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Babesiosis Surveillance — United States, 2011–2015

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Babesiosis Surveillance — United States, 2011–2015

Elizabeth B. Gray, MPH[1]; Barbara L. Herwaldt, MD[1]
[1]*Division of Parasitic Diseases and Malaria, Center for Global Health, CDC*

Abstract

Problem/Condition: Babesiosis is caused by parasites of the genus *Babesia*, which are transmitted in nature by the bite of an infected tick. Babesiosis can be life threatening, particularly for persons who are asplenic, immunocompromised, or elderly.

Period Covered: 2011–2015.

Description of System: CDC has conducted surveillance for babesiosis in the United States since January 2011, when babesiosis became a nationally notifiable condition. Health departments in states in which babesiosis is reportable voluntarily notify CDC of cases through the National Notifiable Diseases Surveillance System (NNDSS) and submit supplemental case information by using a babesiosis-specific case report form (CRF). As of 2015, babesiosis was a reportable condition in 33 states compared with 22 states in 2011.

Results: For the 2011–2015 surveillance period, CDC was notified of 7,612 cases of babesiosis (6,277 confirmed [82.5%] and 1,335 probable [17.5%]). Case counts varied from year to year (1,126 cases for 2011, 909 for 2012, 1,761 for 2013, 1,742 for 2014, and 2,074 for 2015). Cases were reported among residents of 27 states. However, 7,194 cases (94.5%) occurred among residents of seven states with well-documented foci of tickborne transmission (i.e., Connecticut, Massachusetts, Minnesota, New Jersey, New York, Rhode Island, and Wisconsin). Maine (152 cases) and New Hampshire (149 cases) were the only other states that reported >100 cases for the 5-year period, and both states also reported increasing numbers of cases over time. The median age of the 7,173 patients with available information was 63 years (range: <1–99 years; interquartile range: 51–73 years); 4,156 (57.9%) were aged ≥60 years, and 15 (<1%) were aged <1 year. The proportion of patients with symptom onset during June–August was >70% for each of the 5 surveillance years. Approximately half (3,004 of 6,404 [46.9%]) of the patients with available data were hospitalized at least overnight. Hospitalization rates ranged from 16.0% among patients aged 10–19 years (16 of 100) to 72.6% among those aged ≥80 years (552 of 760). Hospitalizations were reported significantly more often among patients who were asplenic than among patients who were not (106 of 126 [84.1%] versus 643 of 1,396 [46.1%]). Fifty-one cases of babesiosis among recipients of blood transfusions were classified by the reporting health department as transfusion associated. The median intervals from the earliest date associated with each case of babesiosis to the initial report via NNDSS and submission of supplemental CRF data to CDC were approximately 3 months and 1 year, respectively.

Interpretation: For the first 5 years of babesiosis surveillance, the reported cases occurred most frequently during June–August in the Northeast and upper Midwest. Maine and New Hampshire reported increasing numbers of cases over time, which suggests that foci of transmission might be expanding. Hospitalizations were common, particularly among patients who were asplenic or elderly.

Public Health Action: Persons who live in or travel to regions where babesiosis is endemic should avoid tick-infested areas, apply repellent to skin and clothing, conduct full-body inspections for ticks after being outdoors, and remove attached ticks with fine-tipped tweezers as soon as possible. Prevention measures are especially important for persons at risk for severe babesiosis. Increases in the number and geographic range of reported cases warrant investigation to identify contributory factors (e.g., changes in tick density or in testing or surveillance methods). Complete and timely submission of risk factor data could facilitate assessments of the geographic ranges and transmission routes of *Babesia* parasites. Efforts to allow for electronic submission of CRF data are under way at CDC; electronic submission is expected to improve the timeliness, uniformity, and completeness of the data.

Introduction

Babesiosis is caused by intraerythrocytic protozoan parasites of the genus *Babesia*. *Babesia* infection can be asymptomatic or cause nonspecific influenza-like symptoms (e.g., fever, chills, headache, body aches, and fatigue), hemolytic anemia, and thrombocytopenia (*1*–*3*). Multiorgan system dysfunction or failure and other potentially life-threatening complications can occur. Risk factors for symptomatic infection and severe disease include being asplenic, immunocompromised, or elderly.

Corresponding author: Elizabeth Gray, Center for Global Health, CDC. Telephone: 404-718-4725; E-mail: djn8@cdc.gov.

Babesiosis can be diagnosed by using parasitologic or molecular methods to confirm the presence of *Babesia* parasites or their DNA, respectively; serologic methods can provide supportive evidence of the diagnosis. To diagnose acute symptomatic cases of babesiosis in the clinical setting, health care providers should request nonautomated light-microscopic examination of peripheral blood smears by a laboratory technician. Morphologic differentiation between *Babesia* and *Plasmodium* (malaria) parasites (such as between *Babesia microti* and *Plasmodium falciparum*) can be difficult, as can differentiation between parasites and artifacts (e.g., platelet or stain debris). Confirmation of the diagnosis by a reference laboratory might be needed (*4*). Detection of *Babesia* parasites by blood smear examination does not allow for species identification. For example, *B. microti* and *Babesia duncani* are morphologically indistinguishable, but they can be distinguished by molecular and serologic techniques.

