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Emerging Tickborne Diseases in New Hampshire

Key Points and Recommendations:

1. Blacklegged ticks transmit four different infections in NH: Lyme, Anaplasma, Babesia, and Powassan. They may transmit other emerging infections.
2. NH has one of the highest rates of Lyme disease in the nation, and 50-60% of blacklegged ticks sampled in NH have been found to be infected with *Borrelia burgdorferi*, the bacterium that causes Lyme disease.
3. Powassan was identified in two NH residents during past seasons: 2013 and 2016. While uncommon, Powassan can cause a debilitating neurological illness, so providers should maintain an index of suspicion for patients presenting with an unexplained meningoencephalitis.
 - a. Testing for Powassan can be arranged through the NH Public Health Laboratories by calling the NH DPHS Bureau of Infectious Disease Control at the number below.
4. Providers should ask patients with suspected Babesiosis whether they have donated blood or received a blood transfusion.
5. For any non-Lyme tickborne disease, providers should determine most likely geographical area for exposure and report that information on the case report form as this information will help define the location of tickborne disease in New Hampshire.
6. If testing for Lyme disease is negative, yet you still suspect a tickborne disease, consider testing for other pathogens, such as *Borrelia miyamotoi*.
7. Report all tickborne diseases, confirmed or suspected, to the NH DPHS Bureau of Infectious Disease Control at 603-271-4496 (after hours 603-271-5300).

Background:

New Hampshire has evidence of local transmission of four tickborne diseases. Lyme disease (*Borrelia burgdorferi*), babesiosis (*Babesia microti* and other species), anaplasmosis (*Anaplasma phagocytophilum*), and Powassan virus are transmitted by the bite of the blacklegged tick (*Ixodes scapularis*), also known as the deer tick. Although the lifespan of this tick is two years, people are most likely to be infected between May and August when the aggressive nymph stage is active. Nymphs are very small (< 2mm) and difficult to see unless they become engorged with blood. Household pets commonly bring ticks in from outdoors that can serve as a source of infection for their owners.

There are also other emerging tickborne diseases which have not yet been identified in New Hampshire, but should be considered in the appropriate setting:

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1. Neighboring states have reported cases of *Borrelia miyamotoi*, which is also transmitted by the blacklegged tick.
2. *Borrelia mayonii*, which was identified as a disease causing agent in 2013 in the Midwest, is also found in blacklegged ticks in upper Midwestern states.
3. Heartland virus has been identified in residents of Missouri and Tennessee, but one study demonstrated that New Hampshire deer and moose had serological evidence of Heartland virus infection. The vector for this in New Hampshire is currently unknown. (https://wwwnc.cdc.gov/eid/article/21/10/15-0380_article)

Epidemiology:

Lyme disease has been identified in all 10 New Hampshire counties and incident cases have been stable for the last five years. Anaplasmosis and babesiosis continue to increase across the state. Powassan virus is rare, with only two reported cases, one in 2013 and one in 2016. The last year for which complete data exists is 2015. Additional data, as well as our Tickborne Disease Bulletin, can be found on our website at:

<http://www.dhhs.nh.gov/dphs/cdcs/lyme/publications.htm>.

Table 1. Tickborne disease incidence in New Hampshire by year, 2011-2015.

	2011	2012	2013	2014	2015
Lyme Disease	1321	1456	1691	1416 ¹	1371 ¹
Anaplasmosis	30	52	88	130	110
Babesiosis	14	19	22	40	53
Powassan Virus	0	0	1	0	0

1. Due to staffing vacancies and elimination of positions, suspect cases of Lyme disease reported in 2014 and 2015 could not be confirmed. The number of cases in 2014 and 2015 was estimated based on the number of reports received and historical data.

Tick surveillance performed during 2013-2014 in NH counties showed that >50% of adult ticks tested in most counties were infected with the bacteria causing Lyme disease with the exception of Carroll, Cheshire, Coos and Sullivan counties where very low numbers of ticks were collected, precluding prevalence assessment. *Babesia* and *Anaplasma* have been detected in ticks in NH, although reliable prevalence data for these pathogens in ticks is not available due to small sample size. Tick surveillance maps by county from 2013-2014 are available at:

<http://www.dhhs.nh.gov/dphs/cdcs/lyme/documents/blacklegged13-14.pdf>.

