sukalski, Dave Boxrud, Brian Nefzger, Victoria Lappi, Katie Harry, Net Bekele, Jacob Garfin, Gongping Liu, Ruth Rutledge, Lisa Levoir, Barbara Miller, Fatuma Sharif-Mohamed, Asli Ashkir, Hinda Omar, Minnesota Department of Health; Kris Bisgard, Stacy Holzbauer, Raj Mody, Paul Gastañaduy, Paul Rota, Rebecca McNall, Adam Wharton, CDC.

## Conflict of Interest

No conflicts of interest were reported.

[1]Epidemic Intelligence Service, CDC; [2]Minnesota Department of Health; [3]Hennepin County Human Services and Public Health Department, Minneapolis, Minnesota.

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# Mortality from Amyotrophic Lateral Sclerosis and Parkinson's Disease Among Different Occupation Groups — United States, 1985–2011

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Amyotrophic lateral sclerosis (ALS) and Parkinson's disease, both progressive neurodegenerative diseases, affect >1 million Americans (*1*,*2*). Consistently reported risk factors for ALS include increasing age, male sex, and cigarette smoking (*1*); risk factors for Parkinson's disease include increasing age, male sex, and pesticide exposure, whereas cigarette smoking and caffeine consumption are inversely associated (*2*). Relative to cancer or respiratory diseases, the role of occupation in neurologic diseases is much less studied and less well understood (*3*). CDC evaluated associations between usual occupation and ALS and Parkinson's disease mortality using data from CDC's National Institute for Occupational Safety and Health (NIOSH) National Occupational Mortality Surveillance (NOMS), a population-based surveillance system that includes approximately 12.1 million deaths from 30 U.S. states.* Associations were estimated using proportionate mortality ratios (PMRs), standardizing indirectly by age, sex, race, and calendar year to the standard population of all NOMS deaths with occupation information. Occupations associated with higher socioeconomic status (SES) had elevated ALS and Parkinson's disease mortality. The shifts in the U.S. workforce toward older ages and higher SES occupations† highlight the importance of understanding this finding, which will require studies with designs that provide evidence for causality, detailed exposure assessment, and adjustment for additional potential confounders.

NOMS is a collaborative effort among 30 participating U.S. states' Vital Statistics Offices (hereafter "states"),§ CDC's NIOSH and National Center for Health Statistics (NCHS), and previously NIH's National Cancer Institute and the U.S. Census Bureau. All participating states, or NCHS under states' direction, share selected data from their death certificates with NIOSH through data sharing agreements. NOMS contains data on 12,710,846 deaths that occurred during 1985–1999, 2003–2004, and 2007–2011 in 30 states, although the number of states that contributed data in any 1 year was 10–22 (participation varied, related to funding and other concerns). After excluding 247,443 (2%) deaths among persons with ages reported as <18 years or >120 years, and 334,629 (3%) deaths without occupation information, 12,128,774 (95%) remaining deaths were included in this analysis.

ALS and Parkinson's disease deaths were identified using *International Classification of Diseases*,¶ *9th Revision* (ICD-9) codes until 1998 and *10th Revision* (ICD-10) codes thereafter. ALS deaths were defined as decedents with underlying or contributing cause of death codes 335.2 (ICD-9) or G12.2 (ICD-10) and Parkinson's disease deaths as those with underlying or contributing cause of death codes 332 (ICD-9) or G20 (ICD-10). Usual occupation,** recorded on death certificates in a text field, was assigned a U.S. Census 1990 or 2000 occupation code.†† These were converted to 2000 codes using a crosswalk based on U.S. Census data.§§ Occupation codes were then grouped into 26 categories based on similar job duties and ordered roughly from high SES (e.g., management) to low SES (e.g., transportation and material moving) (Table 1).¶¶ Associations between the 26 categories and ALS and Parkinson's disease mortality were estimated via PMRs, standardizing indirectly by age, sex, race, and calendar year (*4*)***; 95% confidence

* https://www.cdc.gov/niosh/topics/NOMS/.

† The shifts in the U.S. workforce mentioned can be seen by comparing tables of data from the Bureau of Labor Statistics' Current Population Survey for the years 2011 and 2015 at https://www.bls.gov/cps/demographics.htm.

§ Data for this study were provided by Vital Statistics Offices from the following U.S. states: Alaska, Colorado, Georgia, Hawaii, Idaho, Indiana, Kansas, Kentucky, Louisiana, Maine, Michigan, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin.

¶ https://www.cdc.gov/nchs/icd/.

** Usual occupation was ascertained on death certificates via the following field: DECEDENT'S USUAL OCCUPATION (Indicate type of work done during most of working life. DO NOT USE RETIRED). The standard U.S. death certificate is available at https://www.cdc.gov/nchs//nvss/mortality_methods.htm.

†† U.S. Census 1990 and 2000 occupation codes are available at https://www.census.gov/people/io/methodology/.

§§ The crosswalk is based on data in Table 2 of U.S. Census Bureau Technical Paper #65: https://www.census.gov/people/io/files/techpaper2000.pdf.

¶¶ Bureau of Labor Statistics tables showing occupation by educational attainment and occupation by income are available at https://www.bls.gov/emp/ep_table_111.htm and https://www.bls.gov/oes/current/oes_nat.htm, respectively.

*** For example, the PMR for ALS for the management category was calculated as the observed number of ALS deaths in the management category divided by the expected number of ALS deaths in that category. The expected number of ALS deaths for management was calculated as the sum of the stratum-specific expected numbers of ALS deaths for management, where the strata were defined by crosstabulations of the variables used for standardization. The stratum-specific expected numbers of ALS deaths in the management category were calculated as the stratum-specific observed numbers of ALS deaths for all occupation categories multiplied by the stratum-specific observed numbers of deaths from all causes in the management category divided by the stratum-specific observed numbers of deaths from all causes for all occupation categories.

**TABLE 1. The 26 occupation categories* derived from Census 2000 occupation codes†**

| Occupation category | Census 2000 occupation codes |
|---|---|
| Management | 001–003, 034–035, 041, 043 |
| Business operations | 013, 015, 050–073 |
| Financial | 012, 080–095 |
| Computer and mathematical | 011, 100–124 |
| Architecture and engineering | 030, 130–156 |
| Life, physical, and social science | 036, 160–196 |
| Community and social services | 042, 200–206 |
| Legal | 210–215 |
| Education, training, and library | 023, 220–255 |
| Arts, design, entertainment, sports, and media | 006, 260–296 |
| Health care practitioners and technical | 300–354 |
| Health care support | 360–365 |
| Protective service | 370–395 |
| Food preparation and serving | 031, 400–416 |
| Building and grounds cleaning and maintenance | 420–425 |
| Personal care and service | 032–033, 430–465 |
| Sales | 004–005, 470–496 |
| Office and administrative support | 010, 040, 500–593 |
| Farming, fishing, and forestry | 020–021, 600–613 |
| Construction | 022, 620–676 |
| Extraction | 680–694 |
| Installation, maintenance, and repair | 700–762 |
| Production | 014, 770–896 |
| Transportation and material moving | 016, 900, 903–904, 907–909, 911–975 |
| Military specific | 983–985 |
| Nonpaid workers | 901–902, 905–906, 910 |

* Categories modified from the IPUMS website, which orders categories roughly from high to low socioeconomic status: https://usa.ipums.org/usa/volii/occ2000.shtml.

† Census 1990 occupation codes were converted to Census 2000 occupation codes using a crosswalk based on data in Table 2 of U.S. Census Bureau Technical Paper #65: https://www.census.gov/people/io/files/techpaper2000.pdf.

intervals (CIs) for PMRs were calculated using formulas based on Byar's approximation to the exact Poisson test (*5*).

Because cause-specific PMRs are mutually dependent, a higher mortality proportion for one cause results in a lower mortality proportion for another cause (*4*). Occupational categories reflect job duties and SES; therefore, higher SES occupations might have higher (or lower) PMRs for ALS and Parkinson's disease because deaths from other causes which might be related to SES might be lower (or higher) in these occupations. To test whether this limitation of using PMRs for analysis might explain results for ALS and Parkinson's disease, a sensitivity analysis was conducted in which chronic disease of the endocardium††† was used as a negative control outcome (i.e., an outcome not expected to be related to occupation or SES) (*6*). A PMR pattern for chronic disease of the endocardium similar to that of ALS and Parkinson's disease would suggest that higher (or lower) PMRs for ALS and Parkinson's disease are caused by deficits (or surpluses) in other causes of death. Deaths for this additional analysis were defined as decedents with underlying or contributing cause of death codes for chronic disease of the endocardium (424 [ICD-9] or I34–I38 [ICD-10]).

The analysis included 26,917 ALS deaths, 115,262 Parkinson's disease deaths, and 158,618 chronic disease of the endocardium deaths (Table 2). In crude analyses, ALS decedents were younger and more likely to be male and white than were decedents from all causes, whereas Parkinson's disease decedents were older and more likely to be male and white than

**TABLE 2. Crude frequencies and percentages for characteristics of deaths from all-causes, ALS,* Parkinson's disease,† and chronic disease of the endocardium§ — National Occupational Mortality Surveillance, United States, 1985–1999, 2003–2004, and 2007–2011**

| Characteristic | No. (%) total deaths¶ | No. (%) ALS deaths¶ | No. (%) Parkinson's disease deaths¶ | No. (%) chronic disease of the endocardium deaths¶ |
|---|---|---|---|---|
| **Total** | **12,128,774 (100)** | **26,917 (100)** | **115,262 (100)** | **158,618 (100)** |
| **Age group (yrs)** | | | | |
| 18–25 | 162,518 (1) | 39 (<1) | 4 (<1) | 290 (<1) |
| 26–30 | 119,777 (1) | 66 (<1) | 2 (<1) | 390 (<1) |
| 31–35 | 152,495 (1) | 167 (1) | 4 (<1) | 610 (<1) |
| 36–40 | 195,859 (2) | 338 (1) | 10 (<1) | 959 (1) |
| 41–45 | 258,111 (2) | 671 (2) | 34 (<1) | 1,398 (1) |
| 46–50 | 353,626 (3) | 1,122 (4) | 131 (<1) | 2,073 (1) |
| 51–55 | 476,610 (4) | 1,708 (6) | 295 (<1) | 2,853 (2) |
| 56–60 | 648,794 (5) | 2,545 (9) | 759 (1) | 4,166 (3) |
| 61–65 | 900,238 (7) | 3,601 (13) | 2,143 (2) | 6,452 (4) |
| 66–70 | 1,169,674 (10) | 4,471 (17) | 5,783 (5) | 10,129 (6) |
| 71–75 | 1,456,778 (12) | 4,492 (17) | 13,603 (12) | 15,948 (10) |
| 76–80 | 1,699,612 (14) | 3,913 (15) | 25,509 (22) | 23,442 (15) |
| 81–85 | 1,787,507 (15) | 2,508 (9) | 31,599 (27) | 31,542 (20) |
| 86–90 | 1,508,379 (12) | 1,009 (4) | 23,998 (21) | 32,108 (20) |
| 91–95 | 884,866 (7) | 226 (1) | 9,395 (8) | 19,512 (12) |
| 96–100 | 299,456 (2) | 38 (<1) | 1,828 (2) | 5,953 (4) |
| 101–105 | 50,196 (<1) | 3 (<1) | 155 (<1) | 735 (<1) |
| 105–120 | 4,278 (<1) | 0 (0) | 10 (<1) | 58 (<1) |
| Median±IQR | 76 ± 21 | 69 ± 16 | 82 ± 10 | 82 ± 14 |
| **Sex** | | | | |
| Male | 6,072,802 (50) | 14,314 (53) | 65,477 (57) | 68,075 (43) |
| Female | 6,055,972 (50) | 12,603 (47) | 49,785 (43) | 90,543 (57) |
| **Race** | | | | |
| White | 10,633,589 (88) | 25,279 (94) | 109,281 (95) | 146,195 (92) |
| Black | 1,293,267 (11) | 1,245 (5) | 3,823 (3) | 9,637 (6) |
| Other | 201,918 (2) | 393 (1) | 2,158 (2) | 2,786 (2) |

**Abbreviations:** ALS = amyotrophic lateral sclerosis; ICD = *International Classification of Diseases*; IQR = interquartile range.

* Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 335.2, *10th Revision*: G12.2.

† Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 332, *10th Revision*: G20.

§ Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 424, *10th Revision*: I34–I38.

¶ 334,629 (3%) deaths from all-causes, 551 (2%) deaths from ALS, 1,853 (2%) deaths from Parkinson's disease, and 2,791 (2%) deaths from chronic disease of the endocardium were excluded from this analysis because they were missing occupation information.

††† Chronic disease of the endocardium includes nonrheumatic mitral valve disorders; nonrheumatic aortic valve disorders; nonrheumatic tricuspid valve disorders; pulmonary valve disorders; and endocarditis, valve unspecified.

were decedents from all causes. Deaths from chronic disease of the endocardium were older and more likely to be female and white than decedents from all causes (Table 2).

In standardized analyses, among ALS decedents, the PMRs for 14 occupation categories were significantly above 1.00, and for four (computer and mathematical; architecture and engineering; legal; and education, training, and library) were ≥1.50 (Table 3). In contrast, PMRs were significantly below 1.00 for 10 occupation categories, and none had a PMR ≤0.67 (Table 3). Among Parkinson's disease decedents, PMRs for 13 occupation categories were significantly above 1.00, and none had a PMR ≥1.50. In contrast, PMRs were significantly below 1.00 for 11 occupation categories, and one (extraction [e.g., mining or oil and gas drilling]) had a PMR ≤0.67. Among chronic disease of the endocardium decedents, the PMRs for nine occupation categories were significantly above 1.00, but the magnitudes were much less than those observed for ALS and Parkinson's disease; the highest (1.15) was for the legal category. The PMRs for seven occupation categories were significantly below 1.00, but, again, the magnitudes were much less than those observed for ALS and Parkinson's disease; the lowest PMR for chronic disease of the endocardium was 0.81 (extraction category).

