

# Lyme Disease

## 1. DISEASE REPORTING

### A. Purpose of Reporting and Surveillance

1. To assess trends in Lyme disease (LD) incidence.
2. To identify zoonotic sources of infection.
3. To identify endemic geographic areas.

### B. Laboratory and Physician Reporting Requirements

1. Physicians are required to report LD cases within one working day of diagnosis.
2. Labs are required to report positive results.

### C. Local Health Department Reporting and Follow-Up Responsibilities

1. Report all confirmed and presumptive (but *not* suspect) cases (see definitions below) to the Oregon Public Health Division (OPHD) by the end of the calendar week.
2. Begin follow-up investigation within one working day. Use the Lyme disease investigation form. Send a copy of the completed form to OPHD within 7 days of initial report.

## 2. THE DISEASE AND ITS EPIDEMIOLOGY

### A. Etiologic Agent

In the United States, *Borrelia burgdorferi*, a spirochetal bacterium. Other *Borrelia* spp. are associated with Lyme-like infections in Europe and elsewhere. Other spirochetes of note include *B. recurrentis* (tick-borne relapsing fever), *Treponema pallidum* (syphilis), and *Helicobacter pylori*.

### B. Description of Illness

The diagnosis of LD is complicated by its protean dermatologic, neurologic, and cardiologic manifestations. The infection may abort at any stage, with or without treatment. Definitive diagnosis is difficult; false positive and false negative test results may be common.

#### 1. Early Lyme Disease (Stage I)

Early illness is usually marked by one or more non-specific signs and symptoms: fatigue, chills and fever, headache, myalgias, arthralgias, and lymphadenopathy.

Erythema migrans (EM), which occurs in 60%-80% of cases, is the most common and distinctive feature of early LD and, if adequately documented, is all but pathognomonic for LD. EM lesions typically have a "bull's eye" appearance, with partial central clearing. The rash is usually >5 cm (2 inches) in diameter, but may enlarge to a diameter of 15 cm (6 inches) or more. Occasionally, EM may appear as a solid red rash with a vesicular center. EM lesions are most common at the site of a tick bite, often the thigh, groin, trunk, or armpits, but primary and satellite lesions can occur anywhere. The rash may be warm or pruritic, but is generally not painful. EM develops 3-32 days after the tick bite; lesions occurring within hours of a bite are not caused by LD. EM usually resolves spontaneously within 3-4 weeks, if untreated, and within one week if treated.

#### 2. Early Disseminated Lyme Disease (Stage II)

Several weeks after the tick bite, some infected persons develop small, multiple annular lesions. Other symptoms include fatigue, malaise, regional or generalized lymphadenitis, and migratory joint, bone, and muscle pain. Lyme arthritis, which may occur weeks to months after infection is acquired, is characterized by intermittent attacks of oligoarticular arthritis in large joints, especially the knees. Neurologic s/s develops in some persons (<20%) weeks to months after the tick bite. Bell's palsy, painful radiculitis, cranial neuritis, or meningitis may develop.

Atrioventricular (AV) block or pericarditis occurs in fewer than 10% of patients, but may be the most serious complication. AV block may progress from first to second to third degree. Heart block can be expected to resolve spontaneously, but a temporary pacemaker may be required.

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### 3. Late Infection (Stage III)

Distinguishing chronic LD from fibromyalgia, chronic fatigue syndrome, or other causes of encephalopathy, polyneuropathy, and rheumatic disease can be difficult. It is not clear how many s/s may be caused by persistent spirochetal infection or may be attributable to an autoimmune reaction.

Mono- or polyarthritis is most common in the knees and shoulders. This may last several years, but usually resolves spontaneously. Neurologic abnormalities are varied and include encephalopathy, mood, sleep, or memory impairment; and polyneuropathy manifesting as spinal or radicular pain or distal paresthesias. Leukoencephalitis may mimic dementia or multiple sclerosis. Neuropathies can persist for ten years. Acrodermatitis chronica atrophicans (skin swelling or bluish-red discoloration at the site of the original tick bite) occurs in a few patients.

