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Asthma Among Employed Adults, by Industry and Occupation — 21 States, 2013

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Workers in various industries and occupations are at risk for work-related asthma* (*1*). Data from the 2006–2007 adult Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-back Survey (ACBS), an in-depth asthma survey conducted with respondents who report an asthma diagnosis, from 33 states indicated that up to 48% of adult current asthma might be related to work and could therefore potentially be prevented (*2*). Identification of the industries and occupations with increased prevalence of asthma might inform work-related asthma intervention and prevention efforts. To assess the industry-specific and occupation-specific proportions of adults with current asthma by state, CDC analyzed data from the 2013 BRFSS industry and occupation module, collected from 21 states for participants aged ≥18 years who, at the time of the survey interview, were employed or had been out of work for <12 months. Among these respondents, 7.7% had current asthma; based on the Asthma Call-back Survey results, this finding means as many as 2.7 million U.S. workers might have asthma caused by or exacerbated by workplace conditions. State-specific variations in the prevalence of current asthma by industry and occupation were observed. By state, current asthma prevalence was highest among workers in the information industry (18.0%) in Massachusetts and in health care support occupations (21.5%) in Michigan. Analysis of BRFSS industry and occupation and optional asthma modules can be used to identify industries and occupations to assess for asthma among workers, identify workplace exposures, and guide the design and evaluation of effective work-related asthma prevention and education programs (*1*).

BRFSS is a state-based, random-digit–dialed telephone survey of the noninstitutionalized U.S. population aged ≥18 years that collects information on health risk factors, preventive health practices, and disease status. The survey includes core questions, optional modules, and state-specific questions.† During 2013, the industry and occupation module§ was administered for the first time in 19 states. The module collected information on the industry and occupation of respondents employed in the 12 months preceding the interview for their current or most recent job. Two additional

*Work-related asthma includes occupational asthma (i.e., new-onset asthma caused by factors related to work) and work-exacerbated asthma (i.e., preexisting or concurrent asthma worsened by factors related to work). http://www.cdc.gov/niosh/topics/asthma/occasthmaprevention.html.

† http://www.cdc.gov/brfss/annual_data/annual_2013.html.
§ http://www.cdc.gov/brfss/questionnaires/index.htm.

INSIDE

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

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states (Washington[¶] and Wyoming[**]) collected industry and occupation information using state-added questions. The median American Association of Public Opinion Research response rate among the 21 states collecting information on industry and occupation was 44.0% (range = 31.1%–59.2%).[††]

BRFSS participants who responded "yes" to both questions: "Has a doctor, nurse, or other health professional ever told you that you had asthma?" and "Do you still have asthma?" were considered to have current asthma. Participants who, at the time of the interview, indicated that they were employed for wages, out of work for <1 year, or self-employed were considered employed in the 12 months before the interview. Information on respondent's industry of employment and occupation was coded by CDC coders based on the 2002 North American Industry Classification System and the 2000 Standard Occupational Classification System, respectively.[§§] The current analysis used 21 industry categories and 23 occupation categories.

Landline and cellular telephone household data were weighted to produce estimates representative of the state populations using the survey sample weight for each BRFSS participant. Estimated proportions with corresponding 95% confidence intervals (CIs) were calculated. Statistically significant differences in distribution were determined using the Rao-Scott chi-square test with statistical significance at $p \leq 0.05$.

A sample of 208,788 adults in the 21 states, representing an estimated 125 million persons, participated in BRFSS and completed the industry and occupation module. Among these participants, 107,327 adults, representing an estimated 74 million persons (59.8% of the estimated survey population) were employed in the 12 months before the interview during 2013. Among adults employed at any time in the 12 months preceding the interview, 7.7% had current asthma.

The proportion of workers with current asthma differed significantly by age, sex, race/ethnicity, household income, and state (Table 1). Overall, prevalence of current asthma among workers ranged from 5.0% in Mississippi to 10.0% in Michigan, and was highest in the health care and social assistance industry (10.7%) and in health care support occupations (12.4%) (Table 2). Industry-specific, and occupation-specific prevalence of current asthma was highest among workers in the information industry (18.0%) in Massachusetts and in health care support occupations (21.5%) in Michigan (Table 3). Among the five industries with the highest current asthma prevalence, health care and social assistance was identified in 20 of the 21 states, retail trade in 16 states, and education in 14 states. Among the five occupations with the highest current asthma prevalence, office and administrative support was identified in 16 of the 21 states, health care practitioners and technical in 15 states, and sales and related in 13 states.

¶ Washington State Department of Health, Center for Health Statistics, Behavioral Risk Factor Surveillance System.
** Wyoming Department of Health, Public Health Division, Behavioral Risk Factor Surveillance System.
†† http://www.cdc.gov/brfss/annual_data/2013/pdf/2013_dqr.pdf.
§§ https://wwwn.cdc.gov/niosh-nioccs/.

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TABLE 1. Prevalence of current asthma* among adults employed during the 12 months preceding the interview,† by selected characteristics and state of residence — Behavioral Risk Factor Surveillance System (BRFSS), 21 states, 2013

Characteristic/State	No. in sample§	Weighted no. (thousands)¶	Current asthma %¶ (95% CI)
Total	**107,327**	**74,111**	**7.7 (7.4–8.1)**
Age group (yrs)**			
18–44	42,441	40,877	8.2 (7.7–8.7)
45–64	53,509	29,157	7.4 (6.9–7.9)
≥65	10,398	3,611	5.8 (4.9–6.7)
Sex**			
Men	50,730	40,516	5.7 (5.3–6.2)
Women	56,597	33,595	10.2 (9.6–10.8)
Race/Ethnicity**			
White, non-Hispanic	83,935	44,493	8.1 (7.7–8.5)
Black, non-Hispanic	7,217	7,478	8.9 (7.7–10.2)
Hispanic	8,551	13,879	6.5 (5.5–7.4)
Other	5,980	7,033	6.9 (5.5–8.4)
Education			
High school diploma or less	31,254	27,023	7.5 (6.9–8.2)
Some college	30,274	22,835	8.2 (7.5–8.8)
College graduate	45,565	24,089	7.6 (7.1–8.2)
Household income**			
<$15,000	5,302	5,557	11.4 (9.5–13.3)
$15,000–$24,999	12,154	9,388	8.0 (7.1–9.0)
$25,000–$34,999	9,558	6,608	7.5 (6.3–8.7)
$35,000–$49,999	14,212	9,114	6.9 (6.1–7.7)
≥$50,000	56,542	36,608	7.5 (7.0–8.0)
State**			
California	3,966	16,866	7.6 (6.6–8.6)
Florida	13,737	8,520	6.7 (5.8–7.5)
Illinois	2,962	6,069	6.7 (5.5–7.9)
Louisiana	2,356	1,998	6.5 (4.9–8.1)
Maryland	7,126	2,956	8.6 (7.5–9.7)
Massachusetts	8,238	3,287	9.9 (8.9–10.9)
Michigan	6,262	4,279	10.0 (9.0–11.1)
Minnesota	8,725	2,828	7.3 (6.4–8.2)
Mississippi	3,190	1,260	5.0 (4.0–6.0)
Montana	5,270	480	7.1 (6.2–7.9)
Nebraska	4,877	922	6.3 (5.2–7.3)
New Hampshire	3,582	666	8.2 (7.1–9.4)
New Jersey	2,616	4,285	7.7 (6.0–9.4)
New Mexico	4,661	885	8.2 (7.1–9.3)
New York	2,327	9,162	7.9 (6.5–9.3)
North Dakota	4,817	380	7.8 (6.6–8.9)
Oregon	2,825	1,709	9.3 (7.9–10.7)
Utah	7,400	1,322	8.2 (7.4–9.0)
Washington	5,607	3,224	8.5 (7.6–9.4)
Wisconsin	3,581	2,728	7.9 (6.6–9.2)
Wyoming	3,202	286	8.3 (7.0–9.6)

Abbreviation: CI = confidence interval.
* "Yes" response to both questions: "Have you ever been told by a doctor or other health professional that you have asthma?" and "Do you still have asthma?"
† Participants who, at the time of the interview, indicated they were employed for wages, out of work for <1 year, or self-employed.
§ Unweighted sample size.
¶ Weighted to the state population using the survey sample weights for each BRFSS participant.
** For differences in current asthma prevalence: Rao-Scott chi-square test; p-value <0.05.

TABLE 2. Prevalence of current asthma* among adults employed in the 12 months preceding the interview,† ranked by industry and occupation categories — Behavioral Risk Factor Surveillance System (BRFSS), 21 states, 2013

Industry	%§ (95% CI)	Occupation	%§ (95% CI)
Health care and social assistance	10.7 (9.6–11.8)	Health care support	12.4 (9.7–15.2)
Education	9.1 (7.8–10.3)	Community and social services	12.2 (7.9–16.6)
Arts, entertainment, and recreation	9.0 (5.1–13.0)	Personal care and service	12.1 (9.3–14.9)
Information	8.7 (6.3–11.1)	Arts, design, entertainment, sports, and media	11.7 (8.5–14.8)
Retail trade	8.7 (7.3–10.2)	Office and administrative support	10.2 (8.7–11.7)
Finance and insurance	8.4 (6.4–10.3)	Health care practitioners and technical	9.2 (7.9–10.5)
Other services (except public administration)	8.3 (6.6–9.9)	Legal	9.2 (5.9–12.5)
Professional, scientific, and technical services	7.6 (6.1–9.1)	Food preparation and serving	8.3 (6.5–10.2)
Accommodation and food services	7.4 (6.0–8.7)	Education, training, and library	8.2 (6.8–9.5)
Transportation and warehouse	7.1 (4.8–9.3)	Sales and related	7.6 (6.5–8.8)
Public administration	7.0 (5.8–8.2)	Life, physical, and social science	7.5 (4.6–10.4)
Real estate, rental, and leasing	6.9 (4.4–9.4)	Business and financial operations	7.2 (5.6–8.9)
Administrative and support, waste management, and remediation	6.4 (4.4–8.3)	Building and grounds cleaning and maintenance	7.1 (5.4–8.9)
Manufacturing	6.1 (5.1–7.2)	Management	6.9 (5.7–8.0)
Mining, oil and gas	6.0 (3.6–8.3)	Transportation and material moving	6.7 (4.7–8.7)
Construction	5.9 (4.5–7.2)	Computer and mathematical	6.7 (4.9–8.6)
Wholesale trade	5.8 (3.4–8.3)	Protective service	6.6 (4.1–9.2)
Agriculture, forestry, fishing and hunting	4.2 (2.0–6.4)	Production	5.7 (4.1–7.3)
Utilities	—¶	Installation, maintenance, and repair	5.7 (3.9–7.5)
Management of companies and enterprises	—	Construction and extraction	4.6 (3.4–5.8)
Armed forces	—	Architecture and engineering	4.1 (2.8–5.4)
		Farming, fishing, and forestry	2.6 (1.1–4.1)
		Military active duty	—

Abbreviation: CI = confidence interval.
* "Yes" response to both questions: "Have you ever been told by a doctor or other health professional that you have asthma?" and "Do you still have asthma?"
† Participants who, at the time of the interview, indicated they were employed for wages, out of work for <1 year, or self-employed.
§ Weighted to the state population using the survey sample weights for each BRFSS participant.
¶ Unreliable estimates with a relative standard error ≥30 are not reported.

TABLE 3. The five industries and occupations with the highest prevalence of current asthma* among adults employed in the 12 months preceding the interview,† by state — Behavioral Risk Factor Surveillance System (BRFSS), 21 states, 2013

State/Industry	%§ (95% CI)	Occupation	%§ (95% CI)
California			
Education	11.4 (7.0–15.8)	Personal care and service	16.0 (7.4–24.6)
Health care and social assistance	10.9 (6.8–15.1)	Office and administrative support	13.0 (7.9–18.2)
Professional, scientific, and technical services	9.5 (5.0–13.9)	Education, training, and library	8.6 (4.5–12.6)
Construction	7.8 (4.3–11.4)	Management	7.5 (4.0–11.1)
Retail trade	7.6 (3.7–11.5)	Sales and related	7.1 (3.8–10.4)
Florida			
Retail trade	10.0 (5.6–14.4)	Health care practitioners and technical	13.4 (8.1–18.6)
Education	9.2 (5.2–13.1)	Education, training, and library	7.0 (3.1–10.9)
Health care and social assistance	9.1 (7.0–11.2)	Office and administrative support	6.9 (4.5–9.3)
Other services (except public administration)	8.3 (3.9–12.6)	Sales and related	6.9 (4.2–9.6)
Finance and insurance	4.2 (2.0–6.5)	Management	4.1 (2.3–5.9)
Illinois			
Health care and social assistance	10.9 (6.7–15.2)	Health care practitioners and technical	14.7 (7.9–21.4)
Retail trade	10.2 (4.3–16.0)	Office and administrative support	9.5 (5.3–13.8)
Education	6.1 (3.3–9.0)	—¶	—
Louisiana			
Health care and social assistance	10.8 (5.1–16.4)	—	—
Maryland			
Other services (except public administration)	14.8 (7.5–22.1)	Arts, design, entertainment, sports and media	14.6 (6.1–23.2)
Health care and social assistance	10.4 (7.2–13.6)	Community and social services	13.7 (5.9–21.5)
Education	9.4 (6.3–12.4)	Office and administrative support	10.8 (7.1–14.6)
Public administration	9.2 (6.7–11.6)	Education, training, and library	10.0 (6.2–13.7)
Professional, scientific, and technical services	8.1 (4.5–11.8)	Health care and technical	9.4 (5.7–13.1)
Massachusetts			
Information	18.0 (7.7–28.3)	Community and social services	13.8 (7.2–20.5)
Accommodation and food services	14.5 (7.9–21.2)	Education, training, and library	12.8 (8.8–16.9)
Public administration	13.5 (7.0–20.0)	Food preparation and service	12.8 (5.6–19.9)
Health care and social assistance	13.1 (10.1–16.1)	Health care practitioners and technical	12.4 (8.8–16.1)
Retail trade	10.7 (6.5–14.8)	Office and administrative support	11.8 (8.3–15.4)
Michigan			
Health care and social assistance	15.2 (12.1–18.3)	Health care support	21.5 (12.8–30.2)
Accommodation and food services	14.9 (9.4–20.4)	Food preparation and service	14.4 (8.4–20.5)
Education	11.5 (8.5–14.4)	Community and social services	13.4 (7.8–19.0)
Retail trade	11.4 (7.7–15.0)	Sales and related	12.4 (8.3–16.4)
Transportation and warehouse	10.9 (5.2–16.7)	Personal care and service	12.3 (6.8–17.9)
Minnesota			
Finance and insurance	13.2 (6.1–20.3)	Personal care and service	13.4 (6.1–20.7)
Accommodation and food services	12.9 (6.3–19.5)	Health care practitioners and technical	10.1 (5.9–14.3)
Health care and social assistance	10.3 (7.5–13.0)	Sales and related	9.3 (4.9–13.7)
Manufacturing	7.5 (4.4–10.7)	Business and financial operations	8.5 (4.0–13.1)
Retail trade	6.4 (3.5–9.4)	Office and administrative support	6.5 (3.7–9.2)
Mississippi			
Health care and social assistance	7.5 (4.3–10.7)	Health care practitioners and technical	6.8 (2.8–10.9)
Retail trade	6.1 (2.7–9.4)	—	—
Education	4.3 (1.9–6.7)	—	—
Montana			
Accommodation and food services	9.4 (5.0–13.9)	Office and administrative support	8.0 (4.8–11.3)
Retail trade	8.3 (5.3–11.4)	Management	7.9 (5.0–10.8)
Health care and social assistance	8.1 (5.4–10.7)	Health care practitioners and technical	7.7 (4.0–11.4)
Construction	7.9 (4.2–11.6)	Construction and extraction	7.6 (4.0–11.1)
Education	7.8 (4.7–11.0)	Sales and related	7.3 (4.0–10.7)
Nebraska			
Retail trade	7.5 (3.3–11.8)	Sales and related	9.5 (4.2–14.7)
Education	6.5 (3.6–9.3)	Office and administrative support	7.6 (4.2–11.1)
Health care and social assistance	6.2 (4.0–8.4)	Health care practitioners and technical	6.7 (3.0–10.4)
Public administration	5.7 (2.5–9.0)	Management	3.9 (2.0–5.8)
Agriculture, forestry, fishing, and hunting	5.0 (2.4–7.6)	—	—

See table footnotes on the next page.