## Discussion

Most previous studies of occupation and ALS and Parkinson's disease have focused on exposures to toxicants (e.g., pesticides, solvents, lead, welding fume, and electromagnetic fields) that occur more frequently in lower SES occupations (e.g., farming, construction, production, and military service) (*1*–*3*). This study, however, did not find positive associations between lower SES occupations and ALS and Parkinson's disease mortality; rather, positive associations were identified between ALS and Parkinson's disease mortality and higher SES occupations such as computer and mathematical; architecture and engineering; legal; and education, training, and library occupations. Understanding the reasons for this finding is important for a number of reasons. The burdens of ALS and Parkinson's disease mortality could increase in the future because the U.S. workforce is increasing in age, and increasing age is a recognized risk factor for ALS and Parkinson's disease (*1*,*2*). If the associations between higher SES occupations and ALS and Parkinson's disease mortality are real, then the burdens of ALS and Parkinson's disease mortality could also increase in the future because the U.S. workforce is increasing in the number and proportion of workers employed in higher SES occupations. Substantially elevated PMRs for respiratory disease and injury-related mortality among extraction workers might explain lower PMRs for ALS and Parkinson's disease in that occupation.

The findings in this report are subject to at least six limitations. First, usual occupation and outcomes might have been misclassified. A 1990 study based on 1980 U.S. Census occupation codes and 15 occupation categories reported the agreement between occupation ascertained from death certificates and company records was only 58% (*7*). However, a recent study based on 2010 U.S. Census Standard Occupational Classification codes and 22 occupation categories found the concordance between self-reported usual and current occupation was good ($\kappa = 0.763$; 95% CI = 0.754, 0.772) (*8*). Second, although the sensitivity of death certificates for ascertaining ALS is high (85%) (*9*), it is lower for Parkinson's disease (56%) (*10*), which suggests misclassification of Parkinson's disease deaths was likely more prevalent than misclassification of ALS deaths. Third, the broad occupation categories used for this analysis aggregated workers who might have had substantially different working conditions, limiting interpretation of results. For example, if an insecticide were positively associated with Parkinson's disease mortality, this analysis might not have found a positive association between farming, fishing, and forestry and Parkinson's disease mortality because that occupation category includes farmers who both did and did not use the insecticide as well as fishing and forestry workers who likely never used it. Fourth, death certificates do not collect dates of employment or of diagnosis, but the progressive natures of ALS and Parkinson's disease make it unlikely that much of decedents' time employed in their usual occupations would have occurred after diagnosis. Therefore, reverse causality (i.e., that diagnoses of ALS or Parkinson's disease would cause workers to switch their usual occupations) and misclassification of usual occupation is unlikely. Fifth, this study was unable to separate effects of occupation and SES on ALS and Parkinson's disease mortality, and results might have been affected by unmeasured confounders such as cigarette smoking. Finally, there are recognized limitations of using PMRs for analysis (*4*). The negative control outcome analysis, however, suggests that these limitations did not meaningfully affect results for higher SES occupations. Strengths of this study include its large sample size; complete, representative, and population-based sample, and that PMRs were indirectly standardized by measured confounders.

This study identified higher ALS and Parkinson's disease mortality among workers in higher SES occupations, but was unable to identify occupational or nonoccupational factors that might explain these findings. Future studies of workers in higher SES occupations are needed to assess the consistency of these findings and identify factors that might explain elevated ALS and Parkinson's disease mortality, using study designs that provide evidence for causality (e.g., cohort or case-control), individual exposure data for specific agents or experiences, and occupation categories formed on the basis of exposure to specific agents or experiences and linked to job exposure

**TABLE 3. Usual occupation category and mortality from ALS,* Parkinson's disease,† and chronic disease of the endocardium§ — National Occupational Mortality Surveillance, United States, 1985–1999, 2003–2004, and 2007–2011.**

| Census 2000 occupation categories¶ | Total | ALS | | | Parkinson's disease | | | Chronic disease of the endocardium | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Deaths** | Deaths** | | | Deaths** | | | Deaths** | | |
| | Observed (No.) | Observed (No.) | Expected (No.) | Standardized†† PMR (95% CI§§) | Observed (No.) | Expected (No.) | Standardized†† PMR (95% CI§§) | Observed (No.) | Expected (No.) | Standardized†† PMR (95% CI§§) |
| **Total** | **12,128,774** | **26,917** | — | — | **115,262** | — | — | **158,618** | — | — |
| Management | 315,750 | 1,201 | 865 | 1.39 (1.31–1.47) | 5,103 | 4,402 | 1.16 (1.13–1.19) | 5,567 | 4,919 | 1.13 (1.10–1.16) |
| Business operations | 92,346 | 367 | 248 | 1.48 (1.33–1.64) | 1,178 | 1,040 | 1.13 (1.07–1.20) | 1,383 | 1,299 | 1.06 (1.01–1.12) |
| Financial | 142,828 | 509 | 376 | 1.35 (1.24–1.48) | 2,147 | 1,716 | 1.25 (1.20–1.31) | 2,103 | 2,061 | 1.02 (0.98–1.07) |
| Computer and mathematical | 33,962 | 189 | 114 | 1.66 (1.43–1.91) | 346 | 265 | 1.31 (1.17–1.45) | 407 | 371 | 1.10 (0.99–1.21) |
| Architecture and engineering | 208,426 | 845 | 544 | 1.55 (1.45–1.66) | 3,663 | 2,847 | 1.29 (1.25–1.33) | 3,115 | 2,842 | 1.10 (1.06–1.14) |
| Life, physical, and social science | 59,989 | 215 | 156 | 1.38 (1.20–1.57) | 931 | 701 | 1.33 (1.24–1.42) | 843 | 782 | 1.08 (1.01–1.15) |
| Community and social services | 97,004 | 304 | 223 | 1.36 (1.21–1.53) | 1,482 | 999 | 1.48 (1.41–1.56) | 1,357 | 1,270 | 1.07 (1.01–1.13) |
| Legal | 43,936 | 178 | 110 | 1.62 (1.39–1.87) | 703 | 500 | 1.40 (1.30–1.51) | 674 | 584 | 1.15 (1.07–1.25) |
| Education, training, and library | 426,012 | 1,431 | 857 | 1.67 (1.58–1.76) | 6,148 | 4,203 | 1.46 (1.43–1.50) | 6,918 | 6,534 | 1.06 (1.03–1.08) |
| Arts, design, entertainment, sports, and media | 111,895 | 383 | 280 | 1.37 (1.23–1.51) | 1,252 | 1,102 | 1.14 (1.07–1.20) | 1,457 | 1,455 | 1.00 (0.95–1.05) |
| Health care practitioners and technical | 299,250 | 950 | 710 | 1.34 (1.25–1.43) | 3,325 | 2,772 | 1.20 (1.16–1.24) | 4,542 | 4,279 | 1.06 (1.03–1.09) |
| Health care support | 133,029 | 270 | 322 | 0.84 (0.74–0.94) | 863 | 902 | 0.96 (0.89–1.02) | 1,653 | 1,681 | 0.98 (0.94–1.03) |
| Protective service | 148,058 | 396 | 393 | 1.01 (0.91–1.11) | 1,295 | 1,509 | 0.86 (0.81–0.91) | 1,641 | 1,676 | 0.98 (0.93–1.03) |
| Food preparation and serving | 348,863 | 610 | 799 | 0.76 (0.70–0.83) | 2,585 | 2,896 | 0.89 (0.86–0.93) | 4,541 | 4,620 | 0.98 (0.95–1.01) |
| Building and grounds cleaning and maintenance | 456,452 | 687 | 881 | 0.78 (0.72–0.84) | 2,884 | 3,277 | 0.88 (0.85–0.91) | 4,611 | 4,902 | 0.94 (0.91–0.97) |
| Personal care and service | 338,556 | 816 | 729 | 1.12 (1.04–1.20) | 2,019 | 2,208 | 0.91 (0.88–0.96) | 3,055 | 3,290 | 0.93 (0.90–0.96) |
| Sales | 861,453 | 2,318 | 2,044 | 1.13 (1.09–1.18) | 10,004 | 9,357 | 1.07 (1.05–1.09) | 11,934 | 11,648 | 1.02 (1.01–1.04) |
| Office and administrative support | 895,316 | 2,534 | 2,132 | 1.19 (1.14–1.24) | 9,631 | 8,717 | 1.10 (1.08–1.13) | 13,245 | 13,135 | 1.01 (0.99–1.03) |
| Farming, fishing, and forestry | 515,654 | 773 | 898 | 0.86 (0.80–0.92) | 5,867 | 6,090 | 0.96 (0.94–0.99) | 6,278 | 6,267 | 1.00 (0.98–1.03) |
| Construction | 769,246 | 1,491 | 1,879 | 0.79 (0.75–0.83) | 6,148 | 7,432 | 0.83 (0.81–0.85) | 7,562 | 8,166 | 0.93 (0.91–0.95) |
| Extraction | 81,813 | 132 | 192 | 0.69 (0.58–0.82) | 599 | 942 | 0.64 (0.59–0.69) | 761 | 945 | 0.81 (0.75–0.87) |
| Installation, maintenance, and repair | 342,080 | 777 | 876 | 0.89 (0.83–0.95) | 3,279 | 3,677 | 0.89 (0.86–0.92) | 3,714 | 3,914 | 0.95 (0.92–0.98) |
| Production | 1,322,655 | 2,721 | 2,964 | 0.92 (0.88–0.95) | 12,578 | 13,902 | 0.90 (0.89–0.92) | 16,437 | 16,901 | 0.97 (0.96–0.99) |
| Transportation and material moving | 890,931 | 1,563 | 2,099 | 0.74 (0.71–0.78) | 6,562 | 7,972 | 0.82 (0.80–0.84) | 9,008 | 9,479 | 0.95 (0.93–0.97) |
| Military specific | 110,555 | 286 | 290 | 0.99 (0.87–1.11) | 1,131 | 1,182 | 0.96 (0.90–1.01) | 1,178 | 1,236 | 0.95 (0.90–1.01) |
| Nonpaid workers¶¶ | 3,082,715 | 4,971 | 5,935 | 0.84 (0.81–0.86) | 23,539 | 24,653 | 0.95 (0.94–0.97) | 44,634 | 44,364 | 1.01 (1.00–1.02) |

**Abbreviations:** ALS = amyotrophic lateral sclerosis; CI = confidence interval; ICD = *International Classification of Diseases*; NOMS = National Occupational Mortality Surveillance; PMR = proportionate mortality ratio.

* Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 335.2, *10th Revision*: G12.2.

† Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 332, *10th Revision*: G20.

§ Identified as deaths with the following ICD codes for the underlying or contributing causes of death: *9th Revision*: 424, *10th Revision*: I34–I38.

¶ Census 1990 occupation codes were converted to Census 2000 occupation codes using a crosswalk based on data in Table 2 of US Census Bureau Technical Paper #65: https://www.census.gov/people/io/files/techpaper2000.pdf.

** 334,629 (3%) deaths from all-causes, 551 (2%) deaths from ALS, 1,853 (2%) deaths from Parkinson's disease, and 2,791 (2%) deaths from chronic disease of the endocardium were excluded from this analysis because they were missing occupation information.

†† Indirectly standardized to the standard population of all NOMS deaths with occupation information by age, sex, race (white, black, other), and calendar year (1985–1989, 1990–1994, 1995–1998, 1999 and 2003–2004, 2007–2011). Different age group (years) categories were used for ALS, Parkinson's disease, and chronic disease of the endocardium because the age distributions for these outcomes were different and numbers were small in the tails of the age distributions for ALS and Parkinson's disease. The age group (years) categories that were used for ALS were ≤30, 31–35, 36–40, 41–45, 46–50, 51–55, 56–60, 61–65, 66–70, 71–75, 76–80, 81–85, 86–90, >90. The age group (years) categories that were used for Parkinson's disease were ≤50, 51–55, 56–60, 61–65, 66–70, 71–75, 76–80, 81–85, 86–90, 91–95, 96–100, >100. The age group (years) categories that were used for chronic disease of the endocardium were 18–25, 26–30, 31–35, 36–40, 41–45, 46–50, 51–55, 56–60, 61–65, 66–70, 71–75, 76–80, 81–85, 86–90, 91–95, 96–100, 101–105, >105.

§§ Calculated using formulas based on Byar's approximation to the exact Poisson test (http://www.iarc.fr/en/publications/pdfs-online/stat/sp82/).

¶¶ Includes housewife or homemaker (2,789,320; 90%), volunteer (1,936; <1%), student (46,221; 1%), retired (51,567; 2%), and none, never worked, patient, disabled, or inmate (193,671; 6%).

**Summary**

What is already known about this topic?

Amyotrophic lateral sclerosis (ALS) and Parkinson's disease are progressive neurodegenerative diseases that affect >1 million Americans. Factors consistently reported to be either positively or inversely associated with ALS and Parkinson's disease are primarily demographic or behavioral. The role of occupation in these diseases is relatively understudied and poorly understood.

What is added by this report?

This study described the burden of ALS and Parkinson's disease mortality by usual occupation in a large, complete, representative, and population-based sample in the United States and found higher ALS and Parkinson's disease mortality among workers in occupations associated with higher socioeconomic status (SES).

What are the implications for public health practice?

