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Firearm Homicides and Suicides in Major Metropolitan Areas — United States, 2006–2007 and 2009–2010

Firearm homicides and suicides are a continuing public health concern in the United States. During 2009–2010, a total of 22,571 firearm homicides and 38,126 firearm suicides occurred among U.S. residents (*1*). This includes 3,397 firearm homicides and 1,548 firearm suicides among persons aged 10–19 years; the firearm homicide rate for this age group was slightly above the all-ages rate. This report updates an earlier report* that provided statistics on firearm homicides and suicides in major metropolitan areas for 2006–2007, with special emphasis on persons aged 10–19 years in recognition of the importance of early prevention efforts. Firearm homicide and suicide rates were calculated for the 50 most populous U.S. metropolitan statistical areas (MSAs)† for 2009–2010 using mortality data from the National Vital Statistics System (NVSS) and population data from the U.S. Census Bureau. Comparison statistics were recalculated for 2006–2007 to reflect revisions to MSA delineations and population estimates subsequent to the earlier report. Although the firearm homicide rate for large MSAs collectively remained above the national rate during 2009–2010, more than 75% of these MSAs showed a decreased rate from 2006–2007, largely accounting for a national decrease. The firearm homicide rate for persons aged 10–19 years exceeded the all-ages rate in many of these MSAs during 2009–2010, similar to the earlier reporting period. Conversely, although the firearm suicide rate for large MSAs collectively remained below the national rate during 2009–2010, nearly 75% of these MSAs showed an increased rate from 2006–2007, paralleling the national trend. Firearm suicide rates among persons aged 10–19 years were low compared with all-ages rates during both periods. These patterns can inform the development and monitoring of strategies directed at reducing firearm-related violence.

* Available at http://www.cdc.gov/mmwr/pdf/wk/mm6018.pdf.

† An MSA is defined by the U.S. Office of Management and Budget (OMB) as "a core area containing a substantial population nucleus, together with adjacent communities." This report is based on the revised geographic delineations for MSAs issued by OMB in February 2013.

NVSS mortality data for 2006–2007 and 2009–2010 (the most recent available) were used to identify deaths attributed to firearm homicides (*International Classification of Diseases, 10th Revision* [ICD-10] underlying cause codes X93–X95 and U01.4 [provisional]) and firearm suicides (codes X72–X74) among U.S. residents. Firearm homicide and suicide counts were tabulated for county groupings forming the 50 largest MSAs (by population rank mid-year 2010).§ Tabulated counts were integrated with U.S. Census Bureau population estimates for the counties forming these MSAs to calculate annual firearm homicide and suicide rates for persons of all ages (excluding those aged <10 years for suicides because intent for self-harm typically is not attributed to young children). Rates were calculated similarly for persons aged 10–19 years. All-ages rates were age-adjusted to the year 2000 U.S. standard. MSA-level data involving firearm homicide or suicide counts <20 are not reported separately because of concerns about statistical stability and data privacy. However, such data were included in the calculations for all MSAs combined.

§ The same MSAs were the 50 most populous during both reporting periods; rankings by total population changed slightly.

INSIDE

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

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All-ages firearm homicide rates during 2009–2010 varied widely by MSA, ranging from 1.1 to 19.0 per 100,000 residents per year (Table). The rate for all MSAs combined was 4.3, compared with a national rate of 3.7. This represents a decrease from 2006–2007, when the combined MSA rate was 5.2 and the national rate was 4.2. Firearm homicide rates decreased for 78% of MSAs (39 of 50) across reporting periods, accounting for most of the national decrease. The firearm homicide rate among persons aged 10–19 years for the MSAs collectively was 5.1 during 2009–2010. This also reflects a decrease from 2006–2007, when the combined MSA rate for persons aged 10–19 years was 6.6. Rates for this age group exceeded all-ages rates in 72% of MSAs during 2009–2010 (23 of 32 MSAs with reportable youth firearm homicide statistics), comparable to the percentage observed for the earlier period. Males accounted for approximately 85% of firearm homicide victims (all ages) during both reporting periods, for all MSAs combined as well as nationally.

All-ages firearm suicide rates during 2009–2010 also varied widely by MSA, ranging from 1.6 to 11.4 (Table). The combined MSA rate was 5.4, compared with a national rate of 7.0. This represents an increase from 2006–2007, when the combined MSA rate was 5.1 and the national rate was 6.5. Across reporting periods, firearm suicide rates increased for 74% of MSAs (37 of 50), mirroring the national trend. Firearm suicide rates among persons aged 10–19 years were low compared with all-ages rates; the combined MSA rate for this age group was 1.2 during both reporting periods. Males represented approximately 87% of firearm suicides (all ages) in both reporting periods for all MSAs combined and nationally.

Reported by

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Editorial Note

During 2009–2010, homicide was the 15th leading cause of death (all ages) in the United States and the second leading cause among persons aged 10–19 years; a firearm injury was the underlying cause in 68% of all homicides and in 83% of homicides among youths (*1*). The findings in this report show that despite declining firearm homicide rates in most large metropolitan areas, rates collectively remained higher in these areas compared with the United States overall. Residents of the 50 largest MSAs represented 54% of the U.S. population during 2009–2010 (unchanged from 2006–2007) but accounted for 64% of firearm homicide victims nationally (somewhat below the percentage for 2006–2007). These MSAs accounted for 70% of the national firearm homicide total (2,368 of 3,397) among persons aged 10–19 years.

Concurrently, suicide was the 10th leading cause of death (all ages) nationally and the third leading cause for persons aged 10–19 years; a firearm injury was the underlying cause in

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TABLE. Numbers and annual rates (per 100,000 population) of firearm homicides and suicides for the 50 most populous metropolitan statistical areas (MSAs), by selected age groups — United States, 2006–2007 and 2009–2010*

		Firearm homicides				Firearm suicides			
		All ages		Aged 10–19 yrs		Aged ≥10 yrs		Aged 10–19 yrs	
MSA (ordered alphabetically)	Years	No.†	Rate§	No.	Rate	No.†	Rate§	No.	Rate
U.S. total	2006–2007	25,406	4.2	4,166	4.9	34,232	6.5	1,446	1.7
	2009–2010	22,560	3.7	3,397	4.0	38,122	7.0	1,548	1.8
MSA total (50 MSAs)	2006–2007	17,149	5.2	3,060	6.6	14,253	5.1	570	1.2
	2009–2010	14,428	4.3	2,368	5.1	15,960	5.4	578	1.2
Atlanta – Sandy Springs – Roswell, GA	2006–2007	661	6.4	84	5.8	566	7.0	21	1.4
	2009–2010	515	4.8	64	4.2	672	7.8	26	1.7
Austin – Round Rock, TX	2006–2007	50	1.4	¶	¶	171	6.6	¶	¶
	2009–2010	66	1.7	¶	¶	187	6.9	¶	¶
Baltimore – Columbia – Towson, MD	2006–2007	543	10.3	96	12.7	235	5.0	¶	¶
	2009–2010	409	7.7	54	7.4	223	4.6	¶	¶
Birmingham – Hoover, AL	2006–2007	242	11.0	33	10.9	181	9.4	¶	¶
	2009–2010	186	8.4	¶	¶	216	10.7	¶	¶
Boston – Cambridge – Newton, MA-NH	2006–2007	167	1.9	40	3.3	141	1.7	¶	¶
	2009–2010	166	1.8	32	2.7	165	2.0	¶	¶
Buffalo – Cheektowaga – Niagara Falls, NY	2006–2007	111	5.2	26	8.1	77	3.8	¶	¶
	2009–2010	103	4.7	¶	¶	73	3.5	¶	¶
Charlotte – Concord – Gastonia, NC-SC	2006–2007	215	5.3	31	5.4	261	7.5	¶	¶
	2009–2010	190	4.4	27	4.4	305	8.0	¶	¶
Chicago – Naperville – Elgin, IL-IN-WI	2006–2007	1,152	6.0	253	9.3	491	3.1	24	0.9
	2009–2010	1,139	6.0	213	7.9	527	3.2	¶	¶
Cincinnati, OH-KY-IN	2006–2007	177	4.3	35	5.8	233	6.5	¶	¶
	2009–2010	140	3.4	¶	¶	246	6.6	¶	¶
Cleveland – Elyria, OH	2006–2007	215	5.6	27	4.5	198	5.3	¶	¶
	2009–2010	146	3.9	21	3.7	168	4.5	¶	¶
Columbus, OH	2006–2007	165	4.3	26	5.1	221	7.1	¶	¶
	2009–2010	174	4.4	29	5.5	219	6.7	¶	¶
Dallas – Fort Worth – Arlington, TX	2006–2007	540	4.3	70	3.9	628	6.5	32	1.8
	2009–2010	469	3.6	57	3.0	762	7.4	25	1.3
Denver – Aurora – Lakewood, CO	2006–2007	122	2.5	26	4.0	353	8.6	¶	¶
	2009–2010	117	2.3	¶	¶	375	8.6	¶	¶
Detroit – Warren – Dearborn, MI	2006–2007	792	9.5	117	9.0	436	5.6	¶	¶
	2009–2010	686	8.6	119	9.5	461	6.1	31	2.5
Hartford – West Hartford – East Hartford, CT	2006–2007	62	2.7	¶	¶	46	2.1	¶	¶
	2009–2010	75	3.3	¶	¶	78	3.5	¶	¶
Houston – The Woodlands – Sugar Land, TX	2006–2007	761	6.7	115	6.9	590	6.7	32	1.9
	2009–2010	701	5.8	83	4.7	730	7.7	39	2.2
Indianapolis – Carmel – Anderson, IN	2006–2007	218	6.0	29	5.6	217	7.0	¶	¶
	2009–2010	188	5.1	25	4.7	248	7.7	¶	¶
Jacksonville, FL	2006–2007	243	9.3	37	10.1	183	8.1	¶	¶
	2009–2010	198	7.4	26	7.1	255	10.8	¶	¶
Kansas City, MO-KS	2006–2007	226	6.0	40	7.3	257	7.7	¶	¶
	2009–2010	260	6.8	62	11.3	284	8.2	¶	¶
Las Vegas – Henderson – Paradise, NV	2006–2007	221	6.0	46	9.2	340	11.1	¶	¶
	2009–2010	164	4.2	24	4.5	376	11.4	¶	¶
Los Angeles – Long Beach – Anaheim, CA	2006–2007	1,612	6.0	410	10.7	687	3.2	¶	¶
	2009–2010	1,141	4.2	251	6.7	755	3.5	22	0.6
Louisville/Jefferson County, KY-IN	2006–2007	119	5.2	¶	¶	194	9.2	¶	¶
	2009–2010	105	4.4	¶	¶	202	9.1	¶	¶
Memphis, TN-MS-AR	2006–2007	298	11.4	47	11.7	176	8.2	¶	¶
	2009–2010	249	9.4	43	10.7	182	8.4	¶	¶
Miami – Fort Lauderdale – West Palm Beach, FL	2006–2007	657	6.3	112	7.8	547	5.4	¶	¶
	2009–2010	594	5.6	81	5.8	580	5.5	¶	¶
Milwaukee – Waukesha – West Allis, WI	2006–2007	182	5.9	44	9.9	125	4.8	¶	¶
	2009–2010	139	4.5	¶	¶	156	5.6	¶	¶

See table footnotes on page 600.

