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American Heart Month — February 2019

Heart disease is the leading cause of death for men and women in the United States, and heart attacks are a major category of heart disease; someone in the United States has a heart attack every 40 seconds (*1*). February is American Heart Month, an ideal time to remind all adults to focus on their hearts and encourage them, their families, friends, and communities to learn the important signs and symptoms of heart attack and how to respond. Recognizing that someone might be having a heart attack and calling emergency services (9-1-1) are crucial for optimizing access to lifesaving emergency cardiac care and receipt of advanced treatments and improving survival. Five common symptoms of a heart attack are 1) pain or discomfort in the jaw, neck, or back; 2) feeling weak, lightheaded, or faint; 3) chest pain or discomfort; 4) pain or discomfort in the arms or shoulder; and 5) shortness of breath. If someone is suspected to be having a heart attack, 9-1-1 should be called immediately.

A report in this issue of *MMWR* shows that, although the percentage of persons who are aware of all five heart attack symptoms increased from 39.6% in 2008 to 50.2% in 2017, sociodemographic disparities existed (*2*). Education is needed to more widely disseminate information about how to recognize a possible heart attack and contact lifesaving emergency services.

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Awareness of Heart Attack Symptoms and Response Among Adults — United States, 2008, 2014, and 2017

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Heart disease is the leading cause of death in the United States (*1*). Heart attacks (also known as myocardial infarctions) occur when a portion of the heart muscle does not receive adequate blood flow, and they are major contributors to heart disease, with an estimated 750,000 occurring annually (*2*). Early intervention is critical for preventing mortality in the event of a heart attack (*3*). Identification of heart attack signs and symptoms by victims or bystanders, and taking immediate action by calling emergency services (9-1-1), are crucial to ensure timely receipt of emergency care and thereby improve the chance for survival (*4*). A recent report using National

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Health Interview Survey (NHIS) data from 2014 found that 47.2% of U.S. adults could state all five common heart attack symptoms (jaw, neck, or back discomfort; weakness or lightheadedness; chest discomfort; arm or shoulder discomfort; and shortness of breath) and knew to call 9-1-1 if someone had a heart attack (*5*). To assess changes in awareness and response to an apparent heart attack, CDC analyzed data from NHIS to report awareness of heart attack symptoms and calling 9-1-1 among U.S. adults in 2008, 2014, and 2017. The adjusted percentage of persons who knew all five common heart attack symptoms increased from 39.6% in 2008 to 50.0% in 2014 and to 50.2% in 2017. The adjusted percentage of adults who knew to call 9-1-1 if someone was having a heart attack increased from 91.8% in 2008 to 93.4% in 2014 and to 94.9% in 2017. Persistent disparities in awareness of heart attack symptoms were observed by demographic characteristics and cardiovascular risk group. Public health awareness initiatives and systematic integration of appropriate awareness and action in response to a perceived heart attack should be expanded across the health system continuum of care.

NHIS is an annual survey that collects health-related information on the civilian, noninstitutionalized U.S. population (*6*). In 2008, 2014, and 2017, the survey asked questions about symptoms of a heart attack and the best action to take when someone was thought to be having a heart attack. Five yes/no questions assessed whether the respondent was aware of these five symptoms of heart attack: 1) pain or discomfort in the jaw, neck or back; 2) feeling weak, lightheaded, or faint; 3) chest pain or discomfort; 4) pain or discomfort in the arms or shoulder; and 5) shortness of breath. Respondents were then asked, "If you thought someone was having a heart attack, what is the best thing to do right away?" The appropriate response was "Call 9-1-1" (or another emergency number). The total sample sizes were 21,781 (2008), 36,697 (2014), and 26,741 (2017). After excluding approximately 1% of respondents with missing information, the final analytic samples were 21,525 (2008), 36,289 (2014), and 26,480 (2017).

Descriptive characteristics of respondents included sex, age, race/ethnicity, and the highest level of education achieved. History of coronary heart disease (a condition caused by narrowing of the arteries that supply blood to the heart) included a reported history of coronary heart disease, myocardial infarction, or angina pectoris. Five selected self-reported cardiovascular disease (CVD) risk factors included hypertension (high blood pressure), high blood cholesterol, diabetes, current smoking, and obesity (body mass index ≥30 kg/m^2 calculated from self-reported weight and height). Presence of CVD risk factors were evenly weighted and summed (0–5).

The prevalences of awareness of all five common heart attack symptoms, as well as the appropriate response when recognizing a heart attack (unadjusted and adjusted for age, sex, race/ethnicity, level of education, history of coronary heart disease, and number of CVD risk factors) were estimated overall and by selected demographic characteristics

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and CVD risk factors in 2008, 2014, and 2017. P-values for difference from 2008 to 2017 were obtained using the t-test; p-values <0.05 were considered statistically significant. Within-group comparisons for awareness and response were assessed by demographic characteristics and CVD risk factors in 2017 using the Wald F-test. SAS-callable SUDAAN (version 11.0, Research Triangle Institute) that accounted for the NHIS complex sample design, NHIS sampling weights, and design variables was used for all analyses.

During the three study years, the adjusted percentage of all survey respondents aware of the five common heart attack symptoms increased from 39.6% (2008), to 50.0% (2014), and to 50.2% (2017) (p-value for difference <0.001) (Table 1). Similar increases were observed in the unadjusted percentages and in all subgroups by demographic characteristics and CVD risk factors, except among those with four or five CVD risk factors. In 2017, knowledge of the five heart attack symptoms was lower among men, younger age groups, racial/ethnic minorities (especially non-Hispanic Asians and Hispanics), and persons with lower levels of educational attainment than among women, older adults, non-Hispanic whites, and adults with at least a high school education.

The adjusted percentage of survey respondents who knew to call 9-1-1 in the event of a suspected heart attack increased across the observation period, from 91.8% (2008) to 93.4% (2014), and to 94.9% (2017) (p-value for difference <0.001) (Table 2). A significant increase in prevalence of knowing to call 9-1-1 was observed in all demographic subgroups and CVD risk factors, except among non-Hispanic Asians and respondents with history of coronary heart disease. In 2017, the adjusted percentage persons of appropriately responding to a heart attack by calling 9-1-1 was lower among men, adults aged ≥65 years, non-Hispanic Asians, persons with less than a high school education, and those having four or five CVD risk factors than among women, adults aged 18–44 years and 45–64 years, non-Hispanic whites and non-Hispanic blacks, persons with at least a high school diploma, and those with fewer than four CVD risk factors.

Discussion

Delays in receipt of appropriate care lead to worse outcomes among heart attack victims (*3*). Although this nationally representative survey indicates improvement in the percentage of adults who know the signs and symptoms of a heart attack and to call 9-1-1 if they witness someone having a heart attack, in 2017, approximately half of respondents (50.2%) knew all five common heart attack signs and symptoms, and disparities in awareness and response exist among all demographic groups and by CVD risk status.

Summary

What is already known about this topic?

An estimated 750,000 heart attacks occur annually in the United States. Early intervention is critical in reducing morbidity and mortality. Improving public knowledge of the signs and symptoms of a heart attack can lead to improved survival and better outcomes.

What is added by this report?

Analysis of National Health Interview Survey data for 2008, 2014, and 2017 found that knowledge of five common signs and symptoms of a heart attack and the appropriate emergency response increased significantly (from 40% to 50% and from 92% to 95%, respectively); however, sociodemographic disparities in knowledge persist.

What are the implications for public health practice?

A multifaceted approach across clinical and community settings is needed to increase awareness.

Data from 14 states reporting in the 2005 BRFSS found that 85.8% of respondents had the knowledge to call 9-1-1 as the first action when witnessing a heart attack and 31% were aware of all five heart attack symptoms (*4*). Although the percentage of persons with this knowledge was higher in this study than in the 2005 BRFSS, disparities by sex, race/ethnicity and level of education persisted. Both the BRFSS data and estimates from this report identify a need for increased awareness regarding the signs and symptoms of one of the most common important health events that can occur in persons in the United States. Recognizing this need, the U.S. Department of Health and Human Services *Healthy People 2020* (HP2020) program included objectives specifically calling for an increase in the awareness of heart attack signs and symptoms and the appropriate response (*7*). Using the 2008 NHIS data as the HP2020 baseline, the target for awareness of five common heart attack symptoms was set at 43.6% (10% increase from the 2008 adjusted prevalence of 39.6%), and the target for knowing to call 9-1-1 if someone is having a heart attack was set at 93.8% (2% increase from 91.8%). Although data from the current study indicate that in 2017 these goals for awareness of heart attack symptoms (50.2%) and calling 9-1-1 (94.9%) were met overall, estimates for certain subpopulations remained below the HP2020 target, including racial/ethnic minorities and adults with less than a high school education.

