Lyme Disease Knowledge, Beliefs, and Practices of New Hampshire Primary Care Physicians

Julie M. Magri, MD, MPH, Melissa T. Johnson, MS, Timothy A. Herring, MPH, and Jesse F. Greenblatt, MD, MPH

Background: **Lyme disease is the most commonly reported vectorborne illness in the United States and is endemic in many counties in the Northeast, including counties in New Hampshire. Previous studies conducted elsewhere on Lyme disease have indicated substantial differences between physician practices and published consensus guidelines for diagnosis and treatment.**

Methods: **During 1999, we mailed a 21-item questionnaire to 600 randomly selected family practice physicians, internists, and pediatricians in New Hampshire.**

Results: **Respondents answered a median of 10 (76.9%) of 13 knowledge items correctly. Most physicians (73.6%) underestimated the incidence of erythema migrans among Lyme disease patients, and 41.2% would either test or offer treatment to an asymptomatic patient with deer-tick bite. When surveyed, most respondents (72.4%) planned to recommend Lyme disease vaccine to high-risk persons. Approximately one half (44.8%) reported giving empiric antibiotic treatment of Lyme disease solely because of patient concern.**

Conclusions: **New Hampshire primary care physicians indicated good knowledge about Lyme disease. Lack of awareness about Lyme disease diagnostic criteria, however, could contribute to misdiagnosis through overreliance on laboratory testing. Lyme disease vaccine appeared to be well accepted by physicians, although the vaccine has since been withdrawn from the US market. Both inappropriate management of tick bite and empiric treatment of unsubstantiated Lyme disease diagnoses were common. (J Am Board Fam Pract 2002;15:277–84.)**

Lyme disease, a tickborne zoonosis caused in North America by infection with the spirochete *Borrelia burgdorferi*, is the most commonly reported vectorborne illness in the United States. From 1992 to 1998, the number of cases reported annually to the Centers for Disease Control and Prevention (CDC) increased by 70%, from 9,896 cases to 16,802 cases.[1] Lyme disease has increased in incidence concurrent with the geographic spread of tick vectors (ie, *Ixodes scapularis* and *I pacificus*) in the United States.[2] The distribution of Lyme disease endemicity in the United States is highly focal, with eight Northeastern states (New York, Connecticut, Pennsylvania, New Jersey, Rhode Island, Maryland, Massachusetts, and Delaware) and two North Central states (Wisconsin and Minnesota) accounting for 92% of cases reported from 1992 to 1998.[1] Although reported incidence of Lyme disease in New Hampshire is lower than in these states, all New Hampshire counties reported one or more cases of Lyme disease among residents from 1992 to 1998, and two southeastern New Hampshire counties ranked in the top 10th percentile of reported cases by county nationwide during this time.[1]

During the past decade, consensus groups and expert panels have published recommendations to help physicians diagnose and treat Lyme disease.[3–8] Previous surveys of Lyme disease knowledge, attitudes, and practices conducted among physicians in endemic areas of the Northeast in 1994 and Mid-Atlantic in 1991 have documented major differences between physician practices and published recommendations.[9,10] We are not aware, however, of any study that has focused on physician knowledge, attitudes, and practices in a moderate-incidence state. In December 1998 the US Food and

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From the Epidemic Intelligence Service (JMM), Division of Applied Public Health Training, Epidemiology Program Office, State Branch, Centers for Disease Control and Prevention, Atlanta; and the Office of Community and Public Health (JMM, MTJ, TAH, JFG), New Hampshire Department of Health and Human Services, Concord, NH. Reprint are not available from the author.

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Drug Administration (FDA) licensed the LYMErix Lyme disease vaccine. Although recommendations for its use were published in June 1999,[11] we are not aware of any data regarding physician attitudes toward this vaccine or their willingness to recommend it to patients. To characterize physicians' knowledge, attitudes, and practices in New Hampshire, and to characterize physician attitudes regarding the recently licensed vaccine, we conducted a survey of primary care physicians in New Hampshire.

