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School-Associated Student Homicides — United States, 1992–2006

School-associated student homicide events, especially those involving multiple victims, generate considerable media attention, prompting questions regarding whether rates of school-associated violent deaths are increasing and regarding the characteristics of such events. During the 1990s, the rate of school-associated single-victim student homicides decreased significantly, whereas rates for school-associated homicides in which two or more students were killed (i.e., multiple-victim homicides) increased (1). Additional studies of such events during the same decade documented the rarity of lethal school-associated violence (2,3). To 1) update temporal trends in rates for school-associated student homicides during July 1992–June 2006 and 2) describe the epidemiologic characteristics of school-associated student homicides that occurred during July 1999–June 2006 (the period for which the most recent data are available), CDC analyzed data from the School-Associated Violent Death (SAVD) study.* This report describes the results of that analysis, which indicated that rates of school-associated student homicides decreased during the overall period, July 1992–June 2006, but stabilized during July 1999–June 2006, when 116 students were killed in 109 school-associated homicide events. Although school-associated student homicides are rare and represent approximately 1% of homicides that occur among school-age youths, schools should expand use of comprehensive measures to prevent behaviors that often precede fatal violence. In addition, comprehensive approaches that address risk factors and protective risk factors for violence at the individual, family, school, and community levels will help address violence both on and off school grounds.

The SAVD study is conducted by CDC in collaboration with the U.S. Department of Education and the U.S.

Department of Justice. The cases of school-associated homicide described in this report involved the homicide of a student in which the fatal injury occurred 1) on the campus of a functioning public or private elementary or secondary school in the United States, 2) while the victim was on the way to or from regular sessions at such a school, or 3) while the victim was attending or traveling to or from an official school-sponsored event. Cases involved the death of at least one student but might have included the deaths of nonstudents (e.g., faculty, school staff, family members, or community residents). Cases were identified through a systematic search of two computerized newspaper and broadcast media databases (i.e., Lexis-Nexis and Dialog) (2,3). To confirm the facts of each event, a brief interview was conducted with at least one law-enforcement officer or school official familiar with the event.

Rates were calculated to estimate the risk for student school-associated homicide. Denominators for rate estimates were obtained from the U.S. Department of Education[†] and the U.S. Current Population Survey,[§] which provide national school-enrollment data. Mortality data from the National Center for Health Statistics (NCHS) for the

[†] Common Core of Data, Private School Universe Survey, available at <http://nces.ed.gov/ccd>.

[§] Available at <http://www.census.gov/cps>.

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* Additional information available at <http://www.cdc.gov/ncipc/sch-shooting.htm>.

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period July 1999–June 2004[‡] were used as the denominator to estimate the proportion of homicides among all school-age children (i.e., aged 5–18 years) that were school associated. Trends in school-associated homicide rates for two periods, July 1992–June 2006 and July 1999–June 2006, were assessed using Poisson regression models, with a systematic component incorporating year as a linear term.

During July 1999–June 2006, a total of 116 school-associated homicides occurred among students (an average annual homicide rate of 0.03 per 100,000 students) and were associated with 109 events (Table); approximately 78% of these deaths occurred on a school campus. Eight of the 109 events included more than one death. Most homicides included gunshot wounds (65%), stabbing or cutting (27%), and beatings (12%). Calculations using NCHS mortality data for July 1999–June 2004 indicated that the proportion of homicides among school-age children that were school associated was 0.96% (i.e., 79 of 8,236 total homicides).

The mean and median age of decedents was 15 years (range: 6–18 years). Male students, students in senior high schools (or schools that combined high-school grades with lower grades), students attending schools in central cities, and public-school students accounted for the largest proportions of victims. However, rates did not differ significantly in rural areas compared with urban fringe/large town** areas or in public schools compared with private schools.

Overall and single-victim school-associated student homicide rates decreased significantly during July 1992–June 2006; both decreased from 0.07 per 100,000 students to 0.03 per 100,000 students ($p < 0.001$ and $p = 0.004$ by chi-square test, respectively). However, rates for overall and single-victim school-associated homicides during a more recent period, July 1999–June 2006, did not change significantly (Figure). During both periods (July 1992–June 2006 and July 1999–June 2006), multiple-victim student homicide rates remained stable.

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[‡] During the period in which this study was conducted, NCHS mortality data for July 2004–June 2006 were not available for use. Therefore, calculations were based on homicides that occurred during July 1, 1999–June 30, 2004.

** A composite category including 1) territories within a consolidated metropolitan statistical area (CMSA) or metropolitan statistical area (MSA) of a large or midsize city defined as urban by the U.S. Census Bureau and 2) incorporated places or U.S. census–designated places with a population $\geq 25,000$ and located outside a CMSA or an MSA.

TABLE. Total, single-, and multiple-student school-associated homicide rates* among students aged 5–18 years, by sex and selected school characteristics — United States, July 1999–June 2006

Characteristic	Total				Single victim				Multiple victims			
	No. of deaths	Rate	Rate ratio	(95% CI) [†]	No. of deaths	Rate	Rate ratio	(95% CI)	No. of deaths	Rate	Rate ratio	(95% CI)
All students	116[§]	0.03	—	—	101	0.03	—	—	15	<0.01	—	—
Sex												
Female	23	0.01	1.00	—	17	0.01	1.00	—	6	<0.01	1.00	—
Male	93	0.05	4.39	(2.78–6.93)	84	0.04	5.37	(3.19–9.04)	9	<0.01	1.63	(0.58–4.58)
School level/grade												
Elementary/middle	25	<0.01	1.00	—	22	<0.01	1.00	—	3	<0.01	1.00	—
Secondary	90	0.08	18.47	(11.86–28.73)	78	0.07	18.19	(11.34–29.20)	12	0.01	20.53	(5.79–72.74)
NCES school locale[¶]												
Central city	50	0.06	3.47	(1.80–6.66)	45	0.05	3.81	(1.86–7.80)	5	0.01	1.91	(0.37–9.82)
Urban fringe/large town	17	0.02	0.86	(0.40–1.84)	15	0.01	0.93	(0.41–2.12)	2	<0.01	0.56	(0.08–3.95)
Rural small town	11	0.02	1.00	—	9	0.01	1.00	—	2	<0.01	1.00	—
School type												
Private	5	0.01	1.00	—	5	0.01	1.00	—	0	<0.01	—	—
Public	110	0.02	1.22	(0.50–2.99)	95	0.01	1.05	(0.43–2.59)	15	<0.01	—	—

* Per 100,000 students.

[†] Confidence interval.[§] Associated with 109 events.[¶] National Center for Education Statistics. Includes only data from 1999 to 2004 because information on the number of students enrolled in private schools in various locales during 2004–2006 is not available.

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Editorial Note: Homicide is the second leading cause of death among youths aged 5–18 years in the United States (4). The finding that <1% of all homicides in this population during July 1999–June 2004 were school associated is consistent with estimates from previous studies (1,2) and indicates that the risk for student-associated homicides in schools is very low.

Overall rates of school-associated student homicide during July 1999–June 2006 are lower than those reported when the SAVD study was first conducted (July 1992–July 1994). Data for 1999–2006 have patterns that are similar to those documented previously, with substantially

higher homicide rates among male students and students in urban areas, and homicides involving single victims occurring more frequently than those with multiple victims (1). SAVD data continue to indicate that individual violent events involving numerous homicides, such as the 1999 event that involved 15 deaths at Columbine High School in Colorado, are rare. Most school-associated student homicides continue to involve a single victim and a single offender.

The findings in this report are subject to at least three limitations. First, cases were identified through news media reports. Therefore, cases not reported in the media were not included, and changes over time in media coverage of school-associated violence might have affected the trends identified in the study. For example, events involving fewer victims might have been less likely to appear in media reports and might have been excluded. Second, because only cases involving students at public or private U.S. schools were included, changes in overall schooling patterns (e.g., greater use of home schooling or cooperative teaching arrangements) might have resulted in certain student deaths not being included. Finally, the lack of NCHS data for 2004–2006 precluded the use of numerator data for these study years when calculating the proportion of homicides among school-age children that were school associated.

Because each incident of school violence is different, lethal school violence cannot be eliminated using a single approach. However, research on school-associated violent deaths has described patterns in the timing of violent events

FIGURE. Total, single-, and multiple-student school-associated homicide rates* among students aged 5–18 years, by school years — United States, July 1992–June 2006

* Per 100,000 students.

and the characteristics of incidents and behaviors that precede violence (e.g., bullying experiences, suicidal ideation, and a high prevalence of threats and warning signs) that could be targets for prevention measures (1,5–7).

Most lethal youth violence does not occur in schools, and most acts of youth violence do not lead to death. Therefore, youth violence prevention measures should focus on a range of aggressive behaviors by addressing risk factors at individual, family, and community levels and in a range of locales. Such strategies should be guided by reviews of empirically validated prevention programs and guidelines for promoting school safety, reducing risk for youth violence and suicide, and comprehensive crisis planning (8–10). The National Youth Violence Prevention Resource Center provides information about youth violence prevention for students, parents, researchers, and others (available at <http://www.safeyouth.org>).

Partnerships between researchers and community agencies can help promote use of evidence-based prevention strategies. CDC funds eight to 10 National Academic Centers of Excellence (ACE) on Youth Violence Prevention. ACEs involve collaboration among community members and educational, justice, and social work partners to develop action plans, partnerships, and priorities to prevent youth violence in local communities. For example, the Johns Hopkins Bloomberg School of Public Health Center for the Prevention of Youth Violence has developed a comprehensive program to reduce youth violence. Projects include evaluating community-based violence interventions and schoolwide systems for enhancing positive behaviors, collaborations to improve home-visiting programs for families with young children, research on alternative strategies for supporting parents and family members, community programs for youths involved in the juvenile justice system, and collaborations to increase youth development programs and youth-driven solutions to problems. Such partnerships among students, parents, schools, law enforcement, research institutions, and community mental health and social service agencies can improve understanding of local needs and selection and implementation of prevention strategies.