TABLE. (*Continued*) Numbers and annual rates (per 100,000 population) of firearm homicides and suicides for the 50 most populous metropolitan statistical areas (MSAs), by selected age groups — United States, 2006–2007 and 2009–2010*

		Firearm homicides				Firearm suicides			
		All ages		Aged 10–19 yrs		Aged ≥10 yrs		Aged 10–19 yrs	
MSA (ordered alphabetically)	Years	No.†	Rate§	No.	Rate	No.†	Rate§	No.	Rate
Minneapolis – St. Paul – Bloomington, MN-WI	2006–2007	119	1.8	25	2.7	261	4.7	¶	¶
	2009–2010	90	1.3	¶	¶	295	5.1	¶	¶
Nashville-Davidson – Murfreesboro – Franklin, TN	2006–2007	169	5.2	¶	¶	266	9.8	¶	¶
	2009–2010	158	4.6	27	6.0	251	8.7	¶	¶
New Orleans – Metairie, LA	2006–2007	491	23.2	89	30.0	167	8.7	¶	¶
	2009–2010	449	19.0	80	25.6	157	7.5	¶	¶
New York – Newark – Jersey City, NY-NJ-PA	2006–2007	1,233	3.2	208	4.0	533	1.6	¶	¶
	2009–2010	1,101	2.8	203	3.9	574	1.6	¶	¶
Oklahoma City, OK	2006–2007	104	4.2	20	6.1	160	7.8	¶	¶
	2009–2010	90	3.5	20	5.9	207	9.5	¶	¶
Orlando – Kissimmee – Sanford, FL	2006–2007	242	5.7	28	4.8	210	5.9	¶	¶
	2009–2010	151	3.4	¶	¶	269	7.1	¶	¶
Philadelphia – Camden – Wilmington, PA-NJ-DE-MD	2006–2007	899	7.7	166	9.7	483	4.6	¶	¶
	2009–2010	729	6.2	124	7.5	478	4.4	¶	¶
Phoenix – Mesa – Scottsdale, AZ	2006–2007	555	6.9	96	8.5	616	9.2	33	2.9
	2009–2010	331	4.0	39	3.2	688	9.8	28	2.3
Pittsburgh, PA	2006–2007	187	4.4	35	5.7	296	6.7	¶	¶
	2009–2010	192	4.5	31	5.3	298	6.8	¶	¶
Portland – Vancouver – Hillsboro, OR-WA	2006–2007	62	1.4	¶	¶	264	7.2	¶	¶
	2009–2010	66	1.4	¶	¶	302	7.8	¶	¶
Providence – Warwick, RI-MA	2006–2007	47	1.5	¶	¶	76	2.6	¶	¶
	2009–2010	56	1.8	¶	¶	90	3.1	¶	¶
Raleigh, NC	2006–2007	50	2.5	¶	¶	91	5.4	¶	¶
	2009–2010	52	2.3	¶	¶	100	5.4	¶	¶
Richmond, VA	2006–2007	175	7.4	35	10.5	162	7.9	¶	¶
	2009–2010	134	5.7	¶	¶	151	7.1	¶	¶
Riverside – San Bernardino – Ontario, CA	2006–2007	396	4.8	80	5.7	356	5.6	¶	¶
	2009–2010	283	3.3	56	3.9	366	5.3	¶	¶
Sacramento – Roseville – Arden-Arcade, CA	2006–2007	149	3.5	30	4.8	204	5.7	¶	¶
	2009–2010	132	3.0	23	3.7	231	6.0	¶	¶
St. Louis, MO-IL	2006–2007	393	7.3	83	10.5	334	6.8	¶	¶
	2009–2010	436	8.1	82	10.6	354	7.0	¶	¶
Salt Lake City, UT	2006–2007	44	2.0	¶	¶	137	8.6	¶	¶
	2009–2010	32	1.5	¶	¶	194	11.2	¶	¶
San Antonio – New Braunfels, TX	2006–2007	185	4.5	27	4.4	240	7.3	¶	¶
	2009–2010	155	3.6	27	4.2	267	7.4	¶	¶
San Diego – Carlsbad, CA	2006–2007	149	2.4	30	3.5	251	5.0	¶	¶
	2009–2010	75	1.1	¶	¶	282	5.2	¶	¶
San Francisco – Oakland – Hayward, CA	2006–2007	576	6.9	106	10.4	242	3.2	¶	¶
	2009–2010	439	5.2	101	9.9	325	4.2	¶	¶
San Jose – Sunnyvale – Santa Clara, CA	2006–2007	45	1.2	¶	¶	79	2.6	¶	¶
	2009–2010	48	1.3	¶	¶	106	3.3	¶	¶
Seattle – Tacoma – Bellevue, WA	2006–2007	158	2.3	24	2.8	346	6.0	¶	¶
	2009–2010	105	1.5	¶	¶	406	6.7	¶	¶
Tampa – St. Petersburg – Clearwater, FL	2006–2007	179	3.5	21	3.1	395	7.8	¶	¶
	2009–2010	161	3.1	26	3.8	490	9.1	¶	¶
Virginia Beach – Norfolk – Newport News, VA-NC	2006–2007	198	5.6	32	6.6	179	6.2	¶	¶
	2009–2010	203	5.7	29	6.2	216	7.4	¶	¶
Washington – Arlington – Alexandria, DC-VA-MD-WV	2006–2007	593	5.4	93	6.4	351	3.9	¶	¶
	2009–2010	440	3.8	76	5.1	418	4.3	¶	¶

* Numbers and rates reflect decedent's place of residence, not place of occurrence. This table includes only the 50 most populous MSAs among the 381 U.S. MSAs currently delineated, and therefore cannot be used to establish comprehensive national rankings.
† These national and MSA-specific numbers correspond to age-adjusted rates and exclude a small fraction of records with undocumented decedent age (28 firearm homicides and seven firearm suicides).
§ Rates are age-adjusted to the year 2000 U.S. standard population.
¶ Entry suppressed because of statistical instability or data confidentiality concerns (both associated with small numbers).

What is already known on this topic?

Firearm homicide rates for large metropolitan statistical areas (MSAs) have been found to be higher than for the United States overall, with rates also higher among persons aged 10–19 years than among persons of all ages. In contrast, firearm suicide rates have been found to be lower in these large urban areas than for the nation overall.

What is added by this report?

Although geographic and age-specific differences in firearm homicide rates have persisted, rates declined from 2006–2007 to 2009–2010 for most large MSAs, as well as nationally. The national decline in the firearm homicide rate can be attributed primarily to declines in these large metropolitan areas. Geographic differences in firearm suicide rates also have persisted; however, firearm suicide rates increased from 2006–2007 to 2009–2010 for most large MSAs and nationally.

What are the implications for public health practice?

Prevention and intervention research should focus on identifying effective strategies for sustaining declines in firearm homicide rates and stemming recent increases in firearm suicide rates. Although further study is needed, initiatives for reducing firearm-related violence can draw upon a growing evidence base for effectively addressing behavioral and environmental factors associated with both firearm and nonfirearm violence.

51% of all suicides and in 40% of suicides among youths (*1*). Firearm suicide rates increased in most large metropolitan areas across reporting periods; however, rates collectively remained lower in these areas compared with the United States overall. Although residents of the large MSAs comprised more than half of the U.S. population, they accounted for just 42% of firearm suicides nationally (identical to the percentage for 2006–2007). For persons aged 10–19 years, these MSAs accounted for 37% of firearm suicides nationwide.

The findings in this report are subject to at least four limitations. First, statistics for central cities within MSAs are not presented because of lack of age-specific population estimates suitable for supporting rate comparisons across the periods considered. Second, statistics on nonfatal injuries associated with firearm assault or self-harm are not presented because population-based nonfatal injury data are not available for MSAs. Third, although the statistics for victims aged 10–19 years convey the serious impact of firearm-related violence on youths, other age groups not separately considered in this report had higher firearm homicide rates (e.g., persons aged 20–39 years, for whom rates have been declining recently) or higher firearm suicide rates (most or all other age groups, for whom rates variously have been level or increasing). Finally, the fraction of NVSS records with the underlying cause of death coded as "other ill-defined and unspecified causes of mortality" (ICD-10 code R99) was higher than usual for several states (New Jersey, Ohio, and West Virginia) and the District of Columbia for 2009. The influence of nonspecific cause codes on firearm fatality statistics is not known; however, the annual fraction of such records remained low (approximately 5% or less) for each of these states.

The observed declines in firearm homicide rates and increases in firearm suicide rates are consistent with longer-term trends in homicide and suicide nationally (*1*). Homicide rates generally have been declining in the United States during the past two decades (*1*). Factors identified by previous research as influencing this decline include shifting demographics, changes in markets for illegal drugs (e.g., type, demand, and participants), law enforcement responses to gun violence and drug-related crime, increased incarceration rates, community policing and related efforts, and improving economic conditions throughout much of the 1990s (*2*). Increasing suicide rates have been prominent in the middle-aged population during the past decade as the percentage of suicides accounted for by this group has steadily increased (*1,3*). Suicide rates within this age group previously have been associated with business cycles (*4*); national unemployment rates notably doubled from 2006–2007 to 2009–2010 (*5*).