Although the reasons for the findings of this study are not understood, it provides information for future targeted studies among workers in higher SES occupations to identify risk factors for ALS and Parkinson's disease. These studies should use designs that provide evidence for causality, detailed exposure assessment, and adjustment for additional potential confounders.

matrices for exposures of interest. Adjusting for potential confounding by cigarette smoking and socioeconomic status, using incidence rather than mortality to ascertain outcomes, and incorporating information regarding the timing of exposures relative to the timing of outcomes might help further elucidate the reasons for these findings, so that strategies for prevention could be developed.

## Acknowledgments

Vital Statistics Offices from participating U.S. states; National Occupational Mortality Surveillance staff, National Institute for Occupational Safety and Health, CDC; National Center for Health Statistics, CDC; National Cancer Institute, NIH; U.S. Census Bureau.

## Conflict of Interest

No conflicts of interest were reported.

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# Racial and Geographic Differences in Breastfeeding — United States, 2011–2015

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Breastfeeding provides numerous health benefits for infants and mothers alike. The American Academy of Pediatrics recommends exclusive breastfeeding for approximately the first 6 months of life and continued breastfeeding with complementary foods through at least the first year (*1*). National estimates indicate substantial differences between non-Hispanic black (black) and non-Hispanic white (white) infants across breastfeeding indicators in the United States (*2*). CDC analyzed 2011–2015 National Immunization Survey (NIS) data for children born during 2010–2013 to describe breastfeeding initiation, exclusivity through 6 months and duration at 12 months among black and white infants. Among the 34 states (including the District of Columbia [DC]) with sufficient sample size (≥50 per group), initiation rates were significantly ($p<0.05$) lower among black infants than white infants in 23 states; in 14 of these states (primarily in the South and Midwest), the difference was at least 15 percentage points. A significant difference of at least 10 percentage points was identified in exclusive breastfeeding through 6 months in 12 states and in breastfeeding at 12 months in 22 states. Despite overall increases in breastfeeding rates for black and white infants over the last decade, racial disparities persist. Interventions specifically addressing barriers to breastfeeding for black women are needed.

NIS is a national ongoing, random-digit–dialed cellular and landline telephone survey conducted among households with children aged 19–35 months (*3*). The survey primarily is intended to estimate vaccination coverage rates for U.S. children. Questions on breastfeeding were added to the survey in 2001 and have since been used for national breastfeeding surveillance.

Because children are aged 19–35 months at the time of the NIS interview, each cross-sectional survey includes children born in 3 different calendar years. To increase sample size and allow for representative state-level analyses stratified by race, a cohort of children born during 2010–2013 was created by combining data from the 2011–2015 surveys. The Council of American Survey and Research Organizations response rates for the landline sample of NIS years 2011–2015 ranged from 59.2% to 76.1%. Response rates for the cellular telephone sample of NIS years 2011–2015 ranged from 25.2% to 33.5%. The child's breastfeeding history and race/ethnicity, and the mother's age, education, household percent of poverty level, and participation in the Supplemental Nutrition Program for Women, Infants, and Children (WIC), were reported by the parent or guardian. Breastfeeding initiation, exclusivity through 6 months (only breast milk; no solids, water, or other liquids), and duration at 12 months were calculated among all infants and at the state level among black and white infants. Data were suppressed when the group's sample size was <50 for that state. Breastfeeding estimates were weighted to adjust for multiple phone lines, mixed telephone use (landline and cellular), household nonresponse, and the exclusion of phoneless households, and accounted for the complex sampling design of NIS (*3*). Statistical analyses were conducted using chi-square tests to determine whether estimates for black infants were significantly different ($p<0.05$) from estimates for white infants.

Among all children born during 2010–2013, national estimates for breastfeeding initiation, exclusivity through 6 months, and duration at 12 months were 79.2%, 20.0%, and 27.8%, respectively (Table 1). Breastfeeding estimates varied by race/ethnicity, mother's age and education, participation in WIC, and ratio of family income to the federal poverty threshold. Because black infants have consistently had the lowest rates of breastfeeding initiation and duration compared to other groups, the state-level estimates presented are limited to black and white infants (*2*).

Among the 34 states* with sufficient sample size for analytic comparison, breastfeeding initiation ranged from 37.0% in Kentucky to 90.8% in Minnesota among black infants, and from 65.1% in Kentucky to 96.3% in DC among white infants. The state-specific percentage point differences (calculated as prevalence among white infants minus prevalence among black infants) in breastfeeding initiation between white and black infants ranged from −4.8 to 36.0, with substantial disparities in the South and Midwest. In 14 states, the difference in breastfeeding initiation between white and black infants was greater than 15 percentage points and the disparity exceeded 25 percentage points in seven of these states. The percentage point differences between white and black infants in exclusive breastfeeding through 6 months ranged from −4.2 in Rhode Island to 17.8 in Wisconsin, and at 12 months duration, the difference ranged from −4.4 in Minnesota to 31.6 in DC. A percentage point difference of ≥10 between white and black

*Alabama, Arizona, Arkansas, California, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, and Wisconsin.

**TABLE 1. National prevalence of breastfeeding initiation, exclusive breastfeeding through age 6 months, and duration of breastfeeding at age 12 months* among children aged 19–35 months, by selected demographic characteristics — National Immunization Survey, United States, 2011–2015†**

| Characteristic | No. of respondents§ | Initiated breastfeeding % (95% CI) | Breastfed exclusively through 6 months % (95% CI) | Breastfed at 12 months % (95% CI) |
|---|---|---|---|---|
| **Total** | 88,436–90,692 | 79.2 (78.7–79.7) | 20.0 (19.5–20.5) | 27.8 (27.2–28.4) |
| **Child's race/ethnicity¶,**** | | | | |
| White, non-Hispanic | 49,868–51,359 | 81.5 (80.9–82.1) | 22.5 (21.9–23.1) | 30.8 (30.1–31.5) |
| Black, non-Hispanic | 9,091–9,255 | 64.3 (62.7–65.9) | 14.0 (12.7–15.3) | 17.1 (15.8–18.4) |
| Hispanic | 17,775–18,075 | 81.9 (80.8–83.0) | 18.2 (17.0–19.4) | 26.3 (24.9–27.7) |
| **% of poverty level††** | | | | |
| <100 | 22,840–23,232 | 70.7 (69.6–71.8) | 14.7 (13.8–15.6) | 20.3 (19.3–21.3) |
| 100–199 | 17,735–18,184 | 77.6 (76.5–78.7) | 18.9 (17.9–19.9) | 26.0 (24.8–27.2) |
| 200–399 | 22,579–23,193 | 84.9 (84.1–85.7) | 23.9 (22.9–24.9) | 33.1 (32.0–34.2) |
| 400–599 | 13,727–14,149 | 88.0 (87.1–88.9) | 26.5 (25.1–27.9) | 36.7 (35.2–38.2) |
| ≥600 | 11,555–11,934 | 90.1 (89.2–91.0) | 25.8 (24.1–27.5) | 36.8 (35.0–38.6) |
| **Recipient of WIC** | | | | |
| Yes | 40,182–40,925 | 72.1 (71.3–72.9) | 14.5 (13.8–15.2) | 19.7 (18.9–20.5) |
| No (but eligible) | 6,265–6,461 | 81.9 (79.9–83.9) | 27.6 (25.6–29.6) | 37.9 (35.7–40.1) |
| No (not eligible) | 41,576–42,865 | 89.6 (89.1–90.1) | 27.2 (26.4–28.0) | 38.3 (37.4–39.2) |
| **Mother's education** | | | | |
| Less than high school diploma or GED | 9,329–9,496 | 68.8 (67.2–70.4) | 14.5 (13.1–15.9) | 21.8 (20.2–23.4) |
| High school diploma or GED | 16,317–16,651 | 69.7 (68.5–70.9) | 16.0 (15.0–17.0) | 19.7 (18.6–20.8) |
| Some college | 23,230–23,809 | 80.5 (79.6–81.4) | 17.8 (16.8–18.8) | 23.4 (22.3–24.5) |
| College graduate | 39,560–40,736 | 91.1 (90.7–91.5) | 27.7 (26.9–28.5) | 40.3 (39.4–41.2) |
| **Mother's age (yrs)¶** | | | | |
| <20 | 760–768 | 60.1 (53.7–66.5) | 7.3 (4.1–10.5) | 8.7 (5.4–12.0) |
| 20–29 | 32,148–32,841 | 74.0 (73.1–74.9) | 16.4 (15.6–17.2) | 19.8 (19.0–20.6) |
| ≥30 | 55,528–57,083 | 83.5 (82.9–84.1) | 23.1 (22.4–23.8) | 34.3 (33.5–35.1) |

**Abbreviations:** CI = confidence interval; GED = General Education Development certificate; WIC = Special Supplemental Nutrition Program for Women, Infants and Children.

* Breastfeeding initiation was determined based on response to the question, "Was [child] ever breastfed or fed breast milk?" Breastfeeding duration was assessed by asking, "How old was [child's name] when [child's name] completely stopped breastfeeding or being fed breast milk?" Exclusive breastfeeding was defined as only breast milk (no solids, no water, and no other liquids). To assess the duration of exclusive breastfeeding participants were asked two questions about age: 1) "How old was [child's name] when they were first fed formula?" and 2) "How old was [child's name] when they were first fed anything other than breast milk or formula?" (including juice, cow's milk, sugar water, baby food, or anything else that [child] might have been given, even water). Breastfeeding duration and exclusivity rates are estimated among all infants included in the survey and not only infants whose mothers started breastfeeding.

† Among children born during 2010–2013.

§ The number of respondents varies depending on the indicator.

¶ Differences in initiation, exclusive through 6 months, and at 12 months duration by demographic variables are statistically significant ($p<0.05$, chi-square test). Race/ethnicity test of significance was limited to non-Hispanic blacks and non-Hispanic whites.

** All racial/ethnic groups are included in the total in all other demographic breakdowns, but only the largest groups are presented here.

†† Ratio of self-reported family income to the federal threshold value, defined by the U.S. Census Bureau.

infants for 6 months of exclusive breastfeeding was observed in 12 states and for 12 months of breastfeeding in 22 states (Figure). These differences were significant ($p<0.05$) in each of these states (Table 2).

## Discussion

National estimates of breastfeeding initiation and duration have consistently improved among black and white infants over the past decade (*2*); however, the difference in breastfeeding rates between black and white infants remains substantial. Among infants born during 2010–2013, the gap in breastfeeding initiation between black and white infants was 17.2 percentage points, only slightly less than the 19.9 percentage point difference between black and white infants born during 2003–2006 (a timeframe when the methodology only included the landline sample) (*4*). The percentage point difference in the rate of exclusive breastfeeding through 6 months between black and white infants was 7.8 for children born during 2003–2006 (CDC, Nutrition Branch, unpublished data, 2016), and 8.5 for infants born during 2010–2013. The percentage point difference in the rate of breastfeeding at 12 months between black and white infants was 9.7 among infants born during 2003–2006 and 13.7 among infants born during 2010–2013 (*4*).

Multiple factors influence a woman's decision to start and continue breastfeeding. Lack of knowledge about breastfeeding, unsupportive cultural and social norms, concerns about milk supply, poor family and social support, and unsupportive work and childcare environments make it difficult for many mothers to meet their breastfeeding goals (*5*). Certain barriers are disproportionately experienced by black women (e.g., earlier return to work, inadequate receipt of breastfeeding information from providers, and lack of access to professional

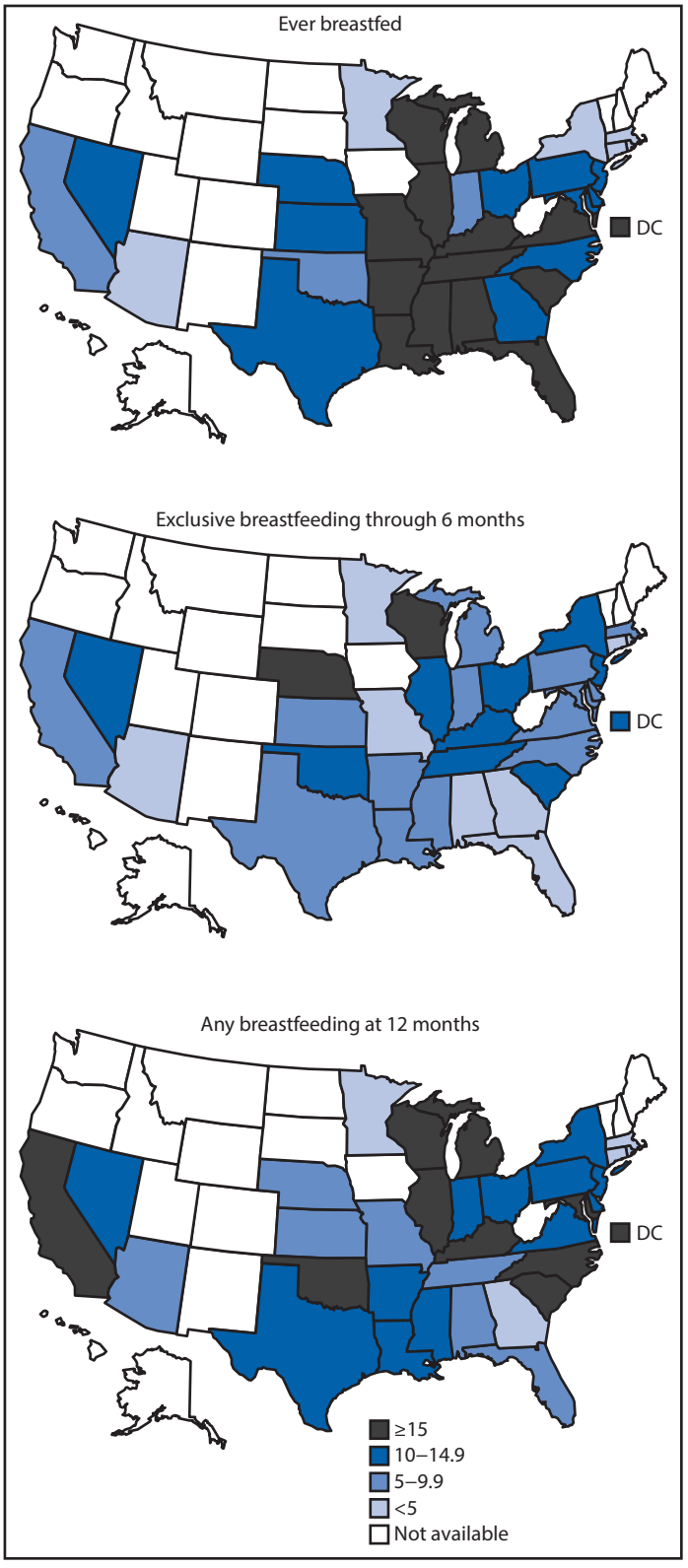
breastfeeding support), (*6*). For example, although evidence-based maternity care practices that support breastfeeding have been reported to increase breastfeeding initiation, exclusivity, and duration (*5*), black mothers might not have consistent access to these supportive practices. A study of hospital support for breastfeeding indicated that facilities located in zip codes with higher percentages of black residents than the national average were less likely to meet five indicators for supportive breastfeeding practices (early initiation of breastfeeding, limited use of breastfeeding supplements, rooming-in, limited use of pacifiers, and post-discharge support), than those located in areas with lower percentages of black residents (*7*).