The recommended antimicrobial therapy for *Babesia* infection in symptomatic persons is the combination of either atovaquone plus azithromycin or clindamycin plus quinine for at least 7–10 days (*1–3*); combination therapy with clindamycin plus quinine is the standard of care for persons with severe babesiosis.

Most human cases of babesiosis in the United States are caused by *B. microti*, which is transmitted by *Ixodes scapularis* ticks. Tickborne transmission of *B. microti* occurs primarily in the Northeast and upper Midwest during spring and summer months. Sporadic cases of infection caused by other *Babesia* species also have been reported (e.g., cases of infection with *B. duncani* in the West and of infection with *Babesia divergens*-like parasites in various parts of the United States) (*5–8*). Although tickborne transmission is the most common, *Babesia* parasites also can be transmitted via blood transfusion or congenitally (*9–14*).

In 1966, the first documented human case of babesiosis in the United States occurred in an asplenic resident of California (*15*); the causative *Babesia* species was not determined. In 1969, the first U.S. case of babesiosis documented to be caused by *B. microti* occurred in a resident of Nantucket Island, Massachusetts, who had a functional spleen (*16*). Since then, cases of *B. microti* infection have been well documented in parts of the Northeast and upper Midwest (*10*,*17–25*). CDC has conducted surveillance for babesiosis in the United States since January 2011, when babesiosis became a nationally notifiable condition (*26*).

This report summarizes national surveillance data for the 5-year period of 2011–2015. Public health authorities, health care providers, and laboratorians can use the findings summarized in this report to improve detection, reporting, investigation, and prevention of babesiosis cases.

Methods

Health departments notify CDC of babesiosis cases via the National Notifiable Diseases Surveillance System (NNDSS) (*27*), using a standard case definition developed jointly by the Council of State and Territorial Epidemiologists and CDC (Box). Although babesiosis is a nationally notifiable condition, it is a reportable condition only in jurisdictions in which laws or regulations mandate that health care providers, hospitals, laboratories, or others report cases to the health department. In jurisdictions in which babesiosis is reportable, health departments voluntarily notify CDC of cases. The number of states in which babesiosis is a reportable condition can change from year to year as additional states begin to conduct surveillance.

Data Sources

Case data applicable to all nationally notifiable conditions, such as patient age, sex, and state and county of residence (referred to herein as generic data), are submitted electronically by health departments via NNDSS. Supplemental data (e.g., travel history, other risk factors for infection, clinical manifestations, and laboratory results) can be submitted to CDC by using a babesiosis-specific case report form (CRF), either a state-developed form or the CRF developed by CDC in 2011 to promote standard data collection (*28*). Supplemental data derived from CRFs were merged manually with NNDSS records by matching case identification numbers or demographic data. If case records had conflicting data, the more detailed record was considered correct. For many babesiosis-specific questions in CDC's CRF, such as those regarding clinical manifestations, complications, and antimicrobial therapy, the form includes a preset list of responses along with a free-text field to capture "other" responses. Information missing from data fields but provided in a notes field was included in the analyses.

Cases are reported by state and county of residence, which might differ from where the exposure occurred. The year in which a case was counted was assigned by the health department and might reflect the year of symptom onset, diagnosis, or reporting to or by the health department. In this report, data for confirmed and probable cases were combined.

Data Analysis

Incidence rates were calculated by using postcensal estimates of the resident populations of states by year from the U.S. Census Bureau (*29*). Mann-Whitney U, Pearson's chi-square, and Fisher's exact tests were used to assess associations between variables; a two-tailed p value of <0.05 was considered significant. Certain data in this report (e.g., annual case counts)

BOX. 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

* CDC's case definitions for infectious conditions under public health surveillance (https://wwwn.cdc.gov/nndss/conditions/babesiosis/case-definition/2011/).

might differ from data that were published previously (*26,27*) because of differences in the timelines used for incorporating health department-approved corrections and finalizing the data.

Results

For the 2011–2015 surveillance period, CDC was notified of 7,612 cases of babesiosis. The annual number of reported cases ranged from 909 cases for 2012 to 2,074 for 2015 (Figure 1) (Table 1). The total annual population-adjusted incidence rates ranged from 0.6 cases per 100,000 persons for 2012 to 0.9 for 2015 (Table 1). Of the 7,612 total cases, 6,277 (82.5%) were classified by the reporting health jurisdiction as confirmed and 1,335 (17.5%) as probable. The annual proportion of cases classified as confirmed was 75.2% in 2011 and 87.1% in 2015.

The number of states conducting surveillance for babesiosis increased from 22 states in 2011 to 33 in 2015 (Table 1)

(Figure 2). The 11 states in which surveillance began during 2011–2015 notified CDC of 21 cases (<1%) (Table 1).

Babesiosis-specific CRFs were submitted for 7,434 patients (97.7%). However, the completeness of the data varied. For example, data on clinical manifestations were provided for 7,306 patients (98.3%), whereas data on outdoor activities were provided for only 819 patients (11.0%). Information was provided in free-text notes fields on 1,144 CRFs (15.4%).