A factor likely affecting firearm homicide and suicide is access to firearms by persons at risk for harming themselves or others. Potential strategies for reducing firearm-related violence among such persons include initiatives promoting safe storage of guns (*6*), waiting periods to reduce the consequences of impulsive suicidal behavior (*7*), designing firearms to make them safer (*8*), and efforts such as background checks to prevent high-risk persons from possessing firearms (e.g., persons convicted of violent crimes, persons subject to protective orders because of threats of domestic violence, and persons with documented mental illness posing a risk to themselves or others) (*9*). Further research is needed to assess the effectiveness of such strategies.

Effective approaches for preventing violence include early education through school-based programs addressing social, emotional, and behavioral competencies; parent and family-based programs promoting positive relationships, communication, support, and proper supervision; and efforts to improve school, neighborhood, and community environments in ways that reduce the likelihood of violence (*10*).[¶] Promoting the capacity of communities to implement such approaches might prove essential to achieving population-level impacts.

¶ Additional information available at http://www.cdc.gov/violenceprevention/stryve/index.html and http://www.thecommunityguide.org/violence/schoolbasedprograms.html.

Acknowledgments

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Mycoplasma pneumoniae Outbreak at a University — Georgia, 2012

On October 17, 2012, the Georgia Department of Public Health (DPH) was notified by the Fulton County Department of Health and Wellness that a local university, the Georgia Institute of Technology, was experiencing a pneumonia outbreak among students. DPH epidemiologists investigated to identify the etiology, find additional cases, and recommend control measures. Respiratory swabs collected from students with pneumonia and tested at CDC using a quantitative real-time polymerase chain reaction (qPCR) assay were positive for *Mycoplasma pneumoniae.* The university alerted students, faculty, and staff members to the outbreak and recommended prevention measures by e-mail, social media, and posters. A survey administered to students assessed illness prevention behaviors, outbreak awareness, and communication preferences. Eighty-three cases were diagnosed among students during September 1–December 4, 2012, making this outbreak the largest reported at a U.S. university in 35 years (*1*). No cases were reported among faculty or staff members. Of the 83 patients, 19 had specimens tested by qPCR, of which 12 (63%) were positive for *M. pneumoniae*. Despite university communication efforts, approximately half of students surveyed were unaware of the outbreak when surveyed in December. DPH recommendations included implementing university policies that facilitate students staying home and seeking medical care when ill and refining health messages and communication methods to improve awareness of disease outbreaks among students.

M. pneumoniae is a common cause of respiratory infection among children and young adults, causing up to 40% of all cases of community-acquired pneumonia (*2*). In rare cases, *M. pneumoniae* can cause extrapulmonary manifestations, including neurologic, dermatologic, hematologic, and cardiac syndromes. Recommended first-line antibiotic treatments include tetracyclines and macrolides; however, a growing trend of macrolide-resistance worldwide has been reported (*2,3*). Outbreaks largely occur in closed and semiclosed settings, including schools and universities (*4–6*).

To investigate the outbreak, university health services records were reviewed weekly, beginning October 17, 2012, to identify cases of pneumonia among students, and information regarding demographics, signs and symptoms, underlying conditions, and treatment was collected. Retrospective record review was performed to identify cases diagnosed as early as September 1, 2012. Beginning on October 17, 2012, oropharyngeal and nasal or nasopharyngeal swabs were obtained from consenting students who agreed to testing and who received a diagnosis of pneumonia from a university health services physician. Initial patient specimens were tested using qPCR for 20 respiratory pathogens to identify the causative agent (*7*); subsequent specimens were tested for *M. pneumoniae*, *Chlamydophila pneumoniae*, and *Legionella* species using a multiplex qPCR assay (*8*). Culture and macrolide resistance testing were attempted on all *M. pneumoniae*-positive specimens using previously described methods (*9*).

Probable cases were defined as a physician diagnosis of pneumonia in a Georgia Institute of Technology student during September 1–December 4, 2012, with or without qPCR evidence. Confirmed cases met the criteria for a probable case and had *M. pneumoniae* detected in oropharyngeal, nasal, or nasopharyngeal swabs by qPCR. During September 1–December 4, 2012, a total of 83 cases were identified, including 12 confirmed and 71 probable cases. Illness onset occurred during August 4–December 2, 2012 and peaked at the beginning of November (Figure). Patients were predominantly men (72%), and the age range was 18–30 years (median: 21 years), both representative of the overall student population. Ten (12%) patients had underlying asthma; this rate of asthma is statistically similar to the expected rate among adults aged 18–24 years in Georgia, according to results from the 2010 Behavioral Risk Factor Surveillance System survey.* A total of 79 patients (95%) reported cough, 64 (77%) fever, 36 (43%) headache, and 34 (41%) sore throat. Five (6%) patients with no underlying medical conditions were hospitalized with complications, including four with respiratory failure and one with perimyocarditis; all recovered. Forty-three (52%) patients were treated with doxycycline, 23 (28%) with azithromycin, and seven (8%) with other or multiple antibiotics (Table 1).

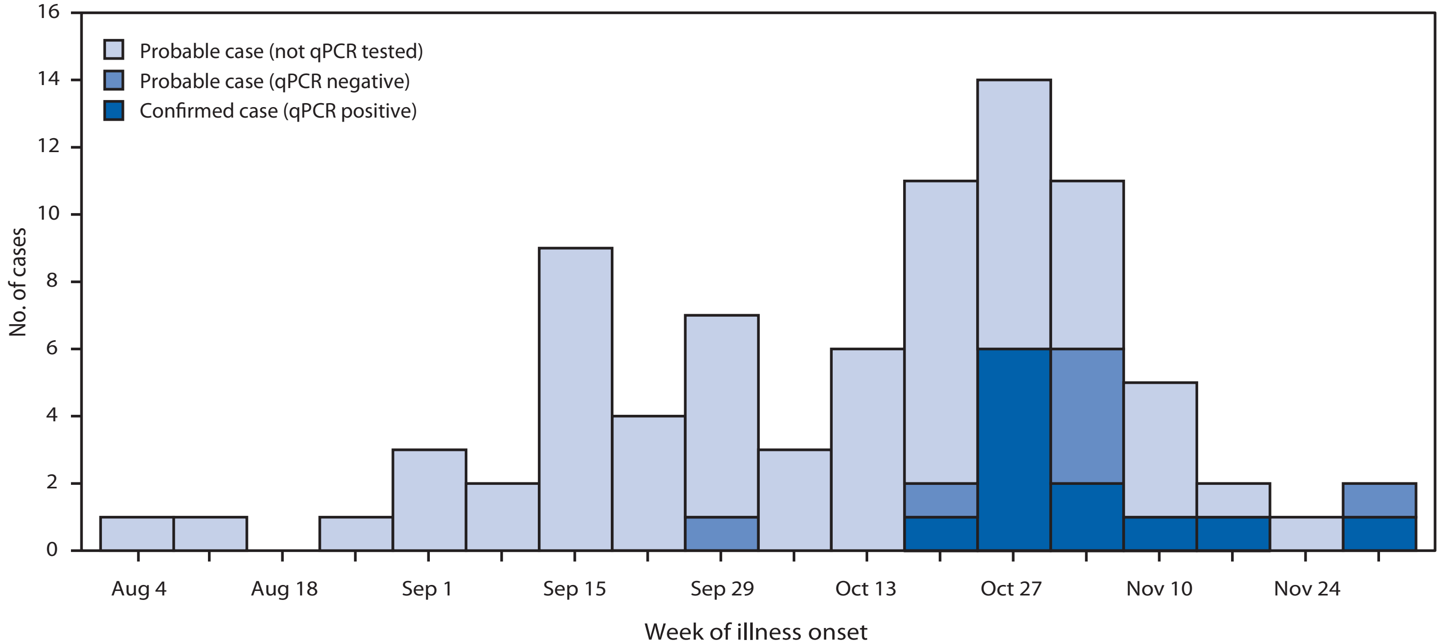
Nineteen (23%) of 83 cases had specimens tested by qPCR; 12 (63%) specimens were positive for *M. pneumoniae* and were cultured, yielding 10 isolates identified as *M. pneumoniae*. No other pathogens were identified. All 12 qPCR-positive specimens tested negative for macrolide resistance by qPCR testing of the primary specimen or isolate. Radiographs were administered for 99% of students with pneumonia diagnoses; 61 (74%) had radiographic findings consistent with pneumonia.

Public Health Response

On November 7, 2012, DPH provided the university with recommendations to curtail the outbreak, including initiation of an outreach campaign to alert the university community to the outbreak and education regarding preventive health behaviors to reduce the spread of illness. During November, the university began an outreach campaign that included a

*Additional information available at http://www.cdc.gov/brfss.

FIGURE. Number of *Mycoplasma pneumoniae* cases (N = 83*) among students at a university, by week of illness onset and qPCR testing status — Georgia, 2012



Abbreviation: qPCR = quantitative real-time polymerase chain reaction.
* Probable cases were defined as clinically diagnosed pneumonia, with or without qPCR evidence of pneumonia, among students at the university during September 1–December 4, 2012. Confirmed cases were probable cases with *M. pneumoniae* detected in oropharyngeal, nasal, or nasopharyngeal swabs by qPCR.

universitywide e-mail, social media postings, and posters displayed around campus. Communications focused on measures to prevent respiratory illness, including proper hand hygiene, respiratory hygiene, and staying home and seeking medical care when ill with a cough and fever.

To assess the effectiveness of the outreach campaign, investigators administered a knowledge, attitudes, and practices survey on December 5, 2012, 2 weeks before winter break, to a convenience sample of 105 students who did not have pneumonia; some students did report having a mild illness during the fall semester. These students were asked to select one or more options from a list to indicate 1) their behaviors whenever they were ill with cough and fever, 2) their preferred health communication methods, and 3) if and how they became aware of the pneumonia outbreak. Of the 105 students surveyed, 48 (46%) were aware of the outbreak; of these 48 students, 38 (79%) reported that they were more likely to use good respiratory hygiene as a result of this knowledge. Thirty-one (30%) of 105 students surveyed indicated that they would stay home with a cough and fever, and 34 (32%) said they would seek medical care for those symptoms. Twenty-seven (26%) students learned about the outbreak from an e-mail, 23 (22%) from a friend, six (6%) from a poster, and two (2%) from social media.

