
Hazard Information Bulletin



U.S. Department of Labor
Occupational Safety and Health Administration

HIB 00-4-20

LYME DISEASE

Purpose

This bulletin provides guidance for workers and employers about how to decrease the risk of Lyme disease in individuals who may be potentially exposed on the job to Lyme disease-causing ticks. OSHA has received inquiries on occupational exposure to Lyme disease-causing ticks for individuals who work outdoors in heavily wooded or grassy areas. These workers include those with certain construction and forestry duties as well as individuals in other occupations. The concerns are due to two events: an increase in the number of reported cases of Lyme disease since 1982 and the possible long-term health effects resulting from untreated infection. If recognized early, Lyme disease can be easily treated with antibiotic medication. However, if the disease goes unrecognized and untreated, chronic conditions may ensue, including varying degrees of permanent damage to the joints or the nervous system.¹ The Centers for Disease Control and Prevention (CDC) has published several guidelines on the prevention of Lyme disease, including avoiding or clearing tick-infested habitat; using personal protective measures, such as clothing and repellent; performing tick checks; and removing ticks early. (See CDC website at www.cdc.gov) The CDC Advisory Committee on Immunization Practices (ACIP) has also stated that Lyme disease vaccine should or may be considered for some individuals at risk. When followed, these guidelines should minimize the risk of infection and reduce the number of cases that may develop. The strategies for preventing tick bites are described by the CDC as the first line of defense against Lyme disease and other tick-borne illnesses. Preventing tick bites also prevents other tick-borne diseases, including babesiosis, ehrlichiosis, tularemia, and Rocky Mountain spotted fever.

This HIB is not a new standard or regulation, and it creates no legal obligations. It is advisory in nature, informational in content, and is intended for use by employers seeking to provide a safe and healthful workplace through an effective Lyme disease prevention program.

For a fuller description of the nature and effect of Hazard Information Bulletins, see the Important Information box on page 6.

Background

Lyme Disease is a multisystem, multistage, inflammatory illness caused by *Borrelia burgdorferi*, a corkscrew-shaped bacterium. The disease is transmitted to humans by blood-feeding ticks infected with *B. burgdorferi*. The most important vector for the spread of the disease in the northeast United States is the deer tick, *Ixodes scapularis*; on the West Coast, the western black-legged tick, *Ixodes pacificus*, is the most important vector.² These ticks are much smaller than common dog and cattle ticks. They can attach to any part of the human body but are especially likely to attach to the more hidden and hairy areas of the body such as the armpits, groin, and scalp.¹ *B. burgdorferi* is primarily transmitted to humans by ticks in the nymphal stage of development, but adult ticks can also transmit *B. burgdorferi*. At this stage, the tick is usually not much larger than the head of a pin and can easily go unnoticed if attached to an individual. These ticks are slow feeders. Transmission of *B. burgdorferi* from an infected tick is unlikely to occur before 36 hours of tick

attachment,³ and infected ticks are most likely to transmit infection after approximately 2 or more days of feeding.⁴

Lyme Disease currently accounts for more than 95% of all vector-borne diseases reported in the United States.^{3,4} There have been more than 128,000 cases reported since 1982.⁴ In 1998, the estimated incidence of Lyme disease was about 6 per 100,000 people in the U.S.; however, there may be considerable underreporting. In addition, incidence rates vary considerably from state to state and even within states and counties. In a few highly endemic counties, incidence rates exceed 100 per 100,000 people. State and local health departments can be consulted for more information regarding risk in particular areas.

The incidence and prevalence of the disease from occupational exposure has not been precisely defined. Several studies, however, have identified outdoor occupational exposure as a risk factor.^{5,6} The true incidence of occupationally acquired Lyme disease is hard to define because pinpointing the exact circumstances of infection is exceedingly difficult. In fact, the majority of infected persons do not recall being bitten by a tick.

Awareness of Lyme disease and its signs and symptoms is essential for diagnosing the disease. In some cases, the diagnosis is not made because many of the signs and symptoms associated with Lyme disease are similar to those of the flu. Lyme disease often presents with a characteristic “bull’s-eye” rash termed erythema migrans. This rash is seen in 60-80% of people who develop the infection; some people may have the disease without the presence of a rash.⁴ In addition to this rash, other non-specific symptoms may be present, including fever, lymph node swelling, neck stiffness, generalized fatigue, headaches, migrating joint aches, or muscle aches. The diagnosis is primarily based on a history of known exposure and the development of clinical signs and symptoms. Blood testing can provide valuable supportive diagnostic information. Following a diagnosis, Lyme disease, in most cases, can be successfully treated with standard antibiotic regimens. It is very important that the infection be diagnosed and treated with appropriate antimicrobial medication as early as possible because untreated Lyme dis-

ease may result in symptoms that are severe, chronic, and disabling. These disorders include chronic inflammatory arthritis, chronic muscle pain, heart disease, and/or neurological (brain and peripheral nerves) disorders.^{3,7} In addition, Lyme disease in a later stage is more difficult to diagnose, and treatment may be more prolonged and costly.