Methods

Questionnaire

We conducted a cross-sectional survey of primary care physicians in New Hampshire using a four-page, 21-item questionnaire. This questionnaire included 4 questions regarding respondent demographics (medical specialty, number of years in practice, town or city where practice is currently located, and number of patients seen per week); 6 multiple-choice questions on Lyme disease knowledge (ie, epidemiology, symptoms, diagnosis) that constituted 13 scorable items; 7 multiple-choice questions on practices, including three patient scenarios; and 4 multiple-choice questions regarding beliefs about and attitudes toward local endemicity, Lyme disease vaccine, and patient concern regarding Lyme disease. The survey instrument was pretested with a convenience sample of 10 primary care physicians, after which minor revisions were made. For the knowledge portion of the survey, respondents received one point for each correct answer, and the score was converted to the percentage of 13 knowledge items answered correctly. We conducted a review of the Lyme disease literature, including current consensus guidelines, to determine the correct answers to the knowledge portion of the survey.

Sample

Our study was conducted with approval of the CDC Institutional Review Board and with support of the local chapters of the family practice, pediatrics, and internal medicine societies in New Hampshire. We used the physician listing as of 22 June 1999 from the State of New Hampshire Board of Medicine to choose a random sample of 600 of the 990 primary care physicians in that state. For the purposes of the study, we defined primary care physicians as family physicians, internists, and pediatricians. We considered physicians eligible for the survey if they were primary care physicians currently in active clinical practice in New Hampshire.

Confidential, coded questionnaires were mailed to the 600 physicians on 20 July 1999. Three weeks later, reminder postcards were sent to nonresponders, followed by a telephone call to encourage participation, provide replacement questionnaires if needed, and ascertain reasons for nonparticipation. By 31 October 1999 completed questionnaires had been returned by 328 respondents.

Analysis

We performed statistical analyses using Epi-Info 6.04b software (CDC, Atlanta). These analyses included Yates-corrected chi-square tests for 2×2 contingency tables and Fisher exact test when expected cell values were less than 5. We used two-tailed tests and considered $P < .05$ statistically significant.

We excluded 32 returned questionnaires from both the sample and the analysis because the respondents were either not currently practicing clinical medicine in New Hampshire (n = 22) or did not consider themselves primary care physicians (n = 10). From information obtained during follow-up with nonresponders, we excluded 45 nonresponders from the sample who were not currently practicing clinical medicine in the state (n = 24) or did not consider themselves primary care physicians (n = 21). Accordingly, we analyzed 296 completed questionnaires from eligible respondents of a total sample of 523 eligible physicians, yielding a response rate of 56.6%.

We determined the board-certification status of physicians in our sample through New Hampshire Board of Medicine records. We analyzed responses geographically, comparing respondents practicing in the two counties where the number of reported Lyme disease cases is in the top 10th percentile nationwide (Hillsborough and Rockingham counties), with respondents practicing in all other New Hampshire counties.

To assess response bias, we also compared respondents according to the date they returned their questionnaire. We defined eager responders as those physicians who returned their questionnaires before receiving any reminders and reluctant responders as those who returned their question-

Table 1. Demographic Characteristics of Survey Respondents.

Demographics	Eligible Sample (n = 523) No. (%)	Eligible Respondents (n = 296) No. (%)	Response Rate	*P* Value
Specialty				.4
Family practice	221 (42.3)	129 (43.6)	58.4	
Internal medicine	206 (39.4)	103 (34.8)	50.0	
Pediatrics	96 (18.4)	59 (19.9)	61.5	
Overlapping specialties or missing information	0 (0.0)	5 (1.7)	–	
Board certified				.001
Yes	445 (85.1)	266 (89.9)	59.8	
No	77 (14.7)	30 (10.1)	39.0	
Unknown	1 (0.2)	0 (0.0)	–	
Region of New Hampshire				.99
Hillsborough and Rockingham counties*	245 (46.8)	138 (46.6)	56.3	
All other New Hampshire counties	278 (53.2)	158 (53.4)	56.8	

*Counties in top 10th percentile of reported Lyme disease cases nationally.

naires only after receiving a reminder postcard or telephone call.

Results

The demographics of the survey respondents compared with the survey sample are shown in Table 1. Response rates were not statistically different by specialty. Physicians from the two counties with high incidence of Lyme disease were not overrepresented among survey respondents. Respondents had been in practice for a median of 14 years (range 1–45 years) and saw a median of 80 patients per week (range 5–400).

Knowledge

The median knowledge score was 76.9%, representing 10 of 13 items answered correctly (interquartile range: 69.2%–84.6%, overall range: 15.4%–100%). Most respondents (93.9%) correctly selected the causative agent of Lyme disease, *B burgdorferi* (Table 2). Approximately two thirds (65.2%) knew that the incubation period from tick bite to development of erythema migrans rash is 3 to 30 days. Approximately one half (52.4%) knew that erythema migrans alone can be sufficient to diagnose Lyme disease, but fewer respondents (26.4%) correctly answered that erythema migrans occurs in at least 60% of persons with Lyme disease. Most respondents correctly classified whether various clinical signs and symptoms were related to Lyme disease.