When asked to identify "the best way to communicate these matters to you" and told they could indicate more than one method, 93 students (89%) said they preferred receiving health communications by e-mail, 45 (43%) indicated posters placed on campus, 19 (18%) indicated social media, and 19 (18%) indicated text messages (Table 2).

The last *M. pneumoniae* case was identified on December 4, 2012. Active surveillance was discontinued at university health services on January 1, 2013.

Reported by

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Editorial Note

The outbreak of *M. pneumoniae* at the Georgia Institute of Technology is the largest reported at a U.S. university in 35 years (*1*). *M. pneumoniae* has been implicated in other pneumonia outbreaks at universities (*5*) and is recognized as a common cause of community-acquired pneumonia among university students (*4*). These outbreaks can be prolonged because of the long incubation period (up to 3 weeks) (*2*).

TABLE 1. Number and percentage of *Mycoplasma pneumoniae* cases (N = 83) among students at a university, by selected characteristics — Georgia, 2012

Characteristic	No.*	(%)
Case type	83	(100)
Confirmed case	12	(14)
Probable case	71	(86)
Sex		
Men	60	(72)
Women	23	(28)
Symptom		
Cough	79	(95)
Fever	64	(77)
Shortness of breath	23	(28)
Body aches	26	(31)
Headache	36	(43)
Sore throat	34	(41)
Nasal congestion	32	(39)
Rash	3	(4)
Radiograph		
No. of patients administered	82	(99)
No. with findings consistent with pneumonia	61	(73)
Underlying condition		
Asthma	10	(12)
Allergies	5	(6)
Antibiotic treatment		
Azithromycin	23	(28)
Doxycycline	43	(52)
Other†	7	(8)
None	3	(4)
Information missing	7	(8)

Abbreviation: qPCR = quantitative real-time polymerase chain reaction.

* Probable cases were defined as clinically diagnosed pneumonia, with or without qPCR evidence of pneumonia among students at the university during September 1–December 4, 2012. Confirmed cases were probable cases with *M. pneumoniae* detected in oral or nasal or nasopharyngeal swabs by qPCR.

† Includes combination therapy, ceftriaxone, erythromycin, clarithromycin, and levofloxacin.

Because *M. pneumoniae* infection most commonly causes upper respiratory illness (only an estimated 3%–10% of persons with infection experience pneumonia [*2,3*]), infected persons often go about their normal activities and infect others, as in this outbreak. No cases were identified among faculty or staff members, perhaps in part because they generally do not use university health services. The five hospitalizations demonstrate the risk for severe complications during substantial outbreaks of *M. pneumoniae*; early outbreak recognition is critical because control measures can limit transmission and complications (*3*).

The multiplex qPCR assay was used as the primary testing method in this investigation because of the documented sensitivity and specificity (*8*), cost-effectiveness, and status as a Clinical Laboratory Improvement Amendments (CLIA)–approved testing method. Culture, a less reliable method for *M. pneumoniae* detection (*2*), was used in this investigation to obtain isolates that could be further characterized through additional molecular testing methods.

TABLE 2. Knowledge and practices of surveyed students (N = 105) regarding outbreak of *Mycoplasma pneumoniae* at a university — Georgia, 2012

Knowledge/Practices	No.	(%)
Are you aware of increased pneumonia on campus?		
Yes	48	(46)
No	57	(54)
How did you hear about it?		
E-mail	27	(26)
Friend	23	(22)
Posters around campus	6	(6)
Health services website	5	(5)
Professor	4	(4)
Social media	2	(2)
Best way to communicate these matters to you?*		
E-mail	93	(89)
Posters in common areas	45	(43)
Social media	19	(18)
Text messages	19	(18)
Campus newspaper	17	(16)
Residence advisors	15	(14)
Academic advisors	6	(6)
Which are you most likely to do if you become ill?*		
Cover cough and sneezes more often	62	(59)
Take over-the-counter medications	53	(50)
Wash hands more	46	(44)
Go to a doctor	34	(32)
Stay home when not feeling well	31	(30)
Do nothing	7	(7)
Are you more likely to wash your hands, cover your cough, or stay home if ill after seeing the posters and e-mails? (n = 48)		
Yes	38	(79)
No	10	(21)

* Students could select multiple answers.

M. pneumoniae is spread through respiratory droplets; therefore, preventive health behaviors, including proper hand and respiratory hygiene and self-isolation when ill, can limit the spread of disease (*3*). No data are available to support the use of antibiotic prophylaxis during university outbreaks. Inducing preventive health behaviors among university students requires that they become aware of the outbreak, perceive a personal risk, and know of a behavior that can reduce the risk for infection (*10*). In a survey of 105 students, 54% said they were unaware of the outbreak despite a campuswide e-mail message, social media postings, and posters placed around campus. Among the 46% of students who were aware of the outbreak, 79% said they would be more likely to engage in preventive health behaviors because of this awareness.

To be effective during a *M. pneumoniae* outbreak at a university, health messages need to reach students and educate them regarding their risk for infection and behaviors that can prevent infection. More research is needed to determine the most effective ways to communicate these messages to university students. Sending multiple e-mails and text messages with attention-getting words in the subject line (e.g., outbreak or pneumonia) and the use of informal social networks (e.g., announcements at

What is already known on this topic?

Mycoplasma pneumoniae is a common cause of respiratory infection and community-acquired pneumonia among young adults. Approximately 3%–10% of persons infected with *M. pneumoniae* experience pneumonia, and a limited proportion of persons can experience extrapulmonary manifestations, including cardiac syndromes. Outbreaks are known to occur in closed and semiclosed settings, including schools and universities.

What is added by this report?

During September 1–December 4, 2012, a total of 83 cases of *M. pneumoniae* infection were diagnosed among students at a university in Georgia, the largest reported outbreak of *M. pneumoniae* at a U.S. university in 35 years. Despite multiple communication efforts, approximately half of students surveyed in December said they were unaware of the outbreak. Students unaware of an outbreak are unlikely to adopt preventive health behaviors that might limit disease spread

What are the implications for public health practice?

M. pneumoniae should be considered in outbreaks of pneumonia among university students. University students are more likely to engage in preventive health behaviors when they are aware of an outbreak, yet students can be difficult to reach, even when their preferred methods of health communication are employed. Health messages should be tailored to reach students and educate them about their risk for infection, and behaviors to prevent infection; more research needs to be done to determine the most effective way to communicate health messages to students.

group activities or in classes) might serve to increase awareness. Effective communications, coupled with university policies that facilitate students staying home and seeking medical care when ill, might reduce transmission of *M. pneumoniae* and the severe complications that can go with it.

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Vaccination Coverage Among Children in Kindergarten — United States, 2012–13 School Year

State and local school vaccination requirements are implemented to maintain high vaccination coverage and minimize the risk from vaccine preventable diseases (*1*). To assess school vaccination coverage and exemptions, CDC annually analyzes school vaccination coverage data from federally funded immunization programs. These awardees include 50 states and the District of Columbia (DC), five cities, and eight U.S.-affiliated jurisdictions.* This report summarizes vaccination coverage from 48 states and DC and exemption rates from 49 states and DC for children entering kindergarten for the 2012–13 school year. Forty-eight states and DC reported vaccination coverage, with medians of 94.5% for 2 doses of measles, mumps, and rubella (MMR) vaccine; 95.1% for local requirements for diphtheria, tetanus toxoid, and acellular pertussis (DTaP) vaccination; and 93.8% for 2 doses of varicella vaccine among awardees with a 2-dose requirement. Forty-nine states and DC reported exemption rates, with the median total of 1.8%. Although school entry coverage for most awardees was at or near national *Healthy People 2020* targets of maintaining 95% vaccination coverage levels for 2 doses of MMR vaccine, 4 doses of DTaP† vaccine, and 2 doses of varicella vaccine (*2*), low vaccination and high exemption levels can cluster within communities, increasing the risk for disease. Reports to CDC are aggregated at the state level; however, local reporting of school vaccination coverage might be accessible by awardees. These local-level data can be used to create evidence-based health communication strategies to help parents understand the risks for vaccine-preventable diseases and the benefits of vaccinations to the health of their children and other kindergarteners.

Vaccination coverage among children entering kindergarten is assessed annually by awardees. Each school year, the health department, school nurse, or other school personnel assess the vaccination and exemption status of a census or sample of kindergarteners enrolled in public and private schools to determine vaccination coverage, as defined by state and local school requirements established to protect children from vaccine-preventable diseases. Among the 50 states and DC, 43 awardees used an immunization information system (IIS) as at least one source of data for some of their school assessment. To collect data, 33 awardees used a census of kindergarteners; 11 a sample of schools, kindergarteners, or both; two a voluntary response of schools; and five a mix of methods. Results of the school-level assessments are reported to the health department. Aggregated data are reported to CDC for public and private schools. Data for homeschooled students were not reported to CDC. All estimates of coverage and exemption were weighted based on each awardee's response rates and sampling methodology, unless otherwise noted. Of the 50 states and DC, 12 awardees met CDC standards for school assessment methods in 2012–13.§

Kindergarteners were considered up-to-date for each vaccination if they had received all of the doses required for school entry in their jurisdiction. School entry requirements varied by awardee: all reporting awardees required 2 doses of MMR vaccine; for DTaP vaccine, two awardees required 3 doses, 35 required 4 doses, and 20 required 5 doses; and for varicella vaccine, 13 required 1 dose, 41 required 2 doses, and three did not require varicella vaccination.

The types of exemptions allowed varied by awardee. All reporting awardees allowed medical exemptions, 46 allowed religious exemptions, 18 allowed philosophic exemptions, and two (Mississippi and West Virginia) did not allow exemptions for religious or philosophic reasons. Medical, religious, and philosophic exemptions were reported as the percentage of kindergarteners with each type of exemption. Total exemptions were reported as the percentage of kindergarteners with any exemption.