Many educational efforts have historically been undertaken to promote increased awareness about and response to a heart attack. For example, CDC and other federal agencies, such as the National Heart, Lung and Blood Institute and principal nonfederal partners, such as the American Heart Association, have promoted awareness of and response to heart attacks

TABLE 1. Unadjusted and adjusted prevalence of knowledge of five common heart attack signs and symptoms by demographic characteristics, history of coronary heart disease (CHD), and number of cardiovascular disease (CVD) risk factors and change from 2008 to 2017 — National Health Interview Survey, United States, 2008, 2014, and 2017

	Unadjusted					Adjusted*				
Characteristic	2008 % (SE)	2014 % (SE)	2017 % (SE)	Percentage point change 2008 to 2017†	p-value (2008 versus 2017)	2008 % (SE)	2014 % (SE)	2017 % (SE)	Percentage point change 2008 to 2017†	p-value (2008 versus 2017)
Total	**39.4 (0.5)**	**49.9 (0.5)**	**50.4 (0.6)**	**10.9**	**<0.001**	**39.6 (0.5)**	**50.0 (0.5)**	**50.2 (0.5)**	**10.6**	**<0.001**
Sex§										
Men	35.5 (0.7)	45.9 (0.6)	45.9 (0.7)	10.4	<0.001	35.7 (0.6)	45.9 (0.6)	45.6 (0.6)	9.8	<0.001
Women	43.1 (0.7)	53.7 (0.6)	54.5 (0.7)	11.4	<0.001	43.3 (0.7)	53.8 (0.6)	54.4 (0.6)	11.2	<0.001
Age group (yrs)§										
18–44	32.5 (0.7)	41.8 (0.6)	43.5 (0.7)	11.0	<0.001	34.9 (0.7)	44.9 (0.7)	46.4 (0.7)	11.2	<0.001
45–64	46.7 (0.8)	57.3 (0.7)	55.6 (0.8)	8.9	<0.001	44.5 (0.8)	55.4 (0.7)	53.8 (0.8)	9.5	<0.001
≥65	45.3 (0.9)	56.7 (0.8)	57.4 (0.9)	12.1	<0.001	42.2 (0.9)	52.8 (0.8)	53.2 (0.9)	11.1	<0.001
Race/Ethnicity§,¶										
White	45.2 (0.6)	55.8 (0.6)	56.6 (0.6)	11.4	<0.001	44.6 (0.6)	54.5 (0.6)	54.8 (0.6)	10.2	<0.001
Black	30.0 (1.1)	44.2 (1.1)	42.7 (1.4)	12.8	<0.001	31.2 (1.1)	44.9 (1.0)	43.1 (1.3)	11.6	<0.001
Asian	25.2 (2.0)	30.1 (2.0)	33.1 (2.6)	8.0	0.015	25.7 (1.9)	30.7 (2.0)	33.5 (2.5)	7.6	0.017
Hispanic	22.7 (0.9)	34.1 (1.1)	35.2 (1.3)	12.5	<0.001	27.0 (1.1)	38.9 (1.1)	38.9 (1.3)	11.1	<0.001
Other	30.9 (2.2)	43.8 (1.8)	47.0 (2.1)	16.1	<0.001	31.6 (2.2)	43.3 (1.8)	46.4 (2.1)	15.2	<0.001
Education§										
Less than HS	28.3 (1.0)	39.3 (1.2)	40.5 (1.2)	12.1	<0.001	28.9 (1.0)	41.5 (1.2)	42.3 (1.2)	13.3	<0.001
HS graduate	39.5 (0.9)	49.2 (0.8)	47.9 (0.8)	8.5	<0.001	37.1 (0.8)	47.1 (0.8)	46.4 (0.8)	9.4	<0.001
Some college	44.9 (0.8)	55.8 (0.7)	54.2 (0.8)	9.3	<0.001	43.0 (0.8)	53.8 (0.7)	52.4 (0.8)	9.3	<0.001
College graduate	46.4 (1.0)	55.1 (0.7)	56.7 (0.8)	10.3	<0.001	45.5 (1.0)	54.0 (0.7)	56.0 (0.8)	10.5	<0.001
CHD,†† **										
With CHD	51.9 (1.4)	61.9 (1.5)	59.2 (1.4)	7.3	<0.001	47.2 (1.4)	56.9 (1.5)	53.7 (1.4)	7.6	<0.001
Without CHD	38.6 (0.6)	49.2 (0.5)	49.8 (0.6)	11.2	<0.001	39.1 (0.5)	49.5 (0.5)	49.9 (0.5)	10.8	<0.001
No. of CVD risk factors§,§§										
0	35.0 (0.8)	46.4 (0.7)	45.9 (0.8)	11.0	<0.001	36.9 (0.8)	48.5 (0.7)	47.8 (0.8)	10.9	<0.001
1	38.1 (0.8)	49.2 (0.7)	49.8 (0.8)	11.7	<0.001	38.6 (0.8)	49.5 (0.7)	49.9 (0.7)	11.2	<0.001
2	45.0 (0.9)	52.8 (0.9)	55.2 (0.9)	10.1	<0.001	42.8 (0.9)	50.5 (0.9)	52.6 (0.9)	9.7	<0.001
3	46.7 (1.4)	57.2 (1.2)	57.8 (1.2)	11.1	<0.001	43.8 (1.3)	54.1 (1.2)	54.4 (1.2)	10.8	<0.001
4–5	51.0 (2.3)	57.8 (1.8)	56.0 (1.8)	5.0	0.091	47.9 (2.3)	55.0 (1.8)	52.8 (1.8)	5.0	0.124

Abbreviations: HS = high school; SE = standard error.

* Adjusted by age, sex, race/ethnicity, education, history of CHD, and CVD risk factor.

† Estimates might differ from manual calculations because of rounding.

§ p<0.001 from Wald F of adjusted percentage by characteristics for 2017 data.

¶ Persons identified as Hispanic might be of any race. Persons identified as white, black, Asian, or other race are non-Hispanic.

** p<0.05 from Wald F of adjusted percentage by characteristics for 2017 data.

†† Includes self-reported coronary heart disease, angina pectoris, or myocardial infarction.

§§ Includes self-reported hypertension, high cholesterol, diabetes, smoking, or obesity.

through public health messaging campaigns and improved early identification of heart attack symptoms when entering the emergency response system (*8–10*). Despite these promotion efforts, general knowledge about the symptoms of a heart attack remain suboptimal. Consistent messaging campaigns should be complemented with regular contact with a health care provider because screening and evaluation might lead to early intervention.

The findings in this report are subject to at least three limitations. First, because all data were self-reported, they are subject to recall and social desirability bias. Second, the questions assessing the symptoms of a heart attack were closed-ended (yes/no) and included only the correct answers and, therefore, might overestimate knowledge. Finally, NHIS includes only civilian, noninstitutionalized persons in the United States, excluding those living in nursing homes, long-term care facilities, prisons, or other comparable settings and, therefore, might not be generalizable. A strength of the study is its large size and representative sample selection.

Because of the high prevalence and significant health impact of heart attacks, awareness of the major signs and symptoms of a heart attack and the appropriate response to the event should be common knowledge among all adults. However, the suboptimal knowledge among U.S. adults identified in this study, especially among racial/ethnic minority groups, those with lower levels of education, and those with more CVD risk factors, highlight a need for enhanced and focused educational efforts. Clinical, community, and public health efforts are needed to continue to systematically improve the awareness of heart attack symptoms throughout the United States.

TABLE 2. Unadjusted and adjusted prevalence of knowing to call 9-1-1 in response to a heart attack, by demographic characteristics, history of coronary heart disease (CHD), and number of cardiovascular disease (CVD) risk factors, and change from 2008 to 2017 — National Health Interview Survey, United States, 2008, 2014, and 2017