TABLE 3. (*Continued*) The five industries and occupations with the highest prevalence of current asthma* among adults employed in the 12 months preceding the interview,† by state — Behavioral Risk Factor Surveillance System (BRFSS), 21 states, 2013

State/Industry	%§ (95% CI)	Occupation	%§ (95% CI)
New Hampshire			
Public administration	12.3 (5.7–18.9)	Office and administrative support	12.3 (7.1–17.4)
Health care and social assistance	9.9 (7.0–12.8)	Sales and related	11.7 (7.0–16.5)
Manufacturing	9.2 (5.5–12.9)	Computer and mathematical	11.4 (5.0–17.8)
Retail trade	8.7 (4.7–12.6)	Health care practitioners and technical	10.8 (6.0–15.6)
Other services (except public administration)	8.1 (3.9–12.3)	Education, training, and library	7.6 (4.1–11.1)
New Jersey			
Education	9.5 (5.3–13.7)	Education, training, and library	8.9 (3.9–13.9)
Health care and social assistance	9.0 (4.7–13.3)	Health care practitioners and technical	8.5 (3.6–13.4)
Retail trade	7.7 (3.2–12.2)	Management	7.5 (3.4–11.7)
New Mexico			
Education	11.2 (7.3–15.2)	Personal care and service	12.7 (6.6–18.8)
Public administration	10.6 (5.6–15.6)	Health care practitioners and technical	11.7 (6.3–17.1)
Retail trade	9.5 (5.2–13.8)	Education, training, and library	11.3 (6.2–16.3)
Other services (except public administration)	9.4 (4.1–14.7)	Sales and related	11.1 (6.5–15.6)
Health care and social assistance	8.9 (6.2–11.7)	Office and administrative support	9.3 (5.6–13.0)
New York			
Health care and social assistance	9.5 (6.1–12.8)	Office and administrative support	10.3 (4.2–16.3)
Education	8.1 (4.3–12.0)	Management	9.8 (4.2–15.5)
North Dakota			
Manufacturing	11.2 (5.6–16.7)	Office and administrative support	11.2 (6.9–15.5)
Health care and social assistance	9.2 (6.0–12.4)	Health care practitioners and technical	8.8 (4.2–13.5)
Mining, oil, and gas	8.8 (4.2–13.5)	Construction and extraction	8.1 (3.4–12.7)
Construction	7.6 (3.2–11.9)	Education, training, and library	7.6 (3.9–11.3)
Retail trade	6.4 (3.5– 9.3)	Sales and related	5.9 (3.2–8.5)
Oregon			
Public administration	16.7 (9.1–24.2)	Sales and related	14.7 (6.7–22.8)
Health care and social assistance	14.0 (9.8–18.1)	Office and administrative support	12.5 (7.6–17.4)
Manufacturing	9.9 (5.6–14.2)	Health care practitioners and technical	10.9 (5.9–15.8)
Education	8.9 (5.0–12.9)	Education, training, and library	8.7 (4.0–13.4)
Utah			
Mining, oil, and gas	13.5 (5.8–21.2)	Personal care and service	14.0 (7.3–20.7)
Other services (except public administration)	12.4 (7.4–17.4)	Production	12.9 (8.1–17.8)
Manufacturing	10.4 (7.3–13.6)	Transportation and material moving	10.9 (5.9–15.9)
Transportation and warehouse	10.1 (5.3–15.0)	Education, training, and library	10.1 (6.8–13.4)
Professional, scientific, and technical services	9.9 (5.9–13.9)	Office and administrative support	9.2 (6.7–11.6)
Washington			
Accommodation and food services	16.1 (9.0–23.1)	Personal care and service	17.4 (9.6–25.2)
Retail trade	12.5 (8.6–16.4)	Food preparation and service	16.1 (8.3–23.8)
Health care and social assistance	12.5 (9.4–15.6)	Building and grounds cleaning and maintenance	14.2 (6.6–21.8)
Administrative, support, waste management, and remediation	11.5 (5.6–17.4)	Health care practitioners and technical	11.8 (7.4–16.1)
Professional, scientific, and technical services	9.4 (6.3–12.4)	Sales and related	11.6 (7.0–16.2)
Wisconsin			
Health care and social assistance	11.4 (6.8–15.9)	Office and administrative support	9.6 (5.1–14.1)
Manufacturing	8.1 (4.8–11.5)	Sales and related	7.8 (3.3–12.2)
Retail trade	7.5 (3.8–11.2)	—	—
Education	7.3 (3.3–11.3)	—	—
Wyoming			
Accommodation and food services	15.0 (7.3–22.6)	Production	14.1 (6.1–22.2)
Education	10.9 (6.7–15.1)	Education, training, and library	12.5 (7.1–17.8)
Health care and social assistance	10.4 (6.2–14.6)	Sales and related	9.7 (4.2–15.2)
Mining, oil, and gas	7.6 (3.6–11.6)	Office and administrative support	8.4 (4.3–12.5)
Retail trade	7.4 (3.1–11.7)	Health care practitioners and technical	8.1 (3.4–12.9)

Abbreviation: CI = confidence interval.
* "Yes" response to both questions: "Have you ever been told by a doctor or other health professional that you have asthma?" and "Do you still have asthma?"
† Participants who, at the time of the interview, indicated they were employed for wages, out of work for <1 year, or self-employed.
§ Weighted to the state population using the survey sample weights for each BRFSS participant.
¶ Unreliable estimates with a relative standard error ≥30 are not reported.

Discussion

The findings in this report provide the first state-specific estimates of current asthma by industry and occupation category for 21 states administering BRFSS and collecting industry and occupation data, and indicate state-specific variations in current asthma prevalence by industry and occupation. These variations are consistent with previous findings (*3*) and likely reflect differences in the characteristics of state working populations (e.g., age, race/ethnicity, and education), socioeconomic factors (e.g., state-specific distribution of industries and occupations and unemployment rate), health insurance coverage (e.g., type of insurance and access to medical care), state laws (e.g., workers' compensation), geographic differences in prevalence of sensitization to aeroallergens (*4*,*5*), and risk for exposure to agents causing asthma in the workplace. For example, sales and related occupations were the top employers in 2015 for all 21 states assessed in this study according to the Bureau of Labor and Statistics (http://www.bls.gov/home.htm) and that might explain why this occupation appears consistently across several states.

Work-related asthma includes occupational asthma (i.e., new-onset asthma caused by factors related to work) and work-exacerbated asthma (i.e., preexisting or current asthma worsened by factors related to work) (*1*). Persons with work-related asthma have more symptomatic days, use more health care resources, and have lower quality of life (*6*). Moreover, asthma exacerbations accelerate decline in lung function (*7*). Each of the industries and occupations identified in this report is associated with a specific set of existing and emerging workplace exposures, including irritant chemicals, dusts, secondhand smoke, allergens, emotional stress, temperature, and physical exertion, that have been associated with new-onset and work-exacerbated asthma (*8*,*9*). For example, it is well recognized that workers in the health care and social assistance industry who are exposed to cleaning and disinfection products, powdered latex gloves, and aerosolized medications have a twofold increased likelihood of new-onset asthma (*9*). A previous study reported that as much as 48% of adult asthma is caused or made worse by work (*2*); therefore, as many as 2.7 million workers might have asthma caused or exacerbated by workplace conditions in these 21 states. To assist clinicians in assessing potential workplace exposures among employed patients with new-onset or exacerbated asthma, the Association of Occupational and Environmental Clinics published a list of substances that meet criteria for causing work-related asthma by sensitization or acute irritant-induced asthma.¶¶

¶¶ http://www.aoecdata.org/ExpCodeLookup.aspx.

Summary

What is already known about this topic?

Data from the 2006–2007 adult Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-back Survey from 33 states indicated that up to 48% of adult current asthma might be related to work and could potentially be prevented. Asthma prevalence is higher among adults working in certain industries and occupations.

What is added by this report?

Among an estimated 74 million adults employed at some time in the 12 months preceding the interview in 21 states, 7.7% had current asthma (range = 5.0% [Mississippi]–10.0% [Michigan]). Based on the Asthma Call-back Survey results, this finding means as many as 2.7 million U.S. workers might have asthma caused by or exacerbated by workplace conditions. The findings indicate state-specific variation in the prevalence of current asthma by industry and occupation. State-specific prevalence of current asthma was highest among workers in the information industry (18.0%) in Massachusetts and in health care support occupations (21.5%) in Michigan.

What are the implications for public health practice?

Analysis of BRFSS industry and occupation and asthma module data might aid in identification of industries and occupations with high current asthma prevalence and facilitate assessment of workers for new-onset or work-exacerbated asthma who could benefit from work-related asthma prevention and education programs. Routine collection of industry and occupation information is needed to estimate state-specific work-related asthma prevalence by industry and occupation.

The findings in this report are subject to at least four limitations. First, information on asthma was self-reported and not validated by medical records or follow-up with health care providers; thus, estimates might be subject to misclassification. Second, although the BRFSS optional ACBS collects detailed information on asthma (e.g., work-related asthma), it was not possible to determine whether the current asthma was associated with work using 1 year of data because of the small number of respondents with both information on work-related asthma diagnosis and industry and occupation. Also, small sample sizes resulted in unreliable estimates for some industries and occupations. Combining multiple years of data from ACBS and industry and occupation module is needed to estimate the state-specific work-related asthma prevalence by industry and occupation. Third, workers with current asthma might leave employment in industries and occupations with workplace exposures that exacerbate their asthma (i.e., the healthy worker effect); thus, industry and occupation in this report might not accurately represent the industries and occupations where exposures occur. Finally, because data are limited

to 21 states, the results might not be nationally representative or representative of nonparticipating states.

Physicians should consider collecting a detailed occupational history among adults with asthma because this is critical for making a work-related asthma diagnosis and recommending optimal treatment and management (*1*). Reduction or elimination of workplace exposures (i.e., substitution of hazardous products with nonhazardous products or improved ventilation) or removal of the worker from the environment might be necessary for management of asthma symptoms related to work (*1*,*10*). For example, reduction in exposure to latex allergens by replacing powdered latex gloves with powder-free natural rubber latex or nonlatex gloves considerably reduced work-related asthma in the health care industry (*10*).

Twenty-two *Healthy People 2020* respiratory disease objectives*** for asthma address prevention, detection, treatment, and education efforts; in 2009, CDC funded 34 states, the District of Columbia, and Puerto Rico to help meet these objectives.††† The Council of State and Territorial Epidemiologists in its 2010 Position Statement§§§ recommends continued surveillance for and evaluation of the burden of asthma, including work-related asthma, to help target prevention programs and activities. BRFSS data provide a unique opportunity to assess state-level asthma prevalence by industry and occupation. The findings in this report might assist physicians and state public health officials in identifying workers in industries and occupations with a high current asthma prevalence who should be evaluated for work-related asthma in order to plan and target interventions. Potential work-related asthma exposures can be identified, and effective prevention and education strategies can be implemented (*8*). Routine collection of industry and occupation information is needed to estimate state-specific work-related asthma prevalence by respondents' industry and occupation.

*** https://www.healthypeople.gov/2020/topics-objectives/topic/respiratory-diseases/objectives.

††† http://www.cdc.gov/asthma/pdfs/asthma_facts_program_grantees.pdf.

§§§ http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/10-EH-01.pdf.

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References

1. Tarlo SM, Balmes J, Balkissoon R, et al. Diagnosis and management of work-related asthma: American College Of Chest Physicians consensus statement. Chest 2008;134(Suppl):1S–41S. http://dx.doi.org/10.1378/chest.08-0201
2. Knoeller GE, Mazurek JM, Moorman JE. Work-related asthma among adults with current asthma in 33 states and DC: evidence from the Asthma Call-Back Survey, 2006–2007. Public Health Rep 2011;126:603–11.
3. Anderson NJ, Fan ZJ, Reeb-Whitaker C, Bonauto DK, Rauser E. Distribution of asthma by occupation: Washington State Behavioral Risk Factor Surveillance System data, 2006–2009. J Asthma 2014;51:1035–42. http://dx.doi.org/10.3109/02770903.2014.939282
4. Xu F, Mawokomatanda T, Flegel D, et al. Surveillance for certain health behaviors among states and selected local areas—Behavioral Risk Factor Surveillance System, United States, 2011. MMWR Surveill Summ 2014;63(No. SS-9).
5. Salo PM, Arbes SJ Jr, Jaramillo R, et al. Prevalence of allergic sensitization in the United States: results from the National Health and Nutrition Examination Survey (NHANES) 2005–2006. J Allergy Clin Immunol 2014;134:350–9. http://dx.doi.org/10.1016/j.jaci.2013.12.1071
6. Balmes J, Becklake M, Blanc P, et al. American Thoracic Society statement: occupational contribution to the burden of airway disease. Am J Respir Crit Care Med 2003;167:787–97. http://dx.doi.org/10.1164/rccm.167.5.787
7. O'Byrne PM, Pedersen S, Lamm CJ, Tan WC, Busse WW; START Investigators Group. Severe exacerbations and decline in lung function in asthma. Am J Respir Crit Care Med 2009;179:19–24. http://dx.doi.org/10.1164/rccm.200807-1126OC
8. Henneberger PK, Redlich CA, Callahan DB, et al.; ATS Ad Hoc Committee on Work-Exacerbated Asthma. An official American Thoracic Society statement: work-exacerbated asthma. Am J Respir Crit Care Med 2011;184:368–78. http://dx.doi.org/10.1164/rccm.812011ST
9. Pechter E, Davis LK, Tumpowsky C, et al. Work-related asthma among health care workers: surveillance data from California, Massachusetts, Michigan, and New Jersey, 1993–1997. Am J Ind Med 2005;47:265–75. http://dx.doi.org/10.1002/ajim.20138
10. Heederik D, Henneberger PK, Redlich CA; ERS Task Force on the Management of Work-related Asthma. Primary prevention: exposure reduction, skin exposure and respiratory protection. Eur Respir Rev 2012;21:112–24. http://dx.doi.org/10.1183/09059180.00005111

Progress with Scale-Up of HIV Viral Load Monitoring — Seven Sub-Saharan African Countries, January 2015–June 2016

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The World Health Organization (WHO) recommends viral load testing as the preferred method for monitoring the clinical response of patients with human immunodeficiency virus (HIV) infection to antiretroviral therapy (ART) (*1*). Viral load monitoring of patients on ART helps ensure early diagnosis and confirmation of ART failure and enables clinicians to take an appropriate course of action for patient management. When viral suppression is achieved and maintained, HIV transmission is substantially decreased, as is HIV-associated morbidity and mortality (*2*). CDC and other U.S. government agencies and international partners are supporting multiple countries in sub-Saharan Africa to provide viral load testing of persons with HIV who are on ART. This report examines current capacity for viral load testing based on equipment provided by manufacturers and progress with viral load monitoring of patients on ART in seven sub-Saharan countries (Côte d'Ivoire, Kenya, Malawi, Namibia, South Africa, Tanzania, and Uganda) during January 2015–June 2016. By June 2016, based on the target numbers for viral load testing set by each country, adequate equipment capacity existed in all but one country. During 2015, two countries tested >85% of patients on ART (Namibia [91%] and South Africa [87%]); four countries tested <25% of patients on ART. In 2015, viral suppression was >80% among those patients who received a viral load test in all countries except Côte d'Ivoire. Sustained country commitment and a coordinated global effort is needed to reach the goal for viral load monitoring of all persons with HIV on ART.