Overall, among the 48 states and DC that reported 2012–13 school vaccination coverage, median 2-dose MMR vaccination coverage was 94.5% (range: 85.7% in Colorado to ≥99.9% in Mississippi); 20 reported coverage ≥95% (Table 1). Median DTaP vaccination coverage was 95.1% (range: 82.9% in Colorado and Arkansas to ≥99.9% in Mississippi); 25 reported coverage ≥95%. Median 2-dose varicella vaccination coverage among the 36 states and DC requiring and reporting 2 doses was 93.8% (range: 84.6% in Colorado to ≥99.9% in Mississippi); 14 reported coverage ≥95%.

An estimated 91,453 exemptions were reported among a total estimated population of 4,242,558 kindergarteners. Overall, among the 49 states and DC that reported 2012–13 school vaccination exemptions, the percentage of

* Vaccination coverage and exemption data were reported to CDC by Guam, the Commonwealth of the Northern Mariana Islands, Palau, Puerto Rico, and the U.S. Virgin Islands. No data were reported by American Samoa, the Marshall Islands, and the Federated States of Micronesia. Data from these U.S.-affiliated jurisdictions were excluded from the national analysis.

† The *Healthy People 2020* DTaP vaccination coverage target (IID-10.1) is based on 4 doses of DTaP vaccine. This report describes compliance with state regulations of 3, 4, or 5 doses of DTaP vaccine. Of the 51 awardees, only Nebraska, New York, and Pennsylvania report <4 doses of DTaP vaccine.

§ CDC standards included use of a census or random sample to assess public and private schools or students, assessment using number of doses recommended by the Advisory Committee on Immunization Practices, assessment of vaccination status before December 31, collection of data by health department personnel or school nurses, validation of data collected by school administrative staff, and vaccination documentation from a health-care provider.

TABLE 1. Estimated vaccination coverage[*] among children enrolled in kindergarten, by state/area, type of survey conducted, and selected vaccines — United States, 2012–13 school year

State/Area	Estimated kindergarten population	Total surveyed	Proportion surveyed (%)	Type of survey conducted[†]	MMR[§] (%)	DTaP/DT[¶] (%)	Varicella 1 dose (%)	Varicella 2 doses (%)
Alabama[**]	72,929	**72,929**	(100.0)	Census	(92.8)	(92.8)	(91.9)	NReq
Alaska	10,319	**10,092**	(97.8)	Voluntary response	—[††]	—[††]	—	—[††]
Arizona	90,054	**87,909**	(97.6)	Census	(94.5)	(94.6)	(96.8)	NReq
Arkansas	43,212	**41,602**	(96.3)	Census (public), Voluntary response (private)	(85.9)	(82.9)	—	(84.8)
California[**]	535,523	**530,418**	(99.0)	Census (public), Voluntary response (private)	(92.7)	(92.5)	(95.6)	NReq
Colorado	70,657	**350**	(0.5)	Simple random	(85.7)	(82.9)	—	(84.6)
Connecticut	41,604	**41,604**	(100.0)	Census	(97.1)	(97.2)	—	(96.8)
Delaware	11,997	**934**	(7.8)	2-Stage cluster	(≥95.7)	(≥95.7)	—	(≥95.7)
District of Columbia	7,842	**7,842**	(100.0)	Census	(91.8)	(91.6)	—	(91.5)
Florida	234,628	**234,628**	(100.0)	Census	(≥92.1)[§§]	(≥92.1)[§§]	—	(≥92.1)[§§]
Georgia	142,732	**3,388**	(2.4)	2-Stage cluster	(≥95.1)	(≥95.1)	—	(≥95.1)
Hawaii[**]	20,104	**1,339**	(6.7)	2-Stage cluster	(97.3)	(98.0)	(99.3)	NReq
Idaho	23,888	**23,888**	(100.0)	Census	(88.4)	(88.3)	—	(86.6)
Illinois	166,884	**166,884**	(100.0)	Voluntary response	(95.5)	(94.6)	(96.6)	NReq
Indiana	86,983	**72,532**	(83.4)	Census	(95.4)	(90.1)	—	(93.9)
Iowa	41,701	**41,663**	(99.9)	Census	(≥90.5)	(≥90.5)	—	(≥90.5)
Kansas	40,738	**12,943**	(31.8)	Mixed design (public), Census (private)	(90.0)	(88.9)	—	(88.4)
Kentucky[**]	58,466	**56,846**	(97.2)	Census (public), Voluntary response (private)	(92.4)	(94.1)	—	(89.5)
Louisiana	68,874	**68,874**	(100.0)	Census	(96.6)	(98.3)	—	(96.5)
Maine[**]	14,313	**13,533**	(94.6)	Census	(91.3)	(95.2)	(95.1)	NReq
Maryland[**]	75,007	**63,212**	(84.3)	Census	(98.2)	(99.4)	(99.6)	NReq
Massachusetts[**]	79,661	**77,767**	(97.6)	Census	(94.8)	(93.1)	—	(93.6)
Michigan	124,662	**124,662**	(100.0)	Census	(94.4)	(95.1)	—	(92.9)
Minnesota[**]	73,310	**73,310**	(100.0)	Census	(96.3)	(96.7)	—	(95.9)
Mississippi	46,595	**46,595**	(100.0)	Census	(≥99.9)	(≥99.9)	—	(≥99.9)
Missouri	78,416	**4,634**	(5.9)	2-Stage cluster	(96.7)	(96.5)	—	(96.1)
Montana	12,516	**11,990**	(95.8)	Census	(94.8)	(94.5)	—	NReq
Nebraska[**]	24,999	**24,153**	(96.6)	Census	(96.0)	(95.5)	—	(94.7)
Nevada	36,070	**1,561**	(4.3)	2-Stage cluster	(93.6)	(96.6)	—	(92.2)
New Hampshire	12,943	**12,839**	(99.2)	Census	—[††]	—[††]	—	—[††]
New Jersey	122,516	**118,447**	(96.7)	Census	(≥97.0)	(≥97.0)	—	(≥97.0)
New Mexico	29,279	**971**	(3.3)	2-Stage cluster	(93.9)	(96.6)	—	(94.0)
New York[**]	239,484	**239,484**	(100.0)	Census	(96.6)	(98.4)	(98.4)	NReq
North Carolina	130,612	**127,150**	(97.3)	Census	(97.3)	(97.2)	(98.0)	NReq
North Dakota	9,503	**466**	(4.9)	2-Stage cluster	(89.9)	(89.0)	—	(88.5)
Ohio	163,687	**142,170**	(86.9)	Census	(96.3)	(96.3)	—	(95.7)
Oklahoma	56,943	**54,381**	(95.5)	Census (public), Voluntary response (private)	(90.5)	(90.2)	(92.8)	NReq
Oregon	47,102	**47,102**	(100.0)	Census	(93.5)	(93.4)	(94.5)	NReq
Pennsylvania	151,364	**147,582**	(97.5)	Census	(87.0)	(90.7)	—	(85.7)
Rhode Island[**]	12,552	**9,445**	(75.2)	Census	(94.2)	(95.2)	—	(94.2)
South Carolina	61,799	**11,039**	(17.9)	1-Stage cluster	(≥90.9)	(≥90.9)	—	(≥90.9)
South Dakota	12,468	**12,468**	(100.0)	Census	(97.9)	(97.7)	—	(96.0)
Tennessee	85,801	**83,188**	(97.0)	Census	(≥94.5)	(≥94.5)	—	(≥94.5)
Texas	414,688	**400,510**	(96.6)	Census	(97.5)	(97.3)	—	(97.2)
Houston	34,407	**2,447**	(7.1)	2-Stage cluster (private)	(95.8)	(96.4)	—	(96.2)
Utah	54,605	**54,605**	(100.0)	Census	(96.3)	(97.8)	(99.6)	NReq
Vermont	6,792	**6,792**	(100.0)	Census	(92.8)	(92.6)	—	(90.1)
Virginia	104,826	**4,399**	(4.2)	2-Stage cluster	(93.1)	(98.5)	—	(91.2)
Washington	87,773	**83,082**	(94.7)	Census	(91.7)	(91.9)[¶¶]	—	(90.3)

See footnotes on page 609.

TABLE 1. (*Continued*) Estimated vaccination coverage* among children enrolled in kindergarten, by state/area, type of survey conducted, and selected vaccines — United States, 2012–13 school year

State/Area	Estimated kindergarten population	Total surveyed	Proportion surveyed (%)	Type of survey conducted†	MMR§ (%)	DTaP/DT¶ (%)	Varicella 1 dose (%)	Varicella 2 doses (%)
West Virginia	22,588	**19,549**	(86.5)	Census	(96.3)	(96.3)	—	(96.2)
Wisconsin	72,416	**1,337**	(1.8)	2-Stage cluster	(92.8)	(96.1)	—	(91.1)
Wyoming	8,133	**8,133**	(100.0)	Census (public)	(97.5)	(97.4)***	—	(97.0)
Median†††					*(94.5)*	*(95.1)*		*(93.8)*
American Samoa	NA	**NA**	NA	Not conducted				
Guam	2,835	**1,054**	(37.1)	2-Stage cluster	(89.8)	(91.2)	—	NReq
Marshall Islands	NA	**NA**	NA	Not conducted				
Micronesia	NA	**NA**	NA	Not conducted				
N. Mariana Islands	847	**847**	(100.0)	Census	(54.7)	(92.8)	—	(54.7)
Palau	471	**471**	(100.0)	Census (public)	(76.2)	(84.5)	—	NReq
Puerto Rico**	39,106	**979**	(2.5)	2-Stage cluster	(85.2)	(81.9)	—	(88.7)
U.S. Virgin Islands	1,498	**851**	(56.8)	2-Stage cluster	(92.3)	(78.9)	—	(81.9)

Abbreviations: MMR = measles, mumps, and rubella vaccine; DTaP/DT = diphtheria and tetanus toxoids (DT) and acellular pertussis vaccine; NA = not available; NReq = not required for school entry.

* Estimates are adjusted for nonresponse and weighted for sampling where appropriate, except where complete data were unavailable. Percentages for Delaware, Georgia, and Puerto Rico are approximations. Estimates for South Carolina and Colorado were provided by the awardee. Estimates based on a completed vaccine series (i.e., not antigen-specific) are designated by use of the ≥ symbol.

