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Invasive *Staphylococcus aureus* Infections Associated with Pain Injections and Reuse of Single-Dose Vials — Arizona and Delaware, 2012

Transmission of life-threatening bacterial infections can occur when health-care personnel do not adhere to Standard Precautions and instead use medication in containers labeled as single-dose or single-use for more than one patient (*1*). This report summarizes the investigation of two outbreaks of invasive *Staphylococcus aureus* infection confirmed in 10 patients being treated for pain in outpatient clinics. In each outbreak, the use of single-dose or single-use vials (SDVs) for more than one patient was associated with infection transmission. In both investigations, clinicians reported difficulty obtaining the medication type or vial size that best fit their procedural needs. These outbreaks are a reminder of the serious consequences that can result when SDVs are used for more than one patient. Clinician adherence to safe injection practices, particularly when appropriately sized SDVs are unavailable, is important to prevent infection transmission. If SDVs must be used for more than one patient, full adherence to *U.S. Pharmacopeia* standards is critical to minimize the risks of multipatient use.

Pain Management Clinic — Arizona

On April 8, 2012, the Arizona Department of Health Services was notified of a patient with acute mediastinitis with blood and pleural fluid cultures positive for methicillin-resistant *Staphylococcus aureus* (MRSA). The report indicated this patient and two other patients with culture-confirmed invasive MRSA infections had undergone procedures recently at an outpatient pain management clinic.

Investigations by the county and state health departments confirmed that the three MRSA-infected patients received pain injections on the same day, along with 25 other patients. Two MRSA-infected patients received epidural steroid injections, and one received a stellate ganglion block. Ten persons, including the MRSA-infected patients, received contrast injections for radiologic imaging to guide medication needle placement. Each morning, clinic staff members typically prepared contrast medium in the patient procedure room, before the arrival of patients; two new syringes were used to withdraw 5 mL each from a 10 mL SDV of contrast medium (300 mgl/mL) and a 10 mL SDV of saline solution. The contents from each syringe then were transferred to the alternate vial, resulting in two 10 mL vials of diluted contrast solution, one for use in the morning and one reserved for the afternoon. Among patients receiving contrast on the day of the outbreak, six received injections from the morning vial and four from the afternoon vial. All of the patients with MRSA infections received diluted contrast from the afternoon vial.

The three patients with MRSA infections went to a local hospital 4–8 days after their outpatient pain remediation procedures. They required inpatient care for severe infections, including acute mediastinitis, bacterial meningitis, epidural abscess, and sepsis. Hospitalization ranged from 9 to 41 days, with additional long-term acute care required for one patient. The fourth recipient of diluted contrast from the afternoon vial was found deceased at home, 6 days after treatment at the clinic. The cause of death was reported as multiple-drug overdose; however, invasive MRSA infection could not be ruled out.

Samples from six unopened vials of contrast medium from the lot in use by the facility at the time of the outbreak were sent to CDC for analysis. No intrinsic contamination was identified using standard bacterial culture methods. Unopened vials of saline were not cultured because the lot in use at the time of the outbreak was not available and saline was routinely used

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as part of other procedures at the clinic that were not associated with infection. The Food and Drug Administration was contacted for additional reports of intrinsic contamination associated with the contrast medium; none had been reported.

In addition to identifying improper reuse of SDVs for more than one patient, county health officials also noted that health-care personnel did not adhere to Standard Precautions because they failed to wear face masks when performing spinal injections (*2*). In response to this outbreak, the Arizona Department of Health Services provided recommendations to the facility regarding Standard Precautions, including safe injection practices, and CDC's *Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care* (*3*).

Orthopedic Clinic — Delaware

The Division of Public Health of the Delaware Department of Health and Social Services was notified on March 19 of seven patients admitted to a hospital with evidence of septic arthritis or bursitis. Cultures of fluids from the affected sites (knee [three patients], hip [two], ankle [one], and thumb [one]) indicated that all of the patients had methicillin-susceptible *S. aureus* infections. All seven patients required debridement of the infected sites and intravenous antimicrobial therapy, with an average length of hospitalization of 6 days (range: 3–8 days). All seven patients had received joint injections from the same outpatient clinic during March 6–8.

Site visits to this hospital-affiliated orthopedic clinic were conducted by personnel from hospital infection prevention and risk management departments. Thirteen patients had received joint injections for pain remediation during the 3-day period. Of the seven patients with *S. aureus* infections, five received their injections on the same day. Three additional patients who received injections during March 6–8 developed symptoms that suggested an infection but did not have cultures taken and were treated with oral antibiotics on an outpatient basis.

The reuse of SDVs of the anesthetic bupivacaine for multiple patients was the only breach of safe practice identified during the investigation and represented a recent change. Previously, the orthopedic practice had used 10 mL SDVs of bupivacaine for single-patient use. When a national drug shortage disrupted the supply of 10 mL SDVs, office staff members began using 30 mL SDVs of bupivacaine for multiple patients. The joint injection procedures typically required 1–8 mL of anesthetic, with each injection prepared immediately in advance of the procedure in a separate, clean, medication preparation room. Only one 30 mL vial of bupivacaine was opened at any given time; each vial was accessed over a course of several hours for multiple patients until all contents were withdrawn. Occasionally, an opened 30 mL vial was stored in a medical cabinet for use the next day.

Six *S. aureus* isolates from clinical cultures were tested by CDC, found indistinguishable by pulsed-field gel electrophoresis (PFGE), and identified as PFGE type USA600. As

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What is already known on this topic?

Transmission of life-threatening infections can occur when single-dose or single-use vials (SDVs) are used improperly for multiple patients. In 2007, CDC included injection safety as part of Standard Precautions.

What is added by this report?

In 2012, a total of 10 patients in Arizona and Delaware were confirmed to have invasive *Staphylococcus aureus* infections following pain injections at two outpatient clinics. These Infections were associated with multipatient use of SDVs. Difficulties in obtaining appropriate vial sizes, either because of a national drug shortage or because the vial size needed by health-care providers was not manufactured, might have led to deviation from recommended practices. Since 2007, the year that injection safety was included as part of Standard Precautions, at least 20 outbreaks associated with use of single-dose or single-use medications for more than one patient have occurred.

What are the implications for public health practice?

