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Adults with One or More Functional Disabilities — United States, 2011–2014

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Nearly 40 million persons in the United States have a disability, as defined by responses to six questions recommended by the U.S. Department of Health and Human Services as the national standard for identifying disabilities in population-based health surveys (*1*). Although these questions have been used to estimate prevalence of functional disabilities overall, as well as types of functional disabilities (disability type), no study has yet investigated the characteristics of U.S. adults by number of disability types. Knowing the characteristics of persons living with multiple disability types is important for understanding the overall functional status of these persons. CDC analyzed data from the family component of the National Health Interview Survey (NHIS) for the years 2011–2014 to estimate the percentage of adults aged 18–64 years with one, two, three, or four or more disability types, by selected demographic and socioeconomic characteristics. Overall, 22.6 million (11.9%) working-age adults were found to have any disability, and in this population, most (12.8 million) persons had only one disability type. A generally consistent pattern between increasing indicators of low socioeconomic status and the number of disability types was observed. Understanding the demographic and socioeconomic characteristics of working-age adults with disabilities, including those with multiple disability types, might help to further the inclusion of persons with disabilities in public health programs and policies.

NHIS is a continuous, in-person household survey that is nationally representative of the civilian, noninstitutionalized U.S. population.* Final response rates for the family component ranged from 73.1% to 81.3% during 2011–2014. NHIS includes six questions† recommended by the U.S. Department of Health and Human Services to identify disabilities in six disability type categories: hearing, vision, cognition, mobility, self-care, and independent living.§ Disability was assessed for 130,455 adults aged 18–64 years, of whom 2,441 were excluded because of missing information on any of the six questions,¶ resulting in a final analytic sample of 128,014 persons. Persons who responded "yes" to any of the six questions were classified as having a disability

* http://www.cdc.gov/nchs/nhis/.

† Based on section 4302 of the Affordable Care Act, the Department of Health and Human Services issued data collection standard guidance to include a standard set of disability identifiers in all national population health surveys (https://aspe.hhs.gov/datacncl/standards/aca/4302/index.pdf).

§ Respondents were categorized as having a disability if they answered "yes" to any of the following six questions: 1) "Are you deaf or do you have serious difficulty hearing?" (hearing); 2) "Are you blind or do you have serious difficulty seeing, even when wearing glasses?" (vision); 3) "Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?" (cognition); 4) "Do you have serious difficulty walking or climbing stairs?" (mobility); 5) "Do you have difficulty dressing or bathing?" (self-care); and 6) "Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?" (independent living).

¶ Estimates of disability in this report might differ from other disability estimates derived from this data set because of analytical differences (e.g., treatment of missing responses).

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and as having a specific disability type if they responded "yes" to the question corresponding to that disability type. For each person who had any disability, the number of disability types was calculated by summing the number of "yes" responses to the six questions. Persons with "no" responses to all six questions were classified as having no disability.

Data were weighted to account for the probability of selection and nonresponse; weights were divided by four to account for combining 4 years of data. Prevalence and 95% confidence intervals (CIs) were calculated for any disability, disability type, and number of disability types (one, two, three, four or more**), as well as demographic (age [18–44, 45–64 years]; sex; race/ethnicity [non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other]) and socioeconomic status variables among adults with no disability, any disability, and one, two, three, or four or more disability types. Socioeconomic status variables were income-to-poverty ratio†† (<1.00, 1.00–2.00, ≥2.00); labor force status (in the labor force [employed, looking for work], not in the labor force [retired, student, or homemaker; not working because of health reasons or disability; other]); and education level (less than high school, high school/GED/some college, associate degree, college degree). Statistical software was used to account for the complex survey design of NHIS.

** Because of small sample sizes, persons with four, five, or six disability types were combined into a single category.

†† Income-to-poverty ratio is the ratio of family income to the federal poverty threshold, given family size and number of children.

Overall, 22.6 million (11.9%) working-age adults had any disability; among these 22.6 million persons, 51.0% had a mobility disability and 38.3% had a cognitive disability (Table 1). Most (12.8 million) of those with any disability had only one disability type; the most common disability type was mobility (33.5%), followed by hearing (24.4%), and cognition (23.1%). A total of 4.8 million working-age adults had two disabilities, 2.7 million had three disabilities, and 2.2 million had four or more disabilities (data not shown). Among adults with two or more disabilities, the most common types were mobility, independent living, and cognition (Table 1).

Compared with working-age adults with no disability, a higher percentage of those with any disability were aged 45–64 years or non-Hispanic black; no differences were observed for sex. As the number of disability types increased, the percentages of adults who were aged 45–64 years or non-Hispanic black increased. Disparities in indicators of low socioeconomic status were noted for those with any disability compared with those with no disability (less than a high school education [26.9% versus 13.1%], income-to-poverty ratio <1.00 [29.2% versus 13.3%], and in the labor force but looking for work [16.2% versus 7.5%]) (Table1) (Table 2). As the number of disability types increased, the prevalence of low socioeconomic status indicators generally increased as well. For example, the prevalence of being in the labor force but looking for work was 7.5% (no disability), 13.8% (one type), 21.4% (two types), 29.0% (three types), and 26.4% (four or more types) (Table 2). Similar observations were noted for income-to-poverty ratio <1.00 and having less than a high school education.

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TABLE 1. Sociodemographic characteristics among adults aged 18–64 years, by disability status and number of functional disability types* — National Health Interview Survey, United States, 2011–2014

Characteristic	Overall population (N = 128,014†) % (95% CI)	Disability status % (95% CI)		No. of functional disability types % (95% CI)			
		No disability (n = 112,417†)	Any disability (n = 15,597†)	1 (n = 8,730†)	2 (n = 3,342†)	3 (n = 1,908†)	≥4 (n = 1,617†)
Disability status							
Any disability	11.9 (11.6–12.2)	—§	—§	—§	—§	—§	—§
Cognitive	4.6 (4.4–4.7)	—§	38.3 (37.3–39.3)	23.1 (21.9–24.3)	46.4 (44.3–48.4)	55.5 (52.8–58.2)	87.4 (85.4–89.1)
Hearing	3.0 (2.8–3.1)	—§	24.8 (24.0–25.6)	24.4 (23.3–25.5)	19.6 (18.1–21.2)	21.7 (19.7–23.8)	41.9 (39.0–44.9)
Mobility	6.1 (5.9–6.3)	—§	51.0 (50.0–52.0)	33.5 (32.2–34.7)	58.7 (56.6–60.8)	82.9 (80.7–85.0)	96.0 (94.8–97.0)
Vision	2.5 (2.4–2.6)	—§	20.8 (19.9–21.7)	14.4 (13.4–15.5)	20.2 (18.6–21.9)	24.1 (22.0–26.2)	54.9 (52.0–57.7)
Self-care	1.7(1.6–1.8)	—§	14.6 (13.9–15.3)	0.8 (0.6–1.1)	8.7 (7.6–10.0)	41.0 (38.5–43.5)	73.7 (71.1–76.1)
Independent living	3.6(3.4–3.7)	—§	30.1 (29.2–31.1)	3.9 (3.4–4.4)	46.3 (44.4–48.2)	74.9 (72.5–77.1)	91.7 (90.0–93.2)
No disability	88.1 (87.9–88.3)	—§	—§	—§	—§	—§	—§
Age group (yrs)							
18–44	57.6(57.1–58.1)	60.7 (60.2–61.3)	34.3 (33.3–35.3)	37.7 (36.3–39.1)	32.0 (30.1–33.9)	27.9 (25.6–30.2)	27.6 (24.9–30.5)
45–64	42.4(41.9–42.9)	39.3 (38.7–39.8)	65.7 (64.7–66.7)	62.3 (60.9–63.7)	68.0 (66.1–69.9)	72.1 (69.8–74.4)	72.4 (69.5–75.1)
Sex							
Male	49.1 (48.9–49.4)	49.1 (48.9–49.4)	49.1 (48.3–49.9)	51.3 (50.1–52.4)	46.7 (44.9–48.6)	45.0 (42.4–47.5)	46.7 (44.1–49.3)
Female	50.9 (50.6–51.1)	50.9 (50.6–51.1)	50.9 (50.1–51.7)	48.7 (47.6–49.9)	53.3 (51.4–55.1)	55.0 (52.5–57.6)	53.3 (50.7–55.9)
Race/Ethnicity							
White, non-Hispanic	64.5 (63.8–65.2)	64.1 (63.4–64.9)	67.3 (66.2–68.4)	68.7 (67.4–70.1)	66.8 (64.9–68.7)	64.7 (62.1–67.3)	63.3 (60.3–66.1)
Black, non-Hispanic	12.6 (12.1–13.1)	12.1 (11.6–12.6)	16.0 (15.2–16.9)	14.0 (13.1–15.0)	18.0 (16.5–19.6)	19.0 (17.0–21.2)	19.7 (17.4–22.2)
Hispanic	16.4 (15.8–17.0)	16.9 (16.3–17.6)	12.8 (12.0–13.7)	13.2 (12.2–14.3)	11.6 (10.5–12.8)	12.1 (10.6–13.7)	13.9 (12.2–15.8)
Other, non-Hispanic¶	6.5 (6.2–6.8)	6.8 (6.5–7.2)	3.8 (3.5–4.3)	4.0 (3.5–4.5)	3.6 (3.0–4.3)	4.2 (3.2–5.5)	3.1 (2.4–4.1)
Education level**							
Less than high school	14.9 (14.5–15.3)	13.1 (12.7–13.6)	26.9 (25.9–27.8)	23.7 (22.5–25.0)	29.5 (27.7–31.3)	30.4 (28.2–32.6)	35.0 (32.3–37.7)
High school/GED/ some college	22.8 (22.4–23.3)	22.4 (21.9–22.8)	26.1 (25.2–26.9)	25.4 (24.4–26.5)	26.8 (25.0–28.8)	26.3 (23.9–28.8)	27.5 (24.9–30.2)
Associate degree	29.8 (29.4–30.2)	29.4 (29.0–29.9)	32.2 (31.3–33.2)	32.4 (31.2–33.6)	32.5 (30.4–34.6)	33.0 (30.6–35.4)	29.8 (27.1–32.6)
College degree	32.5 (31.8–33.2)	35.1 (34.3–35.9)	14.9 (14.2–15.6)	18.5 (17.5–19.5)	11.3 (9.9–12.7)	10.4 (8.6–12.5)	7.7 (6.2–9.6)
Income-to-poverty ratio††							
<1.00	15.2 (14.7–15.8)	13.3 (12.8–13.8)	29.2 (28.1–30.3)	24.3 (23.1–25.6)	33.4 (31.4–35.5)	35.9 (33.4–38.5)	40.0 (37.1–43.0)
1.00 to <2.00	17.8 (17.3–18.2)	16.8 (16.4–17.3)	24.6 (23.6–25.7)	22.8 (21.6–24.0)	26.4 (24.4–28.5)	27.6 (25.3–30.1)	27.6 (24.9–30.4)
≥2.00	67.0 (66.2–67.7)	69.9 (69.1–70.6)	46.2 (44.9–47.5)	52.9 (51.4–54.4)	40.2 (37.9–42.5)	36.4 (33.7–39.2)	32.4 (29.4–35.5)
In the labor force§§							
Yes	78.1 (77.7–78.4)	82.6 (82.3–82.9)	44.8 (43.6–45.9)	59.6 (58.3–60.9)	33.4 (31.5–35.4)	20.2 (18.1–22.4)	13.8 (11.6–16.3)
No	21.9 (21.6–22.3)	17.4 (17.1–17.7)	55.2 (54.1–56.4)	40.4 (39.1–41.7)	66.6 (64.6–68.5)	79.8 (77.6–81.9)	86.2 (83.7–88.4)

