

though GISP has been successful in identifying important shifts in gonococcal epidemiology and antimicrobial susceptibility, its effectiveness should be complemented through partnerships with local health departments and health-care providers. Clinicians should remain vigilant for treatment failures (evidenced by persistent symptoms or a positive follow-up test despite treatment) among patients treated for gonorrhea with CDC-recommended antibiotics and obtain specimens for gonococcal culture from patients with possible treatment failure. Clinicians caring for patients with gonorrhea, particularly MSM in the western United States, might consider having patients return 1 week after treatment for test-of-cure with culture, preferably, or with nucleic acid amplification tests (NAATs).

If a patient experiences cefixime treatment failure, clinicians should re-treat the patient with 250 mg ceftriaxone intramuscularly and 2 g azithromycin orally.<sup>4</sup> If a patient experiences a ceftriaxone treatment failure, clinicians should consult with an infectious disease expert and CDC regarding re-treatment. These patients should return for tests-of-cure within 1 week, preferably with culture, or, if culture is not available, with NAAT. If the follow-up NAAT result is positive, a specimen for culture should be obtained. Clinicians also should ensure that the patient's sex partners from the preceding 2 months are tested for gonorrhea (preferably with culture) and empirically treated with ceftriaxone 250 mg intramuscularly and azithromycin 2 g orally. Finally, these treatment failures should be reported to the local or state health department within 24 hours. Laboratorians are requested to report gonococcal isolates with decreased cefixime or ceftriaxone susceptibility ( $\geq 0.5$   $\mu\text{g/mL}$ ) to their local or state health departments within 24 hours of identification. Local and state health departments are requested to report these cases immediately to CDC (gispinfo@cdc.gov or 404-639-8659). Isolates can be submitted to CDC's

Neisseria Reference Laboratory for confirmation susceptibility testing.\*

Local and state health departments also should promote maintenance of local gonococcal culture capacity, despite the widespread use of NAATs. Gonococcal antibiotic susceptibility testing (AST), necessary for identification of resistant isolates, only can be performed with culture specimens. Health departments should establish options for local availability of gonococcal cultures and AST, and consider enhancing surveillance for cephalosporin-resistant gonorrhea. Options for local culture and AST availability might involve building or enhancing local gonorrhea reference laboratory testing capacity, partnering with regional clinical laboratories or academic institutions, or sending isolates to CDC for susceptibility testing. Enhanced surveillance might include monitoring of multiple cases from the same patient reported within 30-60 days, often discarded as presumed duplicates. Finally, effective alternative antibiotics or antibiotic combinations for the treatment of gonorrhea are needed urgently; thus, the development of novel antibiotics and clinical trials to study combinations of existing antibiotics is necessary.

The findings in this report are subject to at least two limitations. First, data available in GISP only include results from urethral gonococcal isolates from males attending publicly funded STD clinics. Second, the clinical significance of shifts in MICs below CLSI criteria for decreased susceptibility is unclear, and transient increases and decreases in cephalosporin MICs have been observed previously in GISP. However, in light of similar trends in other regions of the world, the patterns observed in GISP with higher MICs in isolates from the west and MSM, and the ability of *N. gonorrhoeae* to develop resistance, the increasing MICs to cephalosporins in the United States are concerning. Vigilance of clinicians and enhanced surveillance by local and state health departments will be critical for early detection of treatment failures.

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\*Instructions available at [http://www.cdc.gov/std/gonorrhea/arg/specimen\\_shipping\\_instructions1-29-08.pdf](http://www.cdc.gov/std/gonorrhea/arg/specimen_shipping_instructions1-29-08.pdf).