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Update: Potential Exposures to Attenuated Vaccine Strain *Brucella abortus* RB51 During a Laboratory Proficiency Test — United States and Canada, 2007

In November 2007, New York State Department of Health (NYSDOH) officials notified CDC of potential exposures to attenuated vaccine strain *Brucella abortus* RB51 (RB51) in multiple clinical laboratories that participated in a Laboratory Preparedness Survey (LPS) proficiency test (1). NYSDOH conducted a survey of participating laboratories and identified 17 laboratories that reported handling the RB51 sample in a manner placing lab workers at potential risk for exposure. Subsequently, CDC recommended that public health officials conduct a review of biosafety practices at all LPS-participating laboratories to identify any additional RB51 exposures. This report summarizes the results of investigations in 36 states, two cities, one county, and the District of Columbia. As of January 14, 2008, follow-up by public health officials with LPS-participating laboratories throughout the United States identified a total of 916 laboratory workers in 254 laboratories with potential RB51 exposure. The results highlight the need for routine adherence to recommended biosafety practices when working with infectious organisms, particularly during widespread infectious-disease events, including bioterrorism attacks.

LPS is a voluntary proficiency-testing survey developed in partnership with the College of American Pathologists, the Association of Public Health Laboratories, and CDC. The survey is designed to simulate a scenario in which presence of a bioterrorism agent is suspected in a clinical

laboratory and to exercise Laboratory Response Network (LRN) sentinel laboratory protocols* for “rule-out” or “referral” of potential bioterrorism agents. RB51 is an attenuated vaccine strain of *B. abortus* used to vaccinate cattle against brucellosis; human illness is known to have resulted from RB51 vaccine-related exposures (2). During October–November 2007, an LPS kit containing simulated or modified strains (i.e., attenuated) of pathogens identified as potential bioterrorism agents, including RB51 for the first time, was distributed to 1,316 laboratories throughout the United States and Canada. The LPS kit included written instructions stating that all samples should be handled inside a Class II biological safety cabinet (BSC) with biosafety level 3 (BSL-3) primary barriers and safety equipment. The extent of identification and degree of manipulation of the LPS samples within each laboratory was determined by the laboratory’s analytic capabilities. Basic laboratory procedures performed included preparing specimens for culture by reconstitution and inoculation onto appropriate media, preparing and performing a Gram stain, and possibly performing biochemical spot/slide tests (e.g., oxidase, indole, or catalase).

On November 27, 2007, CDC was notified by NYSDOH officials of potential RB51 exposures during the LPS exercise. The exposures reported initially occurred after an RB51 specimen was mislabeled as a routine patient specimen and submitted by an LPS-participating laboratory to the New York state bacteriology laboratory. As a result, routine benchtop procedures were used by NYSDOH laboratory personnel to handle the isolate, resulting in 24 laboratorians with potential exposure to RB51. Further investigation by NYSDOH determined that 16 LPS-participating laboratories in the state had not handled the RB51 samples properly, despite correct labeling of the samples. CDC then recommended that all state health departments review biosafety practices used by LPS-participating laboratories in their states while working with the RB51 sample to identify any additional persons who were potentially exposed. Canadian health officials also were notified of the event because Canadian laboratories participated in LPS. To facilitate this review, CDC provided a set of questions identifying the types of manipulations and

widespread aerosol-generating procedures that might result in exposure.

Risk-assessment definitions were developed by CDC, categorizing the level of exposure risk (e.g., high, low, or none) based on the specific laboratory practices performed and the proximity of workers to any manipulations or aerosol-generating procedures. RB51 exposure was deemed to have occurred if the specimen was handled in a manner other than the established recommended practice (i.e., working inside a Class II BSC using BSL-3 primary barriers and safety equipment) (3,4). Persons with high-risk exposure were defined as those who either 1) performed a potentially high-exposure practice (e.g., sniffing bacteriologic cultures), 2) were within 5 feet of any manipulation of RB51 on an open bench, or 3) were present in the laboratory during a widespread aerosol-generating event (e.g., vortexing) involving RB51. Persons with low-risk exposure were defined as those present in the laboratory when a high-risk exposure occurred. Postexposure prophylaxis (PEP) was recommended only for persons identified as having high-risk exposures but also was offered to those categorized as having low-risk exposures.

To assess the magnitude of this event at the national level, on December 11, CDC requested information from state health departments regarding the number of LPS-participating laboratories in which exposures occurred, the number of persons categorized with high- and low-risk exposures, and the number of persons recommended to receive PEP. States also were asked whether any illnesses that occurred in potentially exposed persons were consistent with brucellosis symptoms.

Voluntary reports from 36 states, two cities, one county, and the District of Columbia identified 254 laboratories that had handled the RB51 specimen under conditions that resulted in potential exposures. These areas reported 916 laboratory workers with exposure to RB51, including 679 (74%) with high-risk exposures and 237 (26%) with low-risk exposures. Data regarding the percentage of persons who received PEP were not available. As of January 14, no cases of brucellosis related to these exposures had been reported to CDC.

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Editorial Note: Laboratory-proficiency testing is an accepted assessment tool, not unique to bioterrorism preparedness, designed to measure performance and improve the diagnostic and biosafety expertise of participating laboratories. Proficiency-testing samples containing nonattenuated

*LRN, established in 1999, is a network of international, national, reference, and sentinel laboratories that are equipped to respond rapidly to acts of terrorism (biologic or chemical), emerging infectious diseases, and other public health emergencies. Sentinel laboratories (e.g., private clinical or hospital based), using American Society of Microbiology protocols, perform presumptive identification of possible biologic terrorism agents and submit isolates to reference laboratories for confirmatory testing. Additional information is available at <http://www.bt.cdc.gov/lrn>.

pathogenic agents such as *Mycobacterium tuberculosis* and other organisms requiring biosafety precautions are sent routinely from the College of American Pathologists to approximately 1,000 laboratories. In 2006, LPS was revised to include attenuated organisms such as RB51 that more closely mimic those on the CDC list of category A, B, or C bioterrorism agents[†] after participating LRN sentinel laboratories indicated a need for a more realistic exercise. Because some of the attenuated vaccine strains can cause infection if not handled appropriately, the LPS kit shipped to participating laboratories included written instructions stating that all samples should be handled inside a Class II BSC with BSL-3 primary barriers and safety equipment. All participating laboratories confirmed that they had a functioning Class II BSC.

Clinical laboratories routinely encounter hazardous organisms (e.g., *Neisseria meningitidis* or *Mycobacterium tuberculosis*) that require biosafety precautions. Brucellosis is the most commonly reported laboratory-acquired bacterial infection, is easily aerosolized, and has the potential to cause acute and chronic illness (2,5–7). Human illness associated with the vaccine strain RB51 has been documented from inadvertent needle sticks or inoculation of conjunctiva or open wounds with RB51 (2,7). Definitions for laboratory exposure risk to *Brucella* spp. and recommendations for PEP have been developed by CDC[§] and were applied to the laboratory-acquired brucellosis cases that occurred in Indiana and Minnesota in 2006 (8).

The numerous exposures identified during this LPS highlights the importance of adhering to biosafety practices when handling samples during proficiency testing and when handling specimens routinely entering clinical laboratories for identification. Biosafety practices minimize the risk for exposure; however inadvertent exposures still can occur when infectious agents enter the laboratory. All clinical laboratories that handle and test unknown specimens should establish and adhere to written diagnostic test protocols (e.g., American Society of Microbiology guidelines for avian influenza or sentinel laboratory guidelines to rule out suspected agents of bioterrorism[¶]). These protocols should be

incorporated directly into routine bench procedures and should indicate laboratory findings that signal the need for increased biosafety precautions (9).

One lesson from this event is the potential vulnerability of laboratorians during large-scale events (e.g., bioterror or widespread illness) involving highly lethal infectious agents, even when the agent is recognized. During such events, additional recommendations for higher-level biosafety practices might be needed. When such events occur, exposures to highly lethal agents can be minimized by rapid communication among laboratories and by rapid implementation of situation-specific recommendations (10).

Because CDC category A, B, or C bioterrorism agents are not often associated with naturally occurring disease, laboratory professionals might be less familiar with these agents than more commonly identified organisms. Laboratory readiness should include annual review of biosafety protocols with particular attention to training laboratorians in the characteristics of particular agents and the biosafety practices recommended for their handling and testing. For example, in routine practice, observance of small, gram-negative coccobacilli on Gram stain should alert laboratorians to the potential presence of *Brucella* spp. or *Francisella tularensis*, especially when a patient has symptoms compatible with illness caused by those organisms. Clinicians should alert laboratory personnel when specimens are submitted from patients with clinical findings suggestive of infectious agents that pose a threat to laboratorians during handling.

Exercises such as LPS designed to test skills and procedures in laboratories are an important part of overall preparedness. LPS is one of the few exercises specifically designed to test laboratory response to bioterrorism agents. CDC is continuing to review the event described in this report to further understand the factors that led to the variances in biosafety practices during this laboratory proficiency test. This review will provide additional insights that should improve proficiency-testing programs and biosafety training.

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[†] The CDC list of category A, B, or C bioterrorism agents includes organisms considered to be priority agents because they can be easily disseminated or transmitted person-to-person, can cause high rates of morbidity or mortality with the potential for major public health effects, can cause public panic and social disruptions, and require special action for public health preparedness. Four species of *Brucella*, including *B. abortus*, are listed as category B bioterrorism agents. Additional information is available at <http://www.bt.cdc.gov/agent/agentlist-category.asp>.

