Lyme Disease Trends — Dutchess County, New York, 1992–2000

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Abstract

Background: Lyme disease is a vector-borne infectious disease, accounting for more than 95% of all reported vector-borne illness in the United States. From 1992–2000, Dutchess County reported more cases of Lyme disease than any other county in the United States, consistently ranking among the top ten in incidence rates. We analyzed 1992–2000 Dutchess County Lyme disease surveillance data to characterize Lyme disease trends, identify high-risk populations, and examine the frequency of the characteristic lesion, erythema migrans.

Methods: A Lyme disease case was defined as a person with physician-diagnosed erythema migrans or at least one "late" manifestation of the disease, with laboratory confirmation. A surveillance database of cases reported in Dutchess County from 1992–2000 was obtained from the New York State Department of Health. Annual incidence rates by age, gender, race, ethnicity, and ZIP codes, and frequency of erythema migrans were calculated.

Results: From 1992 through 2000, a total of 9,548 cases of Lyme disease were reported by Dutchess County to the New York State Department of Health, for a crude mean annual incidence rate of 400 cases per 100,000 persons per year. The incidence rate peaked at 683/100,000 in 1996, and then declined from 1998 to 2000. A bimodal age distribution was seen, with the initial peak among children aged 5–9 years (617/100,000) and the second peak among adults aged 60–64 years (627/100,000). A male preponderance was clearly seen between the ages of 5–19 years, and beyond the age of 60 years. Highest incidence rates were reported in central Dutchess County. Onset of illness occurred most frequently in June, July, and August. Ninety-four percent of cases occurred among the predominantly white population, which had the highest incidence rate (431/100,000) among the races. Incidence rate for non-Hispanics was more than double that for Hispanics. Eighty-one percent of reported cases had erythema migrans.

Conclusions: While some prevention programs could be broadly targeted to the entire Dutchess County population, other interventions might be most effective if they focused on the high-risk population groups and areas defined in this report. The high proportion of cases with erythema migrans suggests that early diagnosis and treatment should be effective in reducing late-stage complications of Lyme disease in Dutchess County. Surveillance data for other endemic counties and states can be similarly analyzed to enhance and monitor local prevention programs.

Key Words: Lyme disease, *Borrelia burgdorferi*, incidence, surveillance.

Introduction

LYME DISEASE IS A VECTOR-BORNE infectious disease, accounting for more than 95% of all reported vector-borne illness in the United States in 1996 (1). First recognized in North America in 1975, Lyme disease is caused by the spirochete *Borrelia burgdorferi*, which is transmitted to humans by ticks of the species *Ixodes* (deer ticks). Measures that may be effective in preventing Lyme disease include wearing protective clothing, using insect repellents, and the early detection and removal of ticks. Antibiotic prophylaxis given within 72 hours of a deer tick bite may be effective in highly endemic areas (2). Exclusion or removal of deer, removal of leaf litter, and acaracide application to rodent, deer, and tick habitats may be useful in reducing tick populations.

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The study was done at the Epidemic Intelligence Service and the Division of Vector-Borne Infectious Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Fort Collins, CO. It is based on data received from the Dutchess County Department of Health, Poughkeepsie, NY and the New York State Department of Health, Albany, NY.

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The Centers for Disease Control and Prevention (CDC) initiated Lyme disease surveillance in the United States in 1982. Surveillance in Dutchess County soon followed, in 1986, when reporting of Lyme disease was mandated in New York State. In 1991, Lyme disease was added to the list of nationally notifiable diseases. From 1992 to 2000, the annual reported incidence of Lyme disease in the United States nearly doubled to 17,730 cases (3). During this time period, Dutchess County reported more cases of Lyme disease than any other county in the U.S., consistently ranking among the top ten counties in incidence rates. In 2001, the American Lyme Disease Foundation and the Dutchess County Department of Health (DCDOH), with funding through a cooperative agreement with the CDC, initiated a community-based Lyme disease prevention program in Dutchess County.

We analyzed Dutchess County Lyme disease surveillance data for 1992–2000, to assess the public health status of Lyme disease in Dutchess County. We characterized Lyme disease trends, identified high-risk populations, and examined the frequency of the characteristic lesion, erythema migrans (EM), among the reported cases.