# Adult Blood Lead Epidemiology and Surveillance—United States, 2008-2009

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2 figures, 1 table omitted

LEAD EXPOSURE CAN RESULT IN ACUTE or chronic adverse effects in multiple organ systems, ranging from subclinical changes in function to symptomatic, life-threatening toxicity. Despite improvements in public health policies and substantial reductions in blood lead levels (BLLs) in adults, lead exposure remains an important health problem worldwide. Approximately 95% of all elevated BLLs reported among adults in the United States are work-related,<sup>1</sup> and recent research has raised concerns regarding the toxicity of BLLs as low as 5  $\mu\text{g/dL}$ .<sup>2,3</sup> CDC's state-based Adult Blood Lead Epidemiology and Surveillance (ABLES) program tracks laboratory-reported elevated BLLs. To update rate trends and identify industry subsectors and nonoccupational activities with high lead exposures, CDC collected and analyzed 2008-2009 data from 40 state ABLES programs. The results of that analysis indicated that a decline in the prevalence of elevated BLLs ( $\geq 25$   $\mu\text{g/dL}$ ) was extended, from 14.0 per 100,000 employed adults in 1994 to 6.3 in 2009. Industry subsectors with the

highest numbers of lead-exposed workers were battery manufacturing, secondary smelting and refining of nonferrous metals, and painting and paper hanging. The most common nonoccupational exposures to lead were shooting firearms; remodeling, renovating, or painting; retained bullets (gunshot wounds); and lead casting. The findings underscore the need for government agencies, employers, public health professionals, health-care providers, and worker-affiliated organizations to increase interventions to prevent workplace lead exposure, and the importance of conducting lead exposure surveillance to assess the effectiveness of these interventions.

State ABLES programs (1) collect data on adult BLLs from laboratories and physicians through mandatory reporting requirements; (2) assign unique identifiers to each adult to account for multiple BLL records; (3) follow-up on adults with BLLs  $\geq 25$   $\mu\text{g}/\text{dL}$  with laboratories, health-care providers, employers, or workers to ensure completeness of information (e.g., the industry where the adult is employed and whether the exposure source is occupational, nonoccupational, or both); and (4) code the industry where the adult worked using the 1987 Standard Industrial Classification (SIC) or the 2002 North American Industry Classification System (NAICS). The requirement for laboratories and health-care providers to notify state authorities about BLLs varies among ABLES states, ranging from the reporting of all BLLs to only BLLs  $\geq 40$   $\mu\text{g}/\text{dL}$ .<sup>\*</sup> Most ABLES states submit data on all BLLs to CDC's National Institute for Occupational Safety and Health (NIOSH), including records from adults whose BLLs fall below the state reporting requirement.

Adults were defined as persons aged  $\geq 16$  years. For adults with more than one BLL record in a given year, only the highest BLL was included. Elevated BLLs were defined as blood lead concentrations  $\geq 25$   $\mu\text{g}/\text{dL}$ . Prevalence numerators were either "state residents" (adults residing in the reporting state)

or "state residents and nonresidents" (all adults reported by a state) with elevated BLLs (a distinction in the data since 2002); both employed and un-employed persons were included in the numerators. Denominators were the annual employed population aged  $\geq 16$  years for the period 2008-2009, as obtained from the U.S. Bureau of Labor Statistics.<sup>4</sup> To calculate annual state prevalences, the numbers of adults with elevated BLLs from each of the 40 states reporting<sup>†</sup> were divided by the state's annual employed population and expressed as a rate per 100,000 employed adults. The combined state numerators and denominators for each year were then used to calculate national (40-state) prevalence rates for 2008-2009. The percentage of adults with BLL  $\geq 40$   $\mu\text{g}/\text{dL}$  among adults with BLL  $\geq 25$   $\mu\text{g}/\text{dL}$  in each industry subsector was used to identify industry subsectors with the highest lead exposures. Additional information regarding interpretation of specific state ABLES data, definitions, and rate calculations is available at the ABLES program website.<sup>5</sup>