In 2011, *The Surgeon General's Call to Action to Support Breastfeeding* outlined 20 action steps to support breastfeeding across various sectors of society, including a call to better understand and address breastfeeding disparities (*5*). A U.S.-based review of randomized trials evaluating breastfeeding interventions targeting minorities showed that group prenatal education, peer counseling interventions, breastfeeding-specific clinic appointments, and enhanced hospital practices/WIC-based services positively affected breastfeeding outcomes among minority women (*8*). CDC is currently funding a hospital-based quality improvement initiative designed to support hospitals to implement evidence-based maternity care practices. Currently 93 U.S. hospitals participate in EMPower Breastfeeding: Enhancing Maternity Practices[†] in 24 states, primarily in the South and Midwest, where the disparities in breastfeeding rates between black and white infants is greatest.

The findings in this report are subject to at least three limitations. First, estimates do not account for other factors potentially associated with lower breastfeeding rates among black infants, e.g. in-hospital formula feeding and socioeconomic characteristics such as percentage of poverty level and participation in WIC. However, previous analyses have indicated that racial differences exist that are independent of socioeconomic and demographic factors (*9*). Nevertheless, because the racial disparity in breastfeeding might depend on factors such as income and education, future studies examining the interactions among these factors are warranted to understand the independent contribution of each factor. Second, breastfeeding behaviors were self-reported by the respondent retrospectively when the child was aged 19–35 months, which could be subject to recall bias and social desirability. However, maternal recall for estimating breastfeeding initiation and duration is a reasonably valid and reliable method (*10*). Finally, despite combining survey years, in 17 states, the sample size for black infants was less than 50, limiting the ability to assess racial differences in all states.

[†] http://empowerbreastfeeding.org.

**FIGURE. Percentage-point difference in breastfeeding indicators for non-Hispanic white and non-Hispanic black infants — National Immunization Survey, United States, 2011–2015*,†**




* Among children born during 2010–2013.
† Data were suppressed when the group's sample size was <50 for the state.

**TABLE 2. Prevalence of breastfeeding initiation, exclusive duration through age 6 months, and duration at age 12 months,* among children aged 19–35 months, by state and race — National Immunization Survey, United States, 2011–2015†**

| | White, non-Hispanic | | | | Black, non-Hispanic | | | |
|---|---|---|---|---|---|---|---|---|
| State | No. of respondents§ | Initiated breastfeeding % (95% CI) | Breastfed exclusively through 6 months % (95% CI) | Breastfed at 12 months % (95% CI) | No. of respondents§ | Initiated breastfeeding % (95% CI) | Breastfed exclusively through 6 months % (95% CI) | Breastfed at 12 months % (95% CI) |
| Alabama | 847–867 | 69.9 (65.8–74.0) | 13.8 (11.2–16.4) | 16.1(13.5–18.7) | 305–308 | 52.5 (45.5–59.5)¶ | 12.2 (7.3–17.1) | 11.0 (6.7–15.3)¶ |
| Alaska | 870–901 | 93.2 (91.2–95.2) | 33.7 (30.0–37.4) | 44.8 (41.0–48.6) | —** | — | — | — |
| Arizona | 756–790 | 83.2 (79.5–86.9) | 23.9 (20.0–27.8) | 32.6 (28.5–36.7) | 61–64 | 82.2 (70.1–94.3) | 25.1 (10.4–39.8) | 25.1 (11.1–39.1) |
| Arkansas | 883–910 | 67.2 (63.0–71.4) | 14.5 (11.6–17.4) | 18.1 (15.2–21.0) | 160–162 | 40.0 (30.5–49.5)¶ | 5.6 (1.9–9.3)¶ | 6.6 (2.7–10.5)¶ |
| California | 699–718 | 94.4 (91.7–97.1) | 34.3 (28.9–39.7) | 48.1 (42.4–53.8) | 87–89 | 85.1 (75.6–94.6) | 28.4 (14.3–42.5) | 32.0 (17.9–46.1)¶ |
| Colorado | 1,020–1,056 | 90.2 (87.6–92.8) | 28.3 (24.8–31.8) | 40.0 (36.3–43.7) | — | — | — | — |
| Connecticut | 870–912 | 85.0 (82.0–88.0) | 23.1 (19.9–26.3) | 28.3 (25.0–31.6) | 131–139 | 81.6 (73.6–89.6) | 19.9 (11.9–27.9) | 27.9 (18.7–37.1) |
| Delaware | 702–722 | 73.7 (69.8–77.6) | 18.5 (15.3–21.7) | 24.7 (21.2–28.2) | 253–259 | 59.5 (52.3–66.7)¶ | 9.3 (5.6–13.0)¶ | 14.3 (9.8–18.8)¶ |
| District of Columbia | 677–700 | 96.3 (94.5–98.1) | 27.7 (23.7–31.7) | 47.9 (43.4–52.4) | 569–582 | 65.5 (60.8–70.2)¶ | 14.8 (11.3–18.3)¶ | 16.3 (12.8–19.8)¶ |
| Florida | 745–768 | 83.6 (80.0–87.2) | 21.7 (17.7–25.7) | 26.9 (22.8–31.0) | 206–210 | 67.8 (59.9–75.7)¶ | 17.7 (11.1–24.3) | 18.9 (12.1–25.7)¶ |
| Georgia | 669–685 | 74.8 (69.7–79.9) | 16.7 (13.2–20.2) | 20.1 (16.1–24.1) | 394–404 | 61.1 (54.2–68.0)¶ | 17.2 (11.6–22.8) | 17.0 (12.4–21.6) |
| Hawaii | 282–285 | 92.4 (88.9–95.9) | 37.5 (30.8–44.2) | 55.1 (48.2–62.0) | — | — | — | — |
| Idaho | 1,029–1,054 | 91.1 (89.0–93.2) | 24.1 (21.1–27.1) | 33.5 (30.2–36.8) | — | — | — | — |
| Illinois | 1,653–1,691 | 81.4 (78.7–84.1) | 20.6 (18.3–22.9) | 28.1 (25.4–30.8) | 536–544 | 58.7 (53.0–64.4)¶ | 9.7 (6.5–12.9)¶ | 12.6 (9.0–16.2)¶ |
| Indiana | 1,087–1,114 | 72.6 (69.3–75.9) | 18.1 (15.3–20.9) | 24.0 (21.1–26.9) | 146–149 | 63.6 (53.9–73.3) | 11.1 (5.1–17.1)¶ | 12.6 (6.8–18.4)¶ |
| Iowa | 1,053–1,084 | 79.7 (76.5–82.9) | 21.4 (18.4–24.4) | 26.6 (23.5–29.7) | — | — | — | — |
| Kansas | 867–881 | 82.9 (79.9–85.9) | 21.0 (17.9–24.1) | 29.4 (26.0–32.8) | 58 | 71.5 (57.5–85.5) | 15.6 (2.5–28.7) | 20.1 (6.6–33.6) |
| Kentucky | 1,013–1,030 | 65.1 (61.3–68.9) | 16.6 (13.9–19.3) | 19.4 (16.6–22.2) | 85 | 37.0 (24.3–49.7)¶ | 2.2 (0.2–4.2)¶ | 4.3 (0.6–8.0)¶ |
| Louisiana | 884–909 | 70.5 (66.8–74.2) | 13.9 (11.3–16.5) | 15.4 (12.7–18.1) | 429–435 | 38.7 (33.2–44.2) | 8.9 (5.8–12.0)¶ | 4.4 (2.5–6.3)¶ |
| Maine | 1,174–1,198 | 80.0 (77.0–83.0) | 24.0 (21.2–26.8) | 33.0 (29.9–36.1) | — | — | — | — |
| Maryland | 878–907 | 85.4 (81.8–89.0) | 28.2 (23.7–32.7) | 37.6 (32.9–42.3) | 494–506 | 75.4 (69.5–81.3)¶ | 19.0 (13.8–24.2)¶ | 21.4 (16.6–26.2)¶ |
| Massachusetts | 984–1023 | 84.4 (81.6–87.2) | 23.7 (20.5–26.9) | 35.2 (31.6–38.8) | 75–79 | 89.2 (82.1–96.3) | 18.5 (8.2–28.8) | 35.8 (23.6–48.0) |
| Michigan | 952–981 | 81.1 (77.8–84.4) | 22.0 (18.7–25.3) | 28.3 (24.9–31.7) | 157–158 | 55.1 (45.1–65.1)¶ | 12.2 (6.1–18.3)¶ | 10.2 (5.2–15.2)¶ |
| Minnesota | 1,005–1,043 | 87.9 (85.2–90.6) | 28.1 (24.7–31.5) | 35.5 (31.9–39.1) | 85–88 | 90.8 (83.6–98.0) | 25.9 (14.4–37.4) | 39.9 (25.9–53.9) |
| Mississippi | 722–737 | 67.1 (62.6–71.6) | 13.9 (10.6–17.2) | 16.2 (12.9–19.5) | 498–504 | 41.7 (36.1–47.3)¶ | 4.0 (2.1–5.9)¶ | 4.9 (2.6–7.2)¶ |
| Missouri | 983–1018 | 77.7 (74.4–81.0) | 18.0 (15.2–20.8) | 23.7 (20.7–26.7) | 131–132 | 56.2 (45.9–66.5)¶ | 17.4 (9.7–25.1) | 16.8 (9.1–24.5) |
| Montana | 1,056–1,088 | 91.5 (89.3–93.7) | 27.4 (24.0–30.8) | 36.2 (32.6–39.8) | — | — | — | — |
| Nebraska | 949–977 | 83.0 (79.9–86.1) | 22.3 (19.3–25.3) | 27.8 (24.6–31.0) | 54–55 | 69.4 (55.0–83.8) | 7.1 (1.1–13.1)¶ | 18.0 (7.1–28.9) |
| Nevada | 703–724 | 83.7 (80.3–87.1) | 24.1 (19.6–28.6) | 29.8 (25.9–33.7) | 105–110 | 69.9 (59.7–80.1)¶ | 11.8 (4.6–19.0)¶ | 19.0 (10.2–27.8)¶ |
| New Hampshire | 1,100–1,140 | 84.9 (82.4–87.4) | 26.1 (23.1–29.1) | 33.5 (30.4–36.6) | — | — | — | — |
| New Jersey | 816–853 | 79.7 (76.0–83.4) | 21.0 (17.4–24.6) | 31.3 (27.4–35.2) | 158–159 | 69.6 (60.9–78.3)¶ | 11.0 (5.3–16.7)¶ | 18.6 (11.6–25.6)¶ |
| New Mexico | 430–454 | 90.7 (87.2–94.2) | 28.0 (22.7–33.3) | 39.0 (33.5–44.5) | — | — | — | — |
| New York | 1,632–1,695 | 83.3 (81.0–85.6) | 22.6 (20.2–25.0) | 36.9 (34.2–39.6) | 412–423 | 80.8 (76.3–85.3) | 11.9 (8.3–15.5)¶ | 23.6 (18.8–28.4)¶ |
| North Carolina | 865–892 | 80.0 (76.0–84.0) | 22.2 (18.6–25.8) | 32.4 (28.5–36.3) | 274–277 | 66.0 (58.8–73.2)¶ | 16.2 (10.7–21.7) | 17.4 (11.9–22.9)¶ |
| North Dakota | 1,273–1,308 | 84.3 (81.9–86.7) | 22.3 (19.6–25.0) | 24.9 (22.2–27.6) | — | — | — | — |
| Ohio | 1,008–1,032 | 72.6 (69.0–76.2) | 19.3 (16.4–22.2) | 25.5 (22.3–28.7) | 178–179 | 59.6 (51.0–68.2)¶ | 8.5 (3.8–13.2)¶ | 12.1 (6.6–17.6)¶ |
| Oklahoma | 756–782 | 76.6 (72.8–80.4) | 19.4 (16.0–22.8) | 25.7 (22.0–29.4) | 105–106 | 70.3 (59.5–81.1) | 7.4 (1.3–13.5)¶ | 9.0 (2.9–15.1)¶ |
| Oregon | 888–917 | 93.1 (91.1–95.1) | 28.6 (25.2–32.0) | 41.6 (37.9–45.3) | — | — | — | — |
| Pennsylvania | 1,874–1,927 | 77.8 (74.9–80.7) | 20.2 (17.6–22.8) | 31.4 (28.4–34.4) | 787–793 | 64.4 (59.0–69.8)¶ | 10.3 (7.7–12.9)¶ | 18.4 (13.7–23.1)¶ |
| Rhode Island | 826–856 | 77.0 (73.4–80.6) | 20.3 (17.2–23.4) | 27.9 (24.5–31.3) | 74–77 | 79.8 (69.0–90.6) | 24.5 (11.2–37.8) | 25.8 (14.8–36.8) |
| South Carolina | 871–885 | 75.2 (71.4–79.0) | 21.1 (17.8–24.4) | 25.0 (21.5–28.5) | 319–321 | 55.1 (48.3–61.9)¶ | 10.0 (6.2–13.8)¶ | 8.1 (4.8–11.4)¶ |
| South Dakota | 922–938 | 85.4 (82.4–88.4) | 23.4 (20.2–26.6) | 28.8 (25.5–32.1) | — | — | — | — |
| Tennessee | 969–992 | 73.8 (70.3–77.3) | 17.4 (14.5–20.3) | 20.0 (17.1–22.9) | 180–188 | 55.5 (46.6–64.4)¶ | 7.3 (3.0–11.6)¶ | 14.4 (8.6–20.2) |
| Texas | 2,065–2,121 | 83.8 (80.9–86.7) | 23.6 (20.7–26.5) | 30.2 (27.0–33.4) | 560–568 | 70.1 (63.1–77.1)¶ | 16.3 (11.2–21.4)¶ | 17.6 (12.5–22.7)¶ |
| Utah | 1,063–1,119 | 91.5 (89.4–93.6) | 22.1 (19.1–25.1) | 39.5 (36.1–42.9) | — | — | — | — |
| Vermont | 1,203–1,257 | 85.4 (83.0–87.8) | 29.5 (26.7–32.3) | 41.1 (38.1–44.1) | — | — | — | — |
| Virginia | 1,153–1,178 | 84.2 (80.2–88.2) | 23.7 (19.7–27.7) | 36.5 (31.9–41.1) | 217–221 | 67.0 (57.6–76.4)¶ | 14.8 (8.5–21.1)¶ | 22.4 (14.6–30.2)¶ |
| Washington | 856–886 | 94.2 (92.2–96.2) | 28.0 (24.3–31.7) | 39.2 (35.2–43.2) | — | — | — | — |
| West Virginia | 1,230–1,246 | 61.1 (57.7–64.5) | 11.8 (9.8–13.8) | 16.0 (13.7–18.3) | — | — | — | — |
| Wisconsin | 939–960 | 84.5 (81.5–87.5) | 25.8 (22.5–29.1) | 33.1 (29.6–36.6) | 86–89 | 48.5 (34.9–62.1)¶ | 8.0 (2.2–13.8)¶ | 4.9 (0.8–9.0)¶ |
| Wyoming | 1,043–1,071 | 88.7 (86.1–91.3) | 25.7 (22.5–28.9) | 34.1 (30.7–37.5) | — | — | — | — |