Geographic Region

For the 2011–2015 surveillance period, cases were reported among residents of 27 states. However, 7,194 (94.5%) of the 7,612 reported cases occurred among residents of seven states with well-established foci of tickborne transmission of *B. microti*, including five states in the Northeast and two in the upper Midwest: New York (2,257 cases), Massachusetts (1,865 cases), Connecticut (998 cases), New Jersey (869 cases), Rhode Island (633 cases), Wisconsin (300 cases), and Minnesota (272 cases) (Table 1) (Figure 2).

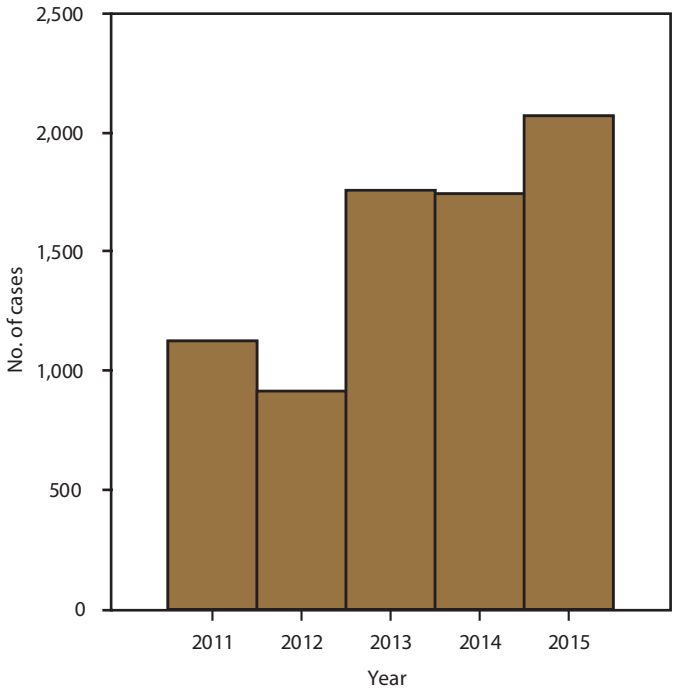
Maine (152 cases) and New Hampshire (149 cases) were the only other states that reported >100 cases for the 5-year period (Table 1). Both states reported increasing numbers of cases over time: Maine reported an increase from nine cases in 2011 to 55 cases in 2015, and New Hampshire reported an increase from 13 cases in 2011 to 53 cases in 2015. Among the 301 cases reported by Maine and New Hampshire, supplemental travel data were provided to CDC for 69 cases (22.9%), of which 30 (43.5%) occurred among patients who reportedly had a history of travel during the 8-week period before symptom onset or diagnosis (whichever date was earlier) to at least one of the seven states with well-established tickborne transmission of *B. microti*.

The remaining 117 cases (1.5% of 7,612) were reported by 18 states, which notified CDC of a median total of four cases per state for the 5-year period (range: 2–22 cases) (Table 1). At least 31 (26.5%) of these 117 cases occurred among patients who reportedly had a history of travel to states with well-established tickborne transmission of *B. microti*.

Demographic Information

The median age of the 7,173 patients with available information was 63 years (range: <1–99 years; interquartile range [IQR]: 51–73 years). For each of the 5 surveillance years, the largest number of cases was reported among patients aged 60–69 years (Figure 3). Among the 7,173 patients of known age, 4,156 (57.9%) were aged ≥60 years. Of the 7,481 patients of known sex, more were male (65.9%) than were female (34.1%). Among patients with available data on race/ethnicity, most were identified as white (4,468 of 5,015 [89.1%]) and non-Hispanic (3,689 of 4,065 [90.7%]) (Table 2).

FIGURE 1. Number* of reported cases of babesiosis, by year — United States, 2011–2015†



* A total of 7,612 cases of babesiosis were reported (n = 1,126 for 2011, n = 909 for 2012, n = 1,761 for 2013, n = 1,742 for 2014, and n = 2,074 for 2015).
† Year as reported by the health department.

Seasonality

Month of symptom onset was available for 5,931 (77.9%) of the 7,612 patients. For each of the 5 surveillance years, >70% of patients had symptom onset during June–August (Figure 4).

Babesia Laboratory Testing

Among the 7,612 patients, laboratory test results were available for 6,399 (84.1%), of whom 5,343 (83.5%) had positive results by blood smear, animal inoculation (one patient), or polymerase chain reaction. Of the 6,399 patients with available laboratory test results, 1,056 (16.5%) had positive results only with serologic testing, which, for surveillance purposes, is considered laboratory supportive rather than confirmatory for a case of babesiosis (Box).