The Joint United Nations Programme on HIV/Acquired Immune Deficiency Syndrome (UNAIDS) "90-90-90" goals are to increase to 90% by 2020 the proportions of 1) persons living with HIV infection who know their status, 2) persons living with HIV infection receiving ART, and 3) persons living with HIV infection on ART who have achieved viral suppression (*3*). Substantial progress has been made in initiating ART among HIV-infected persons. In 2015, an estimated 17 million persons with HIV accessed treatment compared with 7.5 million in 2010, with sub-Saharan Africa accounting for approximately two thirds (11.8 million) of the persons on ART (*4*). Despite progress in ART coverage, substantial challenges with access to viral load testing in resource-limited countries remain (*4*,*5*). Unlike western countries, which have relied on viral load testing to monitor virologic response to ART, low- and middle-income countries have historically relied on CD4 cell counts (which monitor immunologic improvement for patients on ART) because of the higher cost of viral load testing.

Challenges to viral load testing scale-up have been identified, including weaknesses in sample transport and laboratory workflow; finance and procurement; human resources (i.e., staffing shortages); laboratory equipment maintenance; and laboratory-clinic interfaces (*5*,*6*). To address these barriers and increase access to viral load testing, the Diagnostic Access Initiative (which includes representatives from the U.S. President's Emergency Plan for AIDS Relief [PEPFAR], UNAIDS, WHO, and others), was launched to increase laboratory capacity and reduce pricing from manufacturers for better access to viral load testing (*7*). PEPFAR collaborates with manufacturers for procurement and viral loading testing reagents. CDC provides technical expertise in support of viral load testing, and the United States Agency for International Development (USAID) focuses on supply chain management, working with manufacturers for procurement and maintenance of viral load testing platforms. A previous evaluation found that countries were at various stages of implementation and that scale-up of viral load testing was feasible (*6*).

The seven sub-Saharan African countries were selected based on availability of data and agreements with ministries of health for January 2015–June 2016. Ministries of Health, CDC, and USAID program officers jointly collected information on viral load testing targets, viral load testing capacity, cumulative number of ART patients, number of ART patients with more than one viral load test, percentage of viral load tests indicating viral suppression (<1,000 virus copies/mL), test turnaround time, and number of CD4 tests. The WHO algorithm for viral load testing suggests starting viral load testing 6 months after ART initiation, followed by viral load testing at 12 months if viral suppression is achieved, and yearly thereafter (*8*). Each country set their viral load testing targets (i.e., the number of persons to receive viral load testing) based on several factors, including the number of persons with HIV on ART and the country's ability to increase viral load testing. Information

on the number of testing platforms and the overall testing capacity for each country was provided by the manufacturers, Roche and Abbott. Among the seven countries participating in the CDC HIV-1 Viral Load Proficiency Testing program, 62 laboratories were enrolled.

By June 2016, 176 molecular testing platforms were in use within the seven countries; Roche accounted for 107 (61%) and Abbott 69 (39%). By June 2016, based on the target numbers for viral load testing set by each country, adequate equipment capacity resided in all but Uganda. However, three countries (Malawi, Tanzania, and Uganda) did not have the capacity to test all the persons with HIV currently on ART at least once per year (Table 1) (Table 2). Of the 62 laboratories enrolled in viral load proficiency testing, 92% passed proficiency testing; only a few laboratories in Malawi and one in Kenya did not pass (Table 1). During January–June 2016, the mean test turnaround time was ≤4 days in Namibia and South Africa, but was 28–50 days in all other countries (Table 1). During January 2015–June 2016, turnaround times decreased in Kenya and Uganda, but increased in Côte d'Ivoire, Malawi, and Tanzania.

During January 2015–June 2016, the number of patients on ART increased in all countries, with the greatest proportional increase observed in Uganda (13%) and the lowest in Malawi (2%) and Tanzania (2%) (Table 2). The percentage of ART patients with one or more viral load tests during 2015 varied substantially across countries. Two countries tested >85% of patients on ART: Namibia (91%) and South Africa (87%). Four countries, tested <25% of ART patients: Côte d'Ivoire (10%), Malawi (19%), Tanzania (5%), and Uganda (23%) (Table 2). During January–June 2016, all countries reported testing <50% of patients. Viral suppression was ≥82% in all countries except Côte d'Ivoire (66%) and Tanzania (72%). During January 2015–June 2016, viral suppression rates decreased by 12% in Côte d'Ivoire and 16% in Tanzania. CD4 test data were available for five countries. Overall, during January 2014–June 2016, four countries had declines in CD4 testing volume; Côte d'Ivoire had increases (Table 2).

Discussion

Global support from international agencies and collaboration with manufacturers has led to four of seven countries in sub-Saharan Africa having adequate capacity to perform viral load testing of all persons with HIV on ART per WHO guidance. All countries increased the number of patients receiving

TABLE 1. Human immunodeficiency virus viral load testing capacity and quality monitoring indicators, by country — seven sub-Saharan African countries, January 2015–June 2016

	Established target no. of tests		Equipment capacity	Molecular testing platforms		Laboratory proficiency testing		Mean turnaround time* (days)	
Country	2015	2016	2015/2016	Roche	Abbott	No. participated	No. passed	2015	Jan–Jun 2016
Côte d'Ivoire	0	102,967	399,168	22	0	3	3	17	50
Kenya	1,200,000	1,393,557	1,464,372	15	21	16	15	48	36
Malawi†	166,652	237,815	391,608	0	14	15	11	31	42
Namibia	190,382	211,394	309,960	6	2	0	0	5	4
South Africa	3,600,000	3,900,000	5,973.912	37	14	16	16	3	3
Tanzania	87,589	207,277	412,776	9	8	8	8	30	34
Uganda	200,000	800,000	739,368	18	10	4	4	43	28

* Mean turnaround time from whole blood draw to report sent from testing laboratory.
† Malawi guidelines recommend viral load testing every other year for persons on antiretroviral therapy.

TABLE 2. Human immunodeficiency virus treatment monitoring indicators, by country — seven sub-Saharan African countries, January 2015–June 2016

	Total no. of ART patients		No. of ART patients with ≥1 viral load test		% ART patients with ≥1 viral load test		% viral load tests with viral suppression*		No. CD4 tests		
Country	2015	2016	2015	2016	2015	2016	2015	2016	2014	2015	2016
Côte d'Ivoire	147,947	160,561	15,502	17,114	10	11	78	66	186,159	145,755	177,815
Kenya	860, 297	923,000	650,645	456,756	76	49	83	84	ND	ND	ND
Malawi†	595,186	606,673§	115,971	115,528	19	19	82	89	125,543	75,973	16,164
Namibia	143,805	148,940	130,367	63,732	91	43	87	87	50,091	23,424	8,048
South Africa	3,318,384	3,422,724	2,875,734	3,125,011	87	91	83	83	3,933,588	3,627,960	1,736,211
Tanzania	758,344	769,527	41,289	66,344	5	9	88	72	ND	ND	ND
Uganda	1,066,519	1,213,091	243,099	267,140	23	22	91	92	1,097,691	960,241	341,019

Abbreviations: ART = antiretroviral therapy; ND = data not available.
* Suppression = <1,000 copies/mL.
† Malawi guidelines recommend viral load testing every other year for persons on ART.
§ These numbers reflect reported numbers from January–March 2016.

ART, thus creating a greater demand for viral load testing. This increase is expected to continue as countries strive to reach the goal of initiating ART for all persons with HIV. Although the number of patients who have received viral load testing has increased, the percentage of patients on ART with at least one viral load test was ≤25% for four of the seven countries. In contrast, Namibia, Kenya, and South Africa tested >75% of patients on ART. Among the seven countries, Namibia is closest to reaching the third "90" UNAIDS goal (to increase to 90% the proportion of persons with HIV infection on ART who have achieved viral suppression), followed by South Africa and Kenya. The remaining countries will need to make substantial progress to meet this goal.

Since 2014, the landscape for HIV patient monitoring has changed. CD4 testing is declining and viral load testing is increasing. This change is expected to continue as countries with limited resources prioritize monitoring efficacy of ART to reach viral suppression goals.

During January–June 2016, the turnaround time from specimen collection to return of results was 28–50 days in five countries, compared with ≤4 days in two countries (Namibia and South Africa). Optimally, turnaround time would be ≤2 weeks. Reasons for long turnaround time included equipment breakdown, reagent stock depletion, inefficient systems for specimen transport, and personnel shortages. Prolonged turnaround times can delay the prompt use of results for patient management, such as intense adherence counseling or switching to second-line ART, both of which improve viral load suppression. Substantially decreasing turnaround time is a factor that needs more focused attention in many countries.

The findings in this report are subject to at least three limitations. First, capacity for viral load testing was calculated using the optimal number of specimens that could be run on a machine based on guidance from manufacturers. Second, field conditions such as staffing shortages and power outages might decrease actual capacity. Finally, low viral load suppression rates might be the result of targeted testing for suspected treatment failure rather than unbiased testing of all persons with HIV on ART.

Successful scale-up of HIV viral load testing requires a global response. Because of coordinated efforts, millions of persons with HIV receive viral load testing despite limited resources. PEPFAR works directly with ministries of health and implementing partners to support viral load scale-up through establishing and optimizing systems. CDC, USAID, and other U.S. agencies provide complementary activities in molecular diagnostics, management of supply chain, and building human capacity. WHO has developed guidelines for viral load testing. The Clinton HIV/AIDS Initiative supports creation of electronic dashboards for data management. Continued coordination and effective partnerships are necessary to provide a harmonized, comprehensive approach that can maximize efficiencies and strengthen health systems for effective viral load scale-up.

Summary

What is already known about this topic?

Persons with human immunodeficiency virus (HIV) who have viral suppression have improved health outcomes and a lower risk for transmitting HIV infection to others. Thus, viral load testing is recommended for monitoring patients with HIV receiving antiretroviral therapy (ART). Increasing and monitoring the capacity for viral load testing are important measures for global control of HIV, particularly in sub-Saharan Africa, which has the highest prevalence of HIV worldwide.

What is added by this report?

During 2015–2016, among the seven sub-Saharan African countries evaluated, the number of patients with HIV receiving ART increased. Four countries now have the capacity to perform viral load testing for all patients currently on HIV treatment. All seven countries increased testing capacity. However, the percentage of patients on HIV treatment who received viral load testing was <25% for four countries.

What are the implications for public health practice?

Continued international collaborative initiatives are needed to increase capacity for viral load testing, as well as access of these services among patients on HIV treatment in sub-Saharan Africa.

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References

1. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach. Geneva Switzerland: World Health Organization; 2013. http://apps.who.int/iris/bitstream/10665/85321/1/9789241505727_eng.pdf
2. Cohen MS, Chen YQ, McCauley M, et al.; HPTN 052 Study Team. Prevention of HIV-1 infection with early antiretroviral therapy. N Engl J Med 2011;365:493–505. http://dx.doi.org/10.1056/NEJMoa1105243

3. Joint United Nations Programme on HIV/AIDS. 90–90–90: a transformative agenda to leave no one behind. Geneva, Switzerland: Joint United Nations Programme on HIV/AIDS; 2014. http://www.unaids.org/en/resources/presscentre/unaidsspeeches/2014/20141025_SP_EXD_Vietnam_launch_of_909090_en.pdf
4. Joint United Nations Programme on HIV/AIDS. UNAIDS fact sheet 2016. Geneva, Switzerland: Joint United Nations Programme on HIV/AIDS; 2016. http://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_en.pdf
5. Roberts T, Cohn J, Bonner K, Hargreaves S. Scale-up of routine viral load testing in resource-poor settings: current and future implementation challenges. Clin Infect Dis 2016;62:1043–8. http://dx.doi.org/10.1093/cid/ciw001
6. Lecher S, Ellenberger D, Kim AA, et al. Scale-up of HIV viral load monitoring—seven sub-Saharan African countries. MMWR Morb Mortal Wkly Rep 2015;64:1287–90. http://dx.doi.org/10.15585/mmwr.mm6446a3
7. Peter T, Ellenberger D, Kim AA, et al. Early antiretroviral therapy initiation: access and equity of viral load testing for HIV treatment monitoring. Lancet Infect Dis. E-pub October 20, 2016.
8. World Health Organization. Technical and operational considerations for implementing HIV viral load testing. Geneva, Switzerland: World Health Organization; 2014. http://who.int/hiv/pub/arv/viral-load-testing-technical-update/en/

Vital Signs: Trends in HIV Diagnoses, Risk Behaviors, and Prevention Among Persons Who Inject Drugs — United States

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Abstract

Background: Persons who inject drugs (PWID) are at increased risk for poor health outcomes and bloodborne infections, including human immunodeficiency virus (HIV), hepatitis C virus and hepatitis B virus infections. Although substantial progress has been made in reducing HIV infections among PWID, recent changes in drug use could challenge this success.

Methods: CDC used National HIV Surveillance System data to analyze trends in HIV diagnoses. Further, National HIV Behavioral Surveillance interviews of PWID in 22 cities were analyzed to describe risk behaviors and use of prevention services among all PWID and among PWID who first injected drugs during the 5 years before their interview (new PWID).

Results: During 2008–2014, HIV diagnoses among PWID declined in urban and nonurban areas, but have leveled off in recent years. Among PWID in 22 cities, during 2005–2015, syringe sharing decreased by 34% among blacks/African Americans (blacks) and by 12% among Hispanics/Latinos (Hispanics), but remained unchanged among whites. The racial composition of new PWID changed during 2005–2015: the percentage who were black decreased from 38% to 19%, the percentage who were white increased from 38% to 54%, and the percentage who were Hispanic remained stable. Among new PWID interviewed in 2015, whites engaged in riskier injection behaviors than blacks.

Conclusions: Decreases in HIV diagnoses among PWID indicate success in HIV prevention. However, emerging behavioral and demographic trends could reverse this success.

Implications for public health practice: Access to comprehensive prevention services is essential for all PWID. Syringe services programs reduce syringe sharing and can help PWID access prevention and treatment services for HIV and other bloodborne diseases, such as hepatitis C and hepatitis B.

Introduction

Persons who inject drugs (PWID) are at higher risk for human immunodeficiency virus (HIV) infection. Although acquired immune deficiency syndrome (AIDS) diagnoses among PWID have decreased approximately 90% since their peak in 1993 (*1*), and only an estimated 0.3% of the U.S. population has injected drugs in the past 12 months (*2*), approximately 9% of HIV infections diagnosed in recent years are among PWID (*3*). Although HIV diagnoses among PWID have decreased over time (*3*), recent increases in acute hepatitis C virus (HCV) infections (*4*), which are frequently associated with injection drug use, suggest this progress could be negatively affected by increases in opioid (*5*) and heroin (*6*) use. The U.S. National HIV/AIDS Strategy* identifies PWID as a priority population for HIV prevention. Surveillance data were analyzed to determine recent trends in annual HIV diagnoses and characteristics and behaviors of PWID to better understand emerging opportunities and challenges in HIV prevention among PWID.

Methods

CDC's National HIV Surveillance System data reported through June 2016 from 50 states and the District of Columbia were used to obtain the number of PWID with HIV diagnosed† during 2008–2014. Data were statistically adjusted for missing transmission categories by multiple imputation (*7*). National HIV Behavioral Surveillance (*8*) (NHBS) data include PWID who injected drugs during the 12 months before their NHBS interview in 22 U.S. cities

* https://www.aids.gov/federal-resources/national-hiv-aids-strategy/nhas-update.pdf.