Description of the Hazard

Many activities can place an individual at risk of exposure to ticks infected with the *B. burgdorferi* bacterium. These activities can be occupational or non-occupational. Most *B. burgdorferi* infections occur after residential exposure to infected ticks during property maintenance, recreational, or leisure activity.³ Non-occupational exposures also occur when individuals away from home participate in recreational activities such as hiking, camping, fishing, and hunting. Occupations that require outdoor activity/work in areas where the disease is endemic can place an individual at increased risk of exposure to an infected tick and therefore to Lyme disease. Occupations that may be associated with an increased risk of exposure to infected ticks include construction, landscaping, forestry, brush clearing, land surveying, farming, railroad work, oil field work, utility line work, and park/wildlife management.^{1,3}

The CDC estimates that the number of annually reported cases of Lyme Disease has increased 33-fold since national surveillance began in 1982 (based on 16,801 cases in 1998 versus 497 cases in 1982). Cases of Lyme disease have been reported in 48 of the 50 states as well as the District of Columbia⁴; 25% of states include at least one area with moderate to high risk of tick infection with the *B. burgdorferi* bacterium. The states that include areas with the highest risk are those in the northeast U.S., from Massachusetts to Maryland; the north-central region including Wisconsin and Minnesota; and an area in northern California in the pacific-coastal region. There is a high prevalence of *B. burgdorferi* in the tick population in these areas and therefore an increased risk of acquiring Lyme disease from a tick bite. The remainder of the states have no or few ticks infected with *B. burgdorferi* and are considered low, minimal, or no risk for Lyme disease.

Several other factors must be considered when determining risk of exposure to *B. burgdorferi*-infected ticks. For example, an individual's daily activities should be taken into consideration. As previously mentioned, certain occupations and leisure activities are likely to put one at risk; other considerations include the frequency, duration, and season of a likely exposure. Although adult ticks also carry *B. burgdorferi* and can be a source for human infection, the majority of Lyme disease cases result from bites by infected nymphs. Ticks in the nymphal stage feed predominately in the late spring and early summer, although this season may be prolonged in some areas, depending on climatic conditions. State and local health departments are good sources of further information regarding a particular geographic area.

Prolonged, frequent exposure to infected tick habitats, especially during the season when nymphal ticks are feeding, significantly increases the risk of being bitten by ticks. Another factor for consideration is the density of vector ticks in the environment. This vector-tick density also varies with geographic location. Vector ticks are present in most of the states throughout the U.S. There are, however, some areas that are more highly populated with infected ticks (as discussed earlier), and thus individuals in these locations would be at greater risk. Finally, the prevalence of *B. burgdorferi* infection in the vector ticks must be considered. All of these conditions are important considerations in determining an individual's risk of developing Lyme disease.³ Individuals who engage in high-risk leisure activities or occupations, especially during nymphal tick feeding season, in areas heavily infested with ticks carrying *B. burgdorferi* are at greatest risk of infection.

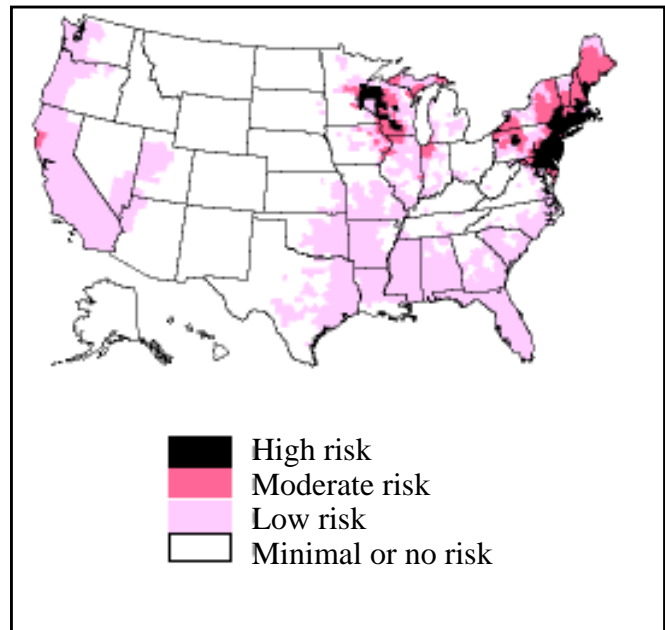
Prevention

Contact Avoidance

Avoiding tick bites is of utmost importance in the prevention of Lyme disease and other tick-borne illnesses. The CDC discusses several strategies to prevent tick-human contact:

- Avoiding brushy, overgrown grassy, and wooded habitats, particularly in spring and early summer when nymphal ticks feed³;

National Lyme disease risk map with four categories of risk



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. See reference 1 for details on risk definition.