* Six functional disability types are serious difficulty in cognition, hearing, mobility, and vision, and any difficulty in self-care and independent living.
† Unweighted denominator.
§ Not applicable.
¶ Other, non-Hispanic includes those of multiple races.
** For persons aged ≥25 years.
†† Income-to-poverty ratio is the ratio of family income to the federal poverty threshold, given family size and number of children.
§§ Persons were considered in the labor force if they were employed or looking for work and were considered not in the labor force if they were retired, a student, a homemaker, not working because of health reasons or disability, or other.

Discussion

Findings in this analysis indicate that approximately 12% of working-age adults have any disability, and among this population, most (approximately 60%) have only one disability type. Although the rank order of specific disability types varied by number of disabilities, among adults with multiple disabilities, difficulties in mobility, cognition, and independent living were the most common types.

Considerable socioeconomic disparities exist between working-age adults with any number of disability types and those without disability. The largest percentage point increase in indicators of low socioeconomic status generally occurred among adults with only one disability type compared with none. For example, among persons aged 18–64 years with one disability type, the prevalences of living in poverty (income-to-poverty ratio <1.00), having less than a high school education, and of being in the labor force but looking for work were approximately twice as high as among those without disability. A generally consistent pattern of increasing prevalence of these low socioeconomic status indicators as the number of disability types increased was observed.

TABLE 2. Status in the labor force among adults aged 18–64 years, by disability status and number of functional disability types* — National Health Interview Survey, United States, 2011–2014

Labor force status	Overall population (N = 128,014†) % (95% CI)	Disability status % (95% CI)		No. of functional disability types % (95% CI)			
		No disability (n = 112,417†)	Any disability (n = 15,597†)	1 (n = 8,730†)	2 (n = 3,342†)	3 (n = 1,908†)	≥4 (n = 1,617†)
In the labor force§							
Employed	**91.9 (91.6–92.2)**	92.5 (92.2–92.7)	83.8 (82.8–84.8)	86.2 (85.1–87.3)	78.6 (75.8–81.1)	71.0 (65.1–76.3)	73.6 (66.4–79.8)
Looking for work	**8.1 (7.8–8.4)**	7.5 (7.3–7.8)	16.2 (15.2–17.2)	13.8 (12.7–14.9)	21.4 (18.9–24.2)	29.0 (23.7–34.9)	26.4 (20.2–33.6)
Not in the labor force¶							
Retired, student, or homemaker	**63.1 (62.2–63.9)**	80.6 (79.9–81.3)	22.2 (21.2–23.3)	35.6 (33.7–37.5)	18.1 (16.2–20.2)	9.5 (7.7–11.7)	7.4 (6.0–9.1)
Not working because of health reasons or disability	**29.6 (28.8–30.4)**	11.0 (10.5–11.6)	72.9 (71.7–74.1)	58.0 (55.8–60.1)	77.9 (75.8–79.8)	87.4 (85.0–89.4)	88.8 (86.9–90.4)
Other	**7.3 (6.9–7.7)**	8.4 (7.9–8.9)	4.8 (4.3–5.4)	6.5 (5.5–7.6)	4.0 (3.2–5.0)	3.1 (2.3–4.1)	3.8 (2.8–5.0)

Abbreviation: CI = confidence interval.
* Six functional disability types are serious difficulty in cognition, hearing, mobility, and vision, and any difficulty in self-care and independent living.
† Unweighted denominator.
§ Estimated only among persons in the labor force.
¶ Estimated only among persons not in the labor force.

Disability is a multidimensional concept involving factors related to both the person, reflected in difficulties with basic actions (i.e., cognition, hearing, mobility, and vision), and the person's interaction with their environment, reflected in complex activity limitations (i.e., independent living and self-care) (*2*). The conceptual relationship between these two domains has been described as one in which complex activities require the execution of basic actions (*2*), and a reported limitation in both domains might indicate an increased severity of disability. Thus, the findings that difficulty in independent living and self-care are infrequent among persons with only one type of disability is expected.

Disability is a complex concept and adults with disabilities are a heterogeneous group; however, many within this group have in common the experience of limitation to full participation in society (*3*). Other research has indicated that having any disability, measured dichotomously, is associated with disparities in such factors as socioeconomic status and health (*2–5*). This report expands on previous work by measuring the number of disability types a person might experience at one time, further demonstrating a pattern of decreasing socioeconomic status as the number of disabilities increases. Programs and policies designed to improve social participation for adults with disabilities might improve socioeconomic status for this population. Federal policies such as the Americans with Disabilities Act[§§] aim to prevent employment discrimination and support full participation in society for persons living with disability. In addition, given the known association between socioeconomic status and health (*6–10*), the national health goals outlined in *Healthy People 2020*[¶¶] include specific objectives intended to encourage increased community participation and employment for persons with disabilities.

The findings in this report are subject to at least five limitations. First, NHIS data are self-reported or reported by a family member or proxy respondent and might be subject to reporting or recall bias. Second, the final response rate for the family component ranged from 73.1%–81.3%; therefore, the findings might reflect some response bias. Third, because NHIS is cross-sectional, causality cannot be determined; it is not known whether low socioeconomic status precedes disability onset, follows it, or both. Fourth, NHIS does not include persons living in institutional settings or group homes, which might systematically exclude persons with disabilities, because persons residing in these settings are more likely to have disabilities. Finally, some persons might not be identified using this disability measure, including those with disabilities other than those measured by these six questions and those with moderate disabilities, because four of the questions ask only whether or not a respondent has "serious" difficulty. Because these last two limitations can result in an underestimation of the disability prevalence among all U.S. adults, the estimates reported here are likely to be conservative.

This report demonstrates that lower socioeconomic status disproportionately affects working-age adults living with disability, although the temporal relationship is unknown. These disparities increase as the number of disability types increases, but are evident even among adults with only one disability type. Understanding the demographic and socioeconomic characteristics of working-age adults with disabilities, including those with multiple disabilities, might help to further the inclusion of persons with disabilities in public health programs and policies, thereby increasing their social participation.

§§ https://www.ada.gov/pubs/adastatute08.htm.
¶¶ https://www.healthypeople.gov/.

Summary

What is already known about the topic?

Approximately 40 million persons in the United States have a disability, as measured by six questions recommended by the U.S. Department of Health and Human Services as the national standard for use in population-based health surveys. These questions have been used previously to assess functional disability overall and individual disability types.

What is added by this report?

This is the first study to investigate the characteristics of U.S. adults by number of functional disability types. Overall, 22.6 million (11.9%) working-age adults have any disability; most (12.8 million) have only one type of disability. A generally consistent pattern was observed of increasing prevalence of indicators of low socioeconomic status (income-to-poverty ratio <1.00, having less than a high school education, and being in the labor force but looking for work) as the number of disability types increased.

What are the implications for public health practice?

Understanding the demographic and socioeconomic characteristics of working-age adults with disabilities, including adults with multiple disabilities, might help to further the inclusion of persons with disabilities in public health programs and policies, thereby increasing their social participation.

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Influenza Vaccination Coverage Among Health Care Personnel — United States, 2015–16 Influenza Season

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The Advisory Committee on Immunization Practices recommends annual influenza vaccination for all health care personnel to reduce influenza-related morbidity and mortality among both health care personnel and their patients (*1–4*). To estimate influenza vaccination coverage among U.S. health care personnel for the 2015–16 influenza season, CDC conducted an opt-in Internet panel survey of 2,258 health care personnel during March 28–April 14, 2016. Overall, 79.0% of survey participants reported receiving an influenza vaccination during the 2015–16 season, similar to the 77.3% coverage reported for the 2014–15 season (*5*). Coverage in long-term care settings increased by 5.3 percentage points compared with the previous season. Vaccination coverage continued to be higher among health care personnel working in hospitals (91.2%) and lower among health care personnel working in ambulatory (79.8%) and long-term care settings (69.2%). Coverage continued to be highest among physicians (95.6%) and lowest among assistants and aides (64.1%), and highest overall among health care personnel who were required by their employer to be vaccinated (96.5%). Among health care personnel working in settings where vaccination was neither required, promoted, nor offered onsite, vaccination coverage continued to be low (44.9%). An increased percentage of health care personnel reporting a vaccination requirement or onsite vaccination availability compared with earlier influenza seasons might have contributed to the overall increase in vaccination coverage during the past 6 influenza seasons.

