Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 67 / No. 5
February 9, 2018

Nonfatal Assaults Among Persons Aged 10–24 Years — United States, 2001–2015

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In 2015, persons aged 10–24 years who were treated for nonfatal assault injuries in emergency departments (EDs) in the United States accounted for 32% of the approximately 1.5 million patients of all ages that EDs treated for nonfatal assault injuries (*1*). CDC analyzed data from the National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP) to examine 2001–2015 trends in nonfatal assault injuries among youths treated in EDs, by sex and age group, and to assess current rates by sex, age group, mechanism of injury, and disposition (*1*). Rates for 2001–2015 were significantly higher among males than among females and among young adults aged 20–24 years than among youths aged 10–14 and 15–19 years. During 2011–2015, rates declined for all groups. The 2015 rate among persons aged 10–24 years was 753.2 per 100,000 population, the lowest in the 15-year study period. Despite encouraging trends, the assault rate among young persons remains high. Rates in 2015 were higher among males, persons aged 20–24 years, and those who incurred intentional strike or hit injuries. Nearly one in 10 patients were admitted to the hospital, transferred to another hospital, or held for observation. Youth violence prevention strategies, including primary prevention approaches that build individual skills, strengthen family relationships, or connect young persons treated in EDs to immediate and ongoing support, can be implemented to decrease injuries and fatalities (*2*).

NEISS-AIP collects data from a nationally representative sample of EDs, using specific guidelines for recording the primary diagnosis and mechanism of all types of treated injuries. NEISS-AIP is operated by the U.S. Consumer Product Safety Commission in collaboration with CDC's National Center for Injury Prevention and Control. Data are accessible using CDC's Web-based Injury Statistics Query and Reporting System (*1*). The analysis was limited to patients treated for nonfatal assault injuries, which included injury resulting from an act of violence where physical force by one or more persons was involved and excluded injuries related to sexual assault. Data were stratified by calendar year, sex, and 5-year age group (10–14, 15–19, and 20–24 years). Data for 2015 were also stratified by mechanism of injury (struck by/against, cut/pierce, firearm, or other) and disposition (treated and released, transferred to another hospital, held for observation, left against medical advice, or left without being seen

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by physician). Annual injury rates (per 100,000 population) were computed overall and for the indicated strata. Joinpoint regression* was used to test the significance of trends from 2001 to 2015. Changes in the annual nonfatal assault rate among persons aged 10–24 years by sex and age group were examined. Annual percentage change (APC) estimates that were statistically significant ($p<0.05$) are presented to indicate the magnitude and direction of significant trends.

During 2001–2015, approximately 9.6 million persons aged 10–24 years were treated in EDs for nonfatal assault injuries, an average annual rate of 1,003.9 per 100,000 (Table). Rates were significantly higher among males (1,265.3 per 100,000) than among females (729.0). Rates were higher for young adults aged 20–24 years (1,376.5) than for persons aged 10–14 years (461.7) and 15–19 years (1,159.7). The overall nonfatal assault rate per 100,000 persons aged 10–24 declined during the 15-year study period from 1,179.7 in 2001 to 753.2 in 2015, the lowest rate in the study period (Figure 1). During 2011–2015, the overall nonfatal assault injury rate declined 27.5% (Table). During this period, rates for males and females declined 30.1% and 22.7%, respectively; the average annual percentage decrease was 8.5% for males and 7.4% for females (Figure 1). Also during 2011–2015, rates for persons aged 10–14, 15–19, and 20–24 years declined 35.5%, 30.6%, and 23.8%, respectively (Table). The injury rate declined 11.5% per year for persons aged 10–14 years, 9.2% for persons aged 15–19 years, and 5.6% for persons aged 20–24 years (Figure 2).

In 2015, an estimated 485,610 persons aged 10–24 years were treated in EDs for nonfatal assault injuries. The rate of nonfatal assault injuries among persons aged 10–24 years was 914.9 per 100,000 for males and 583.9 for females; by age group, it was 267.0 per 100,000 for persons aged 10–14 years, 813.1 for persons aged 15–19 years, and 1,138.6 for persons aged 20–24 years.

Most persons aged 10–24 years treated in an ED for nonfatal assault injuries (81.2%) were treated for injuries related to being intentionally struck or hit. Other leading mechanisms of nonfatal injuries included being cut, stabbed, or pierced (8.1%), and having firearm-related injuries (5.7%). Most persons in this age range who visited an ED for assault injuries were treated and released (87.0%); 9.9% were hospitalized, transferred to another hospital, or held for observation; and 3.1% left the ED against medical advice or left without being seen by a physician.

Discussion

For decades, young persons have represented a substantial proportion of patients receiving treatment in EDs for assault injuries. The findings in this report demonstrate that the rate of nonfatal assault injuries among persons aged 10–24 years has declined since 2001, with significant declines overall and

* https://surveillance.cancer.gov/joinpoint/.

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

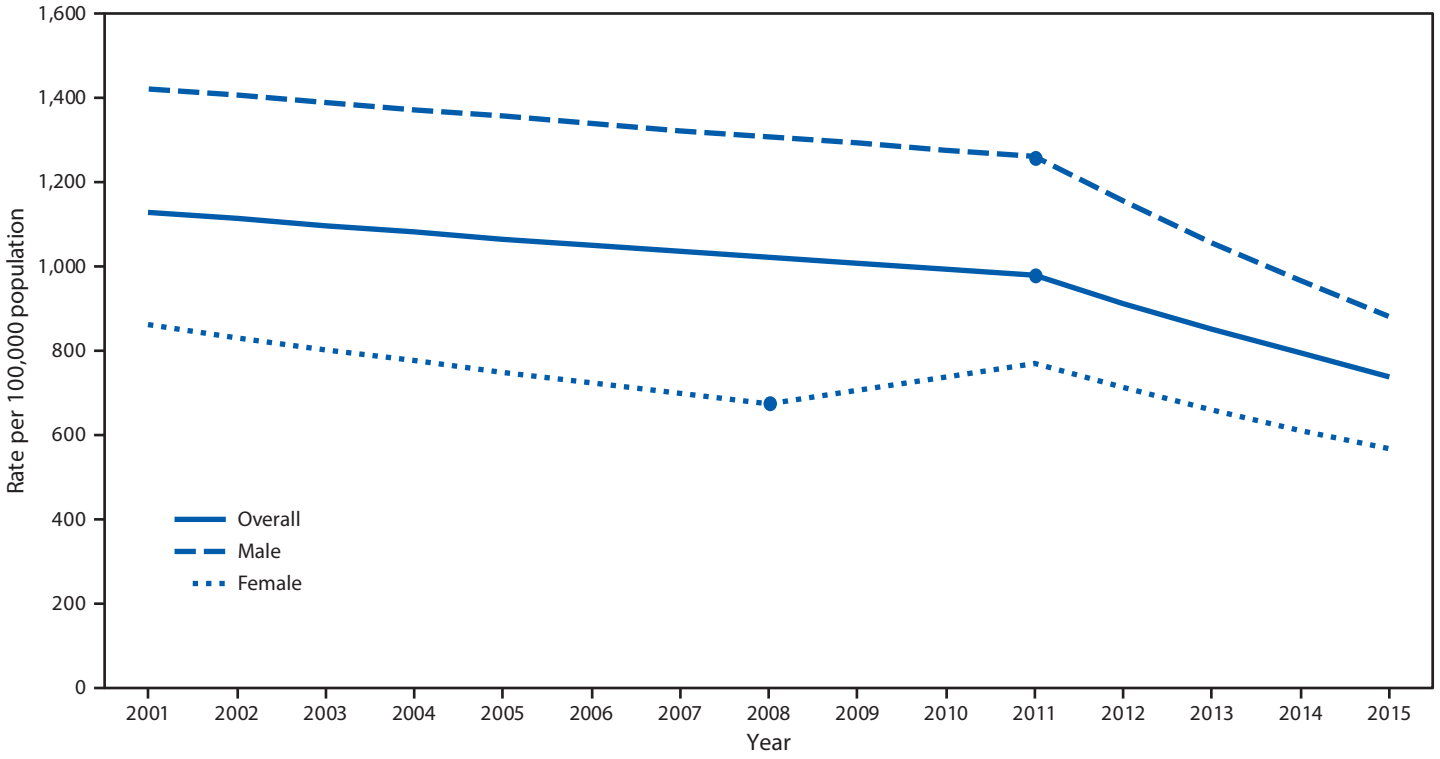
Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2018;67:[inclusive page numbers].

TABLE. Average annual rate of nonfatal assault injuries per 100,000 population among persons aged 10–24 years treated in hospital emergency departments, by sex and age group — United States, 2001–2015

Characteristic	No. of sample cases	National estimate* (%)	Average annual rate† (95% CI)	No. of joinpoints	Joinpoint year range	APC	Rate† range during joinpoint year	% reduction in rate during joinpoint year range
Total	**185,645**	**9,603,933 (100.0)**	**1,003.9 (805.0–1,202.8)**	**1**	**2001–2011**	**-1.4§**	**(1,179.7–1,039.0)**	**11.9**
					2011–2015	**-6.8§**	**(1,039.0–753.2)**	**27.5**
Sex								
Male	120,930	6,200,495 (64.6)	1,265.3 (1,003.6–1,527.1)	1	2001–2011	-1.2§	(1,476.8–1,309.5)	11.3
					2011–2015	-8.5§	(1,309.5–914.9)	30.1
Female	64,687	3,401,887 (35.4)	729.0 (589.9–868.1)	2	2001–2008	-3.4§	(8,66.6–676.4)	21.9
					2008–2011	4.5	—	—
					2011–2015	-7.4§	(7,55.7–583.9)	22.7
Age group (yrs)								
10–14	34,132	1,447,593 (15.1)	461.7 (321.2–602.2)	2	2001–2008	-8.7§	(683.2–3,85.7)	43.5
					2008–2011	2.1	—	—
					2011–2015	-11.5§	(413.7–267.0)	35.5
15–19	74,267	3,724,730 (38.8)	1,159.7 (930.2–1,389.1)	1	2001–2011	-1.7§	(1,362.0–1,170.8)	14.0
					2011–2015	-9.2§	(1,170.8–813.1)	30.6
20–24	77,246	4,431,610 (46.1)	1,376.5 (1,132.3–1,620.7)	1	2001–2011	0.1	—	—
					2011–2015	-5.6§	(1,494.5–1,138.6)	23.8

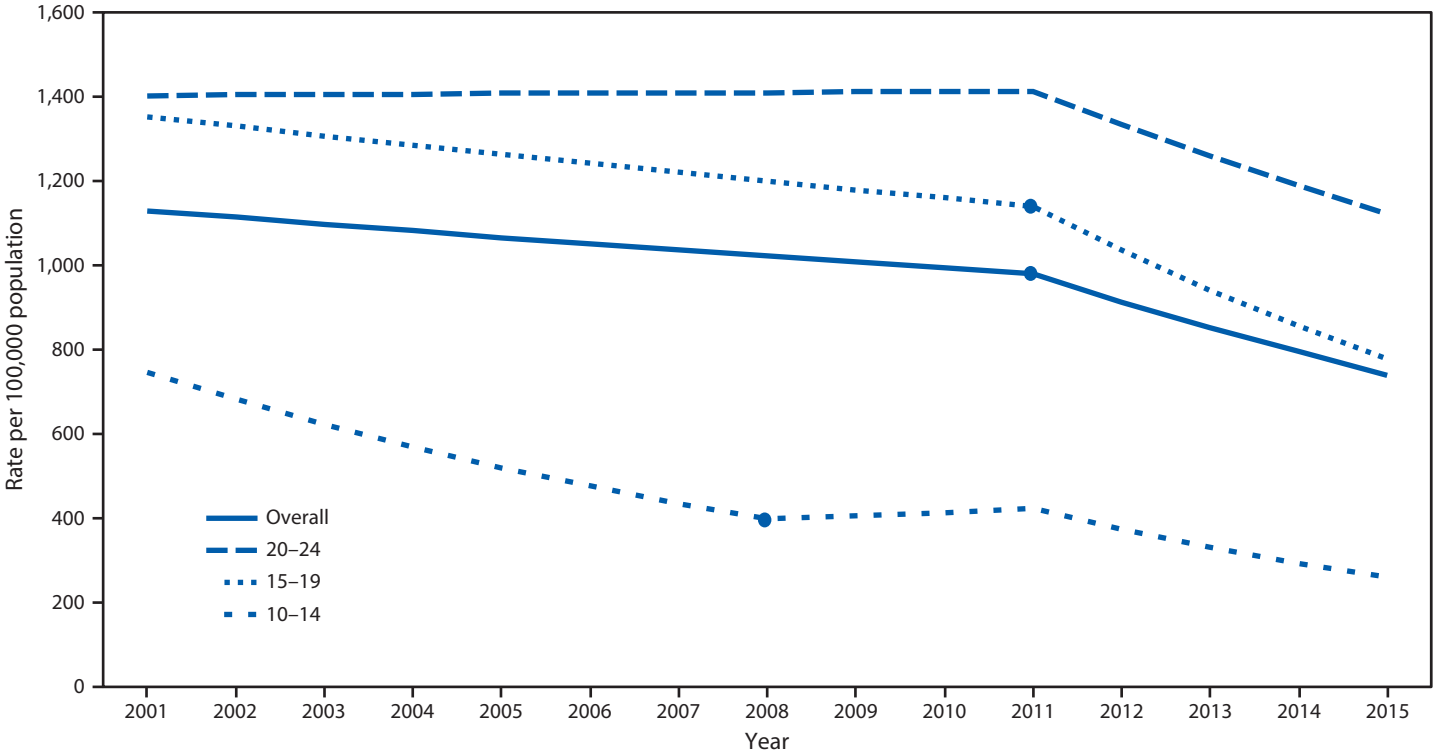
Abbreviations: APC = annual percentage change; CI = confidence interval.
* Excludes sexual assault cases; includes assault cases with unknown sex. Estimates might not sum to total because of rounding.
† Crude rate per 100,000 population.
§ Statistical significance of regression results (p<0.05).