[§] Available at http://www.cdc.gov/ncidod/dbmd/diseaseinfo/brucellosis_g.htm#recommendations.

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in the two microbiologists were caused by two unrelated isolates. Because *Brucella* spp. pose a risk for aerosol-transmitted infection, CDC recommended risk assessment for all *Brucella*-exposed laboratory workers, postexposure prophylaxis (PEP) for those at high risk, surveillance for symptoms of disease, and serologic follow-up with workers. The events in Indiana and Minnesota emphasize the importance of adhering to recommended biosafety practices, timely sharing of information regarding laboratory exposures, and rapid implementation of response protocols.

Case Reports

Indiana. On September 28, 2006, a microbiologist aged 47 years (microbiologist A) who worked at a clinical laboratory had onset of high fever, sweating, malaise, anorexia, headache, and hip pain. Initially, her symptoms were not severe; she did not seek medical treatment until 3 weeks later, after her symptoms had progressively worsened. The microbiologist was hospitalized on October 22 and recovered fully with treatment. On October 26, an unidentified blood culture isolate from microbiologist A (isolate A) was submitted for identification to a Minnesota clinical laboratory and determined to be *Brucella* spp.; both MDH and IDSH were notified of the finding. Epidemiologic investigation later revealed that, on July 17, microbiologist A had subcultured on an open laboratory bench an unidentified isolate (isolate C) from a referring laboratory. Isolate C subsequently was forwarded for identification to the same Minnesota clinical laboratory and identified as *Brucella* spp.

Minnesota. On October 25, a microbiologist aged 61 years (microbiologist B), who worked at the same Minnesota clinical laboratory that received microbiologist A's isolate, had onset of low-grade fever, fatigue, and night sweats. She was hospitalized and recovered with treatment. On November 9, the Minnesota laboratory identified a blood culture isolate from microbiologist B (isolate B) as *Brucella* spp. and notified MDH. The subsequent investigation determined that microbiologist B had not handled isolate A from microbiologist A. However, previously she had handled on an open bench two unidentified isolates subsequently identified as *Brucella* spp. Her first exposure had occurred on July 21 while she was handling isolate C, which had been forwarded from the Indiana clinical laboratory. The second exposure had occurred on August 8 during testing of an isolate from a Texas referring clinical laboratory (isolate D).

Laboratory-Acquired Brucellosis — Indiana and Minnesota, 2006

In November 2006, two cases of brucellosis in microbiologists at two clinical laboratories were reported to state health departments in Indiana and Minnesota. The Minnesota Department of Health (MDH) contacted CDC regarding this suspected multistate cluster of laboratory-acquired brucellosis. MDH and the Indiana State Department of Health (ISDH) asked CDC to conduct further testing on *Brucella* isolates suspected of causing the infections and to provide recommendations for appropriate response by the laboratories. This report summarizes the investigation conducted jointly by MDH, ISDH, and CDC, provides guidance on safe laboratory handling of *Brucella* spp., and makes recommendations for responding to *Brucella* laboratory exposures. The results of that investigation determined that 146 workers at the two laboratories had been exposed to *Brucella* and that, although two *Brucella* isolates had been handled by both laboratories, infections

Investigation and Response

The investigation revealed that all potentially implicated specimens or isolates had been manipulated on an open bench, the routine practice for handling unidentified isolates in these laboratories. No spills or aerosol-generating procedures had occurred. Neither laboratory had formal protocols for 1) notification and follow-up of staff members who worked with isolates identified as *Brucella* spp. or 2) notification of laboratories that forwarded isolates later identified as *Brucella* spp.

Brucella-exposed workers* from each laboratory were identified, and their exposures were classified as either high risk or low risk.† In Indiana, 105 staff members were exposed; 15 of those exposures were classified as high risk, including the exposure of microbiologist A. In Minnesota, 41 staff members were exposed; 13 of those exposures were classified as high risk, including the exposure of microbiologist B. All staff members classified with high-risk exposure, other than the two microbiologists who received antimicrobial therapy, were advised to receive PEP.

To determine the source of the *Brucella* infections, CDC compared blood culture isolates from the two microbiologists with the isolates they handled, using multiple-locus variable number tandem repeats analysis at 21 genomic regions. All isolates were identified as *Brucella melitensis* biovar 3. Matching of 16 genomic amplicons suggested that isolate C was the source of infection for microbiologist A, the Indiana microbiologist. Matching of 17 genomic amplicons suggested that isolate D was the source of infection for microbiologist B, the Minnesota microbiologist.

Serial serum samples from the 105 exposed Indiana laboratory staff members, excluding microbiologist A, were tested at CDC for anti-*Brucella* antibodies, using the *Brucella* microagglutination test (BMAT); the Minnesota laboratory conducted voluntary serial BMAT testing for 11 exposed laboratory staff members. No additional infections were detected in either group.

* A *Brucella*-exposed worker was defined as any person present in the microbiology laboratory from the time the culture was first manipulated until all culture isolates were destroyed or removed from the laboratory.

† A high-risk exposure was defined as 1) having direct personal exposure (e.g., sniffing bacteriologic cultures; direct skin contact; pipetting by mouth; inoculation; or spraying into the eyes, nose, or mouth), 2) performing work on an open bench (i.e., outside of biosafety level 3 containment equipment) with an open culture plate containing a *Brucella* isolate or being in close proximity to such work (e.g., across an open bench top or within 5 feet), or 3) presence in the laboratory during any procedure conducted on a *Brucella* isolate that might result in generation of aerosolized organisms and inhalational exposure (e.g., vortexing or catalase testing). A low-risk exposure was defined as being present in the laboratory during an exposure but not meeting the definition for a high-risk exposure.

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Editorial Note: Brucellosis is a bacterial zoonotic infection usually caused by *Brucella abortus*, *B. melitensis*, *Brucella suis*, or less commonly by *Brucella canis*. Humans usually are infected by occupational exposure to infected animals, consumption of unpasteurized dairy products from infected animals, or inhalation of infectious aerosols. The average incubation period for brucellosis is 2–10 weeks but ranges from a few days to 6 months. Symptoms include intermittent fever, chills, malaise, sweating, joint and lower back pain, headache, anorexia, and fatigue (1). Untreated brucellosis can last from several weeks to several years. Chronic untreated brucellosis can lead to abscesses in the liver, spleen, heart valves, brain, or bone; osteoarticular complications; and, in rare cases, death. A definitive diagnosis requires that bacteria be cultured from clinical specimens. A presumptive diagnosis requires demonstrating high or rising titers of specific antibodies in the serum (1).

Since 1986, fewer than 150 cases of brucellosis have been reported annually in the United States (2; CDC, unpublished data, 2007). However, brucellosis is among the most commonly reported laboratory-acquired bacterial infections (3). In a review of laboratory-associated infections during 1979–1999, *Brucella* spp. accounted for approximately 8% of all laboratory infections, 16% of bacterial infections, and 4% of deaths (4). Infections have occurred from sniffing culture plates, spilling blood-culture bottles, mucocutaneous exposure to sprays of organism-containing suspensions, aerosol generation from ruptured centrifuge tubes, or routine laboratory work with *Brucella* cultures outside of biological safety cabinets (5–9).

Biosafety level 3 (BSL-3) practices, containment equipment, and facilities are recommended for all manipulations of *Brucella* cultures (Box 1) (10). Because unidentified isolates are commonly manipulated on an open bench, inadvertent exposure can occur when *Brucella* unexpectedly grows in a culture. A formal notification and response protocol must be used after identification of *Brucella* spp. Timely identification, notification, and appropriate follow-up of potentially exposed workers, in combination with worker training to maximize awareness and observance of appropriate safety practices, can prevent unnecessary illness and hospitalization from brucellosis. Exposures can be minimized by clinicians and forwarding laboratories clearly identifying specimens they suspect to be *Brucella*.

BOX 1. Recommendations for safe laboratory practices to avoid exposure to *Brucella* spp.

- When brucellosis is suspected, clinicians or forwarding laboratories should note on the laboratory submission: "Suspect or rule out brucellosis."
- Review laboratory containment methods and microbiologic procedures to ensure compliance with recommendations in the *Biosafety in Microbiological and Biomedical Laboratories, Fifth Edition*.
- Use primary barriers (i.e., safety centrifuge cups, personal protective equipment, and Class II or higher biological safety cabinets [BSCs]) for procedures with a high likelihood of producing droplet splashes or aerosols.
- Use secondary barriers: restrict access to the laboratory when work is being performed and maintain the integrity of the laboratory air-handling system by keeping external doors and windows closed.
- Avoid causing splashes or aerosols when performing procedures on unidentified isolates.
- Prohibit sniffing of open culture plates to assist in the identification of isolates.
- Manipulate isolates of small gram-negative or gram-variable rods initially inside a BSC.

Once *Brucella* has been identified (or is highly suspect), clinical laboratories should notify the state health department and send the isolate to the state public health laboratory or nearest Laboratory Reference Network laboratory for confirmation and species identification. When *Brucella* is confirmed, the state public health laboratory should notify all other laboratories that handled the specimen, and exposure to workers should be assessed at the submitting laboratory and other laboratories involved.