Species-level data from molecular or serologic testing were reported for 2,867 cases (37.7%). The proportion of cases for which the causative *Babesia* species was reported varied by year, from 30.0% in 2015 (622 of 2,074) to 46.0% in 2014 (801 of

TABLE 1. Number* and incidence rate† of reported cases of babesiosis, by state/area§ and year¶ — United States, 2011–2015

State/Area	2011		2012		2013		2014		2015		Total no.
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	
Alabama	1	<0.1	0	0.0	0	0.0	1	<0.1	2	<0.1	**4**
Alaska	—**	—	—	—	—	—	—	—	—	—	**—**
Arizona	—	—	—	—	—	—	—	—	—	—	**—**
Arkansas	—	—	—	—	—	—	—	—	0	0.0	**0**
California	1	<0.1	2	<0.1	3	<0.1	3	<0.1	5	<0.1	**14**
Colorado	—	—	—	—	—	—	—	—	—	—	**—**
Connecticut	74	2.1	123	3.4	268	7.5	205	5.7	328	9.1	**998**
Delaware	1	0.1	0	0.0	2	0.2	1	0.1	1	0.1	**5**
District of Columbia	—	—	—	—	—	—	—	—	—	—	**—**
Florida	—	—	—	—	—	—	—	—	—	—	**—**
Georgia	—	—	—	—	—	—	—	—	—	—	**—**
Hawaii	—	—	—	—	—	—	—	—	—	—	**—**
Idaho	—	—	—	—	—	—	—	—	—	—	**—**
Illinois	—	—	—	—	—	—	1	<0.1	3	<0.1	**4**
Indiana	0	0.0	1	<0.1	1	<0.1	0	0.0	0	0.0	**2**
Iowa	—	—	—	—	—	—	—	—	—	—	**—**
Kansas	—	—	—	—	—	—	—	—	—	—	**—**
Kentucky	—	—	—	—	—	—	—	—	0	0.0	**0**
Louisiana	—	—	—	—	2	<0.1	0	0.0	1	<0.1	**3**
Maine	9	0.7	10	0.8	36	2.7	42	3.2	55	4.1	**152**
Maryland	4	0.1	3	0.1	9	0.2	2	<0.1	4	0.1	**22**
Massachusetts	208	3.1	261	3.9	417	6.2	535	7.9	444	6.5	**1,865**
Michigan	0	0.0	0	0.0	2	<0.1	2	<0.1	3	<0.1	**7**
Minnesota	73	1.4	41	0.8	64	1.2	49	0.9	45	0.8	**272**
Mississippi	—	—	—	—	—	—	—	—	—	—	**—**
Missouri	—	—	—	—	—	—	—	—	—	—	**—**
Montana	—	—	—	—	—	—	0	0.0	0	0.0	**0**
Nebraska	0	0.0	1	0.1	1	0.1	0	0.0	0	0.0	**2**
Nevada	—	—	—	—	—	—	—	—	—	—	**—**
New Hampshire	13	1.0	19	1.4	22	1.7	42	3.2	53	4.0	**149**
New Jersey	166	1.9	92	1.0	171	1.9	159	1.8	281	3.1	**869**
New Mexico	—	—	—	—	—	—	—	—	—	—	**—**
New York††	418	2.1	253	1.3	534	2.7	471	2.4	581	2.9	**2,257**
North Carolina	—	—	—	—	—	—	—	—	—	—	**—**
North Dakota	1	0.1	0	0.0	1	0.1	0	0.0	3	0.4	**5**
Ohio	—	—	—	—	—	—	1	<0.1	2	<0.1	**3**
Oklahoma	—	—	—	—	—	—	—	—	—	—	**—**
Oregon	1	<0.1	0	0.0	0	0.0	1	<0.1	2	<0.1	**4**
Pennsylvania	—	—	—	—	—	—	—	—	—	—	**—**
Rhode Island	73	6.9	56	5.3	142	13.5	172	16.3	190	18.0	**633**
South Carolina	—	—	—	—	1	<0.1	3	0.1	2	<0.1	**6**
South Dakota	—	—	—	—	1	0.1	1	0.1	0	0.0	**2**
Tennessee	1	<0.1	0	0.0	0	0.0	0	0.0	1	<0.1	**2**
Texas	—	—	—	—	1	<0.1	1	<0.1	1	<0.1	**3**
Utah	—	—	—	—	—	—	0	0.0	0	0.0	**0**
Vermont	2	0.3	2	0.3	6	1.0	3	0.5	9	1.4	**22**
Virginia	—	—	—	—	—	—	—	—	—	—	**—**
Washington	0	0.0	0	0.0	1	<0.1	4	0.1	2	<0.1	**7**
West Virginia	—	—	—	—	0	0.0	0	0.0	0	0.0	**0**
Wisconsin	80	1.4	45	0.8	76	1.3	43	0.7	56	1.0	**300**
Wyoming	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	**0**
Total§§	**1,126**	**0.8**	**909**	**0.6**	**1,761**	**1.0**	**1,742**	**0.8**	**2,074**	**0.9**	**7,612**

* N = 7,612.
† Per 100,000 population, calculated using postcensal estimates of the resident populations of states by year from the U.S. Census Bureau.
§ Cases were reported by state/area of residence, which was not necessarily where the exposure occurred. Jurisdictions (50 states and the District of Columbia) are listed regardless of whether they notified CDC of any cases or whether babesiosis was a reportable condition. Cases reported by New York State and New York City were totaled together for the purpose of the incidence calculations.
¶ Year as reported by the health department.
** Not reportable.
†† Including New York City, which reported a total of 279 cases for the 5 surveillance years (57 for 2011, 28 for 2012, 75 for 2013, 50 for 2014, and 69 for 2015).
§§ The denominators for calculations of total incidence rates included only the populations of states in which babesiosis was a reportable condition during the surveillance year.