	Unadjusted					Adjusted*				
Characteristic	2008 % (SE)	2014 % (SE)	2017 % (SE)	Percentage point change 2008 to 2017†	p-value (2008 versus 2017)	2008 % (SE)	2014 % (SE)	2017 % (SE)	Percentage point change 2008 to 2017†	p-value (2008 versus 2017)
Total	**91.9 (0.3)**	**93.3 (0.3)**	**94.8 (0.3)**	**3.0**	**<0.001**	**91.8 (0.3)**	**93.4 (0.3)**	**94.9 (0.2)**	**3.1**	**<0.001**
Sex§										
Men	91.2 (0.4)	92.8 (0.4)	94.4 (0.3)	3.2	<0.001	91.1 (0.4)	92.8 (0.4)	94.4 (0.3)	3.4	<0.001
Women	92.5 (0.3)	93.8 (0.3)	95.2 (0.3)	3.0	<0.001	92.5 (0.3)	93.9(0.3)	95.3 (0.3)	2.8	<0.001
Age group (yrs)¶										
18–44	92.8 (0.4)	94.4 (0.3)	95.8 (0.4)	3.0	<0.001	92.9 (0.4)	94.6 (0.3)	95.9 (0.4)	3.0	<0.001
45–64	92.1 (0.4)	93.1 (0.5)	94.6 (0.3)	2.5	<0.001	91.9 (0.4)	93.0 (0.5)	94.5 (0.3)	2.5	<0.001
≥65	88.4 (0.6)	91.1 (0.5)	92.9 (0.4)	4.4	<0.001	88.6 (0.6)	91.0 (0.5)	92.8 (0.4)	4.4	<0.001
Race/Ethnicity¶,**										
White	92.3 (0.3)	94.0 (0.3)	95.3 (0.2)	3.0	<0.001	92.3 (0.3)	94.0 (0.3)	95.4 (0.2)	3.1	<0.001
Black	91.8 (0.7)	93.8 (0.6)	95.0 (0.8)	3.2	0.002	91.8 (0.7)	93.7 (0.6)	95.0 (0.8)	3.3	0.002
Asian	89.8 (1.3)	87.9 (1.4)	91.2 (1.7)	1.4	0.519	89.2 (1.4)	87.1 (1.5)	90.8 (1.8)	1.6	0.462
Hispanic	90.5 (0.7)	91.3 (0.6)	93.6 (0.6)	3.1	<0.001	90.8 (0.7)	91.6 (0.6)	93.7 (0.6)	2.9	0.001
Other	89.4 (1.5)	93.6 (1.2)	93.7 (0.9)	4.3	0.013	88.6 (1.6)	93.1 (1.2)	93.2 (1.0)	4.5	0.011
Education¶										
Less than HS	87.7 (0.8)	89.5 (0.7)	92.3 (0.7)	4.6	<0.001	89.0 (0.7)	90.9 (0.6)	93.4 (0.6)	5.1	<0.001
HS graduate	91.7 (0.5)	93.2 (0.5)	94.4 (0.4)	2.7	<0.001	91.8 (0.5)	93.5 (0.5)	94.7 (0.4)	3.0	<0.001
Some college	92.6 (0.5)	93.5 (0.5)	95.2 (0.3)	2.6	<0.001	92.4 (0.5)	93.5 (0.5)	95.3 (0.3)	2.9	<0.001
College graduate	93.3 (0.4)	94.2 (0.4)	95.9 (0.3)	2.6	<0.001	93.1 (0.4)	94.2 (0.4)	95.9 (0.3)	2.8	<0.001
CHD§,††										
With CHD	90.8 (1.0)	90.2 (0.9)	91.7 (0.8)	0.9	0.454	92.7 (0.8)	92.3 (0.8)	93.5 (0.7)	1.0	0.436
Without CHD	91.9 (0.3)	93.5 (0.3)	95.0 (0.3)	3.1	<0.001	91.7 (0.3)	93.4 (0.3)	95.0 (0.3)	3.2	<0.001
No. of CVD risk factors§§										
0	92.1 (0.4)	94.0 (0.3)	95.4 (0.4)	3.3	<0.001	91.5 (0.4)	93.6 (0.3)	95.0 (0.5)	3.2	<0.001
1	92.0 (0.4)	94.0 (0.4)	95.1 (0.3)	3.1	<0.001	91.9 (0.4)	93.9 (0.4)	95.1 (0.3)	3.2	<0.001
2	92.0 (0.5)	92.2 (0.7)	94.5 (0.4)	2.5	<0.001	92.4 (0.5)	92.7 (0.7)	94.9 (0.4)	2.7	<0.001
3	91.4 (0.8)	91.9 (0.8)	93.6 (0.6)	2.2	0.028	92.3 (0.7)	92.9 (0.7)	94.4 (0.6)	2.4	0.017
4–5	87.6 (1.7)	91.3 (0.9)	91.8 (1.2)	4.2	0.042	89.1 (1.5)	92.5 (0.8)	93.1 (1.1)	4.6	0.028

Abbreviations: HS = high school; SE = standard error.
* Adjusted by age, sex, race/ethnicity, education, history of CHD, and CVD risk factor.
† Estimates might differ from manual calculations because of rounding.
§ p<0.05 from Wald F of adjusted percentage by characteristics for 2017 data.
¶ p<0.0001 from Wald F of adjusted percentage by characteristics for 2017 data.
** Persons identified as Hispanic might be of any race. Persons identified as white, black, Asian, or other race are non-Hispanic.
†† Includes self-reported coronary heart disease, angina pectoris, or myocardial infarction.
§§ Includes self-reported hypertension, high cholesterol, diabetes, smoking, or obesity.

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Actions in Support of Newborn Screening for Critical Congenital Heart Disease — United States, 2011–2018

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In 2011, the U.S. Department of Health and Human Services added critical congenital heart disease (CCHD), which occurs in two of every 1,000 births, to the list of conditions recommended to states for universal newborn screening (*1*). Without early detection, infants with CCHD are at risk for substantial morbidity and death in the first weeks and months of life (*2*). Based on 2007–2013 data, deaths from CCHD and other cardiac causes in infants aged <6 months significantly declined in infants born in eight states after they had fully implemented mandated newborn CCHD screening policies by June 2013 (*3*). CDC collaborated with the American Academy of Pediatrics (AAP) and the Association of Public Health Laboratories' Newborn Screening Technical Assistance and Evaluation Program (NewSTEPs) to update a 2015 report (*4*) on states' actions toward adopting and implementing policies supporting CCHD newborn screening. In 2018, all 50 states and the District of Columbia (DC) had implemented CCHD screening policies, and, with one exception, all states mandated that screening be done (California mandates that screening be offered). However, not all states had data systems in place for tracking all screening results and outcomes. Ongoing evaluation activities, which rely on screening data, could help identify program improvement opportunities and monitor the impact of early identification of CCHD.

Congenital heart defects occur in approximately eight of every 1,000 live births; one fourth of infants born with congenital heart defects have CCHD (*1*,*2*). CCHD typically requires surgical or catheter intervention before age 1 year (*2*). Newborn screening can identify newborns with CCHD before signs or symptoms are evident and before hospital discharge after birth. CCHD screening supplements clinical detection of CCHD to facilitate timely identification, treatment, and management of affected infants. Infants are screened for CCHD using pulse oximetry, a noninvasive method to estimate the oxygen saturation in an infant's arterial blood. Hypoxemia (abnormally low oxygen saturation) detected by pulse oximetry screening can result from CCHD or other causes. Additional testing (e.g., chest radiograph or echocardiography) is needed after an abnormal screen to determine the cause of the hypoxemia (*2*,*5*,*6*).

CDC, AAP, and NewSTEPs assessed actions by states (i.e., legislation, regulations, or both) toward adoption and implementation of policies supporting CCHD newborn screening. In the context of this report, a statute is a law enacted by a state legislature and signed into law, a regulation is considered to be a rule promulgated by a state agency with the force of law, and legislation is a bill reviewed and acted upon by a state legislature. Policies include statutes, regulations, and other measures, such as appropriations. The effective date of a statute can differ from the date it is implemented by health care providers. For example, Maryland enacted a screening mandate in May 2011 that legally took effect in July 2011 (*4*). However, the effect of the statute was to direct the state health department to begin the process of preparing regulations that, once issued, would require hospitals and other delivery care providers to screen for CCHD. The date on which the Maryland screening mandate was actually implemented at the provider level was September 1, 2012 (*3*). In this report, the implementation date is the date when providers were expected or required to begin universal screening of newborns for CCHD.

AAP and NewSTEPs used several methods to gather and compile enactment, effective, and implementation dates of screening policies, as well as information on screening data collection and data sharing. AAP monitored state legislation using legal and regulatory tracking software and researched regulatory and hospital guidelines on state websites. AAP obtained primary information through direct contact and partnership with AAP state chapters. State-specific information on collection of screening data elements was provided by state CCHD screening programs directly to the NewSTEPs Data Repository (*7*). NewSTEPs surveyed state CCHD newborn screening coordinators to assess data sharing and collaboration between birth defects surveillance programs, which track cases of CCHD, and newborn screening programs. Newborn screening programs in all 51 jurisdictions (50 states and DC) participated in the survey.

From 2013 to 2018, the number of jurisdictions that had implemented CCHD screening policies increased from 22 to 51 (Table 1). States used various approaches to adopt newborn screening for CCHD. Thirty-nine (76%) jurisdictions adopted statutes that either mandated screening or the offer of screening or called for the issuance of regulations to mandate that screening be offered; the other 12 jurisdictions implemented mandates exclusively through regulations. The content of policies varies among states. For example, in 2015, Colorado mandated that infants born in a birthing center located below 7,000 feet elevation be screened for CCHD (infants born at

TABLE 1. State legislation and regulations for newborn screening for critical congenital heart disease (CCHD) — United States, 2011–2018

