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Lyme Carditis Identified by a Novel Syndromic Surveillance Definition, New York State, 2017-2021

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Abstract

Objectives: Lyme carditis is a rare, potentially fatal manifestation of Lyme disease. Although Lyme disease is nationally notifiable, data on clinical manifestations are not collected systematically in the United States. We developed a syndromic surveillance definition to identify patients with Lyme carditis in New York State during 2017-2021.

Methods: We developed a definition of Lyme carditis by using diagnostic codes and keywords to identify emergency department visits related to Lyme carditis through the National Syndromic Surveillance Program's BioSense Platform. We systematically abstracted information for each identified patient by reviewing medical records in New York State's regional health information exchange system. Physician reviewers independently assigned a clinical case status to each record. We mapped cases of Lyme carditis by county and described their characteristics.

Results: We identified records for 173 individuals; 32% (n = 55) were classified as confirmed, 16% (n = 27) as probable, and 53% (n = 91) as not a case of Lyme carditis. In total, we identified 82 cases of confirmed or probable Lyme carditis; the positive predictive value of the definition was 47%. Cases occurred in 49% of New York State counties and peaked annually in July and August. Among patients with confirmed and probable Lyme carditis, age distribution was bimodal, with incidence peaking at about ages 32 and 70 years; 71% were male. Eighty-four percent had positive 2-tiered serologic test results for Lyme disease, and second- or third-degree atrioventricular block was present in two-thirds of patients (67%).

Practical Implications: This definition may be a useful tool to detect changing patterns of Lyme carditis in areas with a high incidence of Lyme disease.

Keywords

Lyme disease, syndromic surveillance, health information exchange, vector-borne disease

Lyme disease, transmitted by the bite of an infected *Ixodes* tick and caused by the spirochetal bacteria *Borrelia burgdorferi*, is the most common vector-borne disease in the United States and in New York State.[1] In 2019, New York State, excluding New York City, identified 8378 cases[2]; however, previous studies have shown that this is likely an underestimate.[3-5]

Standardized surveillance and reporting for Lyme disease in the United States began in 1991. Before 2022, the surveillance case definition included a requirement for clinical manifestations, necessitating investigation by the jurisdictional health department to collect information about symptoms.[6] As the incidence of Lyme disease increased, the burden of case investigation proved to be unsustainable for many jurisdictions with high incidence, including New York State.[7] Because implementation of disease surveillance is left to the discretion of individual jurisdictions, in 2007, New York

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State began conducting Lyme disease surveillance using sampling estimation, which involved investigating only a subset of cases and applying the national surveillance case definition to the sample. In 2022, the Council of State and Territorial Epidemiologists updated the national case definition for Lyme disease in jurisdictions with a high incidence of Lyme disease (hereinafter, high-incidence jurisdictions) to rely on laboratory test results, without regard to clinical manifestations, thereby reducing the investigation burden on health departments.[7] While these adaptations to Lyme disease surveillance in high-incidence jurisdictions are pragmatic,[8] they also challenge health jurisdictions' ability to detect trends in clinical manifestations, such as Lyme carditis.

Lyme carditis is a rare condition that occurs when the spirochetes that cause Lyme disease enter heart tissue. A manifestation of early disseminated disease, Lyme carditis typically occurs 3 to 6 weeks after the onset of the erythema migrans (EM) rash, the early localized form of Lyme disease.[9,10] It can cause both inflammation of heart muscle and surrounding tissues (myopericarditis) and disturbances in the heart's electrical conduction system, including heart block and other arrhythmias that can be diagnosed by electrocardiogram (ECG). Without early recognition and treatment, Lyme carditis can be severe and, rarely, fatal.[11] Diagnosis is typically based on a combination of clinical features, compatible exposures, and results of serologic testing. Standard 2-tiered serologic tests are not as sensitive for Lyme carditis as for later manifestations of disease; the more recently available modified 2-tiered serologic tests have shown better sensitivity but still sometimes produce negative results when testing patients with early disease.[12,13]

Lyme carditis has been documented in approximately 1% of reported Lyme disease cases in the United States, but its true incidence is unknown.[14] Some strain types of *B burgdorferi* may exhibit differential capabilities for dissemination in humans, which could result in temporospatial clustering of certain severe manifestations, such as Lyme carditis.[15]

In 2021, the Centers for Disease Control and Prevention (CDC) and the New York State Department of Health (NYSDOH) were approached by a physician in New York State regarding 2 patients hospitalized with Lyme carditis whose cases were epidemiologically linked, an unusual occurrence. Because New York State was routinely investigating only a subset of Lyme disease cases in 2021, public health authorities were unable to immediately ascertain whether an unusual cluster of Lyme carditis cases had occurred. To identify any additional cases in the region, CDC and NYSDOH staff developed a novel Lyme carditis syndromic surveillance definition for Lyme carditis–related emergency department (ED) visits. We conducted a systematic evaluation of this definition to assess its utility to rapidly and accurately detect Lyme carditis cases. We describe the process of development and validation of the Lyme carditis definition and describe cases of Lyme carditis in New York State during 2017-2021 detected by using this definition.