**Abbreviation**: CI = confidence interval.

* Breastfeeding initiation was determined based on response to the question, "Was [child] ever breastfed or fed breast milk?" Breastfeeding duration was assessed by asking, "How old was [child's name] when [child's name] completely stopped breastfeeding or being fed breast milk?" Exclusive breastfeeding was defined as only breast milk (no solids, no water, and no other liquids). To assess the duration of exclusive breastfeeding participants were asked two questions about age: 1) "How old was [child's name] when they were first fed formula?" and 2) "How old was [child's name] when they were first fed anything other than breast milk or formula?" (including juice, cow's milk, sugar water, baby food, or anything else that [child] might have been given, even water). Breastfeeding duration and exclusivity rates are estimated among all infants included in the survey and not only infants whose mothers started breastfeeding.

† Among children born during 2010–2013.

§ The number of respondents varies depending on the indicator.

¶ Referent group is non-Hispanic whites. Estimate is statistically significant ($p<0.05$).

** Not available. Data were suppressed when sample size was <50.

**Summary**

What is already known about this topic?

The American Academy of Pediatrics recommends exclusive breastfeeding for the first 6 months of a baby's life and continued breastfeeding with complementary foods until age ≥12 months. Over the past decade, national estimates of breastfeeding initiation and duration have consistently improved among both non-Hispanic black (black) and non-Hispanic white (white) infants; however, differences in breastfeeding rates by race have persisted.

What is added by this report?

Differences in breastfeeding rates between black and white infants vary by state, and rates are lower among blacks in most states. Breastfeeding initiation rates were significantly lower among black infants in 23 states; in 14 of these states, the difference was at least 15 percentage points. A significant difference of at least 10 percentage points in exclusive breastfeeding through 6 months was found between black and white infants in 12 states, and at 12 months of breastfeeding in 22 states.

What are the implications for public health practice?

To increase the rate of breastfeeding among black infants, interventions are needed to address barriers experienced disproportionately by black mothers, including earlier return to work, inadequate receipt of breastfeeding information from providers, and lack of access to professional breastfeeding support. Enhanced understanding of these barriers could improve the effectiveness of interventions.

The difference in breastfeeding indicators among black and white infants by state continues to be substantial. Though certain interventions targeting black families have positively affected breastfeeding outcomes, additional research is needed to better understand the underlying factors contributing to the widespread persistence of the gap in breastfeeding rates by race (*6*,*8*). To reduce the disparities in rates of breastfeeding between black and white infants, interventions need to specifically address breastfeeding barriers experienced disproportionally by black mothers (*6*).

## Conflict of Interest

No conflicts of interest were reported.

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# Pneumococcal Vaccination Among Medicare Beneficiaries Occurring After the Advisory Committee on Immunization Practices Recommendation for Routine Use Of 13-Valent Pneumococcal Conjugate Vaccine and 23-Valent Pneumococcal Polysaccharide Vaccine for Adults Aged ≥65 Years

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On September 19, 2014, CDC published the Advisory Committee on Immunization Practices (ACIP) recommendation for the routine use of 13-valent pneumococcal conjugate vaccine (PCV13) among adults aged ≥65 years, to be used in series with 23-valent pneumococcal polysaccharide vaccine (PPSV23) (*1*). This replaced the previous recommendation that adults aged ≥65 years should be vaccinated with a single dose of PPSV23. As a proxy for estimating PCV13 and PPSV23 vaccination coverage among adults aged ≥65 years before and after implementation of these revised recommendations, CDC analyzed claims for vaccination submitted for reimbursement to the Centers for Medicare & Medicaid Services (CMS). Claims from any time during a beneficiary's enrollment in Medicare Parts A (hospital insurance) and B (medical insurance) since reaching age 65 years were assessed among beneficiaries continuously enrolled in Medicare Parts A and B during annual periods from September 19, 2009, through September 18, 2016. By September 18, 2016, 43.2% of Medicare beneficiaries aged ≥65 years had claims for at least 1 dose of PPSV23 (regardless of PCV13 status), 31.5% had claims for at least 1 dose of PCV13 (regardless of PPSV23 status), and 18.3% had claims for at least 1 dose each of PCV13 and PPSV23. Claims for either type of pneumococcal vaccine were highest among beneficiaries who were older, white, or with chronic and immunocompromising medical conditions than among healthy adults. Implementation of the National Vaccine Advisory Committee's standards for adult immunization practice to assess vaccination status at every patient encounter, recommend needed vaccines, and administer vaccination or refer to a vaccinating provider might help increase pneumococcal vaccination coverage and reduce the risk for pneumonia and invasive pneumococcal disease among older adults (*2*).

CDC monitored PCV13 and PPSV23 claims submitted for reimbursement to CMS among beneficiaries aged ≥65 years who were continuously enrolled in Medicare Parts A and B* during annual periods from September 19, 2009, through September 18, 2016. Enrollment periods covered the 5 years before through 2 years after the recommendation for routine use of PCV13 and PPSV23 in series for adults aged ≥65 years (*1*). The number of beneficiaries per annual enrollment period ranged from 23.7 million to 25.0 million during these years. Beneficiaries were considered to be vaccinated with either PPSV23 or PCV13 or both if a claim for vaccination was submitted at any time during a beneficiary's history of enrollment in Medicare Parts A and B since reaching age 65 years and before the end of the enrollment period of interest. However, claims are only available in the CMS database beginning January 1, 1999. PCV13 and PPSV23 were identified by current procedural technology codes 90670 and 90732, respectively. Claims submitted from any hospital or outpatient setting (including pharmacies) were included. Claims submitted to CMS for at least 1 PCV13 dose (regardless of PPSV23 status), at least 1 PPSV23 dose (regardless of PCV13 status), at least 1 dose each of PCV13 and PPSV23, and at least 1 dose of either vaccine were stratified by age, race/ethnicity, state of residence, and the presence of chronic or immunocompromising medical conditions for which PCV13 or PPSV23 or both are indicated among adults aged <65 years (*3*). Race/ethnicity was categorized as Hispanic or Latino, black, white, Asian, American Indian/Alaskan Native, and "other."† Chronic and immunocompromising medical conditions were identified by the presence of *International Classification of Diseases, Ninth Revision* (ICD-9) and ICD-10 codes listed on any claim submitted to CMS during a beneficiary's history of enrollment in Medicare Parts A and B through the end of the enrollment period of interest. The proportion

* Analysis includes only Medicare beneficiaries in fee-for-service plans (Medicare Parts A and B). Beneficiaries receiving Medicare services through Medicare Advantage or other health plan (Medicare Part C) are excluded. Under Part C health plans, Medicare is not billed separately for vaccinations.

† Beneficiaries identified as Hispanic or Latino might be of any race. Beneficiaries identified as black, white, Asian, American Indian/Alaskan Native, or other race are non-Hispanic. "Other" includes persons of multiple race. Race/ethnicity information for Medicare beneficiaries was historically obtained from the Social Security Administration's master beneficiary record. Before 1980, the Social Security application form only allowed classification of race into White, Black, and Other. Since 1980, the categories have been expanded to White (non-Hispanic); Black (non-Hispanic); Hispanic; Asian, Asian American, or Pacific Islander; American Indian or Alaska Native; and Unknown. The Health Care Financing Administration (now Centers for Medicare & Medicaid Services) conducted surveys of beneficiaries in attempts to better classify race/ethnicity of those enrolled before 1980. However, misclassification of race/ethnicity among beneficiaries included in the current analysis might remain, particularly those of Hispanic ethnicity and races other than white or black.

of beneficiaries with claims submitted for PCV13 by the end of each month during September 2014–September 2016 was also assessed. The denominator for each month included beneficiaries continuously enrolled in Medicare Parts A and B for at least 12 months before and including the month of interest.

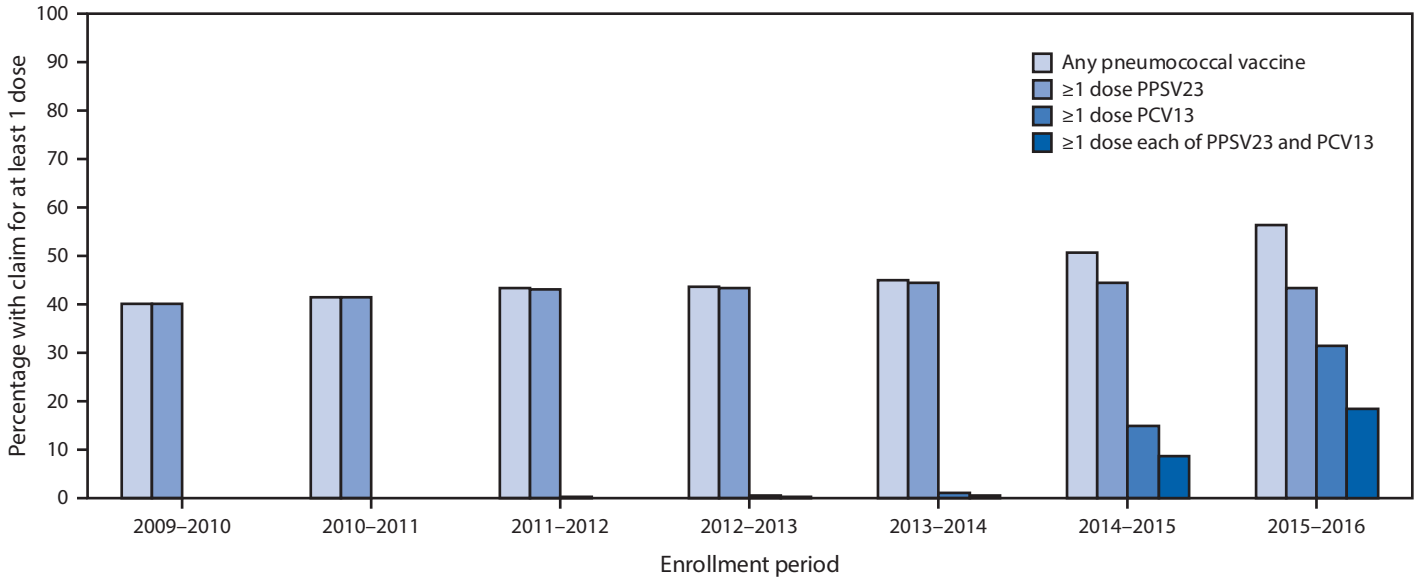
By September 18, 2015, 14.8% of Medicare beneficiaries aged ≥65 years had claims for PCV13, and 8.7% had claims for both PCV13 and PPSV23 (Figure 1). By September 18, 2016, claims for PCV13 and claims for both PCV13 and PPSV23 increased to 31.5% and 18.3%, respectively. Claims for PPSV23 increased from 40.0% by September 18, 2010 to 44.5% by September 18, 2014; claims for at least one pneumococcal vaccine of any type increased from 40.0% by September 18, 2010 to 56.4% by September 18, 2016.

