

Key Findings and Public Health Messages

- The California Department of Public Health (CDPH) received 374 reports of Lyme disease with estimated symptom onset dates from 2009 through 2012. This corresponds to an average annual incidence rate of 0.25 cases per 100,000 Californians.
- Lyme disease incidence rates were relatively stable during the 2009-2012 surveillance period. Incidence rates declined from 0.28 per 100,000 (102 cases) in 2009 to 0.21 per 100,000 (81 cases) in 2012.
- Average annual Lyme disease incidence rates during the surveillance period were highest among adults 55 to 64 years of age (0.35 per 100,000) and children 5 to 14 years of age (0.34 per 100,000).
- Counties of the Far North (1.64 per 100,000) and Central Coast (0.86 per 100,000) regions reported the highest average annual incidence rates.
- Avoiding exposure to vector ticks provides the best opportunity for preventing and controlling Lyme disease. If potential exposure is unavoidable, important risk reduction measures include using both protective clothing and tick repellents, checking the entire body for ticks daily, and prompt removal of attached ticks.

Background

Lyme disease is caused by the bacteria *Borrelia burgdorferi* which is transmitted to humans by the bite of an infected tick. Lyme disease is the most common tick-borne infection in North America, with nearly 30,000

cases reported in the United States (US) each year. Over 95 percent of cases occur in the Northeastern, mid-Atlantic, and upper mid-Western states.¹ The most common initial sign of Lyme disease is a red, usually painless expanding rash (erythema migrans) that appears within 30 days after the bite of an infected tick. Other early symptoms include flu-like body aches, fatigue, fever, chills and swollen lymph nodes. If not treated, some patients can develop neurologic conditions or cardiac abnormalities during the next few weeks, or more severe central nervous and musculoskeletal disease up to several months later. Lyme disease is diagnosed based on symptoms, physical findings (e.g., erythema migrans), history of engaging in outdoor activity during the incubation period in areas where vector ticks are known to occur, and supportive laboratory testing. Most cases of Lyme disease can be treated successfully with oral or intravenous antibiotics.¹⁻²

We describe here the epidemiology of confirmed and probable Lyme disease cases in California with estimated illness onset from 2009 through 2012 reported to CDPH by November 2015. Data for 2012 are provisional and may differ from data in future publications. For a complete discussion of the definitions, methods, and limitations associated with this report, please refer to the Technical Notes.³ The epidemiologic description of Lyme disease for the 2001-2008 surveillance period can be found in the *Epidemiologic Summary of Lyme disease in California, 2001-2008*.⁴

California reporting requirements and surveillance case definitions

California Code of Regulations, Title 17, requires health care providers to report suspected cases of Lyme disease to their local health department within seven calendar days of identification. Laboratories are also required to report laboratory testing results suggestive of *B. burgdorferi* infection to either the California Reportable Disease

Information Exchange (CalREDIE) (via electronic laboratory reporting) or the local health department; reporting must occur within one working day after the health care provider has been notified.

California regulations also require local health officers to report to CDPH cases of Lyme disease. CDPH counted cases that satisfied the US Centers for Disease Control and Prevention (CDC)/Council of State and Territorial Epidemiologists' surveillance case definition of a confirmed or probable case.⁵ During the surveillance period, a confirmed case was defined as one with: (i) a physician diagnosed erythema migrans of at least 5 cm diameter with either a known exposure or laboratory evidence of infection or (ii) at least one objective late manifestation (i.e., musculoskeletal, cardiovascular, or neurological) and laboratory evidence of infection. A probable case was defined as any other case of physician-diagnosed Lyme disease that had laboratory evidence of infection. Laboratory evidence of infection included: (1) a positive culture of *B. burgdorferi* or (2) two-tiered testing (a sensitive enzyme immunoassay (EIA) or immunofluorescence antibody assay (IFA) followed by a Western blot) interpreted using established criteria, where a positive IgM test result was sufficient only when the test was performed within 30 days from symptom onset, and a positive IgG test result was sufficient at any point during the patient's illness or (3) single-tier IgG immunoblot seropositivity interpreted using established criteria.⁶⁻⁸ Beginning in 2011, laboratory evidence of infection could also include the demonstration of antibody production against *B. burgdorferi* in cerebrospinal fluid (CSF) via EIA or IFA, evidenced by a higher titer of antibody in CSF than in serum.