Materials and Methods

The National Syndromic Surveillance Program (NSSP) is a collaborative program among CDC, federal partners, local and state health departments, and academic and private sector partners to support the collection and analysis of electronic health data. Excluding New York City, 65% (93 of 144) of EDs in New York State contributed data to NSSP in 2017; this proportion increased to 91% (131 of 144) in 2021. NSSP collects information on ED visits, including free-text chief complaint terms, administrative discharge diagnosis codes, and patient demographic characteristics. Diagnosis information is collected using the *International Classification of Diseases, 10th Revision, Clinical Modification* (ICD-10-CM),[16] *ICD, Ninth Revision, Clinical Modification* (ICD-9-CM),[17] and Systematized Nomenclature of Medicine (SNOMED)[18] concepts. The NYSDOH Institutional Review Board reviewed this study and deemed it exempt as secondary research data, for which consent is not required. CDC's human subjects committee determined the study to be nonresearch and exempt from full committee review.

Syndromic Surveillance Definition Development

We constructed a syndromic surveillance definition specifically for Lyme carditis by using discharge diagnosis codes and free-text chief complaint terms (eFigure 1 in Supplemental Material). The definition required that an ED visit meet both the general Lyme disease syndromic surveillance definition (CDC Lyme Disease v1)[19] and a carditis syndrome definition. The general Lyme disease syndromic surveillance definition included ICD-10-CM diagnostic codes, along with direct mentions of Lyme disease (including 1 common misspelling, "Lime") or a bull's-eye rash (characteristic of EM rash) in the chief complaint text. To ensure that only data on acute Lyme disease episodes were captured, the general Lyme disease syndromic surveillance definition excludes records with chief complaint text that included "history of Lyme." No specific ICD-10-CM or ICD-9-CM codes or SNOMED codes are available for Lyme carditis; therefore, we developed a list of ICD-9-CM and ICD-10-CM codes and SNOMED concepts that describe myocarditis, pericarditis, or heart block or chief complaint terms including "heart block," "heartblock," "atrioventricular block," "AV block," or "carditis." The presence of 1 of these discharge diagnosis codes or 1 of these terms in the chief complaint text field satisfied the carditis syndrome definition.

To refine the definition of Lyme carditis, NSSP data scientists and local/state epidemiologists in the NSSP Syndrome Definition Work Group applied the draft definition to nationwide and local/state ED data in NSSP and suggested iterative changes to the authors to further optimize the definition to improve sensitivity and specificity by excluding specific codes or keywords that were more likely to generate false-positive cases. We evaluated encounter frequency by month