- Removing leaves, tall grass, and brush from areas surrounding work areas or residential areas, thereby reducing tick, deer, and rodent habitat;
- Applying tick-toxic chemicals (e.g., Damminix, Dursban, Sevin, etc.) to surrounding work or residential areas has resulted in suppression of the tick population. Pesticides should be used only in accordance with federal Environmental Protection Agency (EPA) and applicable state and local regulations. Their application may be controversial or considered inappropriate in some communities. Some concerns regarding widespread use, including long-term effects on water supply and wildlife, have been raised. Investigation into various environmental aspects of these measures continues.

Although tick habitat should be avoided or cleared where possible, there are some job duties where this is not possible. The probability of tick bites can be decreased by using personal protection. Several measures have been recommended for personal protection, and have been used, including^{4,8}:

- Wearing light-colored clothing so that ticks can be more easily seen and removed before attachment occurs;
- Wearing long-sleeved shirts and tucking pant legs into socks or boots to prevent ticks from reaching the skin;
- Wearing high boots or closed shoes that cover the entire foot;
- Wearing a hat;
- Spraying insect repellents (containing n,n-diethyl-m-toluamide [DEET]) on exposed skin, excluding the face, in accordance with EPA guidelines. Using permethrin on clothes to kill ticks on contact;
- Showering, and washing and drying clothes at a high temperature, after outdoor exposure;
- Checking the body carefully for ticks; once found, promptly removing them with tweezers and cleansing the skin area with an antiseptic.

Although extensive statistical analyses of the effectiveness of these protective measures have not been accomplished, these practices are recommended by public health experts, and they are used by tick research personnel and others with unavoidable exposure to ticks. Studies have examined some of these measures and have indicated that some of them are effective.⁶

Vaccine

Although two vaccines have been developed for the prevention of Lyme disease, the U.S. Food and Drug Administration (FDA) has approved only LYMERix for use in the U.S. This approval is for use in individuals 15-70 years of age, an age range that includes most workers. The LYMERix vaccine may exert its primary action by causing the body to produce antibodies that kill the *B. burgdorferi* bacteria in the gut of the tick.³ The vaccine requires a series of three injections for optimal protection. The second dose is given 1 month after the initial injection; the final dose is administered 12 months fol-

lowing the first injection. In a randomized, controlled trial (phase 3) of LYMERix, after two doses of the vaccine the protection rate against “definite” Lyme disease was 49% and after three doses was 76%.³ Protection against asymptomatic infection was 83% after 2 doses and 100% after the third dose. The manufacturer observed no serious side effects after 20 months of study.³ After infection with *B. burgdorferi*, however, persons who express certain MHC II molecules (a particular genetic sequence) are more likely than others to develop chronic, poorly understood Lyme arthritis associated with high levels of antibody to OspA (the primary antigenic expression of *B. burgdorferi* in the tick gut) in serum and synovial (joint) fluid.^{3,9} The underlying etiology of this immune reactivity is not clearly understood,^{5,10,11,12} and LYMERix contains a lipidated recombinant OspA (rOspA) protein. The vaccine should not be administered to persons with a history of treatment-resistant Lyme arthritis³. In clinical trials, 5,469 subjects received at least one dose of vaccine, while 5,467 subjects received at least one placebo injection. Information regarding adverse events that were believed to be related to or possibly related to injection was available from 4,999 subjects in each group. Reports of arthritis, a rare event, were not significantly different between vaccine and placebo recipients, but vaccine recipients were significantly more likely to report joint or muscle aches within 30 days following each dose. Vaccinees were significantly more likely to report redness and swelling at the injection site, muscle pain, flu-like illness, fever, and chills, although none of these was reported by more than 3.2% of subjects. For this group of vaccinees, no statistically significant differences existed in the incidence of adverse events more than 30 days after receiving a dose of vaccine. It should be noted that the rarer the event, the less likely a statistical difference will occur in a given subject population. Communications with the Vaccine Adverse Events Reporting System (VAERS) Hotline during September 1999 indicated that some reports of adverse events relating to LYMERix have been made. Long-term events associated with the Lyme disease vaccine continue to be monitored through reports to VAERS, and the vaccine manufacturer has agreed to conduct a phase 4 study to obtain long-term safety data for the Lyme disease vaccine.¹³