Epidemiology of Lyme disease in California

CDPH received reports of 374 cases of Lyme disease with estimated symptom onset dates from 2009 through 2012. This corresponds to an average annual incidence rate of 0.25 cases per 100,000 Californians. Incidence rates during the 2009-2012 surveillance period

were relatively stable, showing moderate fluctuations [Figure 1]. Incidence rates ranged from a minimum of 0.21 per 100,000 (81 cases) in 2012 to a maximum of 0.28 per 100,000 (102 cases) in 2009. During the surveillance period, no case-patients were reported to have died by the time of case report. Average annual incidence rates for the surveillance period were highest among adults 55 to 64 years of age (0.35 per 100,000) and children 5 to 14 years of age (0.34 per 100,000) [Figure 2]. The ratio of male to female cases was 1.2:1.0. Rates by race/ethnicity were not calculated due to the substantial portion of missing data (35.6 percent). However, Lyme disease cases with complete data reported White non-Hispanic race/ethnicity (84.6 percent) more frequently than would be expected (40.2 percent) based on the overall demographic profile of California [Figure 3].

County-specific average annual incidence rates from 2009 through 2012 ranged from 0 to 7.86 per 100,000, with Mendocino (5.40 per 100,000) and Humboldt (4.64 per 100,000) counties showing the highest average rates [Figure 4]. Average annual incidence rates for the surveillance period were 3.9 times higher in Northern California (0.43 per 100,000) than in Southern California (0.11 per 100,000). The Far North (1.64 per 100,000) and Central Coast (0.86 per 100,000) regions reported the highest average annual incidence rates during the surveillance period.

A total of 182 (48.7 percent) cases had estimated illness onsets during the months of June through August.

Figure 1. California Lyme disease case counts and incidence rates by estimated year of illness onset, 2001-2012*