Borrelia miyamotoi was first identified in 1995 in ticks from Japan, and to date fewer than 60 human cases of have been documented in the United States. No cases have been identified in New Hampshire, but have been identified in surrounding states. New Hampshire ticks have tested positive for *B. miyamotoi* (https://www.tickreport.com/stats/search_results).

Borrelia mayonii is even less common, and from 2012-2014, six individuals tested positive in the upper Midwest of the United States as part of a retrospective serosurvey.

Heartland virus has been diagnosed in only eight individuals in the U.S. in Missouri and Tennessee since March 2014. No cases have been identified in New Hampshire; however, deer and moose have demonstrated evidence of exposure to this virus. The full clinical spectrum and geographical distribution of these emerging infectious diseases are not well understood.

Tickborne Disease Symptoms

General: Many tickborne diseases present similarly with nonspecific symptoms that may include malaise, fever, chills, sweats, headache, stiff neck, muscle and joint pains, and lymphadenopathy. Some may also present with other systemic symptoms (neurological, cardiovascular, respiratory or gastrointestinal symptoms).

Powassan Virus Infection:

Powassan (POW) virus has an incubation period of 7-30 days following the bite of an infected tick. Although most infections are subclinical, symptoms may include fever, headache, vomiting, and generalized weakness that can progress to meningoencephalitis. About half of those that survive clinical disease have permanent neurological sequelae.

Borrelia miyamotoi:

Symptoms of *Borrelia miyamotoi* include fever, chills, headache, body aches, joint pain, and fatigue. Rash is uncommon, occurring in about 8% of infected individuals.

Borrelia mayonii:

Symptoms of early infection may include fever, headache, rash, and neck pain. Nausea and vomiting may also occur. Later stages of disease may cause arthritic like symptoms.

Heartland Virus:

Symptoms in the eight identified cases included fever, fatigue and thrombocytopenia. Some also experienced headaches, myalgia, diarrhea, anorexia and/or nausea. Most required hospitalization.

Tickborne Disease Diagnostic Testing

For Lyme disease, anaplasmosis and babesiosis, use your already established testing networks. Powassan virus testing should be coordinated through New Hampshire's Public Health Laboratories. If you suspect another tickborne disease for which testing may be limited or not accessible, such as *Borrelia miyamotoi* or Heartland virus, please contact the Bureau of Infectious Disease Control at 603-271-4496 (after hours 603-271-5300).

For testing information on *Borrelia miyamotoi*, please see attachment 1.

For tickborne disease treatment information, please see attachments 2 and 3.

Reporting Tickborne Diseases:

Clinicians should report suspected and confirmed cases of all tickborne diseases to the NH DPHS Bureau of Infectious Disease Control at 603-271-4496 (after hours 603-271-5300).

There is a specific Lyme disease case report form that should be used for reporting. Please record the date of symptom onset because this information is used to determine whether a case meets the CDC case definition for surveillance. When complete, please mail or fax to the number listed on the form. The form is attached, or can be downloaded from:

<http://www.dhhs.nh.gov/dphs/cdcs/documents/lymediseasereport.pdf>.

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Additional Resources

New Hampshire Tickborne Disease Page	https://www.dhhs.nh.gov/dphs/cdcs/lyme/
Tickborne Diseases of the United States: A Reference Manual for Health Care Providers, Second Edition (CDC)	https://www.cdc.gov/lyme/resources/TickborneDiseases.pdf
Tickborne Disease (CDC)	https://www.cdc.gov/ticks/index.html
Powassan (CDC)	https://www.cdc.gov/powassan/
<i>Borrelia miyamotoi</i> (CDC)	https://www.cdc.gov/ticks/miyamotoi.html
<i>Borrelia mayonii</i> (CDC)	https://www.cdc.gov/ticks/mayonii.html
Heartland Virus (CDC)	https://www.cdc.gov/ncezid/dvbd/heartland/index.html
Heartland virus wildlife serosurvey article	https://wwwnc.cdc.gov/eid/article/21/10/15-0380_article