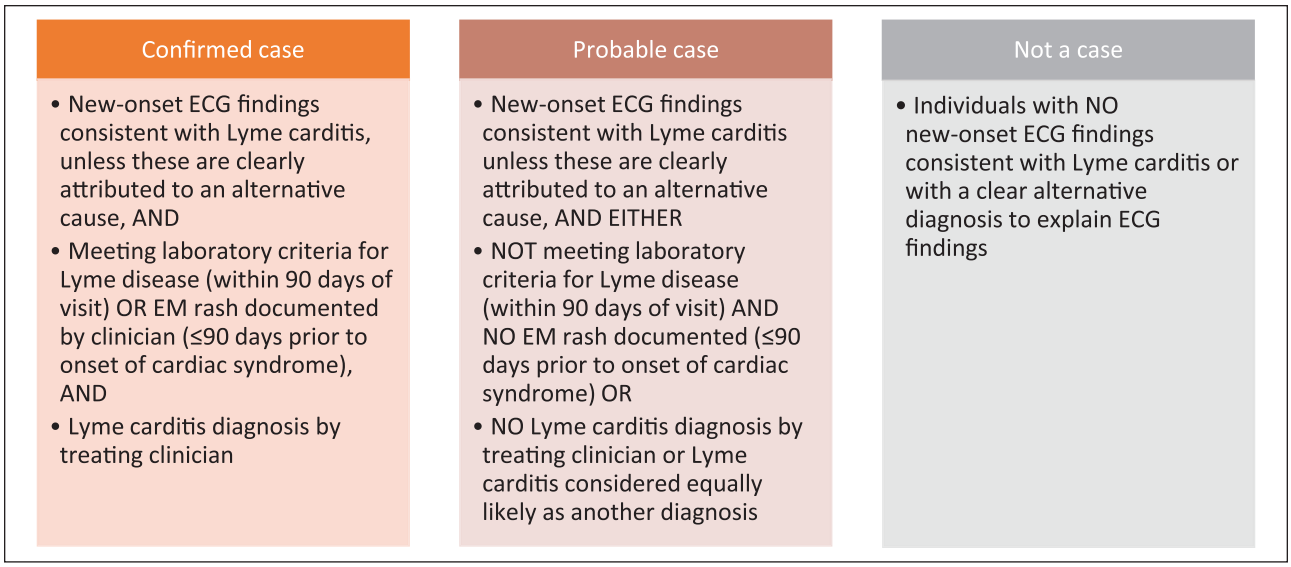

Figure 1. Case criteria used to classify emergency department visits in New York State (excluding New York City) during 2017-2021 identified by the Lyme carditis definition in the National Syndromic Surveillance Program as a confirmed or probable case of Lyme carditis or not a case. For the purposes of this case classification, electrocardiogram (ECG) findings consistent with Lyme carditis included atrioventricular block (first, second, or third degree), right or left bundle branch block, new-onset atrial fibrillation or atrial flutter, T-wave inversion, ST segment elevation, prolonged QT interval, or bradycardia. Laboratory criteria for Lyme disease included isolation of *Borrelia burgdorferi* sensu stricto or *B mayonii* in culture, detection of *B burgdorferi* sensu stricto or *B mayonii* in a clinical specimen by a *B burgdorferi* group–specific nucleic acid amplification test assay, detection of *B burgdorferi* group–specific antigens by immunohistochemistry assay on biopsy or autopsy tissues, or positive 2-tier serologic test, defined as either (a) positive or equivocal total antibody screen, positive or equivocal IgM screen, or positive or equivocal IgG screen) and positive IgM immunoblot or positive IgG immunoblot) or (b) positive test according to modified 2-tier test criteria (must be noted as modified 2-tier test) or positive single-tier IgG Western blot. Abbreviations: EM, erythema migrans; IgG, immunoglobulin G; IgM, immunoglobulin M.

and year, hypothesizing that we would observe a mid-summer seasonal peak following the expected annual peak of *Ixodes* tick bites in late spring and early summer.[20,21] We used the Rnssp R package (R Core Team) to produce a report of the most common discharge diagnosis terms, chief complaint terms, and combinations of discharge diagnosis or chief complaint terms associated with the ED encounters that were identified after applying the draft Lyme carditis definition. Based on report findings, we further added several combinations of discharge diagnosis and chief complaint terms that had not been included in the draft definition, for example, the code I51.89 "Other ill-defined heart disease" and the terms "complete heart," "degree block," and "degree heart" (eFigure 1 in Supplemental Material).

Evaluation and Validation of the Lyme Carditis Syndromic Surveillance Definition

We applied the final Lyme carditis syndrome definition to ED encounters from 2017-2021 in NYSDOH's syndromic surveillance platform to evaluate performance. Because New York City is a separate public health jurisdiction, we excluded it from this analysis.

We developed a medical record data abstraction instrument in REDCap that included medical history, laboratory results, ECG results, and text from admission history and physical notes, discharge summaries, and consultation notes with infectious disease and cardiology specialists (eFigure 2 in Supplemental Material).[22] We also developed a functional case definition to classify Lyme carditis cases to aid in clinician review (Figure 1): confirmed (new, compatible ECG findings and laboratory evidence of Lyme disease or clinician-diagnosed EM rash and diagnosis of Lyme carditis), probable (new, compatible ECG findings not meeting criteria for a confirmed case and lacking a clear alternative diagnosis), and not a case (no new, compatible ECG findings or new ECG findings accompanied by a clear alternative diagnosis).