The Internet panel survey was conducted for CDC by Abt Associates, Inc. (Cambridge, Massachusetts) during March 28–April 14, 2016, to provide estimates of influenza vaccination coverage among health care personnel during the 2015–16 influenza season. Similar surveys have been conducted since the 2010–11 influenza season, and survey methodology has been reported previously (*5*). Health care personnel were recruited from two preexisting national opt-in Internet sources: Medscape, a medical website managed by WebMD Health Professional Network,* and general population Internet panels operated by Survey Sampling International (SSI).† Responses were weighted to the distribution of the U.S. population of health care personnel by occupation, age, sex, race/ethnicity, work setting, and Census region.§ Because the study sample was based on health care personnel from opt-in Internet panels rather than probability samples, no statistical tests were performed (*6*). A change was considered as an increase or decrease when there was at least a 5-percentage point difference between estimates; estimates with smaller differences were considered similar.

Among the 2,396 health care personnel who started the survey from either source (Medscape or SSI) and had eligible responses to the screening questions, 2,316 (96.7%) completed the survey.¶ Fifty-seven respondents with completed surveys who reported working in "other health care settings" were excluded because examination of their other survey responses indicated that they were either unlikely to have contact with patients or that their work setting was not one of the health care settings of interest for this analysis, and one respondent was excluded because vaccination status was unknown, leaving a final analytic sample of 2,258 health care personnel.

Overall, 79.0% of respondents reported having received an influenza vaccination during the 2015–16 season, an increase of 15.5 percentage points compared with the 2010–11 season estimate, but similar to the 77.3% coverage estimate reported in the 2014–15 season (Figure) (Table 1). Coverage continued to be highest among physicians (95.6%) and lowest among assistants and aides (64.1%) (Figure). Among vaccinated health care personnel, 72.7% were vaccinated at their workplace.

* Physicians, nurse practitioners, physician assistants, nurses, dentists, pharmacists, allied health professionals, technicians, and technologists) were recruited from the current membership roster of Medscape. Additional information on Medscape is available at http://www.medscape.com.

† Assistants, aides, and nonclinical personnel (such as administrators, clerical support workers, janitors, food service workers, and housekeepers) were recruited from general population Internet panels operated by Survey Sampling International. Additional information on Survey Sampling International and its incentives for online survey participants is available at https://www.surveysampling.com.

§ Population control totals of U.S. health care personnel by occupation and work setting were obtained from the Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics, May 2014 National Industry-specific Occupational Employment and Wage Estimates (http://www.bls.gov/oes/current/oessrci.htm). Population control totals by other demographic characteristics were obtained from the U.S. Census Bureau, Current Population Survey Monthly Labor Force Data, September 2015 (http://www.census.gov/programs-surveys/cps/data-detail.html).

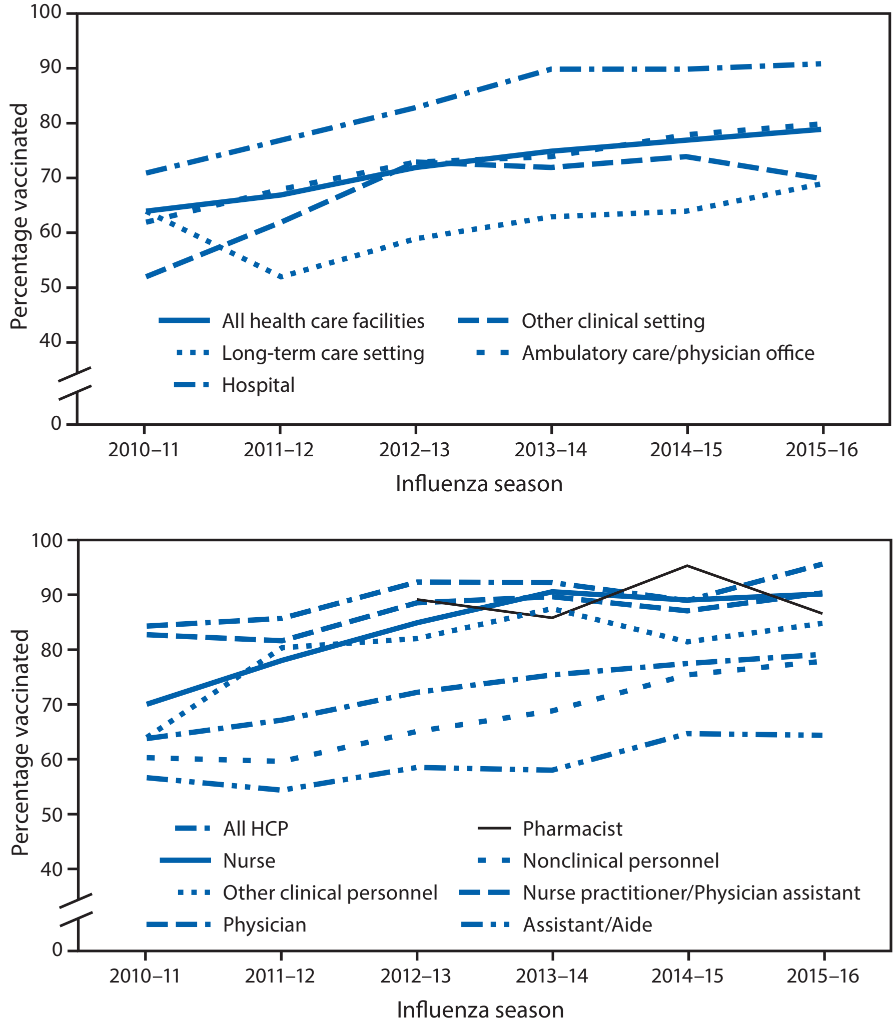
¶ A survey response rate requires specification of the denominator at each stage of sampling. During recruitment of an online opt-in survey sample, such as the Internet panels described in this report, these numbers are not available; therefore, a response rate cannot be calculated. Instead, the survey cooperation rate is provided.

Coverage among health care personnel working in long-term care settings increased from 63.9% in the 2014–15 season to 69.2% in the 2015–16 season; for all other work settings, coverage in the 2015–16 season was similar to coverage in the 2014–15 season (Figure) (Table 1). Although influenza vaccination coverage has increased in all work settings since the 2011–12 season, health care providers in long-term care settings have consistently had lower coverage than health care personnel working in hospital and ambulatory care settings (Figure).

During the 2015–16 influenza season, vaccination coverage was 96.5% among health care personnel working in settings where vaccination was required (Table 2). Overall, 37.8% of surveyed health care personnel were required to be vaccinated against influenza, similar to the percentages in the 2013–14 and 2014–15 seasons. Sixty-one percent of health care personnel working in hospitals had requirements for influenza vaccination, which is at least 27 percentage points more than the proportion in any other work setting. By occupation, physicians (51.0%), nurses (49.8%), and other clinical personnel (47.4%) reported the highest prevalences of influenza vaccination requirements in the 2015–16 season, and assistants and aides reported the lowest requirement prevalence of influenza vaccination requirements (22.5%, data not shown).

Among health care personnel whose employers did not have a requirement for vaccination, coverage was higher among personnel who worked in locations where vaccination was available at the worksite at no cost for >1 day (82.8%) or 1 day (82.1%) than among personnel who worked in locations where their employer did not provide influenza vaccination onsite at no cost but actively promoted vaccination through other mechanisms** (67.8%). Vaccination coverage was lowest (44.9%) among health care personnel working in locations where employers neither required vaccination, provided vaccination onsite at no cost, nor promoted vaccination (Table 2). Health care personnel working in ambulatory, long-term care, and other clinical settings more frequently reported that their employer neither required, provided, nor promoted

FIGURE. Percentage of health care personnel who reported receiving influenza vaccination, by work setting*,†,§ and occupation type,¶,,††,§§ — Internet panel surveys, United States, 2010–11 through 2015–16 influenza seasons**



* Respondents could select more than one work setting.
† Ambulatory care/physician office category includes physician's office, medical clinic, and other ambulatory care setting.
§ Other clinical setting category includes dentist office or dental clinic, pharmacy, laboratory, public health setting, emergency medical services setting, or other setting where clinical care or related services was provided to patients.
¶ In the 2010–11 season, dentists were included in the physician category.
** Before the 2012–13 season, separate data on pharmacists were not collected.
†† Other clinical personnel category includes allied health professionals, technicians, and technologists.
§§ Nonclinical personnel category includes administrative support staff or managers and nonclinical support staff members (e.g., food service workers, laundry workers, janitors, and other members of the housekeeping and maintenance staffs).

** Employer promoted influenza vaccination among employees through public identification of vaccinated persons, financial incentives or rewards to individual persons or groups of employees, competition between units or care areas, free or subsidized cost of vaccination, personal reminders to be vaccinated, publicizing of the number or percentage of employees receiving vaccination, or making vaccination available at special events organized on site.

TABLE 1. Percentage of health care personnel* who reported receiving influenza vaccination, by work setting and occupation type — Internet panel surveys, United States, 2014–15 and 2015–16 influenza seasons