Public health authorities play a critical role in investigating outbreaks in health-care settings and helping to implement control measures. In addition, practices identified as part of these investigations help in the development of evidence-based infection prevention recommendations. This report reminds health-care providers of the serious consequences of multipatient use of SDVs that can occur even when health-care workers believe they are being careful.

part of the investigation, nasal swabs were collected from the three clinic medical providers and four ancillary staff members who were involved with the preparation or administration of injections. Two staff members whose responsibilities included preparing injections were colonized with *S. aureus*; one had a strain that was indistinguishable from the outbreak strain.

In response to this outbreak, health-care providers and ancillary staff members received extensive education regarding Standard Precautions, including safe injection practices. The Division of Public Health also issued a statewide health alert to the medical community regarding injection safety (*4*).

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Editorial Note

The outbreaks described in this report demonstrate the serious consequences that can result from misuse of SDVs. Medications labeled as "single dose" or "single use" typically are preservative-free and should be dedicated for single-patient use to protect patients from infection risks (*5*). In both outbreaks, health-care providers reported difficulty in obtaining specific medication types and vial sizes, prompting them to use contents from SDVs for more than one patient. As evidenced by these outbreaks, the smallest vial size manufactured can exceed the amount routinely needed for individual patients. Furthermore, although contrast medium is manufactured in lower concentrations, such that dilution can be avoided, the Arizona clinic reported difficulty obtaining a reliable supply of the lower concentration.

Proper use of SDVs in clinical settings consists of 1) withdrawing contents into a new sterile syringe in an aseptic manner, 2) promptly using the contents for a single patient during a single procedure, and 3) disposing of the vial and any remaining contents. To prevent unsafe practices and patient harm, CDC recently issued a communication clarifying recommended practices for safe use of SDVs (*1*). The safest option remains dedicating SDVs to individual patients. When individually packaged and appropriately sized SDVs are unavailable, qualified health-care personnel may repackage medication from a previously unopened SDV into multiple single-use vehicles (e.g., vials or syringes). However, this procedure should only be performed using a laminar-flow hood in accordance with standards in *U.S. Pharmacopeia* General Chapter 797 (Pharmaceutical Compounding — Sterile Preparations). Strict adherence to *U.S. Pharmacopeia* 797 standards is critical and might have helped prevent recent outbreaks associated with unsafe practices (*6,7*). These outbreaks could be avoided if smaller medication vial sizes that better fit procedural needs were manufactured.

Since 2007, the year that injection safety was included as part of Standard Precautions, 20 outbreaks associated with use of single-dose or single-use medications for more than one patient have been reported (*1*; CDC, unpublished data, 2012). These investigations help remind health-care providers of infection prevention practices that are critical for patient safety. These outbreaks also demonstrate the critical role of public health experts in investigating clusters of health-care–associated infections. Whereas the Delaware facility received infection prevention assistance from an affiliated hospital, the Arizona facility did not have access to a similar resource, apart from the guidance provided by the state and county health departments. When outbreaks or clusters are identified, prompt notification of public health authorities is imperative to ensure that appropriate case-finding activities and infection control measures are implemented to prevent additional harm.

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Babesiosis Surveillance — 18 States, 2011

Babesiosis is caused by protozoan parasites of the genus *Babesia* that infect red blood cells. *Babesia* infection can range from asymptomatic to life threatening. Clinical manifestations might include fever, other nonspecific influenza-like symptoms, and hemolytic anemia (*1*). *Babesia* parasites in nature usually are tickborne but they also are transmissible via blood transfusion or congenitally (*1,2*). In recent years, reports of tickborne and transfusion-associated cases have increased in number and geographic distribution (*2–6*). However, the lack of a standard case definition hindered the ability of public health authorities to monitor cases and to develop evidence-based prevention and control measures. In January 2011, national surveillance for human babesiosis was begun in 19 jurisdictions (18 states and one city), using a standard case definition developed jointly by CDC and the Council of State and Territorial Epidemiologists (*7*). This report summarizes the results for 2011. For the first year of babesiosis surveillance, health departments notified CDC of 1,124 confirmed and probable cases. Cases were reported by 15 of the 18 states where babesiosis was reportable; however, 1,092 cases (97%) were reported by seven states (Connecticut, Massachusetts, Minnesota, New Jersey, New York [including New York City], Rhode Island, and Wisconsin). Cases were identified in persons aged <1–98 years; 57% were in persons aged ≥60 years. Among patients for whom data were available, 82% (717 of 879) had symptom onset dates during June–August. Ongoing national surveillance using the standard case definition will provide a foundation for developing evidence-based prevention and control measures to reduce the burden of babesiosis.

Health departments notify CDC of cases of babesiosis via the National Notifiable Diseases Surveillance System (NNDSS), using a standard case definition (Table 1). In addition to basic demographic information (e.g., age, sex, and county of residence) provided via NNDSS, supplemental data (e.g., symptoms and history of transfusion) can be submitted to CDC using a disease-specific case report form (CRF). In 2011, babesiosis was reportable in 18 states and one city (Table 2) (*8*). Because babesiosis has been a reportable condition in some states for years, state-developed CRFs already had been in use to capture supplemental data. To promote standard data collection, CDC developed a babesiosis CRF, which was approved by the Office of Management and Budget in August 2011.* Supplemental data, derived from CDC's or a state's CRF, were merged manually with NNDSS records by matching a case identification number or demographic data. If case records had conflicting data, the more detailed record was considered correct.

*The CDC-developed babesiosis CRF is available at http://www.cdc.gov/parasites/babesiosis/resources/babesiosis_case_report_form.pdf.

In this summary, data for confirmed and probable cases were combined. Incidence rates were calculated by using 2010 population data from the U.S. Census Bureau (*9*). The seven states with well-established foci of zoonotic transmission (Connecticut, Massachusetts, Minnesota, New Jersey, New York, Rhode Island, and Wisconsin) are referred to as *Babesia microti*–endemic states (*2*). The Wilcoxon rank-sum test was used to compare the ranked distributions of ordinal variables.

For 2011, CDC was notified via NNDSS of 1,124 cases of babesiosis: 847 were classified as confirmed cases and 277 as probable cases. Supplemental data were provided for 797 (71%) of the 1,124 cases. The median age of patients was 62 years (range: <1–98 years); 63% were male, 34% were female, and the sex was unknown for 3% (Table 2). Among the 583 cases for which data on both race and ethnicity were available, more cases were reported in non-Hispanic whites than in persons of other races and ethnicities.