FIGURE 1. Nonfatal assault* injury rate among persons aged 10–24 years treated in hospital emergency departments, by sex — United States, 2001–2015†



* Excluding sexual assault.
† Joinpoint regression analysis was used to determine annual percentage change with statistically significant trend and significant joinpoints indicated (p<0.05).

FIGURE 2. Nonfatal assault* injury rate among persons aged 10–24 years treated in hospital emergency departments, by age group — United States, 2001–2015†



* Excluding sexual assault.
† Joinpoint regression analysis was used to determine annual percentage change with statistically significant trend and significant joinpoints indicated (p<0.05).

by sex and age group since 2011. These encouraging declines are consistent with previous analyses and recent trends in youth violence (*3*,*4*). The declines might indicate increased implementation and beneficial effects of evidence-based prevention strategies that reach young persons (*2*,*5*). A number of primary prevention strategies have been shown to reduce the risk for and occurrence of youth violence, including school-based programs that build communication and problem-solving skills and family approaches that help caregivers set age-appropriate rules, monitor youth activities and relationships, and address other risk factors (e.g., childhood conduct problems and delinquency) (*2*).

The ED is an important implementation setting for prevention, in part because a large proportion of patients will experience a subsequent assault-related injury or premature death within a few years of a treated injury (*6*,*7*). For example, one study compared persons aged 14–24 years who sought treatment in the ED and reported substance use in the 6 months before the visit. Of the young persons who were seen initially for an assault-related injury, 36.7% were seen again for an assault-related injury within 24 months, compared with 22.4% of the young persons initially seen for other conditions (e.g., unintentional injury or illness) (*6*).

The implementation of brief ED interventions to reduce the continuation and escalation of violence is growing (*8*). These programs vary in design and duration but typically identify youths in the ED when they are examined for a violence-related injury. The programs are implemented by trained staff members (e.g., medical personnel, community service providers, and program outreach workers) who provide immediate and follow-up services to increase risk awareness, conflict resolution skills, and connection to community support (e.g., academic or vocational supports and mental health treatment). Research has shown that these programs have significant benefits, including sustained reductions in perpetration and victimization of peer violence (*9*). Evaluation of a specific program found that participants were 70% less likely than nonparticipating youths to be arrested for any offense during the 6 months after the program (*10*).

The findings of this report are subject to at least four limitations. First, injury rates are likely underestimates of the actual prevalence because data are limited to persons treated in EDs and do not include those who had injuries treated in other health care facilities (e.g., physician's office or urgent care center) or those for whom no treatment was needed or sought. Second, data were coded by trained personnel based on narratives abstracted from patients' medical records, for which details

Summary

What is already known about this topic?

Persons aged 10–24 years account for a substantial proportion of nonfatal assault injuries treated in emergency departments (EDs) in the United States.

What is added by this report?

The 2015 rate for nonfatal injuries among persons aged 10–24 years was 753.2 per 100,000 population, the lowest rate in the 15-year study period (2001–2015). From 2011 to 2015, injury rates declined among both males and females and all age groups examined. Despite these findings, assault injuries continue to occur often, with 485,610 young persons treated in EDs for assault-related injuries in 2015.

What are the implications for public health practice?

Primary prevention strategies that build communication and problem-solving skills and address risk factors for violence among young persons can stop violence before it starts. Expansion of these strategies and additional interventions focused on injured young persons while they are receiving ED treatment to connect to immediate and ongoing community support might decrease the risk for reinjury or fatality. CDC's technical package to prevent youth violence helps communities and states prioritize strategies with the best available evidence.

of the injuries and circumstances varied. Inaccuracies in the abstraction and coding process might have occurred. Third, differences by race and ethnicity could not be examined because of the high prevalence of missing race/ethnicity data (20.3%). Finally, data are based on information in the ED record and are not linked to other data sources (e.g., police reports or school disciplinary reports) that might provide additional information about the circumstances related to the injury or the relationship between the perpetrator and victim.

Although the number of young persons treated for nonfatal assault injuries in EDs is declining, and this trend is promising, these injuries remain common and costly. In 2015, approximately 485,610 young persons were treated for assault-related injuries, and associated medical and lost productivity costs were approximately $3.4 billion (*1*). These injuries continue to occur most often among males and among young adults aged 20–24 years, highlighting the groups that need to be reached with continued and enhanced prevention strategies. Violence among young persons is preventable with the implementation of evidence-based policies and programs that significantly reduce the risk for injuries and associated risk factors. CDC's *A Comprehensive Technical Package for the Prevention of Youth Violence and Associated Risk Behaviors* (https://www.cdc.gov/violenceprevention/pdf/yv-technicalpackage.pdf) can help states and communities focus their collaborative action on strategies supported by the best available evidence (*2*).

Conflict of Interest

No conflicts of interest were reported.

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Outbreak of Fluoroquinolone-Resistant *Campylobacter jejuni* Infections Associated with Raw Milk Consumption from a Herdshare Dairy — Colorado, 2016

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In August 2016, a local public health agency (LPHA) notified the Colorado Department of Public Health and Environment (CDPHE) of two culture-confirmed cases of *Campylobacter* infection among persons who consumed raw (unpasteurized) milk from the same herdshare dairy. In Colorado, the sale of raw milk is illegal; however, herdshare programs, in which a member can purchase a share of a herd of cows or goats, are legal and are not regulated by state or local authorities. In coordination with LPHAs, CDPHE conducted an outbreak investigation that identified 12 confirmed and five probable cases of *Campylobacter jejuni* infection. Pulsed-field gel electrophoresis (PFGE) patterns for the 10 cases with available isolates were identical using the enzyme *Sma*. In addition, two milk samples (one from the dairy and one obtained from an ill shareholder) also tested positive for the outbreak strain. Five *C. jejuni* isolates sent to CDC for antimicrobial susceptibility testing were resistant to ciprofloxacin, tetracycline, and nalidixic acid (*1*). Although shareholders were notified of the outbreak and cautioned against drinking the milk on multiple occasions, milk distribution was not discontinued. Although its distribution is legal through herdshare programs, drinking raw milk is inherently risky (*2*). The role of public health in implementing control measures associated with a product that is known to be unsafe remains undefined.

Investigation and Results

On August 23, 2016, El Paso County Public Health notified CDPHE of two culture-confirmed cases of *C. jejuni* infection; campylobacteriosis is a reportable disease in Colorado. Both patients reported drinking unpasteurized milk from the same herdshare dairy in Pueblo County. Since 2005, obtaining raw milk by joining a herdshare program has been legal for Colorado residents, but selling raw milk is illegal. By purchasing a share of a herd (cows or goats), shareholders are entitled to a portion of the raw milk.

Because the prevalence of consuming unpasteurized milk is low (2.4% in Colorado, 2006–2007 FoodNet Population Survey; 3.1%, 2009 Colorado Behavioral Risk Factor Surveillance System), two cases of enteric illness with a common exposure to raw milk are unlikely to occur by chance (*3*,*4*). In this outbreak, a confirmed case was defined as diarrheal illness with onset on or after August 1, 2016, in a person with known consumption of unpasteurized milk from the same herdshare dairy and culture-confirmed *C. jejuni* infection. A probable case was defined as diarrhea onset on or after August 1, lasting 1 or more days, in a person with either known consumption of milk from the same herdshare dairy or with an epidemiologic link to a confirmed case.

Cases were identified through routine passive reporting with follow-up interviews, a Health Alert Network broadcast to area providers, and attempts to contact all shareholders. A public health order was issued to obtain a list of shareholders with their contact information after it was not provided by the dairy within 5 days of the initial request. CDPHE attempted to contact shareholders to inform them about the outbreak and assess possible illness. Up to three calls were made to each shareholder household. Epidemiologists contacted laboratories to request that isolates from potential outbreak-associated cases be forwarded to the state public health laboratory.

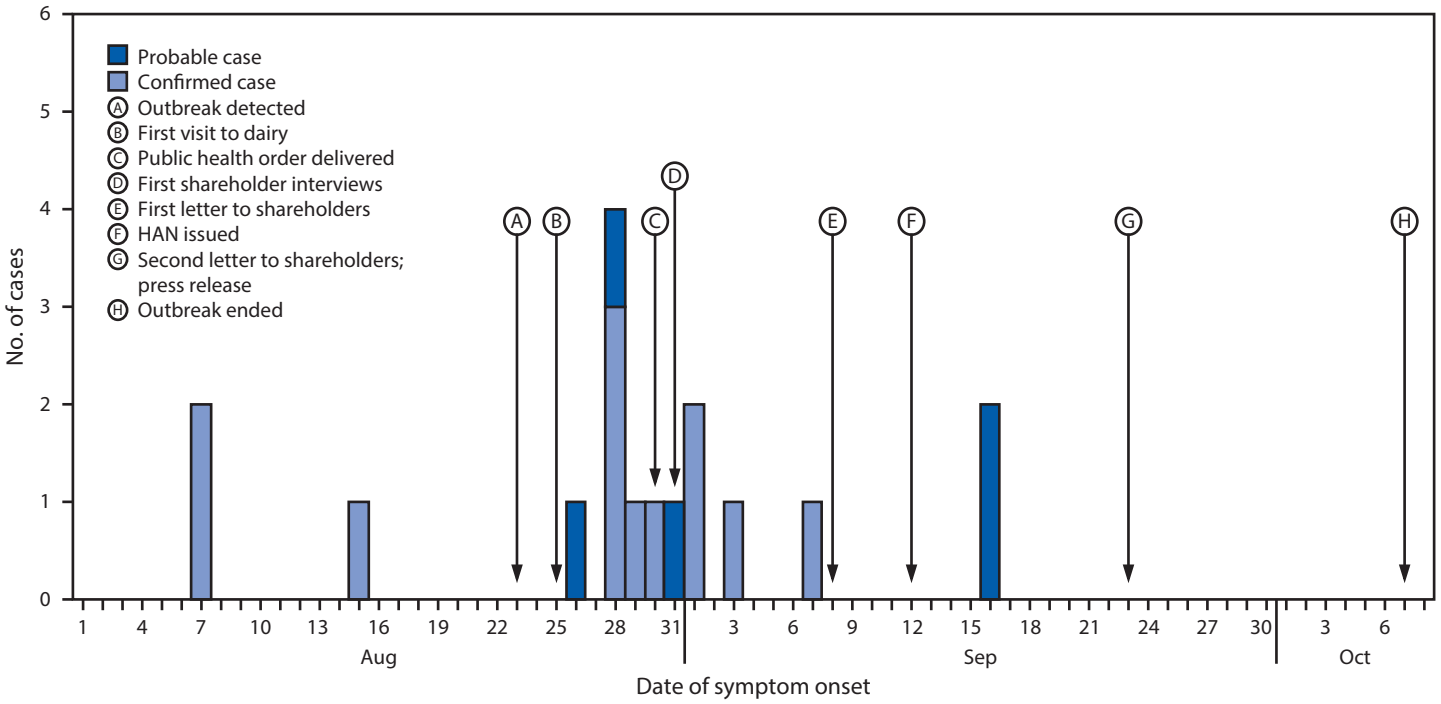
Among 91 (53%) of 171 shareholder households that responded to requests for follow-up interviews, representing 207 persons in five or more Colorado counties, 12 confirmed and five probable cases were identified (Figure). Among confirmed cases, patients ranged in age from 12 to 68 years (median = 58 years); nine were male. Duration of illness ranged from 3 to >10 days. One hospitalization occurred; there were no deaths. In addition to diarrhea, among the 12 confirmed cases, the majority of patients also experienced fever (10), abdominal pain or cramps (eight), headache (eight), and myalgia (seven); vomiting and bloody diarrhea were reported less frequently (in five and four persons, respectively).