State	Citation	Statute*	Regulation/ Guidance†	Actions	Date enacted	Date effective	Date universal screening policy implemented§
Alabama	Ala. Admin. Code 420–10–1	—	X¶	Mandates screening	May 2013	Jun 2013	Jun 21, 2013
Alaska	Alaska Stat § 18.15.205	X¶	—	Mandates screening	Sep 2013	Jan 2014 (Jan 2016 for providers who attend <20 births/yr)	Mar 19, 2014
	Alaska Admin. Code tit. 7, § 27.630 Alaska Admin. Code tit. 7, § 27.635	—	X	Specifies type of provider who is required to perform screen; reporting requirements	Feb 2014	Mar 2014	
Arizona	Ariz. Rev. Stat. § 36–694	X¶	—	Mandates screening	Apr 2014	Jul 2014	Jul 1, 2015
	Ariz. Admin. Code § R9–13–202	—	X	Screening and reporting requirement	May 2015	Jul 2015	
Arkansas	Ark. Code Ann. § 20–9-13	X¶	—	Mandates screening	Apr 2013	Aug 2013	Jul 1, 2015
California	Cal. Hsc. Code § 124121	X	—	Mandates screening be offered	Sep 2012	Jan 2013	Jul 1, 2013
Colorado	Colo. Rev. Stat. § 25–4-1004.3	X¶	—	Mandates screening in birthing facilities below 7,000 ft. altitude	May 2015	Aug 2015	Jan 1, 2016
	Colo. Rev. Stat. § 12–37–105	X	—	Mandates direct entry midwives perform screen**	Jun 2016	Aug 2016	
Connecticut	Conn. Gen. Stat. § 19a-55	X¶	—	Mandates screening	May 2012	Jan 2013	Jan 1, 2013
Delaware	16 Del. Admin. Code § 4107.4	—	X¶	Mandates screening	May 2013	May 2013	May 1, 2013
District of Columbia	D.C. Code § 7–857.02	X¶	—	Mandates screening	Jun 2015	Sep 2015	Sep 7, 2015
Florida	Fla. Admin. Code r. 64C-7.002	—	X¶	Mandates screening	Oct 2014	Oct 2014	Mar 26, 2015
Georgia	Ga. Comp. R. and Regs. 511–5-5-.03	—	X¶	Mandates screening	May 2014	Jun 2014	Jul 1, 2015
Hawaii	Haw. Rev. Stat. § 321–296	X¶	—	Mandates screening	Jul 2015	Jul 2015	Jan 2014
Idaho	Idaho. Admin. Code. r. 16.02.12.301	—	X¶	Mandates screening	Jul 2018	Jul 2018	Jul 1, 2018
Illinois	410 Ill. Comp. Stat. § 240/1.10	X¶	—	Mandates screening	Aug 2013	Aug 2013	Aug 20, 2013
Indiana	Ind. Code § 16–41–17–2	X¶	—	Mandates screening	May 2011	Jan 2012	Jan 1, 2012
Iowa	Iowa Code § 136A.5A	X¶	—	Mandates screening	Jun 2013	Jul 2013	Jan 8, 2015
	Iowa Admin. Code r. 641.4.3	—	X	Screening and reporting requirements	Dec 2014	Jan 2015	
Kansas	Kan. Admin. Regs. § 28–4-502	—	X¶	Mandates screening	Feb 2018	Feb 2018	Feb 2018
Kentucky	Ky. Rev. Stat. Ann. § 214.155	X¶	—	Mandates screening	Mar 2013	Jan 2014	Jan 1, 2014
	902 Ky. Admin. Regs. 4:030	—	X	Screening and reporting requirements	Dec 2013	Dec 2013	
Louisiana	La. Stat. Ann. § 40:1083.3	X¶	—	Mandates screening	Jun 2013	Aug 2013	Aug 1, 2013
Maine	Me. Stat. tit. 22, § 1532	X¶	—	Mandates screening	Jul 2013	Jul 2013	Oct 9, 2013
	10–144 Me. Code. R. 709	—	X	Screening and reporting requirements	Sep 2015	Sep 2015	
Maryland	Md. Code, Health. Law § 13–111	X¶	X	Mandates screening and creates advisory committee to develop implementation recommendations	May 2011	Jul 2011	Sep 1, 2012
	Md. Code Regs. 10. 52.15.01-.08	—	X	Screening and reporting requirements	Oct 2012	Oct 2012 (emergency adoption) Apr 2013 (permanent adoption)	
	Md. Code, Bus. and Occ. Law § 8–6C-2	X¶	—	Mandates direct entry midwives** perform screen	May 2015	Jun 2015	
Massachusetts	Mass. Gen. Laws ch. 111, § 110C	X¶	—	Mandates screening	Mar 2014	Jun 2014	Jun 2014
	105 Code Mass. Regs. 142.303	—	X	Requires freestanding birth centers to develop screening protocols	Oct 2014	Jan 2015	
	105 Code Mass. Regs. 130.616	—	X	Requires hospitals to develop screening protocols	Oct 2014	Jan 2015	
Michigan	CCHD mandate letter to hospital administrators (authority under Mich. Comp. Laws § 333.5431)	—	X¶	Mandates screening	Oct 2013	Apr 2014	Apr 1, 2014
Minnesota	Minn. Stat. § 144.1251	X¶	—	Mandates screening	May 2013	Aug 2013	Aug 1, 2013
Mississippi	Miss. Code R. § 15.4.1.1	—	X¶	Mandates screening	Oct 2014	Nov 2014	Jul 1, 2015
Missouri	Mo. Rev. Stat. § 191.334	X¶	—	Mandates screening	Jul 2013	Aug 2013	Jan 1, 2014
Montana	Mont. Admin. R. 37.57.305	—	X¶	Mandates screening	Jun 2014	Jul 2014	Jul 1, 2014
Nebraska	Neb. Rev. Stat. § 71–556	X¶	—	Mandates screening	Jun 2013	Sep 2013	Sep 6, 2013
	181 Neb. Admin. Code 10	—	X	Screening requirements	Aug 2014	Aug 2014	
Nevada	Nev. Rev. Stat. § 442.680	X¶	—	Mandates screening	Jun 2013	Jul 2015	Jul 2015

See table footnotes on the next page.

TABLE 1. (*Continued*) State legislation and regulations for newborn screening for critical congenital heart disease (CCHD) — United States, 2011–2018

State	Citation	Statute*	Regulation/ Guidance†	Actions	Date enacted	Date effective	Date universal screening policy implemented§
New Hampshire	N.H. Rev. Stat. Ann. § 132:10-aa	X¶	—	Mandates screening	Jun 2012	Aug 2012	Aug 11, 2012
New Jersey	N.J. Rev. Stat. § 26:2–111.4	X¶	—	Mandates screening	Jun 2011	Aug 2011	Aug 31, 2011
	N.J. Code Admin. § 8:43G-19.15	—	X	Reporting requirements	Dec 2013	Jan 2014	
New Mexico	N.M. Stat. § 24–1-6	X¶	—	Mandates screening	Mar 2014	May 2014	Jul 1, 2014
New York	N.Y. P.B.H. Law § 2500-A	X¶	—	Mandates screening	Jul 2013	Jan 2014	Jan 27, 2014
North Carolina	N.C. Gen. Stat. § 130A-125	X¶	—	Mandates screening	May 2013	May 2013	Jul 25, 2014
	10 N.C. Admin. Code 43K.0102–0103	—	X	Screening and reporting requirements	Jul 2014	Jul 2014 (temporary effective date) Apr 2015 (permanent effective date)	
North Dakota	N.D. Cent. Code § 25–17–06	X¶	—	Mandates screening	Apr 2013	Aug 2013	Aug 2013
Ohio	Ohio Rev. Code § 3701.5010	X¶	—	Mandates screening	Jun 2013	Sep 2013	Oct 1, 2014
	Ohio Admin. Code 3701:54	—	X	Reporting requirements	Jun 2014	Oct 2014	
Oklahoma	Okla. Stat. tit. 63, § 1–550.5 Okla. Admin. Code § 310:550	X¶	—	Mandates screenin	Apr 2013	Jul 2013	Jul 1, 2013
	Okla. Admin. Code § 310:550	—	X	Screening and reporting requirements	Jun 2014	Sep 2014	
Oregon	Or. Rev. Stat. § 433.318	X¶	—	Mandates screening	Jun 2013	Jun 2013	Mar 1, 2014
	Or. Admin. R. 333–520–0060	—	X	Screening requirements	Dec 2013/ Jun 2014	Jan 2014 (temporary effective date) Jun 2014 (permanent effective date)	
Pennsylvania	42 Pa. B. 7348	—	X	Mandates reporting if screening is performed	Dec 2012	Mar 2013	Sep 2014
	Act of Jul. 2, 2014, P.L. 853, No. 94	X¶	—	Mandates screening	Jul 2014	Sep 2014	
Rhode Island	216 R.I. Code R. § 20–05–01	—	X¶	Mandates screening	Aug 2014	Jul 2015	Jul 1, 2015
South Carolina	S.C. Code Ann. § 44–37–70	X¶	—	Mandates screening	Jun 2013	Sep 2013	Sep 11, 2013
	S.C. Code Regs. 61–123	—	X	Screening requirements	Jun 2014	Jun 2014	
South Dakota	S.D. Codified Laws §34–24–32	X¶	—	Mandates screening	Mar 2013	Jul 2013	Jul 2013
Tennessee	Tenn. Code Ann. § 68–5-507	X	—	Creates advisory committee to develop screening program	Mar 2012	Jan 2013	May 31, 2013
	Tenn. Comp. R. and Regs. 1200–15–01	—	X¶	Mandates screening	May 2013	May 2013	
Texas	Tex. HSC. Code § 33.011	X¶	—	Mandates screening	Jun 2013	Sep 2013	Aug 7, 2014
	Tex. Admin. Code § 37.78-.79	—	X	Screening and reporting requirements	Jul 2014	Aug 2014	
Utah	Utah Code § 26–10–6	X¶	—	Mandates screening	Mar 2013	Oct 2014	Oct 1, 2014
Vermont	18 Vt. State. Ann. § 5087	X	—	Requires screening rules be issued	May 2016	Jul 2016	Dec 2016
	13 Vt. Code R. 140 057	—	X¶	Mandates screening	Dec 2016	Dec 2016	
Virginia	Va. Code Ann. § 32.1–65.1	X¶	—	Mandates screening	Feb 2014/ Mar 2014	Jul 2014	Jan 1, 2015
	12 Va. Admin. Code § 5–71–30/12 Va. Admin. Code § 5–71–210	—	X¶	Screening and reporting requirements	Aug 2016	Oct 2016	
Washington	Wash. Rev. Code § 70.83.090	X¶	—	Mandates screening	Apr 2015	Jul 2015	Jul 24, 2015
West Virginia	W. Va. Code § 16–44–2	X¶	—	Mandates screening	Apr 2012	Jun 2012	Sep 1, 2012
Wisconsin	Wis. Stat. § 253.13	X	—	Allows the state's department of health to add conditions to the state's screening panel of disorders	Mar 2014	Mar 2014	Jul 3, 2014
	Wis. Admin. Reg. Em. Rule 1410	—	X¶	Mandates screening	Jun 2014	Jul 2014 (emergency effective date)	
	Wis. Admin. Code DHS § 115	—	X¶	Mandates screening	Jul 2015	Aug 2015 (permanent effective date)	
Wyoming	Wyo. Code R. § 048.0035.1.09072017	—	X¶	Mandates screening	Sep 2017	Sep 2017	Sep 7, 2017

Abbreviation: X = presence of state action.