Lyme disease vaccine does not protect all recipients against infection with *B. burgdorferi* and offers no protection against other tick-borne diseases. Consequently, vaccinated persons, as well as the unvaccinated, should continue to practice good prevention and personal protective measures to prevent tick bites, and they should seek medical attention for early diagnosis and treatment of suspected tickborne infections. The duration of protection with LYMERix is not known,¹⁴ although vaccine recipients continue to be monitored by the manufacturer to ascertain this information. LYMERix is not recommended for certain groups of people (see below).

The Advisory Committee on Immunization Practices has made the following recommendations regarding the LYMERix vaccine^{3,4}:

- **Persons Who Work, Reside, or Recreate in Areas of High or Moderate Risk** (see map p.3)
 - Vaccine **should be considered** in persons aged 15-70 years who engage in activities which result in frequent or prolonged exposure to tick-infested habitat;
 - Vaccine **may be considered** in persons aged 15-70 years who are exposed to tick-infested habitat but whose exposure is neither frequent nor prolonged;
 - Vaccine is **not recommended** for persons whose exposure to tick-infested habitat is minimal or none.
- **Persons Who Work, Reside, or Recreate in Areas of Low or No Risk**
Vaccine is **not recommended** for persons in these areas
- **Travelers to Areas of High or Moderate Risk**
Vaccine **should be considered** in travelers aged 15-70 years whose exposure to tick-infested habitat is frequent or prolonged. It should be noted that travelers will not achieve optimal protection unless all three doses are received, although some protection is afforded from two doses of vaccine.
- **Pregnant Women**
Vaccine is **not recommended** for pregnant women because the safety of rOspA vaccines administered during pregnancy has not been established.

- **Persons with Immunodeficiency**
No data available (persons with immunodeficiency were excluded from phase 3 safety and efficacy trial).
- **Persons with Musculoskeletal Disease**
Limited data available regarding Lyme disease vaccine in persons with diseases associated with joint swelling (including rheumatoid arthritis) or diffuse musculoskeletal pain because these individuals were excluded from phase 3 safety and efficacy trials
- **Persons with Previous History of Lyme Disease**
 - Consideration of vaccine **depends on the medical course** of the previous Lyme disease infection:
 - (1) **Consider vaccine** for persons with a history of previous uncomplicated Lyme disease who are at continued high risk.
 - (2) **No vaccination** for persons who have treatment-resistant Lyme arthritis, because of the association between this condition and immune reactivity to OspA.
 - (3) **Safety and efficacy are unknown** for persons with chronic joint or neurological illness related to Lyme disease because individuals with these characteristics were excluded from phase 3 safety and efficacy trials.
 - (4) **Safety and efficacy are unknown** for persons with second- or third-degree atrioventricular block, because individuals with these disorders were excluded from phase 3 safety and efficacy trials.

Conclusions

The incidence and prevalence of occupationally acquired Lyme disease has not been precisely defined; several studies have addressed this issue and have indicated that outdoor workers in areas where the disease is endemic are at increased risk.

The risk of encountering ticks infected with *B. burgdorferi* varies from state to state, within states, and even within counties. Current information regarding risk in specific areas is best obtained from state and local public health authorities.

Preventing tick bites is of utmost importance in preventing Lyme disease and other tickborne illnesses. Tick bite prevention strategies include

avoidance or clearing of tick-infested habitats and use of personal protective measures (e.g., repellents and protective clothing). Tick checks should be done regularly, and ticks should be removed promptly. Lyme disease vaccine should be considered for some outdoor workers as specified in ACIP recommendations.³

If an individual engaged in outdoor work in heavily wooded or brushy areas develops flu-like symptoms (fever, chills, muscle aches, joint pains, neck stiffness, headache) or a bulls-eye rash, the worker should seek medical attention even if there is no recall of a tick bite.³ A person, including an outdoor worker, who has experienced a tick bite in a high endemic area for Lyme disease should remove the tick and seek medical attention if signs and/or symptoms of tick-borne diseases occur.³ Medical evaluation following a tick bite in a high-endemic area for Lyme disease or other tickborne illness may help to alleviate concerns and establish a baseline for follow-up of the bitten individual should signs and symptoms develop.