Tickborne Disease Prevention

An individual's risk of tickborne disease depends on their outdoor activities and the abundance of infected ticks. All tickborne diseases are prevented the same way. There are options for personal protection through the use of appropriate clothing and repellents, as well as options for environmental management and control. The use of environmental management and control is successful in preventing tick encounters, thereby reducing the risk of tick bites. There are several resources available to educate your patients about how to reduce their risk of tick encounters and tick bites.

State of New Hampshire Tickborne Disease Prevention Plan:
<https://www.dhhs.nh.gov/dphs/cdcs/lyme/documents/tbdpreventionplan.pdf>

University of New Hampshire Cooperative Extension's Biology and Management of Ticks in New Hampshire:
https://extension.unh.edu/resources/files/Resource000528_Rep1451.pdf

Connecticut Agricultural Experiment Station's Tick Management Handbook:
http://www.ct.gov/dph/lib/dph/infectious_diseases/lyme/TickManagementHandbook2007.pdf

CDC Tick Bite Prevention:
<https://www.cdc.gov/ticks/avoid/index.html>

Prevention Messages for Patients:

- Avoid tick-infested areas when possible and stay on the path when hiking to avoid brush.
- Wear light-colored clothing that covers arms and legs so ticks can be more easily seen.
- Tuck pants into socks before going into wooded or grassy areas.
- Apply insect repellent (20-30% DEET) to exposed skin. Other repellent options may be found here: https://www.epa.gov/insect-repellents/find-insect-repellent-right-you#search_tool
- Outdoor workers in NH are at particular risk of tickborne diseases and they should be reminded about methods of prevention.
- Perform daily tick checks to look for ticks on the body, especially warm places like behind the knees, the groin, and the back and neck.

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- Pets returning inside may also bring ticks with them. Performing tick checks and using tick preventatives on pets will minimize this occurrence.
- Encourage landscape or environmental management to reduce tick habitat and encounters.
- Shower soon after returning indoors to wash off any unattached ticks and check clothes for any ticks that might have been carried inside. Placing dry clothes in the dryer on high heat for ten minutes or one hour for wet or damp clothes effectively kills ticks.
- Remove ticks promptly using tweezers. Tick removal within 36 hours of attachment can prevent Lyme disease, but transmission of other tick-borne diseases can occur with shorter periods of attachment time.
- Monitor for signs and symptoms of tickborne diseases for 30 days after a tick bite. Patients should contact their healthcare provider if symptoms develop.

Additional background information about tickborne diseases and prevention can be found in the State of New Hampshire Tickborne Disease Prevention Plan at:

<http://www.dhhs.nh.gov/dphs/cdcs/lyme/documents/tbdpreventionplan.pdf>

For any questions regarding the contents of this message, please contact NH DHHS, DPHS, Bureau of Infectious Disease Control at 603-271-4496 (after hours 603-271-5300).

To change your contact information in the NH Health Alert Network, contact Thom Flynn at 603-271-7499 or tdflynn@dhhs.nh.gov.

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From: Abigail Mathewson, DVM, MPH - State Public Health Veterinarian
Originating Agency: NH Department of Health and Human Services, Division of Public Health Services

Attachments: 1. *Borrelia miyamotoi* lab testing table; 2. Tickborne diseases treatment table; 3. Lyme disease prophylaxis guidelines; 4. Lyme disease case report form

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ATTACHMENT 1

***Borrelia miyamotoi* lab testing**

Currently, confirmation of a diagnosis relies on 1) the use of polymerase chain reaction (PCR) tests that detect DNA from the organism (preferred) or 2) antibody-based tests. Both types of tests are under development and not widely commercially available but can be ordered from a limited number of CLIA-approved laboratories.