† Includes persons with HIV infection with a history of ever injecting drugs, including men who ever had sex with men and injected drugs.

during 2005–2015.[§] Among all PWID, trend analyses[¶] of receipt of syringes[**] and syringe sharing[††] were conducted to understand changes in HIV-associated injection behaviors. Additional analyses were limited to PWID who injected drugs for the first time during the 5 years before interview[§§] (new PWID) for 1) trends since 2005 in racial/ethnic composition[¶¶] of new PWID, and 2) comparisons of demographic characteristics, HIV and HCV testing, injection behaviors, and HIV[***] and self-reported HCV prevalence, by race/ethnicity[†††] among new PWID interviewed in 2015.

Results

During 2008–2014, HIV diagnoses among PWID in the United States decreased by 48% (from 6,604 to 3,461). During this same period, diagnoses among black/African American (black) and Hispanic/Latino (Hispanic) PWID decreased by approximately 50% in both urban (from 2,452 to 950 among blacks; from 1,185 to 639 among Hispanics) and nonurban (from 523 to 222 among blacks; from 197 to 95 among Hispanics) areas,[§§§] with a slower decrease observed in the more recent years (Figure 1). Diagnoses among white PWID in urban areas decreased by 28% (from 1,350 to 977) during 2008–2012, but remained stable past 2012. In nonurban areas, diagnoses among white PWID decreased by 28% (from 481 to 345) during 2008–2010, but remained stable during 2010–2014. The majority of HIV diagnoses (79%) among PWID occurred in urban areas.

NHBS data[¶¶¶] indicate that, although the percentage of PWID in 22 cities who received syringes from a syringe services program (SSP)[****] (*9*) increased during 2005–2015 for all racial/ethnic groups ($p<0.001$), less than one third of PWID received all their syringes from sterile sources (Figure 2). During 2005–2015, the percentage of black PWID who received all their syringes from sterile sources increased by 48% ($p<0.001$). During the same period, the percentages of Hispanic PWID and white PWID who received all their syringes from sterile sources did not change (Hispanics, $p = 0.16$, whites, $p = 0.72$). Hispanic PWID had the largest percentage of persons receiving all their syringes from sterile sources in each year. In 2015, overall 25% of PWID interviewed received all their syringes from sterile sources (blacks = 28%; Hispanics = 29%; whites = 22%) (Figure 2).

During 2005–2015, the percentages of black and Hispanic PWID in 22 cities who shared syringes decreased (blacks, $p<0.001$; Hispanics, $p = 0.005$) (Figure 2). The largest decrease, 34%, was among black PWID, followed by Hispanic PWID (12%). During 2005–2015, the percentage of white PWID who shared syringes did not change ($p = 0.14$). In 2015, the highest percentage of PWID interviewed who shared syringes were white (43%), followed by Hispanic (33%) and black (21%). Across all years, 31% of PWID who received at least one syringe from SSPs had shared syringes, compared with 38% who had not received any syringes from SSPs. Among PWID who received all their syringes from sterile sources,[††††] 13% had shared syringes in the past year; 41% of PWID who did not receive all their syringes from sterile sources[§§§§] had shared syringes in the previous year.

[§] National HIV Behavioral Surveillance data include PWID recruited using respondent-driven sampling in 22 U.S. cities during 2005–2006, 2009, 2012, and 2015. The target sample size in each city each year was 500 PWID. The number of cities included each year varied; 2005: 22 cities; 2009, 2012, and 2015: 19 cities. The following cities were included in all years: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Miami, Florida; Nassau–Suffolk, New York; New York City, New York; Newark, New Jersey; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; Seattle, Washington. Additional cities were included as follows: in 2005, Fort Lauderdale, Florida; Las Vegas, Nevada; Norfolk-Portsmouth, Virginia; St. Louis, Missouri; in 2009, 2012, 2015, New Orleans, Louisiana; Washington, D.C.

[¶] Separate Poisson regression models with generalized estimating equations (GEE) clustered on recruitment chain were used to examine trends overall and stratified by race/ethnicity. Interview year was included in the models as an ordinal variable to examine changes over time. Models were adjusted for continuous age to account for changing demographics over time. A single model utilizing interactions by race yielded similar results.

[**] A person was considered to have received a syringe from a syringe services program (SSP) if he or she reported receiving a sterile syringe or needle, at least once, from an SSP or syringe/needle exchange program during the 12 months before interview. A person was considered to have received syringes only from sterile sources if he or she reported receiving syringes from at least one of the following: SSP, pharmacy, or healthcare provider and NOT any other source during the 12 months before interview.

[††] A person was considered to have shared a syringe during the 12 months before interview if he or she reported using a syringe to inject drugs that had previously been used for drug injection by someone else.

[§§] Calculated based on age at first injection and year of interview.

[¶¶] To assess trends in the racial composition of new PWID, we defined three dummy variables representing blacks/African Americans (blacks), Hispanics/Latinos (Hispanics), and whites, and conducted Poisson regression models with GEE clustered on recruitment chain. For each racial/ethnic group, the corresponding dummy variable was included in the model as a dependent variable, year as an ordinal variable, and continuous age as a covariate.

[***] Determined by HIV test administered immediately after the interview.

[†††] P-values comparing blacks to whites and Hispanics to whites were calculated using GEE regression clustered on recruitment chain, with race/ethnicity as the covariate. All models were adjusted for continuous age, except for analysis of age and age at first injection.

[§§§] Urban areas include metropolitan statistical areas with populations of ≥500,000 persons; areas with populations <500,000 persons were considered nonurban.

[¶¶¶] NHBS data are limited to PWID in urban areas who likely have greater access to SSPs and other resources than PWID outside of urban centers.

[****] SSPs and syringe/needle exchange programs allow PWID to exchange used syringes or needles for new, sterile syringes. SSPs provide comprehensive services such as HIV or HCV testing, linkage to care, and medication-assisted treatment. NHBS does not collect information on what services are offered at SSPs.

[††††] Sterile sources include SSPs, pharmacies, and health care providers.

[§§§§] Includes PWID who only received syringes from nonsterile sources and PWID who received syringes from both sterile and nonsterile sources. Among PWID who only received syringes from nonsterile sources, 41% shared syringes; among PWID who received syringes from both sterile and nonsterile sources 42% shared syringes in the past 12 months.

During 2005–2015, the racial/ethnic distribution of new PWID changed (Figure 3). The percentage of new PWID who were black decreased by 51%, from 38% in 2005 to 19% in 2015 (p<0.001). The percentage who were Hispanic remained stable at approximately 21% (p = 0.72). The percentage who were white increased by 40% from 38% in 2005 to 54% in 2015 (p = 0.002).

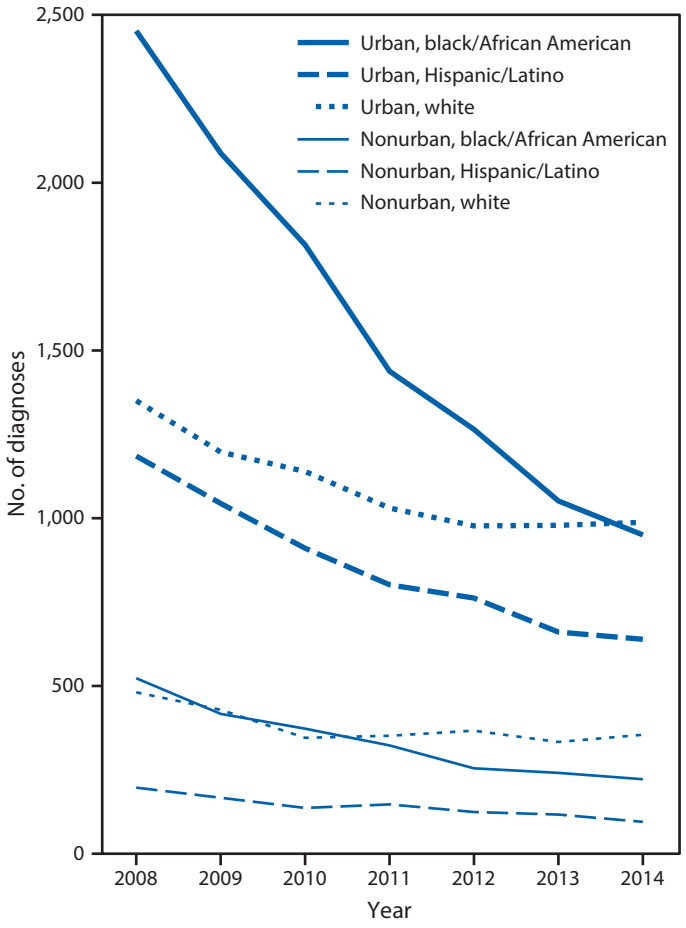
In 2015, 54% of new PWID were white, 21% were Hispanic, and 19% were black (Table). (In 2015, among PWID who had been injecting for ≥5 years, 37% were white, 18% were Hispanic, and 40% were black.) Overall, 48% of new PWID were aged 18–29 years; however, variations by race/ethnicity were observed: 21% of black, 49% of Hispanic, and 56% of white new PWID were aged 18–29 years. Syringe sharing was most commonly reported among whites (46%), followed by Hispanics (32%) and blacks (28%). Regardless of race/ethnicity, most new PWID injected at least one time per day (83%) and primarily injected heroin (27%) or heroin and other drugs (61%) during the 12 months before their interview. Among new PWID, prescription opioid misuse during the past 12 months was most common among whites (27% injection; 46% noninjection), followed by Hispanics (21% injection; 37% noninjection) and blacks (10% injection; 30% noninjection). HIV testing in the 12 months before the interview was most commonly reported among blacks (65%), followed by Hispanics (58%) and whites (57%). HIV prevalence was highest among blacks (9%), followed by Hispanics (4%) and whites (2%). Having ever been tested for HCV was most common among whites (72%), followed by blacks (69%) and Hispanics (64%). Self-reported HCV prevalence, among new PWID who had previously been tested, was highest among whites (22%), followed by Hispanics (19%) and blacks (13%). New PWID who received syringes from SSPs were more likely to dispose of all their syringes safely (37%) than those who had not received syringes from SSPs (7%).

Conclusions and Comments

Trends in protective behavior might explain why HIV diagnoses have declined more among black PWID than among white PWID. Fewer blacks are injecting drugs now than before (*10*) and the percentage of new PWID who are black decreased by 51% during 2005–2015. Further, during that time, the percentage of black PWID who shared syringes decreased by 34%. During 2005–2015, the percentage of new white PWID increased by 40%; syringe sharing among white PWID remained high, at approximately 43%.

Black PWID currently account for <20% of new PWID. This decrease might be partially explained by changes in social norms regarding drug injection in black communities (*10*), as well as increases in injection drug use among whites (*11*).

FIGURE 1. Diagnoses of human immunodeficiency virus (HIV) infection among persons who inject drugs — National HIV Surveillance System,* United States, 2008–2014



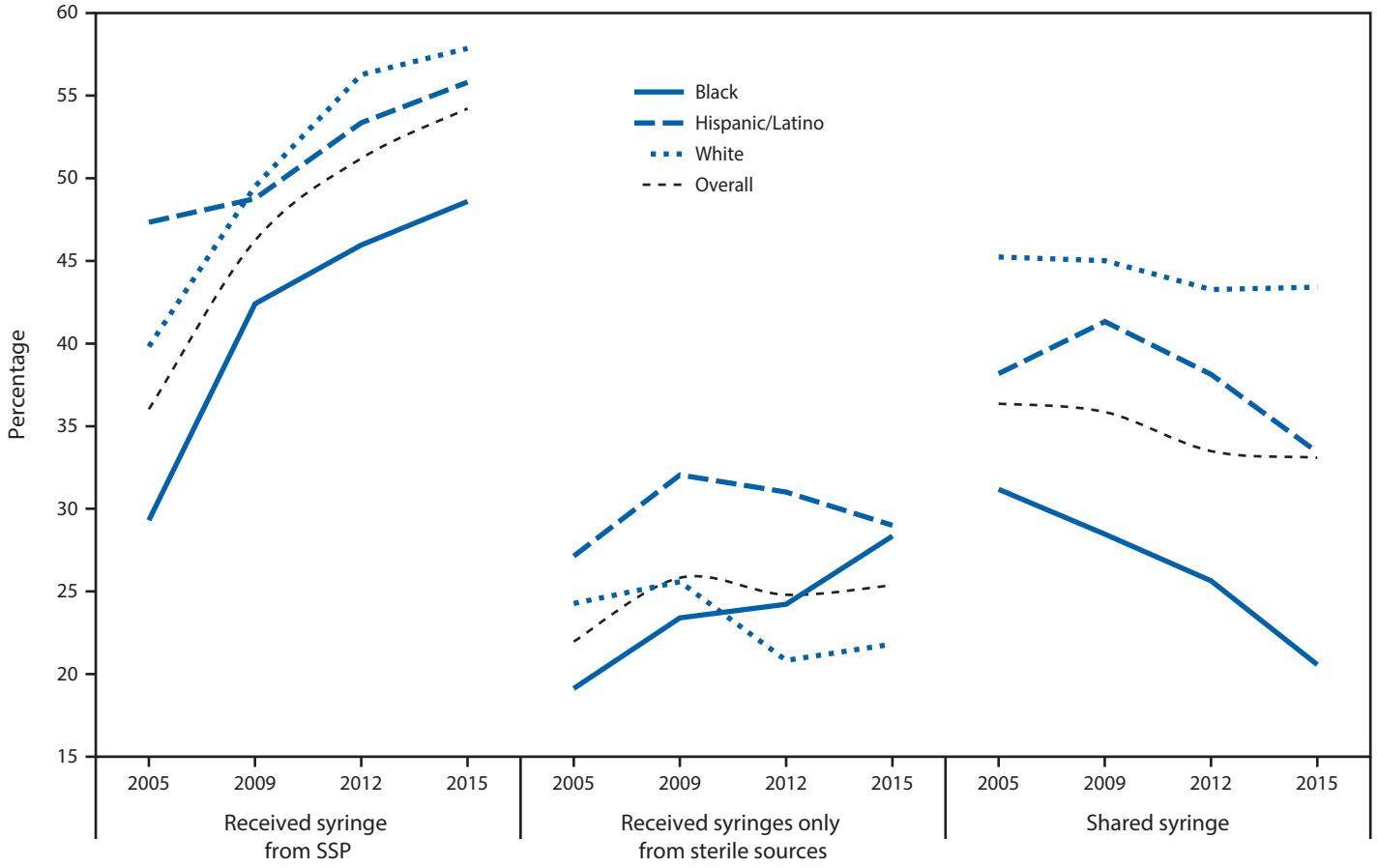
* http://www.cdc.gov/hiv/statistics/surveillance/index.html.

Black PWID tend to be older, and fewer report sharing syringes than do Hispanics or whites (*12*). Encouraging trends in use of SSPs and receipt of all syringes from sterile sources contribute to reducing the risk for HIV among black PWID. However, blacks remain at increased risk for HIV because of the high prevalence of HIV in their communities (*3*).

HIV diagnoses also decreased among Hispanic PWID. Although the data do not suggest that fewer Hispanics inject drugs now than previously, behavioral surveillance data suggest a trend of reduced syringe sharing, which is potentially related to increased access to SSPs and relatively high, steady rates of receiving all syringes from sterile sources.