Most cases of early Lyme disease can be successfully treated with commonly available antibiotics; therefore, early diagnosis and initiation of therapy are important to ensure the best treatment outcome possible.

Information Availability

Investigation continues into various aspects of Lyme disease, including more precise definition of occupational transmission, relative effectiveness of the various recommended preventive measures, and long-term epidemiological studies of the safety, efficacy, prevention effectiveness, cost effectiveness, and patterns of use of the Lyme disease vaccine. Meanwhile, workers and employers need to be aware of the present state of knowledge regarding Lyme disease and methods of protection. Workers should be advised of the signs and symptoms of Lyme disease, as well as the primary and secondary preventive measures for decreasing the risk of Lyme disease transmission, acute illness, and chronic health effects.

The ACIP Recommendations for the Use of Lyme Disease Vaccine³ are available on the CDC web site (www.cdc.gov) and can be consulted

for more information regarding Lyme disease, including protective measures and treatment considerations.

OSHA field staff and consultation personnel should be aware of the potential for Lyme disease transmission to outdoor workers in areas endemic for *B. burgdorferi* infected ticks.

Please distribute copies of this bulletin to Area Offices, State Plan States, and Consultation Projects.

Important Information on the Nature and Effect of Hazard Information Bulletins

The Directorate of Technical Support issues Hazard Information Bulletins (HIBs) in accordance with OSHA instruction CPL 2.65 to provide relevant information regarding unrecognized or misunderstood health hazards, inadequacies of materials, devices, technique, and safety engineering controls. HIBs are initiated based on information provided by the field staff, studies, reports and concerns expressed by safety and health professionals, employers and the public. Bulletins are developed based on thorough evaluation of available facts in coordination with appropriate parties. The HIB is not intended to address issues related to patient care.

An HIB is not a new standard or regulation, and it creates no legal obligations. It is advisory in nature, informational in content, and is intended for use by employers seeking to provide a safe and healthful workplace.

The *Occupational Safety and Health Act* requires employers to comply with hazard-specific safety and health standards. In addition, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm under Section 5(a)(1), the General Duty Clause of the Act. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take steps to prevent or abate the hazard. However, failure to implement HIB recommendations is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

References

1. Lyme Disease. CDC, National Centers For Infectious Diseases, Division of Vector-Borne Infectious Diseases. 1/1/1991. (see www.cdc.gov)
2. Schwartz B, Goldstein M. "Lyme Disease: A Review for the Occupational Medicine Physician." *Journal of Occupational Medicine* 1989, 31:9; 735-742.
3. "Recommendations for the use of Lyme Disease Vaccine; Recommendations of the Advisory Committee on Immunization Practice." *MMWR Weekly* 6/4/1999, 48 (RR07); 1-17. (see www.cdc.gov)
4. Lyme Disease: Introduction; Bacterium; Natural History; Diagnosis; Epidemiology; Prevention and Control; Vaccine Recommendations. CDC, CID, DVID 6/1999. (see www.cdc.gov)
5. Schwartz B, Goldstein M, Childs J. "Longitudinal Study of *Borrelia burgdorferi* Infection in New Jersey Outdoor Workers, 1988-1991." *American Journal of Epidemiology* 1994; 139:5, 504-512.
6. Schwartz B, Goldstein M. "Lyme Disease In Outdoor Workers: Risk factors, Preventive measures, and tick removal methods." *American Journal of Epidemiology* 1990; 131:5, 877-885.
7. Lewis, Ricki. *Getting Lyme Disease to Take a Hike*. U.S. FDA 6/1994. (see www.cdc.gov)
8. *Lyme Disease*. FDA, 1997. (see www.fda.gov)
9. Kalish RA, Leong JM, Steere AC. "Association of treatment-resistant chronic Lyme arthritis with HLA-DR4 and antibody reactivity to OspA and OspB of *Borrelia burgdorferi*." *Infect Immun* 1993; 61:2774-9.
10. US DHHS FDA CBER Vaccines and Related Biological Products Advisory Committee Meeting, 5/26/98, transcript. (see www.fda.gov)
11. Marwick, Charles. "Guarded Endorsement for the Lyme Vaccine." *JAMA* 6/24/1998; 279:24, 1937-38.
12. Gardner, Pierce. "Lyme Disease Vaccines." *Annals of Internal Medicine* 10/98; 129:7, 583-84.
13. Donlon, JA and Hardegree, MC. FDA letter accompanying issuance of biologics license number to Smith Kline Beecham Biologicals, 12/21/98
14. Lewis, Carol. "New Vaccine Targets Lyme Disease." *FDA Consumer Magazine* May-June 1999:99, 1304.