Claims for pneumococcal vaccination by September 18, 2016, varied by demographic characteristics and the presence of chronic and immunocompromising medical conditions (Table). The percentages of beneficiaries with claims for all pneumococcal vaccine outcomes were lowest among beneficiaries aged 65–69 years and highest among beneficiaries aged 80–84 years. Claims for PPSV23 were 133% higher among beneficiaries aged 80–84 years (58.5%) than among those aged 65–69 years (25.1%); claims for PCV13 were 33% higher among beneficiaries aged 80–84 years (34.0%) than among those aged 65–69 years (28.2%). Claims for PPSV23, PCV13, or both vaccines were higher among white beneficiaries than among beneficiaries of other racial/ethnic groups; the largest differences were between white and Hispanic beneficiaries (44.6% compared with 32.2% [PPSV23]; 33.1% compared with 13.9% [PCV13]; and 19.5% compared with 6.8% [both PPSV23 and PCV13]). The percentages of beneficiaries aged ≥65 years with chronic medical conditions with claims for PPSV23 (47.1%), PCV13 (33.3%), and both vaccines (19.9%) were higher than for beneficiaries without these conditions (22.2%, 21.8%, and 9.8%, respectively). Similarly, the percentages of beneficiaries with immunocompromising medical conditions with claims for PPSV23, PCV13, and both vaccines were higher than the percentage among beneficiaries without these conditions (50.7% compared with 29.9%, 35.1% compared with 25.2%, and 21.8% compared with 12.2%, respectively).

Claims for pneumococcal vaccination by September 18, 2016 among beneficiaries aged ≥65 years also varied by state of residence (Table). Claims for PPSV23 ranged from 25.4% in Alaska to 52.3% in Wisconsin, claims for PCV13 ranged from 20.7% in Mississippi to 53.9% in Wisconsin, and claims for both vaccines ranged from 9.4% in Alaska to 34.9% in Wisconsin.

Monthly claims for PCV13 among beneficiaries aged ≥65 years after publication of the September 2014 recommendation increased from 0.9% in September 2014 to 22.9% in December 2015 (Figure 2). The steepest monthly increase

**FIGURE 1. Percentage of Medicare beneficiaries aged ≥65 years with claims submitted for pneumococcal vaccination* — United States, September 2009–September 2016†**




**Abbreviations:** PCV13 = 13-valent pneumococcal conjugate vaccine; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

* Percentage with at least one claim for pneumococcal vaccination since January 1, 1999 through the end of the enrollment period.

† Each enrollment period extends from September 19 of the first year through September 18 of the subsequent year, with the exception of the 2011–2012 period, which ends on October 12, 2012, corresponding to the date of publication of the first recommendation for the use of PCV13 in series with PPSV23 in adults with certain immunocompromising conditions; denominators include all beneficiaries continuously enrolled in Medicare Parts A and B for the duration of the enrollment period.

**TABLE. Percentage of Medicare beneficiaries aged ≥65 years with claims submitted for pneumococcal vaccination, by age, race/ethnicity, presence of chronic and immunocompromising medical conditions, and state — United States, September 2016***

| Characteristic | Total no. enrolled beneficiaries | % | | | |
|---|---|---|---|---|---|
| | | ≥1 dose PPSV23[†] | ≥1 dose PCV13[§] | Both PPSV23 and PCV13[¶] | Any pneumococcal** |
| **Age group (yrs)** | | | | | |
| 65–69 | 7,939,433 | 25.1 | 28.2 | 11.0 | 42.2 |
| 70–74 | 6,056,516 | 43.0 | 33.2 | 19.3 | 56.9 |
| 75–79 | 4,481,971 | 53.7 | 34.4 | 23.7 | 64.5 |
| 80–84 | 3,179,177 | 58.5 | 34.0 | 24.3 | 68.2 |
| ≥85 | 3,345,213 | 57.8 | 30.1 | 20.9 | 67.1 |
| **Race/Ethnicity[††]** | | | | | |
| White | 21,436,465 | 44.6 | 33.1 | 19.5 | 58.3 |
| Black | 1,846,978 | 33.2 | 19.4 | 10.3 | 42.4 |
| Asian | 468,070 | 42.2 | 23.9 | 13.1 | 53.0 |
| Hispanic | 379,943 | 32.2 | 13.9 | 6.8 | 39.3 |
| American Indian/Alaskan Native | 113,646 | 36.5 | 25.6 | 12.0 | 50.1 |
| Other race | 423,720 | 39.5 | 28.1 | 15.7 | 52.0 |
| **Immunocompromising condition[§§]** | | | | | |
| Yes | 15,972,169 | 50.7 | 35.1 | 21.8 | 64.0 |
| No | 9,030,141 | 29.9 | 25.2 | 12.2 | 42.9 |
| **Chronic medical condition[¶¶]** | | | | | |
| Yes | 21,104,617 | 47.1 | 33.3 | 19.9 | 60.5 |
| No | 3,897,693 | 22.2 | 21.8 | 9.8 | 34.2 |
| **State of residence** | | | | | |
| Alabama | 468,852 | 41.5 | 23.1 | 13.3 | 51.3 |
| Alaska | 59,323 | 25.4 | 23.0 | 9.4 | 39.0 |
| Arizona | 499,658 | 41.4 | 29.9 | 16.5 | 54.8 |
| Arkansas | 317,732 | 42.7 | 27.1 | 16.1 | 53.7 |
| California | 2,107,110 | 40.2 | 27.3 | 15.1 | 52.4 |
| Colorado | 332,022 | 43.4 | 36.9 | 20.8 | 59.5 |
| Connecticut | 318,829 | 46.2 | 34.9 | 20.5 | 60.7 |
| Delaware | 122,037 | 48.6 | 40.5 | 24.3 | 64.8 |
| District of Columbia | 43,433 | 38.0 | 26.8 | 14.9 | 49.9 |
| Florida | 1,712,605 | 44.3 | 26.1 | 15.8 | 54.7 |
| Georgia | 674,242 | 42.5 | 29.9 | 17.3 | 55.1 |
| Hawaii | 83,703 | 42.1 | 33.3 | 19.7 | 55.6 |
| Idaho | 131,744 | 38.1 | 26.2 | 14.5 | 49.8 |
| Illinois | 1,124,884 | 43.2 | 31.1 | 18.5 | 55.7 |
| Indiana | 592,448 | 47.6 | 33.5 | 20.5 | 60.5 |
| Iowa | 352,685 | 43.8 | 41.1 | 23.7 | 61.2 |
| Kansas | 302,081 | 41.6 | 33.0 | 19.1 | 55.5 |
| Kentucky | 389,989 | 42.3 | 26.4 | 15.5 | 53.1 |
| Louisiana | 348,808 | 42.5 | 21.5 | 12.5 | 51.4 |
| Maine | 150,171 | 41.2 | 39.4 | 22.3 | 58.4 |
| Maryland | 586,357 | 43.7 | 36.5 | 20.9 | 59.2 |
| Massachusetts | 632,551 | 41.1 | 43.1 | 21.1 | 63.0 |
| Michigan | 827,012 | 45.3 | 28.9 | 17.3 | 56.9 |
| Minnesota | 230,895 | 49.7 | 47.7 | 30.3 | 67.1 |
| Mississippi | 314,296 | 39.1 | 20.7 | 11.6 | 48.2 |
| Missouri | 528,914 | 43.4 | 32.5 | 19.6 | 56.3 |
| Montana | 118,967 | 37.7 | 36.4 | 19.7 | 54.4 |
| Nebraska | 205,497 | 44.8 | 36.9 | 22.5 | 59.1 |
| Nevada | 197,861 | 34.0 | 23.6 | 11.8 | 45.8 |
| New Hampshire | 170,816 | 46.1 | 47.1 | 26.9 | 66.3 |
| New Jersey | 889,614 | 43.0 | 26.9 | 15.4 | 54.5 |
| New Mexico | 163,879 | 40.3 | 24.1 | 13.5 | 50.9 |
| New York | 1,332,798 | 42.3 | 28.9 | 17.1 | 54.1 |
| North Carolina | 840,134 | 46.6 | 38.6 | 23.3 | 61.9 |
| North Dakota | 70,805 | 42.3 | 41.3 | 24.0 | 59.6 |
| Ohio | 809,510 | 46.6 | 34.3 | 21.0 | 59.9 |
| Oklahoma | 385,745 | 44.0 | 26.8 | 15.6 | 55.3 |
| Oregon | 275,942 | 40.8 | 34.9 | 19.6 | 56.2 |
| Pennsylvania | 992,016 | 45.1 | 41.2 | 23.9 | 62.4 |
| Rhode Island | 77,264 | 35.6 | 31.0 | 14.1 | 52.6 |
| South Carolina | 507,588 | 42.6 | 32.3 | 18.1 | 56.7 |

See table footnotes on the next page.

**TABLE. (*Continued*) Percentage of Medicare beneficiaries aged ≥65 years with claims submitted for pneumococcal vaccination, by age, race/ethnicity, presence of chronic and immunocompromising medical conditions, and state — United States, September 2016***

| Characteristic | Total no. enrolled beneficiaries | % | | | |
|---|---|---|---|---|---|
| | | ≥1 dose PPSV23† | ≥1 dose PCV13§ | Both PPSV23 and PCV13¶ | Any pneumococcal** |
| South Dakota | 90,734 | 41.5 | 35.4 | 20.5 | 56.4 |
| Tennessee | 538,577 | 44.4 | 32.3 | 18.8 | 57.9 |
| Texas | 1,661,198 | 44.3 | 23.9 | 14.2 | 54.0 |
| Utah | 154,746 | 41.0 | 32.7 | 16.5 | 57.2 |
| Vermont | 86,650 | 38.6 | 37.1 | 19.8 | 55.9 |
| Virginia | 789,897 | 46.8 | 40.1 | 23.9 | 63.0 |
| Washington | 568,297 | 40.3 | 34.3 | 19.0 | 55.6 |
| West Virginia | 191,465 | 38.0 | 21.2 | 11.5 | 47.7 |
| Wisconsin | 435,666 | 52.3 | 53.9 | 34.9 | 71.3 |
| Wyoming | 70,165 | 34.8 | 27.3 | 13.7 | 48.4 |
| Median | — | 42.5 | 32.5 | 18.8 | 55.7 |
| Range across states | — | 25.4–52.3 | 20.7–53.9 | 9.4–34.9 | 39.0–71.3 |

**Abbreviations:** PCV13 = 13-valent pneumococcal conjugate vaccine; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

* Denominator in each subgroup includes all beneficiaries continuously enrolled in Medicare Parts A and B during September 19, 2015–September 18, 2016.

† Percentage of beneficiaries with at least one claim for PPSV23 during January 1, 1999–September 18, 2016.

§ Percentage of beneficiaries with at least one claim for PCV13 during January 1, 1999–September 18, 2016.

¶ Percentage of beneficiaries with at least one claim for PPSV23 and at least one claim for PCV13 during January 1, 1999–September 18, 2016.

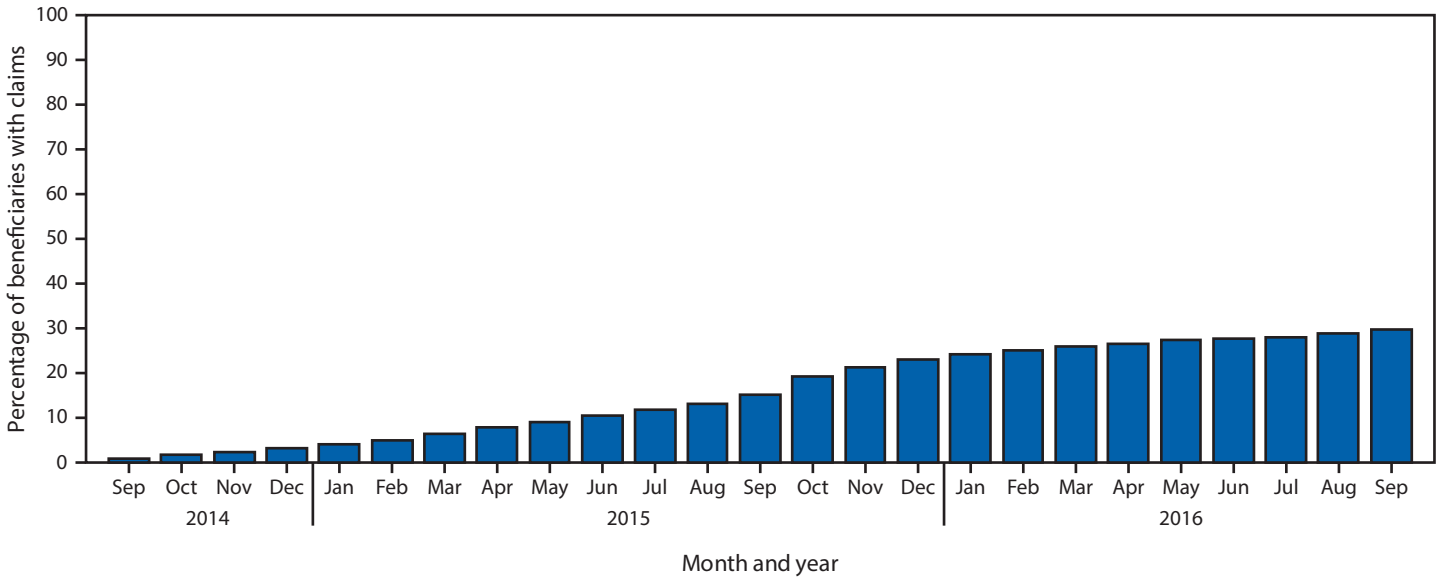
** Percentage of beneficiaries with at least one claim for PPSV23 or PCV13 during January 1, 1999–September 18, 2016.

