

Lyme disease

Knowledge, beliefs, and practices of physicians in a low-endemic area

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Abstract

Objective To determine physicians' level of awareness and knowledge of Lyme disease (LD) in a low-prevalence area and whether physicians' practices align with current guidelines for treatment of LD.

Design A 23-item questionnaire assessing demographic characteristics, general knowledge about LD, laboratory testing for LD, and responses to 3 clinical scenarios.

Setting British Columbia (BC).

Participants Pediatricians, FPs, and internal medicine specialists who were licensed to practise in BC.

Main outcome measures Knowledge of signs and symptoms of LD, beliefs about risk of LD, attitudes toward LD in patients in their practices, and application of accepted practice guidelines for the treatment of LD in clinical scenarios.

Results Overall, 80.6% of respondents were FPs. Average knowledge score was 72.5% for FPs and 75.0% for other specialists. Most respondents (75.6% of FPs and 71.8% of other specialists) underestimated the occurrence of erythema migrans (EM), and only 26.1% and 28.3%, respectively, knew that EM alone was diagnostic for LD. A total of 30.5% of FPs and 12.1% of other specialists reported having treated a patient for the disease despite not believing that the patient had LD. Of all the respondents, 62.1% knew that LD was a reportable disease in BC. Respondents' reports of risk of LD in their areas were appropriately associated with actual risk based on ecological niche.

Conclusion Physicians are knowledgeable about the clinical signs and symptoms of LD and aware of the risk of the disease despite being in a low-endemic area. Physicians in BC are comfortable with treating patients empirically for LD. Education is needed to inform physicians that EM is diagnostic and no laboratory testing is indicated before treatment. Raising awareness among physicians that LD is reportable might improve reporting of future cases.

EDITOR'S KEY POINTS

- British Columbia physicians are knowledgeable about the signs and symptoms of Lyme disease (LD) and are diagnosing and treating it in accordance with published guidelines. Physicians have a realistic understanding of the risk of the disease. Physician knowledge was lower regarding the appropriateness of clinical diagnosis (ie, based on erythema migrans alone) or serologic testing.
- A substantially greater number of respondents reported that they had diagnosed cases of LD in the preceding year than the number of cases officially reported to public health authorities in British Columbia.
- Education is needed to inform physicians that erythema migrans alone is diagnostic of LD and no laboratory testing is indicated before treatment.

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La maladie de Lyme

Connaissances, croyances et pratiques des médecins dans une région à faible endémicité

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Résumé

Objectif Déterminer à quel point les médecins sont sensibilisé à la maladie de Lyme (ML) et la connaissent, dans une région à faible endémicité et vérifier si leurs pratiques s'accordent avec les lignes directrices actuelles pour le traitement de cette maladie.

Type d'étude Un questionnaire de 23 items permettant d'évaluer les caractéristiques démographiques, les connaissances générales sur la ML et les examens de laboratoire appropriés, et les réponses à 3 scénarios cliniques.

Contexte La Colombie-Britannique (C.-B.).

Participants Pédiatres, MF et internistes avec droit de pratique en C.-B.

Principaux paramètres à l'étude Connaissance des signes et symptômes de la ML, croyances au sujet du risque de ML, attitudes envers les patients de leur clientèle qui souffrent de la ML et application à des scénarios cliniques des directives de pratique reconnues pour le traitement de la ML.

Résultats Dans l'ensemble, 80,6% des répondants étaient des MF. Le score moyen pour les connaissances était de 72,5% pour les MF et de 75,0% pour les autres spécialistes. La plupart des répondants (75,6% des MF et 71,8% des autres spécialistes) sous-estimaient la fréquence de l'érythème migrant (EM) et seulement 26,1% et 28,3% respectivement savaient que l'EM à lui seul était pathognomonique de la ML. Au total, 30,5% des MF et 12,1% des autres spécialistes disaient avoir traité un patient pour cette maladie en dépit du fait qu'ils ne croyaient pas que le patient en souffrait. Sur l'ensemble des répondants, 62,1% savaient que la ML est une maladie à déclaration obligatoire en Colombie-Britannique. L'opinion des répondants sur le risque de ML dans leur région concordait avec le risque réel correspondant à leur niche écologique.