* Thirty-nine states and District of Columbia (DC) have enacted legislation related to newborn screening for CCHD; laws in 35 of those states (and DC) require screening.

† Thirty-one states issued regulations related to newborn screening; 15 of those states issued regulations requiring screening.

§ Implementation date refers to the date on which all birthing hospitals were expected to be screening, which might differ from the date when the health department implemented a screening policy or reporting requirement.

¶ Mandates CCHD screening of newborns.

** Direct entry midwives are midwives who typically attend home births and who have become credentialed without first becoming a nurse.

higher-elevation locations typically have lower normal oxygen saturation levels, which have not yet been incorporated in screening guidelines). One year later, the state required midwives attending home births to either screen newborns or refer the parents to a physician or health facility. Kansas, which previously had a successful voluntary CCHD screening project in place since 2013, added CCHD to its required newborn screening panel by regulation in early 2018. In Idaho, regulations went into effect in July 2018 that require all newborns to be screened for CCHD, including those born outside of a birthing center or hospital.

Forty-one (80%) jurisdictions reported receiving CCHD screening data from hospitals or birthing centers (Table 2). Among these jurisdictions, 32 (78%) receive some type of individual-level screening results for all infants screened, including 19 jurisdictions that receive all screening data (oxygen saturation values and dates and times of screening), one that receives only data on the final screen, and 12 that receive only the final interpretation result (pass/fail). Five (12%) of 41 jurisdictions reported receiving only aggregate data on the numbers of infants screened and CCHD cases detected, and four (10%) reported receiving individual-level screening results (oxygen saturation values and dates and times of screening) only for CCHD cases detected through screening.

Nineteen (37%) jurisdictions reported data sharing between birth defects surveillance programs and newborn screening programs, maximizing the surveillance capabilities of these public health programs (Table 2). Shared data are used to identify cases of CCHD missed by screening, to ensure cases match between birth defects and newborn screening programs, or to perform postdiagnostic follow-up of infants identified by CCHD screening; six jurisdictions reported sharing for all three purposes. Among the 19 jurisdictions that reported data sharing, five had electronic linkage between newborn screening and birth defects surveillance data systems, two had a shared data system that encompasses both CCHD newborn screening and birth defects, and the remaining 12 shared data manually through direct communication, email, and reports. Among reasons cited by the 32 jurisdictions that do not share data between birth defects surveillance programs and CCHD newborn screening programs are absence of a birth defects surveillance program (five, 16%); lack of individual-level pulse oximetry screening data (10, 31%); and data systems that are not linked (17, 53%).

TABLE 2. Receipt of critical congenital heart disease (CCHD) screening data and data sharing with birth defects surveillance programs — United States, 2018

Characteristic	No. (%) of jurisdictions
Receipt of CCHD screening data by jurisdiction	
Receive any CCHD screening data	41 (80)*
Receive any individual-level data	32 (78)†
Receive all individual-level screening data	19 (46)†
Receive individual screening data for CCHD cases only	4 (10)†
Receive data on final screen only	1 (2)†
Receive final pass/fail result	12 (29)†
Receive aggregate data only	5 (12)†
Data sharing with birth defects surveillance systems	
Data sharing exists	19 (37)*
Mechanism of data sharing	
Electronic linkage	5 (26)
Shared data system	2 (11)
Manual	12 (63)
No data sharing	32 (63)*
Reasons for no data sharing	
No birth defects surveillance program	5 (16)
No individual level pulse oximetry screening data	10 (31)
Data systems not linked	17 (53)

* Percentage of all 51 jurisdictions (50 U.S. states and the District of Columbia).
† Percentage of jurisdictions that receive any data.
§ Percentage of jurisdictions that share data.
¶ Percentage of jurisdictions that do not share data.

Discussion

Policies for newborn screening of CCHD were gradually adopted in all U.S. states and DC from 2011 through 2018, thus facilitating improved survival of affected infants. Newborn screening mandates for CCHD have been found to save lives (*3*); however, opportunities continue for program improvement, particularly around data collection. Despite the implementation of CCHD screening policies in all jurisdictions, data collection efforts have lagged. In 2014, among 43 states that had implemented CCHD screening policies, 24 states were collecting data, although the types of data collected varied by state (*4*). By 2017, among 49 states with CCHD screening policies implemented, 41 were collecting data. Jurisdictional level data collection practices vary widely based upon state statute, financial and staff member resources, and capabilities to collect data (*8*). Completeness of data collection is important for surveillance, monitoring of outcomes, process improvement, and evaluation of state CCHD screening programs (*2*,*4*–*6*,*8*–*10*). States use screening algorithms as step-by-step guides for screening and determination of pass or fail and for the assessment of false positive and false negative cases (*6*,*9*). Evaluation and potential refinement of screening algorithms rely upon individual-level screening and outcome data.

Another opportunity for CCHD screening program evaluation and improvement lies in fostering collaborations between the two public health programs most invested in CCHD screening (newborn screening programs and birth defects surveillance programs). Because of the role of birth defects surveillance programs in monitoring new cases of CCHD, regardless of mode of detection, these programs have the ability to aid in evaluation of CCHD screening by assessing mortality, outcomes, and service utilization by children with

CCHD (*8*). Integrating population-level screening and follow-up data from a CCHD newborn screening program with the targeted oversight of newly identified CCHD cases by birth defects surveillance programs is integral to establishing and maintaining a robust surveillance system. Ultimately, this integration can facilitate evaluation of the complete CCHD screening process, including the effectiveness of and adherence to the screening algorithm, screening sensitivity and specificity, and assessment of outcomes and needs of affected infants and their families. In Minnesota, for example, staff members of the CCHD newborn screening and birth defects surveillance program work together and share data regularly. Birth defects program and follow-up staff members have access to the same data system that collects individual-level CCHD screening data, facilitating rapid reporting of infants identified via CCHD screening to the birth defects surveillance program for diagnostic confirmation and connection to resources. Cases reported to the birth defects surveillance program also can be assessed easily for screening status and results, and previously undetected cases can be documented in the system.

The findings in this report are subject to at least two limitations. First, because of difficulty obtaining exact dates and interpretation of language in jurisdictions' statutes and regulations, slight variability in the legislation, regulations, and guidelines presented might occur. Second, although all 51 jurisdictions completed the survey, the responses were reported by the jurisdictions' CCHD screening contact person and not independently verified.

Newborn screening for CCHD in the United States has been implemented nationwide, with numerous infants' lives being saved or improved as a result. Improved data collection practices and standardization across all jurisdictions could increase effective monitoring and evaluation of CCHD screening. Ongoing evaluation remains important to ensure the best possible outcomes.

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Summary

What is already known about this topic?

Critical congenital heart disease (CCHD) occurs in two of every 1,000 births and might be undetected at birth. Affected infants are at risk for substantial morbidity and death early in life. In 2011, the U.S. Department of Health and Human Services Secretary endorsed the Advisory Committee on Heritable Disorders in Newborns and Children's recommendation to add CCHD to the recommended universal newborn screening panel.

What is added by this report?

By 2018, all U.S. states and the District of Columbia had implemented newborn CCHD screening policies. Opportunities for program improvement, particularly around data collection, persist. Not all jurisdictions collect screening data or share data among relevant programs.

What are the implications for public health practice?

All U.S. newborns, regardless of which state they are born in, now have the opportunity to be screened for CCHD.

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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger — United States, 2019

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At its October 2018 meeting, the Advisory Committee on Immunization Practices (ACIP)* voted to recommend approval of the Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger, United States, 2019. The 2019 child and adolescent immunization schedule summarizes ACIP recommendations, including several changes from the 2018 immunization schedule,† on the cover page, three tables, and notes found on the CDC immunization schedule website (https://www.cdc.gov/vaccines/schedules/index.html). This immunization schedule is recommended by ACIP and approved by the CDC Director, the American Academy of Pediatrics, the American Academy of Family Physicians, and the American College of Obstetricians and Gynecologists. Health care providers are advised to use the tables and the notes together.

ACIP's recommendations on use of each vaccine are developed after in-depth reviews of vaccine-related data, including disease epidemiology and burden, vaccine efficacy and effectiveness, vaccine safety, quality of evidence, feasibility of program implementation, and economic analyses of immunization policy (*1*). The child and adolescent immunization schedule is published annually to consolidate and summarize updates to ACIP recommendations on vaccination of children and adolescents and to assist health care providers in implementing current ACIP recommendations. The use of trade names of vaccines in this report and in the child and adolescent immunization schedule is for identification purposes only and does not imply endorsement by ACIP or CDC.

For further guidance on the use of each vaccine, including contraindications and precautions, health care providers are referred to the respective ACIP vaccine recommendations at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Changes in recommended use of vaccines can occur between annual updates to the child and adolescent immunization schedule. These changes, if made, are available at https://www.cdc.gov/vaccines/acip/recommendations.html).§ Printable versions of the 2019 child and adolescent immunization schedule and ordering instructions are available on the immunization schedule website.

Vaccine Changes in the 2019 Immunization Schedule for Children and Adolescents

Vaccine changes in the 2019 immunization schedule for children and adolescents aged ≤18 years include new or revised ACIP recommendations for hepatitis A vaccine (HepA) (*2*), hepatitis B vaccine (Hep B) (*3*), influenza vaccine (*4*), and tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap) (*5*), as well as clarification of the recommendations for inactivated poliovirus vaccines (IPV).