Less sensitive and specific methods for detecting *B miyamotoi* and agents of tickborne relapsing fever include identification of spirochetes in peripheral blood films and spinal fluid preparations and serologic testing.

Lab	Test	Specimen	Volume	Storage	Shipping	Turnaround time	Comments
Immugen	<i>Borrelia</i> PCR	CSF, Synovial Fluid or EDTA Whole Blood	2.0 ml (0.5 ml minimum)	Refrigerate	Ambient	24-48 hours from receipt	Doesn't differentiate between <i>B. burgdorferi</i> and <i>B. miyamotoi</i>
Immugen	<i>B. miyamotoi</i> serology (IgM and IgG)	Serum or CSF	2.0 ml (0.5 ml minimum)	Refrigerate	Ambient	24-48 hours from receipt	Most patients acutely symptomatic with <i>Borrelia miyamotoi</i> infection are seronegative. If the clinical history strongly suggests infection, collect/submit a convalescent specimen 3-4 weeks later.
Mayo	<i>B. miyamotoi</i> PCR	EDTA whole blood	1.0 ml (0.3 ml minimum volume)	Refrigerate	Ambient	Unknown	
Quest	<i>B. miyamotoi</i> PCR	CSF, synovial fluid, whole blood (EDTA)	1.0 ml (0.3 ml minimum volume)	Refrigerate	Ambient	Unknown	

ATTACHMENT 2

Tick bites and single-dose doxycycline as prophylactic treatment for Lyme disease in NH (Based on the 2006 Infectious Disease Society of America guidelines)

A **single** dose of doxycycline (200 mg) may be offered to adult patients and to children ≥ 8 years of age (4 mg/kg up to a maximum dose of 200 mg) when ALL of the following conditions exist:

1. The attached tick is a blacklegged tick (deer tick, *Ixodes scapularis*). Tick identification is most accurately performed by an individual trained in this discipline. However, blacklegged ticks are very common in southeastern and central New Hampshire and there are many images available online to help identification. AND
2. The tick has been attached for at least 36 hours. This determination can be made by asking the patient about outdoor activity in the time before the tick bite was noticed to estimate attachment time, or by asking about degree of engorgement. Unengorged (unfed) blacklegged ticks are typically flat. Any deviation from this “flatness,” which is often accompanied by a change in color from brick red to a gray or brown, is an indication that the tick has been feeding. AND
3. Prophylaxis can be started within 72 hours of the time that the tick was removed. This time limit is suggested because of an absence of data on the efficacy of prophylaxis for tick bites following longer time intervals after tick removal. AND
4. Doxycycline prophylaxis is not contraindicated. Doxycycline is contraindicated in pregnant women and children less than 8 years old. The other common antibiotic treatment for Lyme disease, amoxicillin, is not recommended for prophylaxis because of an absence of data on an effective short-course prophylaxis regimen, the likely need for a multi-day regimen along with its possible adverse effects, and the excellent efficacy of treatment if signs or symptoms do develop.

Note that single-dose doxycycline is not 100% effective for prevention of Lyme disease; consequently, patients who receive this therapy should monitor themselves for the development of Lyme disease as well as other tickborne diseases including anaplasmosis and babesiosis.

Adapted from: Wormser GP, et al. The Clinical Assessment, Treatment, and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis: Clinical Practice Guidelines by the Infectious Diseases Society of America. *Clinical Infectious Diseases*; 2006; 43:1089 –1134. Available online at: <http://cid.oxfordjournals.org/content/43/9/1089.full>

ATTACHMENT 3

NH DPHS Treatment Recommendations for Tickborne Diseases Summary of 2006 Infectious Disease Society of America Guidelines (<http://www.idsociety.org/Organism/#LymeDisease>)