† Sample designs varied by state/area: census = all schools (public and private) and all children within schools were included in the assessment; simple random = a simple random sample design was used; mixed design = a census was conducted among public schools, and a random sample of children within the schools were selected; 1-stage or 2-stage cluster sample = schools were randomly selected, and all children in the selected schools were assessed (1-stage) or a random sample of children within the schools were selected (2-stage); voluntary response = a census among those schools that sent in assessment data.

§ Most awardees require 2 doses; California, Illinois, New York, and Oregon require 2 doses of measles, 1 dose of mumps, and 1 dose of rubella.

¶ DTaP vaccination coverage might include some DTP (diphtheria and tetanus toxoids and pertussis) or DT vaccinations if administered in another country or vaccination provider continued to use after 2000. Most awardees require 4 doses of DTaP/DT vaccine; 5 doses are required for school entry in Colorado, District of Columbia, Hawaii, Idaho, Iowa, Kansas, Massachusetts, Minnesota, Mississippi, North Carolina, Oregon, Rhode Island, Texas (including Houston), Vermont, Washington, Wyoming, Northern Mariana Islands, and Puerto Rico; 3 doses are required by Nebraska and New York; 4 doses of DT and 2 doses of pertussis vaccine are required by the U.S. Virgin Islands. Pertussis vaccine is not required in Pennsylvania; the estimate for Pennsylvania represents DT only.

** Awardee counts the vaccine doses received regardless of Advisory Committee on Immunization Practices recommended age and time interval; vaccination coverage rates might be higher than those recommended.

†† Vaccination coverage and exemption levels were reported together. Vaccination coverage estimates could not be provided separately for this report.

§§ Does not include nondistrict-specific, virtual, and college laboratory schools, or private schools with less than 10 students.

¶¶ For DT only; coverage for pertussis was 92.4%.

*** Diphtheria coverage was 97.3%; tetanus and pertussis were 97.4%.

††† The median is the center of the estimates in the distribution. The median does not include Alaska, New Hampshire, Houston, Guam, the Commonwealth of the Northern Mariana Islands, Palau, Puerto Rico, and the U.S. Virgin Islands.

kindergarteners with an exemption was <1% for nine awardees and >4% for 11 awardees (range: <0.1% in Mississippi to 6.5% in Oregon), with a median of 1.8% (Figure; Table 2). The largest increases in total exemptions between 2011–12 and 2012–13 were reported by Georgia and West Virginia, each with an increase of 1.0 percentage point; four states reported decreases of >1.0 percentage points (range: -1.3 in Colorado to -1.6 in New Mexico). Where reported separately, the median medical exemption level was 0.3% (range: <0.1% in five states [Arkansas, Minnesota, Mississippi, North Dakota, and Virginia] to 1.6% in Alaska). Where allowed and reported separately, the median nonmedical exemption level was 1.5% (range: 0.2% in New Mexico to 6.4% in Oregon).

Reported by

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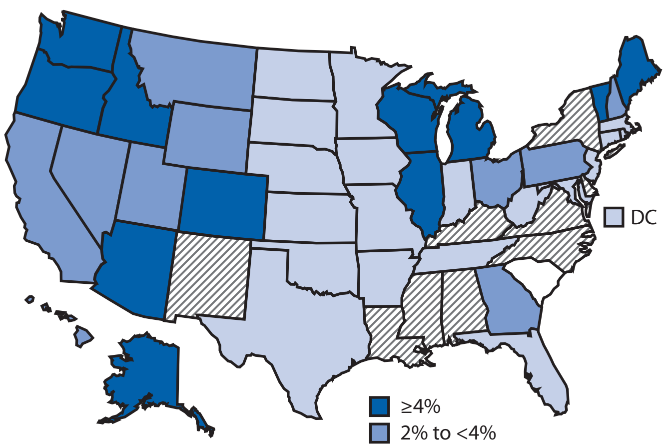
Editorial Note

Kindergarten vaccination coverage for most reporting awardees remained high and exemption levels remained stable for the 2012–13 school year compared with the 2011–12 school year. Although high levels of vaccination coverage at the awardee level is reassuring, vaccine-preventable disease outbreaks can still occur among clusters of unvaccinated persons at local levels in schools and communities (*3,4*). Vaccination exemptions have been shown to cluster geographically (*5,6*). If exemption levels are high in a school or community, the number of unvaccinated kindergarteners might be sufficient to permit transmission of vaccine-preventable diseases, if introduced. Assessing and reporting school vaccination coverage at the local level is critical for state education and health departments to protect

FIGURE. Estimated percentage of children enrolled in kindergarten who have been exempted from receiving one or more vaccines* — United States, 2012–13 school year



* Exemptions might not reflect a child's vaccination status. Children with an exemption who did not receive any vaccines are indistinguishable from those who have an exemption but are up-to-date for one or more vaccines.

kindergarteners and the community from vaccine-preventable diseases. Among the 50 states and DC, a total of 11 awardees reported local-level data online, ensuring that local level data are widely available.[¶] These local-level data can be used by health departments and schools to develop health communication strategies based on the specific vaccine-preventable disease risk at a local school caused by low vaccination coverage or high exemption levels.

An exemption does not necessarily imply a child was not vaccinated. More than 99% of the 2006–2007 birth cohorts who became kindergarteners in 2012–13 received at least one vaccine (*7*). Additionally, in some areas, a parent or guardian may complete the required exemption paperwork if the kindergartener's vaccination history cannot be easily documented at school enrollment (*8,9*). Less stringent exemption standards have been associated with higher numbers of exemptions (*8,9*).

What is already known on this topic?

Vaccine-preventable diseases continue to be transmitted despite high levels of vaccination at the national and state levels. School vaccination assessment can help local health officials determine the risk for vaccine-preventable disease transmission at the local level.

What is added by this report?

For the 2012–13 school year, median vaccination coverage in the 48 states and the District of Columbia continued to be high, with medians of 94.5% for measles, mumps, rubella; 95.1% for diphtheria, tetanus toxoid, and acellular pertussis; and 93.8% for varicella vaccines. The level of exemptions remained low overall, with a median of 1.8%, and four awardees saw decreases of >1 percentage point for children with exemptions in the 2012–13 school year.

What are the implications for public health practice?

High vaccination coverage levels at the national and state levels might mask clustering of unvaccinated children at local levels where vaccine-preventable diseases might be transmitted. Health departments and school systems can use local-level school vaccination assessment data to identify schools with low vaccination coverage and high exemption levels. This local-level evidence can be used to develop local-level health communication campaigns and other strategies to ensure parents understand vaccine-preventable disease risks and vaccination benefits.

School vaccination coverage assessment is a local-level data reporting system required as part of state or local level school vaccination requirements. CDC supports the use of standards to improve the ability to use the school vaccination coverage data to reliably monitor local vaccination coverage, including appropriate sampling methods, data collection by trained staff, and validation. One way to improve the quality of vaccination coverage reporting is to link school vaccination assessment systems to an IIS. In 2011, 45 of 51 awardees allowed schools to obtain data from their IIS, of which 43 awardees reported using the IIS capacity to complete their school vaccination assessment reporting and 20 were able to generate reports for school vaccination coverage (*10*). Allowing school vaccination assessment systems to link to awardee IIS data can help ensure provider-reported vaccinations are reported to the schools, minimizing the reporting burden on busy parents and schools, and might help health and education departments identify local areas with low levels of vaccination coverage.

The findings in this report are subject to at least two limitations. First, these data are cross-sectional, collected at a single point in the school year. Vaccination and exemption status reflected the child's status at the time of assessment. Some children might have been in the process of receiving required vaccines and final vaccination or exemption status might have changed after the survey was completed. Reports might or

¶ Information available, by state, at the following websites: Arizona, http://www.azdhs.gov/phs/immunization/statistics-reports.htm; California, http://www.cdph.ca.gov/programs/immunize/pages/immunizationlevels.aspx; Florida, http://www.doh.state.fl.us/disease_ctrl/immune/resources/surveys/state-surveys.html; Illinois, http://www.isbe.state.il.us/research/htmls/immunization.htm#immu; Iowa, http://www.idph.state.ia.us/immtb/immunization.aspx?prog=imm&pg=auditsl; Kansas, http://www.kdheks.gov/immunize/kindergarten_coverage.htm; New Jersey, http://www.state.nj.us/health/cd/imm_status_report_2012.shtml; Texas, http://www.dshs.state.tx.us/immunize/coverage/schools.shtm; Utah, http://health.utah.gov/immu/statistics/utah%20statistics/immunization%20coverage%20levels/index.html; Vermont, http://healthvermont.gov/hc/imm/ImmSurv.aspx; Washington, http://www.doh.wa.gov/dataandstatisticalreports/schoolimmunization/datareports.aspx.