A total of 40 states submitted data in both 2008 and 2009. Overall, the prevalence of elevated BLLs ( $\geq 25$   $\mu\text{g}/\text{dL}$ ) among state residents and nonresidents declined from 14.0 adults per 100,000 employed adults in 1994<sup>4</sup> to 7.4 in 2008 and 6.3 in 2009. Rates were slightly lower (7.1 and 6.1 respectively) when only state resident adults were included (Figure 1). The number of states with high prevalence of elevated BLLs (i.e.,  $\geq 20$  adults per 100,000 employed adults) decreased from six of 17 states in 1994 to three of 40 states in 2009 (Figure 2). ABLES states reported 9,325 and 7,674 state resident adults with elevated BLLs in 2008 and 2009, respectively. State resident prevalence of elevated BLLs for 2008 ranged from 0.5 per 100,000 employed adults (Hawaii) to 37.6 (Pennsylvania); and for 2009, from 0.3 (Hawaii) to 32.0 (Pennsylvania). Prevalence of state resident and nonresident adults with BLLs  $\geq 40$   $\mu\text{g}/\text{dL}$  declined from 3.5 in 1994 to 1.2 in 2008 and 0.9 in 2009.

### What is already known on this topic?

Lead exposure among adults remains almost exclusively an occupational health problem in the United States, although the health effects from lead exposure are well characterized and controls to reduce lead exposure for workers exist.

### What this report adds?

During 2008-2009, the prevalence of U.S. adults with blood lead levels (BLLs)  $\geq 25$   $\mu\text{g}/\text{dL}$  continued to decrease, to 6.3 per 100,000 employed adults in 2009 from 14.0 in 1994. The highest prevalences of elevated BLLs continue to be found among workers in the manufacturing, construction, and mining industries.

### What are the implications for public health practice?

Measures to improve lead exposure surveillance and preventive interventions focused in the manufacturing, construction, and mining industries should be implemented by government agencies, employers, and worker-affiliated organizations.

In 2008, these rates ranged from 0.2 (Arizona) to 6.5 (Pennsylvania) and in 2009, from zero (Alaska and Wyoming) to 4.2 (Pennsylvania).

Thirty-seven states in 2008 and 38 states in 2009 submitted data on industry and exposure source (8,450 and 7,112 state resident adults with elevated BLLs, respectively).<sup>‡</sup> Among all reported cases of elevated BLLs, exposures at work accounted for 6,081 (71.9%) in 2008 and 4,998 (70.1%) in 2009. Among only those cases with known exposure type (i.e., occupational or nonoccupational), occupational exposures accounted for 94.8% of cases in 2008 and 93.8% in 2009. The greatest proportions of adults with elevated BLLs were employed in three main industry sectors: manufacturing (72.1% in 2008 and 72.3% in 2009), construction (13.2% in 2008 and 14.4% in 2009), and mining (6.6% in 2008 and 5.1% in 2009). Industry subsectors with

the highest numbers of workers with elevated BLLs were manufacturing of storage batteries, secondary smelting and refining of nonferrous metals, and painting and paper hanging. Industry subsectors with the greatest proportions of adults with BLLs  $\geq 40$   $\mu\text{g}/\text{dL}$  among adults with BLLs  $\geq 25$   $\mu\text{g}/\text{dL}$  were painting and paper hanging; bridge, tunnel, and elevated highway construction; copper foundries; special trade contractors; and heavy construction industries. Nonoccupational exposures accounted for 337 (4.0%) and 328 (4.6%) of all adult cases in 2008 and 2009, respectively. The most common nonoccupational exposures were from shooting firearms; remodeling, renovating, or painting; retained bullets; and lead casting.

**Reported by:** Walter A. Alarcon, MD, Janet R. Graydon, Geoffrey M. Calvert, MD, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC. Corresponding contributor: Walter A. Alarcon, CDC, walarcon@cdc.gov, 513-841-4451.