Classification of exposures as high risk or low risk by practitioners of occupational health, infection control, or public health determines PEP recommendations. PEP is recommended for persons with high-risk exposure (Box 2). Serologic follow-up for exposed persons using quantitative assays (e.g., BMAT) should be performed at the time of exposure and at weeks 2, 4, 6, and 24 after exposure. Active, regular (e.g., weekly) surveillance for symptoms consistent with brucellosis should be conducted for all exposed laboratory workers for 6 months after exposure. PEP and monitoring differ for persons exposed to *B. abortus* RB51, an attenuated veterinary vaccine strain that is less commonly associated with human illness, is rifampin resistant in vitro, and does not elicit a measurable serologic response using available tests (Box 2). Laboratory workers who might have

BOX 2. Recommendations for surveillance and postexposure prophylaxis (PEP) after laboratory exposure to *Brucella* isolates

- Evaluate all workers exposed to *Brucella* isolates* and classify exposures as either high risk or low risk.†
- Recommend PEP for workers with high-risk exposures to *Brucella* isolates. PEP should be offered as soon as *Brucella* exposure has been identified, up to the end of the 6-month incubation period.
 - Administer doxycycline 100 mg twice daily and rifampin 600 mg once daily for 3 weeks or doxycycline alone if exposed to *Brucella abortus* RB51 strain, which is resistant to rifampin.
 - Trimethoprim-sulfamethoxazole (160 mg/800 mg) should be considered for patients with contraindications to doxycycline.
 - Pregnant workers with high-risk exposures should be considered for PEP in consultation with their obstetricians.
- Discuss potential PEP with workers who have low-risk exposures to *Brucella* isolates.
- Obtain baseline serum samples from all workers exposed to *Brucella*, unless exposed to *B. abortus* RB51 strain, which does not elicit a measurable serologic response using available assays.
- Arrange for serologic testing on all workers exposed to *Brucella* (e.g., 2, 4, 6, and 24 weeks postexposure) using agglutination testing (e.g., tube or *Brucella* microagglutination testing) at the state public health laboratory or CDC; serologic testing is not recommended for workers exposed to *B. abortus* RB51 strain.
- Arrange for regular (e.g., weekly) active surveillance for febrile illness among all workers exposed to *Brucella* isolates for 6 months after last exposure.

*A *Brucella*-exposed worker is defined as any worker present in the microbiology laboratory during workup and identification of a *Brucella* isolate, from the time the culture is first manipulated until all culture isolates are destroyed or removed from the laboratory.

†A high-risk exposure is defined as 1) having direct personal exposure to *Brucella* (e.g., sniffing bacteriologic cultures, direct skin contact, pipetting by mouth, inoculation, or spraying into the eyes, nose, or mouth), 2) performing work on an open bench (i.e., outside of biosafety level 3 containment equipment) with an open culture plate containing a *Brucella* isolate or being in close proximity to such work (e.g., across an open bench top or within 5 feet), or 3) presence in the laboratory during any procedure conducted on a *Brucella* isolate that might result in generation of aerosolized organisms and inhalational exposure (e.g., vortexing or catalase testing). A low-risk exposure is defined as being present in the laboratory during an exposure but not meeting the definition for a high-risk exposure.

been exposed to *Brucella* and who have unexplained febrile illness consistent with brucellosis should be referred to health-care providers for evaluation. Evaluation should include blood culture and anti-*Brucella* antibody serologic testing, and treatment for brucellosis should be initiated when compatible illness is confirmed.

Brucella spp. are dangerous infectious bacteria listed among CDC's category B bioterrorism agents.[§] CDC and the Animal and Plant Health Inspection Service (APHIS) regulate the transfer, possession, or use of such agents in the United States. New isolations, laboratory exposures, and other incidents associated with the intentional or unintentional release of *B. abortus* (excluding RB51), *B. melitensis*, or *B. suis* must be reported as soon as possible to either CDC or APHIS.[¶] Persons seeking assistance in identifying *Brucella* spp. or serologic monitoring of exposed persons should contact their state health departments or the CDC Bacterial Zoonoses Branch at telephone, 404-639-1711.

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[§] Available at <http://www.bt.cdc.gov/agent/agentlist-category.asp>.

[¶] Instructions for reporting are available at <http://www.selectagents.gov>.

north-central regions of the United States (1). In 2005, New Jersey reported 38.6 LD cases per 100,000 population, the third-highest incidence in the United States after Delaware and Connecticut (1). Since 1980, New Jersey has mandated that health-care providers and clinical laboratories report all LD cases to local health departments, which investigate these reports to confirm that they meet the national surveillance case definition. Reports from health-care providers typically include exposure and clinical information needed for case confirmation. In contrast, reports from laboratories do not contain exposure and clinical information, and local health departments must follow up with health-care providers to obtain the missing information needed to confirm a case for surveillance purposes. In 2002, New Jersey expanded its paper-based laboratory reporting system to include electronic laboratory-reporting (ELR) for all laboratory-reportable diseases. During the next 4 years, New Jersey's local health departments noted that the number of ELR reports for LD and the time needed to handle them had begun to impede the departments' abilities to address other public health priorities. In 2006, to assess these concerns, the New Jersey Department of Health and Senior Services evaluated the state's LD surveillance system. This report summarizes the results of that evaluation, which determined that during 2001-2004, the total annual number of LD reports increased nearly five-fold (from 2,460 in 2001 to 11,957 in 2004), but confirmed reports increased only 18% (from 2,371 in 2001 to 2,791 in 2004). ELR represented 51% of reports received during 2001-2006, but only 29% were confirmed upon investigation. These results illustrate the difficulties associated with ELR reporting of LD in New Jersey, especially the use of resources needed to address other public health problems. Other states with similar difficulties might need to reevaluate the resources used to confirm electronically reported LD and other notifiable diseases.

CDC guidelines for surveillance system evaluations were used to conduct the evaluation (2). Key LD surveillance parameters (e.g., total number of LD reports, number of confirmed LD cases, origin of reports [i.e., ELR versus non-ELR], and investigation completion status) during 2001-2006 were obtained from the New Jersey Communicable Disease Reporting and Surveillance System (NJCDRSS). NJCDRSS was implemented in 2001, and surveillance data from before 2001 are limited to the number of confirmed LD cases per year. For surveillance purposes, NJCDRSS used the national case definition for LD, in which a reportable case of LD was defined as 1) physician-diagnosed erythema migrans >5 cm in diameter or 2) one or more

Effect of Electronic Laboratory Reporting on the Burden of Lyme Disease Surveillance — New Jersey, 2001-2006

Lyme disease (LD) is a vector-borne illness caused by the spirochete *Borrelia burgdorferi* and transmitted in the United States by blacklegged ticks (*Ixodes* spp.). LD is most commonly found in the northeastern, mid-Atlantic, and

objective late manifestations of LD* with laboratory evidence of infection with *B. burgdorferi* (i.e., isolation of the organism or positive serologic testing) in a person with possible exposure to infected ticks (3). Reports with laboratory evidence of infection alone were not considered to be cases. The surveillance case definition remained constant throughout this period.

By using NJCDRSS data and chi-square analysis, the geographic, age, and seasonal distribution of ELR reports was compared with that of non-ELR reports. NJCDRSS data did not permit differentiation of paper-based reports from paper-based health-care provider reports within the surveillance database; therefore, both types were included in the non-ELR category, and analysis of ELR reports compared with non-ELR laboratory reports was not possible. Surveillance system personnel were interviewed to obtain information regarding investigation processes, surveillance system structure and flow, funding, and personnel resources.

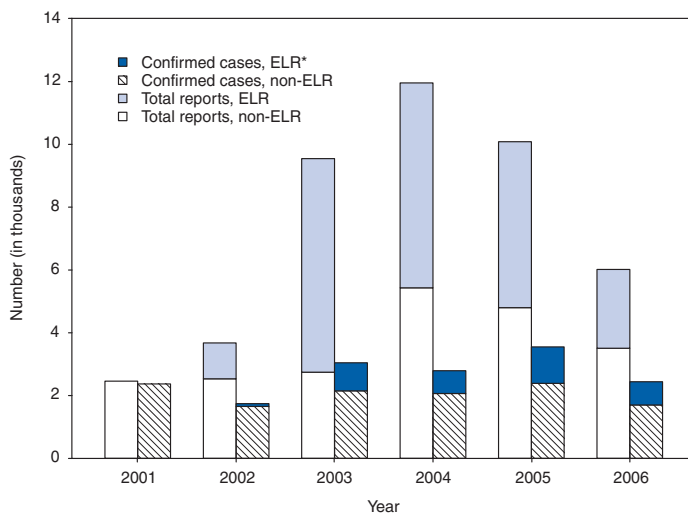
Total annual LD report volume increased from 2,460 in 2001 (before introduction of ELR) to a peak of 11,957 in 2004 before decreasing to 6,015 in 2006 (Figure). From the introduction of ELR in 2002 through 2006, electronic reporting accounted for a substantial number of annual LD reports, ranging from a low of 1,142 (in 2002) to a high of 6,799 (in 2003). These ELR reports accounted for 31%–71% of total annual reports but only 5%–33% of confirmed cases per year (Figure). The absolute number of confirmed cases during 2001–2006 remained steady.

Among the 13,567 confirmed cases reported during 2002–2006, ELR and non-ELR cases differed significantly by patient residence ($p<0.05$) and time of year that illness onset occurred ($p<0.05$). Proportionately more confirmed non-ELR cases (8,067 of 9,958; 81%) than confirmed ELR cases (2,350 of 3,609; 65%) were associated with residence in the higher LD-prevalence region of northern New Jersey than with southern New Jersey. A higher proportion of confirmed non-ELR cases had onset dates during the usual LD transmission season of April–September (6,999 of 8,465; 83%) than confirmed ELR cases (2,191 of 3,031; 72%).[†] ELR

* For purposes of surveillance, late manifestations include any of the following when an alternative explanation is not found: 1) recurrent, brief attacks (during a period of weeks or months) of objective joint swelling in one or a few joints, occasionally followed by chronic arthritis; 2) lymphocytic meningitis; 3) cranial neuritis, particularly facial palsy (possibly bilateral); 4) radiculoneuropathy; 5) encephalomyelitis (confirmed by a higher titer of antibody against *B. burgdorferi* in the cerebrospinal fluid than in serum); or 6) acute onset of second- or third-degree atrioventricular conduction defects that resolve in days to weeks and are occasionally associated with myocarditis.