Work setting/Occupation type†	2014–15			2015–16			Percentage point difference from 2014–15 to 2015–16
	No.	Weighted %§	Weighted % vaccinated	No.	Weighted %§	Weighted % vaccinated	
Overall	**1,914**	**100**	**77.3**	**2,258**	**100**	**79.0**	**1.7**
Occupational setting/Occupation							
Hospital	681	40.4	90.4	803	39.7	91.2	0.8
Physician	99	3.6	92.1	127	3.7	99.4	7.3
NP/PA	61	0.9	93.4	50	0.9	90.0	-3.4
Nurse	70	22.1	93.4	95	23.8	94.6	1.2
Pharmacist	65	2.6	96.1	16	0.7	—¶	—¶
Assistant/Aide	51	9.8	85.8	107	8.9	88.2	2.4
Other, clinical**	195	25.3	91.6	236	23.4	94.4	2.8
Nonclinical††	124	35.5	88.1	155	38.2	87.2	-0.9
Ambulatory care/Physician office§§	746	30.2	78.4	648	27.6	79.8	1.4
Physician	223	9.7	88.2	216	10.4	95.2	7.0
NP/PA	114	2.3	85.1	92	2.4	89.1	4.0
Nurse	69	23.4	90.8	45	20.6	88.6	-2.2
Pharmacist	6	0.3	—¶	6	0.4	—¶	—¶
Assistant/Aide	27	5.8	—¶	57	9.2	62.0	—¶
Other, clinical**	151	22.0	73.6	135	22.0	81.7	8.1
Nonclinical††	142	36.2	70.4	91	34.8	72.9	2.5
Long-term care setting	406	30.6	63.9	659	29.6	69.2	5.3
Physician	26	1.3	—¶	17	0.8	—¶	—¶
NP/PA	12	0.2	—¶	7	0.2	—¶	—¶
Nurse	22	8.0	—¶	23	9.6	—¶	—¶
Pharmacist	4	0.3	—¶	1	0	—¶	—¶
Assistant/Aide	246	57.5	59.8	501	58.4	61.9	2.1
Other, clinical**	45	6.6	78.4	54	7.6	85.9	7.5
Nonclinical††	50	26.0	67.3	54	23.3	70.9	3.6
Other clinical setting¶¶	389	11.2	74.0	409	11.6	69.8	-4.2
Physician	6	0.7	—¶	4	0.6	—¶	—¶
NP/PA	5	0.3	—¶	5	0.3	—¶	—¶
Nurse	19	20.8	—¶	15	15.2	—¶	—¶
Pharmacist	47	7.0	97.6	51	9.5	85.5	-12.1
Assistant/Aide	22	10.0	—¶	42	15.4	51.2	—¶
Other, clinical**	249	31.3	73.5	257	32.9	72.5	-1.0
Nonclinical††	35	29.7	66.6	22	25.3	—¶	—¶
Overall occupation							
Physician	268	3.6	88.9	284	3.6	95.6	6.7
NP/PA	162	1.0	87.0	134	1.0	90.3	3.3
Nurse	161	18.3	89.0	168	18.5	90.1	1.1
Pharmacist	79	1.3	95.3	63	1.3	86.5	-8.8
Assistant/Aide	332	23.3	64.4	673	23.8	64.1	-0.3
Other, clinical**	565	19.5	81.3	599	18.8	84.7	3.4
Nonclinical††	322	32.8	75.2	307	32.9	77.7	2.5

Abbreviation: NP/PA = nurse practitioner/physician assistant.

* Persons who worked in a place where clinical care or related services were provided to patients, or whose work involved face-to-face contact with patients or who were ever in the same room as patients.

† Respondents could specify working in more than one setting.

§ Weights were calculated by occupation, age, sex, race/ethnicity, work setting, and Census region to represent the U.S. population of health care personnel. Work setting and overall occupation are presented as weighted estimates of the total sample. Where the groups are stratified by work setting, the estimates are presented as weighted estimates of the occupation group subsample of each work setting subgroup.

¶ Vaccination coverage estimate not reliable because the sample size was <30.

** Allied health professional, technician, or technologist.

†† Administrative support staff or managers and nonclinical support staff members (including food service workers, laundry workers, janitors, and other members of the housekeeping and maintenance staffs).

§§ Ambulatory care (physician's office, medical clinic, and other ambulatory care setting).

¶¶ Dentist office or dental clinic, pharmacy, laboratory, public health setting, emergency medical services setting, or other setting where clinical care or related services was provided to patients.

TABLE 2. Percentage of health care personnel* who received influenza vaccination, by employer vaccination policy and work setting — Internet panel surveys, United States, 2012–13 through 2015–16 influenza seasons

Employer vaccination policy/Work setting	2012–13 No.	2012–13 Weighted %†	2012–13 Weighted % vaccinated	2013–14 No.	2013–14 Weighted %†	2013–14 Weighted % vaccinated	2014–15 No.	2014–15 Weighted %†	2014–15 Weighted % vaccinated	2015–16 No.	2015–16 Weighted %†	2015–16 Weighted % vaccinated
Vaccination requirement§	549	22.4	96.5	738	35.5	97.8	725	40.1	96.0	841	37.8	96.5
Hospital	388	37.1	95.1	520	58.2	97.7	440	64.8	97.2	510	61.0	96.5
Ambulatory care/Physician office¶	191	20.9	99.8	252	33.6	96.4	277	34.7	96.1	258	33.9	98.7
Long-term care	61	12.8	95.8	88	20.1	98.4	104	26.0	97.3	143	23.4	93.8
Other clinical setting**	38	10.7	100	88	29.3	99.5	109	35.9	85.7	101	24.9	98.5
No vaccination requirement												
Offered onsite vaccination >1 day††	658	28.5	80.5	542	25.1	80.4	407	19.1	83.9	460	19.8	82.8
Hospital	382	37.3	81.9	261	31.4	82.0	151	21.0	86.9	173	23.8	81.8
Ambulatory care/Physician office¶	189	27.8	82.3	183	28.6	80.7	165	23.1	87.8	152	20.8	85.1
Long-term care	115	17.3	74.8	63	11.7	71.6	57	12.4	67.3	96	16.1	80.4
Other clinical setting**	85	28.6	84.3	107	22.0	85.0	97	15.6	81.9	87	12.3	84.1
Offered onsite vaccination 1 day§§	227	9.8	67.6	169	7.6	61.6	230	9.8	73.6	254	10.9	82.1
Hospital	89	9.9	66.3	43	4.2	55.6	51	7.3	72.1	70	8.3	81.1
Ambulatory care/Physician office¶	88	9.3	80.1	76	11.3	69.3	104	10.9	80.6	76	12.8	82.9
Long-term care	58	11.3	49.7	43	10.0	54.1	45	10.0	67.1	77	11.5	83.0
Other clinical setting**	25	7.3	—¶¶	31	6.5	72.9	50	10.8	80.4	54	14.2	85.2
Other vaccination promotion* **	250	17.4	69.2	226	15.5	61.9	216	12.4	59.5	293	13.0	67.8
Hospital	77	13.4	73.4	46	5.1	80.7	24	4.4	—¶¶	39	4.6	91.0
Ambulatory care/Physician office¶	65	13.1	76.8	66	12.2	53.5	67	10.3	60.5	62	11.9	74.0
Long-term care	83	23.6	63.2	90	29.8	62.2	83	21.6	58.5	139	21.4	63.4
Other clinical setting**	55	28.8	71.0	50	16.9	57.5	54	14.6	64.5	67	16.4	54.0
No onsite vaccination or promotion	260	21.9	40.4	207	16.3	36.8	336	18.7	44.0	409	18.4	44.9
Hospital	25	2.3	—¶¶	10	1.2	—¶¶	15	2.6	—¶¶	11	2.3	—¶¶
Ambulatory care/Physician office¶	103	28.9	40.2	72	14.3	26.8	133	21.0	46.6	100	20.6	45.0
Long-term care	110	35.0	37.5	80	28.5	38.6	117	30.0	36.4	204	27.7	40.6
Other clinical setting**	34	24.6	48.7	51	25.3	36.9	79	23.2	53.4	100	32.1	43.4

* Persons who worked in a place where clinical care or related services were provided to patients, or whose work involved face-to-face contact with patients or who were ever in the same room as patients.
† Weights were calculated based on occupation, age, sex, race/ethnicity, work setting, and Census region to represent the U.S. population of health care personnel. Work setting and overall occupation are presented as weighted estimates of the total sample. Where the groups are stratified by work setting, the estimates are presented as weighted estimates of the occupation group subsample of each work setting subgroup.
§ Includes all respondents who indicated that their employer required them to be vaccinated for influenza.
¶ Ambulatory care (physician's office, medical clinic, and other ambulatory care setting).
** Dentist office or dental clinic, pharmacy, laboratory, public health setting, health care education setting, emergency medical services setting, or other setting where clinical care or related services was provided to patients.
†† Employer made influenza vaccination available onsite for >1 day during the influenza season at no cost to employees. Restricted to respondents without an employer requirement for vaccination.
§§ Employer made influenza vaccination available onsite for 1 day during the influenza season at no cost to employees. Restricted to respondents without an employer requirement for vaccination.
¶¶ Vaccination coverage estimate not reliable because sample size was <30.
*** Influenza vaccination was promoted among employees through public identification of vaccinated persons, financial incentives or rewards to individuals or groups of employees, competition between units or care areas, free or subsidized cost of vaccination, personal reminders to be vaccinated, publicizing the number or percentage of employees receiving vaccination, or making vaccination available at special events organized on site. Restricted to respondents without an employer requirement for vaccination or on-site vaccination.

vaccination (20.6%, 27.7%, and 32.1%, respectively), than did personnel working in hospital settings, where only 2.3% reported that their employer neither required, provided, nor promoted vaccination (Table 2).

Discussion

The overall estimate of influenza vaccination coverage among health care personnel during the 2015–16 season was 79.0%, similar to the previous two influenza seasons. The percentage of employers with a vaccination requirement has not changed

Summary

What is already known about this topic?

The Advisory Committee on Immunization Practices recommends annual influenza vaccination for all health care personnel to reduce influenza-related morbidity and mortality in health care settings. For the 2014–15 influenza season, the estimated overall influenza vaccination coverage among health care personnel was 77.3%.

What is added by this report?

Influenza vaccination coverage among health care personnel during the 2015–16 influenza season, assessed using an opt-in Internet panel survey, was 79.0%, similar to coverage during the 2014–15 season. Coverage was highest among physicians, nurse practitioners/physician assistants, nurses, pharmacists, and health care personnel working in hospital settings. Coverage was lowest among assistants and aides and personnel working in long-term care settings. Employer vaccination requirements and offering vaccination at the workplace at no cost were associated with higher vaccination coverage.

What are the implications for public health practice?

Employer vaccination requirements, offering influenza vaccination onsite at no cost, or both can achieve high health care personnel vaccination coverage. Implementing comprehensive evidence-based worksite intervention strategies will be important to ensure health care personnel and patients are protected against influenza.

substantially since the 2013–14 season. As in previous influenza seasons, higher influenza vaccination coverage among health care personnel was associated with employer vaccination requirements and with access to vaccination at the workplace at no cost (*5*), highlighting the value of vaccination requirements and access to influenza vaccination at the worksite as effective tools for increasing overall coverage.