Conclusion Les médecins connaissaient bien les signes et symptômes de la ML, et étaient conscients du risque de cette maladie, même s'ils pratiquaient dans une région à faible endémicité. Les médecins de la C.-B. sont à l'aise pour traiter empiriquement les patients atteints de ML. On devrait enseigner aux médecins que l'EM est pathognomonique de la ML et qu'il n'est pas indiqué de faire des examens de laboratoire avant de traiter. On pourrait améliorer la déclaration des cas de ML à l'avenir si les médecins étaient davantage conscients que c'est une maladie à déclaration obligatoire.

POINTS DE REPÈRE DU RÉDACTEUR

- Les médecins de la Colombie-Britannique connaissent bien les signes et symptômes de la maladie de Lyme (ML), et ils la diagnostiquent et la traitent conformément aux directives publiées. Les médecins évaluent correctement le risque de cette maladie. Ils connaissaient moins bien la façon appropriée de faire le diagnostic clinique (c.-à-d. basé seulement sur l'érythème migrant) ou le test sérologique.
- Un nombre considérablement plus élevé de répondants ont rapporté avoir diagnostiqué des cas de ML au cours de l'année précédente comparativement au nombre officiel de cas déclarés aux autorités de la santé publique de la Colombie-Britannique.
- On devrait enseigner aux médecins que l'érythème migrant à lui seul est pathognomonique de la ML et qu'aucun examen de laboratoire n'est nécessaire avant de traiter.

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Lyme disease (LD) is a tick-borne zoonosis transmitted to humans primarily by the bite of infected *Ixodes* ticks. *Borrelia burgdorferi* is recognized as the infectious agent of LD.¹ In Canada, LD remains uncommon with focal areas of *Borrelia*-positive *Ixodes scapularis* ticks in the central and eastern provinces and *Ixodes pacificus* ticks in BC.^{2,3} The range of *I pacificus* ticks is currently limited to southern BC, although there is concern that global warming might lead to a range expansion.^{3,4} Tick studies have shown that less than 1% of *I pacificus* ticks in BC are infected with *B burgdorferi*.⁵

Acute LD is characterized by erythema migrans (EM)—a characteristic “bull’s-eye” rash—in more than 80% of cases, often accompanied by arthralgia, myalgia, and fever. If a patient presents with EM, no laboratory testing is necessary. While EM is diagnostic for LD, it is not present in all cases. In low-prevalence areas like BC, it is recommended that people with non-EM symptoms after a tick bite or who have late disseminated symptoms undergo serologic testing using a 2-step test (enzyme immunoassay screen and Western blot confirmatory test) to aid in diagnosis.⁶ If the diagnosis is unclear, particularly if EM is atypical or absent, and acute serology results are negative, a convalescent test 2 to 4 weeks later might aid in diagnosis. However, early treatment with antibiotics based on clinical judgment is warranted if the clinical signs and symptoms are compatible with LD and the patient has been in an area where ticks are present. If left untreated, disseminated infection can lead to musculoskeletal, neurologic, or cardiac involvement.⁶

The nonspecific nature of LD symptoms, coupled with the relative rarity of the disease, means treatment patterns might depend on physician knowledge and perceptions about the disease. Previous studies of physicians’ knowledge, attitudes, and practices regarding LD have shown that physicians generally treat symptomatic patients in accordance with published guidelines, but that they are more likely to deviate from guideline recommendations in the use of serologic testing and management of asymptomatic tick bites.⁷ In particular, both testing and treatment of asymptomatic patients were found to be common, a practice potentially related to patients with “Lyme anxiety” pressuring physicians for unnecessary interventions.⁷⁻⁹ Previous studies were conducted in areas of moderate to high risk for LD, and it is unclear if these observations apply to areas of low LD activity such as BC. Lyme disease has received considerable media attention in BC from advocacy groups that contend physicians are not knowledgeable about LD and are missing large numbers of cases. We conducted a survey of physicians in the province to assess clinician knowledge, beliefs, and practices with respect to LD.