The 1,124 cases occurred in residents of 15 of the 18 states in which babesiosis was a reportable disease in 2011 (Table 2); 1,092 cases (97%) were reported by the seven main *B. microti*–endemic states. County-level incidence rates ranged from 0 to >100 cases per 100,000 persons (Figure 1). The state in which exposure occurred was available for 202 patients, 192 (95%) of whom became infected in their state of residence and 10 (5%) in a different state. Of the 295 patients for whom data were available, 156 (53%) recalled a tick bite in the 8 weeks before symptom onset. Reports for nine patients indicated that they also were diagnosed with another tickborne disease, either Lyme disease or anaplasmosis.

Ten cases of babesiosis in transfusion recipients were classified by the reporting health departments as transfusion associated, and two blood donors were reported. Each of the two blood donors was linked to one recipient; linked donors were not reported for eight of the 10 cases. Four other patients received blood transfusions before symptom onset, but whether these cases were transfusion associated was not known. One reported case was attributed to congenital transmission.

Babesia laboratory data were provided for 748 patients (574 with confirmed cases and 174 with probable cases). More than one test result was reported for 243 patients; 345 patients had positive blood-smear results, 409 had positive polymerase chain reaction (PCR) results, and 272 were seropositive (174 were classified as having probable cases, one of whom also had positive PCR results). Species-level data were provided for 429 cases, all of which were caused by *B. microti*. None of the reported cases were known to be caused by *Babesia* species other than *B. microti*.

TABLE 1. National surveillance case definition for babesiosis*

Clinical evidence	**Objective** One or more of the following: fever, anemia, or thrombocytopenia. **Subjective** One or more of the following: chills, sweats, headache, myalgia, or arthralgia.
Epidemiologic evidence for transfusion transmission	For the purposes of surveillance, epidemiologic linkage between a transfusion recipient and a blood donor is demonstrated if all of the following criteria are met: **In the transfusion recipient** Received one or more red blood cell (RBC) or platelet transfusions within 1 year before the collection date of a specimen with laboratory evidence of *Babesia* infection; **and** At least one of these transfused blood components was donated by the donor described below; **and** Transfusion-associated infection is considered at least as plausible as tickborne transmission; **and** **In the blood donor** Donated at least one of the RBC or platelet components that was transfused into the above recipient; **and** The plausibility that this blood component was the source of infection in the recipient is considered equal to or greater than that of blood from other involved donors. (More than one plausible donor can be linked to the same recipient.)
Laboratory criteria for diagnosis	**Laboratory confirmatory** Identification of intraerythrocytic *Babesia* organisms by light microscopy in a Giemsa, Wright, or Wright-Giemsa–stained blood smear; **or** Detection of *Babesia microti* DNA in a whole blood specimen by polymerase chain reaction (PCR); **or** Detection of *Babesia* spp. genomic sequences in a whole blood specimen by nucleic acid amplification; **or** Isolation of *Babesia* organisms from a whole blood specimen by animal inoculation. **Laboratory supportive** Demonstration of a *Babesia microti* indirect fluorescent antibody (IFA) total immunoglobulin (Ig) or IgG antibody titer of ≥1:256 (or ≥1:64 in epidemiologically linked blood donors or recipients); **or** Demonstration of a *Babesia microti* immunoblot IgG positive result; **or** Demonstration of a *Babesia divergens* IFA total Ig or IgG antibody titer of ≥1:256; **or** Demonstration of a *Babesia duncani* IFA total Ig or IgG antibody titer of ≥1:512.
Case classification	
Confirmed	A case that has confirmatory laboratory results and meets at least one of the objective or subjective clinical evidence criteria, regardless of the mode of transmission (can include clinically manifest cases in transfusion recipients or blood donors).
Probable	A case that has supportive laboratory results and meets at least one of the objective clinical evidence criteria (subjective criteria alone are not sufficient); **or** A case that is in a blood donor or recipient epidemiologically linked to a confirmed or probable babesiosis case (as defined above) **and** Has confirmatory laboratory evidence but does not meet any objective or subjective clinical evidence criteria; **or** Has supportive laboratory evidence and might or might not meet any subjective clinical evidence criteria but does not meet any objective clinical evidence criteria.

* Adapted from CDC's *Case Definitions for Infectious Conditions Under Public Health Surveillance*, available at http://www.cdc.gov/osels/ph_surveillance/nndss/casedef/index.htm. The case definition was developed in collaboration with epidemiologists at CDC and the Council of State and Territorial Epidemiologists.

The median intervals from date of illness onset, date of diagnosis, and date of laboratory testing to the date of report to CDC were 147 days (n = 879 cases; range: 7–475 days), 176 days (n = 116; range: 6–393 days), and 204 days (n = 112; range: 15–380 days), respectively.

Among the patients for whom data were available, 82% (717 of 879) had symptom onset dates during June–August (Figure 2). Symptoms were reported for 794 patients; one patient was asymptomatic. The most frequently reported clinical manifestations included fever (85% [550 of 650 patients]), chills (66% [389 of 590]), and myalgia (64% [371 of 576]). Of the 689 patients for whom data were available, 314 (46%) were hospitalized at least overnight. The median length of hospital stay was 4 days (range: 1–34 days). The patients who were hospitalized were significantly older than those who were not (median age of 68 years [range: <1–96 years] and median age of 58 years [range: 3–89 years], respectively; p-value <0.001). Twenty-four patients were known to be asplenic, 19 (79%) of whom were hospitalized. Four deaths were reported. One patient's death was not attributed to babesiosis; whether babesiosis contributed to the other three patients' deaths is not known.