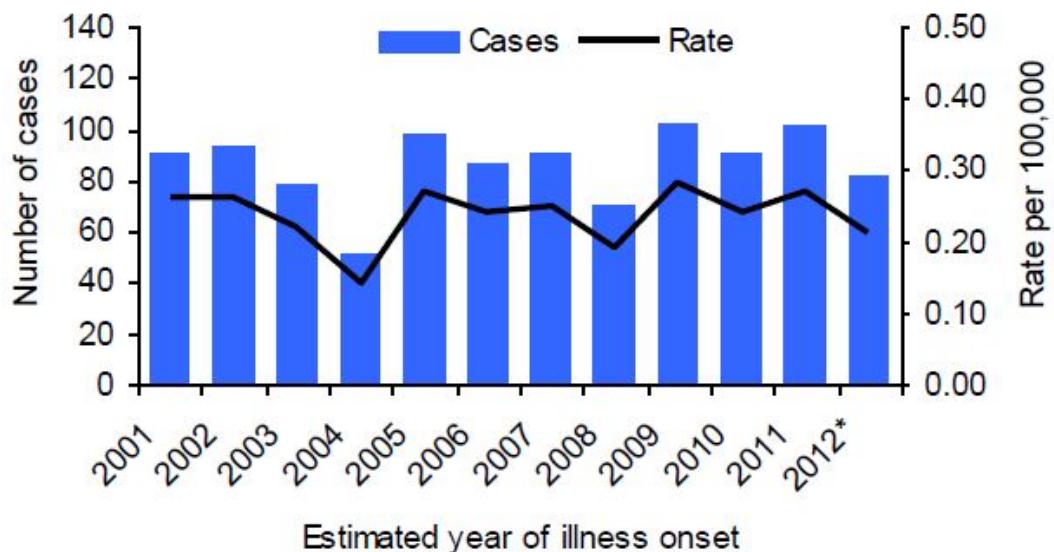


Figure 2. California Lyme disease incidence rates by age group, 2009 - 2012*

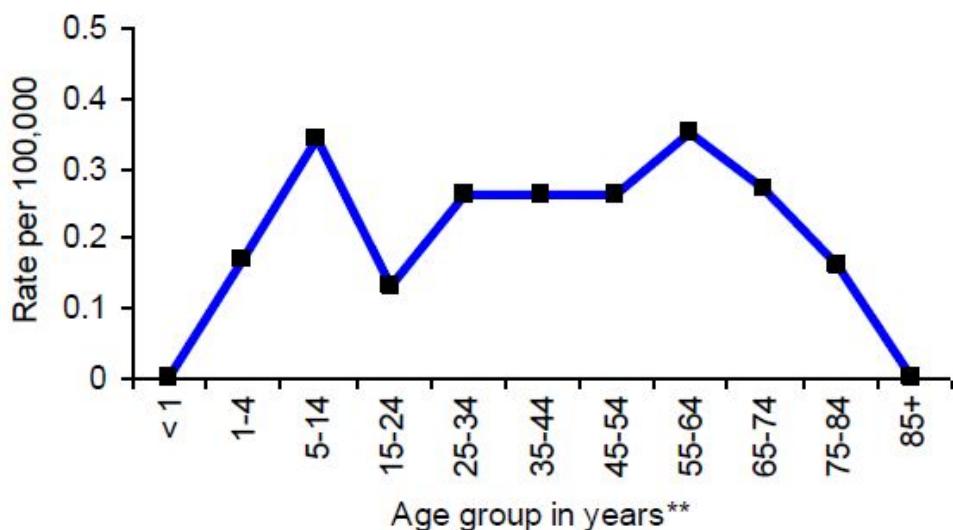
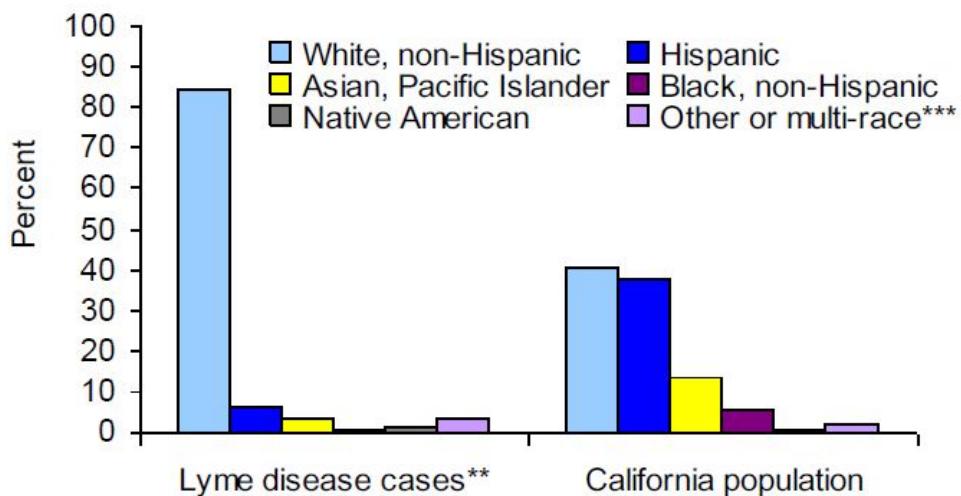


Figure 3. California Lyme disease cases and population by race/ethnicity, 2009-2012*



Notes for Figures 1-4

*2012 data are provisional

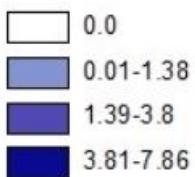
**Unknowns were excluded

***Includes cases who identified 'other' as their race and Californians ('population') who identified more than one race

Figure 4. California county-specific Lyme disease incidence rates, 2009 - 2012*



Cases per 100,000 population



Potentially unreliable rate, relative standard error 23 percent or more

Comment

Incidence rates of reported Lyme disease during the 2009 through 2012 surveillance period were relatively stable. The race/ethnicity, gender, and geographic distribution and temporal pattern of Lyme disease cases incident in California from 2009 through 2012 remained fairly consistent with that of the 2001 through 2008 surveillance period. Conversely, children ages 5 to 14 years of age had a higher incidence rate during 2009 through 2012 than during the previous surveillance period.⁴ The

bimodal age distribution of California cases is similar to the age distribution of cases nationwide.⁹