FIGURE 2. Reported cases of babesiosis, by patient's county of residence* — 33 states, 2015†

* N = 2,070; county of residence was known for all but four (<1%) of the 2,074 total patients. Each dot represents one case; dots were placed randomly within the patient's county of residence.
† Year as reported by the health department.

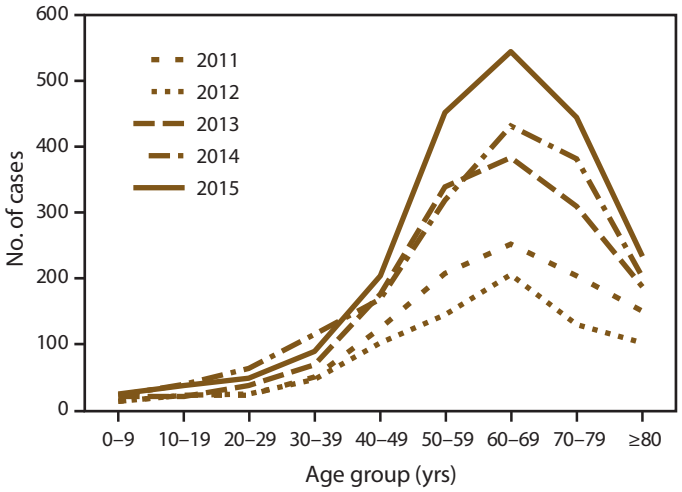
1,742). All but three cases with species-level information were reported to be caused by *B. microti*. The other three cases were attributed to *B. duncani* on the basis of serologic criteria and occurred among residents of Maryland and Connecticut, states in which local transmission of *B. duncani* has not been documented. Information regarding whether the three persons had traveled to the western United States was not provided to CDC.

Clinical Manifestations and Complications

Fever was the most frequently reported clinical manifestation (5,470 of 6,493 patients [84.2%]), followed by chills (3,566 of 5,128 patients [69.5%]) and thrombocytopenia (2,479 of 3,602 patients [68.8%]) (Table 3). Of the 630 patients for whom data were available, 36.7% (231 patients) were reported to have had at least one complication. For patients with detailed information provided, the most commonly reported complications included renal insufficiency or failure (55 patients), hepatic compromise (37 patients), and acute respiratory distress or failure (30 patients). Data on whether any complications developed and patient age were available for 531 patients. Complications were most common among older patients: 46.9% of patients aged ≥60 years (151 of 322) were reported to have had at least one complication.

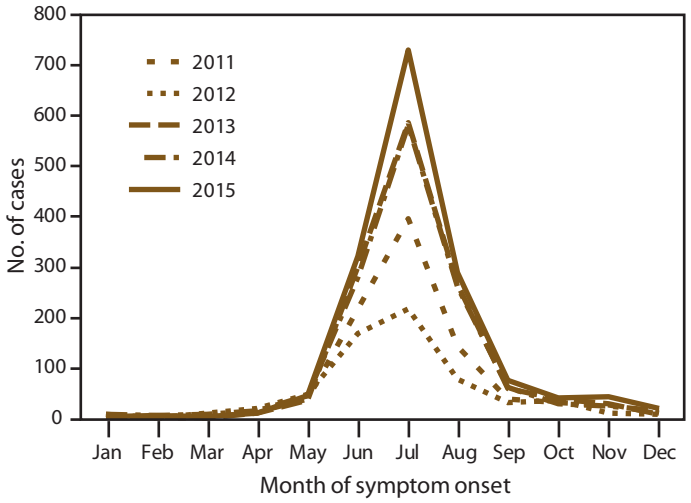
Approximately half (3,004 of 6,404 [46.9%]) of the patients with available data were hospitalized at least overnight (Figure 5). Hospitalization rates ranged from 16.0% among patients aged 10–19 years (16 of 100) to 72.6% among those aged ≥80 years (552 of 760) (Figure 6). The median length

FIGURE 3. Number of reported cases of babesiosis, by patient's age group* and year — United States, 2011–2015†



* Data on age group were available for most of the 7,612 total patients (n = 1,041 of 1,126 for 2011, n = 783 of 909 for 2012, n = 1,535 of 1,761 for 2013, n = 1,740 of 1,742 for 2014, and n = 2,074 of 2,074 for 2015).
† Year as reported by the health department.

FIGURE 4. Number of reported cases of babesiosis, by patient's month of symptom onset* and year — United States, 2011–2015†



* Data on month of symptom onset were available for most of the 7,612 total patients (n = 932 of 1,126 for 2011, n = 642 of 909 for 2012, n = 1,352 of 1,761 for 2013, n = 1,340 of 1,742 for 2014, and n = 1,665 of 2,074 for 2015). The proportions of patients with symptom onset during June–August for the 5 surveillance years were 81.4% for 2011 (n = 759 of 932), 72.3% for 2012 (n = 464 of 642), 85.5% for 2013 (n = 1,156 of 1,352), 83.9% for 2014 (n = 1,124 of 1,340), and 84.0% for 2015 (n = 1,398 of 1,665).
† Year as reported by the health department.