Four milk samples were tested for *C. jejuni*; pathogen identification and PFGE were performed on available isolates from persons epidemiologically linked to the outbreak. *C. jejuni* with one of two outbreak PFGE patterns (PulseNet DBRS16.0008 using the enzyme *Sma* and PulseNet DBRK02.1272 or DBRK02.0028 using the enzyme *Kpn*) was confirmed in 10 isolates that were available at the public health laboratory and two of the four raw milk samples. The National Antimicrobial Resistance Monitoring System performed antimicrobial susceptibility tests on five representative isolates; all were resistant to ciprofloxacin, tetracycline, and nalidixic acid (*1*).

Public Health Response

Public health responses to this outbreak consisted of notifying shareholders about the outbreak on three occasions (Figure) and requiring the dairy to provide additional written notification about the outbreak at milk distribution points. A press

FIGURE. An outbreak of *Campylobacter jejuni* associated with consumption of raw milk from a herdshare dairy and public health response — Colorado, August 1–October 7, 2016



Abbreviation: HAN = Health Alert Network.

release was issued by two LPHAs (Figure) in response to detecting at least one infection in a person who was not a shareholder but was given milk by shareholders. In addition, a number of shareholders reported sharing milk with nonshareholders who might have been unaware of the outbreak. Although milk sample results were positive for *C. jejuni*, CDPHE did not close the dairy or stop distribution of its milk because without pasteurization CDPHE could not create standards for safely reopening the dairy (*5*). Shareholders were, however, urged to discard raw milk distributed since August 1 and were reminded that Colorado statute prohibits redistribution of raw milk.

Discussion

Raw milk from a herdshare dairy was the source of this outbreak of *C. jejuni* infections, and the investigation highlighted the difficulties inherent in addressing an outbreak related to unpasteurized milk from a herdshare dairy. During three previous herdshare-associated outbreaks in Colorado, public health authorities temporarily took action to stop milk distribution until a series of negative tests were obtained from the milk (Alicia Cronquist, CDPHE, personal communication, December 2017). However, because CDPHE could not ensure that unpasteurized milk would be safe in the future, the decision was made not to close the dairy during this outbreak. In addition, CDPHE's Division of Environmental Health and Sustainability chose not to make formal recommendations on the dairy's processes because no protocol improvements short of pasteurization could ensure the product's safety, even with improved sanitation (*5*).

All tested isolates' resistance to three antibiotics was concerning, particularly as fluoroquinolones are frequently used to treat *Campylobacter* infections in those cases where treatment is indicated. Treatment of antibiotic-resistant *Campylobacter* infections might be more difficult, of longer duration, and possibly lead to more severe illness than treatment of nonresistant *Campylobacter* infections (*6*–*8*). In 2015, approximately 25.3% of U.S. *C. jejuni* isolates were resistant to ciprofloxacin, an increase from 21.6% a decade earlier (*1*).

In collaboration with LPHAs, CDPHE is creating guidelines to address future outbreaks related to raw milk from herdshares. As more states legalize the sale or other distribution of unpasteurized milk, the number of associated outbreaks will likely increase (*9*,*10*). The role of public health in responding to raw milk–related outbreaks should be further defined. State-level guidelines might assist with this process.

Conflict of Interest

No conflicts of interest were reported.

Summary

What is already known about this topic?

Raw (unpasteurized) milk has been linked to many foodborne illnesses, including *Campylobacter* infections. In some states, including Colorado, it is legal to distribute unpasteurized milk through herdshare programs. Studies indicate that legalizing the sale of raw milk leads to more raw milk–associated outbreaks.

What is added by this report?

Although sale of raw milk is not legal in Colorado, herdshare programs, in which members may purchase a share of a herd of cows or goats, are legal and are not regulated by state or local authorities. During August–October 2016, 12 confirmed and five probable cases of *Campylobacter jejuni* infections were identified in persons who consumed raw milk from a herdshare dairy in Colorado. Pulsed-field gel electrophoresis identified the outbreak pattern in patients' stools and two milk samples. Shareholders were notified about the outbreak, but the dairy was not ordered to close. This report highlights the public health challenges of addressing a high-risk product that is not regulated.

What are the implications for public health practice?

In states where distribution of raw milk from herdshares is legal, outbreaks associated with raw milk will likely continue to be a problem. The role of public health in implementing control measures associated with a product that is known to be unsafe should be further defined. State level guidelines might assist with this process.

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Vital Signs: Asthma in Children — United States, 2001–2016

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On February 6, 2018, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Abstract

Background: Asthma is the most common chronic lung disease of childhood, affecting approximately 6 million children in the United States. Although asthma cannot be cured, most of the time, asthma symptoms can be controlled by avoiding or reducing exposure to asthma triggers (allergens and irritants) and by following recommendations for asthma education and appropriate medical care.

Methods: CDC analyzed asthma data from the 2001–2016 National Health Interview Survey for children aged 0–17 years to examine trends and demographic differences in health outcomes and health care use.

Results: Asthma was more prevalent among boys (9.2%) than among girls (7.4%), children aged ≥5 years (approximately 10%) than children aged <5 years (3.8%), non-Hispanic black (black) children (15.7%) and children of Puerto Rican descent (12.9%) than among non-Hispanic white (white) children (7.1%), and children living in low income families (10.5%) than among those living in families with income ≥250% of the Federal Poverty Level (FPL) (approximately 7%). Asthma prevalence among children increased from 8.7% in 2001 to 9.4% in 2010, and then decreased to 8.3% in 2016. Although not all changes were statistically significant, a similar pattern was observed among subdemographic groups studied, with the exception of Mexican/Mexican-American children, among whom asthma prevalence increased from 5.1% in 2001 to 6.5% in 2016.

Among children with asthma, the percentage who had an asthma attack in the past 12 months declined significantly from 2001 to 2016. Whereas asthma prevalence was lower among children aged 0–4 years than among older children, the prevalence of asthma attacks (62.4%), emergency department or urgent care center (ED/UC) visits (31.1%), and hospitalization (10.4%) were higher among children with asthma aged 0–4 years than among those aged 12–17 years (44.8%, 9.6%, and 2.8%, respectively).

During 2013, children with asthma aged 5–17 years missed 13.8 million days of school per year (2.6 days per child). Compared with 2003, in 2013, the prevalence of adverse health outcomes and health care use were significantly lower and the prevalence of having an action plan to manage asthma was higher.

Conclusions and Implications for Public Health Practice: Asthma remains an important public health and medical problem. The health of children with asthma can be improved by promoting asthma control strategies, including asthma trigger reduction, appropriate guidelines-based medical management, and asthma education for children, parents, and others involved in asthma care.

Introduction

Asthma is a common chronic lung disease of children that causes repeated episodes of wheezing, breathlessness, chest tightness, and nighttime or early morning coughing (*1*). These symptoms can often be controlled by avoiding or reducing asthma triggers (allergens and irritants) and by following recommendations for appropriate medical care (initiating asthma control medications or adjusting the current treatment regimen when needed) (*1*,*2*).

A 2012 CDC National Surveillance of Asthma report showed an increasing trend in asthma prevalence among children between 2001 and 2010, with children experiencing more asthma attacks and emergency visits than did adults (*3*). Asthma is more common among some children than others. Boys, children aged ≥5 years, black children and children of Puerto Rican descent, and children living in households with income of <100% of FPL had higher prevalence than did girls, children aged <5 years, white children, and children living in households with income >250% FPL (*3*,*4*). Asthma-related hospitalizations were 3.6 times higher and emergency department visits were 3 times higher among black children than among white children (*4*).

Uncontrolled asthma results in significant costs to families and society when asthma exacerbations result in medical encounters, lost school days, and reduced productivity. The cost of asthma for children varies by state. In 2012, the median annual medical cost of asthma was $983 per child (ranging from $833 in Arizona to $1,121 in Michigan) for all payers (*5*).

Because of changing physical, social, and economic environments and medical management of asthma at individual and population levels over time (*6*,*7*), there is a need to update prevalence estimates and to reassess demographic differences in health outcomes and health care use to better define the current burden of asthma overall and among subpopulations. This report reviews the current state of asthma among U.S. children aged 0–17 years and related health outcomes, health care use, and asthma care and management.

Methods

To describe asthma status and to assess trends and demographic differences in self-reported health outcomes, health care use, and asthma care and management among children aged 0–17 years, CDC analyzed annual core* data (2001–2016) and periodic asthma supplemental† data (2003, 2008, and 2013) from the National Health Interview Survey (NHIS).

The NHIS, conducted by CDC's National Center for Health Statistics (NCHS), is a cross-sectional household interview survey of the U.S. civilian noninstitutionalized population in 50 states and the District of Columbia. NHIS uses a multistage, clustered sample design, and applies sampling weights to account for household nonresponse and oversampling of blacks, Hispanics, and Asians to produce national estimates for a variety of health indicators (the sampling design was changed in 2016, and oversampling of these groups was not conducted during that year). NHIS collects additional data on asthma (e.g., routine care visits, hospitalization, missed school days, self-management education, and asthma medication use [rescue and control medications]) every 5 years (i.e., 2003, 2008, and 2013; https://www.cdc.gov/nchs/nhis/about_nhis.htm).

In 2016, persons aged 0–17 years accounted for 11,107 of NHIS respondents, including 960 (8.3%) who had current asthma. Children were considered to have current asthma if proxy adults answered "yes" to the following two questions: "Has a doctor or other health professional ever told you that [child] had asthma?" and "Does [child] still have asthma?" (*3*,*4*). Trends in prevalence of current asthma (asthma) and asthma attack were assessed. Among children with asthma, demographic (age, sex, race/ethnicity, income status, and U.S. Bureau of the Census geographic region) differences in self-reported school absenteeism, asthma attack, and health care use because of asthma (routine care visit, ED/UC visit, and hospitalization) in the past 12 months were assessed. Prevalences of asthma attack and ED/UC visit were defined as the percentage of children with current asthma who experienced an asthma attack and had an ED/UC visit because of an asthma attack in the past 12 months, respectively. School absenteeism was defined as one or more missed school days by a child aged 5–17 years in the past 12 months. NHIS 2003, 2008, and 2013 data were also analyzed to assess changes in health care use (asthma-related routine care visit and hospitalization in the past 12 months) and asthma care status (ever received any of the 6-component asthma self-management education,§ and asthma medication use [rescue medication and asthma control medication] in the past 3 months). Additional information is available at https://www.cdc.gov/nchs/nhis/index.htm.

Statistical software was used for analysis to account for the complex sampling design. Trends in prevalence of current asthma and asthma attack during 2001–2016 were assessed using Joinpoint software from the National Cancer Institute (NCI) (*8*), which characterizes trends as joined linear segments. All stated comparisons between demographic groups were evaluated by using two-sided significance tests with statistical significance defined as $p<0.05$. Relative standard error (RSE), defined as standard error divided by prevalence estimate, was used as a measure of an estimate's reliability (an RSE <0.30 indicates a reliable estimate) (*3*).

Results

During 2016, asthma affected boys (9.2%) more than girls (7.4%), children aged 5–11 years (9.6%) and 12–17 years (10.5%) more than children aged 0–4 years (3.8%), black children (15.7%) and children of Puerto Rican descent (12.9%) more than white children (7.1%), and children living in families with income of less than 100% FPL (10.5%) more than those living in families with income of ≥250% FPL (250% to <450% FPL: 6.9%; ≥450% FPL: 6.7%). However, current asthma prevalence did not differ significantly by U.S. Census region (Table 1) or metropolitan statistical area (MSA).

Asthma prevalence among children aged 0–17 years increased from 8.7% in 2001 to 9.4% in 2010, and then decreased to 8.3% in 2016. Although not all changes were statistically

* Core data include sociodemographic characteristics and information on health conditions, health care access and utilization, health behaviors and risk factors.

† Supplemental modules collect data on new topics or more detailed information on core topics; can change from year to year; and are designed to meet department goals and objectives.

§ The 6-component asthma self-management education includes 1) having been given an action plan, 2) having taken a class to learn how to manage asthma, 3) having been taught to recognize early signs and symptoms of an asthma attack, 4) having been taught how to respond to an asthma attack, 5) having been taught to use a peak flow meter, and 6) having received advice on environmental control.

significant, a similar pattern was observed among all sex, age, and racial/ethnic groups studied, except for Mexican/Mexican-American children, among whom asthma prevalence increased from 5.1% in 2001 to 6.5% in 2016.