### 4. Lyme disease and pregnancy

Published literature on LD during pregnancy is limited. Several case reports in the 1980s suggested that LD might be transmitted transplacentally; however, small follow-up studies of pregnant women with LD have failed to demonstrate a definitive link between LD and adverse fetal outcomes, e.g., fetal death, prematurity, or congenital malformations.

Pregnant women should be aware of potential risk to the fetus if LD is contracted and—like everyone else—should take precautions to minimize tick exposure. Women who acquire LD while pregnant should be treated with penicillin or erythromycin. Spontaneous abortions and stillbirths occurring in mothers treated for LD should be investigated pathologically for *B. burgdorferi* involvement. Newborns of mothers treated for active *B. burgdorferi* infection should be tested for LD. Placental culture should be attempted using BSK media.

## C. Vectors and Reservoirs

From a human perspective, the principal if not only vector of LD are certain *Ixodes* ticks in the *I. ricinus* complex. In Oregon and the rest of the West, *I. pacificus* is the only recognized vector. In the rest of the U.S., *I. scapularis* (né *I. dammini*) is the major player. *Dermacentor* ticks, though common in Oregon, are not known to be competent vectors. *I. pacificus* is found throughout Oregon west of the Cascades and around the mouth of the Deschutes River, and has been reported from Deschutes County, but has not been found elsewhere in eastern Oregon.

*B. burgdorferi* is maintained in nature by complex life cycles involving hard-bodied (ixodid) ticks in the genus *Ixodes* and a variety of mammals, reptiles, and possibly birds. These life cycles may differ significantly between the western United States and other foci of LD in the U.S., Europe, and elsewhere. Natural transmission cycles in the western U.S. may include wood rats, lizards, and other *Ixodes* ticks that do not themselves feed on humans. Deer and other rodents may be of less importance here than in the eastern U.S., although this is uncertain.

The usual 2-year life cycle of the tick includes larval, nymphal, and adult stages. Larvae and nymphs typically become infected while feeding on small rodents (their preferred hosts) and remain infected as they mature (transstadial transmission).

LD has a wide distribution in northern temperate regions of the world. In the United States, the reported incidence is highest in the Northeast (particularly in southern New England); around Wisconsin and Minnesota; and in northern California. Three elements are necessary for LD to be a significant threat: competent vector ticks, enough hosts to provide food for the ticks, and the presence of *B. burgdorferi* bacteria. Data are extremely limited about the co-occurrence of these elements in Oregon, although it appears that the risk of LD is highest in SW Oregon, notably Coos, Curry, Josephine, and Jackson Counties.

## D. Sources and Routes of Transmission

Lyme disease is acquired by tick bite. The probability of transmission is directly correlated with duration of tick attachment. Lab studies suggest that attachment for at least 24–48 hours is required for spirochete transmission to occur. Thus, prompt removal of ticks can prevent transmission. Ixodid tick bites are generally painless, and many LD patients have no recollection of a tick bite, so the absence of a tick bite history is not inconsistent with a diagnosis of LD.

Before the arrival of West Nile, LD was unchallenged as the most commonly reported vector-borne disease in the United States. (In Oregon, imported malaria has historically held the pole

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position, but it was eclipsed by West Nile for the first time in 2006.) In North America, most infections are acquired between May and August, when *Ixodes* nymphs are most active. While all stages of *I. pacificus* can feed on humans, nymphs are probably the most important source of human infections. Adult ticks may feed on deer or other small mammals that, while not directly involved in the life cycle of the spirochete, may be important to the survival of the ticks.

### E. Incubation Period

A few days to a few weeks, although hard to confirm for people who do not develop EM lesions. EM lesions usually develop within 7-10 days (range 3-32 days) of the tick bite.

### F. Period of Communicability

Not transmitted from person-to-person.