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Editorial Note

Babesiosis is a preventable and treatable tickborne disease that can be severe and even life-threatening, especially in persons who are asplenic, elderly, or immunosuppressed (*1*). If the diagnosis of babesiosis is being considered, a nonautomated review of blood smears by a laboratory technician should be requested explicitly. Confirmation by a reference laboratory might be needed. Molecular techniques can be used to detect

TABLE 2. Number* and percentage† of reported cases of babesiosis, by selected characteristics — 18 states and one city,§ 2011

Characteristic	No.	(%)
Sex		
Male	707	(62.9)
Female	387	(34.4)
Unknown/Missing	30	(2.8)
Age group (yrs)		
0–9	14	(1.2)
10–19	21	(1.9)
20–29	26	(2.3)
30–39	56	(5.0)
40–49	140	(12.5)
50–59	221	(19.7)
60–69	268	(23.8)
70–79	218	(19.4)
≥80	158	(14.1)
Unknown/Missing	2	(0.2)
Race		
AI/AN	10	(0.9)
A/PI	20	(1.8)
Black	25	(2.2)
White	645	(57.4)
Other	29	(2.6)
Unknown/Missing	395	(35.1)
Ethnicity		
Hispanic	68	(6.1)
Non-Hispanic	554	(49.3)
Unknown/Missing	502	(44.7)
State/Area of residence		
California¶	1	(0.1)
Connecticut	74	(6.6)
Delaware	1	(0.1)
Indiana	0	(0.0)
Maine	9	(0.8)
Maryland¶	4	(0.4)
Massachusetts	208	(18.5)
Minnesota	73	(6.5)
Nebraska	0	(0.0)
New Hampshire	13	(1.2)
New Jersey	166	(14.8)
New York**	361	(32.1)
New York City	57	(5.1)
Oregon	1	(0.1)
Rhode Island	73	(6.5)
Tennessee	1	(0.1)
Vermont¶	2	(0.2)
Washington	0	(0.0)
Wisconsin	80	(7.1)

Abbreviations: AI/AN = American Indian/Alaska Native and A/PI = Asian/Pacific Islander.

* N = 1,124.

† Percentages might not total 100% because of rounding.

§ The 18 states and one city (New York City) in which babesiosis was a reportable condition in 2011 are listed, three of which (Indiana, Nebraska, and Washington) did not notify CDC of any cases.

¶ Five cases (one in California, two in Maryland, and two in Vermont) reportedly were imported (i.e., acquired in another state).

** Not including New York City.

low levels of parasites. The diagnosis of babesiosis should be confirmed parasitologically whenever possible; however, antibody detection by serologic testing can provide supportive evidence for infection.† Persons with asymptomatic *Babesia* infection typically do not require treatment. Symptomatic persons usually are treated for at least 7–10 days, either with atovaquone plus azithromycin, or, for severe cases, with clindamycin plus quinine (*1*).

In 2011, the reported cases of babesiosis occurred most frequently in the spring and summer and in the Northeast and upper Midwest, but cases also were identified in other seasons and regions (e.g., because of travel or non-vectorborne transmission). In part because of concerns about the potential expansion of the geographic range of babesiosis, documenting where infection was acquired is important. For persons who live in or near *B. microti*–endemic areas, determining the state of exposure can be difficult. Most patients did not recall a tick bite. The 10 travel-associated cases accounted for five of the 32 cases reported outside of the *B. microti*–endemic states; information on location of exposure was not provided for the other 27 patients. Even for patients reportedly infected in their states of residence, differentiating between infection resulting from the expanding range of babesiosis and infection acquired during travel to a *B. microti*–endemic region within a state can be challenging.

Ten cases of transfusion-associated babesiosis in blood recipients were reported via national babesiosis surveillance. Currently, no licensed tests for screening U.S. blood donors for evidence of *Babesia* infection are available (*10*). Persons who

What is already known on this topic?

Babesiosis in humans is a preventable and treatable parasitic disease that ranges in severity from asymptomatic to life threatening. *Babesia* parasites are transmitted primarily by the bite of an infected tick but also can be transmitted through blood transfusion. In the United States, tickborne transmission mainly occurs in parts of the Northeast and upper Midwest and usually peaks during the spring and summer.

What is added by this report?

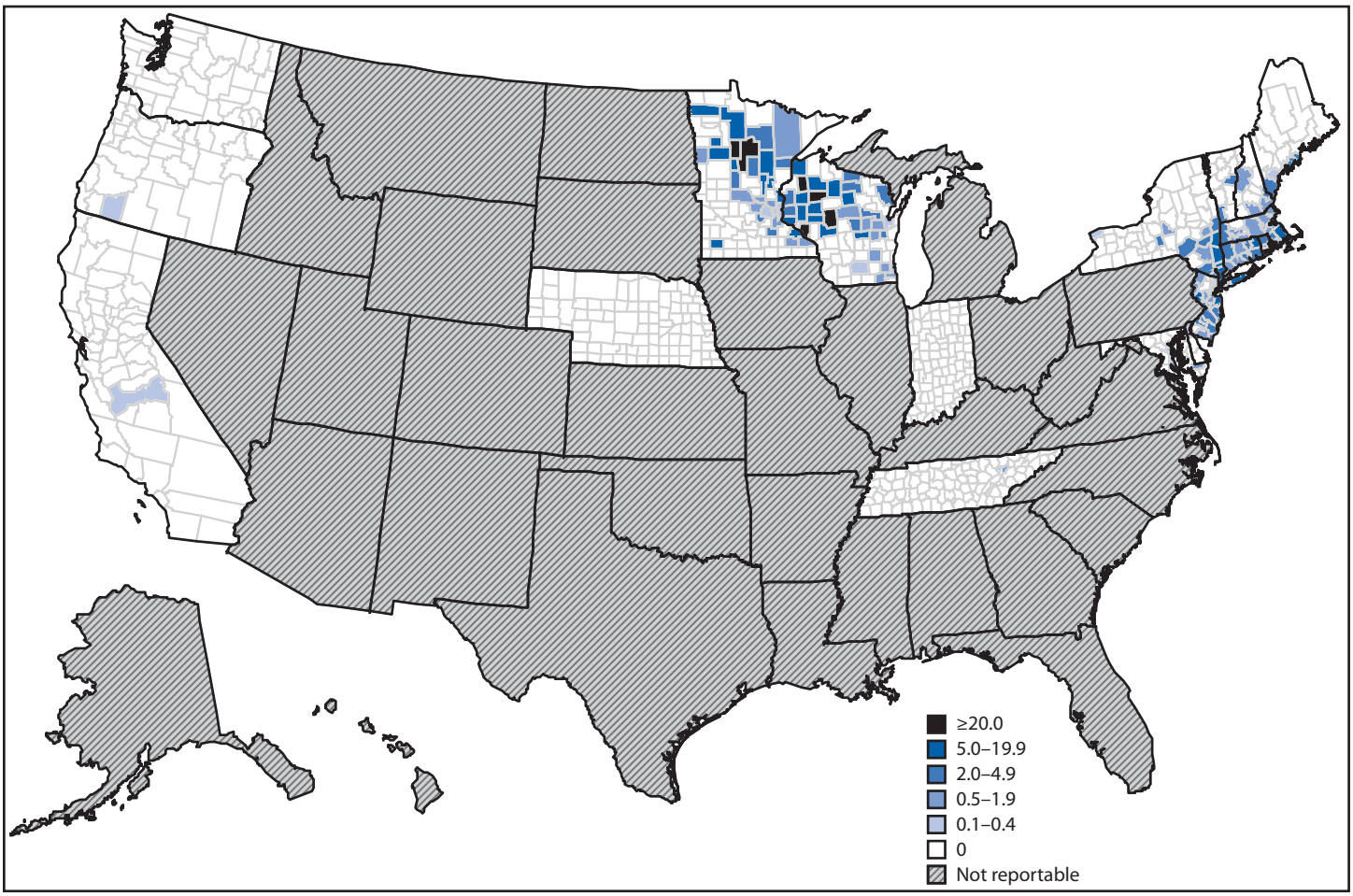
For the first time, U.S. cases of babesiosis were reported using a standard national case definition. In 2011, a total of 1,124 cases of babesiosis were reported. Over half (57%) of the cases were in persons aged ≥60 years, and 97% of cases were reported by seven states.