In 2013 and 2016, nearly 54% of children with asthma were reported to have had ≥1 asthma attack, 71.1% had routine care visits, 4.7% were hospitalized, 16.7% had an ED/UC visit because of an asthma attack, and 49.0% of school-age children with asthma missed one or more school days (Table 2). Having an asthma attack, missing school days, and having health care visits because of asthma (routine care visits and hospitalizations) did not differ by sex, race/ethnicity, and U.S. census region. However, the prevalence of asthma attacks, hospitalizations, and ED/UC visits were higher among children aged 0–4 years than among those aged 12–17 years and ED/UC visits were higher among black children (22.5%) than among white children (12.2%) (Table 2).

During 2001–2016, the percentage of children with asthma who experienced an asthma attack decreased significantly, from 61.7% in 2001 to 53.7% in 2016 (Figure). A significant decline in asthma attacks was experienced across all sex, age, and racial/ethnic groups.

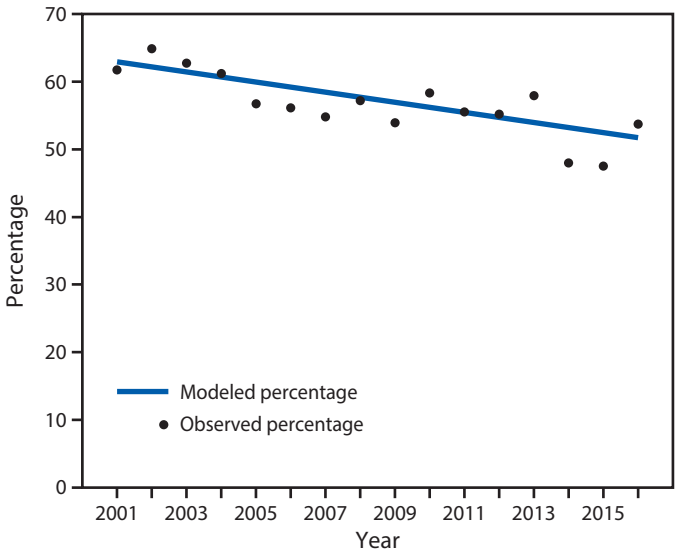
Assessment of asthma self-management education found that 50.8% of children with asthma received an asthma action plan, 11.0% were taking a class to learn how to manage their asthma, 76.0% were taught how to recognize early signs of an asthma attack, 80.0% were taught how to respond to an asthma attack, 50.6% were taught how to use a peak flow meter (a portable, handheld device that is used to measure how well air moves out of the lungs), and 46.4% received advice on environmental control in 2013. Compared with 2003, the percentages of children with asthma who were hospitalized because of asthma and, among school-aged children with asthma, the percentage with missed school days were significantly lower in 2013, while the percentage having an action plan to manage asthma was higher (Table 3). Similar to estimates in 2003, in 2013, 94.4% of children with asthma had health insurance coverage, and 6.4% could not afford prescription medicine during the

TABLE 1. Demographic characteristics and prevalence of current asthma among U.S. children aged 0–17 years — National Health Interview Survey, 2016

Demographic characteristic	Sample size* (U.S. children aged 0–17) (%)†	Prevalence of current asthma (6.1 million)		
		Sample size* (children with current asthma)	% (95% CI)†	p-value§
Total	**11,107 (100)**	**960**	**8.3 (7.7–9.0)**	—¶
Sex				
Boys	5,743 (51.0)	564	9.2 (8.3–10.3)	<0.01
Girls	5,364 (49.0)	396	7.4 (6.6–8.3)	Referent
Age group (yrs)				
0–4	3,042 (27.2)	111	3.8 (3.0–4.9)	Referent
5–11	4,076 (39.0)	421	9.6 (8.5–10.8)	<0.0000
12–17	3,989 (33.8)	428	10.5 (9.4–11.8)	<0.0000
Race/Ethnicity				
White, non-Hispanic	6,110 (51.5)	445	7.1 (6.3–8.0)	Referent
Black, non-Hispanic	1,286 (13.5)	201	15.7 (13.6–18.2)	<0.0000
Other, non-Hispanic	1,305 (10.1)	126	8.8 (6.9–11.1)	—¶
Hispanic	2,406 (24.9)	188	6.7 (5.5–8.2)	—¶
Puerto Rican	243 (2.5)	40	12.9 (8.9–18.4)	<0.05
Mexican/Mexican American	1,518 (15.9)	111	6.5 (5.0–8.5)	—¶
All other Hispanics	645 (6.5)	37	4.9 (3.2–7.5)	—¶
Ratio of family income to poverty threshold				
<100% FPL	1,813 (19.3)	202	10.5 (8.8–12.4)	<0.001
100% to <250% FPL	3,431 (32.2)	350	9.4 (8.2–10.7)	<0.01
250% to <450% FPL	2,943 (25.0)	210	6.9 (5.8–8.1)	—¶
≥450% FPL	2,919 (23.5)	197	6.7 (5.7–8.0)	Referent
U.S. Census region				
Northeast	1,808 (18.0)	167	8.2 (6.7–10.2)	—¶
Midwest	2,294 (21.4)	175	7.8 (6.6–9.2)	—¶
South	3,938 (36.8)	369	9.2 (8.1–10.4)	—¶
West	3,067 (23.7)	249	7.7 (6.5–9.0)	—¶

Abbreviations: CI = confidence interval; FPL = Federal Poverty Level (based on family income and family size, using the U.S. Census Bureau's poverty thresholds).
* Unweighted sample size.
† Weighted percentage and confidence interval.
§ p-value testing for differences in current asthma prevalence between intended group and corresponding referent group.
¶ Not statistically significant.

FIGURE. Percentage of asthma attacks among children aged 0–17 years with current asthma, by year — National Health Interview Survey, 2001–2016



Key Points

- One in 12 children aged 0–17 years had asthma in 2016.
- Asthma was more prevalent among boys, non-Hispanic black children, children of Puerto Rican descent, and children from low-income households.
- The percentage of children with asthma who had an asthma attack during the preceding year declined from 2001 to 2016. Even so, approximately half of children with diagnosed asthma had one or more asthma attack in 2016.
- Children with asthma had fewer missed school days and hospitalizations in 2013 compared with 2003.
- Approximately 55% children with asthma were taking asthma control prescription medicines during the preceding 3 months. Among children who were taking asthma control medicines, only 54.5% of them were taking control medicines regularly as prescribed, which was significantly lower than during 2003.
- The health of children with asthma can be further improved by promoting asthma control strategies, including asthma trigger reduction, appropriate guidelines-based medical management, and asthma education for children, parents, and others involved in asthma care.
- Additional information is available at https://www.cdc.gov/vitalsigns/.

past 12 months. In 2013, nearly 68% of children with asthma were taking asthma rescue medications and 55.2% had taken asthma control medicine in the past 3 months. In addition, approximately 9% of children with asthma overused rescue medications (i.e., used more than three disks or canisters of quick relief inhaler medication in the past 3 months) and 30.1% were taking asthma control medications every day or almost every day as recommended, with 25.1% reporting taking them less often (Table 3). Having received self-management education and use of asthma control prescription medication did not differ by race/ethnicity. However, among children with asthma who were taking asthma control medicine during the preceding 3 months, the percentage of children using asthma control prescription medicine regularly as prescribed declined significantly from 65.7% in 2003 to 54.5% in 2013 ($p<0.01$) (Table 3).

Conclusions and Comments

Although asthma still affects some children more than others, the findings in this report are somewhat encouraging. The prevalence of asthma and asthma attacks have decreased in recent years (since 2010 and 2001, respectively), fewer children with asthma reported missed school days and hospitalizations because of asthma, and more children with asthma received a written asthma action plan during 2013 than did during 2003. Among children with asthma, asthma attacks, hospitalizations, and ED/UC visits were more prevalent among children aged 0–4 years than among children aged 12–17 years. This might be partially explained by more frequent viral respiratory infections among this age group. These infections are the most common precipitants of asthma symptoms and hospitalizations among this age group (*9*).

The findings in this report indicate that more children with asthma received an asthma action plan, were taught how to recognize early signs of an asthma attack, and were taught how to respond to an asthma attack in 2013 than in 2003. However, in 2013 only half (51%) of children with asthma received an asthma action plan and less than half (46%) received advice on environmental control, indicating a need for further improvement in these areas, given that multicomponent self-management education programs, including an written asthma action plan (*1*,*10*,*11*); educating healthcare providers (*12*) can improve asthma-related health outcomes and reduce unnecessary health care use.

Access to and adherence to guidelines-based medical care, including prescribing inhaled corticosteroids, is a key component of effective asthma care (*1*,*13*,*14*). The findings show that just over half (54.5%) of children with asthma who were taking asthma control medications were taking them regularly as prescribed, indicating a need for further improvement in medication adherence.

TABLE 2. Health outcomes and healthcare use by demographic characteristics among children with current asthma — National Health Interview Survey, 2013 and 2016

	Missed school days* (ages 5–17) (2013 NHIS)	Asthma attacks* (2016 NHIS)	Health care use		
			Routine care visits* (2013 NHIS)	Hospitalized* (2013 NHIS)	ED/UC visits*,† (2016 NHIS)
Demographic characteristic	**% (95% CI)§**	**% (95% CI)§**	**% (95% CI)§**	**% (95% CI)§**	**% (95% CI)§**
Total	**49.0 (44.9–53.0)**	**53.7 (49.8–57.7)**	**71.1 (68.0–74.1)**	**4.7 (3.4–6.5)**	**16.7 (13.6–20.2)**
Sex					
Boys	51.3 (46.2–56.4)	54.6 (49.1–60.0)	72.0 (67.7–75.9)	5.3 (3.6–7.6)	17.8 (13.8–22.6)
Girls	46.0 (39.7–52.5)	52.7 (46.3–58.9)	70.0 (64.3–75.1)	4.0 (2.2–7.2)	15.2 (11.0–20.6)
Age group (yrs)					
0–4	NA	62.4 (50.8–72.7)¶	78.2 (68.0–85.8)	10.4 (6.1–17.4)**	31.1 (20.9–43.6)††
5–11	52.0 (46.1–57.8)	59.8 (53.8–65.6)§§	73.0 (67.1–78.2)	4.8 (3.1–7.3)	19.4 (14.7–25.1)¶¶
12–17	45.5 (40.1–51.0)	44.8 (39.0–50.9)	66.6 (61.4–71.4)	2.8 (1.2–6.3)	9.6 (6.5–13.9)
Race/Ethnicity					
White, non-Hispanic	43.8 (37.6–50.3)	53.9 (47.7–60.0)	72.2 (67.2–76.7)	3.3 (1.7–6.2)	12.2 (8.6–17.1)
Black, non-Hispanic	52.7 (44.6–60.7)	53.1 (44.7–61.4)	72.2 (65.1–78.3)	6.8 (3.9–11.7)	22.5 (15.8–31.0)***
Other, non-Hispanic	50.3 (37.0–63.6)	63.6 (52.4–73.5)	59.2 (48.0–69.6)	4.6 (1.5–13.2)	22.1 (13.7–33.6)
Hispanic	56.5 (49.0–63.7)	48.9 (40.5–57.4)	72.5 (65.4–78.7)	5.8 (3.5–9.5)	16.2 (9.8–25.5)
Puerto Rican	50.6 (30.7–70.3)	46.5 (28.8–65.2)	72.2 (48.4–87.7)	6.5 (2.4–16.6)	8.8 (3.0–23.0)†††
Mexican/Mexican-American	57.3 (47.6–66.4)	46.1 (35.8–56.7)	75.6 (68.0–81.8)	7.0 (3.6–13.2)	16.0 (8.4–28.4)†††
All other Hispanics	59.2 (46.3–71.0)	60.5 (39.5–78.3)	66.5 (50.6–79.3)	2.8 (0.9–8.8)	24.1 (8.9–50.9)†††
Ratio of family income to poverty threshold§§§					
<100% FPL¶	54.8 (47.3–62.1)	53.8 (45.3–62.1)	74.4 (68.0–79.8)	7.2 (4.7–10.8)	21.1 (13.9–30.6)
100% to <250% FPL	47.7 (40.4–55.0)	51.9 (45.0–58.7)	73.8 (67.1–79.5)	4.4 (2.2–8.9)	18.7 (13.9–24.7)
250% to <450% FPL	45.1 (36.8–53.7)	53.9 (44.8–62.6)	61.9 (53.2–69.8)	2.1 (0.4–10.4)	11.3 (6.7–18.5)
≥450% FPL	46.4 (38.0–55.0)	57.1 (47.5–66.2)	71.9 (63.6–78.9)	4.0 (1.3–11.4)	13.1 (7.6–21.6)
U.S. Census region					
Northeast	55.4 (45.8–64.6)	55.9 (47.6–64.0)	77.5 (71.1–82.8)	3.4 (1.5–7.5)	12.8 (7.7–20.5)
Midwest	38.4 (31.3–46.0)	52.5 (42.9–61.9)	67.3 (58.4–75.0)	4.2 (2.1–8.4)	18.7 (12.0–28.0)
South	49.1 (42.1–56.1)	51.2 (45.2–57.1)	71.1 (66.3–75.5)	6.0 (3.7–9.7)	17.0 (12.5–22.6)
West	53.4 (45.5–61.1)	57.8 (48.7–66.5)	69.6 (63.0–75.4)	3.9 (2.0–7.3)	17.4 (10.9–26.6)