Changes Affecting Multiple Portions of the Schedule

The overall appearance of the 2019 child and adolescent schedule has been updated because of recommendations resulting from a recent evaluation of the child and adolescent immunization schedule. An internet survey of 249 pediatricians and family medicine physicians was conducted to assess their familiarity with the schedule, the environment in which the schedule is used, the frequency and circumstances of use, and their impressions and preferences on redesigned drafts of the child and adolescent immunization schedule. These changes have been applied to all portions of the immunization schedule, including the cover page, routine immunization schedule

* Recommendations for routine use of vaccines in children and adolescents are developed by ACIP, a federal advisory committee chartered to provide expert external advice and guidance to the CDC Director on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in children and adolescents are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics, the American Academy of Family Physicians, and the American College of Obstetricians and Gynecologists. ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the *Morbidity and Mortality Weekly Report*. Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.

† Past immunization schedules are available at https://www.cdc.gov/vaccines/schedules/past.html.

§ CDC encourages organizations to use syndication as a more reliable method for displaying the most current and accurate immunization schedules on an organization's website rather than copying these schedules to their websites. Use of content syndication requires a one-time step that ensures an organization's website displays current schedules as soon as they are published or revised; instructions for the syndication code are available on CDC's website (https://www.cdc.gov/vaccines/schedules/syndicate.html). CDC also offers technical assistance for implementing this form of content syndication (e-mail request to ncirdwebteam@cdc.gov). Changes in ACIP recommendations in the child and adolescent immunization schedule before the next scheduled annual update, if any, are available at https://www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html.

(Table 1), catch-up schedule (Table 2), medical indications for each vaccine (Table 3), and notes with details for each vaccine.

Cover Page. Changes to the cover page are as follows:

- Guidance on how to use the schedule was added to the top of the document.
- Live attenuated influenza vaccine (LAIV) was added to the vaccine table.
- A Helpful Information section, which includes links to the ACIP recommendations, the General Best Practice Guidelines for Immunization, and the Manual for the Surveillance of Vaccine-Preventable Diseases, has been added.

Table 1. Changes to Table 1 (previously known as Figure 1) are as follows:

- A separate row has been added for LAIV.
- A purple bar has been added to the Hepatitis A (HepA) row at age 6–11 months to represent use in infant travelers.
- Within the Tetanus, diphtheria, & acellular pertussis (Tdap: ≥7 yrs) row, the bar for persons aged 13–18 years has been split into a half green and half purple bar to represent catch-up vaccination and use in pregnant adolescents, respectively.

Table 2. Changes to Table 2 (previously known as Figure 2) are as follows:

- Minor changes to the order in which guidance is presented in the *Haemophilius influenzae* type b and Pneumococcal conjugate rows were made. The criteria under which no further doses are needed are now presented first, followed by recommendation for those for whom additional doses are indicated.

Table 3. Changes to Table 3 (previously known as Figure 3) are as follows:

- A new pink color has been added to the legend, which represents "Delay vaccination until after pregnancy if vaccine indicated." This color is used in the pregnancy column for human papillomavirus vaccine.
- The Contraindicated and Precaution for vaccination boxes in the legend have been defined with narrative text.
- A row for LAIV has been added.
- The Pregnancy cell in the meningococcal B vaccine row has been changed to the orange Precaution for vaccination color.

Notes. The notes (previously known as footnotes) are presented in alphabetical order rather than linked by numerical superscripts as in previous years. Edits have been made throughout the Notes section to harmonize language between the child and adolescent schedule and the adult immunization schedule, where possible. In addition, the following content changes were made:

- The HepA note was revised to include information regarding the use of combined HepA-HepB vaccine in persons aged ≥18 years. A section for international travel has been added with recommendations for vaccination of travelers aged 6–11 months and unvaccinated travelers aged ≥12 months. Homelessness also has been added as an indication for HepA vaccination.
- The HepB note was revised to include information regarding the use of CpG-adjuvanted HepB vaccine and combination HepA-HepB vaccine in persons aged ≥18 years.
- Within the IPV note, a bullet has been added regarding the use of combination vaccines that contain IPV.
- The Influenza vaccines note has been updated to indicate that LAIV can be used during the 2018–19 influenza season. A Special Situations section has been added with information regarding vaccination of persons with a history of egg allergy and circumstances under which LAIV use is not recommended.
- During mumps and meningococcal disease outbreaks, the Additional Information section at the beginning of the notes directs providers to their state or local health department for information regarding vaccination during an outbreak. Therefore, language regarding the use of measles, mumps, and rubella (MMR) vaccine in the setting of a mumps outbreak or the use of meningococcal (groups A, C, W-135, and Y) conjugate (MenACWY) and meningococcal group B (MenB) vaccines in the setting of meningococcal disease outbreaks has been removed from the MMR and meningococcal vaccine notes.
- The Tdap note has been updated to indicate that those persons who received a dose of Tdap or diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP) at age 7–10 years inadvertently or as part of the catch-up series should still receive the routine dose of Tdap at age 11–12 years. A link to information regarding use of Tdap/tetanus and diphtheria toxoids (Td) for wound prophylaxis also has been added.

Acknowledgments

Rosters of current and past members of the Advisory Committee on Immunization Practices (ACIP) are available at https://www.cdc.gov/vaccines/acip/committee/members-archive.html.

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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older — United States, 2019

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In October 2018, the Advisory Committee on Immunization Practices (ACIP)* voted to recommend approval of the Recommended Immunization Schedule for Adults, Aged 19 Years or Older, United States, 2019. The 2019 adult immunization schedule, available at https://www.cdc.gov/vaccines/schedules,† summarizes ACIP recommendations in two tables and accompanying notes. The 2019 adult immunization schedule has been approved by the CDC Director, the American College of Physicians, the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, and the American College of Nurse-Midwives.

ACIP's recommendations on use of each vaccine are developed after in-depth reviews of vaccine-related data, including disease epidemiology and burden, vaccine efficacy and effectiveness, vaccine safety, quality of evidence, feasibility of program implementation, and economic analyses of immunization policy (*1*). The adult immunization schedule is published annually to consolidate and summarize updates to ACIP recommendations on vaccination of adults and assist health care providers in implementing current ACIP recommendations. The use of trade names of vaccines in this report and in the adult immunization schedule is for identification purposes only and does not imply endorsement by ACIP or CDC.

For further guidance on the use of vaccines in the adult immunization schedule, health care providers should refer to the full ACIP recommendations at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Changes in recommended use of vaccines can occur between annual updates to the adult immunization schedule. These changes, if made, are available at https://www.cdc.gov/vaccines/acip/recommendations.html.§ Printable versions of the 2019 adult immunization schedule and instructions for ordering printed copies are available at https://www.cdc.gov/vaccines/schedules/hcp/adult.html#note.

The 2019 adult immunization schedule is a product of extensive formal usability testing of 2017 and 2018 adult immunization schedules, including in-depth interviews with 48 primary care physicians, nurse practitioners, physician assistants, pharmacists, nurses, and medical assistants, who reported being familiar with the adult immunization schedule, and an Internet survey of 251 internal medicine and family medicine physicians to assess their impressions and preferences on redesigned drafts of the adult immunization schedule (*2*). In addition to incorporating new ACIP recommendations on influenza, hepatitis A, and hepatitis B vaccinations, each vaccination section in the 2019 adult immunization schedule was revised for clarity, brevity, and, for vaccines that also appear in the 2019 child and adolescent immunization schedule (*3*), consistency between the two schedules. Because usability testing found that providers rarely used the table of contraindications and precautions for vaccines recommended for adults that was a part of previous iterations of the adult immunization schedule, the table was removed from the 2019 adult immunization schedule. Information on vaccine contraindications and precautions is available at https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs.

Changes in the 2019 Adult Immunization Schedule: Updated ACIP Recommendations

Influenza Vaccination. In June 2018, ACIP updated recommendations on the use of live attenuated influenza vaccine (LAIV) (FluMist Quadrivalent, AstraZeneca) after two influenza seasons (2016–17 and 2017–18), during which

* Recommendations for routine use of vaccines in children, adolescents, and adults are developed by ACIP. ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the CDC Director on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in adults are approved by the American Academy of Family Physicians, American College of Nurse-Midwives, American College of Obstetricians and Gynecologists, and American College of Physicians. ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the *Morbidity and Mortality Weekly Report*. Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.

† Past immunization schedules are available at https://www.cdc.gov/vaccines/schedules/past.html.

§ CDC encourages organizations that previously have relied on copying the adult immunization schedule on their websites to use syndication instead, as a more reliable method for displaying the most current and accurate adult immunization schedule. Use of content syndication requires a one-time step that ensures an organization's website displays the adult immunization schedule as soon as it is published or revised. The syndication code for the adult immunization schedule and instructions for its use can be found at https://www.cdc.gov/vaccines/schedules/syndicate.html. CDC also offers technical assistance for implementing this form of content syndication (e-mail request to ncirdwebteam@cdc.gov). Changes in ACIP recommendations in the adult immunization schedule before the next scheduled annual update, if any, are available at https://www.cdc.gov/vaccines/schedules/hcp/adult.html.

use of LAIV was not recommended in the United States (*4*). For the 2018–19 season, any licensed influenza vaccine that is recommended for age and health status of the patient may be used. LAIV is an option for adults aged ≤49 years, except those who 1) have immunocompromising conditions, including human immunodeficiency virus (HIV) infection; 2) have anatomic or functional asplenia; 3) are pregnant; 4) have close contact with or are caregivers of severely immunocompromised persons in a protected environment; 5) have received influenza antiviral medications in the previous 48 hours; or 6) have a cerebrospinal fluid leak or a cochlear implant. Adults with a history of Guillain-Barré syndrome within 6 weeks of receipt of a previous dose of influenza vaccine generally should not receive influenza vaccine.