†† Race/ethnicity was categorized as Hispanic or Latino, black, white, Asian, American Indian/Alaskan Native, and "other." Beneficiaries identified as Hispanic or Latino might be of any race. Beneficiaries identified as black, white, Asian, American Indian/Alaskan Native, or other race are non-Hispanic. Other includes persons of multiple race.

§§ Includes cerebrospinal fluid leak; cochlear implant; sickle cell disease or other hemaglobinopathy; congenital or acquired asplenia; congenital or acquired immunodeficiency (including B- or T-lymphocyte deficiency, complement deficiencies, and phagocytic disorders excluding chronic granulomatous disease); HIV infection; chronic renal failure; nephrotic syndrome; leukemia; lymphoma; Hodgkin disease; generalized malignancy; immunosuppression caused by treatment with immunosuppressive drugs, including long-term corticosteroids and radiation therapy; solid organ transplant; and multiple myeloma. Use of *International Classification of Diseases* codes might be nonspecific in identifying generalized malignancies if providers use these codes to rule out diagnoses.

¶¶ Includes all immunocompromising conditions listed above plus chronic heart disease (including congestive heart failure and cardiomyopathies, excluding hypertension), chronic lung disease (including chronic obstructive pulmonary disease, emphysema, and asthma), and diabetes mellitus.

**FIGURE 2. Percentage of Medicare beneficiaries aged ≥65 years with claims submitted for 13-valent pneumococcal conjugate vaccine (PCV-13), by month* — United States, September 2014–September 2016†**




* Percentage of beneficiaries with at least one claim for PCV13 before the end of the month of interest. Denominator each month includes beneficiaries continuously enrolled in Medicare Parts A and B for at least 12 months before and including the month of interest.

† The Advisory Committee on Immunization Practices recommendation for the routine use of PCV13 for adults aged ≥65 years was published September 19, 2014.

(4 percentage points) occurred from September 2015 to October 2015. During January–September 2016, the average monthly increase was 0.71 percentage points.

## Discussion

PPSV23 has been demonstrated effective in preventing invasive pneumococcal disease (IPD) in adults. However, approximately 20%–25% of IPD cases and 10% of community-acquired pneumonia cases in adults aged ≥65 years are caused by serotypes unique to PCV13. Broader protection against pneumococcal disease is expected through use of both PCV13 and PPSV23 in series (*1*). In 2014, when ACIP recommended routine use of PCV13 in series with PPSV23 among adults aged ≥65 years, the addition of PCV13 was estimated to prevent 230 cases of IPD and approximately 12,000 cases of community-acquired pneumonia over the lifetime of a single cohort of persons aged 65 years in the United States (*1*). Two years after the ACIP recommendation for routine use of PCV13 in series with PPSV23 in adults aged ≥65 years, claims for PCV13 rose steadily, to 31.5% in September 2016. However, the expected benefits of PCV13 use in terms of cases of IPD and pneumonia prevented were estimated in a setting of 60% coverage (*4*). Claims for PPSV23 were also persistently low, despite a long-standing recommendation for PPSV23 use in this population (*5*). The steepest increase in PCV13 uptake coincided with the beginning of the 2015–16 influenza season, suggesting that older adults might be receiving pneumococcal vaccination when they go to their providers for influenza vaccination. Implementation of the standards for adult immunization practice (*2*) could help improve the initiation and completion of the pneumococcal vaccination series among adults aged ≥65 years to reduce the incidence of pneumonia and invasive pneumococcal disease among these persons.

Implementation of PCV13 and PPSV23 vaccination has not been equal across subgroups of adults aged ≥65 years. White beneficiaries were more likely to have claims for either type of vaccine than were beneficiaries of other racial/ethnic groups, especially Hispanics and blacks. Differences in coverage with pneumococcal vaccine, as well as other vaccines, among older adults by race/ethnicity are well documented, and might be attributable to differences in attitudes toward vaccination and concerns about vaccination safety, in provider recommendation for vaccination, and in quality of care received by different racial/ethnic groups (*6*,*7*). Although PPSV23 and PCV13 are now routinely recommended for all adults aged ≥65 years, beneficiaries aged ≥65 years with chronic or immunocompromising medical conditions were more likely to have been vaccinated with both vaccines than were beneficiaries without such conditions. This higher percentage might be attributable to several factors: beneficiaries with chronic or immunocompromising medical conditions having more frequent provider contacts, and thus more opportunities for vaccination; providers being more aware of vaccination needs for persons with complicated medical conditions; and patients with chronic or immunocompromising conditions being more aware of the need for pneumococcal vaccination. Vaccination with both types of pneumococcal vaccine also varied by state, as has been previously reported for PPSV23 (*7*). State variation in vaccination coverage has been attributed to differences in health care delivery infrastructure and vaccination programs, as well as differences in population characteristics between states (*7*).

The findings in this report are subject to at least five limitations related to the use of Medicare claims data as a proxy for estimating vaccination coverage. First, the percentage of beneficiaries in this study population with claims for pneumococcal vaccination might not be representative of pneumococcal vaccination coverage among all adults aged ≥65 years in the United States. The percentage with claims for any pneumococcal vaccine in this study (56.4%) differs from the 63.5% reported coverage with any pneumococcal vaccine among adults aged ≥65 years from the nationally representative 2015 National Health Interview Survey (*8*). Second, exclusion from the current analysis of beneficiaries enrolled in Medicare Part C (Medicare is not billed separately

**Summary**

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

On September 19, 2014, CDC published a recommendation of the Advisory Committee on Immunization Practices (ACIP) for routine use of 13-valent pneumococcal conjugate vaccine (PCV13) among adults aged ≥65 years, to be used in series with 23-valent pneumococcal polysaccharide vaccine (PPSV23). ACIP will reevaluate the recommendation for routine use of PCV13 in adults aged ≥65 years in 2018 and revise as needed.

**What is added by this report?**

Among Medicare beneficiaries (Parts A and B) aged ≥65 years, 43.2% had received ≥1 dose of PPSV23, 31.5% had received ≥1 dose of PCV13, and 18.3% had received both PCV13 and PPSV23 by September 18, 2016. Receipt of either type of pneumococcal vaccine was highest among beneficiaries who were older, white, or with chronic and immunocompromising medical conditions. Claims for PPSV23 vaccination were persistently low despite long-standing recommendations for its use among adults aged ≥65 years.

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

Initiation and completion of the pneumococcal vaccination series among adults aged ≥65 years can be improved by implementation of the standards for adult immunization practice. Estimates of vaccination with PCV13 and PPSV23 in adults aged ≥65 years are important factors in the consideration of the revision of the recommendation for routine use of PCV13.

for vaccinations for beneficiaries enrolled in Part C health plans) might have contributed to over- or underrepresentation of vaccinated persons in the study population. In 2016, 33% of Medicare beneficiaries were enrolled in Part C, with enrollment by state ranging from 1% to 58%[§] (*9*). Third, the CMS database does not include claims for vaccinations administered before 1999. Whereas not having information on pneumococcal vaccination claims before 1999 would not affect estimates for PCV13 vaccination, the percentage of persons vaccinated with PPSV23 could be underestimated, particularly among older beneficiaries who reached age 65 years before 1999 and might have been vaccinated with PPSV23 after its licensure for use in the United States in 1983. Fourth, doses administered during hospitalization might not be captured if claims for the hospital stay were bundled. Finally, race/ethnicity of Hispanic beneficiaries and those of races other than white or black could potentially be misclassified because of the change in categorization of race/ethnicity information collected by the Social Security Administration in 1980 (*10*).

Despite these limitations, the use of Medicare claims data are an efficient mechanism to monitor the acceptance of PCV13 and PPSV23 among adults aged ≥65 years. The ACIP will reevaluate the recommendation for routine use of PCV13 in adults aged ≥65 years in 2018 and revise as needed (*1*). Timely assessment of PCV13 uptake and completion of the pneumococcal vaccination series with PCV13 and PPSV23 are necessary to evaluate prevention of pneumococcal pneumonia and invasive pneumococcal disease by vaccination. To reduce the incidence of pneumococcal disease, providers should ensure that older adults initiate and complete the recommended pneumococcal vaccination series.

[§] Although data are not available regarding differences in vaccination coverage between beneficiaries enrolled in Parts A and B versus Part C, if differences do exist, some of the variation in claims rates by state could be attributable to the large variation in the percentage of beneficiaries enrolled in Part C across states. The national estimate based on beneficiaries enrolled in Parts A and B could be biased even if coverage among Part C beneficiaries was similar, if residents of states with higher coverage are underrepresented because of a higher percentage of enrollment in Part C compared with residents of states with lower vaccination coverage.

## Conflict of Interest

No conflicts of interest were reported.

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# High Risk for Invasive Meningococcal Disease Among Patients Receiving Eculizumab (Soliris) Despite Receipt of Meningococcal Vaccine

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*On July 7, 2017, this report was posted as an* MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Use of eculizumab (Soliris, Alexion Pharmaceuticals), a terminal complement inhibitor, is associated with a 1,000-fold to 2,000-fold increased incidence of meningococcal disease (*1*). Administration of meningococcal vaccines is recommended for patients receiving eculizumab before beginning treatment (*2*,*3*). Sixteen cases of meningococcal disease were identified in eculizumab recipients in the United States during 2008–2016; among these, 11 were caused by nongroupable *Neisseria meningitidis*. Fourteen patients had documentation of receipt of at least 1 dose of meningococcal vaccine before disease onset. Because eculizumab recipients remain at risk for meningococcal disease even after receipt of meningococcal vaccines, some health care providers in the United States as well as public health agencies in other countries recommend antimicrobial prophylaxis for the duration of eculizumab treatment; a lifelong course of treatment is expected for many patients. Heightened awareness, early care seeking, and rapid treatment of any symptoms consistent with meningococcal disease are essential for all patients receiving eculizumab treatment, regardless of meningococcal vaccination or antimicrobial prophylaxis status.

Eculizumab is licensed in the United States for treatment of paroxysmal nocturnal hemoglobinuria and atypical hemolytic uremic syndrome (*2*); both are rare, life-threatening illnesses. The Food and Drug Administration (FDA)–approved prescribing information includes a boxed warning regarding increased risk for meningococcal disease in eculizumab recipients (*2*). To mitigate the occurrence of and morbidity associated with meningococcal infections, FDA requires a Risk Evaluation and Mitigation Strategy (REMS) (http://www.solirisrems.com/) to educate health care providers and patients about the risk for and early signs of possible meningococcal infection and the need for immediate medical evaluation of signs and symptoms consistent with possible meningococcal infection. A key element of the Soliris REMS is ensuring that patients receive meningococcal vaccines.* The Advisory Committee on Immunization Practices recommends that eculizumab recipients receive both quadrivalent meningococcal conjugate (MenACWY) and serogroup B (MenB) meningococcal vaccines (*3*).

In February 2017, CDC requested that health departments review existing meningococcal disease case investigation records since 2007 to identify cases in eculizumab recipients; isolates or clinical specimens for identified cases were also requested for additional characterization. The requests were made through Epi-X (https://www.cdc.gov/epix/), CDC's secure communications network for public health officials, and follow-up with each health department occurred through individual e-mail correspondence. Forty-seven state health departments and the health departments of New York City and the District of Columbia responded to CDC's request for information. A search of the FDA Adverse Events Reporting System identified additional information on meningococcal vaccines received by patients identified through the Epi-X request.

CDC's Bacterial Meningitis Laboratory performed slide agglutination,† polymerase chain reaction (PCR) testing, and whole genome sequencing (WGS) on isolates to determine the serogroup (*4*); the serogroup for one clinical specimen with no isolate was determined by PCR. The serogroup results from slide agglutination (nongroupable) and WGS (serogroup C) differed for one isolate. For that isolate, the slide agglutination result (nongroupable) was used in analysis, because slide agglutination detects expression of the polysaccharide capsule, which is necessary for protection by MenACWY vaccines. Antimicrobial susceptibility testing also was performed.

In response to the Epi-X request, 16 meningococcal disease cases in eculizumab recipients were identified for the period 2008–2016 from 10 jurisdictions. The median patient age was 30 years (range = 16–83 years). All patients had meningococcemia; six also had evidence of meningitis. Patients were hospitalized for an average of 6.6 days (range = 1–14 days); one patient died (case-fatality ratio = 6%). Ten of the 16 patients were receiving eculizumab for paroxysmal nocturnal hemoglobinuria, five for atypical hemolytic uremic syndrome, and one for another condition, through a clinical trial.

Isolates from 14 patients were available for further characterization; a clinical specimen, but no isolate, was available for one patient; and for one patient no clinical specimen or isolate was available. Four cases were determined to be caused by

* FDA background package for meeting of drug safety and risk management advisory Committee. https://www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Drugs/DrugSafetyandRiskManagementAdvisoryCommittee/UCM423030.pdf.

† Laboratory methods for the diagnosis of meningitis caused by *Neisseria meningitidis*, *Streptococcus pneumoniae*, and *Haemophilus influenzae*. https://www.cdc.gov/meningitis/lab-manual/full-manual.pdf.

serogroup Y and 11 by nongroupable *N. meningitidis* (Table 1). Antimicrobial susceptibility testing was performed on the 14 isolates (Table 2). One patient infected with a penicillin intermediate-susceptible strain had been prescribed penicillin prophylaxis, although the patient reported poor compliance. Further characterization of these isolates is ongoing.

Fourteen patients had documentation of receipt of MenACWY before disease onset (Table 1). Three of four meningococcal disease cases diagnosed after publication of the ACIP recommendations for use of MenB vaccine in persons at increased risk occurred in patients with documentation of receipt of 1 or more doses of MenB vaccine before disease onset. Three of four patients with serogroup Y disease had documentation of previous MenACWY receipt.