Coverage among health care personnel working in long-term care settings increased compared with the 2014–15 season, and has increased by approximately 17 percentage points since the 2011–12 influenza season. Although low, this is the only setting with an appreciable increase in coverage compared with last season. Influenza vaccination among health care personnel in long-term care settings is especially important because influenza vaccine effectiveness is generally lowest in the elderly (*3*). In addition, multiple studies have demonstrated that vaccination of health care personnel in long-term care settings confers a health benefit to patients, including reduced risk for mortality (*2*–*4*). Health care personnel working in long-term care settings consistently are the least likely to report that their employer either required or promoted vaccination, or made vaccination available onsite at no cost.

Implementing strategies shown to improve vaccination coverage among health care personnel in a workplace, including vaccination requirements or offering onsite vaccinations at no cost over multiple days, can help protect long-term care patients from influenza (*7*). Employers can use the long-term care web-based toolkit[††] developed by CDC and the National Vaccine Program Office to access resources, strategies, and educational materials for increasing influenza vaccination among health care personnel in long-term care settings.

The findings in this report are subject to at least three limitations. First, the study used a nonprobability sample of volunteer health care personnel members of Medscape and SSI Internet panels. Second, vaccination status was self-reported and might be subject to recall bias. Finally, coverage findings from Internet survey panels have differed from population-based estimates from the National Health Interview Survey in past influenza seasons (*8*,*9*). These limitations might affect the representativeness of these findings to the U.S. population of health care personnel (*10*).

The highest influenza vaccination coverage among health care personnel continues to be reported in worksites with employer requirements for vaccination. Health care personnel working in long-term care settings had the largest increase in vaccination coverage; despite these increases, this group continues to have the lowest levels of coverage. Employer vaccination requirements likely contributed to the observed gradual increase in vaccination among health care personnel working in settings with the lowest coverage. In the absence of vaccination requirements, expanding the number of health care locations offering vaccination onsite, over multiple days, and at no cost might help sustain and improve influenza vaccination coverage among health care personnel, including in long-term care settings. Employers and health care administrators can make use of the *Guide to Community Preventive Services*, which presents evidence to support onsite vaccination at no or low cost to health care personnel to increase influenza vaccination coverage among health care personnel (*7*).

[††] http://www.cdc.gov/flu/toolkit/long-term-care/index.htm.

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Local Mosquito-Borne Transmission of Zika Virus — Miami-Dade and Broward Counties, Florida, June–August 2016

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During the first 6 months of 2016, large outbreaks of Zika virus disease caused by local mosquito-borne transmission occurred in Puerto Rico and other U.S. territories, but local mosquito-borne transmission was not identified in the continental United States (*1*,*2*). As of July 22, 2016, the Florida Department of Health had identified 321 Zika virus disease cases among Florida residents and visitors, all occurring in either travelers from other countries or territories with ongoing Zika virus transmission or sexual contacts of recent travelers.* During standard case investigation of persons with compatible illness and laboratory evidence of recent Zika virus infection (i.e., a specimen positive by real-time reverse transcription–polymerase chain reaction [rRT-PCR], or positive Zika immunoglobulin M [IgM] with supporting dengue serology [negative for dengue IgM antibodies and positive for dengue IgG antibodies], or confirmation of Zika virus neutralizing antibodies by plaque reduction neutralization testing [PRNT]) (*3*), four persons were identified in Broward and Miami-Dade counties whose infections were attributed to likely local mosquito-borne transmission. Two of these persons worked within 120 meters (131 yards) of each other but had no other epidemiologic connections, suggesting the possibility of a local community-based outbreak. Further epidemiologic and laboratory investigations of the worksites and surrounding neighborhood identified a total of 29 persons with laboratory evidence of recent Zika virus infection and likely exposure during late June to early August, most within an approximate 6-block area. In response to limited impact on the population of *Aedes aegypti* mosquito vectors from initial ground-based mosquito control efforts, aerial ultralow volume spraying with the organophosphate insecticide naled was applied over a 10 square-mile area beginning in early August and alternated with aerial larviciding with *Bacillus thuringiensis* subspecies *israelensis* (Bti), a group biologic control agent, in a central 2 square-mile area. No additional cases were identified after implementation of this mosquito control strategy. No increases in emergency department (ED) patient visits associated with aerial spraying were reported, including visits for asthma, reactive airway disease, wheezing, shortness of breath, nausea, vomiting, or diarrhea. Local and state health departments serving communities where *Ae. aegypti*, the primary vector of Zika virus, is found should continue to actively monitor for local transmission of the virus.†

Investigations of Two Cases of Isolated Local Transmission of Zika Virus

As of July 22, 2016, among the 321 cases of Zika virus infection in Florida residents or visitors, Miami-Dade County and neighboring Broward County reported the highest and second highest numbers of cases in Florida (93 and 51, respectively), accounting for 30.4% and 16.7% of travel-associated cases in nonpregnant women, respectively.

In early July 2016, an adult female resident of Miami-Dade County (patient A) sought treatment at a local hospital with fever, rash, and arthralgia. Serum and urine specimens, which were collected 3 days after symptom onset, were positive for Zika virus by rRT-PCR. Less than 1 week later, an adult male resident of Broward County (patient B) sought treatment for fever, rash, and arthralgia. Zika virus infection was confirmed by rRT-PCR on a urine specimen and serum IgM by enzyme-linked immunosorbent assay (ELISA) (to minimize the potential for false positives, the Florida Department of Health protocol requires two positive results for index case identification). Investigation of both cases indicated no recent travel to or sexual contact with a recent traveler to an area with active Zika virus transmission, no association with household contacts who recently traveled, and no close personal contact with a patient with confirmed Zika virus infection. There were no epidemiologic links between the two patients, and their residences were separated by >10 miles. BG-Sentinel (Biogents AG, Regensburg, Germany) mosquito traps, designed for researchers, collected a limited number of *Ae. aegypti* and *Ae. albopictus* specimens around the patients' residences, and PCR testing of pooled mosquitoes for Zika virus was negative (Sharon Isern, Department of Biological Sciences, Florida Gulf Coast University, personal communication, 2016).

* https://wwwn.cdc.gov/nndss/conditions/zika-virus-disease-and-zika-virus-congenital-infection/case-definition/2016/.

† http://www.cdc.gov/zika/index.html; http://www.floridahealth.gov/diseases-and-conditions/zika-virus/index.html?utm_source=flhealthIndex.

To identify additional evidence of local transmission, household contacts of patients A and B were interviewed regarding recent illness and travel, and specimens were requested for Zika virus testing. Among seven household contacts of the two patients, none reported symptomatic illness and only one had laboratory evidence of recent flavivirus virus infection (Zika virus IgM results and neutralizing antibodies for both Zika virus and dengue, indicating probable Zika virus infection). This person had moved from Haiti to Florida 1 month before onset of symptoms in patient A and was classified as having a travel-associated case of Zika virus disease.

To identify recent infections in the surrounding neighborhoods of patients A and B, systematic surveys were conducted of all households located within 150–300 meters (164–328 yards) of each patient's residence. In addition, an outdoor worksite near patient B's residence also was sampled; these areas were selected based on the typical flight range of *Ae. aegypti* (*4*). Surveys were conducted at the end of July and consisted of urine specimen collection and a standardized questionnaire regarding general risk factors. Three visit attempts were made for each occupied residence. Children aged <5 years and persons with recent travel to an area with ongoing Zika virus transmission were excluded. Among 116 urine specimens collected from persons from 54 households and one worksite, all were negative for Zika virus by rRT-PCR. In addition, enhanced passive surveillance through syndromic surveillance, review of public health and commercial laboratory results, and notification by local health care providers did not identify any additional cases related to patients A and B.

Investigations of an Outbreak of Local Transmission of Zika Virus

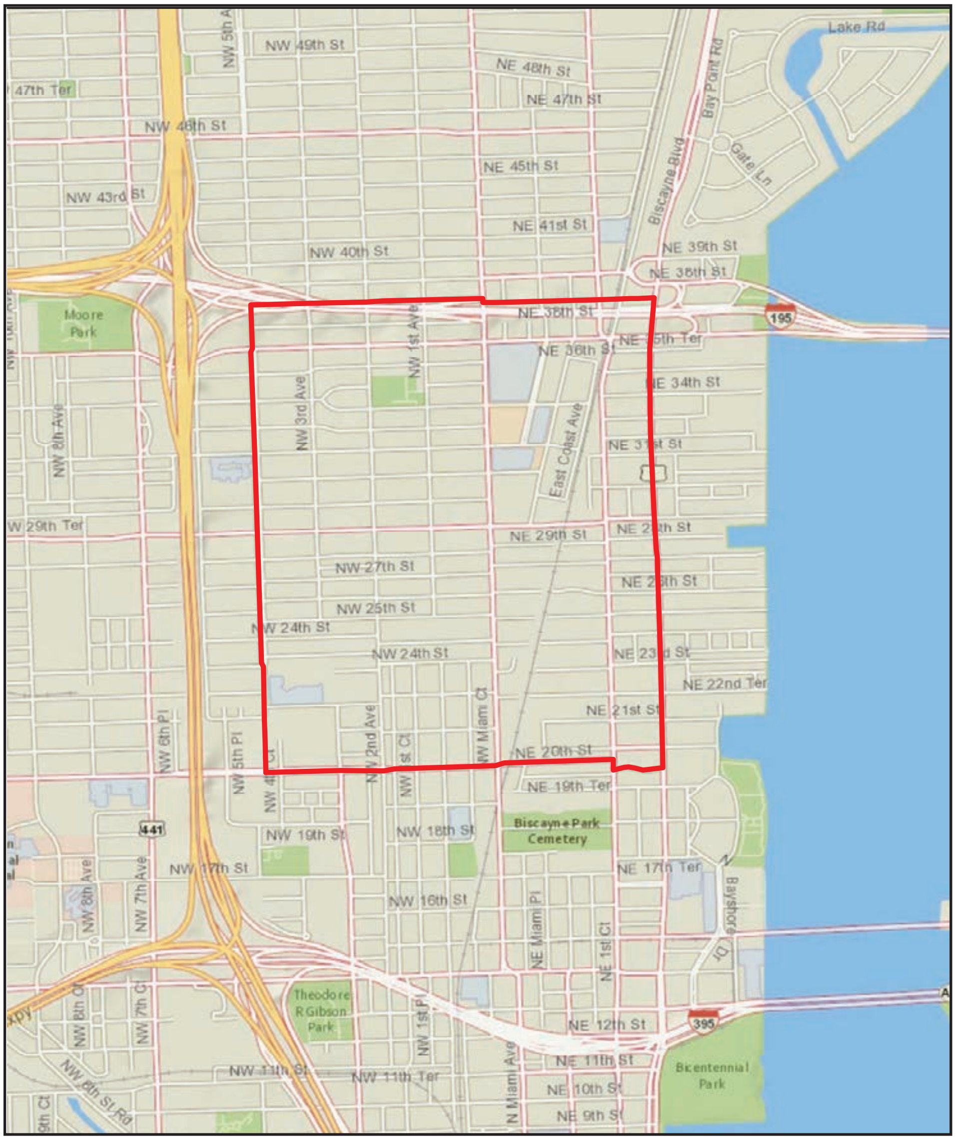
On July 9 and July 10, a resident of Miami-Dade County (patient C) and a resident of Broward County (patient D) had onset of fever, rash, and arthralgia; rRT-PCR confirmation of Zika virus infection was obtained approximately 2 weeks after symptom onset. No epidemiologic links between these patients and patients A and B were identified. Although the residences of patients C and D were >20 miles apart, their workplaces were located within 120 meters of each other in Miami-Dade County, in a mixed-use neighborhood with residences, businesses, and restaurants. Workplace A (the workplace of patient C) was entirely enclosed with air conditioning, but sites for mosquitoes to lay eggs (mosquito larval development sites) were observed in close proximity to the workplace, including an outdoor break area. Investigation of workplace A identified no other symptomatic employees, and no other employees were tested. However, patient C reported having a symptomatic customer. The customer had a positive Zika IgM test, indicative of presumptive recent Zika virus infection; PRNT results are pending. Workplace B (the workplace of patient D) was primarily open air with only a small, enclosed area with air conditioning. Standing water was abundant and multiple mosquito larval development sites were identified on the property. Initial questioning of workplace B employees identified 17 employees with illness compatible with Zika virus infection, 15 of whom provided serum and urine specimens; three employees had rRT-PCR or serologic confirmation of Zika virus infection. In addition, 14 asymptomatic employees consented to provide either urine or serum specimens; two were serologically confirmed to be infected with Zika virus.