Practices

Most respondents (63%) reported that they did not diagnose Lyme disease in any patients during 1998, whereas 33% diagnosed 1 to 3 cases and 4% diagnosed more than 3 cases. Table 3 depicts physician practice preferences, including responses to hypothetical case scenarios. Most physicians (85.5%) would typically prescribe antibiotics to a patient who has erythema migrans but has not had any laboratory testing performed. Compared with phy-

Table 2. Respondents' Knowledge About Lyme Disease.

Lyme Disease Knowledge Item	Percent of All Respondents
Knew causative agent of Lyme disease	93.9
Knew incubation period	65.2
Knew incidence of erythema migrans	26.4
Knew that erythema migrans is diagnostic	52.4
Aware of human granulocytic ehrlichiosis coinfection	56.4
Recognized signs and symptoms related to Lyme disease	
Arthritis	98.6
Fever	96.6
Neuropathy	88.2
Third-degree heart block	87.1
Meningitis	84.1
Recognized signs and symptoms not related to Lyme disease	
Goiter	93.9
Valvular heart disease	74.6
Diarrhea	74.0
Median overall knowledge score	76.9

Table 3. Respondents' Practices Regarding Lyme Disease.

Case Scenario	All Respondents* No. (%)
A patient with erythema migrans; no laboratory testing performed to date	
Typically would treat with an antibiotic for Lyme disease now	247 (85.5)
No antibiotic, reassure patient, no follow-up	0 (0.0)
No antibiotic or testing but see patient again for follow-up	2 (0.6)
No antibiotic, test patient for Lyme disease	38 (13.1)
No antibiotic, refer patient to a specialist	2 (0.6)
A patient with a known deer tick bite, no symptoms, no laboratory testing performed to date, and normal findings on examination	
Typically would treat with an antibiotic for Lyme disease now	36 (12.9)
No antibiotic, reassure and educate patient, follow up as needed	161 (57.7)
No antibiotic, test patient for Lyme disease	79 (28.3)
No antibiotic, refer patient to a specialist	3 (1.1)
A patient with a 3-month history of recurrent, asymmetric arthritis involving large, weight-bearing joints. Patient has no history of erythema migrans and has had multiple negative Western blot tests for Lyme disease during past 3 months. Whether patient has ever been bitten by a deer tick is unknown, but patient spends a lot of time outdoors. No cause for patient's arthritis found on initial work-up	
Typically would treat with an antibiotic for Lyme disease now	39 (13.7)
No antibiotic, continue to investigate other causes for patient's arthritis	137 (48.2)
No antibiotic or Lyme disease testing now, but see patient again for follow-up	4 (1.4)
No antibiotic, test further for Lyme disease now	20 (7.0)
No antibiotic, refer patient to a specialist	84 (29.6)
Has treated for possible Lyme disease in response to a patient's concerns, even when thought the patient did not have Lyme disease	130/290 (44.8)

*Totals were less than 296 because some respondents did not answer all questions.

sicians who knew on the knowledge portion of the survey that erythema migrans was sufficient to diagnose Lyme disease, however, physicians who did not think erythema migrans diagnostic were much more likely to test the patient first (31.3% vs 3.8%, $P < .0001$).

Approximately 13% of physicians would typically prescribe prophylactic antibiotics for an asymptomatic patient with a known deer-tick bite, whereas another 28.3% would test this patient for Lyme disease. Respondents from the two New Hampshire counties with reported Lyme disease cases in the top 10th percentile nationally were somewhat more likely to recommend antibiotic prophylaxis for Lyme disease after a tick bite than respondents from other New Hampshire counties (16.2% vs 9.7%), but this difference was not statistically significant. Approximately 14% of physicians would treat empirically for Lyme disease if a patient had arthritis but multiple negative laboratory tests for Lyme disease and no tick exposure or erythema migrans. Approximately one half of respondents (44.8%) reported that they had treated a patient for possible Lyme disease solely because of the patient's concern.

Attitudes and Beliefs

Most respondents (72.4%) planned to recommend LYMErix vaccine to patients aged 15 to 70 years who live in areas of high risk and have frequent or prolonged exposure to tick habitat (Table 4). Respondents from the two highest incidence counties were not more likely than respondents from other counties to recommend the vaccine (72% vs 71%, $P = .95$).