METHODS

Questionnaires were mailed to all pediatricians, internists, and FPs who were members of the College of Physicians and Surgeons of British Columbia and who gave BC addresses as their primary practice addresses (N=5566). Physicians could return the survey by mail or complete it online using a Web link provided in the cover letter. Reminder postcards were sent to all subjects 1 week after the initial mailing, and reminder letters and replacement surveys were sent to non-respondents 8 weeks later.¹⁰ An answer key with relevant references was sent to all respondents after the survey period was finished.

We modified a previously validated questionnaire to assess physician knowledge, beliefs, and practices regarding LD.¹¹ The 4-page questionnaire contained 23 items addressing respondent demographic characteristics (medical specialty, years in practice, average number of patients seen per week, location of practice), general knowledge about LD, laboratory testing for LD, and 3 clinical scenarios in which respondents were asked about the courses of action they would take. For the knowledge questions, 1 point was assigned for each correct answer and the score was converted to an overall knowledge score out of 12. A question on vaccination was removed from the original instrument as the LD vaccine was no longer available. Questions were also added to explore the perception of geographic risk for LD and awareness that LD is reportable to public health authorities. We conducted a review of LD literature, including current guidelines,¹² to determine correct answers.

We performed statistical analysis using SPSS. Between-group comparisons were made using *t* tests or Mann-Whitney *U* tests as appropriate; we used 2-tailed tests and considered *P* < .05 statistically significant. Logistic regression was used to evaluate factors associated with physician perceptions of LD risk in the geographic area in which they practised based on their answer to the survey question, “Do you think Lyme disease is endemic where you practice?” Estimates of ecological risk were determined through the use of *ecological niche modeling*,⁴ a model-building procedure that estimates the ecological niche—or ecological suitability of an area—for a given disease based on observed occurrence of disease,¹³ providing a proxy measure of true disease risk. This variable was divided into lower risk, moderate risk, and higher risk categories.

Ethics approval for this project was granted by the University of British Columbia Behavioural Research Ethics Board.

RESULTS

Of the 5566 questionnaires mailed, 2040 surveys were returned; 152 (2.9%) were from physicians who indicated they did not practise clinical medicine, 45 (0.9%) were returned blank, and 170 (3.3%) surveys were undeliverable; these were excluded from the analysis, yielding a total response rate of 32.2% (1673 of 5199). Only 87 of 1673 (5.2%) surveys were completed online.

On average, responding FPs had practised for 21 years and saw 122 patients per week, while other specialists had practised for 19 years and saw 74 patients per week (Table 1). Eighty-one percent of respondents were FPs; other specialties (19.4%) included internal medicine (infectious disease and rheumatology), emergency medicine, and pediatrics. We used self-reported status to classify respondents' specialty.

Table 1. Comparison of survey respondents' and BC physicians' years in practice and patients seen per week

CHARACTERISTIC	SURVEY RESPONDENTS	BC AVERAGE	P VALUE
Mean years in practice			
• Family practice	20.7	20.9	.086
• Specialty	18.8	21.5	<.001
Mean patients seen per week			
• Family practice	121.8	113.8	<.001
• Specialty	74.1	61.5	<.001

BC—British Columbia.

Overall, 148 respondents recalled diagnosing a total of 221 cases of LD in 2007 (range 0 to 5 cases per physician). The highest number of patients diagnosed was in the Vancouver Coastal area (72 cases) and the lowest was in northern BC (11 cases); rates per 100 000 population were highest on Vancouver Island (6.7 cases per 100 000 population) and lowest in the Fraser health region (1.5 cases per 100 000 population) (Table 2).

Table 2. Cases of LD diagnosed, rates of diagnosis, and perceived endemicity by health region

HEALTH AUTHORITY	CASES DIAGNOSED AS REPORTED BY RESPONDENTS,* N	RATE DIAGNOSED PER 100 000 POPULATION	PHYSICIANS WHO BELIEVED LD WAS ENDEMIC WHERE THEY PRACTISED, %
Vancouver Island	50	6.7	26
Fraser	23	1.5	16
Northern	11	3.8	2
Interior	45	6.1	15
Vancouver Coastal	72	6.5	20

LD—Lyme disease.

*Excludes travel-related cases.