What are the implications for public health practice?

Tickborne and transfusion-associated cases of babesiosis occur in multiple parts of the United States, including outside of areas of known endemicity. Ongoing national surveillance using the standard case definition will provide a foundation for developing evidence-based prevention and control measures to reduce the burden of babesiosis.

† Additional information available at http://dpd.cdc.gov/dpdx/html/babesiosis.htm.

FIGURE 1. Incidence* of reported cases of babesiosis, by county of residence† — 18 states,§ 2011



* Per 100,000 persons.
† N = 1,116; county of residence was unknown for eight of the 1,124 patients.
§ California, Connecticut, Delaware, Indiana, Maine, Maryland, Massachusetts, Minnesota, Nebraska, New Hampshire, New Jersey, New York, Oregon, Rhode Island, Tennessee, Vermont, Washington, and Wisconsin.

test positive for *Babesia* infection should be advised to refrain indefinitely from donating blood.

The findings in this report are subject to at least three limitations. First, diagnosis of babesiosis requires a high index of suspicion, in part because the clinical manifestations are nonspecific; even severe cases can be missed (*1*,*2*). Second, babesiosis was a reportable condition in only 18 states in 2011; diagnosed cases of babesiosis in residents of states in which babesiosis was not reportable are not included in this surveillance summary. Finally, even for reported cases, the validity of the diagnosis of babesiosis and the case classification was dependent on the completeness and accuracy of the data provided.

Timely, accurate, and complete surveillance data will enable public health authorities to detect trends in the frequency and distribution of tickborne and transfusion transmission of *Babesia* infection. Subsequent years of surveillance data will allow public health authorities to monitor for unusual geographic or demographic patterns, such as changing areas of endemicity. Ongoing national surveillance using a standard case definition and report form will provide a foundation for developing evidence-based prevention and control measures to reduce the overall burden of babesiosis.

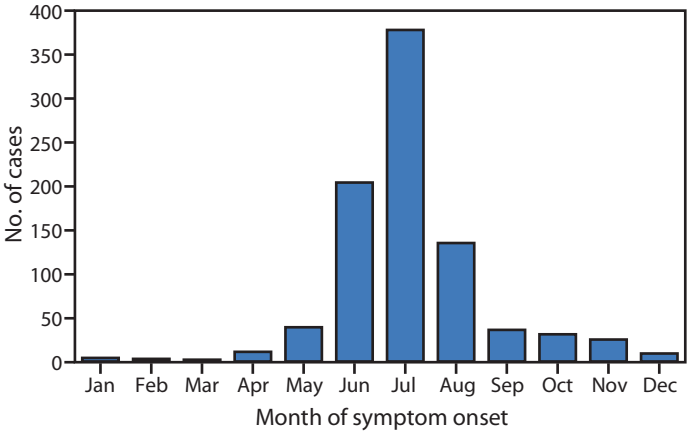
Persons who live in or travel to regions where babesiosis is found should avoid tick-infested areas, apply repellents and wear long pants and long-sleeved shirts when outdoors, shower soon after being outdoors, and check their entire bodies for ticks (*1*).§

§ Additional information available at http://www.cdc.gov/parasites/babesiosis.

Acknowledgments

State and local health departments that provided information to CDC.

FIGURE 2. Number of reported cases of babesiosis,* by month of symptom onset† — 18 states,§ 2011



* N = 879.

† Data for two patients with symptom onset in late December 2010 are not included.

§ California, Connecticut, Delaware, Indiana, Maine, Maryland, Massachusetts, Minnesota, Nebraska, New Hampshire, New Jersey, New York, Oregon, Rhode Island, Tennessee, Vermont, Washington, and Wisconsin.

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West Nile Virus Disease and Other Arboviral Diseases — United States, 2011

Arthropodborne viruses (arboviruses) are transmitted to humans primarily through the bites of infected mosquitoes and ticks. Symptomatic infections most often manifest as a systemic febrile illness and, less commonly, as neuroinvasive disease (e.g., meningitis, encephalitis, or acute flaccid paralysis). West Nile virus (WNV) is the leading cause of domestically acquired arboviral disease in the United States (*1*). However, several other arboviruses also cause seasonal outbreaks and sporadic cases (*1*). In 2011, CDC received reports of 871 cases of nationally notifiable arboviral diseases (excluding dengue); etiological agents included WNV (712 cases), La Crosse virus (LACV) (130), Powassan virus (POWV) (16), St. Louis encephalitis virus (SLEV) (six), Eastern equine encephalitis virus (EEEV) (four), and Jamestown Canyon virus (JCV) (three). Of these, 624 (72%) were classified as neuroinvasive disease, for a national incidence of 0.20 per 100,000 population. WNV and other arboviruses continue to cause focal outbreaks and severe illness in substantial numbers of persons in the United States.