To determine whether an outbreak was occurring in the wider community, a survey was conducted among 96 households within a 150-meter radius (approximately 6 blocks) of the two workplaces during July 28–30. Three visit attempts were made for each occupied residence in the area. Children aged <5 years and persons with recent travel to a Zika-affected area were excluded. Of the 96 approached households, 52 urine specimens were collected from 28 households; six persons tested positive for Zika virus by rRT-PCR, all of whom were asymptomatic. Based on these results, on August 1, CDC issued a health advisory notice, recommending that pregnant women avoid nonessential travel to a 1 square-mile area that included the 6-block area of concern plus a wide buffer zone (*5*) (Figure 1).

To investigate whether active transmission was occurring beyond the 6-block area, three additional surveys were conducted at locations bordering the edges of the 1 square-mile area. In the northwest corner survey, 247 households were approached, and 142 urine specimens were collected from 73 households, one of which was rRT-PCR–positive. Local transmission was ruled out in this case, because the specimen was collected from a person who recently returned from a Zika-affected country. In the second border survey, 127 households were approached, and 102 urine specimens were collected from 50 households. The third border survey approached 68 households, and 45 urine specimens were collected from 27 households. None of the specimens collected from the second or third surveys tested positive by rRT-PCR.

In early August, the health department partnered with a federally qualified health center in the 1 square-mile area to establish a Zika clinic to identify additional infections. The clinic offered testing to persons who lived or worked in the affected area. Three of the 77 urine specimens collected from patients at this local clinic were positive by rRT-PCR. The three patients with infection were all symptomatic and had possible exposure within or adjacent to the initial 6-block area: one patient worked in the area, another was a contact of a workplace B employee who also frequented the area, and the third

FIGURE 1. One square-mile area encompassing the 6-block area of the Zika virus transmission outbreak, plus a buffer zone — Miami-Dade County, Florida, July–August 2016



was a customer of another business in the area (workplace C), which was located within 150 meters of workplaces A and B.

At the request of the employer at workplace C, testing was offered to workplace C employees. Workplace C was an entirely open air workplace, with multiple mosquito larval development sites in close proximity to the workplace. Among 90 employees, serum and urine specimens were collected from five who had a history of Zika-compatible symptoms; an additional three symptomatic employees and 55 asymptomatic employees provided urine specimens only. Three of the 63 employees tested were rRT-PCR–positive, and two additional employees had serologic evidence of infection. All five reported symptoms.

As of September 1, an additional seven symptomatic persons with laboratory evidence of recent Zika virus infection had been reported from the 1 square–mile area: a second customer of workplace C, three residents of the area, and three persons who work in the area. Onset of illness for all 23 symptomatic persons ranged from June 30 to August 5 (Figure 2). Overall, epidemiologic and laboratory investigations of the workplaces and surrounding neighborhood[§] identified 29 persons with laboratory evidence of recent Zika virus infection and likely exposure within an approximate 6-block area.

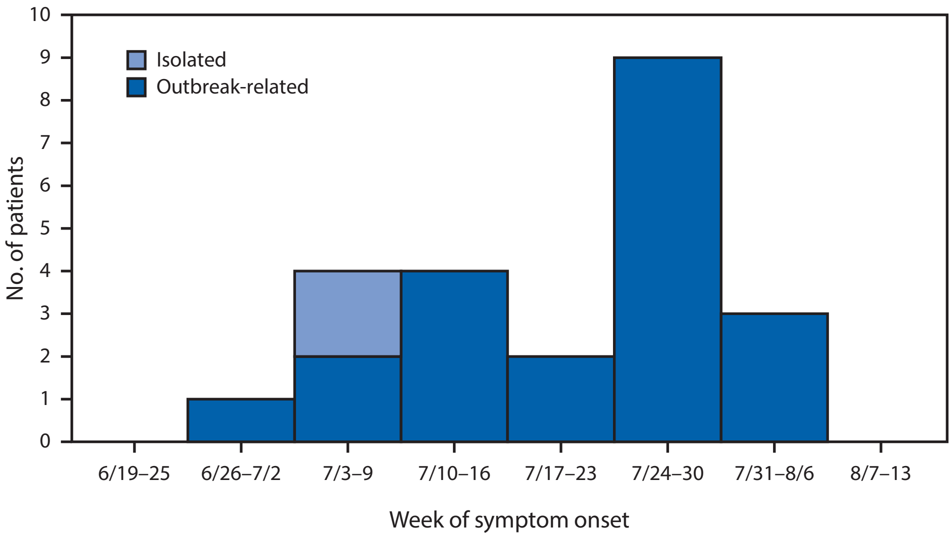
Investigations Related to Mosquito Control Strategies and Implementation

Mosquito trapping in the area with ongoing local transmission identified large numbers of *Ae. aegypti* females as well as a large number of mosquito larval development sites. Initial control efforts, including eliminating standing water, larviciding, and applying insecticides by backpack and truck-mounted spraying to control adult mosquitoes, were later augmented by aerial spraying. On July 23, the day after the workplace exposure link was established, door-to-door inspections and backpack spraying commenced with the pyrethroid insecticides sumithrin/prallethrin in the 6-block core area. The following day, these activities were augmented by truck-mounted spraying with the pyrethroid insecticides sumithrin/prallethrin, permethrin, and deltamethrin over the larger 1-square–mile area. Mosquito trapping produced an average of 24, 27, and 23 female *Ae. aegypti* per trap per day on 3 successive days within 5–7 days of initiating control efforts (Figure 3). None of the mosquito pools tested for Zika virus were positive (Sharon Isern, Department of Biological Sciences, Florida Gulf Coast University, personal communication, 2016).

Because of persistently high numbers of trapped *Ae. aegypti* females, aerial ultralow volume spraying with naled, an organophosphate insecticide used to kill adult mosquitoes, was applied over a 10-square–mile area beginning August 4, and alternated with aerial larviciding with Bti in a central 2-square–mile area

[§] http://www.cdc.gov/zika/pdfs/zika-draft-interim-conus-plan.pdf.

FIGURE 2. Number of patients (n = 23) with symptomatic cases of locally transmitted Zika virus infection, by week of symptom onset and outbreak status — Miami-Dade and Broward counties, Florida, June–August 2016



around the area with ongoing local transmission. To minimize potential human effects, spraying occurred during the early morning hours when fewer persons were outside, and this also limited effects on non-target organisms such as bees. Female *Ae. aegypti* counts decreased to one per trap per day after the second aerial spraying with naled; counts then gradually returned to high levels (>20 per trap per day) in the adulticide-only spray area, but were maintained at about 5–10 per trap per day for at least 1 month in the area treated with both adulticide and larvicide (Figure 3).

In addition, to reduce the number of larval development sites, the Florida Department of Health in Miami-Dade County re-emphasized its ongoing Drain and Cover campaign,¶ encouraging residents to remove or cover standing water around their homes and businesses.

To address public health and community concerns about the use of naled aerial adulticiding, calls to poison information centers and ED visits were monitored in the days following treatments. Seven exposure calls were reported to the Florida Poison Information Center, four of which reported symptoms (vomiting, eye irritation, dizziness, vertigo, and edema). Data captured by the Electronic Surveillance System for the Early Notification of Community-based Epidemics-FL indicated that total ED patient visits by persons residing in the four zip-code areas with spraying were unchanged from the number of visits before spraying. In addition, patient visits for asthma, reactive airway disease, wheezing, or shortness of breath remained the same, and the percentage of ED visits for these four syndromes, when compared week by week, was similar to the same period during the 2 previous years. ED patient visits for nausea, vomiting, or diarrhea also did not increase. Review of historical insecticide-related illness and injury cases from state surveillance data for January 1, 2001, through August 17, 2016, identified one probable and 45 suspected cases** related to naled exposure in Florida; the last case was reported in July 2013.