### G. Treatment

If the diagnosis is suspected, either by the presence of EM, or a constellation of symptoms suggestive of LD, appropriate serology or cultures should be taken prior to treatment.

For Stage I LD, treatments of choice include amoxicillin with or without probenecid, doxycycline, and tetracycline for 3 to 4 weeks. Doxycycline and tetracycline are contraindicated for pregnant or lactating women and children with deciduous teeth (<8 years old). Repeat treatment should be considered if Stage I symptoms do not resolve completely after one course of antibiotics. Treatment for shorter periods may be inadequate, aborting the antibody response but not the infection, and leading to chronic rheumatic, neurologic, or cardiac abnormalities.

For stage II or stage III LD, 2 to 3 weeks of intravenous antibiotics (e.g., cefotaxime, ceftriaxone, amoxicillin, benzylpenicillin G) may be indicated. There is no evidence that more prolonged therapy is more efficacious, and significant side effects have been reported in patients receiving protracted courses of antibiotics.

Prophylaxis is not recommended for asymptomatic persons with histories of tick bites. Repeat as necessary.

## 3. CASE DEFINITIONS, DIAGNOSIS, AND LABORATORY SERVICES

The case definition for Lyme is restrictive and intended to enhance the specificity of surveillance data. Reduced sensitivity (i.e., exclusion of some reports that seem real) is the inevitable result. Get over it. Most reportable cases will be presumptive. If a patient is treated soon after infection based on EM or other history—which might be entirely appropriate—he, she, or it may never seroconvert.

### A. Confirmed Case Definition

Positive *B. burgdorferi* culture<sup>1</sup> (see §3C2), or

Physician-documented EM (solitary lesion  $\geq 5$  cm in diameter or multiple, smaller, annular lesions) and IgM-positive Western blot (see §3C1, *infra*).

### B. Presumptive Case Definition

Physician-documented EM, or

Positive Western blot serologic test (IgG or IgM; see §3C1), and at least one of the following:

- 1) lymphocytic meningitis;
- 2) cranial neuritis, particularly facial palsy;
- 3) radiculoneuropathy;
- 4) recurrent, brief (few weeks or less) attacks of objective swelling in one or more joints;
- 5) encephalitis confirmed by anti-*B. burgdorferi* titer in CSF higher than that in serum;
- 6) acute onset 2nd- or 3rd-degree atrioventricular conduction defect that resolves in days to weeks.

### C. Laboratory Tests for LD

Keep in mind that the diagnosis of early LD is usually clinical. Laboratory results may facilitate the diagnosis of later stages of LD.

<sup>1</sup> Don't hold your breath for too many of these.

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## 1. Serology

Serum should be collected for ELISA and WB assay. In patients with neurologic symptoms, CSF should also be tested. Serology is often negative during the first several weeks after infection because the immune response to spirochetes develops slowly. Early antibiotic therapy can also abort an antibody response, even if treatment is subcurative. False positives are associated with syphilis, Rocky Mountain spotted fever, autoimmune disorders, relapsing fever, and neurologic diseases, and may even be seen in healthy persons. Sadly, results from many commercial labs have been found to be unreliable; if possible, all serology should be confirmed through the PHL.

ELISA: A reaction  $\geq 3$  standard deviations above the mean of negative controls is considered positive. Borderline results should be repeated in six weeks.

Western blots are used as confirmatory tests. To be considered positive, blots must show antibodies to either:

- at least five IgG bands (18, 21, 28, 30, 39, 41, 45, 58, 66, or 93 kDa); *or*
- at least two IgM bands (22-25 kDa [OspC], 39 kDa [BmpA], or 41 kDa [Fla]).

The apparent molecular mass of OspC depends on the strain of *B. burgdorferi*. Any low molecular weight band in the 22–25 kDa range can be considered equivalent.

## 2. Culture

The PHL also may accept skin biopsy specimens in BSK medium and sends them to CDC for culture. But do call first before cutting a hole in your patient. Use form #75 (Bacteriology/Parasitology). All specimens should be sent properly packaged in double containers with absorbent material around them.