One author (J.L.W.) reviewed medical records meeting the syndrome definition in the Statewide Health Information Network for New York, which connects regional health information networks across the state and allows permitted users at NYSDOH to view individual electronic medical records. This review included records for ED encounters that met the syndrome definition for Lyme carditis as well as additional related patient encounters, ECG findings, and laboratory results, as necessary and available. Records were excluded in the first round of review and classified as not a case if any of the following criteria were met: Lyme disease diagnosis was separated by at least 90 days from the occurrence of a cardiac syndrome, or no new ECG abnormalities were noted, including in the 90 days preceding the date of the ED visit, or serologic testing was negative and a clear

alternative diagnosis explained any new ECG findings. The remaining records were abstracted into REDCap hosted at NYSDOH. Where electronic records were inadequate, we requested additional records from the treating facility to complete the abstraction form.

After full record abstraction, deidentified data were securely transmitted to CDC, where 2 clinician author reviewers (A.M.B. and D.W.M.) independently adjudicated a case status for each patient. Reviewers used clear definitions for ECG changes and laboratory findings that would connote Lyme carditis, based on a review of the literature (Figure 1).[23] We calculated a κ statistic to measure reviewer concurrence. When adjudications differed between the 2 initial reviewers, a third clinician author reviewer (G.E.M.) independently adjudicated and assigned a final case status.

Lyme Carditis Case Description and Analysis

After we defined case status for all encounters, we calculated the positive predictive value of the definition to detect confirmed and probable Lyme carditis cases. To elucidate the terms that were most helpful to identify such cases, we compared the presence of specific discharge diagnoses and chief complaint terms for confirmed cases, probable cases, and not a case by using the Fisher exact test. We mapped cases by county of patient residence, adjusting for county population. We described the characteristics of confirmed and probable Lyme carditis cases.

Results

The final Lyme carditis syndrome definition detected 183 visits by 173 unique patients among the 17 million ED visits in New York State reported to NSSP during the study period. Of the 173 unique patients with ED visits for possible Lyme carditis, 25 (14%) were excluded in the first round of review and classified as not a case. Records for the remaining 148 patients were fully abstracted and reviewed. Initial reviewers fully concurred in most cases (n = 106; 72%) with a κ statistic of 0.66, indicating substantial agreement. Final case status was adjudicated as confirmed for 55 of 173 patients (32%) and as probable for 27 patients (16%). Overall, 91 patients (53%) were deemed not a case. The positive predictive value of the syndromic surveillance definition was 47%.

Annual Lyme carditis case counts in NSSP increased gradually during 2017-2021, from 1 case in 2017 to 35 cases in 2021; the mean annual incidence of ED visits for Lyme carditis was 0.01 visits per 10 000 ED visits in NSSP (Figure 2). Most visits (51%) for probable or confirmed Lyme carditis occurred in July and August. Cases occurred in 28 of 57 included counties, with the annual incidence by county ranging from 0 to 4.9 cases per 100 000 county residents (Figure 3).

Among patients with confirmed and probable Lyme carditis, 58 (71%) were male (Table). The median age was 62 (range, 10-97; IQR, 22-73) years; 29 (35%) were aged ≥70 years. We observed a bimodal age distribution among cases, with the incidence peaking around ages 32 and 70 years.

Medical records documented a tick bite in 19 (23%) case patients during the 6 weeks prior to onset; 30 (37%) were noted as having spent time outdoors during that period (Table). A skin rash was documented among a minority (n = 20; 24%) of confirmed and probable cases, with the presence or recent history of EM rash noted in 10% (n = 8) of confirmed and probable cases. Atrioventricular block was documented in most confirmed and probable cases (n = 64; 78%), including 39% with complete, 28% with second-degree, and 11% with first-degree heart block. Complete heart block was documented in 46% of female patients and 36% of male patients. Lyme disease serologic testing was performed in 81 of 82 (99%) confirmed and probable cases, with positive standard 2-tiered testing documented in 63 cases (77%), positive modified 2-tiered testing in 4 cases (5%), unspecified positive 2-tiered testing in 2 cases (2%), negative 2-tiered testing in 12 cases (15%), and negative immunoglobulin M and immunoglobulin G immunoblots only in 1 case (1%), yielding a total positivity rate of 84% for 2-tiered testing. Review of available medical records did not reveal any instances of *B burgdorferi* isolation in culture, direct detection in clinical specimens, or detection of *B burgdorferi* group–specific antigens by immunohistochemistry assay on biopsy/autopsy tissue; however, some medical records (eg, pathology results, autopsy results) were not consistently available for review.

Nearly all patients with confirmed or probable Lyme carditis received antibiotic treatment (n = 81; 99%); the only exception was the patient with negative immunoglobulin M and immunoglobulin G immunoblots (Table). A minority of cases (n = 9; 11%) also received steroids. Ninety percent of patients were admitted to the hospital. The median (range) length of hospital stay was 3 (0-28) days. Thirty percent of patients received cardiac pacing; most of these patients (16 of 25; 64%) received permanent pacemakers. Eighty-one percent of patients were reported to be recovered at the time of discharge. Seventeen percent required admission to the intensive care unit. Two patients (2%) died, both of whom were probable cases.