Abbreviations: CI = confidence interval; ED/UC = emergency department/urgent care; FPL = Federal Poverty Level; NA = not available; NHIS = National Health Interview Survey.
* Self reported asthma related missed school days, asthma attacks, routine care visits, and if hospitalized and had an ED/UC visit in the past 12 months.
† ED/UC visits were among children with current asthma who experienced an asthma attack.
§ Weighted percentage.
¶ p-value <0.01 testing for differences in asthma attack prevalence between children aged 0–4 and aged 12–17.
** p-value <0.05 testing for differences in hospitalization between children aged 0–4 and aged 12–17.
†† p-value <0.001 testing for differences in ED/UC visit prevalence between children aged 0–4 and aged 12–17.
§§ p-value <0.001 testing for differences in asthma attack prevalence between children aged 5–11and aged 12–17.
¶¶ p-value <0.01 testing for differences in ED/UC visit prevalence between children aged 5–11 and aged 12–17.
*** p-value <0.05 testing for differences in ED/UC visit prevalence between non-Hispanic black children and non-Hispanic white children.
††† Relative Standard Errors are >30% indicating "unreliable" estimates.
§§§ FPL is federal poverty level. Based on family income and family size, using the U.S. Census Bureau's poverty thresholds.

The findings in this report are subject to at least two limitations. First, because NHIS is a cross-sectional survey, it provides prevalence estimates and associations, but cannot determine causal associations. Second, NHIS data are based on adult proxy responses for children; therefore, the findings might be biased because of inaccurate recall or the social desirability of providing positive responses.

Asthma remains an important public health and medical problem. Some progress has been made in providing asthma education and in decreasing adverse health outcomes. The health of children with asthma can be further improved by promoting asthma control strategies, including asthma trigger reduction, appropriate guidelines-based medical management, and asthma education for children, parents, and others involved in asthma care. The CDC National Asthma Control Program (https://www.cdc.gov/asthma/nacp.htm) works with 25 funded state and territorial grantees and four nongovernmental organizations to engage persons with asthma, their families, schools, communities, and health care providers to achieve better care and better health outcomes and to decrease unnecessary asthma-related emergency department and urgent care visits and hospitalizations.

Conflict of Interest

No conflicts of interest were reported.

[1]Division of Environmental Health Science and Practice (proposed), National Center for Environmental Health, CDC; [2]Director, National Center for Environmental Health, Agency for Toxic Substances and Disease Registry, CDC.

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TABLE 3. Prevalence of selected characteristics among children aged 0–17 years with current asthma — National Health Interview Survey, 2003, 2008, and 2013

Characteristic	2003 % (95% CI)*	2008 % (95% CI)*	2013 % (95% CI)*	p-value (significant difference in estimates [2003 versus 2013])
Mean no. of missed school days† (95% CI)	4.2 (3.6–4.9)	3.3 (2.5–4.1)	2.6 (2.1–3.2)	p<0.001
Missed school days†	61.4 (56.2–66.4)	59.6 (52.5–66.3)§	49.0 (44.9–53.0)	p<0.001
Hospitalized† because of asthma	9.6 (7.3–12.5)	8.0 (5.3–12.1)	4.7 (3.4–6.5)	p<0.01
Have health insurance coverage	93.1 (90.8–94.8)	93.9 (91.3–95.7)	94.4 (92.5–95.9)	—¶
Cannot afford prescription medicine	6.1 (4.6–8.2)	5.9 (4.2–8.2)	6.4 (4.6–8.7)	—¶
Self-management education**				
Given an action plan	39.5 (36.1–43.0)	44.3 (39.8–48.9)††	50.8 (46.8–54.7)	p<0.0001
Taken a class to learn how to manage their asthma	16.1 (13.8–18.8)	12.5 (9.8–15.9)	11.0 (8.9–13.5)	p<0.01
Taught to recognize early signs and symptoms of an asthma attack	72.4 (69.0–75.6)	72.1 (67.9–76.0)	76.0 (72.4–79.2)	—¶
Taught to respond to an asthma attack	77.5 (74.3–80.4)	78.3 (74.5–81.8)	80.0 (76.7–82.9)	—¶
Taught to use a peak flow meter	56.8 (52.8–60.7)	49.4 (44.8–54.0)††	50.6 (46.8–54.3)	p<0.05
Given advice on environmental control	53.1 (49.6–56.5)	50.6 (46.0–55.1)	46.4 (42.5–50.3)	p<0.05
Rescue asthma medication use in past 3 months				
Rescue asthma medication use	59.8 (56.1–63.3)	59.4 (54.9–63.8)§§	67.7 (64.2–71.0)	p<0.01
Overuse of rescue asthma medication in past 3 months¶¶	9.3 (7.4–11.6)	8.3 (6.2–10.9)	8.8 (6.4–11.9)	—¶
Asthma control medication use during past 3 months***				
Use asthma control medication	49.8 (46.2–53.4)	53.2 (48.6–57.7)	55.2 (51.4–58.9)	—¶
Use every day or almost every day	32.7 (29.4–36.0)	31.5 (27.5–35.8)	30.1 (26.4–34.0)	—¶
Use less often	17.1 (14.6–19.8)	21.7 (18.0–25.8)	25.1 (22.1–28.5)	p<0.001
Never used	50.3 (46.7–53.9)	46.8 (42.3–51.4)	44.8 (41.1–48.6)	—¶
Use asthma control medication				
Use every day or almost every day	65.7 (61.0–70.1)	59.2 (52.9–65.3)	54.5 (49.1–59.7)	p<0.01
Use less often	34.3 (29.9–39.0)	40.8 (34.7–47.1)	45.5 (40.3–50.9)	p<0.01

Abbreviation: CI = confidence interval.

* Weighted percentage.

† Self-reported asthma related missed school days and hospitalization in the past 12 months.

§ p-value <0.05 testing for differences in estimates for "Missed school days" between 2008 and 2013.

¶ Not statistically significant.

** Self-management education related questions were asked every 5 years and if participants were ever been provided these type of education.

†† p-value <0.05 testing for differences in estimates for "Given an action plan" between 2008 and 2013, and for "Taught how to use a peak flow meter" between 2003 and 2008.

§§ p-value <0.01 testing for differences in estimates between 2008 and 2013.

¶¶ Use of more than three canisters or disks of quick relief inhaler (asthma rescue medication) by a child taking asthma rescue medications in the past 3 months.

*** If child taking an asthma control medication and how often (i.e., every day or almost every day, less often, or never) in the past 3 months.

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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger — United States, 2018

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On February 6, 2018, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

In October 2017, the Advisory Committee on Immunization Practices (ACIP) approved the Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger — United States, 2018. The 2018 child and adolescent immunization schedule summarizes ACIP recommendations, including several changes from the 2017 immunization schedules, in three figures and footnotes to the figures. These documents can be found on the CDC immunization schedule website (https://www.cdc.gov/vaccines/schedules/index.html). These immunization schedules are approved by ACIP (https://www.cdc.gov/vaccines/acip/index.html), the American Academy of Pediatrics (https://www.aap.org), the American Academy of Family Physicians (https://www.aafp.org), and the American College of Obstetricians and Gynecologists (https://www.acog.org). Health care providers are advised to use the figures and the footnotes together. The full ACIP recommendations for each vaccine, including contraindications and precautions, can be found at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Providers should be aware that changes in recommendations for specific vaccines can occur between annual updates to the childhood/adolescent immunization schedules. If errors or omissions are discovered within the child and adolescent schedule, CDC posts revised versions on the CDC immunization schedule website.*

Printable versions of the 2018 immunization schedules for children and adolescents aged 18 years or younger and ordering instructions for laminated versions and easy-to-read versions for parents also are available at the immunization schedule website.

For further guidance on the use of each vaccine included in the schedules, including contraindications and precautions, health care providers are referred to the respective ACIP vaccine recommendations.

Recommendations for routine use of vaccines in children, adolescents and adults are developed by the Advisory Committee on Immunization Practices (ACIP). ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the Director of the Centers for Disease Control and Prevention (CDC) 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 (AAP), the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for routine use of vaccines in adults are harmonized with recommendations of AAFP, ACOG, and the American College of Physicians (ACP). ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the Morbidity and Mortality Weekly Report *(*MMWR*). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.*

Changes in the 2018 Child and Adolescent Immunization Schedule

Changes in the 2018 immunization schedules for children and adolescents aged 18 years or younger include new or revised ACIP recommendations for poliovirus (*1*), influenza (*2*), and measles, mumps, and rubella vaccines (*3*), and clarification of the recommendations for rotavirus and pneumococcal vaccines.

Changes Affecting Multiple Portions of the Schedule

Mention of MenHiberix (Hib-MenCY) vaccine has been removed from Figure 1 and Figure 2 and the relevant footnotes (Hib and meningococcal A,C,W,Y). Manufacturing of MenHibrix has been discontinued in the United States and all available doses have expired.

Cover Page. Changes to the 2018 figure from the 2017 schedule† are as follows:

* CDC encourages organizations that previously have relied on copying the schedules to their websites instead to use syndication as a more reliable method for displaying the most current and accurate immunization schedules on an organization's website. 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).

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

- A table was added outlining vaccine type, abbreviation, and brand names for vaccines discussed in the child/adolescent immunization schedule.

Figure 2. Changes to the 2018 figure from the 2017 schedule are as follows:

- The maximum ages for the first and last doses in the rotavirus vaccination series were added to the rotavirus vaccine row.
- The inactivated poliovirus vaccine rows were edited to clarify the catch-up recommendations for children 4 years of age and older.

Figure 3. Changes to the 2018 figure from that in the 2017 schedule are as follows:

- A reference was added to the HIV column of the figure. The reference provides additional information regarding HIV laboratory parameters and use of live vaccines.
- Within the pneumococcal conjugate row, stippling was added to heart disease/chronic lung disease, chronic liver disease, and diabetes columns to clarify that, in some situations, an additional dose of vaccine might be recommended for children with these conditions.

Footnotes. The footnotes are presented in a new simplified format. The goal was to remove unnecessary text, preserve all pertinent information, and maintain clarity. This was accomplished by a transition from complete sentences to bullets, removal of unnecessary or redundant language, and formatting changes. In addition to this overall simplification, content changes were made as follows:

- The Hepatitis B vaccine (HepB) footnote was revised to include information regarding vaccination of <2,000-g infants born to hepatitis B virus surface antigen (HBsAg)−negative mothers.
- The poliovirus vaccine footnote was revised to include updated guidance for persons who received oral poliovirus vaccine as part of their vaccination series.
- The influenza vaccine footnote has been updated to indicate that live attenuated influenza vaccine (LAIV) should not be used during the 2017–2018 influenza season. A reference link to the 2017–2018 season influenza recommendations has been added.
- The measles, mumps, and rubella vaccine (MMR) footnote was updated to include guidance regarding the use of a third dose of mumps virus−containing vaccine during a mumps outbreak.
- The meningococcal vaccine footnote has been edited to create separate footnotes for MenACWY and MenB vaccines.

Acknowledgments

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

ACIP Child/Adolescent Immunization Work Group

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Conflict of Interest

No conflicts of interest were reported.

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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older — United States, 2018

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On February 6, 2018, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

In October 2017, the Advisory Committee on Immunization Practices (ACIP) voted to approve the Recommended Immunization Schedule for Adults Aged 19 Years or Older, United States, 2018. The 2018 adult immunization schedule summarizes ACIP recommendations in two figures and a table of contraindications and precautions for vaccines recommended for adults, and is intended is to assist health care providers in implementing the current ACIP recommendations for vaccinating adults. The schedule can be found at https://www.cdc.gov/vaccines/schedules.* The full ACIP recommendations for each vaccine are available at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. The 2018 adult immunization schedule has also been approved by the American College of Physicians (https://www.acponline.org), the American Academy of Family Physicians (https://www.aafp.org), the American College of Obstetricians and Gynecologists (https://www.acog.org), and the American College of Nurse-Midwives (http://www.midwife.org). The ACIP-recommended use of each vaccine is developed after an in-depth review of vaccine-related data, including data on disease epidemiology, vaccine efficacy and effectiveness, vaccine safety, feasibility of program implementation, and economic aspects of immunization policy (*1*).