Discussion

The first identified occurrence of isolated local mosquito-borne transmission and the first identified outbreak of mosquito-borne Zika virus infection in the continental United States occurred in Florida in Miami-Dade and Broward counties during June–August, 2016. After identification of two cases linked geographically by places of employment, enhanced passive and active case finding identified a cluster of 29 infections with illness onset during June 30–August 5. Multiple cases were identified in residents of the affected area; however, the investigation highlighted the potential risk for workplace mosquito exposure. Workplaces A, B, and C all had significant open-air areas where employees worked or took breaks and which were in close proximity to identified larval development sites. Health departments should collect information on occupation, industry, and workplace as part of ongoing Zika case investigations. Including the systematic collection of this information as part of surveillance might facilitate identifying future workplace-associated outbreaks.

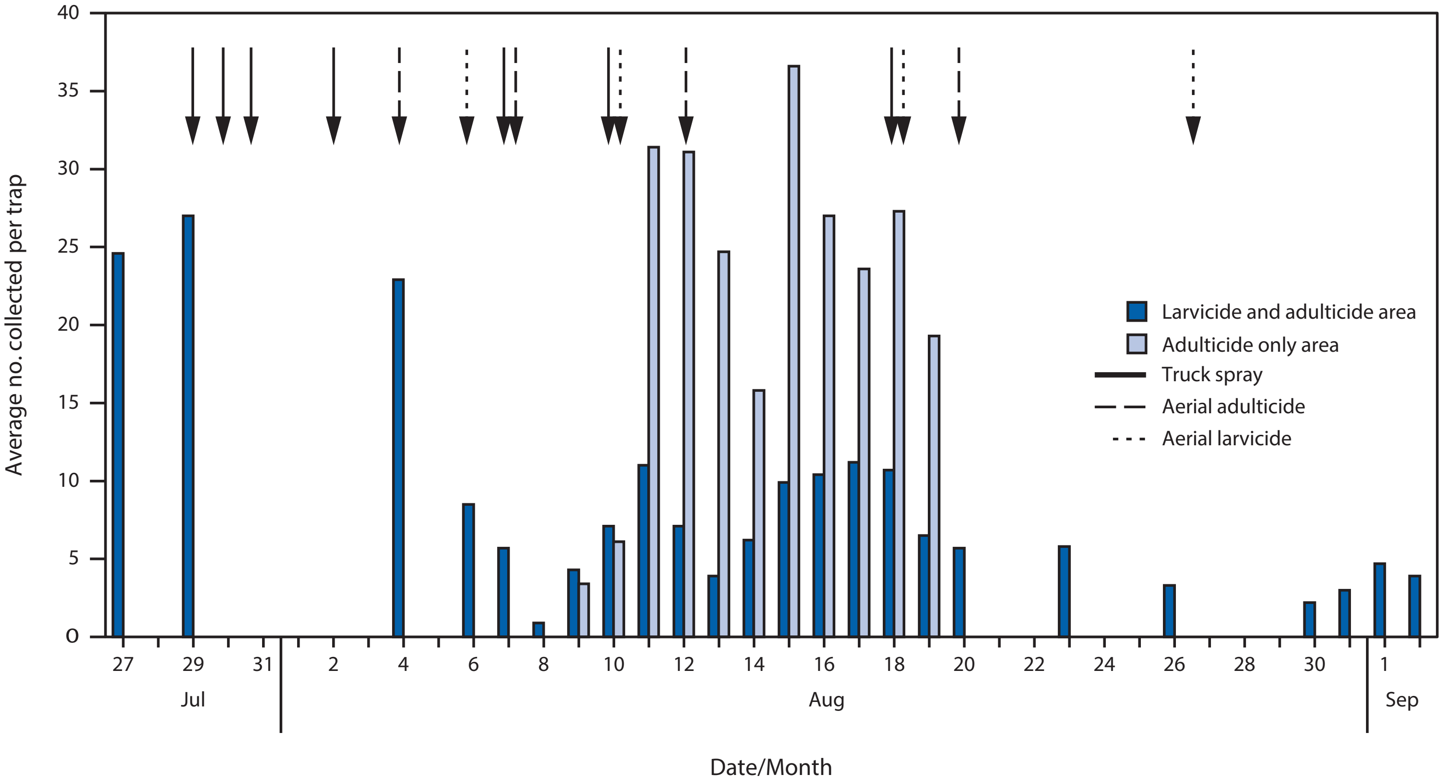
Aggressive mosquito control efforts, including aerial adulticiding and larviciding, most likely contributed to a decrease in Zika virus transmission; no new cases in this area were identified with symptom onset more than 2 weeks after the first aerial adulticide and larvicide applications. The affected community also played a role in preventing new infections when residents and businesses began observing Drain and Cover prevention measures. Although the outbreak continued for more than 1 month, it remained limited to a small geographic area, as has been the case in previous arbovirus outbreaks in Florida (*6*).

Despite intensive investigation, no evidence of further spread was identified within the households or neighborhoods of two unrelated locally transmitted cases. Epidemiologic

¶ http://www.floridahealth.gov/diseases-and-conditions/mosquito-borne-diseases/prevention.html.

** http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef.pdf.

FIGURE 3. Average number of adult female *Aedes aegypti* mosquitoes collected per trap, by date — Miami-Dade County, Florida, July–August 2016



investigations of outbreaks of dengue, a related flavivirus spread by the same vectors, suggest that the wide use of air conditioning and low population densities limit spread of viruses transmitted by *Ae. aegypti*, a mosquito that bites indoors and outdoors and has a limited flight range (*7*); however, other factors might play a role in limited spread. Open doors and windows were observed at the homes of both Patients A and B, but air conditioning appeared functional in neighboring houses, and population density thresholds for flavivirus transmission have not been determined.

Currently, the Food and Drug Administration's Emergency Use Authorization recommends rRT-PCR testing of urine and serum.[††] However, many assessments of ongoing community transmission in these investigations included collection of urine specimens only for rRT-PCR testing. This approach had several advantages. For example, a positive PCR test provides a definitive diagnosis of Zika virus infection, no phlebotomist and fewer laboratory supplies are required (reducing costs and required skills for investigations), and willingness of survey respondents to provide a single, noninvasive specimen might have enhanced participation. In addition, detection of Zika virus RNA has been documented with a higher frequency and for a longer duration in urine than in serum (*8*). However, a disadvantage of only collecting urine is that persons with earlier exposures might no longer have viral RNA present in their urine, and without serologic confirmation, a diagnosis of Zika virus infection could be missed.

Control of *Ae. aegypti* during outbreaks is hampered by factors including a large number of cryptic larval development sites in urban environments, the possibility that truck-based spraying might not reach backyards or areas distant from roads, and the presence of adult mosquitoes indoors. In this affected area, high numbers of *Ae. aegypti* adults persisted despite aggressive efforts at eliminating larval development sites and truck-based and backpack spraying with adulticides. In contrast, mosquito counts decreased >10 fold following two aerial applications of naled at 3-day intervals; however, a sustained reduction was maintained only in the area sprayed aerially with both naled and Bti. Substantial reductions in mosquito counts coincided with apparent cessation of the outbreak.

Aerial insecticide applications have the potential to treat large areas rapidly and more uniformly; however, data on the efficacy of controlling *Ae. aegypti* populations by aerial spraying with modern ultralow volume spray technologies that can precisely control droplet size are limited. Less than one ounce of naled per acre is used for aerial spraying, which might explain the absence of observed negative health effects during and after aerial spraying. This finding is consistent with previous reports

[††] http://www.cdc.gov/zika/laboratories/types-of-tests.html.

Summary

What is already known about this topic?

During the first half of 2016, large outbreaks of Zika virus infection caused by local mosquito-borne transmission of Zika virus occurred in many countries in Latin America and the Caribbean in Puerto Rico and other U.S. territories, but local mosquito-borne transmission was not identified in the continental United States.

What is added by this report?

During June 30–August 5, 2016, the first recognized outbreak of mosquito-borne transmission of Zika virus in the continental United States occurred in a neighborhood in Miami-Dade County, Florida. Twenty-nine persons with Zika virus infection had likely exposure within an approximate 6-block area. The outbreak ended after aerial spraying to control mosquitoes. No increases in short-term health effects were associated with spraying.

What are the implications for public health practice?

To reduce the risk for local Zika virus transmission within the continental United States, persons returning to the continental United States from areas with ongoing Zika virus transmission should use daily mosquito repellent for 3 weeks and follow CDC published guidance to prevent sexual transmission of Zika virus. Investigation of reported cases by local and state health departments provides opportunities to control Zika virus outbreaks within the continental United States. Jurisdictions with *Aedes aegypti* present should ensure ongoing capacity for comprehensive mosquito control.

showing no difference in naled metabolites in urine before and after spraying, suggesting that residents in spray zones have negligible insecticide exposure (*9*,*10*).

The findings in this report are subject to at least four limitations. First, the number of persons infected with Zika virus likely was higher than reported. Most persons identified with Zika virus infection did not seek medical care; several were asymptomatic and were only identified by investigations of workplaces and neighborhood surveys. Second, the neighborhood surveys in the outbreak area were a convenience sample selected to detect ongoing transmission, and thus, the proportions of persons identified with recent infection could not be extrapolated to produce communitywide estimates of infection incidence. No other similar investigations exist for comparison of findings. Third, some persons infected earlier in the course of the outbreak might not have had Zika virus RNA still present in urine, resulting in an underestimation of the number of infected persons among those surveyed. Finally, the threshold reduction of *Ae. aegypti* populations needed to interrupt Zika virus transmission in South Florida is unknown and likely would vary by location and environment. Thus, although the combination of aerially applied naled and Bti along with source reduction and ground-based applications of larvicide and adulticides reduced *Ae. aegypti* populations to low levels, it cannot be concluded definitively that these reductions were responsible for ending the outbreak.

Local and state health departments serving communities with a competent Zika virus vector should continue active monitoring for local virus transmission. To reduce risk for local transmission within the continental United States, persons returning from areas with ongoing Zika virus transmission should use insect repellent routinely for 3 weeks after return to prevent human-to-mosquito-to-human transmission and should use condoms to prevent sexual transmission.[§§] All residents, regardless of travel history, and all business establishments should empty or drain standing water around their homes and businesses. Clinicians who suspect Zika virus disease in patients who reside in or have recently returned from areas with ongoing Zika virus transmission should consider testing for Zika virus and promptly report cases to public health officials. Clinicians in areas where the vector is found might consider testing persons with compatible illness even in the absence of travel.