Hepatitis B Vaccination. In February 2018, ACIP recommended use of the new single-antigen recombinant hepatitis B vaccine with a novel cytosine-phosphate-guanine 1018 oligodeoxynucleotide adjuvant (Heplisav-B, Dynavax) for prevention of hepatitis B virus infection in adults aged ≥18 years (*5*). Approved by the Food and Drug Administration in November 2017, Heplisav-B is routinely administered in 2 doses given ≥4 weeks apart. It can be used as a substitute in a 3-dose series with a different hepatitis B vaccine, but a valid 2-dose series requires 2 doses of Heplisav-B with ≥4 weeks between doses. When feasible, a vaccine from the same manufacturer should be used to complete the vaccination series. However, vaccination should not be deferred if the previously administered hepatitis B vaccine is unknown or if a vaccine from the same manufacturer is not available. A pregnant woman with an indication for hepatitis B vaccination should not receive Heplisav-B because no safety data are available on its use during pregnancy.

Hepatitis A Vaccination. In October 2018, ACIP recommended adding homelessness as an indication for routine hepatitis A vaccination with a 2-dose series of single-antigen hepatitis A vaccine (Havrix, GlaxoSmithKline; Vaqta, Merck) or a 3-dose series of combination hepatitis A and hepatitis B vaccine (Twinrix, GlaxoSmithKline) (*6*). Other populations at increased risk for hepatitis A virus infection or severe hepatitis A disease and recommended to receive vaccination include 1) persons with chronic liver disease or clotting factor disorders; 2) travelers in countries with high or intermediate hepatitis A endemicity; 3) persons with close personal contact with an international adoptee in the first 60 days after arrival from a country with high or endemic hepatitis A prevalence; 4) men who have sex with men; 5) persons who use injection or noninjection drugs; and 6) persons who work with hepatitis A virus in a laboratory or with nonhuman primates infected with the virus (*7–9*). In addition, any person who is not at risk for hepatitis A virus infection but wants protection against it may be vaccinated.

Changes in the 2019 Adult Immunization Schedule: Revised Content, Format, and Graphics

Cover. Recommended Adult Immunization Schedule. The cover page of the 2019 adult immunization schedule has been simplified and contains the following changes:

- Features a shortened title, provides basic instructions on how to use the adult immunization schedule to systematically identify vaccination needs of adults, and lists routinely recommended vaccines and their standardized abbreviations and trade names.
- Includes web links through which health care providers can download the CDC Vaccine Schedules App and access reference materials on surveillance of vaccine-preventable diseases, including case identification and disease outbreak response.
- Simplifies instructions for reporting suspected cases of reportable vaccine-preventable diseases to local or state health departments and for reporting postvaccination adverse events and serious adverse events to the Vaccine Adverse Event Reporting System; information on the Vaccine Injury Compensation Program; and links to other resources, such as Vaccine Information Statements and recommended vaccines for travelers.

Table 1. Recommended Adult Immunization Schedule by Age Group. Table 1 (previously known as Figure 1) describes routine and catch-up vaccination recommendations for adults by age. ACIP recommends routine annual influenza vaccination for all persons aged ≥6 months who do not have contraindications; 1 annual dose of IIV, RIV, or LAIV that is appropriate for age and health status of the vaccine recipient is recommended. Table 1 contains the following change:

- Lists LAIV separately from inactivated influenza vaccine (IIV) (many branded products) and recombinant influenza vaccine (RIV) (Flublok Quadrivalent, Sanofi Pasteur) for adults aged ≤49 years.

Table 2. Recommended Adult Immunization Schedule by Medical Condition and Other Indications. Table 2 (previously known as Figure 2) describes indications for which vaccines, if not previously administered, should be administered unless noted otherwise. Table 2 contains the following changes:

- Lists LAIV separately from IIV and RIV.
- Contains two new display colors for some vaccines: orange and pink. Orange indicates "Precaution—vaccine might be indicated if benefit of protection outweighs risk of adverse reaction"; pink indicates "Delay vaccination until after pregnancy if vaccine is indicated."

- Designates the use of LAIV in pregnant women and immunocompromised adults, including those with HIV infection, as "Contraindicated—vaccine should not be administered because of risk for serious adverse reaction" (red). The risk for associated adverse effects from the use of LAIV in adults with functional or anatomic asplenia or complement deficiencies is not known; however, the use of LAIV in this population has also been designated as "Contraindicated" (red). For adults with end-stage renal disease, heart or lung disease, chronic liver disease, or diabetes, the use of LAIV has been given the "Precaution" (orange) designation.
- Designates the use of serogroup B meningococcal vaccine (MenB) (Bexsero, GlaxoSmithKline; Trumenba, Pfizer) in pregnant women as "Precaution" (orange). MenB should be deferred in pregnant women unless they are at increased risk for serogroup B meningococcal disease and the benefits of vaccination are considered to outweigh potential risks (*10*).
- Maintains the use of meningococcal serogroups A, C, W-135, and Y conjugate vaccine (MenACWY) (Menactra, Sanofi Pasteur; Menveo, GlaxoSmithKline) in pregnant women as "Recommended vaccination for adults with an additional risk factor or another indication" (purple). In contrast to the recommendation to defer administration of MenB vaccine to pregnant women, pregnancy should not preclude the use of MenACWY vaccine if it is otherwise indicated (*11*).
- Designates the use of human papillomavirus (HPV) vaccine (Gardasil 9, Merck) and recombinant zoster vaccine (RZV) (Shingrix, GlaxoSmithKline) in pregnant women as "Delay until after pregnancy" (pink). The use of HPV vaccine is not recommended for pregnant women (*12*,*13*). Pregnant women should consider delaying receipt of RZV, if it is indicated, until after pregnancy (*14*). Live attenuated zoster vaccine (Zostavax, Merck) is contraindicated during pregnancy (*15*).

Notes. Recommended Adult Immunization Schedule. Each routinely recommended vaccine for adults in Tables 1 and 2 is accompanied by notes (previously known as footnotes), designed to provide additional information about routine vaccination and recommendations in special situations. The notes contain the following format changes:

- Lists vaccination sections alphabetically (superscript footnote numbers in the former figures [now tables] have been removed).
- Contains concise information describing vaccine indications, dosing frequencies and intervals, and other published ACIP recommendations for each section.
- Includes new recommendations on influenza, hepatitis B, and hepatitis A vaccines in their respective sections.
- Removes recommendations for vaccination in outbreak settings in measles, mumps, and rubella, and meningococcal vaccination notes.

Additional Information

The Recommended Adult Immunization Schedule, United States, 2019, is available at https://www.cdc.gov/vaccines/schedules/hcp/adult.html and in the Annals of Internal Medicine (*16*). The full ACIP recommendations for each vaccine are also available at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. All vaccines identified in Tables 1 and 2 (except zoster vaccines) also appear in the Recommended Immunization Schedule for Children and Adolescents, United States, 2019 (*3*). The notes for vaccines that appear in both the adult immunization schedule and the child and adolescent immunization schedule have been harmonized to the greatest extent possible.

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Advisory Committee on Immunization Practices (ACIP member rosters are available at https://www.cdc.gov/vaccines/acip/committee/members-archive.html); ACIP Adult Immunization Work Group.

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Notes from the Field

Circulating Vaccine-Derived Poliovirus Type 1 and Outbreak Response — Papua New Guinea, 2018

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The last poliomyelitis cases reported in Papua New Guinea occurred in 1996. Papua New Guinea is one of 37 countries (or areas) of the World Health Organization Western Pacific Region that were certified free of indigenous wild poliovirus in 2000. On June 22, 2018, the National Department of Health confirmed an outbreak of poliomyelitis caused by circulating vaccine-derived poliovirus type 1 (cVDPV1) following isolation of genetically linked virus from a patient with paralysis and nonhousehold community contacts. The index patient was a boy aged 6 years from Lae, Morobe Province, with onset of paralysis on April 25 and history of having received 2 doses of Sabin oral poliovirus vaccine (OPV).* Genetic characterization of the isolate identified 14 nucleotide differences from the Sabin 1 strain in the VP1 coding region, suggesting circulation for >1 year. As of February 4, 2019, a total of 26 confirmed cases had been identified in nine of 22 provinces, including 19 in children aged <5 years, six in patients aged 5–14 years, and one in a patient aged 17 years. The most recent case onset was October 18, 2018 (Figure). Eighteen (69%) cases were linked to areas with large transient populations, including those near mines or plantations.

cVDPVs can emerge in underimmunized populations when Sabin vaccine poliovirus is extensively transmitted person-to-person and reverts to neurovirulence (*1*). Reported national administrative coverage for the third dose of OPV in infancy was 44% in 2017 and never exceeded 70% during 2006–2016 (*2*), with substantial subnational variation. The last previous national OPV vaccination campaign occurred in 2012.