The adult immunization schedule also contains information on general principles of immunization for adults; considerations for special populations, such as pregnant women; reference resources pertinent to adult immunization; instructions for reporting adverse events associated with vaccinations and suspected cases of reportable vaccine-preventable diseases; and an ACIP-approved list of standardized abbreviations for vaccines recommended for adults. The two figures in the adult immunization schedule are accompanied by footnotes that provide important details on vaccination recommendations, such as the number of doses in a vaccination series and dosing intervals. Health care providers are advised to use the figures and the footnotes together. Changes in the 2018 adult immunization schedule from the previous year's schedule include new ACIP recommendations for the use of recombinant zoster vaccine (RZV) for adults aged 50 years or older and the use of an additional dose of measles, mumps, and rubella vaccine (MMR) in a mumps outbreak setting.

Changes in the 2018 Adult Immunization Schedule

Zoster Vaccination (*2*). On October 20, 2017, the Food and Drug Administration approved the use of RZV (SHINGRIX, GlaxoSmithKline [GSK]) for adults aged 50 years or older for the prevention of herpes zoster (shingles) and its complications. On October 25, ACIP recommended the use of 1) RZV among immunocompetent adults aged 50 years or older for the prevention of herpes zoster and related complications, 2) RZV among adults aged 50 years or older who previously received the zoster vaccine live (ZVL) (ZOSTAVAX, Merck and Co.), and 3) either RZV or ZVL for adults aged 60 years or older (RZV is preferred). On October 26, 2017, ACIP recommended the following in the 2018 adult immunization schedule:

Recommendations for routine use of vaccines in children, adolescents and adults are developed by the Advisory Committee on Immunization Practices (ACIP). ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the Director of the Centers for Disease Control and Prevention (CDC) 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 (AAP), the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for routine use of vaccines in adults are harmonized with recommendations of AAFP, ACOG, and the American College of Physicians (ACP). ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the Morbidity and Mortality Weekly Report *(*MMWR*). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.*

* 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. Requests for technical assistance for adult immunization schedule syndication can be sent to ncirdwebteam@cdc.gov.

- Administer 2 doses of RZV 2–6 months apart to adults aged 50 years or older regardless of past episode of herpes zoster or receipt of ZVL.
- Administer 2 doses of RZV 2–6 months apart to adults who previously received ZVL at least 2 months after ZVL.
- For adults aged 60 years or older, administer either RZV or ZVL (RZV is preferred).

The clinical trials for RZV excluded pregnancy and confirmed or suspected immunocompromising conditions that can result from disease (e.g., malignancy, HIV infection) or therapy (e.g., cancer chemotherapy, treatment for autoimmune disorders) (*3*–*6*). Therefore, no ACIP recommendation currently exists for use of RZV among pregnant women (health care providers should consider delaying administration of RZV for pregnant women) or adults with immunocompromising conditions, including HIV infection (additional discussions and recommendations by ACIP on the use of RZV in adults with immunocompromising conditions are pending).

Consistent with the existing recommended use of ZVL, ACIP recommended RZV for adults who are receiving low-dose (<20 mg/day of prednisone or equivalent) or short-term (<14 days of corticosteroids) immunosuppressive therapy, are anticipating immunosuppression, or have recovered from an immunocompromising illness (*7*). The clinical trials for RZV did not exclude adults with non-immunocompromising chronic health conditions (*3*–*6*). Therefore, given the safety and effectiveness profiles of other conjugate vaccines recommended for adults (e.g., hepatitis B and pneumococcal vaccines), ACIP recommended that RZV should routinely be used for age-eligible adults with diabetes mellitus; chronic heart, lung, liver, or kidney disease; functional or anatomical asplenia; or complement deficiencies.

MMR Vaccination (*8*). On 25 October, ACIP updated MMR vaccination recommendations to include the use of a third dose of a mumps virus–containing vaccine for persons previously vaccinated with 2 doses of a mumps virus–containing vaccine who are identified by public health authorities as being a part of a group or population at risk for acquiring mumps because of an outbreak. During a mumps outbreak, persons identified as being at increased risk and who have received ≤2 doses of mumps virus–containing vaccine or whose mumps vaccination status is unknown should receive 1 dose of MMR. This change is described in the 2018 adult immunization schedule as follows:

- Administer 1 dose of MMR to adults who previously received ≤2 doses of mumps virus–containing vaccine and are identified by a public health authority to be at increased risk during a mumps outbreak.

Adults without evidence of immunity to mumps (defined as birth before 1957, documentation of receipt of MMR, or laboratory evidence of immunity or disease) are routinely recommended to receive 1 dose of MMR for mumps prevention. However, students in postsecondary educational institutions, international travelers, or household contacts of immunocompromised persons should receive 2 doses of MMR at least 28 days apart. In a mumps outbreak setting, those adults identified by a public health authority to be at risk should receive 1 dose of MMR regardless of whether they previously received 0, 1, or 2 doses of a mumps virus–containing vaccine.

Notable Changes to Figures 1 and 2. The footnotes in the 2018 adult immunization schedule should be used in conjunction with "Figure 1. Recommended immunization schedule for adults aged 19 years or older, by age group" and "Figure 2. Recommended immunization schedule for adults aged 19 years or older by medical condition and other indications." The footnotes contain additional general information (e.g., dosing intervals for vaccination series) and considerations for special populations (e.g., pregnant women, adults with HIV infection). The footnotes in the adult immunization schedule and the child and adolescent immunization schedule have been harmonized to be more consistent with one another (*9*). Notable changes in Figures 1 and 2 include the following:

- In Figures 1 and 2, "ZVL" replaced the term "HZV" (herpes zoster vaccine) that was used in past adult immunization schedules to refer to the live zoster vaccine. A row for RZV was added above the row for ZVL, and a dashed line was used to separate RZV and ZVL rows to denote that the two zoster vaccines are recommended for the same purpose. In the indication bars for RZV, the text stating that RZV is preferred over ZVL has been added when either RZV or ZVL can be used for adults aged 60 years or older.
- In Figures 1 and 2, "Td/Tdap" (tetanus and reduced diphtheria toxoids/tetanus and reduced diphtheria toxoids and acellular pertussis vaccine) has been replaced by "Tdap or Td," and the text in the indication bar has been revised to "1 dose Tdap, then Td booster every 10 years." 1 dose of Tdap is recommended for adults who have not previously received Tdap as an adult or child (1 dose of Tdap is routinely recommended at age 11–12 years), except for pregnant women, for whom 1 dose of Tdap is recommended in each pregnancy during the early part of gestational weeks 27–36.
- In Figures 1 and 2, the text in the indication bar for MenACWY (serogroups A, C, W, and Y meningococcal vaccine) has been revised to "1 or 2 doses depending on indication, then a booster dose every 5 years if risk remains." Adults with functional or anatomical asplenia, persistent complement component deficiencies, or HIV infection should receive 2 doses of MenACWY and be revaccinated every 5 years. One dose of MenACWY is

recommended for microbiologists who work with isolates of *Neisseria meningitidis* and travelers in countries with endemic or epidemic meningococcal disease, and a booster dose of MenACWY is indicated every 5 years if the risk remains. One dose of MenACWY is recommended for first-year college students living in residence halls and military recruits. MPSV4 (4-valent meningococcal polysaccharide vaccine) is no longer available and has been removed from the adult immunization schedule.

- In Figure 1, the text in the indication bar for MMR has been changed to "1 or 2 doses depending on indication (if born in 1957 or later)." One dose of MMR is routinely recommended for adults born in 1957 or later who do not have evidence of immunity to measles, mumps, or rubella. However, for students in postsecondary educational institutions, international travelers, and household contacts of immunocompromised persons, 2 doses of MMR administered at least 28 days apart are routinely recommended.
- In Figure 1, the text in the indication bars for human papillomavirus (HPV) vaccine for females and males (*10*) has been revised to "2 or 3 doses depending on age at series initiation."

More Information

Details on these updates and information on other vaccines recommended for adults are available online under Adult Immunization Schedule, United States, 2018, at https://www.cdc.gov/vaccines/schedules/hcp/adult.html and in the Annals of Internal Medicine (*11*). The full ACIP recommendations for each vaccine are also available online at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

Acknowledgments

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

Conflict of Interest

Laura E. Riley reports personal fees from Up To Date, outside the submitted work. No other conflicts of interest were reported.

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Potential Confounding of Diagnosis of Rabies in Patients with Recent Receipt of Intravenous Immune Globulin

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Rabies is an acute encephalitis that is nearly always fatal. It is caused by infection with viruses of the genus *Lyssavirus*, the most common of which is *Rabies lyssavirus*. The Council of State and Territorial Epidemiologists (CSTE) defines a confirmed human rabies case as an illness compatible with rabies that meets at least one of five different laboratory criteria.* Four of these criteria do not depend on the patient's rabies vaccination status; however, the remaining criterion, "identification of *Lyssavirus*-specific antibody (i.e. by indirect fluorescent antibody…test or complete [*Rabies lyssavirus*] neutralization at 1:5 dilution) in the serum," is only considered diagnostic in unvaccinated patients. *Lyssavirus*-specific antibodies include *Rabies lyssavirus*–specific binding immunoglobulin G (IgG) and immunoglobulin M (IgM) antibodies and *Rabies lyssavirus* neutralizing antibodies (RLNAs). This report describes six patients who were tested for rabies by CDC and who met CSTE criteria for confirmed human rabies because they had illnesses compatible with rabies, had not been vaccinated for rabies, and were found to have serum RLNAs (with complete *Rabies lyssavirus* neutralization at a serum dilution of 1:5). An additional four patients are described who were tested for rabies by CDC who were found to have serum RLNAs (with incomplete *Rabies lyssavirus* neutralization at a serum dilution of 1:5) despite having not been vaccinated for rabies. None of these 10 patients received a rabies diagnosis; rather, they were considered to have been passively immunized against rabies through recent receipt of intravenous immune globulin (IVIG). Serum RLNA test results should be interpreted with caution in patients who have not been vaccinated against rabies but who have recently received IVIG.

Rabies is preventable after a *Rabies lyssavirus* exposure through use of rabies postexposure prophylaxis; a standard rabies postexposure prophylaxis regimen in an immunocompetent patient who has not previously received rabies vaccination includes human rabies immune globulin and 4 doses of rabies vaccine (*1*). Human rabies immune globulin is prepared from plasma from human donors who have been hyperimmunized with rabies vaccine. It is delivered into wounds or intramuscularly to provide passive immunity during the time needed to develop an active immune response to vaccine antigen (*1*).†

IVIG is a blood product prepared from plasma of thousands of human donors who do not necessarily have a history of rabies vaccination (*2*). IVIG is administered to patients for a number of indications, including immunodeficiency states, neurologic disorders, infections, and autoimmune disorders. IVIG is not a component of rabies postexposure prophylaxis (*1*,*2*).

Data presented in this report were generated through routine clinical care and through testing of donated IVIG§ obtained from hospitals or manufacturers. Laboratory testing of patient specimens and IVIG was conducted at CDC and has been previously described (*3*). Nuchal skin biopsy was tested using the direct fluorescent antibody test for *Rabies lyssavirus* antigen. RNA was extracted and amplified from nuchal skin biopsy and saliva by reverse transcription–polymerase chain reaction targeting the *Rabies lyssavirus* nucleoprotein gene (*3*). Serum, cerebrospinal fluid, and IVIG were tested for *Rabies lyssavirus*–specific binding IgG and IgM antibodies using the indirect fluorescent antibody test and for RLNAs using the rapid fluorescent focus inhibition test (RFFIT).