[§§] http://www.cdc.gov/zika/prevention/protect-yourself-during-sex.html.

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Notes from the Field

Measles Outbreak of Unknown Source — Shelby County, Tennessee, April–May 2016

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On April 15, 2016, local public health officials in Shelby County, Tennessee, were notified of a positive measles immunoglobulin M (IgM) test for a male aged 18 months (patient A). On April 18, 2016, a second positive measles IgM test was reported for a man aged 50 years (patient B). Both patients had rash onset on April 9, 2016. The Shelby County Health Department initiated an investigation, and confirmatory testing for measles virus on oropharyngeal swabs by polymerase chain reaction (PCR) at CDC was positive for both patients. On April 21, 2016, public health officials were notified of a third suspected measles case in a female aged 7 months (patient C) who had developed a rash on April 14; PCR testing was positive. Genotyping conducted at CDC identified genotype B3 measles virus in all three cases. Genotype B3 is known to be circulating globally and has previously been associated with imported cases in the United States (*1*).

Repeated, detailed interviews with the three patients or their families did not yield an outbreak source or an epidemiologic link among patients A, B, and C. None of these patients, their families, or close contacts reported any recent international travel or exposure to international travelers. The three patients resided at least 15 miles from one another and were members of three distinct geographic, cultural, and socioeconomic groups. However, given the later timing of symptom onset, there is the possibility that patient C was infected by an unidentified epidemiologic link to patient A or B. By May 7, 2016, an additional four laboratory-confirmed cases of measles were identified in Shelby County; all were epidemiologically linked to patients A, B, or C. Age range for the seven patients was 7 months–50 years (median age = 2 years); three (43%) were infants aged <12 months. Six (86%) patients were unvaccinated, three of whom were eligible for measles vaccine, but had missed opportunities to be vaccinated for various reasons. These included one patient who had moved between health care systems and was not identified as being unvaccinated, one whose initial measles, mumps, and rubella (MMR) vaccine dose had been delayed because of illness, and one whose family reported not vaccinating because of concerns about autism. One patient had received 1 age-appropriate dose of measles-containing vaccine.

As has been documented during previous measles outbreaks, rapid and effective public health response required extensive resources (*2*). Methods to identify potential contacts included reviewing available public setting patron lists, health care facility patient lists, and appointment records; employee interviews, and reviewing hospital security videos. Interviews identified 25 public locations visited by measles patients during their infectious periods (4 days before through 4 days after rash onset), during which transmission might have occurred. Among these locations, six (24%) were hospitals, 12 (48%) were outpatient clinics, and seven (28%) were public settings not related to health care. Comprehensive contact tracing identified 985 potentially exposed persons; 92 (9%) were close contacts of ill persons, and the remaining 893 (91%) were potentially exposed in health care settings. Persons potentially exposed at public locations (i.e.,not health care–related) were not individually identified.

Among the 893 health care setting exposures, 235 (26%) were among health care workers and 658 (74%) were among persons who were not health care workers; 678 (76%) occurred in hospitals and 215 (24%) occurred in outpatient clinics. Approximately 90% of exposed health care workers could not provide documentation of MMR vaccination within 24 hours of public health requests for this information; however, 206 (98%) provided documentation within the required 5 days of exposure, and five (2%) were furloughed while obtaining vaccination records or laboratory confirmation of immunity. The Shelby County Health Department issued quarantine orders to 41 close contacts of patients with subsequent daily active monitoring by public health. Approximately 400 doses of MMR vaccine were administered at public health vaccination clinics and community-located events, and postexposure intramuscular immune globulin was administered within 6 days to 18 infants aged <12 months, none of whom developed measles (*3*).

This outbreak, with three epidemiologically distinct chains of transmission and no identified common source, highlights the importance of high 2-dose MMR vaccination coverage among vaccine-eligible persons and the need for ongoing, vigilant surveillance for measles virus in the United States (*3*). Clinical providers and public health officials should maintain a high index of suspicion for measles because delayed recognition and delayed reporting to public health officials can lead to a rapid propagation of cases and difficulty in tracking epidemiologic links during investigations. One patient in this outbreak was admitted to a tertiary care hospital for 72 hours, and although measles IgM testing was ordered, the patient was not placed in airborne isolation. The provider thought a measles diagnosis was unlikely because no documented measles cases had been reported in Shelby County for >10 years and vaccination rates in the area are generally high (approximately 90%) (*4*).

As demonstrated in this outbreak, a lack of international travel and absence of recent measles cases in the community can provide false reassurance, and it is important that patients with clinically compatible illness and an uncertain vaccination history be evaluated for measles. This outbreak serves as a reminder that certain communities are susceptible to measles outbreaks; however, risks for these outbreaks can be mitigated through prompt identification of potential cases with early notification of public health officials to suspected cases, rapid public health response, and maintenance of high 2-dose MMR vaccination coverage in the community. In addition, all health care workers born during or after 1957 should receive 2 doses of MMR vaccine and ensure that their immunization records are easily accessible for confirmation (*5*).

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Announcement

Final 2015–16 Influenza Vaccination Coverage Estimates for Selected Local Areas, States, and the United States Available Online

Final 2015–16 influenza season vaccination coverage estimates are available online at FluVaxView (http://www.cdc.gov/flu/fluvaxview/). The online information includes estimates of the cumulative percentage of persons vaccinated through the end of each month during July 2015–May 2016, for selected local areas, states, and regions as designated by the U.S. Department of Health and Human Services, and the United States overall.

Analyses were conducted using National Immunization Survey-Flu influenza vaccination data for children aged 6 months–17 years and Behavioral Risk Factor Surveillance System (BRFSS) influenza vaccination data for adults aged ≥18 years. Estimates are provided by age group and race/ethnicity. These estimates are presented in an interactive report (http://www.cdc.gov/flu/fluvaxview/interactive.htm) and are complemented by an online summary report (http://www.cdc.gov/flu/fluvaxview/coverage-1516estimates.htm).

Final 2015–16 influenza vaccination coverage estimates among pregnant women in the United States also are available online (https://www.cdc.gov/flu/fluvaxview/pregnant-coverage_1516estimates.htm). The online information includes national estimates of the percentage of women vaccinated before and during pregnancy since July 2015, among women who were pregnant during October 2015–January 2016. Analyses were conducted using data collected from an Internet panel survey of pregnant women during March 29–April 7, 2016.

Errata

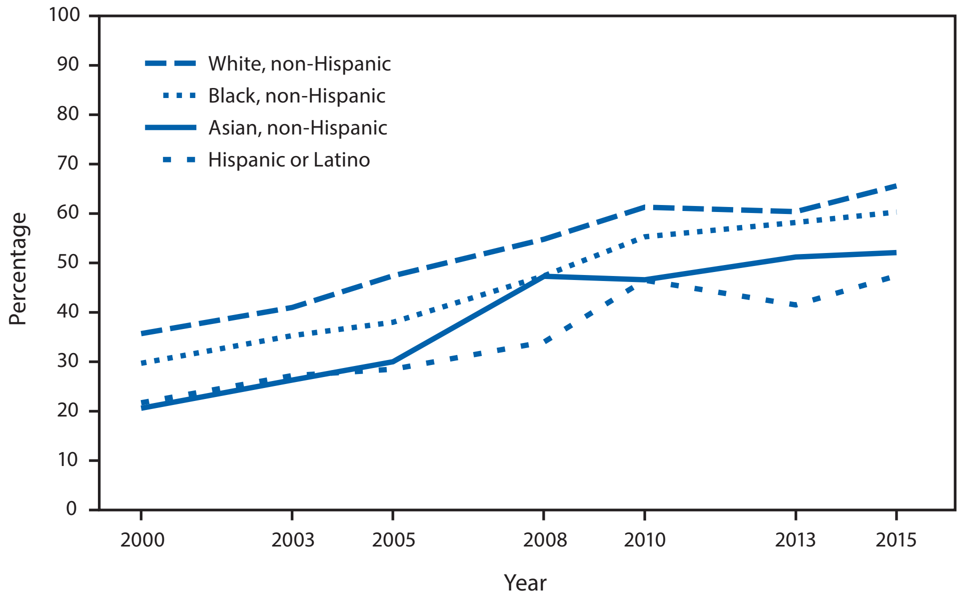
Vol. 65, No. 36

In the report, "Investigation of *Escherichia coli* Harboring the *mcr-1* Resistance Gene — Connecticut, 2016," the Acknowledgments should have included the following: **Alycia McNutt, David Santoro, Christina Nishimura, Diane Noel, Katherine A. Kelley Public Health Laboratory, Connecticut Department of Public Health.**

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Colorectal Cancer Screening* Among Adults Aged 50–75 Years, by Race/Ethnicity† — National Health Interview Survey,§ United States, 2000–2015



* Includes reports of home fecal occult blood test (FOBT) in the past year, sigmoidoscopy procedure in the past 5 years with FOBT in the past 3 years, or colonoscopy in the past 10 years, consistent with the 2008 guidelines from the U.S. Preventive Services Task Force (USPSTF). Colorectal cancer tests and procedures are performed for diagnostic and screening purposes.

† Persons who are of Hispanic ethnicity might be of any race.

§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized population. Questions about colorectal tests or procedures differed slightly on the National Health Interview Survey and were asked on an intermittent schedule in 2000, 2003, 2005, 2008, 2010, 2013, and 2015. Estimates of colorectal cancer screening are presented for adults aged 50–75 years who reported any colorectal test or procedure.

During 2000–2015, among adults aged 50–75 years, the use of colorectal cancer tests or procedures increased for all racial/ethnic groups included in the analysis. Colorectal screening percentages more than doubled for non-Hispanic black, Hispanic, and non-Hispanic Asian adults during that period. Despite these increases, in 2015, the prevalence of colorectal cancer screening was higher among non-Hispanic white (65.6%) adults than among non-Hispanic black (60.3%), non-Hispanic Asian (52.1%), and Hispanic (47.4%) adults.

Source: Health, United States, 2015. http://www.cdc.gov/nchs/hus.htm.

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