The mean knowledge score was 72.5% (8.7 of 12) for FPs and 75.0% (9.0 of 12) for other specialists ($P=.004$) (Table 3). Three clinical scenarios were used to evaluate physician practices related to LD (Table 4). For scenario 1 (a patient with EM and no laboratory testing to date), 58.3% of FPs and 54.8% of other specialists chose the correct answer, which was to "treat with an antibiotic at this time." Those who answered correctly reported diagnosing significantly more cases of LD in 2007 than those who answered incorrectly ($P<.001$). For scenario 2 (an asymptomatic patient with history of a tick bite), 51.3% of FPs and 61.2% of other specialists correctly answered that they would educate and reassure the patient. For scenario 3 (a patient with arthritis, no history of EM, and multiple negative tests for LD), 81.6% of FPs and 81.8% of other specialists correctly answered that they would either investigate causes other than LD or refer the patient to a specialist.

Table 3. Survey respondents' knowledge about LD

KNOWLEDGE	FPS, %	OTHER SPECIALISTS, %
Knew EM appears on 80% of patients with LD	24.4	28.2
Knew EM is diagnostic for LD	26.1	28.3
Correctly identified <i>Borrelia burgdorferi</i> as the causative agent	98.2	99.0
Knew the incubation period is 3–30 d	64.8	56.5
Recognized signs and symptoms related to LD		
• Arthritis	98.4	99.3
• Fever	96.8	97.3
• Radiculoneuropathy	81.7	84.0
• Meningitis	78.6	81.8
• Third-degree heart block	63.1	73.4
Recognized signs and symptoms not related to LD		
• Goitre	95.6	96.2
• Valvular heart disease	75.3	80.4
• Diarrhea	67.0	74.8
Overall knowledge score	7.5	75.0
Knew of possible co-infection with anaplasmosis (formerly human granulocytic ehrlichiosis)	10.1	15.2
Knew LD is reportable to public health authorities in BC	58.5	65.8
Knew testing for LD should take place on initial presentation with follow-up in 2 wk	50.0	57.3
Knew patients with EM and negative test results do not need retesting (as EM is diagnostic)	6.8	8.9

BC—British Columbia, EM—erythema migrans, LD—Lyme disease.

Table 4. Responses to case scenarios: *Most appropriate treatment options indicated with an asterisk (*).*

SCENARIOS	TREATMENT OPTIONS	FPs, N (%)	OTHER SPECIALISTS, N (%)
Scenario 1: A patient with EM and no laboratory testing performed to date	• Yes, treat with an antibiotic at this time*	670 (58.3)	154 (54.8)
	• No antibiotic at this time; reassure and educate the patient, with no further follow-up	2 (0.2)	0 (0.0)
	• No antibiotic at this time; no treatment or testing now, but see the patient for follow-up	24 (2.1)	12 (4.3)
	• No antibiotic at this time; test patient for LD	414 (36.0)	99 (35.2)
	• No antibiotic at this time; refer patient to a specialist	39 (3.4)	16 (5.7)
Scenario 2: A patient with a known tick bite, no symptoms, no laboratory testing performed to date, and normal examination findings	• Yes, treat with an antibiotic at this time	86 (7.5)	10 (3.5)
	• No antibiotic at this time; reassure and educate the patient, with follow-up as needed*	592 (51.3)	177 (61.2)
	• No antibiotic at this time; test patient for LD	464 (40.2)	91 (31.5)
	• No antibiotic at this time; refer patient to a specialist	11 (1.0)	11 (3.8)
Scenario 3: A patient with recurrent, asymmetric arthritis that began 3 months previously, involving large, weight-bearing joints. The patient has no history of EM, and has had multiple negative Western blot test results for LD over the past 3 months. It is unknown if the patient has ever been bitten by a tick, but the patient spends a lot of time outdoors. No cause for the patient's arthritis was found on initial workup	• Yes, treat with an antibiotic at this time	123 (11.1)	23 (8.2)
	• No antibiotic at this time; continue to investigate other possible causes of the arthritis*	451 (40.8)	134 (47.9)
	• No antibiotic at this time; no treatment or testing now, but see patient for follow-up	17 (1.5)	8 (2.9)
	• No antibiotic at this time; further testing for LD now	63 (5.7)	20 (7.1)
	• No antibiotic at this time; refer patient to a specialist*	451 (40.8)	95 (33.9)

EM—erythema migrans, LD—Lyme disease.