In the United States, most arboviruses are maintained in transmission cycles between arthropods and vertebrate hosts (typically birds or small mammals). Humans can become infected when bitten by mosquitoes and ticks that carry blood from those hosts. Person-to-person transmission can occur through blood transfusion and organ transplantation. The majority of human arboviral infections are asymptomatic. Symptomatic infections most often manifest as a systemic febrile illness and, less commonly, as neuroinvasive disease. Most endemic arboviruses are nationally notifiable and are reported to CDC through ArboNET (*2,3*). In addition to human disease cases, ArboNET collects data on viremic blood donors, veterinary disease cases, and infections in mosquitoes, dead birds, and sentinel chickens.* Using standard definitions, human cases with laboratory evidence of recent arboviral infection are classified as neuroinvasive disease or nonneuroinvasive disease (*2*). Because of the considerable morbidity associated with neuroinvasive disease cases, detection and reporting is assumed to be more consistent and complete than for nonneuroinvasive disease cases. Therefore, for this report, incidence rates were calculated only for neuroinvasive disease cases using U.S. Census Bureau 2011 mid-year population estimates.

In 2011, CDC received reports of 871 cases of nationally notifiable arboviral diseases (excluding dengue), including those caused by WNV (712 cases), LACV (130), POWV (16), SLEV (six), EEEV (four), and JCV (three) (Table 1). Arboviral disease cases caused by these viruses were reported from 331 (11%) of the 3,141 U.S. counties. No cases were reported from Alaska, Hawaii, Maine, New Hampshire, Oregon, or Washington. Of the 871 total cases, 624 (72%) were reported as neuroinvasive disease, for a national incidence of 0.20 per 100,000 population.

A total of 712 WNV disease cases were reported from 238 counties in 43 states and the District of Columbia (Figure), including 486 (68%) neuroinvasive and 226 (32%) nonneuroinvasive cases (Table 1). Presumptive WNV infections were identified in 137 blood donors through routine screening of the blood supply. Of these, one (1%) subsequently developed neuroinvasive disease, and 32 (23%) developed nonneuroinvasive disease and are included in the case totals. WNV disease cases peaked in late August with 663 (93%) cases having illness onset during July–September. The median age of patients with WNV disease was 57 years (range: 7–96 years); 424 (60%) were male. Overall, 547 (77%) persons were hospitalized with WNV disease, and 43 (6%) died. The median age of patients who died was 74 years (range: 32–96 years).

Of the 486 WNV neuroinvasive disease patients, 273 (56%) had encephalitis, 183 (38%) had meningitis, and 30 (6%) had acute flaccid paralysis; 28 (93%) of the 30 patients with acute flaccid paralysis also had encephalitis or meningitis. The national incidence of neuroinvasive WNV disease was 0.16 per 100,000 population (Table 2). The highest reported rates were in the District of Columbia (1.62), Mississippi (1.04), Nebraska (0.76), and Arizona (0.76). Five states reported 51% of WNV neuroinvasive disease cases: California (110 cases), Arizona (49), Michigan (32), Mississippi (31), and New York (28). Neuroinvasive WNV disease incidence increased with age, with the highest incidence among persons aged ≥70 years. Among patients with neuroinvasive disease, 42 (9%) died.

The 130 LACV disease cases were reported from 81 counties in 14 states (Figure); 116 (89%) were considered neuroinvasive (Table 1). Dates of illness onset for LACV disease cases ranged from May through October; 110 (85%) had illness onset during July–September. Eighty-two (63%) patients were male. Among patients, median age was 8 years (range: 3 months–84 years), and 123 (95%) patients were aged <18 years. LACV neuroinvasive disease incidence was highest in West Virginia (1.19 per 100,000), Ohio (0.38), and North Carolina (0.27) (Table 2). Those three states reported 102 (78%) LACV disease cases. A total of 118 (91%) patients were hospitalized; one fatal case (1%) was reported.

* Additional information available at http://www.cdc.gov/ncidod/dvbid/westnile/index.htm.

TABLE 1. Number and percentage of reported cases of arboviral disease, by virus type and selected characteristics — United States, 2011

	Virus											
	West Nile		La Crosse		Powassan		St. Louis encephalitis		Eastern equine encephalitis		Jamestown Canyon	
Characteristic	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Total	**712**	**(100)**	**130**	**(100)**	**16**	**(100)**	**6**	**(100)**	**4**	**(100)**	**3**	**(100)**
Age group (yrs)												
<18	12	(2)	123	(95)	2	(13)	—	—	1	(25)	—	—
18–59	377	(53)	4	(3)	7	(44)	2	(33)	—	—	2	(67)
≥60	323	(45)	3	(2)	7	(44)	4	(67)	3	(75)	1	(33)
Sex												
Male	424	(60)	82	(63)	13	(81)	3	(50)	2	(50)	2	(67)
Female	288	(40)	48	(37)	3	(19)	3	(50)	2	(50)	1	(33)
Period of illness onset												
January–March	2	(<1)	—	—	—	—	—	—	—	—	—	—
April–June	10	(1)	11	(8)	9	(56)	—	—	—	—	2	(67)
July–September	663	(93)	110	(85)	5	(31)	4	(67)	3	(75)	1	(33)
October–December	37	(5)	9	(7)	2	(12)	2	(33)	1	(25)	—	—
Clinical syndrome												
Nonneuroinvasive	226	(32)	14	(11)	4	(25)	2	(33)	—	—	1	(33)
Neuroinvasive												
Meningitis	183	(26)	19	(15)	2	(13)	—	—	—	—	—	—
Encephalitis	273	(38)	93	(72)	10	(63)	4	(67)	3	(75)	2	(67)
Acute flaccid paralysis*	30	(4)	4	(3)	—	—	—	—	1	(25)	—	—
Outcome												
Hospitalization	547	(77)	118	(91)	12	(75)	4	(67)	4	(100)	1	(33)
Death	43	(6)	1	(1)	1	(6)	—	—	3	(75)	—	—

* Among the 30 West Nile virus patients with acute flaccid paralysis, 28 also had encephalitis or meningitis. The four La Crosse virus and one eastern equine encephalitis virus patients with acute flaccid paralysis also had encephalitis.

Of the 16 POWV disease cases reported, 12 (75%) were neuroinvasive (Table 1). Cases were reported from 13 counties in three states: Minnesota (11 cases), Wisconsin (four), and Pennsylvania (one). Dates of illness onset ranged from May through November, with 13 (81%) occurring during May–July. The median age of patients was 59 years (range: 3 months–70 years); 13 (81%) were male. Twelve (75%) patients were hospitalized; one died.