TABLE 2. Number* and percentage† of reported cases of babesiosis, by selected patient characteristics — United States, 2011–2015

Characteristic	No. (%)
Sex	
Male	4,928 (64.7)
Female	2,553 (33.5)
Unknown/Missing	131 (1.8)
Age group (yrs)	
0–9	90 (1.2)
10–19	137 (1.8)
20–29	192 (2.5)
30–39	365 (4.8)
40–49	772 (10.1)
50–59	1,461 (19.2)
60–69	1,815 (23.8)
70–79	1,468 (19.3)
≥80	873 (11.5)
Unknown/Missing	439 (5.8)
Race	
American Indian/Alaska Native	38 (0.5)
Asian/Pacific Islander	194 (2.6)
Black	163 (2.1)
White	4,468 (58.7)
Other	152 (2.0)
Unknown/Missing	2,597 (34.1)
Ethnicity	
Hispanic	376 (4.9)
Non-Hispanic	3,689 (48.5)
Unknown/Missing	3,547 (46.6)

* N = 7,612.
† Percentages might not total 100% because of rounding.

TABLE 3. Number and percentage of reported cases of babesiosis, by presence or absence of selected clinical manifestations* — United States, 2011–2015

Clinical manifestation*	Present No. (%)	Absent No. (%)	Total No. (%)
Fever	5,470 (84.2)	1,023 (15.8)	**6,493 (100.0)**
Chills	3,566 (69.5)	1,562 (30.5)	**5,128 (100.0)**
Thrombocytopenia	2,479 (68.8)	1,123 (31.2)	**3,602 (100.0)**
Myalgia	3,523 (68.2)	1,639 (31.8)	**5,162 (100.0)**
Anemia	2,475 (65.5)	1,301 (34.5)	**3,776 (100.0)**
Headache	2,991 (60.2)	1,979 (39.8)	**4,970 (100.0)**
Sweats	1,772 (55.4)	1,427 (44.6)	**3,199 (100.0)**
Arthralgia	2,546 (54.1)	2,162 (45.9)	**4,708 (100.0)**

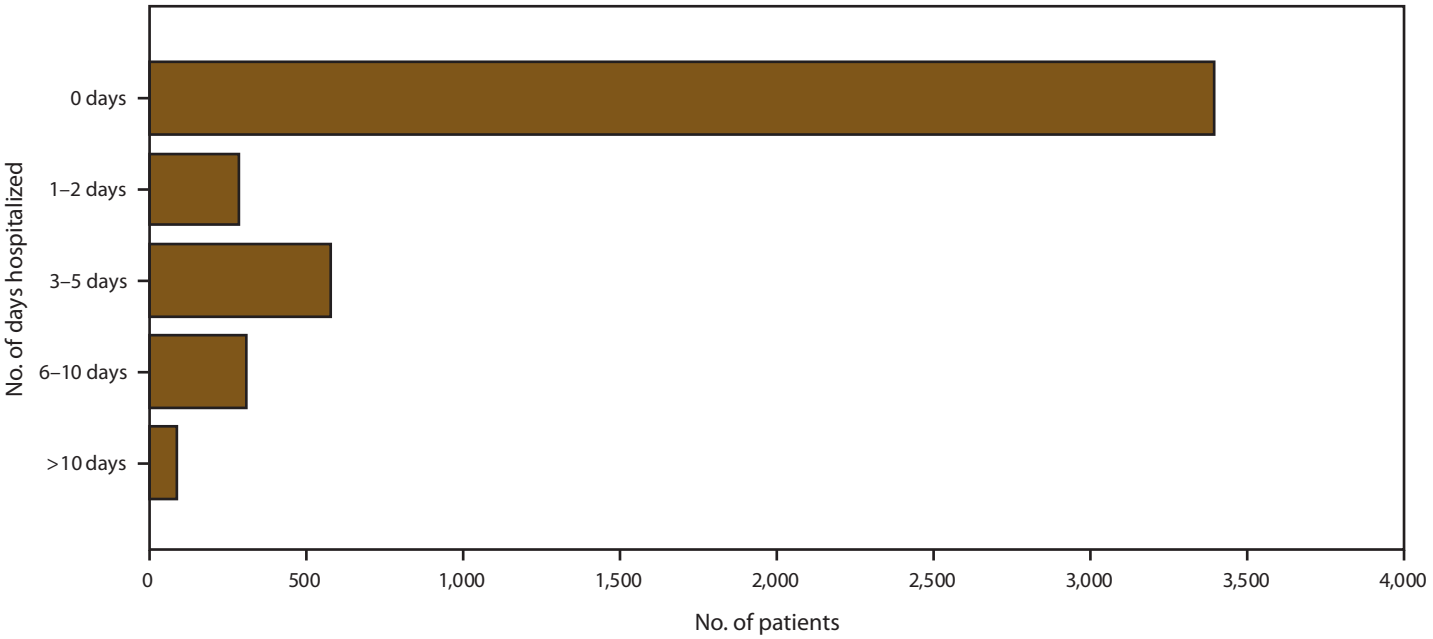
* Data are provided for the objective and subjective manifestations specified in the clinical evidence section of the surveillance case definition for babesiosis.