[†] Differences in denominators for geographic and temporal analyses are the result of missing data.

FIGURE. Number of Lyme disease surveillance reports and confirmed cases, by year and report origin — New Jersey, 2001–2006



SOURCE: New Jersey Communicable Disease Reporting and Surveillance System.

* Received via electronic laboratory reporting.

and non-ELR confirmed cases did not differ by patient age (median: 42 years for both).

For the period 2001–2006, LD investigations required a median of 2 months to complete follow-up and classify the report (range: <1 week–8 months), representing approximately 1 hour of active information collection per case. The balance of the 2-month period was time spent waiting for health-care providers to respond to information requests. Diversion of investigators to other public health priorities also caused delays in LD investigations. Approximately 24% of investigations during the period 2001–2006 were not completed before the close of each surveillance period and were not included in the year-end final surveillance case numbers. Reports that were confirmed after the close of the surveillance period were updated in NJCDRSS for the preceding year but were not included in the published surveillance data.

State surveillance system personnel reported that before the introduction of ELR, a substantial but unmeasured proportion of paper-based laboratory reports was never entered into the electronic database that served as the “investigation pending” list because of a limited number of data-entry personnel. With the introduction of ELR in 2002, all incoming electronic reports were placed automatically on this list. The effect of this change was to substantially enlarge this list and to place a greater demand on local health department personnel as they attempted to process the greater number of pending reports. As a result,

personnel diverted attention from other public health duties. In 2004, the year when the total number of reports referred for investigation peaked, the time required for LD report follow-up peaked at 11,957 hours (or approximately 5.75 full-time-equivalent[§] investigators) statewide, compared with 2,460 hours in 2001, before the advent of ELR.

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Editorial Note: Because of this investigation, New Jersey is modifying its LD surveillance system to reduce the surveillance burden (i.e., the cost of conducting LD surveillance in terms of personnel committed and funding required). New Jersey has adopted the revised national LD surveillance case definition (Box) (4), implemented in January 2008, which provides local and state health departments with additional flexibility to classify LD reports as confirmed, probable, or suspect cases. Although the revised national surveillance case definition alone likely will not decrease the LD surveillance burden in New Jersey or other states, it will provide a more complete measure of the surveillance burden and guide development of sustainable surveillance systems that are consistent among states.

After New Jersey's introduction of ELR in 2002, the subsequent increase in LD reports referred for investigation likely reflected technological improvements in data acquisition and not an actual increase in the number of laboratory reports received. After ELR initiation, the additional volume of pending laboratory reports exceeded local investigative capacity. Although the available capacity for local investigations was not calculated as part of this evaluation, the inability of local health departments to complete LD investigations in a timely manner likely indicates that available resources in New Jersey were inadequate to meet the demand for these investigations.

Previous reports have illustrated the complexity of LD surveillance in the United States (1,5). In New Jersey, ELR implementation increased the proportion of total laboratory reports that were referred for investigation; however, the annual total number of confirmed cases remained steady. Whether the steady number of confirmed cases during 2001–2006 is an actual reflection of the incidence of LD in New Jersey or merely reflects the maximum number of reports that could be confirmed given available resources is unknown. The causes for the observed decrease in LD reports during 2005–2006 have not yet been established.

BOX. Revised national Lyme disease surveillance case definition, implemented January 2008

Confirmed

- A. A case of erythema migrans in a patient with a known exposure to Lyme disease,* or
- B. A case of erythema migrans in a patient with laboratory evidence of infection† and no known exposure to Lyme disease, or
- C. A case in a patient with at least one late manifestation of Lyme disease§ and laboratory evidence of infection.

Probable

Any other case of Lyme disease diagnosed by a health-care provider in a patient with laboratory evidence of infection.

Suspected

- A. A case of erythema migrans in a patient with no known exposure to Lyme disease and no laboratory evidence of infection, or
- B. A case in a patient with laboratory evidence of infection but for whom no clinical information (e.g., a laboratory report) is available.

Lyme disease reports will not be considered cases if the health-care provider specifically states that the illness is not a case of Lyme disease or the only symptom listed is "tick bite" or "insect bite."

SOURCE: Council of State and Territorial Epidemiologists. Position statement 07-ID-11. Revised national surveillance case definition for Lyme disease. Available at <http://www.cste.org/ps/2007ps/2007psfinal/id/07-id-11.pdf>.

* Exposure is defined as having been (≤ 30 days before onset of erythema migrans) in a wooded, brushy, or grassy area (i.e., potential tick habitats) in a county in which at least two confirmed Lyme disease cases have been acquired or in which established populations of a known tick vector are infected with *Borrelia burgdorferi*. A history of tick bite is not required.

† For purposes of surveillance, laboratory evidence of infection with *B. burgdorferi* is defined as a positive culture for *B. burgdorferi*, two-tier testing interpreted using established criteria, or single-tier immunoglobulin G immunoblot seropositivity interpreted using established criteria.

§ For purposes of surveillance, late manifestations include any of the following when an alternative explanation is not found: 1) recurrent, brief attacks (during a period of weeks or months) of objective joint swelling in one or a few joints, occasionally followed by chronic arthritis; 2) lymphocytic meningitis; 3) cranial neuritis, particularly facial palsy (possibly bilateral); 4) radiculoneuropathy; 5) encephalomyelitis (confirmed by a higher titer of antibody against *B. burgdorferi* in the cerebrospinal fluid than in serum); or 6) acute onset of second- or third-degree atrioventricular conduction defects that resolve in days to weeks and are occasionally associated with myocarditis.

This analysis revealed statistically significant differences, by both county and season, between confirmed LD cases in terms of report origin (i.e., ELR versus non-ELR). These differences likely were caused by greater use of paper-based health-care provider (non-ELR) reports during the warmer months, when ticks are more active. This pattern likely is

[§] 2,080 hours per year.

attributable to a higher proportion of patients with early-stage LD caused by recent infection, for which serologic testing typically is not necessary for diagnosis. In addition, in the northern region of the state, where LD prevalence is higher, health-care providers might be more likely to clinically diagnose (and subsequently report) LD. Laboratory reports are useful to identify LD cases that otherwise might not have been reported by health-care providers and are an important component of LD surveillance in New Jersey.

The findings in this report are subject to at least three limitations. First, LD surveillance is influenced by several factors not examined in this evaluation (e.g., accuracy of laboratory tests for LD and willingness of health-care providers to report early-stage cases); accordingly, not all potential determinants of LD surveillance burden are considered in this report (1,5). Second, demographic and clinical data for all confirmed LD cases were not available, and additional differences might exist between cases detected by ELR versus non-ELR beyond those described in this report. Finally, analysis of ELR versus non-ELR laboratory reports was not possible, which prevented comparison of laboratory-reporting types independent of the possible influence of paper-based health-care provider reports.

To address the problems identified in this report, in January 2008, New Jersey began automatically classifying all new ELR LD laboratory reports that meet laboratory evidence criteria[¶] as suspected cases under the new surveillance case definition (4). To reduce the burden associated

with contacting health-care providers, investigators will only follow up on laboratory reports if a concurrent report is received from a health-care provider, until planned enhancements to NJCDRSS are in place that will permit automated mailing of case-report forms to health-care providers for patients with positive LD laboratory test results. Some laboratory reports not accompanied by a paper-based health-care provider report also will be investigated on a case-by-case basis. This change is expected to reduce the burden of follow-up on LD reports. New Jersey will continue to evaluate and refine its LD surveillance system to reduce surveillance burden while improving the quality of surveillance data.

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[¶]For purposes of surveillance, laboratory evidence of infection with *B. burgdorferi* is defined as a positive culture for *B. burgdorferi*, two-tier testing interpreted using established criteria, or single-tier immunoglobulin G immunoblot seropositivity interpreted using established criteria (6–9).

TABLE I. Provisional cases of infrequently reported notifiable diseases (<1,000 cases reported during the preceding year) — United States, week ending January 12, 2008 (2nd Week)*