Four states (Alabama, Arkansas, Maryland, and Missouri) reported six SLEV disease cases overall; four were neuroinvasive (Table 1). Dates of illness onset ranged from July through October. All cases occurred in adults (median age: 69 years, range: 56–81 years); three were male. Four of the six SLEV patients were hospitalized; none died.

One EEEV neuroinvasive disease case was reported from each of four states: Massachusetts, Missouri, New York, and Wisconsin. The Missouri patient acquired the infection in Massachusetts. Dates of illness onset ranged from August through October. Cases occurred in one child (aged 4 years) and three adults (aged ≥60 years); two cases occurred in males. All four patients were hospitalized; three died (Table 1).

Two neuroinvasive and one nonneuroinvasive JCV disease cases were reported from Wisconsin and Mississippi (Table 1). Dates of illness onset ranged from April through September. All three cases occurred in adults aged >50 years; two patients were men. One patient was hospitalized; none died.

Reported by

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Editorial Note

In 2011, WNV was the most common cause of neuroinvasive arboviral disease in the United States; however, LACV was the most common cause of arboviral disease among children, a finding consistent with previous reports (*1,4*). EEEV disease, although rare, remained the most severe arboviral disease, resulting in three deaths among four patients. In

TABLE 2. Number and rate* of reported cases of arboviral neuroinvasive disease, by virus type, U.S. Census division, and state — United States, 2011

	Virus											
	West Nile		La Crosse		Powassan		St. Louis encephalitis		Eastern equine encephalitis		Jamestown Canyon	
U.S. Census division/State†	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
United States	**486**	**0.16**	**116**	**0.04**	**12**	**<0.01**	**4**	**<0.01**	**4**	**<0.01**	**3**	**<0.01**
New England	**15**	**0.10**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**0.01**	**—**	**—**
Connecticut	8	0.22	—	—	—	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Massachusetts	5	0.08	—	—	—	—	—	—	1	0.02	—	—
New Hampshire	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	1	0.10	—	—	—	—	—	—	—	—	—	—
Vermont	1	0.16	—	—	—	—	—	—	—	—	—	—
Middle Atlantic	**35**	**0.09**	**—**	**—**	**1**	**<0.01**	**—**	**—**	**1**	**<0.01**	**—**	**—**
New Jersey	2	0.02	—	—	—	—	—	—	—	—	—	—
New York	28	0.14	—	—	—	—	—	—	1	0.01	—	—
Pennsylvania	5	0.04	—	—	1	0.01	—	—	—	—	—	—
East North Central	**73**	**0.16**	**49**	**0.11**	**2**	**<0.01**	**—**	**—**	**1**	**<0.01**	**2**	**<0.01**
Illinois	22	0.17	—	—	—	—	—	—	—	—	—	—
Indiana	7	0.11	2	0.03	—	—	—	—	—	—	—	—
Michigan	32	0.32	1	0.01	—	—	—	—	—	—	—	—
Ohio	10	0.09	44	0.38	—	—	—	—	—	—	—	—
Wisconsin	2	0.04	2	0.04	2	0.04	—	—	1	0.02	2	0.04
West North Central	**31**	**0.15**	**1**	**<0.01**	**9**	**0.04**	**—**	**—**	**1**	**<0.01**	**—**	**—**
Iowa	5	0.16	—	—	—	—	—	—	—	—	—	—
Kansas	4	0.14	—	—	—	—	—	—	—	—	—	—
Minnesota	1	0.02	1	0.02	9	0.17	—	—	—	—	—	—
Missouri§	6	0.10	—	—	—	—	—	—	1	0.02	—	—
Nebraska	14	0.76	—	—	—	—	—	—	—	—	—	—
North Dakota	1	0.15	—	—	—	—	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—	—	—	—	—
South Atlantic	**67**	**0.11**	**52**	**0.09**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
Delaware	1	0.11	—	—	—	—	—	—	—	—	—	—
District of Columbia	10	1.62	—	—	—	—	—	—	—	—	—	—
Florida	20	0.10	1	0.01	—	—	—	—	—	—	—	—
Georgia	14	0.14	2	0.02	—	—	—	—	—	—	—	—
Maryland	10	0.17	—	—	—	—	—	—	—	—	—	—
North Carolina	2	0.02	26	0.27	—	—	—	—	—	—	—	—
South Carolina	—	—	1	0.02	—	—	—	—	—	—	—	—
Virginia	8	0.10	—	—	—	—	—	—	—	—	—	—
West Virginia	2	0.11	22	1.19	—	—	—	—	—	—	—	—

See table footnotes on page 513.

2011, 91% of mosquitoborne disease cases (i.e., those caused by WNV, LACV, SLEV, EEEV, and JCV) occurred during July–September, and 81% of tickborne disease cases (POWV) occurred during May–July, emphasizing the importance of targeting public health interventions for these periods.

Reported numbers of arboviral disease cases vary from year to year. The national incidence of WNV neuroinvasive disease in 2011 was 0.16 per 100,000 population, which is consistent with incidence rates during 2008–2010 (median: 0.20; range: 0.13–0.23) (*3–5*). The number of LACV neuroinvasive disease cases reported increased by 73% from 2010 to 2011. More POWV disease cases were reported in 2011 than in any previous year, and included the first case ever reported from Pennsylvania. Wisconsin reported its first EEEV case since 1984. In addition to nationally notifiable arboviral diseases, two other domestic arboviral diseases were reported to CDC: Colorado tick fever (two cases) and Cache Valley virus disease (one case).