**CDC Editorial Note:** Job activities known to involve the use or disturbance of lead include the following: handling of lead-containing powders, liquids, or pastes; production of dust or fumes by melting, burning, cutting, drilling, machining, sanding, scraping, grinding, polishing, etching, blasting, torching, or welding lead-containing solids; and dry sweeping of lead-containing dust and debris.<sup>3</sup> Since 1994, ABLES surveillance results indicate an overall decreasing trend in the prevalence of elevated BLLs in U.S. adults and a decrease in the number of states with the highest rates (i.e.,  $\geq 20$  adults per 100,000). This decrease, in part, might be attributable to a decline in the number of manufacturing jobs with potential for lead exposure over time and prevention measures that have been enacted since the early 1990s, including (1) improved interventions by state ABLES programs,<sup>8</sup> worker-affiliated organizations, and federal programs such as the Occupational Safety and Health Administration (OSHA) National Emphasis Program to reduce lead exposure<sup>||</sup> and (2) measures imple-

mented by industry (e.g., engineering and work practice controls,<sup>¶</sup> and respiratory protection). However, the decrease in rates also might reflect low employer compliance with testing and reporting requirements.<sup>6</sup>

ABLES data also underscore that elevated BLLs among adults are almost exclusively an occupational health problem in the United States. Those states with higher rates of elevated BLLs might represent (1) states where higher proportions of workers are employed in high-risk industries (e.g., lead-related manufacturing, construction activities involving lead paint exposure, and lead mining), (2) states where workers in high-risk areas are less likely to be protected by engineering and workplace controls, or (3) states where greater compliance with testing requirements by employers and reporting requirements by laboratories result in larger numbers of reported cases of elevated BLLs. Similar to findings in previous years, the 2008-2009 data indicate that five industry subsectors accounted for approximately 65% and 14 subsectors accounted for approximately 80% of adults with elevated BLLs who were exposed at work. Higher lead exposures likely are present in those industries with the greatest proportions of elevated BLLs  $\geq 40$   $\mu\text{g}/\text{dL}$ .

ABLES data are used to track *Healthy People 2020* objective OSH-7, to reduce the prevalence of persons who have elevated BLLs from work exposures.<sup>7</sup> The *Healthy People 2020* target incorporates the new  $\geq 10$   $\mu\text{g}/\text{dL}$  operational definition for elevated BLLs established by ABLES consistent with guidance from the Association of Occupational and Environmental Clinics and the Council of State and Territorial Epidemiologists.<sup>8</sup>

The findings in this report are subject to at least four limitations. First, the number of adults with elevated BLLs reported to ABLES likely is underreported because some employers might not provide BLL testing to all lead-exposed workers as required by OSHA

regulations and because some laboratories might not report all tests as required by state regulations.<sup>9</sup> Second, because denominators are the numbers of employed persons, aged  $\geq 16$  years, unemployed adults who might be at risk for lead exposure, although included in the numerator, are not included in the denominator. Third, although state ABLES programs ascertain the work-relatedness of a lead exposure by following up with laboratories, physicians, employers, or workers, the possibility of misclassification of occupational versus nonoccupational cases cannot be excluded. Finally, analyzing lead exposures using a threshold of 25  $\mu\text{g}/\text{dL}$  likely underestimates harmful occupational lead exposure because lead-related toxicity can occur at levels as low as 5  $\mu\text{g}/\text{dL}$  and the *Healthy People 2020* target is set at 10  $\mu\text{g}/\text{dL}$ .

Progress toward meeting the *Healthy People 2020* target for reducing the prevalence of adults with BLLs  $\geq 10$   $\mu\text{g}/\text{dL}$  from workplace lead exposures can be aided by improving (1) worker protection programs developed and maintained by employers<sup>#</sup>; (2) government activities such as ABLES programs, which can effectively intervene to prevent lead exposures and the OSHA National Emphasis Program to reduce lead exposure; (3) research and interventions by stakeholder organizations; and (4) education of the public regarding preventing nonoccupational exposures. Emphasis should be placed on those industries identified in this report with the highest numbers of workers with elevated BLLs: manufacturing of storage batteries, secondary smelting and refining of nonferrous metals, painting and paper hanging, and bridge, tunnel, and elevated highway construction.

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\*Information on blood lead laboratory results reporting requirements by state is available at the ABLES program website <http://www.cdc.gov/niosh/topics/ABLES/State-Contacts.html>.

†A total of 40 states submitted data in 2008 and 2009: Alabama, Alaska, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming.

‡A total of 38 of the 40 states (all except Indiana and Kentucky) provided data on industry in 2009 and 37 in 2008 (all except Alabama, Indiana, and Kentucky).