When asked about their patients' risk of developing LD after a tick bite (tick species not specified), 98.6% of FPs and 96.9% of other specialists indicated they believed their patients faced some risk of developing the disease; 18.6% of FPs and 16.4% of other specialists thought LD was endemic where they practised (**Table 5**).

When asked about perceptions of patients requesting evaluation for LD, 78.7% of FPs and 72.1% of other specialists indicated they believed these patients' symptoms were caused by something other than LD. In response to these requests, however, 30.5% of FPs and 12.1% of other specialists reported they had treated a patient for LD despite believing the person did not have the disease (**Table 5**).

Logistic regression modeling showed that physician perceptions of whether LD was endemic in a region were statistically associated with the risk of LD as estimated by ecological niche modeling (**Table 6**). Physicians in areas with minimal risk of LD were significantly less likely to believe the disease was endemic in their area than were physicians in higher risk areas (odds ratio 0.38, 95% CI 0.23 to 0.60). The number of years a physician had practised, whether they were an FP or another specialist, and knowledge scores were not found to be significantly associated with perceptions of risk.

DISCUSSION

The results of this study show BC physicians are knowledgeable about the signs and symptoms of LD and are diagnosing and treating it in accordance with published guidance. Our study also indicates that the primary factor for whether a physician believes LD is endemic is the ecological suitability of the region in which they practise, showing BC physicians have a realistic understanding of the risk of the disease.

In our study, 8.8% of respondents (N=148) reported they had diagnosed a case of LD in the preceding year. This is substantially greater than the number of cases officially reported to public health authorities in BC. In 2007, only 13 cases of LD were reported to public health authorities. Slightly more than half of respondents were aware that LD was a reportable condition in BC and it is clear that under-reporting of clinical cases is a factor. However, the provincial public health laboratory is the sole laboratory that conducts testing for LD in BC and positive tests are reported automatically to public health authorities. Given that laboratory-confirmed cases are automatically reported, it is likely that clinicians are treating patients empirically for tick bites, treating on clinical grounds when LD is suspected, or relying on

Table 5. Respondents' opinions about LD

QUESTION	RESPONSE	FPS, %	OTHER SPECIALISTS, %
Do you believe that LD is endemic where you practise?	Yes	18.6	16.4
	No	66.9	67.1
	Not sure	14.6	16.4
How would you rate your patients' risk of developing LD after a tick bite?	High risk	1.4	1.0
	Moderate risk	14.3	11.0
	Low risk	82.9	84.9
	No risk	1.3	2.3
Who usually brings up the possibility of LD first?	Physician	25.8	27.4
	Patient	57.8	45.1
	Not sure	16.4	27.4
Of your patients who request an evaluation for LD, do you think the patients' symptoms are most likely attributable to another cause?	Yes	78.7	72.1
	No	5.0	1.8
	Not sure	16.3	26.1
Have you treated for possible LD in response to a patient's concerns, even when you thought the patient did not have LD?	Yes	30.5	12.1
	No	65.9	81.3
	Not sure	3.6	6.6
Would you typically submit a tick to be tested for the organism causing LD if a patient brought one to your office?	Yes	60.9	46.1
	No	21.5	25.6
	Not sure	17.5	28.3

LD—Lyme disease.

testing from outside the province. The survey did not ask for any identifying information about cases, and it is possible that multiple physicians reported diagnosing the same patient or might have recalled cases diagnosed over a longer period.

Physicians scored very high on certain knowledge questions, with more than 90% correctly identifying fever and arthritis as signs of LD and the causative agent as *B burgdorferi*. Physician knowledge was lower regarding the appropriateness of clinical diagnosis (ie, based on EM alone) or serologic testing. For a patient with EM, most physicians would immediately prescribe antibiotics, but a sizable minority would instead test the patient for LD. Most patients with EM rashes will test positive using the 2-step (enzyme immunoassay and Western blot) algorithm if testing is done on initial presentation and again after 2 to 4 weeks. Because EM is diagnostic of LD, however, testing can create delays in treatment and confusion if the test is negative. Provision of antibiotics before convalescent testing can interfere with the antibody response, again potentially causing confusion.