Case One

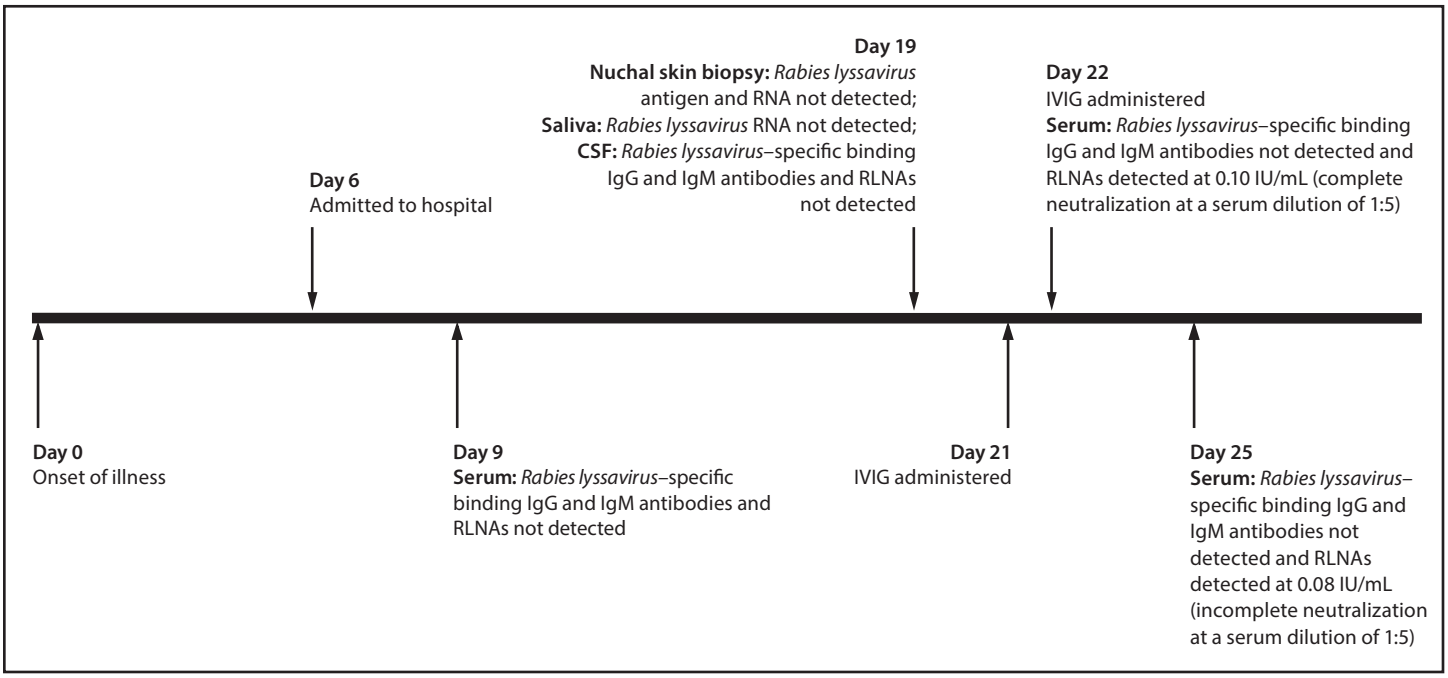
In 2013, a previously healthy man in North Carolina, aged 28 years, with no prior history of rabies vaccination and no known recent mammal exposures experienced fever, body aches, headache, and neck stiffness (Figure 1). On the sixth day after illness onset (day 6), the patient was admitted to a hospital; shortly thereafter, he experienced seizures. He was initially treated empirically with antibiotics; IVIG (1 g/kg; Gamunex-C [Grifols, Los Angeles, California]) was administered on days 21 and 22. Rabies diagnostic testing was performed because of suspicion for rabies. Diagnostic testing did not reveal any evidence of *Rabies lyssavirus* infection, with the exception of detection of RLNAs by RFFIT (Table). RLNAs were not detected in serum collected on day 9, but were detected in sera collected on day 22 (0.10 international units [IU]/mL [complete *Rabies lyssavirus* neutralization at a serum dilution of 1:5]) and day 25 (0.08 IU/mL [incomplete *Rabies lyssavirus* neutralization at a serum dilution of 1:5]). Although

* https://wwwn.cdc.gov/nndss/conditions/rabies-human/case-definition/2011/.

† http://www.grifolsusa.com/documents/10192/60862/ft_hyperrab_eeuu_EN/09f14ece-e450-48f8-9137-3ce7e0aaa8c6.

§ Product, manufacturer, and lot numbers were the following; *case one*: Gamunex-C (Grifols, Los Angeles, California), Lot Numbers 26NN751 and 26NN951; *case two*: Gamunex-C (Grifols, Los Angeles, California Lot Number 26NNCK1; *case nine*: Privigen (CSL Behring, King of Prussia, Pennsylvania), Lot Numbers 4323300137 and 4323400339; *additional testing*: Gammaplex (Bio Products Laboratory, Elstree, England), Lot Number VSC9978.

FIGURE 1. Timeline* of events for a patient with autoimmune encephalitis who met Council of State and Territorial Epidemiologists criteria for diagnosis of human rabies and had recently received intravenous immune globulin



Abbreviations: CSF = cerebrospinal fluid; IgG = immunoglobulin G; IgM = immunoglobulin M; IVIG = intravenous immune globulin; RLNA = *Rabies lyssavirus* neutralizing antibody.
* By number of days after illness onset.

Rabies lyssavirus–specific binding IgG antibodies were not detected in IVIG from the lots that the patient had received, RLNAs were detected at 0.45 IU/mL and 0.46 IU/mL (each lot demonstrated complete *Rabies lyssavirus* neutralization at an IVIG dilution of 1:5). Though the patient met CSTE criteria for confirmed human rabies (had an illness compatible with rabies, had not been vaccinated for rabies, and was found to have serum RLNAs [with complete *Rabies lyssavirus* neutralization at a serum dilution of 1:5]), his serum RLNAs were attributed to passive immunization against rabies through receipt of IVIG. Rabies was therefore ruled out and he received a diagnosis of autoimmune encephalitis. His illness improved after treatment.

Case Two

In 2013, a previously healthy male adolescent in Arkansas, aged 13 years, with no prior history of rabies vaccination and no known recent mammal exposures experienced 3 days of headache and three episodes of new-onset seizures (Figure 2). On the first day after illness onset (day 1), he was hospitalized. He was initially treated empirically with antibiotics; IVIG (1 g/kg; Gamunex-C [Grifols, Los Angeles, California]) was administered on days 2 and 3. Rabies diagnostic testing was performed because of suspicion for rabies. Diagnostic testing did not reveal any evidence of *Rabies lyssavirus* infection, with the exception of detection of RLNAs by RFFIT (Table). RLNAs were detected in serum collected on day 9 (0.06 IU/mL [incomplete *Rabies lyssavirus* neutralization at a serum dilution of 1:5]) but not on day 15. Although *Rabies lyssavirus*–specific binding IgG antibodies were not detected in IVIG from the lot that the patient had received, RLNAs were detected at 0.38 IU/mL (complete *Rabies lyssavirus* neutralization at an IVIG dilution of 1:5). Though the patient had serum RLNAs on day 9, *Rabies lyssavirus* neutralization at a serum dilution of 1:5 was incomplete, and he therefore did not meet CSTE criteria for confirmed human rabies. His serum RLNAs were attributed to passive immunization against rabies through receipt of IVIG. Rabies was therefore ruled out and additional diagnostic testing revealed Eastern equine encephalitis virus infection. Because of his poor prognosis, care was withdrawn and the patient subsequently died (*4*).

Additional Cases

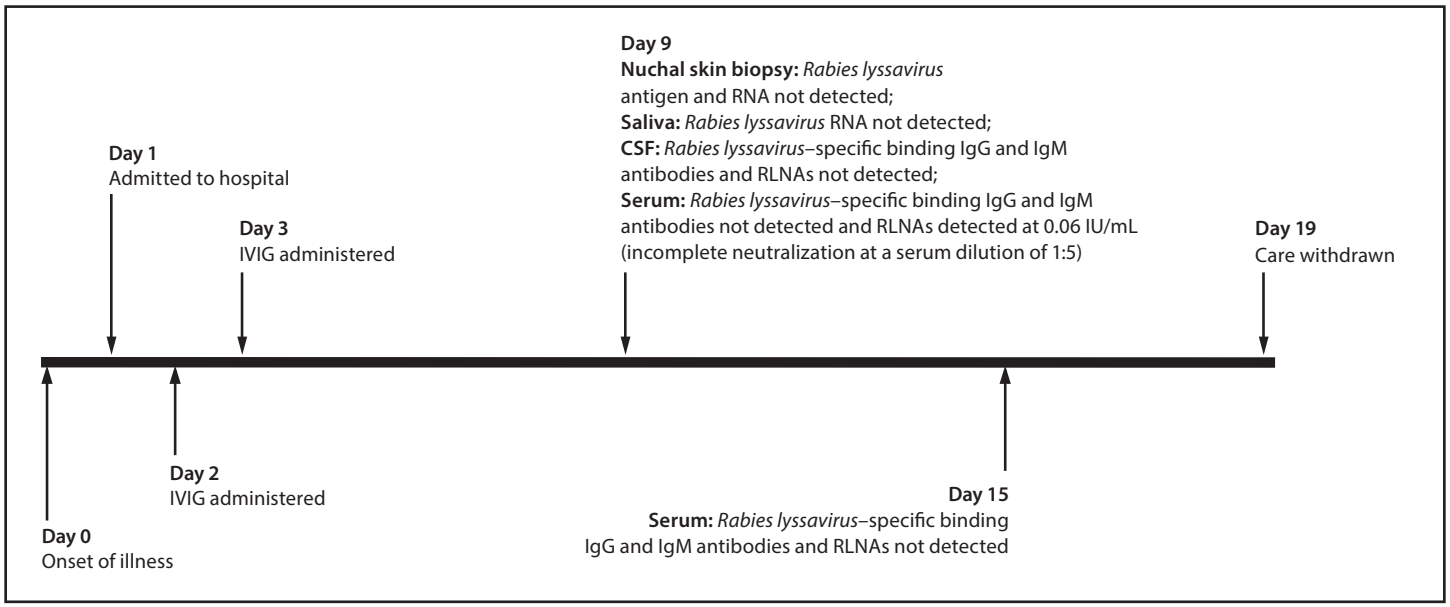
During 2014–2016, diagnostic testing of eight additional patients revealed a similar laboratory profile (Table). All eight patients had illnesses compatible with rabies, had no history of rabies vaccination, and had serum RLNAs (five with complete and three with incomplete *Rabies lyssavirus* neutralization at a serum dilution of 1:5). In each case, RLNAs were detected in sera collected only after IVIG administration. IVIG (Privigen [CSL Behring, King of Prussia, Pennsylvania]) was available from two lots received by one of these eight patients. RLNAs

TABLE. Characteristics and laboratory findings of unvaccinated patients in whom *Rabies lyssavirus* neutralizing antibodies were detected after receiving IVIG — nine states, 2013–2016

					Lyssavirus-specific antibodies								
					Nuchal skin biopsy		Saliva	Cerebrospinal fluid			Serum (after receipt of IVIG)			
Case no.	Age (yrs)	Sex	Year testing was performed	State	*Rabies lyssavirus* antigen	*Rabies lyssavirus* RNA	*Rabies lyssavirus* RNA	IgG*	IgM*	RLNA (IU/mL)	IgG*	IgM*	RLNAs (IU/mL)	Met CSTE rabies case definition†
1	28	M	2013	North Carolina	ND	ND	ND	ND	ND	ND	ND	ND	0.10§	Yes
2	13	M	2013	Arkansas	ND	ND	ND	ND	ND	ND	ND	ND	0.06§	No
3	13	M	2014	Texas	ND	ND	ND	ND	ND	ND	ND	ND	0.07	No
4	61	M	2015	South Carolina	ND	ND	ND	ND	ND	ND	ND	ND	0.08	No
5	38	M	2015	Maryland	IC¶	NT¶	NT¶	ND	ND	ND	ND	ND	0.07	No
6	11	M	2015	Texas	ND	ND	ND	NP	NP	NP	ND	ND	0.10	Yes
7	13	M	2015	Virginia	ND	ND	ND	ND	ND	ND	ND	ND	0.11	Yes
8	23	F	2015	Tennessee	ND	ND	ND	ND	ND	ND	ND	ND	0.18	Yes
9	40	M	2016	Massachusetts	NP	NP	ND	ND	ND	ND	ND	ND	0.20§	Yes
10	16	M	2016	Indiana	NT	ND	ND	ND	ND	ND	ND	ND	0.15	Yes

Abbreviations: CSTE = Council of State and Territorial Epidemiologists; F = female; IC = inconclusive; IgG = immunoglobulin G; IgM = immunoglobulin M; IVIG = intravenous immune globulin; M = male; ND = not detected; NP = not provided; NT = not tested; RLNA = *Rabies lyssavirus* neutralizing antibody.
* *Rabies lyssavirus*–specific binding immunoglobulin.
† These patients met CSTE criteria for diagnosis of human rabies because they had illnesses compatible with rabies, had not been vaccinated for rabies, and had *Rabies lyssavirus* neutralizing antibodies with complete Rabies lyssavirus neutralization at a serum dilution of 1:5.
§ IVIG from the same lot(s) this patient had received was tested for *Rabies lyssavirus*–specific binding IgG antibodies and RLNAs; *Rabies lyssavirus*–specific binding IgG antibodies were not detected, but RLNAs were detected.
¶ Unsatisfactory sample.