Certain discharge diagnosis codes and chief complaint terms were more common among cases than among noncases. In particular, the combination of the words "heart" and "block" in the chief complaint of the medical record was more common among confirmed cases (18%) than among noncases (3%) ($P = .01$), and the ICD-10-CM code for "other conditions associated with Lyme disease" (A69.29) was more common among confirmed cases (53%) than among noncases (15%) ($P < .001$), while noncases were more likely to contain the code for "Lyme disease, unspecified" (A69.20) (68% vs 42% of confirmed cases; $P = .04$). The most common discharge diagnosis codes and chief complaint terms differed for confirmed cases, probable cases, and noncases (eTable).

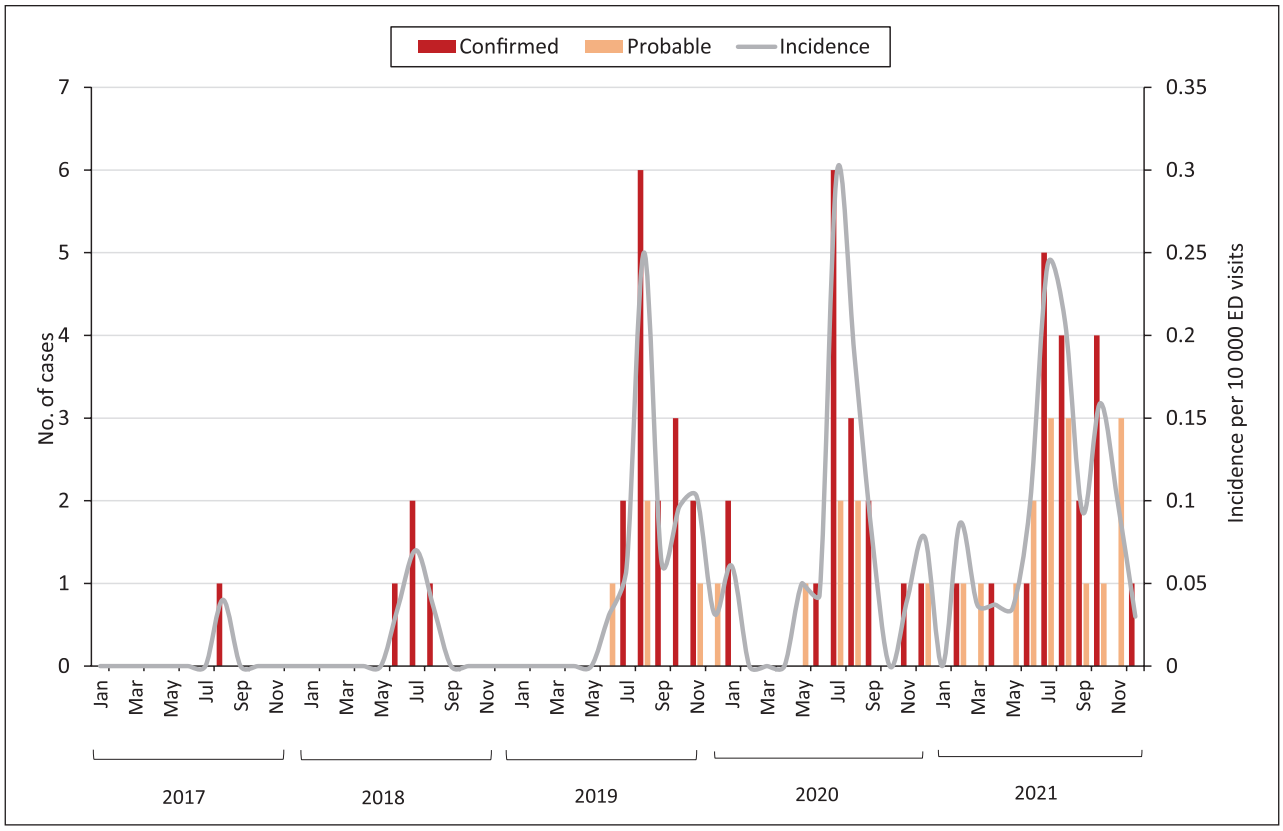

Figure 2. Number of confirmed and probable Lyme carditis cases and overall Lyme carditis incidence per 10 000 emergency department (ED) visits in New York State (excluding New York City) during 2017-2021, as determined by manual medical record review of ED visits identified by the Lyme carditis definition in the National Syndromic Surveillance Program (NSSP).