## 3. Other Tests

Polymerase chain reaction (PCR) assays for the detection of bacterial antigens have been developed; at present they are primarily research tools.

## D. OSPHL Services and Tick Identification

The PHL provides EIA testing of serum for total antibody to *B. burgdorferi* and refers positive specimens to CDC for confirmatory WB testing. Serum can be sent without a cold pack at ambient temperatures if it is sent to the PHL within 24 hours of collection; otherwise, it should be sent with a cold pack. Use form #42.

All specimens should be sent properly packaged in double containers with absorbent material around them.

Tick identification may be done at the local vector control districts depending on the local expertise available for proper identification.

## 4. ROUTINE CASE INVESTIGATION

Interview the case and others who might provide pertinent information.

### A. Evaluate the Diagnosis

If patient has EM, get a photograph if at all possible. Using the case investigation form, itemize signs and symptoms. Determine if the patient has any chronic diseases that could mimic LD. Get copies of laboratory reports that support the diagnosis.

### B. Assess the Possibility of Tick Exposure

Ask about tick bites, if any, and known or possible duration of tick attachment. For exposures that presumably occurred in Oregon, get a detailed description of the geographic location where the exposure may have occurred—good enough that the site can be found by investigators. If the exposure probably occurred outside Oregon, obtain a general description of the area.

If the implicated tick was saved from a patient who meets the presumptive case definition for identification, send it to PHL as outlined above (§3D).

Ask if any pets, particularly dogs, have had ticks removed recently or have exhibited symptoms of intermittent or persistent arthritis. (Other signs of LD are not seen in dogs.)

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### C. Environmental Evaluation

If a case of LD is identified and the geographic location of the tick exposure is known, OPHD may attempt to collect ticks. Consult with OPHD epidemiologists as soon as you hear about a case.

### 5. CONTROLLING FURTHER SPREAD

The role of the local health department is limited to providing general education to interested members of the public, as well as working with other agencies (parks departments, etc.) as indicated. There is no need for patient isolation or work/day care restrictions, and no long-term follow-up is indicated for public health purposes.

As opportunities allow, the following general messages can be disseminated:

- In tick-infested areas, the highest risk of bites is probably between March and July.
- The use of protective clothing, including light-colored garments, long trousers tucked into socks (to prevent ticks from crawling under garments), long-sleeved shirts, hats, etc., as well as tick repellents, may reduce risk. DEET-containing formulations are effective on exposed skin or clothing, albeit somewhat unpleasant to use, and potentially neurotoxic if slathered too liberally on small children. Permethrin repellents can be used on clothing.
- Outdoor activities in tick-infested areas present many opportunities for exposure. Keep yards clear of excessive leaves, brush, and tall grasses. Walk in the center of trails to avoid contact with tall grasses and brush.
- When camping, sleep in screened tents. Hunters should be aware of tick infestations on mammals, especially deer, and check for tick attachments after handling carcasses.
- Keep pets free of ticks, and vice versa.
- Bacterial transmission requires a long attachment—probably more than 24 hours. Checking for and promptly removing mobile or attached ticks after spending time outdoors in tick-infested areas is prudent. Don't forget the scalp, axilla, and groin. A groin is a terrible thing to lose.
- Remove attached ticks *intact*; do not leave embedded head parts. Use gentle, direct traction with tweezers or hemostat. Other methods, such as application of a hot match or petroleum products (e.g., Vaseline®) to the tick, are less reliable and may result in burns or greasy skin. Do not crush ticks *in situ*; this could result in direct inoculation of spirochetes.

### 6. UPDATE LOG

December 2006. Minor tweak to purpose of reporting #1 (old version was belied by restrictive case definition). References to "OHS" replaced by "OPHD." Re-writing and re-formatting of Case Definition section (§3) to clarify definitions; no real substantive change. Bill Keene