Although HIV diagnoses among white PWID have decreased since 2008, recent trends suggest heroin use and injection drug use among whites are increasing (*10*,*11*) and, coupled with high rates of syringe sharing, might challenge the decades of progress in HIV prevention among PWID. For the first time, in 2014, a larger number of white PWID received an HIV

FIGURE 2. Trends in receipt of syringes and syringe sharing in the past 12 months among persons who inject drugs, by year — National HIV Behavioral Surveillance,* selected cities, United States, 2005–2015



Abbreviations: HIV = human immunodeficiency virus; SSP = syringe services program.

* http://www.cdc.gov/hiv/statistics/systems/nhbs/. National HIV Behavioral Surveillance data include persons who inject drugs (PWID) who injected drugs during the past 12 months before being interviewed. PWID were recruited using respondent-driven sampling in 22 U.S. cities during 2005–2006, 2009, 2012, and 2015. The target sample size in each city each year was 500 PWID. The number of cities included each year varied: 2005: 22 cities; 2009, 2012, and 2015: 19 cities. The following cities were included in all years: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Miami, Florida; Nassau–Suffolk, New York; New York City, New York; Newark, New Jersey; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; Seattle, Washington. Additional cities were included as follows: in 2005: Fort Lauderdale, Florida; Las Vegas, Nevada; Norfolk-Portsmouth, Virginia; St. Louis, Missouri; in 2009, 2012, 2015: New Orleans, Louisiana; Washington, D.C.

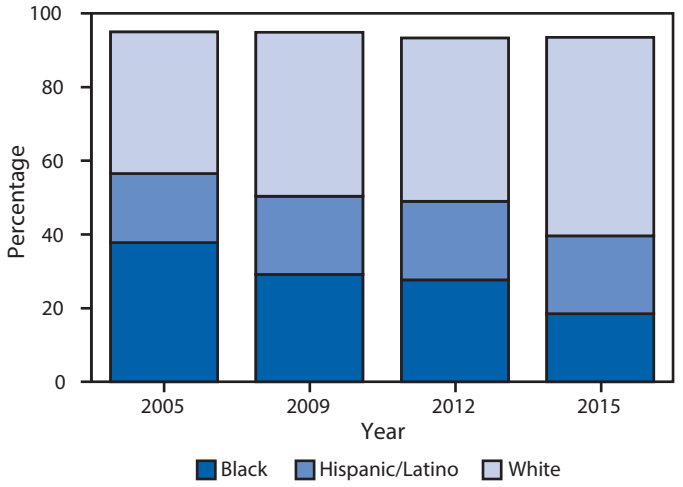
diagnosis than PWID from any other racial/ethnic population in the United States. This analysis indicates that white PWID, who tend to begin injecting at younger ages than blacks or Hispanics (*12*), accounted for >50% of new PWID in 2015. Further, although white PWID in 22 cities reported increases in receipt of sterile syringes from SSPs similar to increases reported among blacks and Hispanics, they were least likely to receive all their syringes from sterile sources and most likely to have shared syringes. Rural areas, which are predominately white, include some of the most vulnerable populations for injection drug use and injection drug use–related HIV outbreaks and might have the greatest unmet need for risk reduction services provided by SSPs (*9*,*13*,*14*).

SSPs reduce syringe sharing and are widely considered to be an effective means for reducing HIV transmission.¶¶¶¶ Reducing syringe sharing through improved access to SSPs is a critical component of HIV prevention among PWID. Although access to syringes from SSPs has increased, the supply of sterile syringes available to most PWID is likely to be insufficient to meet their needs, and barriers remain to accessing SSPs, including lack of SSPs in rural areas (*9*) and absence of legal support in many states (*15*).***** NHBS data indicate that 83% of new PWID interviewed injected one or more times per day; comparing estimates of PWID population size (*2*) with the estimated number of syringes distributed by SSPs in 2013

¶¶¶¶ 76 FR 10038 (https://www.federalregister.gov/a/2011-3990).

***** Only 17 states and Washington, D.C. have laws that explicitly authorize SSPs (http://www.lawatlas.org).

FIGURE 3. Race/ethnicity of persons who reported injecting drugs for the first time during the 5 years before interview — National HIV Behavioral Surveillance,* selected cities, United States, 2005–2015†



Abbreviation: HIV = human immunodeficiency virus.

* http://www.cdc.gov/hiv/statistics/systems/nhbs/. National HIV Behavioral Surveillance data include persons who inject drugs (PWID) who injected drugs during the 12 months before being interviewed. Graph data are limited to PWID who injected drugs for the first time during the past 5 years before being interviewed (considered "new" PWIDs). PWID were recruited using respondent-driven sampling in 22 U.S. cities during 2005–2006, 2009, 2012, and 2015. The target sample size in each city each year was 500 PWID. The number of cities included each year varied: 2005: 22 cities; 2009, 2012, and 2015: 19 cities. The following cities were included in all years: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Miami, Florida; Nassau–Suffolk, New York; New York City, New York; Newark, New Jersey; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; Seattle, Washington. Additional cities were included as follows: in 2005: Fort Lauderdale, Florida; Las Vegas, Nevada; Norfolk-Portsmouth, Virginia; St. Louis, Missouri; in 2009, 2012, 2015: New Orleans, Louisiana; Washington, D.C.

† Percentages for "other, multiple races" not included; therefore, bars do not add to 100%.

(*9*) and the low percentage (25%) of PWID in 22 cities who received all their syringes from sterile sources suggests that the U.S. syringe supply falls short. In addition to providing PWID with sterile syringes and equipment, SSPs serve as a bridge to access condoms; risk-reduction education; testing for HIV and HCV; referrals to health services, such as treatment for HIV, HCV, or substance use disorder, including medication-assisted treatment (e.g., with methadone or buprenorphine); pre-exposure prophylaxis (i.e., PrEP); and safe syringe disposal (*9*). SSPs are an effective tool for reducing substance misuse and risk for HIV infection. Recent changes in federal law†††† afford an opportunity to improve provision of comprehensive prevention services to all PWID through SSPs. It is important for jurisdictions to understand patterns of substance use in their communities, assess their SSP needs, and ensure services are provided to PWID (*13*).

†††† Consolidated Appropriations Act, 2016. Division H, Section 520. (https://www.congress.gov/114/bills/hr2029/BILLS-114hr2029enr.pdf).

Key Points

- Persons who inject drugs (PWID) are at increased risk for human immunodeficiency virus (HIV), hepatitis C virus (HCV), hepatitis B virus, and other negative health outcomes. In 2014, 9% of HIV diagnoses were among PWID. Although substantial progress has been made in reducing HIV infections among PWID, recent changes in drug use could challenge this success.
- HIV diagnoses among black/African American (black) and Hispanic/Latino PWID decreased about 50% during 2008–2014. Blacks now make up 19% of new PWID in 22 cities, down from 38% in 2005. Syringe sharing decreased among black and Hispanic/Latino PWID in 22 cities.
- Diagnoses among urban white PWID decreased 28%, but the decline stopped in 2012. Whites continue to have the highest rate of syringe sharing and now make up over 50% of new PWID.
- Among PWID who received all their syringes from sterile sources in the past year, 13% shared syringes; 41% of PWID who did not receive all their syringes from sterile sources shared syringes.
- Strategies that reduce HIV infections and syringe sharing among PWID should be used to meet emerging challenges in changing PWID populations. Syringe services programs reduce syringe sharing and serve as a bridge to other health services including HIV and HCV diagnosis and treatment and medication-assisted treatment for substance use disorder.
- Additional information is available at http://www.cdc.gov/vitalsigns.

The findings in this report are subject to at least three limitations. First, National HIV Surveillance System data are subject to reporting delays, and not all cases might have been reported at this time. This report presents trends in HIV diagnoses through 2014; preliminary 2015 data are not reliable for trend analysis (*3*). Second, NHBS data are limited to PWID recruited in large U.S. cities with high HIV prevalences using respondent-driven sampling and might not be generalizable to all PWID; recruitment in urban areas might not reflect the demographics and syringe use patterns of PWID living in rural areas. Finally, behavioral data and HCV prevalence are self-reported and subject to social desirability bias.

TABLE. Characteristics and risk behaviors among persons who inject drugs (PWID) whose first injection was during 2010–2015 (new PWID), by race/ethnicity — National HIV Behavioral Surveillance,* 19 cities,† United States, 2015

	New PWID					
	Black (19%)		Hispanic/Latino (21%)		White (54%)	Total§
Characteristic/Risk behavior	No. (%)	p-value¶ versus white	No. (%)	p-value¶ versus white	No. (%)	No. (%)
Sex/Gender						
Male	228 (65.9)	0.198	270 (69.2)	0.049	640 (64.1)	**1,212 (65.2)**
Female	113 (32.7)	0.112	119 (30.5)	0.066	355 (35.6)	**635 (34.2)**
Transgender	5 (1.4)	—**	1 (0.3)	—**	3 (0.3)	**11 (0.6)**
Age group (yrs)						
18–24	24 (6.9)	<0.001	85 (21.8)	0.152	251 (25.1)	**394 (21.2)**
25–29	48 (13.9)	<0.001	106 (27.2)	0.124	313 (31.3)	**496 (26.7)**
30–39	97 (28.0)	0.908	119 (30.5)	0.429	284 (28.4)	**537 (28.9)**
40–49	113 (32.7)	<0.001	61 (15.6)	0.002	96 (9.6)	**288 (15.5)**
≥50	64 (18.5)	<0.001	19 (4.9)	0.517	55 (5.5)	**144 (7.7)**
Age at first injection (yrs)						
<30	91 (26.3)	<0.001	228 (58.5)	0.005	671 (67.2)	**1,065 (57.3)**
≥30	255 (73.7)	<0.001	162 (41.5)	0.004	328 (32.8)	**794 (42.7)**
Heterosexual condomless sex†† (past 12 mos§§)	247 (72.7)	0.337	293 (75.5)	0.232	807 (81.3)	**1,436 (78.0)**
Male-male condomless sex¶¶ (past 12 mos§§)	15 (6.6)	0.633	22 (8.2)	0.760	46 (7.2)	**93 (7.7)**
Shared syringe* (past 12 mos§§)**	96 (27.8)	0.006	123 (31.6)	<0.001	463 (46.4)	**734 (39.5)**
Injection frequency (past 12 mos§§)						
≥1 time/day	263 (76.2)	0.177	327 (84.1)	0.935	842 (84.3)	**1,534 (82.6)**
<1 time/day	82 (23.8)	0.171	62 (15.9)	0.942	157 (15.7)	**323 (17.4)**
Drugs injected (past 12 mos§§)						
Heroin and other drugs†††	164 (47.4)	0.092	229 (58.7)	0.037	659 (66.2)	**1,132 (61.0)**
Heroin only§§§	132 (38.2)	0.023	103 (26.4)	0.224	245 (24.6)	**504 (27.2)**
Not heroin¶¶¶	50 (14.5)	0.510	58 (14.9)	0.004	92 (9.2)	**220 (11.9)**
Injected opioids** (past 12 mos§§)**						
≥1 time/day	6 (1.7)	0.239	19 (4.9)	0.228	37 (3.7)	**68 (3.7)**
<1 time/day	29 (8.4)	<0.001	62 (15.9)	0.010	228 (22.8)	**345 (18.6)**
Never	311 (89.9)	<0.001	309 (79.2)	0.061	734 (73.5)	**1,446 (77.8)**
Injected heroin and opioids†††† (past 12 mos§§)	32 (9.3)	<0.001	77 (19.7)	0.083	255 (25.5)	**390 (21.0)**
Used noninjected opioids§§§§ (past 12 mos§§)	102 (29.5)	<0.001	144 (36.9)	0.014	459 (46.0)	**763 (41.1)**
Tested for HIV infection¶¶¶¶ (past 12 mos§§)	208 (64.8)	0.047	215 (58.1)	0.756	558 (57.4)	**1,050 (58.9)**
HIV prevalence***	29 (8.6)	0.004	15 (3.9)	0.187	20 (2.0)	**69 (3.7)**
Tested for HCV infection††††† (ever)	232 (68.6)	0.239	244 (64.0)	0.021	697 (71.6)	**1,263 (69.6)**
HCV diagnosis (ever)	45 (13.4)	0.003	71 (18.8)	0.539	211 (21.7)	**345 (19.1)**
Total	**346 (18.6)**	**NA**	**390 (21.0)**	**NA**	**998 (53.7)**	**1,858 (100.0)**

Abbreviations: HCV = hepatitis C virus; HIV = human immunodeficiency virus; NA = not applicable.

* http://www.cdc.gov/hiv/statistics/systems/nhbs/.

† The 19 cities include the following: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Miami, Florida; Nassau–Suffolk, New York; New Orleans, Louisiana; New York City, New York; Newark, New Jersey; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; Seattle, Washington; Washington, D.C.

§ Total column includes data on all race/ethnicity groups; therefore, percentages of blacks, Hispanics/Latinos, and whites do not total to 100%.

¶ p-values calculated after adjusting for continuous age.

** Not calculated because of small sample size.

†† Condomless vaginal or anal sex with a partner of the opposite gender.

§§ In the 12 months before interview.

¶¶ Condomless anal sex with a male partner among male PWID.

*** Receptive syringe sharing: participant reported using a needle or syringe to inject drugs that had previously been used for drug injection by someone else.

††† Injected heroin and one or more other drugs, in combination or separately, at least once. Other drugs injected include powder cocaine, crack cocaine, methamphetamine, and prescription painkillers.

§§§ Injected heroin, but did not report injecting any other drug.

¶¶¶ Injected one or more drugs, but not heroin.

**** Injected prescription painkillers such as Oxycontin, Dilaudid, morphine, Percocet, or Demerol; does not include injection of heroin.

†††† Injected heroin and prescription painkillers, such as Oxycontin, Dilaudid, morphine, Percocet, or Demerol, in combination or separately, at least once.

§§§§ Noninjection of prescription painkillers such as Oxycontin, Dilaudid, morphine, Percocet, or Demerol; does not include heroin.

¶¶¶¶ Among participants who did not report a previous HIV-positive test result.

***** Had a confirmed HIV-positive test result during interview.

††††† Self-reported, lifetime diagnosis of HCV infection among participants who reported having ever been tested for HCV infection.

The most effective way for persons to avoid acquiring HIV and other negative health outcomes associated with injection drug use, including HCV, hepatitis B virus, abscesses, bacterial endocarditis, skin and soft tissue infections, and overdose, is not to inject drugs. For those who do inject, provision of sterile syringes and services through SSPs can decrease risk for HIV transmission and other negative health outcomes. A need to address injection drug use and associated risk behaviors exists because of several factors, including recent increases in heroin addiction and overdose (*6*); the HIV outbreak in Scott County, Indiana, which saw an increase in diagnoses from five in 5 years to 181 in 1 year (*14*); and the recent 364% increase of HCV transmission in rural areas (*16*), largely fueled by the current U.S. opioid epidemic (*11*). The window of opportunity for implementing SSPs that provide comprehensive services to prevent, rather than respond to, HIV outbreaks might be closing. Swift action can lead to further decreases in HIV diagnoses and prevent new outbreaks among PWID.