Discussion

Using a novel syndromic surveillance definition, we detected 82 cases of Lyme carditis in New York State during 2017-2021. We characterized the epidemiology of these cases, including demographic characteristics, geography, seasonality, and associated exposures; described the clinical course; and mapped probable and confirmed Lyme carditis cases based on county of residence.

The characteristics of the Lyme carditis cases detected by this definition closely align with what has been described in previous reports, including the predominance of cases among males, a high degree of atrioventricular block, and a bimodal age distribution.[24-26] Higher observed rates of complete heart block among females than among males in this sample contrast with prior reports that documented complete heart block more frequently among males.[14,25] We observed an 84% seropositivity rate among probable and confirmed cases, a value consistent with the range of those previously reported (42%-96%) for early disseminated disease using standard 2-tiered testing.[12,13,27,28] Increased availability and use of modified 2-tiered testing might improve the sensitivity of serologic testing for Lyme carditis, given the test's improved sensitivity in patients with early Lyme disease.[29,30]

The 2022 surveillance case definition for Lyme disease relies on electronic laboratory reporting in high-incidence jurisdictions rather than on individual case investigations. While this approach has obvious benefits for preserving personnel resources, a limitation is that clinical manifestations are not systematically reported. In addition, laboratory-based surveillance does not detect cases when diagnostic testing is not performed or produces negative results, as occurred in 16% of confirmed and probable cases in our sample. Thus, the application of syndromic surveillance to detect early Lyme disease and potentially serious manifestations such as Lyme carditis may be a useful complementary approach to the current national surveillance strategy for high-incidence jurisdictions.

Limitations

This study had several limitations. First, not all cases of Lyme carditis in New York State were captured by this syndromic surveillance definition, notably including the 2 epidemiologically linked cases that prompted the initial investigation. While a substantial and increasing proportion of EDs participate in New York State's syndromic surveillance platform, participation is not universal. In addition, not all patients with Lyme carditis access the ED