TABLE 2. Weighted number and percentage* of children enrolled in kindergarten with a reported exemption to vaccination, by state/area and type of exemption — United States, 2012–13 school year

	Medical exemptions[†]		Nonmedical exemptions[†]				Total exemptions[†]			
State/Area	No.	(%)	Religious no.	Philosophic no.	Total no.	(%)	Total no.	2012–13 (%)	2011–12 (%)	Percentage point difference
Alabama	64	(0.1)	414	—[§]	**414**	(0.6)	**501**	(0.7)	(0.6)	0.1
Alaska	162	(1.6)	415	—[§]	**415**	(4.0)	**564**	(5.6)	(7.0)	-1.4
Arizona	315	(0.3)	—[¶]	—[¶]	**3,475**	(3.9)	**3,790**	(4.2)	(3.7)	0.5
Arkansas	17	(0.0)	99	342	**441**	(1.0)	**458**	(1.1)	(0.9)	0.2
California	923	(0.2)	—[**]	14,921	**14,921**	(2.8)	**15,845**	(3.0)	(2.6)	0.4
Colorado	191	(0.3)	0	2,678	**2,678**	(4.0)	**2,869**	(4.3)	(5.6)	-1.3
Connecticut	124	(0.3)	601	—[§]	**601**	(1.4)	**725**	(1.7)	(1.3)	0.4
Delaware	2	(0.2)	5	—[§]	**5**	(0.5)	**7**	(0.7)	(0.6)	0.1
District of Columbia	101	(1.3)	27	—[§]	**27**	(0.3)	**128**	(1.6)	(2.1)	-0.5
Florida	905	(0.4)	3,281	—[§]	**3,281**	(1.4)	**4,186**	(1.8)	(1.5)	0.3
Georgia	4	(0.1)	73	—[§]	**73**	(2.2)	**77**	(2.3)	(1.3)	1.0
Hawaii[††]	17	(0.3)	138	—[§]	**138**	(2.2)	**156**	(2.5)	(3.9)	-1.4
Idaho	90	(0.4)	171	1,138	**1,309**	(5.5)	**1,399**	(5.9)	(5.4)	0.5
Illinois	2,017	(1.2)	8,082	—[§]	**8,082**	(4.8)	**10,099**	(6.1)	(5.5)	0.6
Indiana	326	(0.4)	804	—[§]	**804**	(0.9)	**1,129**	(1.3)	(1.2)	0.1
Iowa	188	(0.5)	500	—[§]	**500**	(1.2)	**688**	(1.7)	(1.5)	0.2
Kansas	118	(0.3)	363	—[§]	**363**	(0.9)	**436**	(1.1)	(1.3)	-0.2
Kentucky	128	(0.2)	286	—[§]	**286**	(0.5)	**414**	(0.7)	(0.6)	0.1
Louisiana	109	(0.2)	27	322	**349**	(0.5)	**458**	(0.7)	(0.8)	-0.1
Maine	61	(0.4)	17	541	**559**	(3.9)	**620**	(4.3)	(3.9)	0.4
Maryland	237	(0.3)	494	—[§]	**494**	(0.7)	**731**	(1.0)	(0.9)	0.1
Massachusetts	373	(0.5)	843	—[§]	**843**	(1.1)	**1,216**	(1.5)	(1.4)	0.1
Michigan	699	(0.6)	1,086	5,540	**6,626**	(5.3)	**7,325**	(5.9)	(5.5)	0.4
Minnesota	32	(0.0)	—[¶]	—[¶]	**1,149**	(1.6)	**1,181**	(1.6)	(1.6)	0.0
Mississippi	23	(0.0)	—[**]	—[§]			**23**	(0.0)	(0.0)	0.0
Missouri	377	(0.3)	1,665	—[§]	**1,665**	(1.5)	**2,042**	(1.8)	(2.4)	-0.6
Montana	49	(0.4)	380	—[§]	**380**	(3.0)	**439**	(3.5)	(3.0)	0.5
Nebraska	149	(0.6)	269	—[§]	**269**	(1.1)	**418**	(1.7)	(1.5)	0.2
Nevada	85	(0.7)	224	—[§]	**224**	(1.8)	**309**	(2.5)	(1.8)	0.7
New Hampshire	30	(0.2)	298	—[§]	**298**	(2.3)	**328**	(2.5)	(2.2)	0.3
New Jersey	261	(0.2)	1,458	—[§]	**1,458**	(1.2)	**1,719**	(1.4)	(1.3)	0.1
New Mexico	20	(0.2)	27	—[§]	**27**	(0.2)	**47**	(0.4)	(2.0)	-1.6
New York[††]	331	(0.1)	1,335	—[§]	**1,335**	(0.6)	**1,666**	(0.7)	(0.7)	0.0
North Carolina[††]	162	(0.1)	871	—[§]	**871**	(0.7)	**1,032**	(0.8)	(0.8)	0.0
North Dakota	0	(0.0)	6	123	**130**	(1.8)	**130**	(1.8)	(1.0)	0.8
Ohio	650	(0.4)	—[¶]	—[¶]	**2,665**	(1.6)	**3,315**	(2.0)	(1.5)	0.5
Oklahoma	66	(0.1)	179	493	**672**	(1.2)	**738**	(1.3)	(1.1)	0.2
Oregon	72	(0.2)	3,010	—[§]	**3,010**	(6.4)	**3,010**	(6.4)	(5.9)	0.5
Pennsylvania	643	(0.4)	—[¶]	—[¶]	**2,339**	(1.5)	**2,982**	(2.0)	(1.8)	0.2
Rhode Island	45	(0.4)	94	—[§]	**94**	(0.8)	**139**	(1.1)	(1.0)	0.1
South Carolina	NA				**NA**		**NA**		(1.1)	
South Dakota	41	(0.3)	182	—[§]	**182**	(1.5)	**223**	(1.8)	(1.2)	0.6
Tennessee	162	(0.2)	905	—[§]	**905**	(1.1)	**1,066**	(1.2)	(0.7)	0.5
Texas	2,112	(0.5)	—[¶]	—[¶]	**4,936**	(1.2)	**7,048**	(1.7)	(1.5)	0.2
Houston	NA		NA	NA	**NA**		**22**	(0.9)	(0.1)	0.8
Utah	83	(0.2)	6	2,010	**2,016**	(3.7)	**2,099**	(3.8)	(3.8)	0.0
Vermont	30	(0.4)	14	371	**385**	(5.7)	**415**	(6.1)	(5.7)	0.4
Virginia	48	(0.0)	427	—[§]	**427**	(0.4)	**474**	(0.5)	(1.0)	-0.5
Washington[††]	1,092	(1.2)	274	2,774	**3,048**	(3.5)	**4,077**	(4.6)	(4.7)	-0.1
West Virginia	262	(1.2)	—[**]	—[§]			**262**	(1.2)	(0.2)	1.0
Wisconsin	472	(0.5)	276	3,631	**3,907**	(4.0)	**4,380**	(4.5)	(4.5)	0.0
Wyoming	28	(0.3)	155	—[§]	**155**	(1.9)	**183**	(2.3)	NA	NA

See footnotes on page 612.

might not be updated as a child obtained the required vaccines or claimed an exemption later in the school year. Vaccination and exemption status might not have been reported for every child. Second, data collection and methodology varied by awardee and even by school year for the same awardee. Methods and times for data collection differed, as did requirements for vaccinations and exemptions.

School vaccination assessments provide valuable information for state and local immunization programs about vaccination coverage, exemptions, and clustering of unvaccinated kindergarteners in schools, where the potential for disease transmission is higher. Data at the state level alone can mask areas of undervaccination. Health departments can access and use local school vaccination assessment data to target areas

TABLE 2. (*Continued*) Weighted number and percentage* of children enrolled in kindergarten with a reported exemption to vaccination, by state/area and type of exemption — United States, 2012–13 school year

	Medical exemptions†		Nonmedical exemptions†				Total exemptions†			
State/Area	No.	(%)	Religious no.	Philosophic no.	Total no.	(%)	Total no.	2012–13 (%)	2011–12 (%)	Percentage point difference
Median§§		*(0.3)*				*(1.5)*		*(1.8)*	*(1.5)*	*0.3*
American Samoa	NA				**NA**		**NA**			
Guam	0	(0.0)	0	—§	**0**	(0.0)	**0**	(0.0)	(0.0)	0.0
Marshall Islands	NA				**NA**		**NA**			
Micronesia	NA				**NA**		**NA**			
N. Mariana Islands	1	(0.1)	0	—§	**0**	(0.0)	**1**	(0.1)	(0.0)	0.1
Palau	3	(0.6)	0	0	**0**	(0.0)	**3**	(0.6)	(1.3)	-0.7
Puerto Rico	0	(0.0)	0	—§	**0**	(0.0)	**0**	(0.0)	(0.0)	0.0
U.S. Virgin Islands	0	(0.0)	7	—§	**7**	(0.6)	**7**	(0.6)	(0.5)	0.1

Abbreviation: NA = not available (i.e., not tracked or not reported to CDC).

* Estimates are adjusted for nonresponse and weighted for sampling where appropriate, except where complete data were unavailable. Percentages for Delaware, Georgia, and Puerto Rico are approximations. Estimates for South Carolina and Colorado were provided by the awardee. Arkansas and Kansas conduct a census of exemptions.

† Medical and nonmedical exemptions might not be mutually exclusive. Some children might have both medical and nonmedical exemptions. Total exemptions are the number of children with an exemption. Temporary exemptions are included in the total for Alabama, Hawaii, New York, North Carolina, South Carolina, and Washington.

§ Exemptions because of philosophic reasons are not allowed.

¶ Religious and philosophic exemptions are not reported separately.

** Exemptions because of religious reasons are not allowed.

†† Includes both temporary and permanent medical exemptions.

§§ The median is the center of the estimates in the distribution. The median does not include South Carolina, Houston, Guam, the Commonwealth of the Northern Mariana Islands, Palau, Puerto Rico, and the U.S. Virgin Islands.

for vaccination interventions during outbreaks of vaccine-preventable disease. This information also can be used by health departments and schools to develop evidence-based health communication strategies and other interventions that protect kindergarteners and the community against vaccine-preventable diseases.

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Notes from the Field

Use of Electronic Messaging and the News Media to Increase Case Finding During a *Cyclospora* Outbreak — Iowa, July 2013

On Friday, June 28, 2013, the Iowa Department of Public Health (IDPH) routinely reported two cases of cyclosporiasis in its weekly electronic newsletter, the *EPI Update.* The newsletter's primary audience consists of Iowa's public health officials and health-care providers, but readers also include members of the news media.

By Wednesday, July 3, an additional four cases had been reported to IDPH, indicating that an outbreak could be occurring (before 2013, only 10 cases had been reported in Iowa). In response, IDPH released a special *EPI Update Alert* and a Health Alert Network alert to all hospitals, emergency departments, infection preventionists, public health agencies, and other health-care providers in Iowa. Both electronic alerts included information on symptoms of cyclosporiasis, and diagnosis and treatment guidelines. By July 4, when a CDC Epidemic Information Exchange alert was issued, most major media outlets in Iowa had reported on the outbreak. An e-mail press release with updated information was issued on July 8 to nearly 400 members of the news media, and the first round of 14 messages was sent to 5,282 Twitter followers. By July 9, daily updates, including case counts, were being requested by the media and posted on the IDPH website. Over the next several weeks, as health-care providers and the public became aware of the outbreak, many Iowans were tested and given diagnoses of cyclosporiasis.