Some Lyme disease case-patients that reside in low- incidence states, such as California, may have been exposed to the bacteria when traveling to other states where incidence is higher.¹³ However, the western black-legged tick, which spreads Lyme disease in the western US, has been found in many wooded and grassy areas in California. People are most commonly exposed to the Lyme disease bacteria by the immature nymphal

tick which is active in the spring and early summer; a range of 5-15% of nymphal western black-legged ticks in California are infected with *B. burgdorferi*.²

Lyme disease prevention is best effected by avoiding areas where ticks occur, or if potential exposure is unavoidable, using both protective clothing and tick repellents, checking the entire body, clothing and pets for ticks daily, and promptly removing attached ticks.¹

References and resources

[1CDC. Lyme Disease.](#)

<http://www.cdc.gov/lyme/index.html>
(accessed on 5/20/2016).

[2CDPH, Vector-Borne Disease Section. Lyme Disease in California.](#)

<http://www.cdph.ca.gov/HealthInfo/disorder/Documents/LymeDiseaseinCA2011.pdf> (accessed on 5/20/2016).

[3CDPH, Surveillance and Statistics Section. Epidemiologic Summaries of Selected General Communicable Diseases in California, 2009-2012: Technical Notes.](#)

<http://www.cdph.ca.gov/programs/ssss/Documents/TechnicalNotes01-08and09-12.pdf> (accessed on 5/20/2016).

[4CDPH, Surveillance and Statistics Section. Epidemiologic Summaries of Selected General Communicable Diseases in California, 2001-2008: Lyme disease.](#)

<http://www.cdph.ca.gov/data/statistics/Pages/EpiSummariesCDsCA-01-08.aspx> (accessed on 5/20/2016).

[5CDC. National Notifiable Diseases Surveillance System, Case Definitions, Lyme disease.](#)

<http://www.cdc.gov/nndss/conditions/lyme-disease/> (accessed on 5/20/2016).

[6CDC. Recommendations for test](#)

performance and interpretation from the Second National Conference on Serologic Diagnosis of Lyme Disease. MMWR Morb Mortal Wkly Rep. 1995; 44:590-1.

⁷Dressler F, Whalen JA, Reinhardt BN et al. Western blotting in the serodiagnosis of Lyme disease. J Infect Dis. 1993;167:392-400.

⁸Engstrom SM, Shoop E, Johnson RC. Immunoblot interpretation criteria for serodiagnosis of early Lyme disease. J Clin Microbiol. 1995;33(2):419-27.

⁹Hall-Baker PA, Groseclose SL, Jajosky RA et al. Summary of notifiable diseases--United States, 2009. MMWR Morb Mortal Wkly Rep. 2011 May 13;58(53):1-100.

¹⁰Adams DA, Gallagher KM, Jajosky RA et al. Summary of notifiable diseases--United States, 2010. MMWR Morb Mortal Wkly Rep. 2012 Jun 1;59(53):1-111.

¹¹Adams DA, Gallagher KM, Jajosky RA et al. Summary of notifiable diseases--United States, 2011. MMWR Morb Mortal Wkly Rep. 2013 Jul 5;60(53):1-117.

¹²Adams DA, Jajosky RA, Ajani U et al. Summary of notifiable diseases--United States, 2012. MMWR Morb Mortal Wkly Rep. 2014 Sep 19;61(53):1-121.

¹³Forrester JD, Brett M, Matthias J et al. Epidemiology of Lyme disease in low-incidence states. Ticks Tick Borne Dis. 2015 Sep;6(6):721-3.

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