of the hospital stay was 4 days (range: 1–63 days) among the 1,266 patients with available data. Patients who were hospitalized were significantly older than those who were not hospitalized (median ages: 68 years [range: <1–99 years] and 59 years [range: <1–96 years], respectively). Hospitalizations were reported significantly more often among patients who were asplenic than among patients who were not (106 of 126 [84.1%] versus 643 of 1,396 [46.1%]).

Treatment

Among the 2,728 patients who were reported to have received therapy for babesiosis and for whom at least one antimicrobial agent was specified by name, 2,264 patients (83.0%) were administered treatment with at least one of the following drugs:

FIGURE 5. Hospitalization data* for patients with babesiosis, by length of stay — United States, 2011–2015



* Data on hospitalization were available for 6,404 (84.1%) of the 7,612 patients. Among the 3,004 (46.9% of 6,404) patients who were hospitalized for at least 1 day, length of stay was unknown for 1,738 (57.9%, not shown in figure).

atovaquone, azithromycin, clindamycin, or quinine. Of the 2,264 patients, 1,609 (71.1%) were administered evidence-based combination therapy (i.e., atovaquone plus azithromycin or clindamycin plus quinine) (*1–3*). Doxycycline, which is not recommended for treatment of babesiosis, was specified for 1,320 (48.4%) of the 2,728 patients, including 419 patients for whom at least one antimicrobial agent was named but none of the four aforementioned drugs.

Deaths

A total of 46 deaths were reported. Seven deaths were attributed to babesiosis, and four deaths were not attributed to babesiosis. For 35 patients, data on whether babesiosis contributed to their deaths were not provided.

Route of Transmission

Data on history of tick bites were available for 3,173 patients, 1,443 (45.5%) of whom recalled having been bitten during the 8-week period before symptom onset or diagnosis (whichever date was earlier). Among the 1,730 patients who did not recall a tick bite, 400 (23.1%) reported outdoor exposures (i.e., either engaging in outdoor activities or having spent time in or near wooded or brushy areas). A total of 1,051 patients reported having outdoor exposures. Among the 613 patients for whom at least one outdoor activity was specified, the most frequently reported activities were gardening/yard work (291 patients), hiking (82 patients), and camping (50 patients).

Fifty-one cases of babesiosis among recipients of blood transfusions were classified by the reporting health department as transfusion associated. Among the 37 patients whose cases were classified as transfusion associated and whose onset dates were known, 26 (70.3%) became ill during September–May, in contrast to June–August (i.e., months in which >70% of all patients had symptom onset). Among the 15 cases of babesiosis reported among children aged <1 year, four were classified as transfusion associated and one was attributed to congenital transmission.

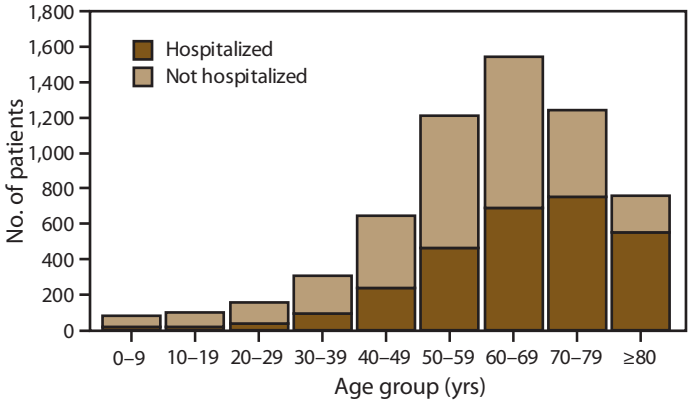
Timeliness of Reporting

The median interval from the earliest date associated with the case (i.e., date of illness onset, diagnosis, or laboratory testing) to the date of the initial report to CDC (i.e., submission of generic NNDSS data) was 85 days (n = 7,595; range: 3–718 days; IQR: 39–210 days). The median interval from the earliest available date to the date of submission of supplemental data to CDC was 369 days (n = 7,374; range: 8–1,497 days; IQR: 328–418 days).

Discussion

For the period of 2011–2015, the first 5 years of national surveillance, the reported cases of babesiosis occurred most

FIGURE 6. Hospitalization data for patients with babesiosis, by age group* — United States, 2011–2015



* Data on hospitalization and age group were available for 6,051 (79.5%) of the 7,612 patients.

frequently in spring and summer and in the Northeast and upper Midwest. Changes in the annual number of reported cases over time (from a low of 909 cases for 2012 to a high of 2,074 cases for 2015) might reflect actual increases in disease incidence in certain areas (e.g., Maine [*30*] and New Hampshire) but also could reflect changes in case ascertainment (e.g., because of changes in health care–seeking behaviors or clinicians' awareness of babesiosis). Documenting where and how persons are exposed is needed for monitoring the geographic ranges and occurrence of tickborne and transfusion transmission of *B. microti* and other *Babesia* species. To determine whether the range of tickborne *B. microti* transmission is expanding, distinguishing locally acquired cases from potential travel-associated cases is necessary. For patients with *Babesia* parasites noted on blood smear examination without molecular or serologic evidence of infection with *B. microti* or *B. duncani*, the possibility of infection with a different *Babesia* agent (e.g., a *B. divergens*-like parasite [*7,8*]) should be considered.