§Interventions include (1) conducting follow-up interviews with physicians, employers, and workers; (2) investigating worksites; (3) providing technical assistance; (4) providing Occupational Safety and Health Administration (OSHA) referrals for consultation and enforcement; and (5) developing and disseminating educational materials and conducting outreach programs.

||Additional information available at [http://www.osha.gov/OshDoc/Directive\\_pdf/CPL\\_03-00-0009.pdf](http://www.osha.gov/OshDoc/Directive_pdf/CPL_03-00-0009.pdf).

¶Engineering controls and good work practices are the preferred methods of minimizing exposures to airborne lead at the worksite. Engineering control methods that can be used to reduce or eliminate lead ex-

posures can be grouped into three main categories: (1) substitution, (2) isolation, and (3) ventilation. Additional information available at [http://www.osha.gov/dts/osta/otm/otm\\_v/otm\\_v\\_3.html#2](http://www.osha.gov/dts/osta/otm/otm_v/otm_v_3.html#2). #Additional information available at [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=fact\\_sheets&p\\_id=161](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=fact_sheets&p_id=161).

## Notes From the Field: Multiple Cases of Measles After Exposure During Air Travel—Australia and New Zealand, January 2011

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IN JANUARY 2011, MEASLES WAS DIAGNOSED in three New Zealand residents recently returned from a 17-day trip to Singapore and the Philippines. On January 11, they had flown on a 7.5-hour flight from Singapore to Brisbane, Australia, remained in a transit lounge for 9.5 hours, and then continued on a 4-hour flight to Auckland, New Zealand. Searches in Australia and New Zealand for secondary cases among passengers on either flight resulted in the identification of three cases among passengers on the Singapore-to-Brisbane flight and five cases among passengers on the Brisbane-to-Auckland flight.

The three index cases had rash onsets occurring January 11-15 and tested positive for measles immunoglobulin M (IgM). One Australian case and one New Zealand case were diagnosed clinically, but the remaining six secondary cases, with rash onsets occurring January 21-26, were positive for measles RNA by nucleic acid amplification testing. Each specimen was genotype D9 with the same genetic sequence. Only three of the eight secondary cases were in persons seated within two rows of a person with an index case: two in unvaccinated persons and one in a person whose measles vaccination status

was unknown. One secondary case was in a person of unknown vaccination status seated four rows away from the nearest person with an index case, one was in a person with a history of having been vaccinated against measles twice who was seated six rows away, and three were in unvaccinated children 11 rows away, in a separate cabin. The three index cases were in unvaccinated children aged 12-17 years.

Australian contact investigation guidelines for exposure to a single passenger with infectious measles aboard an aircraft focus on the seats within two rows of persons with index cases<sup>1</sup>; five of the eight secondary cases in this outbreak were in persons who were farther away. Three persons likely were infectious aboard the aircraft, not one, and recent literature suggests that exposure might extend farther than two rows.<sup>2,3</sup> In addition, because measles is readily transmissible through airborne transmission, the opportunity for exposure existed in the jetways, the arrival and departure terminals, and the transit lounge. This outbreak highlights the transmissibility of measles and the risk for exposure during international travel, which might start at the airport before departure, and the need for travelers to be protected against measles by vaccination.

**Reported by:** Richard Hoskins, MBChB, Auckland Regional Public Health Svc, Auckland District Health Board, New Zealand; Renu Vohra, MD, MBBS, Queensland Medical Laboratory, Murrarie; Susan Vlack, MBBS, Megan Young, MBBS, Kim Humphrey, Central Public Health Svcs; Christine Selvey, MBBS, Frank Beard, MBChB, Communicable Disease Br, Div of the Chief Health Officer, Health Protection Directorate; Michael Lyon, BAppSc, Forensic and Scientific Svcs, Queensland Health, Australia. Corresponding contributor: Susan Vlack, [susan\\_vlack@health.qld.gov.au](mailto:susan_vlack@health.qld.gov.au), +61 7 3142 1800.

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