Acknowledgments

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References

1. CDC. HIV surveillance among persons who inject drugs [slide set]. Atlanta, GA: US Department of Health and Human Services; 2016. http://www.cdc.gov/hiv/library/slidesets/index.html
2. Oster AM, Sternberg M, Lansky A, Broz D, Wejnert C, Paz-Bailey G. Population size estimates for men who have sex with men and persons who inject drugs. J Urban Health 2015;92:733–43. http://dx.doi.org/10.1007/s11524-015-9970-3
3. CDC. Diagnoses of HIV infection in the United States and dependent areas, 2015. HIV Surveillance Report. Vol. 27. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-2015-vol-27.pdf
4. CDC. Viral Hepatitis Surveillance—United States, 2014. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/hepatitis/statistics/2014surveillance/pdfs/2014hepsurveillancerpt.pdf
5. CDC. Vital signs: overdoses of prescription opioid pain relievers and other drugs among women—United States, 1999–2010. MMWR Morb Mortal Wkly Rep 2013;62:537–42.
6. Jones CM, Logan J, Gladden RM, Bohm MK. Vital signs: demographic and substance use trends among heroin users—United States, 2002–2013. MMWR Morb Mortal Wkly Rep 2015;64:719–25.
7. Harrison KM, Kajese T, Hall HI, Song R. Risk factor redistribution of the national HIV/AIDS surveillance data: an alternative approach. Public Health Rep 2008;123:618–27.
8. Lansky A, Abdul-Quader AS, Cribbin M, et al. Developing an HIV behavioral surveillance system for injecting drug users: the National HIV Behavioral Surveillance System. Public Health Rep 2007;122(Suppl 1):48–55.
9. Des Jarlais DC, Nugent A, Solberg A, Feelemyer J, Mermin J, Holtzman D. Syringe service programs for persons who inject drugs in urban, suburban, and rural areas—United States, 2013. MMWR Morb Mortal Wkly Rep 2015;64:1337–41. http://dx.doi.org/10.15585/mmwr.mm6448a3
10. Broz D, Ouellet LJ. Racial and ethnic changes in heroin injection in the United States: implications for the HIV/AIDS epidemic. Drug Alcohol Depend 2008;94:221–33. http://dx.doi.org/10.1016/j.drugalcdep.2007.11.020
11. Cicero TJ, Ellis MS, Surratt HL, Kurtz SP. The changing face of heroin use in the United States: a retrospective analysis of the past 50 years. JAMA Psychiatry 2014;71:821–6. http://dx.doi.org/10.1001/jamapsychiatry.2014.366
12. Broz D, Pham H, Spiller M, et al. Prevalence of HIV infection and risk behaviors among younger and older injecting drug users in the United States, 2009. AIDS Behav 2014;18(Suppl 3):284–96. http://dx.doi.org/10.1007/s10461-013-0660-4
13. Van Handel MM, Rose CE, Hallisey EJ, et al. County-level vulnerability assessment for rapid dissemination of HIV or HCV infections among persons who inject drugs, United States. J Acquir Immune Defic Syndr 2016;73:323–31. http://dx.doi.org/10.1097/QAI.0000000000001098
14. Peters PJ, Pontones P, Hoover KW, et al.; Indiana HIV Outbreak Investigation Team. HIV infection linked to injection use of oxymorphone in Indiana, 2014–2015. N Engl J Med 2016;375:229–39. http://dx.doi.org/10.1056/NEJMoa1515195
15. Bramson H, Des Jarlais DC, Arasteh K, et al. State laws, syringe exchange, and HIV among persons who inject drugs in the United States: history and effectiveness. J Public Health Policy 2015;36:212–30. http://dx.doi.org/10.1057/jphp.2014.54
16. Zibbell JE, Iqbal K, Patel RC, et al. Increases in hepatitis C virus infection related to injection drug use among persons aged ≤30 years—Kentucky, Tennessee, Virginia, and West Virginia, 2006–2012. MMWR Morb Mortal Wkly Rep 2015;64:453–8.

Description of 13 Infants Born During October 2015–January 2016 With Congenital Zika Virus Infection Without Microcephaly at Birth — Brazil

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Congenital Zika virus infection can cause microcephaly and severe brain abnormalities (*1*). Congenital Zika syndrome comprises a spectrum of clinical features (*2*); however, as is the case with most newly recognized teratogens, the earliest documented clinical presentation is expected to be the most severe. Initial descriptions of the effects of in utero Zika virus infection centered prominently on the finding of congenital microcephaly (*3*). To assess the possibility of clinical presentations that do not include congenital microcephaly, a retrospective assessment of 13 infants from the Brazilian states of Pernambuco and Ceará with normal head size at birth and laboratory evidence of congenital Zika virus infection was conducted. All infants had brain abnormalities on neuroimaging consistent with congenital Zika syndrome, including decreased brain volume, ventriculomegaly, subcortical calcifications, and cortical malformations. The earliest evaluation occurred on the second day of life. Among all infants, head growth was documented to have decelerated as early as 5 months of age, and 11 infants had microcephaly. These findings provide evidence that among infants with prenatal exposure to Zika virus, the absence of microcephaly at birth does not exclude congenital Zika virus infection or the presence of Zika-related brain and other abnormalities. These findings support the recommendation for comprehensive medical and developmental follow-up of infants exposed to Zika virus prenatally. Early neuroimaging might identify brain abnormalities related to congenital Zika infection even among infants with a normal head circumference (*4*).

Thirteen infants with laboratory evidence of congenital Zika virus infection and normal head size (less than or equal to 2 standard deviations [SD] below the mean for sex and gestational age) at birth (during October 2015–January 2016) are included in this report. The infants were evaluated by multidisciplinary teams at two referral centers in Brazil: the Rehabilitation Center of Association for Assistance of Disabled Children of Pernambuco, Recife, Pernambuco State, and the Infantil Albert Sabin Hospital, Fortaleza, Ceará State during the months of October 2015–October 2016.

Eleven of the infants came to clinical attention because their birth head circumference was below the level established by the Brazilian Ministry of Health as requiring further evaluation for possible congenital Zika virus infection (http://combateaedes.saude.gov.br/images/sala-de-situacao/Microcefalia-Protocolo-de-vigilancia-e-resposta-10mar2016-18h.pdf). This level was 33 cm before December 2, 2015, and 32 cm for gestational age ≥37 weeks after that date; however, all of these infants had head circumferences at birth that did not exceed 2 SD below the mean for gestational age, and therefore did not meet the definition for microcephaly (more than 2 SD below the mean). These 11 infants were referred for neurologic evaluation and neuroimaging. The remaining two infants who had head circumferences in the normal range at birth were referred for neurologic evaluation at ages 5 and 7 months because of developmental concerns.

A standard form was used to collect demographic and clinical information, including whether the mothers recalled having had a rash during pregnancy. All information was obtained as part of the clinical protocol or as the result of clinical indication. Informed consent was obtained for the collection, use, and publication of clinical photographs of the infants.

Laboratory evidence of congenital Zika virus infection was defined as negative laboratory test results for five infectious causes of congenital microcephaly (toxoplasmosis, cytomegalovirus, rubella, syphilis and human immunodeficiency virus) and serologic evidence of Zika virus infection (a positive Zika virus-specific immunoglobulin M (IgM) capture enzyme–linked immunosorbent assay (MAC-ELISA) result on infant cerebrospinal fluid [CSF] or serum). Conventional reverse transcription–polymerase chain reaction (RT-PCR) was performed for the detection of Zika virus and dengue virus RNA, and real-time RT-PCR was performed for chikungunya virus in the Recife location. Monoplex real-time RT-PCR for Zika virus was performed in the Fortaleza location (*5*,*6*). Maternal testing for evidence of Zika virus infection was not available during the time of the 13 pregnancies.

For this report, microcephaly was defined as head circumference (HC) (also known as occipitofrontal circumference) more than 2 SD below the mean for gestational age and sex, according to the Fetal International and Newborn Growth Consortium

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for the 21st Century (INTERGROWTH-21st) for fetal and newborn growth (https://intergrowth21.tghn.org/) and the World Health Organization Child Growth Standards for infants (www.who.int/childgrowth/en/). Birth weight was evaluated and classified as appropriate, small, or large for gestational age and sex, also using INTERGROWTH-21st standards.

All infants had clinical neurologic and orthopedic evaluations, and brain imaging with computerized tomography (CT) scan without contrast, magnetic resonance imaging (MRI) without contrast, or both, and radiographs of the hips to identify congenital dislocation. In addition, all infants had clinical noninstrumental evaluation of dysphagia by a speech therapist, ophthalmologic examination with ophthalmoscopy assessment, and 11 of 13 infants had auditory evaluation by screening (auditory short latency brainstem evoked response [ABR] to click stimuli) and diagnostic tests (confirmatory frequency-specific ABR with tone burst stimuli) using the routine recommended by Brazilian Heath Ministry and the American Academy of Pediatrics Joint Committee on Infant Hearing (*7*). Infants clinically suspected of having seizure activity had an electroencephalogram to confirm.

The case series included nine male infants and four female infants (Table 1). Eleven patients were born at term (37–41 weeks' gestation) and two were preterm (35 and 36 weeks' gestation). Six of 13 mothers described a cutaneous rash between the second and fifth months of pregnancy. All infants had birth weights that were appropriate for gestational age (i.e., within 2 SD of the mean for sex and gestational age). Craniofacial disproportion was noted in six infants; three had redundant skin on the scalp at birth. Three infants had hip dysplasia, including one infant with arthrogryposis who had bilateral dislocated hips.

All infants had positive tests for Zika virus–specific IgM in either CSF only (nine infants), serum only (two infants) or CSF and serum (two infants). Seven CSF specimens were tested for Zika virus RNA by RT-PCR and all were negative; two of these infants also had negative RT-PCR testing in serum collected at the same time as CSF. RT-PCR testing results on the two serum-only specimens are pending. No Zika virus testing was performed on urine. Most infants (eight of 13) were tested within the first month of life; however, the date of testing of CSF for two infants is not known. Three infants were tested for Zika virus outside the neonatal period. Although identified at birth because of head size, one infant was not tested until age 4 months; two infants were tested at ages 5 months and 7 months when they were first evaluated because of developmental delay. One infant with both CSF and serum IgM testing positive at birth tested negative on serum re-testing at 6 months of age; another remained positive on re-testing at age 5 months.

HCs at birth ranged from 0.30 to -2.00 SD from the mean for gestational age and sex (Table 1). All infants showed a decrease in the rate of HC growth between birth and the time of the last examination. In 11 of 13 infants, postnatal microcephaly was diagnosed because of an HC measurement more than 2 SD below the mean for age and sex. Neuroimaging (CT scan in 13 infants and MRI in 10 infants) showed malformations of cortical development, which were most predominant anteriorly, and calcifications, predominantly in the subcortical region (especially in the transition area between the cortex and white matter). All neuroimaging showed evidence of decreased brain volume, with ventriculomegaly in all infants, and increased extra-axial CSF space in two of 13 infants (Table 2) (Figure).

Dysphagia was found on clinical evaluation in 10 of 13 infants. Seven infants had a diagnosis of epilepsy. Five infants had some degree of irritability, which improved by age 4 months. Most infants (12 of 13) had good visual interaction; one infant exhibited no eye contact. Three of 13 infants had chorioretinal abnormalities. All 11 infants tested had normal hearing evaluations. All infants had some degree of hypertonia; 12 of 13 had pyramidal and extrapyramidal signs with dystonic movement. One infant had spastic hemiparesis and another had bilateral hemiparesis, more severe on the left side. One infant with arthrogryposis was difficult to assess because of increased tone in some muscles and decreased in others. Nine of 13 infants had no voluntary movement of the hands and had a grasp reflex. Good head control was present in eight of 13 infants (supplemental material at https://stacks.cdc.gov/view/cdc/42517).

Discussion

Congenital microcephaly has been a hallmark of intrauterine infection with Zika virus. However, despite the absence of microcephaly at birth, the 13 infants in this report with laboratory evidence of Zika virus infection had brain abnormalities associated with congenital Zika syndrome, including ventriculomegaly and decreased brain volume, cortical malformations and subcortical calcifications, underscoring the importance of neuroimaging in evaluating these infants. In addition some infants had other structural or functional abnormalities that might have brought them to medical attention regardless of their head size; however, these findings did not occur more frequently in infants with the smallest HCs. Congenital Zika virus infection without microcephaly at birth previously has been reported (*8*), as has postnatal development of microcephaly in infants presumed to be infected congenitally (*9*). However, this is the first series of infants with laboratory evidence of congenital Zika virus infection documented to have poor head growth with microcephaly developing after birth.

Decreases in the rate of head growth postnatally in these infants was accompanied by significant neurologic dysfunction,

TABLE 1. Clinical history and physical findings from 13 infants with congenital Zika infection without microcephaly at birth — Brazil, October 2015–October 2016

Patient no.	Sex	Gestational age (wks)	Birth weight (gm)	Reported prenatal ultrasound abnormalities*	Maternal rash	Infant Zika virus IgM antibody by ELISA	Birth HC (cm) and (SD†)	Age (mos) at last follow-up	Follow-up HC (cm) and (SD§)	Ocular findings¶	Craniofacial disproportion at birth**	Arthrogryposis or hip dysplasia at birth††
1	F	35	2,570	no	3 mo.	CSF, serum +	29.5 (-1.72)	11	39 (-3.86)	no	yes	no
2	M	38	3,125	yes	2 mo.	CSF +	33.0 (-0.40)	10	41 (-3.33)	yes	no	yes
3	M	39	2,770	no	none	CSF, serum +	32.0 (-1.63)	11	43 (-2.11)	no	no	no
4	M	37	2,785	yes	2 mo.	CSF +	31.0 (-1.65)	10	43 (-1.98)	no	yes	no
5	F	37	2,465	yes	5 mo.	CSF +	31.0 (-1.39)	12	36 (-6.18)	no	yes	no
6	M	39	2,975	no	4 mo.	CSF +	33.0 (-0.78)	11	42 (-2.89)	no	no	no
7	M	39	3,840	no	none	CSF +	33.0 (-0.78)	12	40 (-4.68)	no	yes	yes
8	F	41	2,955	no	none	CSF +	32.0 (-1.95)	9	39.5 (-3.17)	no	no	yes
9	M	39	3,155	no	3 mo.	CSF +	33.5 (-0.35)	11	42.5 (-2.50)	no	no	no
10	M	40	3,100	no	none	CSF +	32.0 (-2.00)	10	40 (-4.27)	yes	yes	no data
11	M	38	2,965	no	none	CSF +	33.5 (0.02)	7	40 (-2.98)	no	no	no data
12	F	36	2,930	no	none	serum +	32.5 (0.30)	7	40.5 (-1.35)	no	no	no
13	M	40	2,990	no	none	serum +	33.0 (-1.16)	5	40 (-2.12)	yes	yes	no

Abbreviations: CSF = cerebrospinal fluid; ELISA = enzyme-linked immunosorbent assay; F = female; HC = head circumference; IgM = immunoglobulin M; M = male; SD = standard deviation.

* Abnormalities include brain calcifications (patient 2), microcephaly (patient 4), and decreased brain volume with ventriculomegaly (patient 5).

† Standard deviations calculated using INTERGROWTH-21st Newborn Size Application Tool (https://intergrowth21.tghn.org/global-perinatal-package/intergrowth-21st-comparison-application/).

§ Standard deviations calculated using PediTools for World Health Organization growth standard for age 0–24 months (http://peditools.org/growthwho/index.php).

¶ Abnormalities include macular chorioretinal atrophic lesion in right eye (patient 2), discrete chorioretinal macular atrophy in left eye (patient 10), and macular atrophy in left eye (patient 13).

** Abnormalities include redundant scalp (patients 5, 10, 13).

†† Abnormalities include arthrogryposis (patient 2), hip dysplasia (patients 2, 7, 8) and diaphragmatic weakness (patient 2).