**TABLE 1. Meningococcal vaccination status and disease-causing serogroup in eculizumab recipients with meningococcal disease (N = 16) — 10 U.S. jurisdictions, 2008–2016**

| Characteristic | No. (%) |
|---|---|
| **MenACWY vaccination*** | |
| Yes | 14 (88) |
| No/unknown | 2 (12) |
| **MenB vaccination (patients with diagnosis after June 12, 2015)†** | |
| Yes§ | 3 (75) |
| No/unknown | 1 (25) |
| **Disease-causing serogroup** | |
| B | 0 (—) |
| C | 0 (—) |
| Y | 4 (25) |
| Nongroupable¶ | 11 (69) |
| Not determined | 1 (6) |

* MenACWY vaccination includes MenACWY conjugate vaccine, meningococcal polysaccharide vaccine, and meningococcal vaccine of unknown type. Only vaccines received before disease onset are included.
† MenB vaccines were licensed for use in the United States in 2014 and 2015. Advisory Committee on Immunization Practices recommendations for use of MenB vaccine in persons at increased risk for serogroup B meningococcal disease were published on June 12, 2015. No patients had received MenB-FHbp (Trumenba, Pfizer Vaccines); three patients had received MenB-4C (Bexsero, GlaxoSmithKline). Only vaccines received before disease onset are included.
§ Includes 1 or 2 doses of MenB vaccine.
¶ Includes one patient for whom no isolate was available but classified as nongroupable based on polymerase chain reaction testing on a clinical specimen.

## Discussion

Meningococcal disease following MenACWY vaccination in eculizumab recipients has been reported previously (*1*,*5*), and in vitro data have shown that eculizumab impairs meningococcal killing in whole blood even in subjects vaccinated against the relevant meningococcal serogroup (*6*). In addition, although nongroupable *N. meningitidis* is often carried asymptomatically in the nasopharynx, it rarely causes disease in healthy persons (*7*).

MenACWY vaccines target the serogroup-specific polysaccharide capsule and provide no protection against nongroupable *N. meningitidis*. MenB vaccines are licensed specifically for protection against serogroup B meningococcal disease. The extent of any potential cross-protection has not been assessed. The evidence of meningococcal disease in eculizumab recipients vaccinated against the infecting serogroup, together with the susceptibility of these persons to nongroupable meningococcal strains, is consistent with the in vitro data and suggests that eculizumab therapy interferes with the ability of antimeningococcal antibodies to provide protection against invasive disease.

Many clinicians and public health agencies, particularly in the United Kingdom and France, recommend antimicrobial prophylaxis with penicillin for the duration of eculizumab treatment; macrolides are typically recommended for penicillin-allergic patients (*8*).§ Long-term penicillin prophylaxis is generally considered to be safe,¶ although the effectiveness of this strategy for meningococcal disease prevention has not been established. Ten of the 14 isolates characterized in this analysis were fully susceptible to penicillin, three demonstrated intermediate penicillin susceptibility, and one was resistant to penicillin. This finding is consistent with recent studies of invasive meningococcal isolates in the United States, which have shown that most isolates are fully susceptible to penicillin and that penicillin resistance is very rare (*9*). The clinical implications of intermediate penicillin susceptibility are unclear. Meningococcal disease caused by both penicillin-resistant *N. meningitidis* and *N. meningitidis* with intermediate penicillin susceptibility have been reported in eculizumab recipients taking penicillin or amoxicillin prophylaxis (*7*,*10*), but patient compliance was not reported.

Although neither meningococcal vaccination nor antimicrobial prophylaxis can be expected to prevent all cases of meningococcal disease in eculizumab recipients, providers should continue to follow ACIP recommendations for eculizumab recipients to receive both MenACWY and MenB vaccines. Providers could also consider antimicrobial prophylaxis for the duration of eculizumab treatment to potentially reduce the risk for meningococcal disease. Data will continue to be evaluated and additional guidance will be developed as evidence becomes available. Heightened awareness and vigilance for symptoms consistent with meningococcal disease are essential for all patients receiving eculizumab treatment and their health care providers, regardless of meningococcal vaccination or antimicrobial prophylaxis status.

Of note, 10 cases in this report had meningococcemia without meningitis. Although a petechial or purpuric rash is

§ PNH National Service Leeds. 2017. Meningococcal infection and eculizumab. http://www.pnhleeds.co.uk/professionals/meningococcal-infection-and-eculizumab/.
¶ Safety of long term therapy with penicillin and penicillin derivatives. https://www.fda.gov/drugs/emergencypreparedness/bioterrorismanddrugpreparedness/ucm072755.htm.

**TABLE 2. Antimicrobial susceptibility testing on isolates from eculizumab recipients (N = 14) with meningococcal disease — 10 U.S. jurisdictions, 2008–2016**

| Antibiotic | Susceptibility (No.) | | | |
|---|---|---|---|---|
| | Susceptible | Intermediate | Resistant | Nonsusceptible* |
| Ampicillin | 11 | 3 | 0 | N/A |
| Ceftriaxone | 14 | 0 | 0 | N/A |
| Ciprofloxacin | 13 | 0 | 1 | N/A |
| Penicillin | 10 | 3 | 1 | N/A |
| Rifampin | 14 | 0 | 0 | N/A |
| Trimethoprim-sulfamethoxazole | 2 | 1 | 11 | N/A |
| Azithromycin | 14 | N/A | N/A | 0 |

**Abbreviation:** N/A = not applicable.
* Breakpoints for intermediate susceptibility versus resistance not established.

a hallmark of meningococcemia, this rash might not appear until later stages of illness. Initial symptoms of meningococcemia are often relatively mild and nonspecific, and might include fever, chills, fatigue, vomiting, diarrhea, and aches or pains in the muscles, joints, chest, or abdomen; however, these symptoms can progress to severe illness and death within hours. Health care providers should have a high index of suspicion for meningococcal disease in patients taking eculizumab who develop any symptoms consistent with either meningitis or meningococcemia, even if the patient's symptoms initially appear mild, and even if the patient has been fully vaccinated or is receiving antimicrobial prophylaxis.

State health departments are asked to complete a supplemental case report form (available at https://www.cdc.gov/meningococcal/surveillance/index.html) for all meningococcal disease cases occurring among eculizumab recipients; forms should be submitted to CDC via secure e-mail (meningnet@cdc.gov) or secure fax (404-471-8372), along with any available isolates for whole genome sequencing.

**Summary**

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

Eculizumab (Soliris, Alexion Pharmaceuticals), a terminal complement inhibitor, is associated with a 1,000-fold to 2,000-fold increased incidence of meningococcal disease among persons receiving the drug. The Food and Drug Administration (FDA)–approved prescribing information includes a boxed warning regarding increased risk for meningococcal disease in eculizumab recipients. The Advisory Committee on Immunization Practices recommends both MenACWY and MenB vaccination for patients taking eculizumab.

**What is added by this report?**

Following review of existing meningococcal disease case investigation records, 16 cases of meningococcal disease were identified in eculizumab recipients in the United States for the period 2008–2016. The majority of cases were caused by nongroupable *Neisseria meningitidis* and occurred in patients who had documentation of receipt of at least 1 dose of meningococcal vaccine before disease onset.

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

Health care providers should continue to follow recommendations from the Advisory Committee on Immunization Practices for eculizumab recipients to receive both MenACWY and MenB vaccines and could consider antimicrobial prophylaxis for the duration of eculizumab treatment to potentially reduce the risk for meningococcal disease. However, neither vaccination nor antimicrobial prophylaxis can be expected to prevent all cases of meningococcal disease in eculizumab recipients. Heightened awareness, early care seeking, and rapid treatment of any symptoms consistent with meningococcal disease are essential in all patients receiving eculizumab treatment, regardless of meningococcal vaccination or antimicrobial prophylaxis status.

## Acknowledgments

Vaccine-preventable disease surveillance staff members of the following state and large local health departments: Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, New York City, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming; staff members in the Food and Drug Administration's Center for Drug Evaluation and Research and Center for Biologics Evaluation and Research; Amy Blain, Melissa Whaley, How-Yi Chang, David Lonsway, Karen Anderson, CDC.

## Conflict of Interest

No conflicts of interest were reported.

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

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# Announcement

## Implementation of the Vaccine Adverse Event Reporting System 2.0 Reporting Form

The Vaccine Adverse Event Reporting System (VAERS), co-managed by CDC and the Food and Drug Administration (FDA), is the national postmarketing safety monitoring system that accepts reports about adverse events that occur after administration of U.S.-licensed vaccines (*1*,*2*). On June 30, 2017, CDC and FDA implemented a revised reporting form and a new process for submitting reports to VAERS. Persons reporting adverse events are now able to use the VAERS 2.0 online reporting tool to submit reports directly online; alternatively, they may download and complete the writable and savable VAERS 2.0 form and submit it using an electronic document upload feature.

Transition to the VAERS 2.0 form is expected to be completed by the end of December 2017. Accommodations will be made for persons unable to submit reports electronically. The revised VAERS reporting form and system is intended for health care professionals, patients, parents, guardians, caregivers and other nonmanufacturers. Vaccine manufacturers will submit reports to VAERS by a separate process through the FDA Electronic Submissions Gateway (*3*). Instructions for reporting to VAERS are available at https://vaers.hhs.gov/reportevent.html. Additional assistance is available via email at info@vaers.org or by telephone at 1-800-822-7967.

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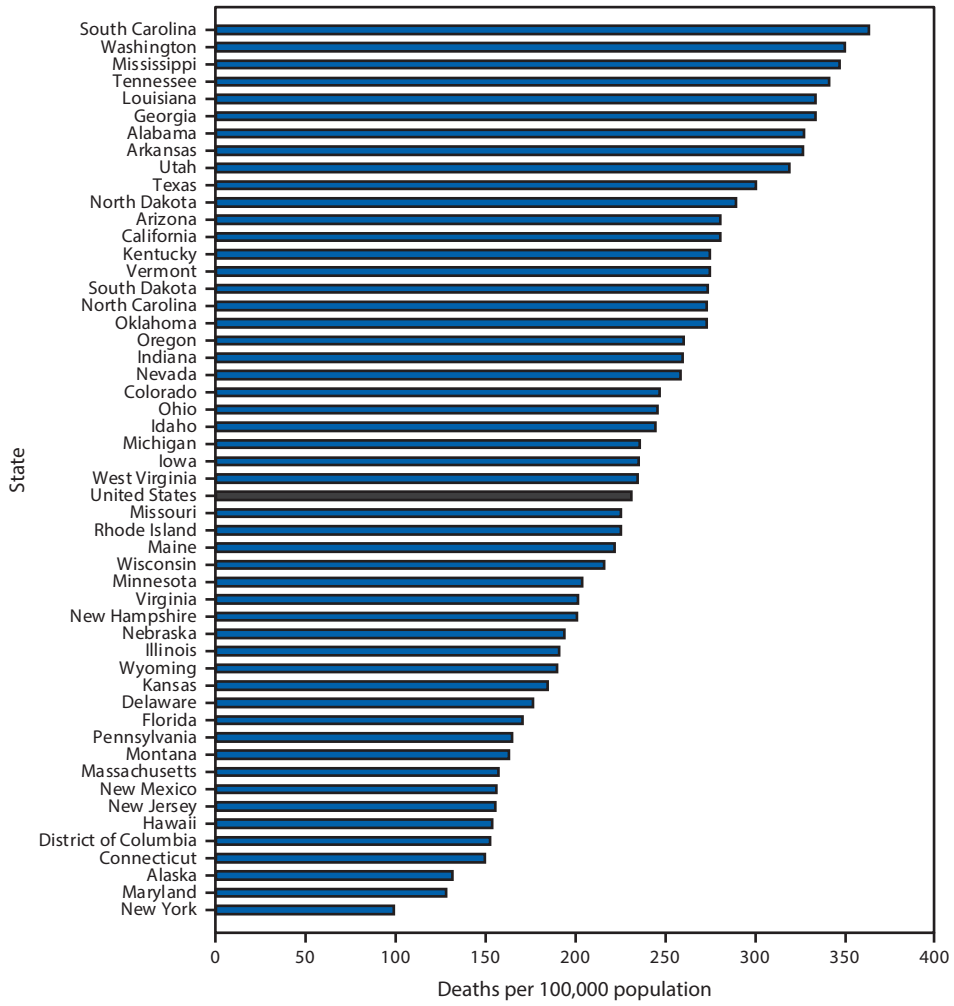
# QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Age-Adjusted* Alzheimer's Disease Death Rates† Among Persons Aged ≥65 Years, by State§ — United States, 2015




* Age-adjusted rates per 100,000 based on the 2000 U.S. standard population. Populations used for computing death rates are postcensal estimates based on the 2010 census estimated as of July 1, 2015.

† Alzheimer's disease (G30) was listed as the underlying cause of death based on the *International Classification of Diseases, 10th Revision* (ICD-10). In 2015, a total of 109,495 deaths from Alzheimer's disease among persons aged ≥65 years were reported in the United States.

§ U.S. residents only.

In 2015, the age-adjusted Alzheimer's disease death rate among persons aged ≥65 years in the United States was 231.0 per 100,000 population. The five states with the highest age-adjusted death rates for Alzheimer's disease were South Carolina (362.8), Washington (349.6), Mississippi (346.5), Tennessee (340.8), and Louisiana (333.6). New York had the lowest rate (99.0), followed by Maryland (128.2), Alaska (131.7), Connecticut (149.3), and the District of Columbia (152.2).

**Source:** National Vital Statistics System. Mortality public use data files, 2015. https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm.

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ISSN: 0149-2195 (Print)