Disease	Current week	Cum 2008	5-year weekly average†	Total cases reported for previous years					States reporting cases during current week (No.)
				2007	2006	2005	2004	2003	
Anthrax	—	—	—	—	1	—	—	—	
Botulism:									
foodborne	1	1	0	19	20	19	16	20	PA (1)
infant	—	2	2	81	97	85	87	76	
other (wound & unspecified)	—	—	1	23	48	31	30	33	
Brucellosis	1	2	3	124	121	120	114	104	OH (1)
Chancroid	—	1	0	34	33	17	30	54	
Cholera	—	—	0	7	9	8	6	2	
Cyclosporiasis§	—	1	2	94	137	543	160	75	
Diphtheria	—	—	—	—	—	—	—	1	
Domestic arboviral diseases§¶:									
California serogroup	—	—	—	44	67	80	112	108	
eastern equine	—	—	—	4	8	21	6	14	
Powassan	—	—	—	1	1	1	1	—	
St. Louis	—	—	0	7	10	13	12	41	
western equine	—	—	—	—	—	—	—	—	
Ehrlichiosis/Anaplasmosis§:									
<i>Ehrlichia chaffeensis</i>	—	—	—	N	N	N	N	N	
<i>Ehrlichia ewingii</i>	—	—	—	N	N	N	N	N	
<i>Anaplasma phagocytophilum</i>	—	—	—	N	N	N	N	N	
undetermined	—	—	—	N	N	N	N	N	
<i>Haemophilus influenzae</i> ,**									
invasive disease (age <5 yrs):									
serotype b	—	—	1	19	29	9	19	32	
nonserotype b	—	—	4	156	175	135	135	117	
unknown serotype	6	9	5	186	179	217	177	227	NY (1), MD (1), GA (2), FL (1), TN (1)
Hansen disease§	1	1	2	62	66	87	105	95	FL (1)
Hantavirus pulmonary syndrome§	—	—	1	32	40	26	24	26	
Hemolytic uremic syndrome, postdiarrheal§	—	—	4	232	288	221	200	178	
Hepatitis C viral, acute	6	11	19	739	766	652	720	1,102	MI (1), MO (1), FL (1), TX (1), OR (1), CA (1)
HIV infection, pediatric (age <13 yrs)††	—	—	4	—	—	380	436	504	
Influenza-associated pediatric mortality§§§	—	—	1	74	43	45	—	N	
Listeriosis	6	9	16	739	884	896	753	696	NY (1), PA (2), OH (2), NE (1)
Measles¶¶	—	—	1	31	55	66	37	56	
Meningococcal disease, invasive***:									
A, C, Y, & W-135	—	—	8	266	318	297	—	—	
serogroup B	—	—	5	131	193	156	—	—	
other serogroup	—	—	1	31	32	27	—	—	
unknown serogroup	—	—	23	566	651	765	—	—	
Mumps	2	6	12	731	6,584	314	258	231	PA (1), MD (1)
Novel influenza A virus infections	—	—	—	4	N	N	N	N	
Plague	—	—	0	6	17	8	3	1	
Poliomyelitis, paralytic	—	—	—	—	—	1	—	—	
Poliovirus infection, nonparalytic§	—	—	—	—	N	N	N	N	
Psittacosis§	—	—	0	11	21	16	12	12	
Q fever§:									
acute	—	—	—	—	—	—	—	—	
chronic	—	—	—	—	—	—	—	—	
Rabies, human	—	—	0	—	3	2	7	2	
Rubella†††	—	—	0	11	11	11	10	7	
Rubella, congenital syndrome	—	—	—	—	1	1	—	1	
SARS-CoV§§§	—	—	—	—	—	—	—	8	
Smallpox§	—	—	—	—	—	—	—	—	
Streptococcal toxic-shock syndrome§	—	—	3	102	125	129	132	161	
Syphilis, congenital (age <1 yr)	5	6	9	535	349	329	353	413	FL (2), LA (1), TX (1), OR (1)
Tetanus	—	—	1	20	41	27	34	20	

—: No reported cases. N: Not notifiable. Cum: Cumulative year-to-date counts.

* Incidence data for reporting years 2007 and 2008 are provisional, whereas data for 2003, 2004, 2005, and 2006 are finalized.

† Calculated by summing the incidence counts for the current week, the 2 weeks preceding the current week, and the 2 weeks following the current week, for a total of 5 preceding years. Additional information is available at <http://www.cdc.gov/epo/dphsi/phs/files/5yearweeklyaverage.pdf>.

§ Not notifiable in all states. Data from states where the condition is not notifiable are excluded from this table, except in 2007 and 2008 for the domestic arboviral diseases and influenza-associated pediatric mortality, and in 2003 for SARS-CoV. Reporting exceptions are available at <http://www.cdc.gov/epo/dphsi/phs/infdis.htm>.

¶ Includes both neuroinvasive and nonneuroinvasive. Updated weekly from reports to the Division of Vector-Borne Infectious Diseases, National Center for Zoonotic, Vector-Borne, and Enteric Diseases (ArboNET Surveillance). Data for West Nile virus are available in Table II.

** Data for *H. influenzae* (all ages, all serotypes) are available in Table II.

†† Updated monthly from reports to the Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. Implementation of HIV reporting influences the number of cases reported. Updates of pediatric HIV data have been temporarily suspended until upgrading of the national HIV/AIDS surveillance data management system is completed. Data for HIV/AIDS, when available, are displayed in Table IV, which appears quarterly.

§§ Updated weekly from reports to the Influenza Division, National Center for Immunization and Respiratory Diseases. One case occurring during the 2007–08 influenza season has been reported.

¶¶ No measles cases were reported for the current week.

*** Data for meningococcal disease (all serogroups) are available in Table II.

††† No rubella cases were reported for the current week.

§§§ Updated weekly from reports to the Division of Viral and Rickettsial Diseases, National Center for Zoonotic, Vector-Borne, and Enteric Diseases.

TABLE I. (Continued) Provisional cases of infrequently reported notifiable diseases (<1,000 cases reported during the preceding year) — United States, week ending January 12, 2008 (2nd Week)*

Disease	Current week	Cum 2008	5-year weekly average†	Total cases reported for previous years					States reporting cases during current week (No.)
				2007	2006	2005	2004	2003	
Toxic-shock syndrome (staphylococcal)§	—	1	2	81	101	90	95	133	
Trichinellosis	—	1	0	6	15	16	5	6	
Tularemia	—	—	2	113	95	154	134	129	
Typhoid fever	4	4	7	324	353	324	322	356	FL (1), TX (1), CA (2)
Vancomycin-intermediate <i>Staphylococcus aureus</i> §	—	—	0	23	6	2	—	N	
Vancomycin-resistant <i>Staphylococcus aureus</i> §	—	—	0	—	1	3	1	N	
Vibriosis (noncholera <i>Vibrio</i> species infections)§	—	1	3	356	N	N	N	N	
Yellow fever	—	—	—	—	—	—	—	—	

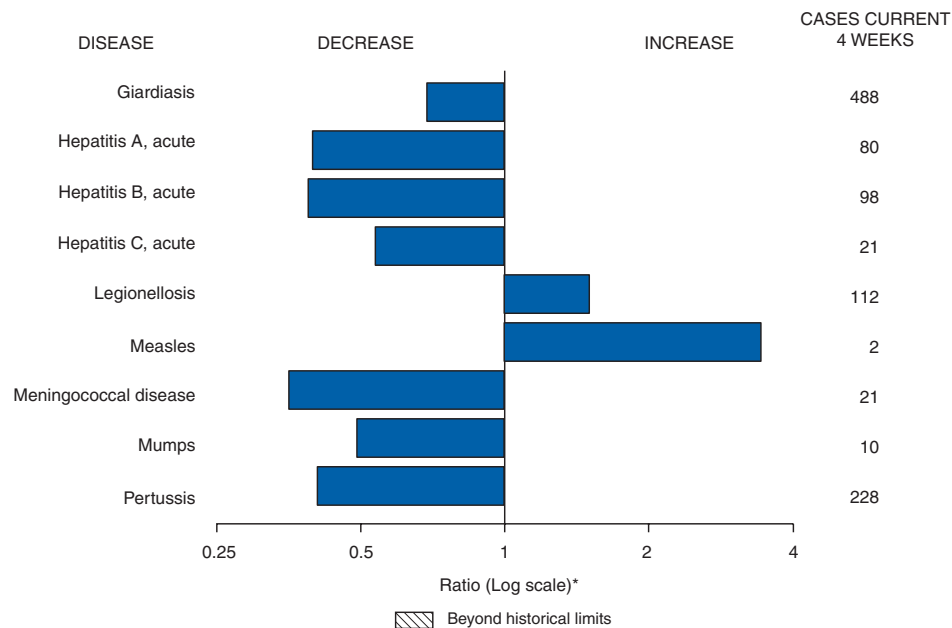
—: No reported cases. N: Not notifiable. Cum: Cumulative year-to-date counts.

* Incidence data for reporting years 2007 and 2008 are provisional, whereas data for 2003, 2004, 2005, and 2006 are finalized.

† Calculated by summing the incidence counts for the current week, the 2 weeks preceding the current week, and the 2 weeks following the current week, for a total of 5 preceding years. Additional information is available at <http://www.cdc.gov/epo/dphsi/phs/files/5yearweeklyaverage.pdf>.

§ Not notifiable in all states. Data from states where the condition is not notifiable are excluded from this table, except in 2007 and 2008 for the domestic arboviral diseases and influenza-associated pediatric mortality, and in 2003 for SARS-CoV. Reporting exceptions are available at <http://www.cdc.gov/epo/dphsi/phs/infdis.htm>.

FIGURE I. Selected notifiable disease reports, United States, comparison of provisional 4-week totals January 12, 2008, with historical data



* Ratio of current 4-week total to mean of 15 4-week totals (from previous, comparable, and subsequent 4-week periods for the past 5 years). The point where the hatched area begins is based on the mean and two standard deviations of these 4-week totals.

