Childhood Lyme disease

CPSP
CANADIAN PAEDIATRIC SURVEILLANCE PROGRAM

PROTOCOLS

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Background

Lyme disease is a multisystem illness caused by *Borrelia burgdorferi*, a spirochete transmitted by ticks (*Ixodes scapularis* in eastern and midwestern USA and central and eastern Canada, and *Ixodes pacificus* in the western USA and in British Columbia, Canada). Infection in children can present in the weeks following a tick bite with a characteristic rash called erythema migrans, or later as heart, joint, skin, or nervous system illness. The changing geographic spread of *I scapularis* ticks into parts of southern Ontario, Quebec, Nova Scotia, New Brunswick, Manitoba and southern British Columbia[1] has led to an increased incidence of Lyme disease in Canada.[2-5] Recent increased awareness of Lyme disease in Canada is likely also contributing to increased reporting of cases. Disease is predicted to become more common as the vector tick populations spread; indeed, the proportion of the Canadian population living in Lyme disease risk areas is anticipated to increase from 18% to 80% by 2020.[6]

While Lyme disease has been reported to be the most commonly reported vector-borne disease in North America, accurate estimates of the burden of illness in Canada are not available. Lyme disease became a nationally notifiable disease in Canada in December 2009.[7] Through the Lyme disease enhanced surveillance (LDES) system of the Public Health Agency of Canada (PHAC), provincial public health programs voluntarily submit data on all reported cases of Lyme disease annually. From 2009 to 2012, the total number of reported cases of Lyme disease increased from 128 to 315 with the overall incidence rate increasing from 0.4 to 1.0 cases per 100,000 population. Current data suggest that Lyme disease risk is not evenly distributed across the country: there are areas and populations with high incidence, some areas where risk is low or absent, and in some areas risk and disease incidence are increasing rapidly.[1,5] The national human case surveillance system is a passive surveillance program, which relies on voluntary reporting, clinical recognition of disease, and appropriate laboratory testing. Most provincial and territorial (P/T) laboratories routinely submit sera for Lyme disease diagnosis at the National Microbiology Laboratory (NML). Most P/T laboratories first screen samples using the first step (ELISA or EIA) of the two-tier

test, and then send samples to the NML for confirmation, using the second, Western blot component of the two-tier test. Public health laboratories of two provinces (Ontario and British Columbia) perform both screening and confirmation steps of the two-tier test, but frequently send positive samples to NML for confirmation. Lack of clinical recognition of Lyme disease, especially when the vector first moves into an area, is likely to play a role in under-reporting and therefore underestimation of disease burden. Finally, the burden of Lyme disease in the US is highest in seniors and children, particularly boys five to nine years of age. Initial analysis of data from Canada suggests that a similar age-related variation in risk is occurring here.

Methods

Passive case surveillance, whereby provinces voluntarily report recognized cases to PHAC, is the cornerstone of the national surveillance system. However, it is likely that reported incidence underestimates true incidence. Through the established methodology of the CPSP, paediatricians and paediatric subspecialists will be asked each month if they have seen cases of Lyme disease. Respondents who identify cases will be subsequently asked to complete a detailed questionnaire for each case.

Case definition

Report a patient less than 16 years of age with Lyme disease, meeting the following criteria:

Confirmed Lyme disease – Patient fulfills one of two conditions:

1. Clinical evidence of illness with laboratory confirmation
   a. isolation of *Borrelia burgdorferi* from an appropriate clinical specimen
   OR
   b. detection of *B burgdorferi* DNA by PCR in appropriate tissues
2. Clinical evidence of illness with a history of residence in, or visit to, an endemic area* and with laboratory evidence of infection
   - positive serologic test using the two-tiered serological approach (i.e., ELISA followed by Western blot assays)

Probable Lyme disease – Patient fulfills one of two conditions:

1. Clinical evidence of illness without a history of residence in, or visit to, an endemic area* and with laboratory evidence of infection
   - positive serologic test using the two-tiered serological approach (i.e., ELISA followed by Western blot assays)
2. Clinician-observed erythema migrans without laboratory evidence but with history of residence in, or visit to, an endemic area*

Exclusion criteria

Confirmation of infection with a non-tick-borne disease, which fully explains symptoms. Cases diagnosed by methods and/or laboratories not recommended by the Public Health Agency of Canada or the US Centers for Disease Control and Prevention will be excluded.

* An endemic area is defined as a locality in which reproducing populations of *Ixodes scapularis* or *Ixodes pacificus* tick vectors are present and transmission of *B burgdorferi* occurs at the location.

Childhood Lyme disease (continued)

Objectives

1) Determine Lyme disease incidence in children, by age, gender, and provincial/ territorial residence using national census data as the denominator.
2) Identify emerging locations of Lyme disease risk, sites of exposure to infected ticks, and environmental risk factors for Lyme disease.
3) Define the spectrum of clinical presentation of Lyme disease among children in Canada.
4) Define the patterns of use of different diagnostic methods (clinical assessment and laboratory methods of culture, polymerase chain reaction [PCR] and serology) in the diagnosis of Lyme disease in children to inform on clinician diagnostic practices in Canada, effects of physician awareness campaigns on Lyme disease and to inform any future modifications of the national surveillance case definition.
5) Describe treatment regimens, frequency of post-treatment clinical manifestations of Lyme disease, and outcomes in different patients and locations.

The overall objective of this project is to improve the health of children at risk or affected by Lyme disease in Canada.

Duration

July 2014 to June 2017

Expected number of cases

Approximately 50 cases per year in children less than 16 years old are expected, but this number will likely increase as: i) planned awareness campaigns on the Lyme disease risk for both the general public and health care professionals take effect, and ii) the proportion of the Canadian population exposed to infected ticks is predicted to increase as a result of the range expansion of vector tick populations in Canada and with increasing awareness amongst the public and medical practitioners. From 2009 to 2013, 121 cases of Lyme disease were reported in Canadian children less than 16 years old. This number represents 13.6% of all Lyme disease cases for which data on age were available.

Ethical approval

Health Canada and the Public Health Agency of Canada's Research Ethics Board

Analysis and publication

Descriptive data will be analyzed to quantitatively summarize demographic variables. Rates of events and risk factors will be calculated using proxy population denominators from census data[8] and other sources (research studies on other health issues). Outputs will include estimates of annual incidence among children in different provinces and territories and geographic regions (for comparison with national surveillance data and estimation of under-reporting), maps of geographic locations of infection, proportions of patients diagnosed by different methods, proportions suffering different symptoms (and identification of any geographic variations in these), proportions of patients receiving prophylactic treatment (including tick removal), treatment regimens used and outcomes of these, and the proportions of infections acquired in different environments.

Knowledge translation

Annual reports will be provided to the CPSP and PHAC, for dissemination through the CPSP Results publication, with number of cases, geographic distribution of cases, and completions rates of questionnaires and rates by province provided to provincial medical officers of health. Final results will be published in peer-reviewed journals and will be presented at conferences. Results of this study may also be used to inform subsequent revisions to the LDES system and PHAC's Action Plan on Lyme disease.

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