TABLE 2. Neuroimaging findings by computerized tomography (CT) and magnetic resonance (MR) for 13 infants with congenital Zika infection without microcephaly at birth — Brazil, October 2015–October 2016

Patient no.	Type of imaging* (age performed)	Decreased brain volume	Malformations of cortical development	Most affected lobes†	Cerebellum or brainstem hypoplasia	Corpus callosum hypoplasia†	Ventriculo-megaly	Increased extra-axial CSF space	Calcifications§
1	CT (1 mo.) MR (4 mo.)	yes	yes	right anterior	yes	yes	yes	no	subcortical and basal ganglia
2	CT (1 wk.) MR (2 mo.)	yes	yes	bilateral diffuse	yes	no	yes	no	subcortical, basal ganglia
3	CT (2 days) MR (1 wk.)	yes†	yes†	right diffuse	no	yes	yes	no	subcortical
4	CT (1 day) MR (7.5 mo.)	yes	yes	unknown	yes	unknown	yes	no	subcortical and basal ganglia
5	CT (3 days) MR (12 mo.)	yes	yes	bilateral diffuse	yes	yes	yes	yes	subcortical and basal ganglia
6	CT (3 days) MR (3.5 mo.)	no	yes†	bilateral anterior	no	yes	yes	no	subcortical
7	CT (2 wks.) MR (9 mo.)	yes	yes	bilateral diffuse	no	yes	yes	yes	subcortical
8	CT (2 mo.)	yes	yes	unknown	no	yes	yes	no	subcortical and basal ganglia
9	CT (3 days) MR (6 mo.)	yes	yes	bilateral anterior	no	no	no	no	subcortical
10	CT (3 mo.)	yes	yes	bilateral diffuse	no	not assessed	yes	no	basal ganglia
11	CT (7 mo.)	yes	yes	bilateral diffuse	no	not assessed	yes	yes	subcortical
12	CT (1 mo.) MR (9 mo.)	yes	yes	bilateral diffuse	no	yes	no	no	subcortical
13	CT (2 mo.) MR (11 mo.)	yes	yes	bilateral diffuse	no	yes	yes	no	subcortical

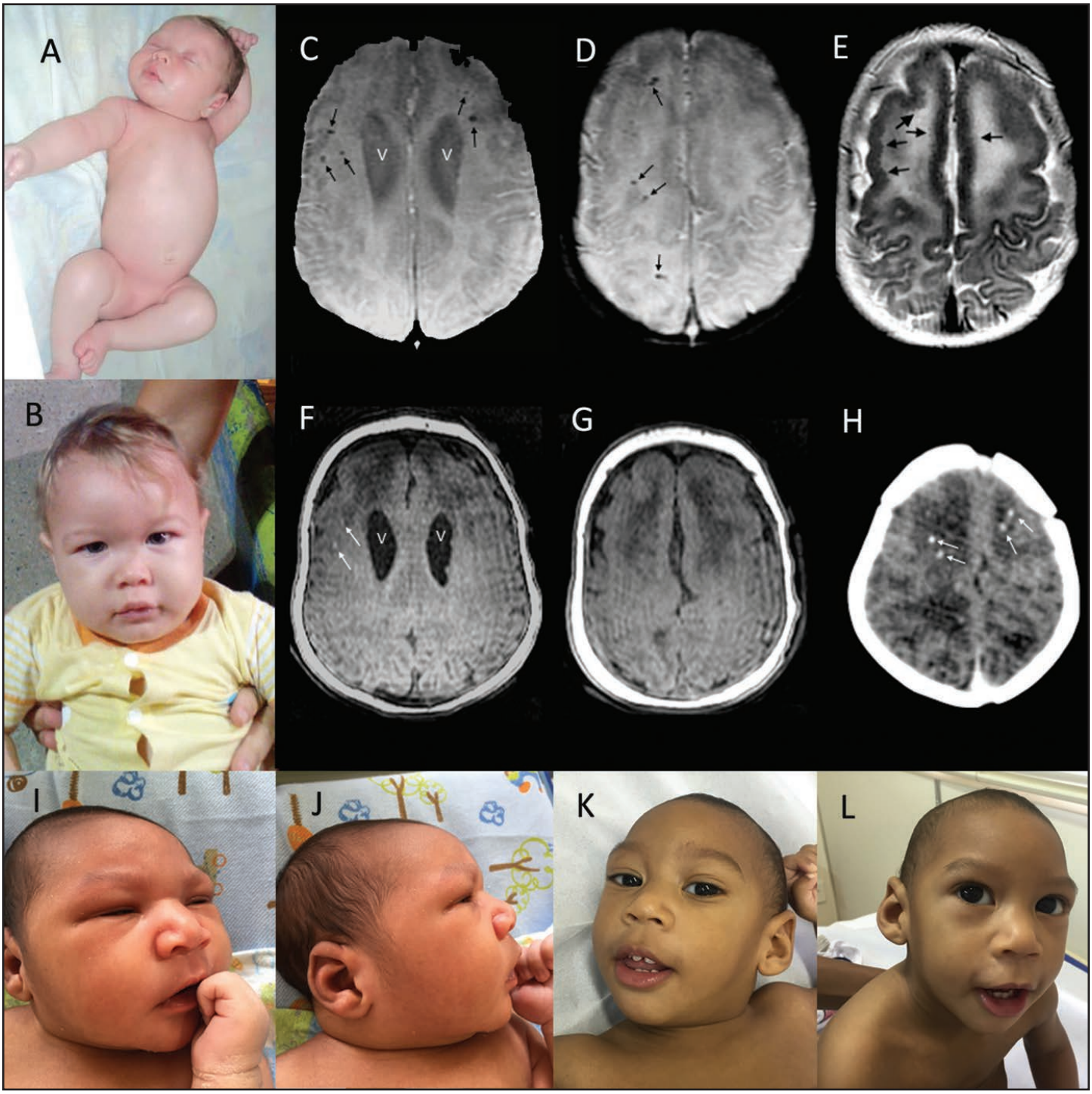
Abbreviations: CT = computed tomography; MR = magnetic resonance.

* Findings for infants evaluated both by CT and MR are consistent unless otherwise noted.

† Based on MR.

§ Based on CT.

FIGURE. Clinical photographs and magnetic resonance (MR) and computed tomography (CT) images of two infants with congenital Zika syndrome* — Brazil, October 2015–October 2016



* **A.** A newborn (patient 6 in Table 2) with no discernable anomalies including no craniofacial disproportion and normal limbs. **B.** Same infant at 11 months with head circumference at almost 3 standard deviations below the mean but no apparent craniofacial anomalies. **C.D.** Axial susceptibility-weighted images at 3.5 months show enlarged lateral ventricles (V) and multiple calcifications (small black arrows). **E.** T2-weighted image shows thickened frontal cortex with reduced frontal sulcation. Slight irregularities of the inner cortical surfaces of the frontal lobes (black arrows), consistent with polymicrogyria. **F.G.** On T1-weighted images the ventricles (V) are slightly more apparent and two of the larger calcifications (white arrows) are seen as areas of hyperintensity. **H.** Noncontrast axial CT from an earlier scan at 3 days shows streak artifacts from patient motion and multiple frontal white matter calcifications (white arrows). **I.J.** Newborn (patient 7 in Table 2) with slightly depressed frontal regions and sloping forehead noted in **I.** but less evident in **J.**, the lateral view. **K.L.** At 12 months, photographs show clear microcephaly but also an engaged infant with good eye contact.

including hypertonia and hemiparesis, dyskinesia/dystonia, dysphagia, epilepsy, and persistence of primitive reflexes. Although these neurologic findings are consistent with previous reports of infants with congenital microcephaly who had prenatal exposure to Zika virus (*2*), infants who did not have microcephaly at birth showed better social interaction (i.e., they made and held eye contact and had a social smile). However, more than 60% of infants in this series had epilepsy (likely related to the cortical malformations), and all had significant motor disabilities consistent with mixed cerebral palsy (*10*). The infants were too young to be adequately assessed for cognitive deficits.

Among the six mothers who reported a rash, four reported rash in the first trimester and two in the second trimester. Therefore, among these mothers, early occurrence of the presumed infection during pregnancy did not result in the most severe congenital Zika phenotype (i.e., microcephaly at birth). Only three infants were reported to have a history of prenatal ultrasound abnormalities consistent with congenital Zika virus infection.

The pathogenesis of postnatal microcephaly from congenital Zika virus infections is not known. The decrease in head growth might be the consequence of earlier in utero destruction of neuroprogenitor or other neural cells, persistent inflammatory response-associated molecules, or continued infection of neural cells. The last seems less likely given the negative Zika virus RT-PCR results in all seven tested CSF samples.

The findings in this report are subject to at least four limitations. First, birth HC measurements were recorded with a resolution of 0.5 cm (in contrast to the customary 0.1 cm), which likely resulted in either overestimate or underestimate of the measure in some infants. Two infants had a birth HC that was at or slightly less than 2 SD below the mean, and their HCs could have been misclassified as falling within the normal range. In addition, calculations of SD can vary among the published growth standards for HC. Second, Zika IgM testing was not confirmed by plaque reduction neutralization testing; therefore, infants could have been misclassified because of cross-reactivity with other flaviviruses or nonspecific reactivity within the ELISA. Third, based on this clinical series alone, the birth prevalence of congenital Zika syndrome without microcephaly in the population cannot be estimated. Finally, because serial neuroimaging in an infant is not clinically indicated, progressive changes such as the rate of brain volume loss cannot be assessed.

Additional information is needed to fully describe the clinical spectrum of findings associated with congenital Zika virus infection. This report documents that microcephaly at birth is not an essential hallmark of congenital Zika syndrome. Infants with normal HC at birth have brain and other abnormalities associated with congenital Zika syndrome and might develop microcephaly after birth. These findings demonstrate the importance of early neuroimaging for infants exposed to Zika virus prenatally and the need for comprehensive medical and developmental follow-up.

Summary

What is already known about this topic?

Congenital Zika virus infection can cause microcephaly and severe brain abnormalities. As more information about the associated clinical syndrome becomes available, the phenotype is expanding to include other, sometimes less severe features, such as brain abnormalities without congenital microcephaly.

What is added by this report?

Although infants with congenital Zika virus infection who have a normal head size have been described in large series, sufficient description of the features of congenital Zika syndrome in these infants has not been available. This report of a series of 13 infants with laboratory evidence of congenital Zika virus infection with normal head size at birth includes the findings from extensive imaging, neurologic, ophthalmologic, auditory, and orthopedic examinations. Follow-up of these infants has shown that for most, head growth deceleration occurs to the point of microcephaly after birth and significant neurologic sequelae are evident.

What are the implications for public health practice?

Additional information is needed to fully describe the spectrum of findings associated with congenital Zika virus infection; however, microcephaly might not be evident at birth but can develop after birth in infants with underlying brain abnormalities. These findings underscore the importance of early neuroimaging for infants exposed to Zika virus prenatally.

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References

1. de Araújo TV, Rodrigues LC, de Alencar Ximenes RA, et al. Association between Zika virus infection and microcephaly in Brazil, January to May, 2016: preliminary report of a case-control study. Lancet Infect Dis 2016. Epub September 15, 2016.
2. Moore CA, Staples JE, Dobyns WB, et al. Characterizing the pattern of anomalies in congenital Zika syndrome for pediatric clinicians. JAMA Pediatr 2016. http://dx.doi.org/10.1001/jamapediatrics.2016.3982
3. Schuler-Faccini L, Ribeiro EM, Feitosa IM, et al. Possible association between Zika virus infection and microcephaly—Brazil, 2015. MMWR Morb Mortal Wkly Rep 2016;65:59–62. http://dx.doi.org/10.15585/mmwr.mm6503e2
4. Russell K, Oliver SE, Lewis L, et al. Update: interim guidance for the evaluation and management of infants with possible congenital Zika virus infection—United States, August 2016. MMWR Morb Mortal Wkly Rep 2016;65:870–8. http://dx.doi.org/10.15585/mmwr.mm6533e2
5. Lanciotti RS, Calisher CH, Gubler DJ, Chang GJ, Vorndam AV. Rapid detection and typing of dengue viruses from clinical samples by using reverse transcriptase-polymerase chain reaction. J Clin Microbiol 1992;30:545–51.
6. Lanciotti RS, Kosoy OL, Laven JJ, et al. Genetic and serologic properties of Zika virus associated with an epidemic, Yap State, Micronesia, 2007. Emerg Infect Dis 2008;14:1232–9. http://dx.doi.org/10.3201/eid1408.080287
7. American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: principles and guidelines for early hearing detection and intervention programs. Pediatrics 2007;120:898–921. http://dx.doi.org/10.1542/peds.2007-2333
8. França GV, Schuler-Faccini L, Oliveira WK, et al. Congenital Zika virus syndrome in Brazil: a case series of the first 1501 livebirths with complete investigation. Lancet 2016;388:891–7. http://dx.doi.org/10.1016/S0140-6736(16)30902-3
9. Moura da Silva AA, Ganz JSS, Sousa PD, et al. Early growth and neurologic outcomes of infants with probable congenital Zika virus syndrome. Emerg Infect Dis 2016;22:1953–6. http://dx.doi.org/10.3201/eid2211.160956
10. Wimalasundera N, Stevenson VL. Cerebral palsy. Pract Neurol 2016;16:184–94. http://dx.doi.org/10.1136/practneurol-2015-001184

Notes from the Field

Large Tuberculosis Contact Investigation Involving Two Hospitals — Okaloosa County, Florida, 2014

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On June 2, 2014, the Director of the Florida Department of Health in Okaloosa County (DOH-Okaloosa) was notified by the infection control practitioner (ICP) at hospital A that four nurses working on the same unit were noted during March–May 2014 to have conversions of tuberculin skin test (TST) results. All four nurses had negative TSTs in 2013, but had induration ranging from 8 mm* to 16 mm during March–May (*1*). Results from follow-up interferon gamma release assays (IGRA) were also positive† (*2–4*). Hospital A was historically considered to be at low risk for tuberculosis according to annual risk assessments (*1*) and had not had any TST conversions among staff members in more than a decade. The testing schedule at hospital A included TSTs for all newly hired employees and random TSTs on hospital staff members from various units throughout the year.

On the basis of a review of annual TST testing results, including zero staff member conversions among 70 random TSTs performed during the first quarter of 2014, the hospital A ICP concluded that tuberculosis transmission had probably recently occurred on the unit where the four nurses worked. The ICP determined from employee screening records that one of the four nurses had tested negative upon hire in August 2013, and had converted by May 2014. This 9-month window represented the shortest period within which to research potential exposure to undiagnosed tuberculosis. The ICP used nurse staff schedules to review medical records of patients cared for by all four nurses, and identified a United States-born, HIV-negative male patient in his early 60s with chronic obstructive pulmonary disease and a history of alcohol and substance abuse as the possible index patient.

The patient had been brought to hospital A on November 16, 2013, after being found unresponsive in his home and received a preliminary diagnosis of aspiration pneumonia. Although his chest radiograph showed pulmonary cavities, tuberculosis was not suspected. No sputum specimens were collected, and the patient was treated with levofloxacin and other broad-spectrum antibiotics. The patient received care on three different units in hospital A, until his discharge on January 27, 2014. Approximately 1 week later, he was admitted to hospital B, where he received care on four different units. Sputum specimens were collected during the patient's admission at hospital B; however, all three acid-fast bacilli smears were negative, and the pending cultures were discarded when the patient died on April 1, 2014. The putative cause of death was listed as respiratory failure, secondary to cardiac arrest. No post-mortem examination was performed.

Contact investigations were initiated on June 10, 2014, (hospital A) and June 18, 2014, (hospital B). Investigators reviewed nursing staff schedules to identify contacts of the putative source patient (*5*). Investigators also reviewed the patient's records from both hospitals. Factors considered when prioritizing hospital contacts included frequency and duration of contact with the patient; the contact's age and immune status; environmental factors; and participation in tracheal intubation and percutaneous endoscopic gastronomy tube suctioning, as these procedures can generate aerosols (*5*). Because tuberculosis transmission was believed to have occurred at hospital A, contacts at high risk included all of the patient's direct caregivers (nurses, nursing assistants, and staff members who had spent at least 8 cumulative hours with the patient), the patient's roommates, and staff members who had shared air with the patient but did not have direct contact with him, including anyone assigned to the units where the patient stayed. At hospital B, the investigation focused only on the patient's direct caregivers and roommates.