The findings in this report are subject to at least two limitations. First, ArboNET is a passive surveillance system that relies on clinicians to consider the diagnosis of an arboviral disease and obtain appropriate diagnostic tests, and on providers and laboratories to report confirmed cases to public health authorities. Second, testing and reporting are incomplete,

TABLE 2. (*Continued*) Number and rate* of reported cases of arboviral neuroinvasive disease, by virus type, U.S. Census division, and state — United States, 2011

	Virus											
	West Nile		La Crosse		Powassan		St. Louis encephalitis		Eastern equine encephalitis		Jamestown Canyon	
U.S. Census division/State†	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
East South Central	**56**	**0.30**	**14**	**0.08**	**—**	**—**	**1**	**0.01**	**—**	**—**	**1**	**0.01**
Alabama	5	0.10	1	0.02	—	—	1	0.02	—	—	—	—
Kentucky	4	0.09	1	0.02	—	—	—	—	—	—	—	—
Mississippi	31	1.04	—	—	—	—	—	—	—	—	1	0.03
Tennessee	16	0.25	12	0.19	—	—	—	—	—	—	—	—
West South Central	**28**	**0.08**	**—**	**—**	**—**	**—**	**3**	**0.01**	**—**	**—**	**—**	**—**
Arkansas	1	0.03	—	—	—	—	3	0.10	—	—	—	—
Louisiana	6	0.13	—	—	—	—	—	—	—	—	—	—
Oklahoma	1	0.03	—	—	—	—	—	—	—	—	—	—
Texas	20	0.08	—	—	—	—	—	—	—	—	—	—
Mountain	**71**	**0.32**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
Arizona	49	0.76	—	—	—	—	—	—	—	—	—	—
Colorado	2	0.04	—	—	—	—	—	—	—	—	—	—
Idaho	1	0.06	—	—	—	—	—	—	—	—	—	—
Montana	1	0.10	—	—	—	—	—	—	—	—	—	—
Nevada	12	0.44	—	—	—	—	—	—	—	—	—	—
New Mexico	4	0.19	—	—	—	—	—	—	—	—	—	—
Utah	1	0.04	—	—	—	—	—	—	—	—	—	—
Wyoming	1	0.18	—	—	—	—	—	—	—	—	—	—
Pacific	**110**	**0.22**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
California	110	0.29	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—	—	—	—

* Per 100,000 population, based on July 1, 2011 U.S. Census population estimates.
† Including District of Columbia.
§ The patient was a resident of Missouri, but the eastern equine encephalitis virus infection was acquired in Massachusetts.

What is already known on this topic?

West Nile virus (WNV) is the leading cause of neuroinvasive arboviral disease in the United States. However, several other arboviruses can cause sporadic cases and seasonal outbreaks of neuroinvasive disease.

What is added by this report?

WNV was the most common cause of neuroinvasive arboviral disease in the United States in 2011. Among children, however, La Crosse virus was the most common cause. Eastern equine encephalitis, although rare, remained the most severe arboviral disease, resulting in three deaths among four patients.

What are the implications for public health practice?

WNV and other arboviruses continue to be a source of severe illness each year for substantial numbers of persons in the United States. Maintaining surveillance remains important to identify outbreaks and guide prevention efforts.

leading to a substantial underestimate of the actual number of cases (*6*). Based on previous studies, for every reported case of WNV neuroinvasive disease, approximately 140–350 human WNV infections occur, with approximately 80% of infected persons remaining asymptomatic and 20% developing nonneuroinvasive febrile disease (*7–9*). Extrapolating from the 486 WNV neuroinvasive disease cases reported, an estimated 13,600–34,000 cases of nonneuroinvasive febrile disease might have occurred in 2011; however, only 226 (1%–2%) nonneuroinvasive disease cases were reported.

WNV and other arboviruses continue to cause severe illness in substantial numbers of persons in the United States. However, cases are focal and sporadic, and the epidemiology varies by virus and area. Surveillance is important to identify outbreaks and guide prevention efforts (*10*). Health-care providers should consider arboviral infections in the differential diagnosis of aseptic meningitis and encephalitis, obtain appropriate specimens for laboratory testing, and promptly report cases to state health departments to allow for appropriate control measures (*2*). Human vaccines against domestic arboviruses are not available commercially in the United States.

FIGURE. West Nile virus and La Crosse virus disease cases reported to ArboNET, by county of residence — United States, 2011

Therefore, prevention of arboviral disease depends on community and household efforts to reduce vector densities (e.g., applying insecticides and reducing numbers of mosquito breeding sites), personal protective measures to decrease exposure to mosquitoes and ticks (e.g., use of repellents and long-sleeved shirts and long pants), and screening blood donors.

Acknowledgment

ArboNET surveillance coordinators in local and state health departments.

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Errata

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In the report, "Sodium Azide Poisoning at a Restaurant — Dallas County, Texas, 2010," on page 459, the first paragraph under the subheading, "Case-Control Study," should read as follows:

"Because no contaminated vehicle was confirmed immediately, a case-control study was conducted to assess the association of the illnesses with specific food and drink. Potential controls were identified among the restaurant patrons and contacted by using records of credit card transactions. A case-patient was defined as a restaurant patron reporting dizziness or fainting within a 6-hour period that encompassed the time of symptom onset for the five known patients. Controls were patrons who purchased food or drink at the restaurant during the same timeframe and did not report dizziness or fainting after their meal. Thirteen of the 14 controls said they did not consume iced tea. The fourteenth control recalled drinking iced tea but having no symptoms; however, further investigation revealed that this person drank iced tea from a different self-serve urn, before the urn used by the five case-patients was placed in service. **Another person, who had been selected as a potential fifteenth control, reported feeling dizzy but did not drink iced tea. This person attributed the dizziness to a chronic condition. However, because the person met the case definition, for purposes of the case-control study this person was counted as a sixth case-patient.** The case-control study found that consuming iced tea was 65 times more likely among the case-patients than the controls (OR = 65.0; CI = 2.4–3,292)."

In the report, "Updated Recommendations for Use of Tetanus Toxoid, Reduced Diphtheria Toxoid, and Acellular Pertussis (Tdap) Vaccine in Adults Aged 65 Years and Older — Advisory Committee on Immunization Practices (ACIP), 2012," on page 468, an extraneous paragraph was erroneously included. The **fourth paragraph** of the report is virtually identical to the second paragraph and should be deleted.

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In the QuickStats, "Rate of Unintentional Motor Vehicle Traffic Deaths, by Age Group — United States, 2004–2010," on page 498, rate changes were misidentified in the text. The text should read as follows: "During 2004–2010, the rate of unintentional motor vehicle traffic deaths declined for the total U.S. population by 27% (from 14.8 per 100,000 population to 10.8). The death rate decreased 44% (from 3.6 per 100,000 population to 2.0) for persons aged <15 years, 38% (from 25.6 per 100,000 population to 16.0) for those aged 15–24 years, 22% (from 15.1 per 100,000 population to 11.8) for those aged 25–64 years, and 25% (from 19.8 per 100,000 population to 14.9) for those aged ≥65 years."

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