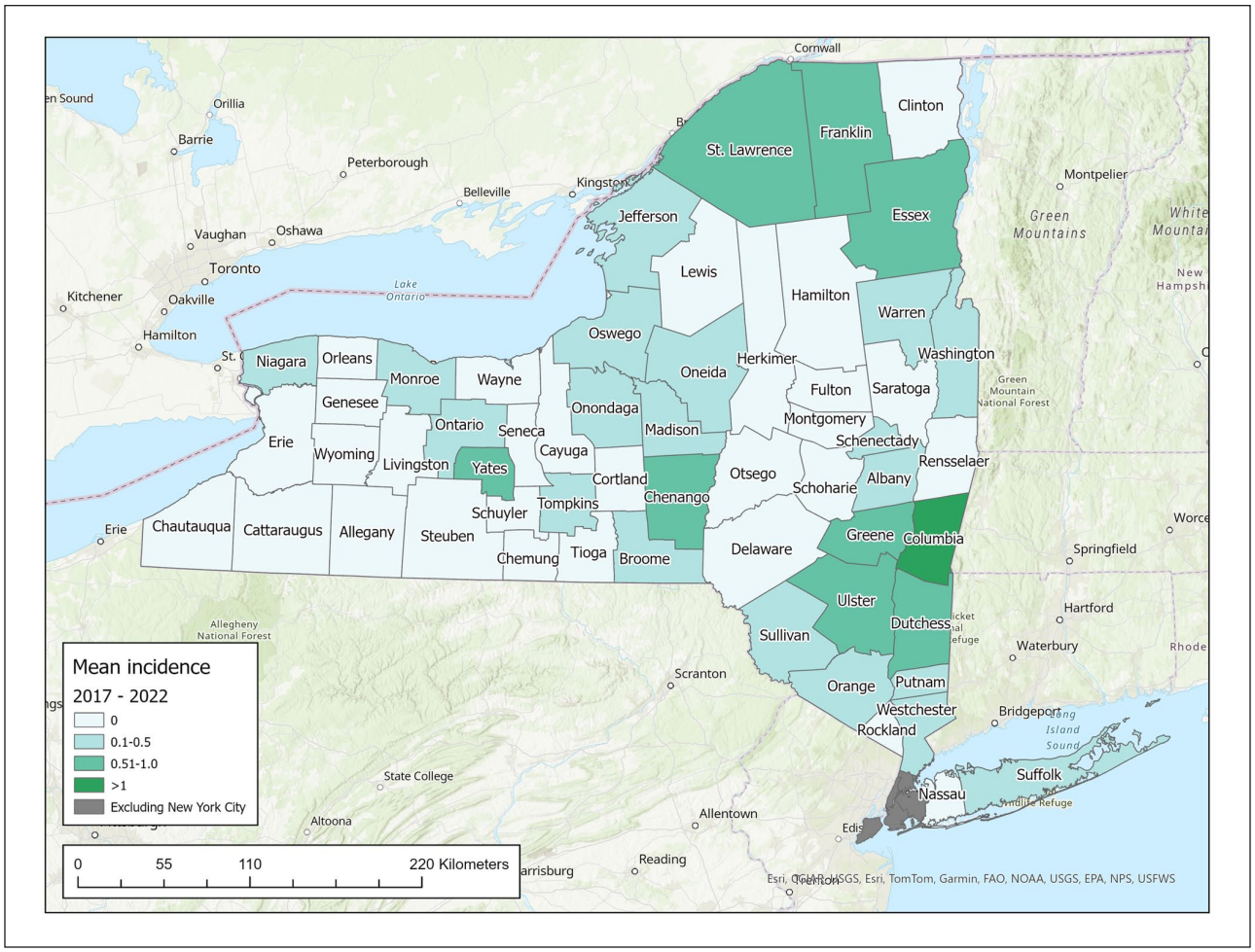

Figure 3. Mean annual incidence of Lyme carditis cases per 100 000 residents, by county, in New York State (excluding New York City) during 2017-2021. Cases of probable or confirmed Lyme carditis were found after manual medical record review of emergency department visits identified by the Lyme carditis definition in the National Syndromic Surveillance Program.

for clinical evaluation; some are diagnosed and treated in outpatient clinics or urgent care centers, where they might be directly admitted to the hospital, bypassing the ED entirely. Second, this syndrome definition depends on the presence of specific ICD-9-CM and ICD-10-CM codes or SNOMED codes; medical coding practices vary among health care systems, institutions, and individual health care providers and may result in differential detection. The lack of a specific diagnostic code for Lyme carditis adds to the challenge of balancing sensitivity and specificity in a syndromic surveillance definition. To further refine the syndromic surveillance definition used in this analysis, diagnostic codes and keywords in the medical records of cases that were not detected by our definition could be reviewed and incorporated.

Third, accurate and consistent case classification was challenging because of the often-equivocal nature of Lyme carditis clinical diagnoses. No single test (in the absence of pathologic examination of cardiac tissue from biopsy or autopsy) allows for a conclusive diagnosis of Lyme carditis, which is often a diagnosis of exclusion. Diagnosis is particularly challenging in individuals with cardiac comorbidities who reside in Lyme-endemic areas. Because antibodies to *B burgdorferi* may be detected for many years even after effective treatment of the infection, Lyme carditis may be diagnosed in individuals with a remote history of Lyme disease who develop heart block for another reason. Conversely, because Lyme carditis is a manifestation of early disseminated disease, antibodies might not yet have had time to develop to detectable levels, and serologic testing sometimes produces negative results. In New York State and other Lyme-endemic areas, health care providers may often initiate antibiotic treatment despite uncertainty about a diagnosis of Lyme carditis, given the potential to treat a reversible cause of heart block and avoid the morbidity associated with permanent pacemaker placement. In this investigation, confirmed cases displayed features consistent with prior reports in the literature (predominance of Lyme disease among

Table. Characteristics of confirmed and probable Lyme carditis cases detected by syndromic surveillance, New York State (excluding New York City), 2017-2022[a]