Cyclospora, a coccidian parasite, can cause prolonged and relapsing watery diarrhea, which, if untreated, can last several weeks to months (*1*). This long duration of diarrhea is unusual among foodborne pathogens and allows time for patients to seek medical attention and have their illness diagnosed (*1,3*). Testing for *Cyclospora* is not routinely done in most U.S. laboratories, even when stool specimens are tested for parasites; health-care providers must specifically request testing for *Cyclospora* when indicated. The preferred treatment for cyclosporiasis is trimethoprim-sulfamethoxazole; to date, no reliably effective alternative treatments have been identified (*1,3*). *Cyclospora* is not spread from person to person because excreted oocysts require several days to weeks outside the host to become infectious. Previous outbreaks in the United States have been associated with fruits (i.e., raspberries [*2*]) and raw vegetables (i.e., mesclun lettuce, basil, and snow peas [*3*]).

As of July 26, nearly all of Iowa's 135 reported cases of cyclosporiasis had been diagnosed by testing at the state's public health laboratory, the State Hygienic Laboratory (SHL) (Figure). The two initial cases, reported in the June 28 issue of *EPI Update*, were diagnosed by a laboratorian at SHL who identified possible *Cyclospora* oocysts on microscopic examination of fresh stool and confirmed this diagnosis using a modified acid-fast stain technique. In June at SHL, before electronic messaging was used and media attention was attracted, 271 stool tests for ova and parasites were requested but none specifically for *Cyclospora*. In contrast, during the first 23 days of July, requests for general ova and parasite stool tests had increased to 762, and specific *Cyclospora* testing was requested on 1,460 specimens.

In addition to case ascertainment, increased attention by the news media and health department notifications led to improved diagnosis and treatment. For example, one patient with severe vomiting and diarrhea was discharged without a diagnosis after a 5-day hospital stay and extensive laboratory testing, only to relapse days later. After reading the *EPI Update Alert,* the patient's health-care provider ordered *Cyclospora* testing on the patient, and the result was positive. The patient was treated with trimethoprim-sulfamethoxazole, and the symptoms resolved.

The use of electronic messaging and media attention in the early stages of this outbreak investigation provided public health agencies a unique opportunity to increase testing for this uncommon disease, which might not otherwise have been considered by health-care providers or their patients. After diagnosis and case reporting, patients provided IDPH with valuable information on their potential exposures to *Cyclospora*, increasing the power of statistical analyses and the likelihood of finding the source of the infection. The *Cyclospora* outbreak investigation is ongoing.

Reported by

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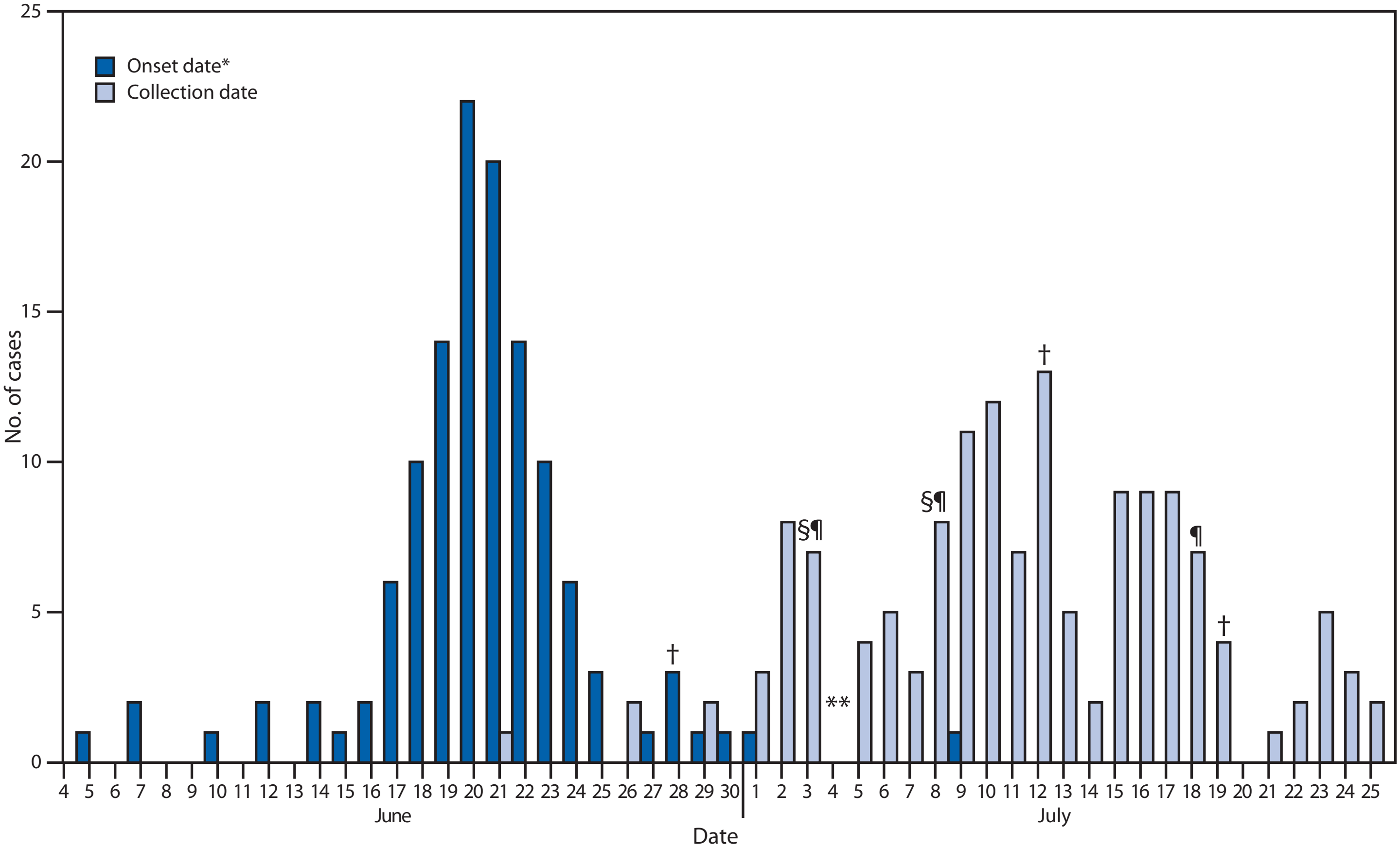
FIGURE. Number of confirmed cases of cyclosporiasis (N = 135), by dates of symptom onset and collection of laboratory specimen, and dates of electronic health alerts — Iowa, June 4–July 25, 2013

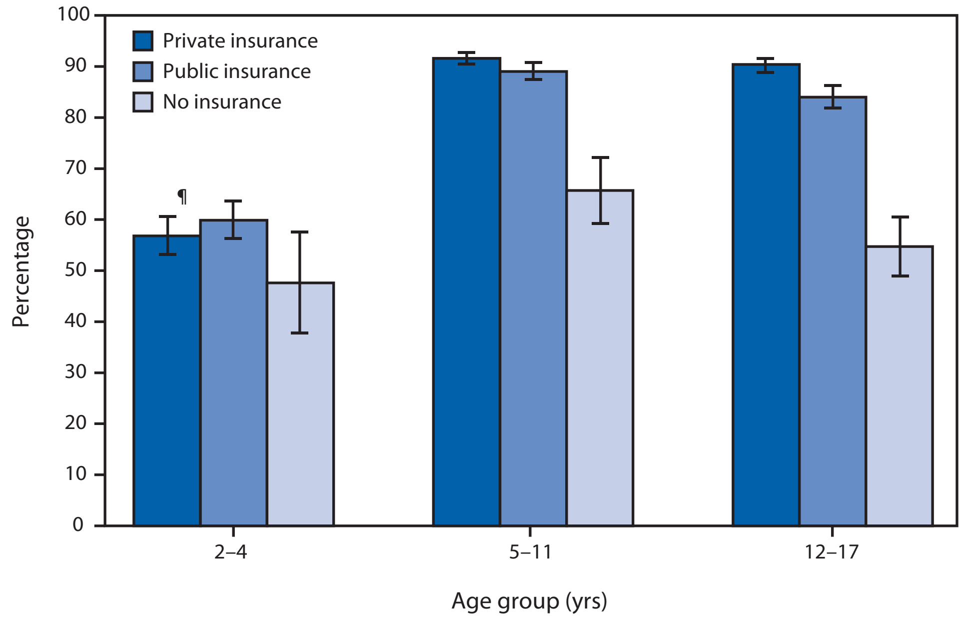


* Illness onset date was not available for 11 confirmed cases.
† Iowa *EPI Update*.
§ Iowa *EPI Update Alert*.
¶ Iowa Health Alert Network alert.
** CDC Epidemic Information Exchange alert.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Children Aged 2–17 Years With a Dental Visit in the Past Year,* by Age Group and Health Insurance Status† — National Health Interview Survey,§ United States, 2011



* Children were identified as having a dental visit in the past year by asking parents, "About how long has it been since your child last saw a dentist?" Parents were directed to include all types of dentists, including orthodontists, oral surgeons, and all other dental specialists, as well as dental hygienists.

† Children with health insurance might or might not have dental coverage. Children with both public and private insurance coverage are placed in the private insurance category. Public health insurance for children consists mostly of Medicaid, but also includes Medicare, the Children's Health Insurance Programs, and Tricare.

§ Estimates were based on household interviews of a sample of the noninstitutionalized, civilian U.S. population and are derived from the National Health Interview Survey sample child component.

¶ 95% confidence interval.

In 2011, the percentage of children aged 5–11 years and aged 12–17 years who had a dental visit in the past year was higher for children from families with private or public health insurance compared with children from families with no health insurance. For children aged 5–11 years, 92% with private insurance, 89% with public insurance, and 66% with no health insurance had a dental visit in the past year. The percentages were similar for children aged 12–17 years: 90% for those with private insurance, 84% for those with public insurance, and 55% for those without insurance. Fewer than two thirds of children aged 2–4 years had a dental visit in the past year, regardless of insurance status.

Source: Federal Interagency Forum on Child and Family Statistics. America's children: key national indicators of well-being, 2013. Washington, DC: US Government Printing Office; 2013. Available at http://childstats.gov.

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