Materials and Methods

For surveillance purposes, a case of Lyme disease was defined as a person with physician-diagnosed EM or at least one "late" manifestation of the disease (rheumatic, neurologic, cardiac, or ophthalmic), with laboratory confirmation.

The DCDOH receives reports of Lyme disease from health care providers and laboratories. Laboratories report positive results via either a weekly facsimile or the recently initiated Electronic Clinical Laboratory Reporting System (ECLRS). Clinical and laboratory information necessary to make case determinations is gathered, and confirmed cases are entered onto DCDOH forms. These data are transferred to the New York State Department of Health (NYSDOH) via the electronic Health Information Network, where the submitted cases are again evaluated and confirmed by NYSDOH staff. Surveillance data from NYSDOH are then forwarded to the CDC National Electronic Telecommunication Surveillance System (NETSS).

Lyme disease surveillance data for 1992–2000 was obtained from the NYSDOH Statistical Unit. Information about each case included: (a) demographics, such as age, sex, and ZIP code of residence; (b) timing of illness, such as date of symptom onset, date of diagnosis, and date of reporting; and (c) for recent years, presence or absence of EM. Descriptive analysis was performed using Microsoft EXCEL and EpiInfo 2000 computer programs (4). Incidence rates by age group and sex were calculated using annual Dutchess County population estimates from the U.S. census. Incidence rates by race and ethnicity were calculated using 1996 Dutchess County population estimates from the U.S. census. Incidence rates by ZIP code were calculated using year 2000 population estimates within the ZIP code boundaries provided by CACI International in ArcMap, and then mapped using categories determined by Jenks optimization (5).

Results

Temporal Trends

From 1992 through 2000, a total of 9,548 cases of Lyme disease were reported by Dutchess County to the NYSDOH, for a mean annual incidence rate of 400 reported cases per 100,000 persons per year. Over the nine-year period, the annual incidence per 100,000 persons peaked at 683 in 1996, dropped to 389 the following year, then decreased from 579 in 1998 to 385 in 2000 (Fig. 1). Dutchess County reported 25% of the total Lyme disease cases recorded by New York State during 1992–2000. The Dutchess County trend is somewhat different from that of New York State (excluding Dutchess County data) (Fig. 2), as well as that of the United States (Fig. 3).

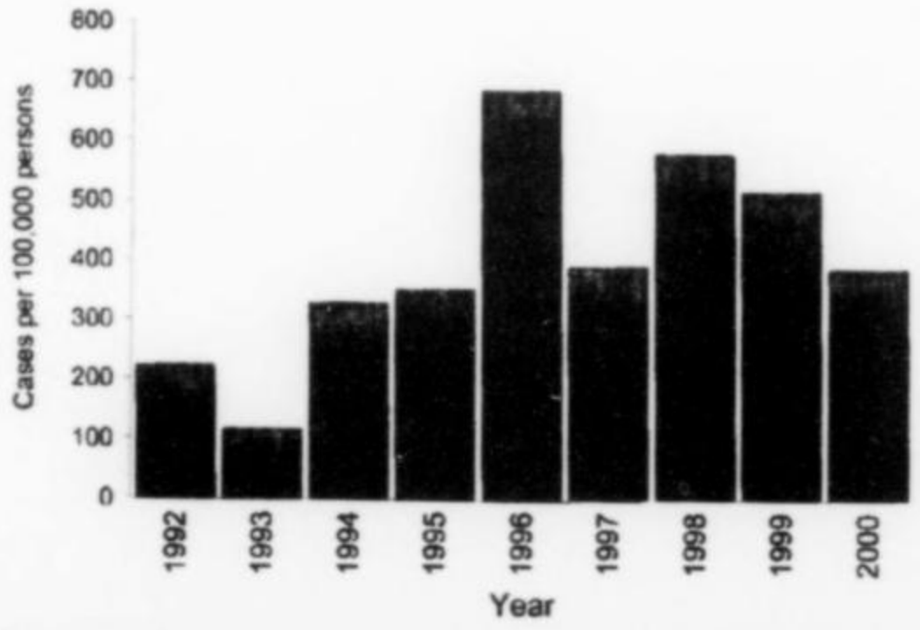

Fig. 1. Incidence rate of reported cases of Lyme disease — Dutchess County, New York, 1992–2000.