For a patient with an asymptomatic tick bite, most physicians would reassure the patient and follow up as necessary, although a substantial number would send the patient for serologic testing. In addition to the issues above, testing in the absence of any clinical findings presents 2 problems. First, when the pretest likelihood of LD is low, as it is in BC, even the 2-step testing algorithm can lead to high numbers of false-positive results,⁶ leading to unnecessary treatment and patient anxiety. Second, individuals might have positive serology results

from past symptomatic or asymptomatic *Borrelia* infections from which they have since recovered. Testing a person in the absence of symptoms can therefore result in unnecessary treatment. Our survey did find that a lower percentage of physicians would give an antibiotic without testing compared with physician responses to the same scenario in other studies.^{7,10}

Logistic regression analysis shows physicians have a good understanding of the spatial distribution of risk within the province, with lower patient risk perceived in areas where ecological conditions are less suitable for disease transmission. Physician knowledge regarding LD did not affect their perception of the degree of risk in their area (that is, those with higher knowledge scores were no more or less likely to perceive risk for their patients than those with lower knowledge scores), nor did the number of years they had been practising or the nature of their practices (family practice vs other specialty) (Table 6).

One limitation of this study was the response rate. Although a 32% response rate is comparable to other mailed physician surveys (eg, 2007 National Physician Survey response rate in BC of 30% for FPs and 31% for other specialists¹⁴), it is unknown whether respondents systematically differed from nonrespondents. Respondents were similar to provincial averages in number of patients seen per week and number of years in practice (Table 1). While the difference between these averages is statistically significant owing to the large sample size, it is not clinically meaningful. Response rates were similar by region (Table 7), indicating our

results were not biased geographically. This indicates our sample was representative of the general physician population.

Table 6. Results of the logistic regression model evaluation of physician perceptions of LD risk: $N = 1086$.

FACTOR	ODDS RATIO	95% CI	P VALUE
Practise in low LD risk area	0.38	0.23–0.60	<.001*
Practise in moderate LD risk area	0.53	0.22–1.30	.16
Practise in high LD risk area (reference category)	1.00		
Knowledge score	1.08	0.99–1.18	.09
No. of patients treated per wk	0.96	0.93–0.99	.012*
≥ 20 y in practice	0.77	0.55–1.08	.13
< 20 y in practice (reference category)	1.00		
Specialist	0.73	0.49–1.11	.14
Family practice (reference category)	1.00		

LD—Lyme disease.

*Significant at the $P < .01$ level.

Table 7. Survey respondents' practice types and locations

CHARACTERISTICS	RESPONDENTS, N (%)	RESPONSE RATE, %
Health authority of practice		
• Fraser	392 (23.4)	30.7
• Interior	295 (17.6)	35.5
• Northern	98 (5.9)	29.4
• Vancouver Coastal	515 (30.8)	30.0
• Vancouver Island	372 (22.2)	39.0
• Total	1672 (100)	
Type of practice*		
• Family practice	1348 (80.6)	NA
• Other specialty		NA
–Internal medicine	135 (8.1)	
–Emergency medicine	108 (6.5)	
–Pediatrics	98 (5.9)	
–Other	104 (6.2)	
• Total*	1793	NA

NA—not available.

*The column total for practice type exceeds the sample size because some physicians identified more than 1 specialty.

Conclusion

Physicians are knowledgeable about the clinical signs and symptoms of LD and are aware of the risk of LD in BC, despite it being a low-endemic area. Physicians treat patients empirically for LD. Education is needed to inform physicians that EM alone is diagnostic of LD and no laboratory testing is indicated before treatment. More cases are clinically diagnosed than are reported to public health authorities; informing physicians that LD is a reportable illness should improve surveillance in BC. 🍁

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Contributors

All authors contributed to the concept and design of the study; data gathering, analysis, and interpretation; and preparing the manuscript for submission.

Competing interests

None declared

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