Disease	Treatment Regimens for Adults	Treatment Regimens for Children
Lyme disease	Oral Options	
	Doxycycline 100 mg PO twice daily*	For children 8 years and older: Doxycycline 4 mg/kg/day in 2 divided doses (max 100 mg/dose)
	Amoxicillin 500 mg PO three times daily	Amoxicillin 50 mg/kg/day in 3 divided doses (max 500 mg/dose)
	Cefuroxime axetil 500 mg PO twice daily	Cefuroxime axetil 30 mg/kg/day in 2 divided doses (max 500 mg/dose)
	Parenteral options	
	Preferred: Ceftriaxone 2g IV Once daily	Preferred: Ceftriaxone 50-75 mg/kg IV Once daily (max 2g)
	Alternative: Cefotaxime 2g IV every 8 hrs	Alternative: Cefotaxime 150-200 mg/kg/day IV in 3-4 divided doses (max 6g/day)
	Alternative: Penicillin G 3-4 million units IV every 4 hrs	Alternative: Penicillin G 200,000-400,000 U/kg/day divided every 4 hr. (max 18-24 million units per day)
Note: Choice of regimen, route and length of treatment for Lyme disease depends on symptoms and stage of disease.		
Anaplasmosis	Doxycycline 100 mg PO twice daily for 10 days*	8 years and older: Doxycycline 4 mg/kg/day PO in 2 divided doses for 10 days (max 100 mg/dose)
	Alternatives: <u>Mild disease:</u> Rifampin 300 mg PO twice a day for 7-10 days (note: rifampin is not effective for Lyme disease. If coinfection exists, Amoxicillin or Cefuroxime would need to be <i>added</i> for treatment of Lyme disease as well)	Under 8 years old (without concomitant Lyme disease): <u>Severe disease:</u> Doxycycline (dose as above) for 4-5 days, with close monitoring after for resolution of symptoms. <u>Mild disease:</u> Rifampin 10 mg/kg PO twice daily (max 300 mg/dose) for 7-10 days, with close monitoring after for resolution of symptoms. Under 8 years old (with concomitant Lyme disease): <u>Severe disease:</u> Doxycycline for 4-5 days (dose as above) then completes a 14-day total course with Amoxicillin OR Cefuroxime axetil (doses as above) after treating with doxycycline. <u>Mild disease:</u> If Rifampin is used, add Amoxicillin or Cefuroxime for treatment of Lyme disease as above.
Babesiosis	Atovaquone 750 mg PO every 12 hrs.	Atovaquone 20 mg/kg PO every 12 hrs.

Disease	Treatment Regimens for Adults	Treatment Regimens for Children
	<p>PLUS Azithromycin 500-1000 mg PO on day 1, then 250 mg PO daily thereafter</p> <p><u>Severe disease:</u> Clindamycin 300-600 mg IV every 6 hrs. (or 600 mg PO every 8 hrs.) PLUS Quinine 650 mg PO every 6-8 hrs. Consider exchange transfusion.</p>	<p>(max 750 mg/ dose) PLUS azithromycin 10 mg/kg/day PO once daily on day 1 (max 500 mg/dose) then 5 mg/kg PO daily (max 250 mg/dose) thereafter.</p> <p><u>Severe disease:</u> Clindamycin 7-10 mg/kg every 6-8 hrs. PO or IV (max 600 mg/dose) PLUS Quinine 8 mg/kg PO every 8 hrs. (max 650 mg/dose). Consider exchange transfusion.</p>
	Note: patients coinfecting with <i>B. burgdorferi</i> or <i>A. phagocytophilum</i> should be treated with additional antibiotics as described above.	
Powassan Virus	Supportive care	Supportive care
<i>Borrelia miyamotoi</i>	Treatment is similar to treatment for tickborne relapsing fever. Please consult an Infectious Disease specialist.	
<i>Borrelia mayonii</i>	Treatment is similar to treatment for Lyme disease. Please consult an Infectious Disease specialist.	
Heartland Virus	Supportive care	Supportive care

***NOTE: For pregnant women, doxycycline should not be used.**

Adapted from: Wormser GP, et al. The Clinical Assessment, Treatment, and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis: Clinical Practice Guidelines by the Infectious Diseases Society of America. *Clinical Infectious Diseases*;2006;43:1089 –1134. Available online at: <http://cid.oxfordjournals.org/content/43/9/1089.full>