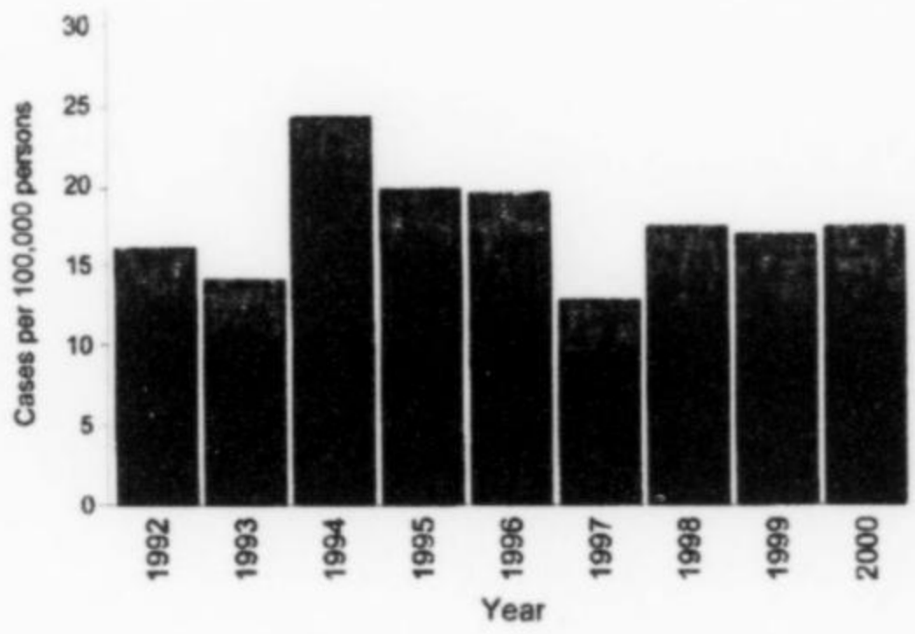

Fig. 2. Incidence rates of reported cases of Lyme disease — New York State with exclusion of Dutchess County, 1992–2000.

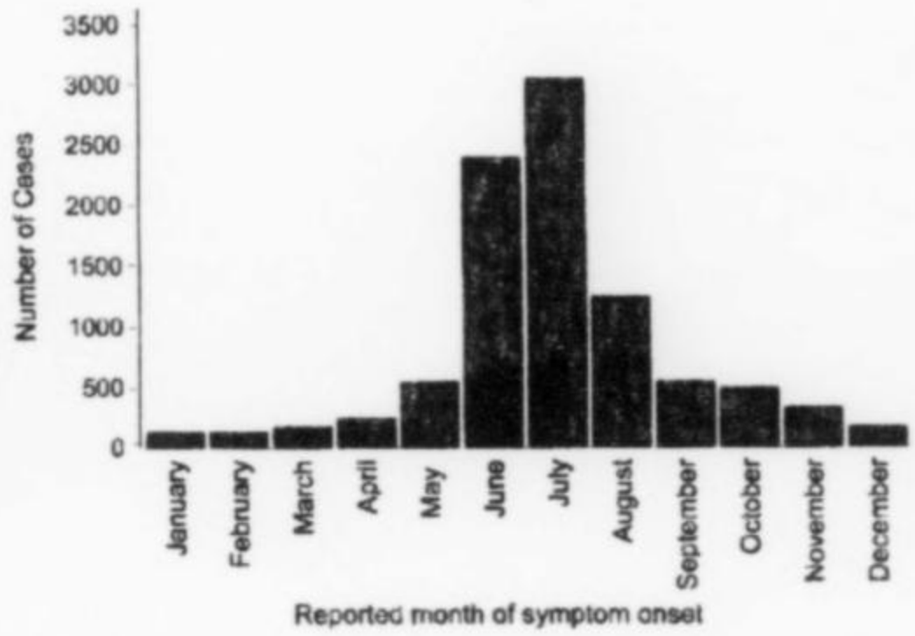

Fig. 4. Month of Lyme disease onset for reported cases — Dutchess County, New York, 1992–2000.