Most respondents (89.7%) believed that most patients who request an evaluation for Lyme disease have some other cause of their symptoms. Approximately one quarter of respondents (26.6%) believed Lyme disease is endemic where they practice. Respondents from the two highest incidence counties were somewhat more likely to consider Lyme disease endemic where they practice compared with respondents from other counties (32.8% vs 24.2%), but this difference was not statistically significant ($P = .35$). Physicians who be-

Table 4. Respondents' Attitudes Regarding Lyme Disease.

Attitude	All Respondents*	
	Number	Percent
Plan to recommend Lyme disease vaccine to patients aged 15–70 years who live in areas of high risk and who have frequent or prolonged exposure to tick habitat	212/293	72.4
Believe Lyme disease is endemic where they practice	78/293	26.6
Believe most patients requesting a Lyme disease evaluation do not have Lyme disease	260/290	89.7

*Totals were less than 296 because some respondents did not answer all questions.

lieved Lyme disease to be endemic where they practice were more likely to have diagnosed Lyme disease in one or more patients during 1998 compared with physicians who did not think Lyme disease was endemic (53.2% vs 29.1%, $P = .0003$). Physicians who believed Lyme disease is endemic where they practice, however, were not more likely than other physicians to prescribe prophylactic antibiotics for tick bite (9.5% vs 12.8%, $P = .48$) or to recommend vaccination (78.9% vs 82.2%, $P = .54$).

Discussion

In this study, we found that New Hampshire primary care physicians generally scored well on the Lyme disease knowledge test but were less familiar with the epidemiologic characteristics and diagnostic criteria of Lyme than they were with the signs and symptoms of various stages of Lyme disease. Incomplete knowledge in these areas could contribute to misdiagnosis. For example, lack of awareness that erythema migrans is sufficient to diagnose Lyme disease could lead to underdiagnosis through overreliance on laboratory testing. The CDC surveillance case definition for Lyme disease states that physician-diagnosed erythema migrans 5 cm in diameter or larger is sufficient to classify a patient as having Lyme disease.[12] Although CDC recommends serologic testing for patients with erythema migrans but no known tick exposure, it does not require such testing for diagnosis. Moreover, the sensitivity of serologic testing in early-stage Lyme disease has been reported to be as low as 40%.[6] A negative test should therefore not rule out the diagnosis of Lyme disease in a patient with sufficient objective clinical evidence, such as erythema migrans.

In our study, approximately one half of physicians did not know that erythema migrans alone can be sufficient to diagnose Lyme disease. These physicians were more likely than the other respondents to test first rather than to treat the erythema migrans. This approach could lead some physicians to discard the diagnosis of Lyme disease in patients with erythema migrans and negative serologic findings, resulting in missed opportunities to treat Lyme disease in its early stage and prevent more severe manifestations of the disease.

In responding to the case scenarios, most physicians followed the current consensus guidelines in choosing to treat Lyme disease when a patient had erythema migrans and not to treat when a patient had arthritis, even though most had not diagnosed a case of Lyme disease during the last full calendar year before our study. We documented substantial deviation from guidelines, however, in the management of the asymptomatic patient with tick bite. Guidelines current at the time of our survey do not recommend either testing or prophylactic antibiotics for an asymptomatic person with a deer-tick bite, even in endemic areas.[11] A recent study[13] has reported that a single dose of doxycycline appears effective in preventing Lyme disease after a proven deer-tick bite. This study, however, was conducted in a New York county where Lyme disease is hyperendemic, and the results might not be generalizable to such nonhyperendemic areas as New Hampshire.

Most physicians in our study thought that most patients who request an evaluation for Lyme disease do not have Lyme disease. Approximately one half, however, reported that they had provided treatment of possible Lyme disease solely in response to patient concern. This finding, along with our observations regarding the management of the patient with tick bite and the patient with arthritis, suggests that treatment of Lyme disease without objective evidence of the disease is quite common.