Notifiable Disease Data Team and 122 Cities Mortality Data Team
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TABLE II. (Continued) Provisional cases of selected notifiable diseases, United States, weeks ending January 12, 2008, and January 13, 2007 (2nd Week)*

Reporting area	Streptococcal disease, invasive, group A					<i>Streptococcus pneumoniae</i> , invasive disease, nondrug resistant† Age <5 years				
	Current week	Previous 52 weeks		Cum 2008	Cum 2007	Current week	Previous 52 weeks		Cum 2008	Cum 2007
		Med	Max				Med	Max		
United States	56	82	168	101	166	17	34	59	34	68
New England	—	5	28	1	11	—	2	8	—	12
Connecticut	—	0	22	—	1	—	0	2	—	2
Maine [§]	—	0	3	—	2	—	0	1	—	—
Massachusetts	—	3	12	—	5	—	1	5	—	7
New Hampshire	—	0	4	1	1	—	0	2	—	1
Rhode Island [§]	—	0	1	—	—	—	0	1	—	1
Vermont [§]	—	0	2	—	2	—	0	1	—	1
Mid. Atlantic	19	16	40	23	30	3	5	38	3	11
New Jersey	—	2	12	—	7	—	1	5	—	2
New York (Upstate)	8	5	20	9	2	3	2	9	3	6
New York City	—	4	13	—	9	—	1	35	—	3
Pennsylvania	11	4	11	14	12	N	0	0	N	N
E.N. Central	8	15	34	14	48	6	4	13	9	15
Illinois	1	4	13	1	19	—	1	6	—	3
Indiana	—	2	10	2	—	—	0	6	—	—
Michigan	1	3	10	2	7	2	1	5	4	5
Ohio	6	4	14	9	18	4	1	5	5	5
Wisconsin	—	0	5	—	4	—	0	2	—	2
W.N. Central	3	4	32	4	7	—	3	7	4	2
Iowa	—	0	0	—	—	—	0	0	—	—
Kansas	—	0	3	—	2	—	0	1	—	—
Minnesota	—	0	29	—	—	—	1	5	—	—
Missouri	3	1	4	4	5	—	0	2	2	2
Nebraska [§]	—	0	3	—	—	—	0	3	2	—
North Dakota	—	0	3	—	—	—	0	1	—	—
South Dakota	—	0	2	—	—	—	0	0	—	—
S. Atlantic	21	21	49	41	33	6	6	14	10	13
Delaware	—	0	1	—	—	—	0	0	—	—
District of Columbia	—	0	3	—	—	—	0	0	—	—
Florida	9	6	16	14	5	3	1	5	4	1
Georgia	5	4	12	9	11	—	0	5	—	2
Maryland [§]	7	4	9	13	9	2	1	5	3	5
North Carolina	—	1	22	—	—	—	0	0	—	—
South Carolina [§]	—	1	7	5	6	1	1	4	3	1
Virginia [§]	—	2	11	—	2	—	0	4	—	4
West Virginia	—	0	3	—	—	—	0	1	—	—
E.S. Central	1	4	13	1	11	—	2	7	—	8
Alabama [§]	N	0	0	N	N	N	0	0	N	N
Kentucky	—	1	3	—	3	N	0	0	N	N
Mississippi	N	0	0	N	N	—	0	1	—	2
Tennessee [§]	1	3	13	1	8	—	2	7	—	6
W.S. Central	3	6	19	4	3	2	5	17	3	3
Arkansas [§]	—	0	2	—	1	—	0	1	—	—
Louisiana	—	0	4	—	—	—	0	4	—	1
Oklahoma	2	1	5	3	1	1	1	4	2	2
Texas [§]	1	4	12	1	1	1	2	13	1	—
Mountain	1	9	21	13	20	—	4	12	3	4
Arizona	—	4	10	4	4	—	2	8	—	3
Colorado	—	3	8	8	6	—	1	4	3	—
Idaho [§]	1	0	2	1	—	—	0	1	—	—
Montana [§]	N	0	0	N	N	N	0	0	N	N
Nevada [§]	—	0	1	—	—	—	0	1	—	—
New Mexico [§]	—	1	4	—	6	—	0	4	—	1
Utah	—	2	6	—	3	—	0	2	—	—
Wyoming [§]	—	0	1	—	1	—	0	0	—	—
Pacific	—	3	7	—	3	—	0	4	2	—
Alaska	—	0	3	—	—	—	0	4	2	—
California	N	0	0	N	N	N	0	0	N	N
Hawaii	—	2	5	—	3	—	0	1	—	—
Oregon [§]	N	0	0	N	N	N	0	0	N	N
Washington	N	0	0	N	N	N	0	0	N	N
American Samoa	—	0	4	—	—	N	0	0	N	N
C.N.M.I.	—	—	—	—	—	—	—	—	—	—
Guam	—	0	0	—	—	N	0	0	N	N
Puerto Rico	—	0	0	—	—	N	0	0	N	N
U.S. Virgin Islands	—	0	0	—	—	—	0	0	—	—

C.N.M.I.: Commonwealth of Northern Mariana Islands.

U: Unavailable. —: No reported cases. N: Not notifiable. Cum: Cumulative year-to-date counts. Med: Median. Max: Maximum.

* Incidence data for reporting years 2007 and 2008 are provisional.

† Includes cases of invasive pneumococcal disease, in children aged <5 years, caused by *S. pneumoniae*, which is susceptible or for which susceptibility testing is not available (NNDS event code 11717).

§ Contains data reported through the National Electronic Disease Surveillance System (NEDSS).

TABLE II. (Continued) Provisional cases of selected notifiable diseases, United States, weeks ending January 12, 2008, and January 13, 2007 (2nd Week)*

Reporting area	<i>Streptococcus pneumoniae</i> , invasive disease, drug resistant†										Syphilis, primary and secondary				
	All ages				Age <5 years										
	Current week	Previous 52 weeks		Cum 2008	Cum 2007	Current week	Previous 52 weeks		Cum 2008	Cum 2007	Current week	Previous 52 weeks		Cum 2008	Cum 2007
		Med	Max				Med	Max				Med	Max		
United States	46	41	97	99	158	7	8	23	11	19	102	208	278	205	336
New England	—	1	7	2	9	—	0	2	1	—	3	5	14	4	4
Connecticut	—	0	5	—	5	—	0	2	—	—	—	0	3	—	—
Maine§	—	0	1	1	2	—	0	1	1	—	—	0	2	—	—
Massachusetts	—	0	0	—	—	—	0	0	—	—	2	3	8	3	4
New Hampshire	—	0	0	—	—	—	0	0	—	—	—	0	3	—	—
Rhode Island§	—	0	3	—	1	—	0	1	—	—	1	0	5	1	—
Vermont§	—	0	2	1	1	—	0	1	—	—	—	0	5	—	—
Mid. Atlantic	5	2	9	8	12	—	0	5	—	2	31	34	46	47	64
New Jersey	—	0	0	—	—	—	0	0	—	—	—	4	9	—	7
New York (Upstate)	1	1	5	1	—	—	0	4	—	—	1	3	7	1	3
New York City	—	0	0	—	—	—	0	0	—	—	23	18	35	39	29
Pennsylvania	4	1	6	7	12	—	0	2	—	2	7	8	17	7	25
E.N. Central	8	11	31	16	51	3	2	8	3	4	7	15	25	18	26
Illinois	—	1	7	—	12	—	1	5	—	1	—	7	14	—	15
Indiana	—	3	11	—	—	—	0	4	—	—	1	1	6	2	1
Michigan	—	0	1	—	—	—	0	1	—	—	—	2	9	—	1
Ohio	8	6	23	16	39	3	1	3	3	3	4	3	9	13	7
Wisconsin	N	0	0	N	N	—	0	0	—	—	2	1	4	3	2
W.N. Central	4	2	49	9	15	—	0	3	—	1	3	7	13	5	3
Iowa	—	0	0	—	—	—	0	0	—	—	—	0	2	—	—
Kansas	—	0	11	—	11	—	0	2	—	—	—	0	2	—	—
Minnesota	—	0	46	—	—	—	0	3	—	—	—	1	4	—	2
Missouri	4	1	5	9	3	—	0	1	—	—	3	4	10	5	1
Nebraska§	—	0	1	—	—	—	0	0	—	—	—	0	1	—	—
North Dakota	—	0	0	—	—	—	0	0	—	—	—	0	0	—	—
South Dakota	—	0	1	—	1	—	0	1	—	1	—	0	3	—	—
S. Atlantic	25	19	39	50	52	3	4	12	6	11	19	49	85	48	68
Delaware	—	0	1	1	—	—	0	1	—	—	—	0	3	—	—
District of Columbia	—	0	1	—	—	—	0	0	—	—	—	3	12	—	2
Florida	23	11	27	41	30	3	2	7	5	8	11	16	33	20	23
Georgia	2	5	19	7	22	—	1	5	1	3	—	8	31	—	6
Maryland§	—	0	1	—	—	—	0	0	—	—	4	6	15	10	12
North Carolina	—	0	0	—	—	—	0	0	—	—	—	5	23	13	21
South Carolina§	—	0	0	—	—	—	0	0	—	—	1	1	11	1	4
Virginia§	N	0	0	N	N	—	0	0	—	—	3	4	16	4	—
West Virginia	—	1	8	1	—	—	0	1	—	—	—	0	1	—	—
E.S. Central	4	3	9	13	7	1	1	3	1	—	13	19	31	25	21
Alabama§	N	0	0	N	N	—	0	0	—	—	3	7	17	7	9
Kentucky	1	0	2	2	1	—	0	1	—	—	1	1	7	4	4
Mississippi	—	0	0	—	—	—	0	0	—	—	1	2	9	1	—
Tennessee§	3	2	9	11	6	1	0	3	1	—	8	7	15	13	8
W.S. Central	—	2	12	—	8	—	0	3	—	—	21	37	55	42	35
Arkansas§	—	0	1	—	—	—	0	0	—	—	1	2	10	2	1
Louisiana	—	1	4	—	3	—	0	2	—	—	3	10	23	3	2
Oklahoma	—	0	10	—	5	—	0	2	—	—	1	1	4	2	3
Texas§	—	0	0	—	—	—	0	0	—	—	16	23	39	35	29
Mountain	—	1	5	1	4	—	0	2	—	1	—	8	25	1	18
Arizona	—	0	0	—	—	—	0	0	—	—	—	4	17	—	5
Colorado	—	0	0	—	—	—	0	0	—	—	—	1	3	1	1
Idaho§	N	0	0	N	N	—	0	0	—	—	—	0	1	—	—
Montana§	—	0	0	—	—	—	0	0	—	—	—	0	3	—	—
Nevada§	—	0	3	1	2	—	0	2	—	—	—	2	6	—	6
New Mexico§	—	0	1	—	—	—	0	0	—	—	—	1	4	—	5
Utah	—	0	5	—	1	—	0	2	—	1	—	0	2	—	1
Wyoming§	—	0	2	—	1	—	0	1	—	—	—	0	1	—	—
Pacific	—	0	0	—	—	—	0	0	—	—	5	40	61	15	97
Alaska	—	0	0	—	—	—	0	0	—	—	—	0	1	—	—
California	N	0	0	N	N	—	0	0	—	—	5	37	58	6	93
Hawaii	—	0	0	—	—	—	0	0	—	—	—	0	2	—	—
Oregon§	N	0	0	N	N	—	0	0	—	—	—	0	2	2	1
Washington	N	0	0	N	N	—	0	0	—	—	—	2	12	7	3
American Samoa	N	0	0	N	N	—	0	1	—	—	—	0	4	—	—
C.N.M.I.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	0	0	—	—	—	0	0	—	—	—	0	0	—	—
Puerto Rico	N	0	0	N	N	—	0	0	—	—	—	3	10	—	1
U.S. Virgin Islands	—	0	0	—	—	—	0	0	—	—	—	0	0	—	—

C.N.M.I.: Commonwealth of Northern Mariana Islands.