Characteristic	Confirmed cases (n = 55), no. (%)	Probable cases (n = 27), no. (%)	Confirmed and probable cases (N = 82), no. (%)
Sex			
Male	42 (76)	16 (59)	58 (71)
Female	13 (24)	11 (41)	24 (29)
Age, y			
0-12	1 (2)	0	1 (1)
13-24	5 (9)	2 (7)	7 (9)
25-39	14 (25)	3 (11)	17 (21)
40-54	10 (18)	0	10 (12)
55-69	11 (20)	6 (22)	17 (21)
≥70	13 (24)	16 (59)	29 (35)
Unknown	1 (2)	0	1 (1)
Known tick bite in 6 weeks before illness onset			
Yes	14 (25)	5 (19)	19 (23)
No	23 (42)	10 (37)	33 (40)
Unknown	18 (33)	12 (44)	30 (37)
Outdoor exposure during 6 weeks before illness onset			
Yes	23 (42)	7 (26)	30 (37)
No	2 (4)	1 (4)	3 (4)
Unknown	30 (55)	19 (70)	49 (60)
Symptom onset during May–September	39 (71)	18 (67)	57 (70)
Documented skin rash			
Erythema migrans (single or multiple)	7 (13)	1 (4)	8 (10)
Other or unknown	10 (18)	2 (7)	12 (15)
Documented heart block			
Third degree	24 (44)	8 (30)	32 (39)
Second degree	18 (33)	5 (19)	23 (28)
First degree	4 (7)	5 (19)	9 (11)
None or unknown	9 (16)	9 (33)	18 (22)
Two-tiered Lyme disease serology (STTT or MTTT)			
Positive	52 (95)	17 (63)	69 (84)
Negative	3 (5)	9 (33)	12 (15)
Not performed	0	1 (4)	1 (1)
IgM Western blot			
Positive	37 (67)	8 (30)	45 (55)
Negative	11 (20)	15 (56)	26 (32)
Not performed or unknown	7 (13)	4 (15)	11 (13)
IgG Western blot			
Positive	30 (55)	12 (44)	42 (51)
Negative	16 (29)	10 (37)	26 (32)
Not performed or unknown	9 (16)	5 (19)	14 (17)
Cardiac pacing			
Temporary	7 (13)	2 (7)	9 (11)
Permanent	10 (18)	6 (22)	16 (20)
Received antibiotic treatment			
Yes	55 (100)	26 (96)	81 (99)
No or unknown	0	1 (4)	1 (1)
Received steroid treatment			
Yes	6 (11)	3 (11)	9 (11)
No	44 (80)	23 (85)	67 (82)
Unknown	5 (9)	1 (4)	6 (7)

(continued)

Table. (continued)

Characteristic	Confirmed cases (n = 55), no. (%)	Probable cases (n = 27), no. (%)	Confirmed and probable cases (N = 82), no. (%)
Length of hospital stay, d			
0 or 1	7 (13)	11 (41)	18 (22)
2 or 3	18 (33)	3 (11)	21 (26)
4-7	21 (38)	6 (22)	27 (33)
>7	8 (15)	5 (19)	13 (16)
Unknown	1 (2)	2 (7)	3 (4)
Intensive care admission			
Yes	9 (16)	5 (19)	14 (17)
No	44 (80)	21 (78)	65 (79)
Unknown	2 (4)	1 (4)	3 (4)
Preexisting cardiac disease	10 (18)	11 (41)	21 (26)
Condition at discharge			
Fully recovered	48 (87)	19 (70)	67 (82)
Partially recovered	3 (5)	2 (7)	5 (6)
Remained in hospital	2 (4)	1 (4)	3 (4)
Died	0	2 (7)	2 (2)
Unknown	2 (4)	3 (11)	5 (6)

Abbreviations: IgG, immunoglobulin; IgM, immunoglobulin M; MTTT, modified 2-tiered test; STTT, standard 2-tiered test.
[a] Cases were identified through manual review of emergency department visit medical records identified by the Lyme carditis definition in the National Syndromic Surveillance Program.

males, younger age, higher proportion of positive serologic testing, and less preexisting cardiac disease). These features are diluted in the probable cases, highlighting the challenge inherent in Lyme carditis diagnosis and surveillance. Our findings of seronegativity among a substantial proportion of probable cases also underscores the importance of health care providers maintaining a high index of suspicion for Lyme carditis when caring for residents of or travelers to Lyme-endemic areas, regardless of serologic testing results, because serologic testing is imperfectly sensitive and prompt antibiotic treatment can be lifesaving.

Despite these limitations, this effort demonstrated the value of a syndrome definition as a tool for Lyme carditis surveillance in high-incidence jurisdictions. Leveraging links between syndromic surveillance platforms and health information exchange networks may enable improved case finding for rare syndromes of public health concern, including Lyme carditis.

Practice Implications

Syndromic surveillance for Lyme carditis may serve multiple purposes in high-incidence jurisdictions: retrospective case finding, investigation of individual Lyme carditis cases, trend evaluation, and temporospatial cluster detection. Syndromic surveillance is a powerful, timely, emerging tool that can complement and augment other forms of Lyme disease surveillance.

Authors' Note

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Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online. The authors have provided these supplemental materials to give readers additional information about their work. These materials have not been edited or

formatted by *Public Health Reports*'s scientific editors and, thus, may not conform to the guidelines of the *AMA Manual of Style*, 11th Edition.

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