Treatment of unsubstantiated Lyme disease in such circumstances exposes the patient to the risk of adverse reactions to antibiotics,[14–17] contributes to the development of antibiotic resistance,[18–21] could cause unnecessary anxiety for patients given a diagnosis of Lyme disease,[17,22] and could delay diagnosis and treatment of the true cause of the patient's symptoms.[23]

Approximately one half of physicians correctly selected human granulocytic ehrlichiosis as a potential coinfection with Lyme disease. First described in 1986, human granulocytic ehrlichiosis is an emerging zoonotic infection with the highest reported average annual incidence rates occurring in the Northeastern and upper Midwestern areas of the United States.[24] Human granulocytic ehrlichiosis and babesiosis are both infections that can be transmitted to a person by the same tick species that transmits Lyme disease,[25–29] and human granulocytic ehrlichiosis has been reported in one New Hampshire resident.[30] Awareness regarding human granulocytic ehrlichiosis coinfection is clinically important because ehrlichiosis is potentially life-threatening[24] and does not respond to amoxicillin, a standard antibiotic used to treat Lyme disease.[5]

Most physicians in our study planned to recommend LYMErix vaccine to patients at high risk for Lyme disease. In 1999, the CDC and the Advisory Committee on Immunization Practices (ACIP) made recommendations for the use of the vaccine based on a CDC geographical classification of Lyme disease risk in the United States.[11] These recommendations stated that the vaccine "should be considered" for persons who live, work, or recreate in areas of moderate or high risk and have frequent or prolonged contact with tick habitat, and that the vaccine "may be considered" for persons with less than frequent or prolonged exposure in the same risk areas. According to the CDC risk classification, all New Hampshire is at least moderately at risk for Lyme disease, and one county is considered at high risk. In February 2002, the manufacturer of LYMErix withdrew the vaccine from the US market citing poor sales.[31] It is possible that New Hampshire physicians' attitudes toward the vaccine did not match those of physicians nationally, that respondents' behavior did not reflect their self-reported attitudes, that physicians who planned to recommend the vaccine in 1999 later changed their minds, or that consumer demand for the vaccine was low despite physicians recommendations.

Previous surveys of physicians' knowledge, attitudes, and practice relating to Lyme disease have reported major deviation from recommended practices for diagnosis and treatment of Lyme disease.[9,10] These studies have reported that 20% to 35% of physicians would prescribe antibiotics for a tick bite alone, and that 83% would treat for possible Lyme disease in a patient with no history of erythema migrans and negative laboratory tests for Lyme disease, compared with 12.9% and 13.7%, respectively, in our study. The discrepancy between the previous findings and our study findings could indicate that physicians in moderate incidence areas, such as New Hampshire, approach Lyme disease diagnosis and treatment differently from physicians in higher-incidence areas. Alternatively, since the previous studies were conducted, greater familiarity with Lyme disease could have led to changes in physicians' knowledge, attitudes, and practice.

The findings in our study should be interpreted in light of certain limitations. First, in assessing practices, our survey relied on self-reporting and might not reflect the actual practice of the respondents. Second, this study could be limited by response bias. Although the 56% response rate is relatively high for a postal survey of physicians, respondents likely do not represent a truly random sample of New Hampshire primary care physicians and are more likely to have greater interest in or knowledge of Lyme disease than nonresponders. The knowledge scores probably overestimate Lyme disease knowledge among New Hampshire primary care physicians as a whole, and respondents' practices might be more in accordance with current guidelines than those of New Hampshire primary care physicians overall.

To assess response bias, we compared eager responders with reluctant responders, postulating that reluctant responders are similar to nonresponders and, given our moderate response rate, are more representative of New Hampshire primary care physicians as a whole. Reluctant responders were more likely than eager responders to give antibiotic prophylaxis for tick bites (18.6% vs 10.7%, $P = .13$). Although this difference did not reach statistical significance, it suggests that New Hampshire primary care physicians as a whole might be more likely to prescribe tick bite prophylaxis than the respondents in our sample.

To diagnose and treat Lyme disease appropriately, primary care physicians in moderate incidence areas should be aware of the clinical manifestations and epidemiology of Lyme disease, understand the limitations of current diagnostic tests, and be familiar with current consensus guidelines. The findings of this knowledge, attitudes, and practice survey suggest that further educational interventions are necessary to promote physician practices that reflect current consensus guidelines, especially regarding appropriate management of tick bites and awareness of other serious tickborne coinfections. Although CDC and physician specialty societies have published educational information on consensus guidelines for physicians, many studies suggest that physician practices are relatively resistant to change[32–35] and that more personalized measures, such as educational outreach visits (ie, academic detailing),[36,37] could be more effective. In addition, further education of the public regarding Lyme disease, especially by state and local public health departments, could reduce inappropriate patient requests for Lyme disease testing and treatment.

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