To determine whether a person became infected via blood transfusion rather than via tickborne transmission, the likelihood of each scenario should be assessed and compared (*9*), which can be particularly difficult in regions with documented tickborne transmission. In certain instances during the surveillance period, resources to conduct thorough and timely assessments might not have been available. In May 2019, the U.S. Food and Drug Administration issued guidance for blood collection agencies that included a recommendation for year-round molecular testing of blood donations collected in 14 states in the East and upper Midwest and in the District of Columbia (*31*). Even with such testing in those areas, transfusion-associated babesiosis could still occur (e.g., because of false-negative test results). Furthermore, transfusion transmission, either of *B. microti* (e.g., from a donor who became infected while traveling) or other *Babesia* species, could occur elsewhere in the country, as has been documented previously (*9*). Therefore, health departments throughout the United States should continue to ask about receipt of blood transfusions when investigating cases of babesiosis.

In aggregate, for the first 5 years of surveillance, the median intervals from the earliest date associated with each case of babesiosis to the initial report via NNDSS and submission of supplemental babesiosis-specific data to CDC were approximately 3 months and 1 year, respectively. More timely submission of risk factor, exposure, and other supplemental data could facilitate assessments and investigations of the geographic ranges and transmission routes of *Babesia* parasites. Efforts to allow for electronic submission of babesiosis CRF data are under way at CDC; electronic submission is expected to improve the timeliness, uniformity, and completeness of the supplemental data.

Limitations

The findings in this report are subject to at least three limitations. First, underdiagnosis was likely, in part because infected persons might not seek health care and clinicians might not consider or diagnose babesiosis. Even if cases of babesiosis are diagnosed, underreporting of cases is likely, in part because NNDSS is a passive surveillance system and babesiosis is not a reportable condition in all U.S. public health jurisdictions.

Second, some of the cases included in this report might have been misdiagnosed as cases of babesiosis or misclassified in various respects. For this report, CDC used the case classifications assigned by the reporting health department, including for cases classified as transfusion associated. Among the 6,146 cases (80.7%) for which CDC received sufficient clinical and laboratory data to evaluate the accuracy of the case classification assigned by the reporting health department, four cases (two classified as confirmed and two as probable) did not fulfill criteria for confirmed or probable cases. However, inclusion of those four cases in the analyses did not appear to have affected any of the overall conclusions. CDC's CRF has not included a question about congenital transmission; additional congenital cases, besides the one reported via a notes field, might not have been categorized as such.

Finally, for certain reported cases, requested data elements were not submitted, were incomplete, or were difficult to evaluate or interpret (e.g., whether patients with comorbidities were hospitalized because of babesiosis). Treatment data are

intended to capture information regarding antimicrobial therapy for babesiosis, not for other tickborne or other infectious diseases. The fact that doxycycline, an antimicrobial agent indicated for various tickborne bacterial infections but not for babesiosis, was specified frequently suggests that treatment data provided to CDC were not always limited to therapies prescribed for babesiosis; however, the possibility that some health care providers mistakenly prescribed doxycycline for babesiosis cannot be excluded.

Conclusion

This report provides information on the epidemiology of reported cases of babesiosis for the first 5 years of national surveillance. Regions in which babesiosis has been endemic for decades (i.e., parts of the Northeast and upper Midwest) accounted for the majority of cases reported for 2011–2015, although the increasing numbers of cases reported in neighboring states in the Northeast suggest that foci of *Babesia* transmission might be expanding. Continued surveillance, including collection of patient exposure histories, is needed to monitor for changing geographic and transmission patterns.

Persons who live in or travel to regions where babesiosis is endemic should avoid tick-infested areas (e.g., walk on cleared trails away from overgrown grass), apply repellent to skin and clothing, conduct full-body inspections for ticks after being outdoors, and remove attached ticks with fine-tipped tweezers as soon as possible. The nymphal stage of *I. scapularis*, the tick vector of *B. microti*, is small (approximately the size of a poppy seed) and easily overlooked if thorough full-body inspections are not conducted. Prevention measures are especially important for persons at risk for potentially life-threatening complications of babesiosis (e.g., asplenic or elderly persons). Health care providers should consider babesiosis in a person with unexplained influenza-like illness, hemolytic anemia, or thrombocytopenia, including in a person with a history of a potential tick exposure or a blood transfusion; request appropriate diagnostic testing; and, if indicated, prescribe combination therapy with azithromycin plus atovaquone or clindamycin plus quinine (*1*–*3*).

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Conflict of Interest

No conflicts of interest were reported.

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