U: Unavailable. —: No reported cases. N: Not notifiable. Cum: Cumulative year-to-date counts. Med: Median. Max: Maximum.

* Incidence data for reporting years 2007 and 2008 are provisional.

† Includes cases of invasive pneumococcal disease caused by drug-resistant *S. pneumoniae* (DRSP) (NNDSS event code 11720).

§ Contains data reported through the National Electronic Disease Surveillance System (NEDSS).

TABLE III. Deaths in 122 U.S. cities,* week ending January 12, 2008 (2nd Week)

Reporting Area	All causes, by age (years)							P&I [†] Total	Reporting Area	All causes, by age (years)							P&I [†] Total
	All Ages	>65	45-64	25-44	1-24	<1	All Ages			>65	45-64	25-44	1-24	<1			
New England	637	459	105	40	7	26	58	S. Atlantic	1,326	844	316	99	33	33	65		
Boston, MA	148	99	29	14	3	3	10	Atlanta, GA	102	65	20	14	1	2	5		
Bridgeport, CT	42	30	6	5	1	—	3	Baltimore, MD	197	108	52	25	4	8	20		
Cambridge, MA	20	16	3	1	—	—	—	Charlotte, NC	130	78	32	11	7	2	7		
Fall River, MA	30	26	2	2	—	—	3	Jacksonville, FL	196	138	38	10	7	2	6		
Hartford, CT	58	36	11	—	—	11	5	Miami, FL	U	U	U	U	U	U	U		
Lowell, MA	26	20	4	1	—	1	2	Norfolk, VA	73	48	16	5	2	2	—		
Lynn, MA	13	11	1	1	—	—	2	Richmond, VA	64	38	13	5	5	3	5		
New Bedford, MA	14	13	1	—	—	—	1	Savannah, GA	125	88	27	8	2	—	11		
New Haven, CT	59	41	8	5	1	4	4	St. Petersburg, FL	77	43	26	4	—	4	3		
Providence, RI	79	58	14	3	2	2	5	Tampa, FL	249	170	59	13	3	4	5		
Somerville, MA	7	3	2	2	—	—	—	Washington, D.C.	99	57	30	4	2	6	1		
Springfield, MA	43	32	6	1	—	4	7	Wilmington, DE	14	11	3	—	—	—	2		
Waterbury, CT	35	29	5	1	—	—	6	E.S. Central	993	639	224	73	26	31	92		
Worcester, MA	63	45	13	4	—	1	10	Birmingham, AL	230	149	36	20	13	12	28		
Mid. Atlantic	2,277	1,608	468	129	36	34	134	Chattanooga, TN	110	77	19	11	1	2	5		
Albany, NY	51	38	10	1	—	2	6	Knoxville, TN	116	78	30	4	3	1	15		
Allentown, PA	14	13	1	—	—	—	1	Lexington, KY	35	24	8	3	—	—	4		
Buffalo, NY	91	64	18	4	3	2	5	Memphis, TN	135	87	29	11	5	3	8		
Camden, NJ	36	22	11	—	2	1	3	Mobile, AL	85	60	22	1	—	2	4		
Elizabeth, NJ	25	17	4	2	1	1	1	Montgomery, AL	76	45	20	7	—	4	9		
Erie, PA	73	59	8	4	1	1	7	Nashville, TN	206	119	60	16	4	7	19		
Jersey City, NJ	31	23	4	3	1	—	2	W.S. Central	1,802	1,195	413	99	46	49	93		
New York City, NY	1,106	777	229	70	16	12	47	Austin, TX	109	63	33	7	2	4	4		
Newark, NJ	15	7	7	1	—	—	2	Baton Rouge, LA	U	U	U	U	U	U	U		
Paterson, NJ	23	10	9	3	—	1	3	Corpus Christi, TX	60	42	14	2	2	—	4		
Philadelphia, PA	346	225	81	25	9	6	21	Dallas, TX	257	154	64	21	10	8	13		
Pittsburgh, PA [‡]	39	28	7	2	1	1	2	El Paso, TX	131	90	28	6	6	1	5		
Reading, PA	37	32	4	—	—	1	4	Fort Worth, TX	175	121	42	8	—	4	8		
Rochester, NY	157	119	30	6	—	2	18	Houston, TX	427	283	103	20	12	9	31		
Schenectady, NY	20	16	4	—	—	—	—	Little Rock, AR	90	54	22	4	6	4	2		
Scranton, PA	39	28	8	1	1	1	1	New Orleans, LA [†]	U	U	U	U	U	U	U		
Syracuse, NY	113	84	22	4	1	2	6	San Antonio, TX	283	202	49	20	4	8	15		
Trenton, NJ	31	21	6	3	—	1	2	Shreveport, LA	69	43	17	3	2	4	3		
Utica, NY	13	11	2	—	—	—	1	Tulsa, OK	201	143	41	8	2	7	8		
Yonkers, NY	17	14	3	—	—	—	2	Mountain	1,347	923	303	73	23	25	90		
E.N. Central	2,485	1,656	578	148	56	47	187	Albuquerque, NM	160	100	37	14	4	5	10		
Akron, OH	74	50	15	8	1	—	4	Boise, ID	55	44	7	3	—	1	4		
Canton, OH	61	46	11	2	—	2	4	Colorado Springs, CO	92	62	23	4	1	2	3		
Chicago, IL	202	112	65	19	4	2	13	Denver, CO	82	46	27	7	2	—	11		
Cincinnati, OH	141	71	41	13	8	8	12	Las Vegas, NV	263	187	59	11	3	3	16		
Cleveland, OH	333	243	71	10	4	5	17	Ogden, UT	47	38	9	—	—	—	4		
Columbus, OH	278	189	65	15	5	4	18	Phoenix, AZ	221	143	46	13	11	8	12		
Dayton, OH	177	125	39	9	3	1	14	Pueblo, CO	38	31	7	—	—	—	4		
Detroit, MI	222	96	84	27	10	5	14	Salt Lake City, UT	151	94	42	11	1	3	10		
Evansville, IN	52	42	10	—	—	—	5	Tucson, AZ	238	178	46	10	1	3	16		
Fort Wayne, IN	98	68	20	6	2	2	7	Pacific	1,871	1,289	396	120	37	29	167		
Gary, IN	8	5	3	—	—	—	—	Berkeley, CA	11	6	2	2	—	1	1		
Grand Rapids, MI	65	41	15	3	3	3	7	Fresno, CA	U	U	U	U	U	U	U		
Indianapolis, IN	184	123	31	21	6	3	13	Glendale, CA	27	23	3	1	—	—	3		
Lansing, MI	73	56	12	4	1	—	6	Honolulu, HI	82	67	10	3	1	1	6		
Milwaukee, WI	133	93	33	2	1	4	7	Long Beach, CA	87	56	23	4	1	3	10		
Peoria, IL	54	37	12	—	1	4	14	Los Angeles, CA	314	225	57	22	6	4	50		
Rockford, IL	78	62	11	—	3	2	5	Pasadena, CA	21	16	3	—	2	—	4		
South Bend, IN	51	42	6	3	—	—	5	Portland, OR	148	93	38	10	4	3	9		
Toledo, OH	126	93	24	4	4	1	14	Sacramento, CA	196	142	39	9	4	2	13		
Youngstown, OH	75	62	10	2	—	1	8	San Diego, CA	191	133	39	12	5	2	19		
W.N. Central	664	426	152	43	23	20	52	San Francisco, CA	158	92	39	20	5	2	20		
Des Moines, IA	40	29	10	—	—	1	1	San Jose, CA	257	181	55	12	2	7	17		
Duluth, MN	41	28	9	3	1	—	3	Santa Cruz, CA	37	27	5	3	1	1	3		
Kansas City, KS	18	12	2	2	2	—	1	Seattle, WA	137	85	34	10	5	3	5		
Kansas City, MO	127	84	32	6	1	4	6	Spokane, WA	55	39	14	1	1	—	4		
Lincoln, NE	60	43	13	4	—	—	9	Tacoma, WA	150	104	35	11	—	—	3		
Minneapolis, MN	74	44	20	6	3	1	7	Total	13,402**	9,039	2,955	824	287	294	938		
Omaha, NE	88	53	18	10	3	4	11										
St. Louis, MO	77	36	16	7	9	9	5										
St. Paul, MN	59	42	14	1	1	1	3										
Wichita, KS	80	55	18	4	3	—	6										

U: Unavailable. —:No reported cases.

* Mortality data in this table are voluntarily reported from 122 cities in the United States, most of which have populations of $\geq 100,000$. A death is reported by the place of its occurrence and by the week that the death certificate was filed. Fetal deaths are not included.[†] Pneumonia and influenza.[‡] Because of changes in reporting methods in this Pennsylvania city, these numbers are partial counts for the current week. Complete counts will be available in 4 to 6 weeks.[§] Because of Hurricane Katrina, weekly reporting of deaths has been temporarily disrupted.

** Total includes unknown ages.

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