At both hospitals, a TST was recommended for all contacts at high risk with no history of a positive TST or IGRA test result, and who had never received a Bacillus Calmette-Guérin (BCG) vaccine, which can cause a false-positive reaction to the TST. IGRAs were recommended for persons who were tested with an IGRA upon hire or who had previously received a BCG vaccine (*1,2*). IGRAs were also used as a secondary test for persons who developed a TST induration <10 mm. A symptom-based assessment was conducted for contacts with a past positive TST or IGRA. Chest radiographs were obtained for persons with TST induration ≥10 mm, a positive IGRA

* Before investigations began, 8 mm would have been classified as a negative result; however, in the context of three other positive tuberculin skin test conversions (>10 mm) among nurses on the same unit, an 8 mm induration in a nurse with a 0 mm TST result upon hire the previous year was considered positive.

† CDC generally recommends against using IGRAs as "confirmatory" tests after a positive TST result, except on a case-by-case basis. It was decided to use IGRAs to confirm the positive TST results in this investigation to determine whether TST conversions might have been because of hospital A's switch from Tubersol (Sanofi Pasteur Limited) purified protein derivative (PPD) tuberculin skin test antigen solution to Aplisol (JHP Pharmaceuticals, LLC) PPD TST antigen solution during a Tubersol shortage from late 2012 to April 2013. According to CDC, TST conversions could be caused by "inherent interproduct or intermethod variability."

result, or symptoms consistent with tuberculosis disease, or history of a positive TST or IGRA result (*5*).

In total, 244 hospital contacts and seven community contacts were sought for examination. Among 177 contacts from hospital A, and 67 from hospital B, 169 (95%) and 62 (93%), respectively, were tested, or had a documented tuberculosis test with a negative result approximately 12 weeks[§] after exposure to the suspected source patient. Thirteen hospital workers (5%) who were no longer employed by the hospitals could not be contacted, despite three attempts by DOH-Okaloosa or hospital personnel. During the hospital A investigation, two additional nurses assigned to the same unit as the original four nurses with TST conversions were found to have positive TST results, bringing the total to six (3%) conversions among 244 hospital staff members tested from both hospitals. Review of nurse staffing records indicated that the six nurses had spent a median duration of 82 hours (range = 12–204 hours) with the suspected source patient at hospital A during November 2013–January 2014; he was presumed to be most infectious early in his hospitalization, before initiation of antibiotic therapy, including levofloxacin.

On the basis of the low number of conversions identified at hospital A, and because the conversions occurred only among nurses who had spent extended periods of time in the suspected source patient's room, testing was not expanded to other persons at hospital A. No conversions were identified at hospital B. Three of four roommates of the suspected source patient from both hospitals were tested; all had negative results. One roommate died of other causes. Three of the seven community contacts had positive results. One contact received treatment for latent tuberculosis infection, one was treated as a clinical tuberculosis disease case until cultures were reported as negative, and the third contact was an out-of-state resident with symptoms consistent with tuberculosis disease identified via a phone interview. The appropriate state health agency was notified through an interjurisdictional transfer, which allowed for follow-up by the state of jurisdiction.

The DOH-Okaloosa's relationships with local ICPs were essential for the successful investigation of this cluster. Earlier consideration of tuberculosis might have reduced tuberculosis transmission at hospital A. This investigation highlights the importance of considering tuberculosis in differential diagnoses, even in counties where tuberculosis is uncommon and when patients are admitted for reasons other than tuberculosis, if patients have findings suggestive of tuberculosis, such as pulmonary cavities.

[§] The recommended period between most recent exposure and final tuberculin skin testing is 8–10 weeks (http://www.cdc.gov/Mmwr/preview/mmwrhtml/rr5415a1.htm). A conservative time period of 12 weeks was used during this investigation, although this is not routine practice.

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References

1. Jensen PA, Lambert LA, Iademarco MF, Ridzon R. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health care settings, 2005. MMWR Recomm Rep 2005;54(No. RR-17).
2. Mazurek GH, Jereb J, Vernon A, LoBue P, Goldberg S, Castro K; IGRA Expert Committee. Updated guidelines for using interferon gamma release assays to detect *Mycobacterium tuberculosis* infection—United States, 2010. MMWR Recomm Rep 2010;59(No. RR-5).
3. Mazurek GH, Jereb J, Lobue P, et al. Guidelines for using the QuantiFERON-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. MMWR Recomm Rep 2005;54(No. RR-15).
4. CDC. Extent and effects of recurrent shortages of purified-protein derivative tuberculin skin test antigen solutions—United States, 2013. MMWR Morb Mortal Wkly Rep 2013;62:1014–5.
5. The National Tuberculosis Controllers Association; CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis. Recommendations from the National Tuberculosis Controllers Association and CDC. MMWR Recomm Rep 2005;54(No. RR-15).

Notes from the Field

Adverse Reaction After Vaccinia Virus Vaccination — New Mexico, 2016

Nicole Middaugh, ScD[1]; Brett Petersen, MD[2]; Andrea M. McCollum, PhD[2]; Chad Smelser, MD[3]

On February 4, 2016, the New Mexico Department of Health (NMDOH) was contacted regarding a patient who had received ACAM2000* smallpox (vaccinia) vaccine 12 days earlier as part of an institutional review board–approved study at a plasma donation center and had numerous lesions surrounding the inoculation site and on the opposite arm, back, and abdomen. ACAM2000 is a live-virus vaccine indicated for active immunization against smallpox. Vaccinia virus is highly effective in preventing smallpox by stimulating an immune response to the closely related *Orthopoxvirus*. The inoculation site is considered infectious until the scab falls off and intact skin has regrown (2–4 weeks) (*1*,*2*). The patient, a man aged 57 years, had no ocular, oral, nasal, or genital lesions. He enrolled in the study on January 22, after meeting inclusion criteria and not having a condition that precluded vaccination (immunosuppression, heart disease, or history or presence of eczema) (*1*). The vaccination study objective was to induce production of high antivaccinia virus antibody titers for the collection of plasma to be used in manufacturing vaccinia immune globulin intravenous (VIGIV), which is produced by removing and purifying antivaccinia antibodies from plasma of persons with immunity to smallpox.

Adverse reactions to vaccinia vaccination range from mild and self-limited to severe and life-threatening, including inoculation site signs and symptoms, constitutional symptoms, generalized vaccinia, eczema vaccinatum, and progressive vaccinia (*1*,*3*). The most frequent complication is inadvertent inoculation at other sites (self and contacts) (*2*–*4*) with an estimated occurrence rate of 42.1 cases per 1 million vaccinations (*1*). Autoinoculation, the unintentional transfer of virus from the vaccination site to elsewhere on the vaccinee's body, can occur from hands or fomites; the most common nonocular transfer sites are the arm, elbow, and shoulder (*2*,*3*). Autoinoculation lesions progress through the same stages as the vaccination site lesion; when autoinoculation occurs >5 days postvaccination, lesions and progression are often attenuated (*2*,*3*).

Study participants received instructions regarding proper inoculation site management and hand hygiene and materials for wound care. On February 3, (day 11 postvaccination), the patient reported a fever of 101°F (38°C) and three lesions near the inoculation site. On February 4, he arrived at the plasma center with numerous lesions surrounding the inoculation site and 20–30 lesions on his contralateral arm, abdomen, and back. Plasma center personnel requested NMDOH assistance in arranging possible hospital admission for VIGIV treatment.

After consulting CDC's Poxvirus and Rabies Branch, NMDOH interviewed the patient and plasma center personnel, communicated with the local hospital and its infectious disease consultant, assessed the patient's residence, and collected specimens from the inoculation site and surrounding lesions. The patient lived alone in a communal apartment building with shared bathrooms, kitchen, laundry facility, and fitness center. He showered in an older unit with limited use by other residents and did not share linens or towels, cook, or use the gym. He had a private bedroom, did not share his bed, and did not report any visits by friends or family members to his single-room apartment. He reported cleaning around the inoculation site with alcohol wipes when changing the dressing. On the basis of the patient interview and review of photos of the transferred lesions, neither hospitalization nor treatment with VIGIV was recommended. The plasma donation center reported the event to the Vaccine Adverse Events Reporting System (VAERS).†

DNA for both *Orthopoxvirus* and nonvariola *Orthopoxvirus* was detected from the patient's specimens, consistent with ACAM2000 vaccination. The patient's lesions likely resulted from inadvertent autoinoculation caused by handling the area around the vaccination site during redressing. To prevent additional direct or indirect transmission, NMDOH advised the patient regarding proper vaccination site bandaging and hand hygiene, cleaning communal spaces (e.g., shower and sinks) with bleach, doing his own laundry, and refraining from gym use until all lesions resolved.

Although inadvertent inoculation is a recognized adverse event following vaccination with vaccinia virus, neither NMDOH nor four of five other public health departments were aware that this study was being conducted, demonstrating the need for communication among commercial sites and state and local health departments to ensure establishment of mutually acceptable patient care protocols. Coordination among the patient, plasma center personnel, hospital, infectious disease consultants, and NMDOH helped prevent spread to others. Adverse events occurring after receipt of vaccines should be reported to VAERS.

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† https://vaers.hhs.gov/index.

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References

1. Food and Drug Administration. Highlights of prescribing information. ACAM2000 (smallpox [vaccinia] vaccine, live). Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2015. http://www.fda.gov/downloads/BiologicsBloodVaccines/Vaccines/ApprovedProducts/UCM142572.pdf
2. Tack DM, Karem KL, Montgomery JR, et al. Unintentional transfer of vaccinia virus associated with smallpox vaccines: ACAM2000 compared with Dryvax. Hum Vaccin Immunother 2013;9:1489–96. http://dx.doi.org/10.4161/hv.24319
3. Casey C, Vellozzi C, Mootrey GT, et al.. Surveillance guidelines for smallpox vaccine (vaccinia) adverse reactions. MMWR Recomm Rep 2006;55(No. RR-1).
4. Wenger P, Oleske JM, Kohl KS, et al. Inadvertent inoculation as an adverse event following exposure to vaccinia virus: case definition and guidelines for data collection, analysis, and presentation of immunization safety data. Vaccine 2007;25:5754–62. http://dx.doi.org/10.1016/j.vaccine.2007.02.087

Announcement

National Influenza Vaccination Week — December 4–10, 2016

The U.S. Department of Health and Human Services, CDC, state and local health departments, and other partners will observe National Influenza Vaccination Week during December 4–10, 2016, with educational and promotional activities across the country. Beginning in 2005, National Influenza Vaccination Week was established to highlight the importance of annual influenza vaccination and to foster greater use of influenza vaccine during the months of December, January, and beyond. Last season, almost half (45.6%) of the U.S. population aged ≥6 months are estimated to have received vaccination against influenza. This is a small decline of 1.5% since the previous season (47.1%), but close to what was seen during the 2013–2014 (46.2%).

As of November 10, 2016, approximately 129.2 million doses of 2016–17 seasonal influenza vaccine have been distributed to vaccination providers in the United States (*1*). The Advisory Committee on Immunization Practices (ACIP) recommends influenza vaccination for all persons aged ≥6 months, with rare exceptions. Because of its low effectiveness against influenza A(H1N1)pdm09 in the United States during the 2013–14 and 2015–16 seasons, ACIP made the interim recommendation that quadrivalent live attenuated influenza vaccine should not be used for the 2016–17 season (*2*).

Influenza vaccination is especially important for persons in certain groups who are at increased risk for influenza-related complications. Those persons at high risk include children aged <5 years, and especially children aged <2 years; persons with certain chronic health conditions, such as heart disease, asthma, and diabetes; pregnant women; and adults aged ≥65 years. Health care personnel are also at risk for acquiring and transmitting influenza to their patients (*3*). Information about events, web tools, and CDC's planned activities for National Influenza Vaccination Week are available at http://www.cdc.gov/flu/nivw/index.htm, and http://www.cdc.gov/flu/freeresources. Additional information and resources for health care professionals are available at http://www.cdc.gov/flu/professionals/index.htm. Influenza vaccination coverage estimates for 2015–16 are available at http://www.cdc.gov/flu/fluvaxview.

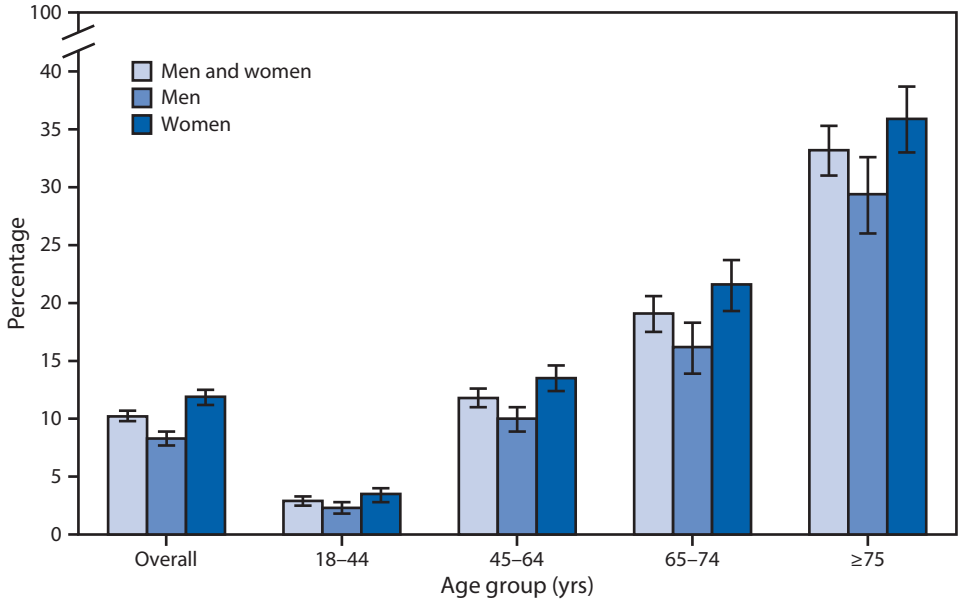
References

1. CDC. Seasonal influenza vaccine and total doses distributed. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. http://www.cdc.gov/flu/professionals/vaccination/vaccinesupply.htm
2. Grohskopf LA, Sokolow LZ, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP)—United States, 2016–17 influenza season. MMWR Recomm Rep 2016;65(No. RR-5). http://dx.doi.org/10.15585/mmwr.rr6505a1
3. Advisory Committee on Immunization Practices. Immunization of health-care personnel: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2011;60(No. RR-7).

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Adults Aged ≥18 Years Who Cannot or Find It Very Difficult to Stand or Be on Their Feet for About 2 Hours Without Using Special Equipment,† by Age Group and Sex — National Health Interview Survey,§ United States, 2015



* With 95% confidence intervals indicated with error bars.
† Based on the survey question that asked "By yourself, and without using any special equipment, how difficult is it for you to stand or be on your feet for about 2 hours?" The response categories consisted of "not at all difficult," "only a little difficult," "somewhat difficult," "very difficult," "can't do at all," or "do not do this activity." The response categories "very difficult" and "can't do at all" are combined for this chart.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Adult component.

A reported 10.2% of adults aged ≥18 years cannot, or find it very difficult to, stand or be on their feet for about 2 hours without using special equipment. The percentage of adults who reported this difficulty increased with age: 2.9% of those aged 18–44 years, 11.8% of those aged 45–64 years, 19.1% of those 65–74 years, and 33.2% of those aged ≥75 years. Overall, women were more likely (11.9%) than men (8.3%) to report this difficulty, and higher percentages were noted for women within each age group.

Source: National Health Interview Survey, 2015 (http://www.cdc.gov/nchs/nhis.htm).

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