The outbreak response included two subnational supplementary immunization activities (SIAs) (Round 1 and Round 2) (Figure) with bivalent OPV (containing OPV types 1 and 3), beginning July 16, 2018, and August 20 and targeting children aged <5 years in provinces with cVDPV1 cases or geographic or travel links to affected provinces. After cVDPV1 cases were detected in other provinces and in additional older children, two national SIAs were conducted (Round 3 and Round 4), targeting 3.26 million children aged <15 years. Reported administrative coverage† was 93% for the nationwide SIA conducted beginning September 24 and 97% for the one beginning October 29. Beginning November 26, a third subnational SIA (Round 5) was conducted, targeting children aged <15 years. All SIAs faced logistical challenges requiring access to remote communities via helicopter, boat, and by foot.

Papua New Guinea was at risk for delayed detection of poliovirus because of an insufficient surveillance system for acute flaccid paralysis (AFP) and delays in seeking health care, often because of geographic inaccessibility. After the initial cVDPV1 case was detected, active AFP case-finding at health facilities was intensified. The annual national nonpolio AFP rate, a key indicator of surveillance sensitivity (*3*), was 7.0 per 100,000 persons aged <15 years in 2018 because of improved surveillance, compared with 0.8 in 2017.§ However, in 2018, adequate stool specimens¶ were received for <50% of AFP cases. After environmental sampling was established at three sites in Port Moresby, the largest city in Papua New Guinea, and two sites in Lae, the second-largest city, cVDPV1 was isolated from seven sewage samples in Port Moresby, beginning in September and most recently on November 6.

A December outbreak response assessment concluded that cVDPV1 transmission likely continues, given the dates of isolation of cVDPV1 from environmental surveillance and the most recent confirmed case. Additional SIAs are planned in Papua New Guinea in 2019. Because of the outbreak, on July 12, 2018, CDC issued a Level 2 Travel Health Notice recommending that all travelers to Papua New Guinea be fully vaccinated against polio. Before traveling to Papua New Guinea, adults who completed their routine polio vaccine series as children are advised to receive a single, lifetime adult booster of polio vaccine.

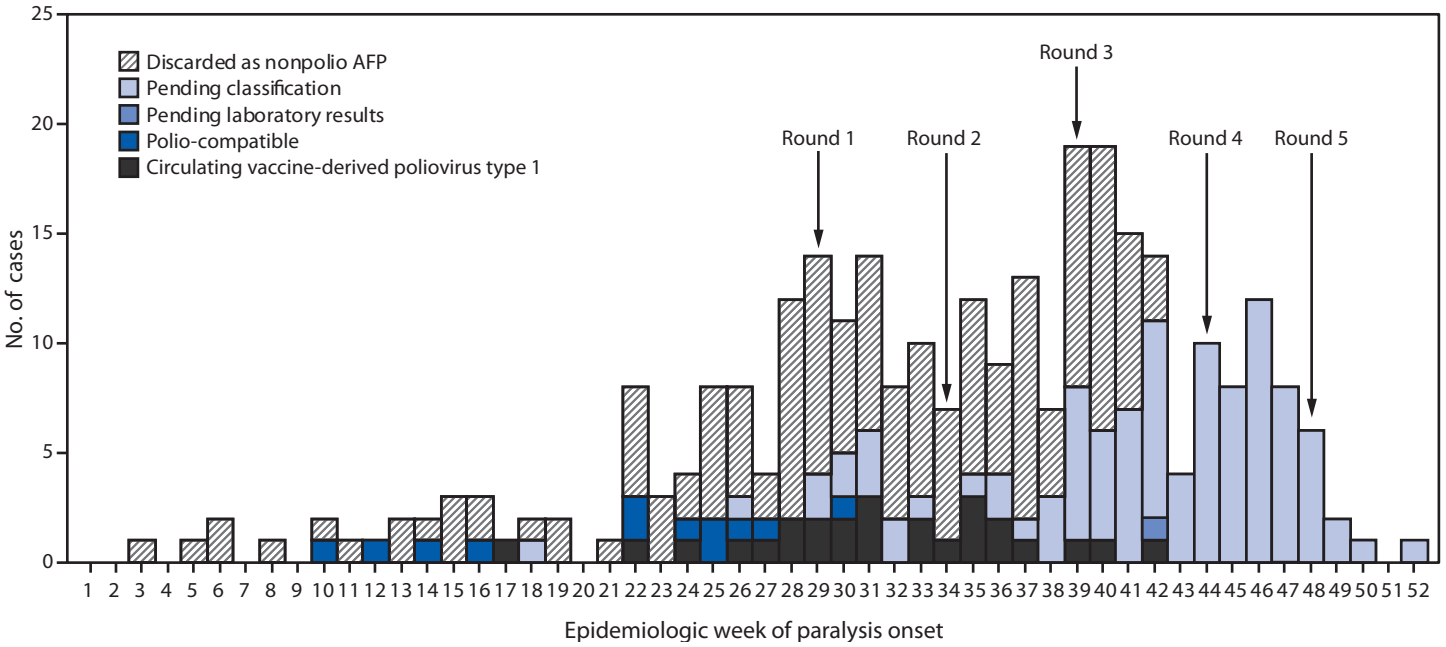
* Before May 2016, all childhood vaccination with OPV was with trivalent (types 1, 2, and 3); since May 2016, vaccination has been with bivalent OPV (types 1 and 3) worldwide.

† Calculated as the number of doses administered divided by the estimated target population, and multiplied by 100.

§ A nonpolio AFP rate of ≥2 per 100,000 persons aged <15 years is considered sufficiently sensitive to detect a case of wild poliovirus or cVDPV if poliovirus is circulating.

¶ Adequate specimens are two stool specimens collected within 14 days of paralysis onset and ≥24 hours apart that arrive at a World Health Organization–accredited laboratory in good condition.

FIGURE. Number of acute flaccid paralysis (AFP) cases, by week* of paralysis onset, case classification,† and SIA round§ — Papua New Guinea, 2018



Abbreviation: SIA = supplementary immunization activity.

* Onset date was missing for 10 cases (two discarded as nonpolio AFP and eight pending classification).

† Pending classification by Papua New Guinea's National Polio Expert Committee. AFP cases pending classification have inadequate stool specimens (adequate = two stool specimens collected within 14 days of paralysis onset and ≥24 hours apart that arrive at a World Health Organization–accredited laboratory in good condition) from which no poliovirus was isolated. After committee review, these cases might be classified as polio-compatible or discarded as nonpolio AFP. Polio-compatible cases are AFP cases with inadequate specimens from which no poliovirus was isolated but in which there is polio-compatible residual paralysis at 60 days, death takes place within 60 days, or the case is lost to follow-up, and the cases are compatible with poliomyelitis based on available clinical information reviewed by the National Polio Expert Committee.

§ Shown are the start weeks for each of the five SIA rounds, during which bivalent (types 1 and 3) oral poliovirus vaccine was administered.

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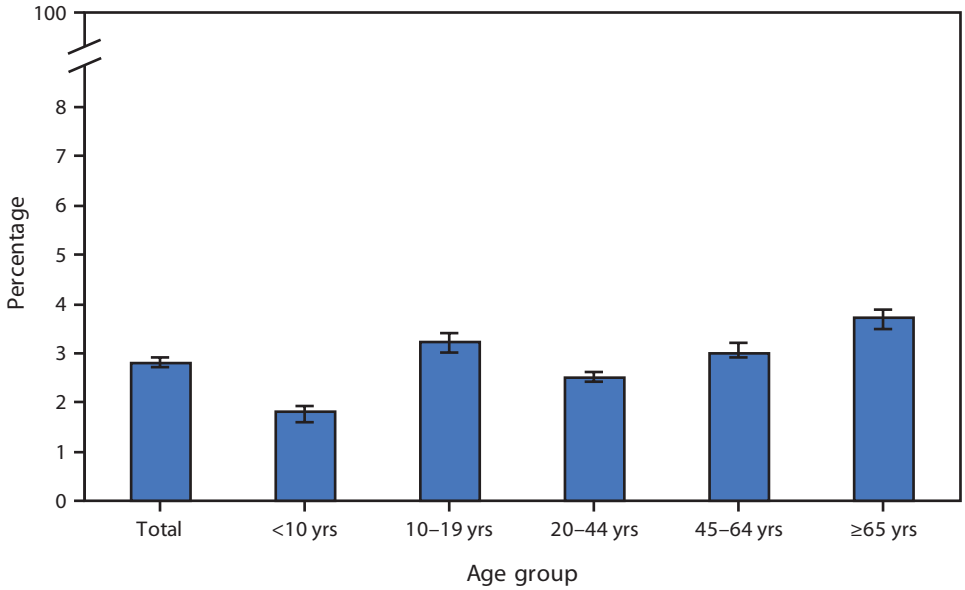
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Persons of All Ages Who Had a Medically Attended Injury During the Past 3 Months,† by Age Group — National Health Interview Survey,§ 2015–2017



* With 95% confidence intervals indicated by error bars.
† Medically attended injury is based on positive response to the survey questions "During the past three months, that is since (91 days before today's date) did [person] have an injury where any part of the body was hurt, for example with a cut or wound, broken bone, sprain or burn?" and "Did [person] talk to or see a medical professional about this injury?"
§ 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 Family component.

During 2015–2017, 2.8% of persons of all ages had a medically attended injury in the past 3 months, and this varied by age. The percentage who had a medically attended injury increased from 1.8% among those aged <10 years to 3.2% among those aged 10–19 years, declined to 2.5% among those aged 20–44 years, and then increased to 3.0% among those aged 45–64 years and to 3.7% among those aged ≥65 years.

Source: National Health Interview Survey, 2015–2017. https://www.cdc.gov/nchs/nhis.htm.

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/injury/.

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