FIGURE 2. Timeline* of events for a patient with Eastern equine encephalitis virus infection who had no history of rabies vaccination, but in whom *Rabies lyssavirus* neutralizing antibodies were detected after receiving intravenous immune globulin



Abbreviations: CSF = cerebrospinal fluid; IgG = immunoglobulin G; IgM = immunoglobulin M; IVIG = intravenous immune globulin; RLNA = *Rabies lyssavirus* neutralizing antibody.
* By number of days after illness onset.

were detected in these two lots at 0.44 IU/mL and 2.3 IU/mL (each lot demonstrated complete *Rabies lyssavirus* neutralization at an IVIG dilution of 1:5). IVIG from lots that the remaining patients had received was unavailable for testing. None of these eight patients received a rabies diagnosis, including the five who met CSTE criteria for confirmed human rabies, because their serum RLNAs were attributed to passive immunization against rabies through receipt of IVIG.

Results of Additional IVIG Testing

IVIG from a lot that had not been administered to any patient described here (Gammaplex [Bio Products Laboratory,

Elstree, England]) was tested. Although *Rabies lyssavirus*–specific binding IgG antibodies were not detected, RLNAs were detected at 0.47 IU/mL (complete *Rabies lyssavirus* neutralization at an IVIG dilution of 1:5).

Discussion

IVIG administration is known to confound serologic diagnosis of infections with pathogens such as human T-lymphotropic virus and *Toxoplasma* (*5*,*6*). This report describes 10 patients in which administration of IVIG confounded the diagnosis of human rabies. RLNAs were detected in serum from all 10 patients despite their never having been vaccinated for rabies, and it was ultimately determined that they had been passively immunized against rabies through receipt of IVIG. Six of these patients met CSTE criteria for human rabies because the concentration of serum RLNAs after IVIG administration was high enough to result in complete *Rabies lyssavirus* neutralization at a serum dilution of 1:5. However, in the absence of other laboratory evidence of rabies, and based on the knowledge that they had recently received IVIG, these patients all received alternative diagnoses.

Laboratory test results from the first patient are particularly illustrative. RLNAs can develop late in the course of illness in human rabies, but in this patient, it is likely that detection of serum RLNAs on days 22 and 25 (after IVIG administration), but not on day 9 (before IVIG administration), resulted from passive immunization through receipt of IVIG (administered on days 21 and 22) (*7*). Furthermore, serum RLNA concentration decreased as time passed after IVIG administration, as would be expected if these serum RLNAs were the result of passive immunity through IVIG, rather than part of an active immune response to a natural *Rabies lyssavirus* infection. A similar decline in serum RLNA concentration after IVIG administration was observed in the second patient.

These data suggest that detection of RLNAs in serum of an unvaccinated patient is a reliable laboratory criterion for human rabies only if IVIG has not been administered shortly before serum collection. If RLNAs are detected in serum collected after IVIG administration, additional testing of IVIG from the lot or lots used to treat the patient can be helpful in evaluating the likelihood of rabies.

There are several possible explanations for the detection of RLNAs in IVIG. First, because the IVIG that was tested was prepared by companies that also prepare human rabies immune globulin, the possibility exists that plasma from persons who were hyperimmunized with rabies vaccine also was used to prepare the IVIG that was tested (*8*).[¶,**] In addition, persons who donated plasma for IVIG preparation might have previously received rabies vaccination for a clinical indication (but were not hyperimmunized with rabies vaccine). IVIG from only six unique lots was tested and accurately evaluating variation in RLNA concentration from one IVIG preparation to the next was not possible, particularly because pathogen-specific antibodies are known to vary among IVIG preparations (*9*). Thus, although RLNAs might be present in IVIG, it is important that IVIG not be used as a replacement for human rabies immune globulin when administering rabies postexposure prophylaxis. Serum RLNA test results in patients who have not been vaccinated for rabies but who have recently received IVIG should be interpreted with caution when assessing whether a patient might have rabies.

Summary

What is already known about this topic?

The presence of a high concentration of serum *Rabies lyssavirus* neutralizing antibodies (RLNAs) in a patient with an illness compatible with rabies and no history of rabies vaccination is considered diagnostic for human rabies. This case definition does not take into account whether the patient has recently received intravenous immune globulin (IVIG).

What is added by this report?

This report describes six patients who met the case definition for human rabies because they had illnesses compatible with rabies, had not been vaccinated against rabies, and were found to have a high concentration of serum RLNAs. However, none of these patients received a rabies diagnosis; rather, they were considered to have been passively immunized for rabies through receipt of IVIG.

What are the implications for public health practice?

Positive RLNA test results should be interpreted with caution in a patient who has not been vaccinated against rabies but who has recently received IVIG. If RLNAs are detected in serum collected after IVIG administration, additional testing of IVIG from the lot or lots used to treat the patient can be helpful in evaluating the likelihood of rabies.

Acknowledgment

Jesse Blanton, Division of High-Consequence Pathogens and Pathology, CDC.

Conflict of Interest

Vance G. Fowler, Jr. reports grants from MedImmune, Cerexa/Forest/Actavis/Allergan, Pfizer, Advanced Liquid Logics, Theravance, Novartis, Cubist/Merck, Medical Biosurfaces, Locus, Affinergy, Contrafect, Karius, and Genentech; consultant fees from Pfizer, Novartis, Galderma, Novadigm, Durata, Debiopharm, Genentech, Achaogen, Affinium, Medicines Co., Cerexa, Tetraphase, Trius, MedImmune, Bayer, Theravance, Cubist, Basilea, Affinergy, Janssen, xBiotech, and Contrafect; educational fees from Green Cross, Cubist, Cerexa, Durata, Theravance, and Debiopharm; royalties from UpToDate; and has a Sepsis Diagnostics patent pending. No other conflicts of interest were reported.

¶ https://www.medicines.org.uk:443/emc/PIL.14821.latest.pdf.

** https://primaryimmune.org/wp-content/uploads/2017/02/IVIG-Chart-2.2017.pdf.

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Notes from the Field

Assessment of Rabies Exposure Risk Among Residents of a University Sorority House — Indiana, February 2017

Betsy Schroeder, DVM[1,2]; Alex Boland, MPH[2]; Emily G. Pieracci, DVM[3]; Jesse D. Blanton, PhD[3]; Brett Peterson, MD[3]; Jennifer Brown, DVM[2]

In February 2017, the Indiana State Department of Health (ISDH) was notified of bat exposures at a university sorority house. The initial complaint was made to ISDH because of concerns for food sanitation. Bats had been routinely sighted in shared living areas and hallways. ISDH, in consultation with CDC, collaborated with the university and sorority to assess residents and staff members for potential rabies risk. In 2016, 4.3% of all bats tested in Indiana were positive for rabies. The longest incubation period recorded for indigenously acquired bat rabies is 270 days (*1*); therefore, out of an abundance of caution, ISDH conducted interviews with 140 students and eight employees who resided or worked in the sorority house during the preceding 12 months, all of whom were considered to have possibly been exposed. A web-based survey was administered in February to collect information about bat exposures, which was used to categorize all respondents into having a low, medium, or high risk for rabies exposure per CDC guidance (*2*).

Persons who reported a bite, scratch, or direct skin contact with a bat were categorized as having a high risk. Persons were categorized as having moderate risk if they reported waking and finding a bat in the same room where they were sleeping. Persons who reported no bat exposure were categorized as having a low risk. Respondents categorized as having a high or moderate risk had follow-up interviews in person or by telephone.

Among the 148 possibly exposed persons, 100 (68%) responded to the questionnaire, including 92 (66%) students and all eight employees; 94 respondents reported ever having seen a bat in the sorority house. Among those 94 persons, 70 (74%) reported having seen a bat within the previous 12 months, and 34 (36%) reported seeing a bat ≤1 month ago. Among respondents who reported ever having seen a bat in the sorority house, 13 (14%) were identified as having a moderate or high risk for rabies exposure, including 11 sorority members, one university employee, and one nonsorority member student. After follow-up interviews, nine of these 13 persons were reclassified as having a low risk for rabies exposure. The remaining four persons were considered to have a high (three persons) or a moderate (one) risk. All four persons received a recommendation for postexposure prophylaxis (PEP), which consists of human rabies immune globulin and a series of 4 doses of rabies vaccine. Two persons completed the PEP series during March 20–April 18, and two declined PEP because of a perceived lack of risk. No respondent had developed clinical rabies as of February 2018.

ISDH learned that bats had been roosting in the building for approximately 30 years. Commercial wildlife operators conducted an environmental investigation in March and identified multiple small openings between the house's exterior wall and doorframe, which can serve as points of ingress or egress for bats. In addition, certain students reported hearing scratching behind a wall inside the house's common space. This wall was scheduled to be removed as part of a house remodel during summer 2017. A commercial wildlife control operator repaired the openings and completed building remediation during this time. Students returned to the house in August 2017. No bat sightings have been reported since students returned.

This is the first reported instance of a mass bat exposure in a fraternity or sorority house. Multiple high-risk rabies exposures occurred in this sorority house, attributable to bat colonization of the building. The initial complaint to ISDH related to concerns for food sanitation, rather than rabies, is consistent with previous reports indicating an underappreciation of the health risks associated with indoor bat exposures (*3*). ISDH communicated the risk for rabies exposure at meetings with students and university housing directors. All bat exposure events should be reported immediately to public health officials, who can provide advice about rabies risk assessments and determination of the need for PEP.

Conflict of Interest

No conflicts of interest were reported.

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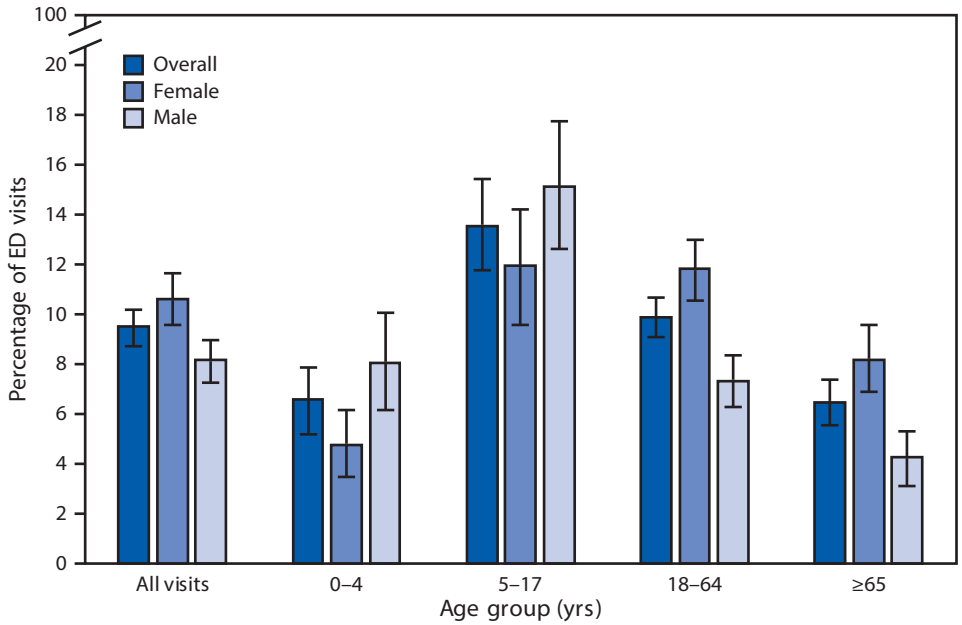
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of All Emergency Department (ED) Visits† Made by Patients with Asthma,§ by Sex and Age Group — National Hospital Ambulatory Medical Care Survey, United States 2014–2015



* With 95% confidence intervals indicated with error bars.
† Based on a sample of visits to EDs in noninstitutional general and short-stay hospitals, exclusive of federal, military, and Veterans Administration hospitals, located in the 50 states and the District of Columbia.
§ Defined as ED visits made by patients with documentation in the medical record of a diagnosis of asthma, regardless of the diagnosis for the current visit.

During 2014–2015, patients who had asthma documented in the medical record accounted for 9.5% of all ED visits in the United States, with the highest percentage for children aged 5–17 years (13.6%), compared with 6.6% for children aged 0–4 years, 9.9% for adults aged 18–64 years, and 6.5% for those aged ≥65 years. Among those aged 0–4 years, boys were more likely than girls to have a visit with asthma recorded, but for the older age groups, 18–64 and ≥65, women with asthma documented were more likely than men to have an ED visit. The difference by sex for those aged 5–17 years was not statistically significant.

Source: NCHS, National Hospital Ambulatory Medical Care Survey, 2014–2015.

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ISSN: 0149-2195 (Print)