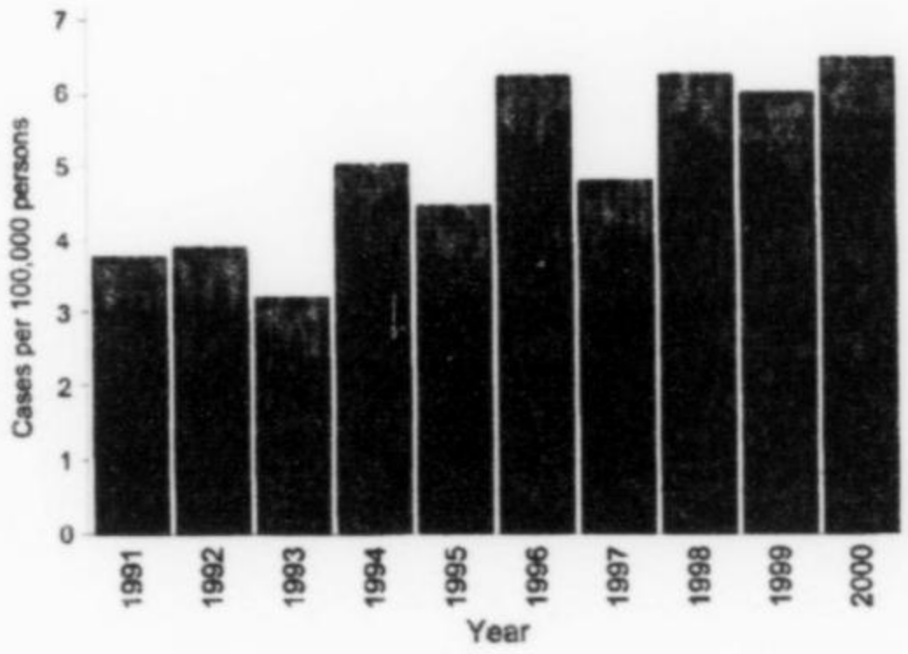

Fig. 3. Incidence rates of reported cases of Lyme disease — United States, 1991–2000.

Seasonality

Information regarding date of symptom onset was available for 9,453 reported cases (99.0%). When numbers of reported cases were plotted by reported month of symptom onset, the peak month of symptom onset was shown to be July (3,047 cases), followed by June (2,391 cases) and August (1,249 cases), respectively (Fig. 4).

Spatial Distribution

Information regarding the ZIP code of residence was available for 9,539 reported cases (99.9%). Of these records, 9,318 indicated ZIP codes that are currently being used in Dutchess County (97.7% of ZIP codes). The three ZIP code areas reporting the highest numbers of cases were within Poughkeepsie, Hopewell Junction, and Wappinger Falls, all in the southwestern region of Dutchess County. However, these three areas were also within the four most populous ZIP codes. The three ZIP code areas reporting the highest incidence rates of Lyme disease were in Millbrook, Verbank, and Salt Point, located in central Dutchess County (Fig. 5).

Demographics

Data regarding both gender and age were reported for 9,477 cases (99.3%). The distribution of mean annual incidence rates by age was bimodal. The initial peak occurred among children between the ages of 5–9 years. The second peak occurred among adults between the ages of 60–64 years, one decade older than the peak reflected in the 1992–1998 United States data (6). Lyme disease incidence rates for persons aged 40–59 years were slightly higher in females; however, a male preponderance was clearly seen between the ages of 5–19 years, and beyond 60 years (Fig. 6).

Race and Ethnicity

Data regarding race was reported for 9,202 cases (96.4%). The majority of reported Lyme disease cases (93.6 %), and the highest incidence rate, occurred among whites, with a mean annual incidence rate of 431 per 100,000 persons. The incidence rates among the county's minority populations were much lower (Fig. 7).

Data regarding ethnicity was reported for 8,732 (91.5%) cases. Among these cases, the mean annual incidence rate per 100,000 persons for non-Hispanic residents (379) was more than double that for Hispanic residents (157).

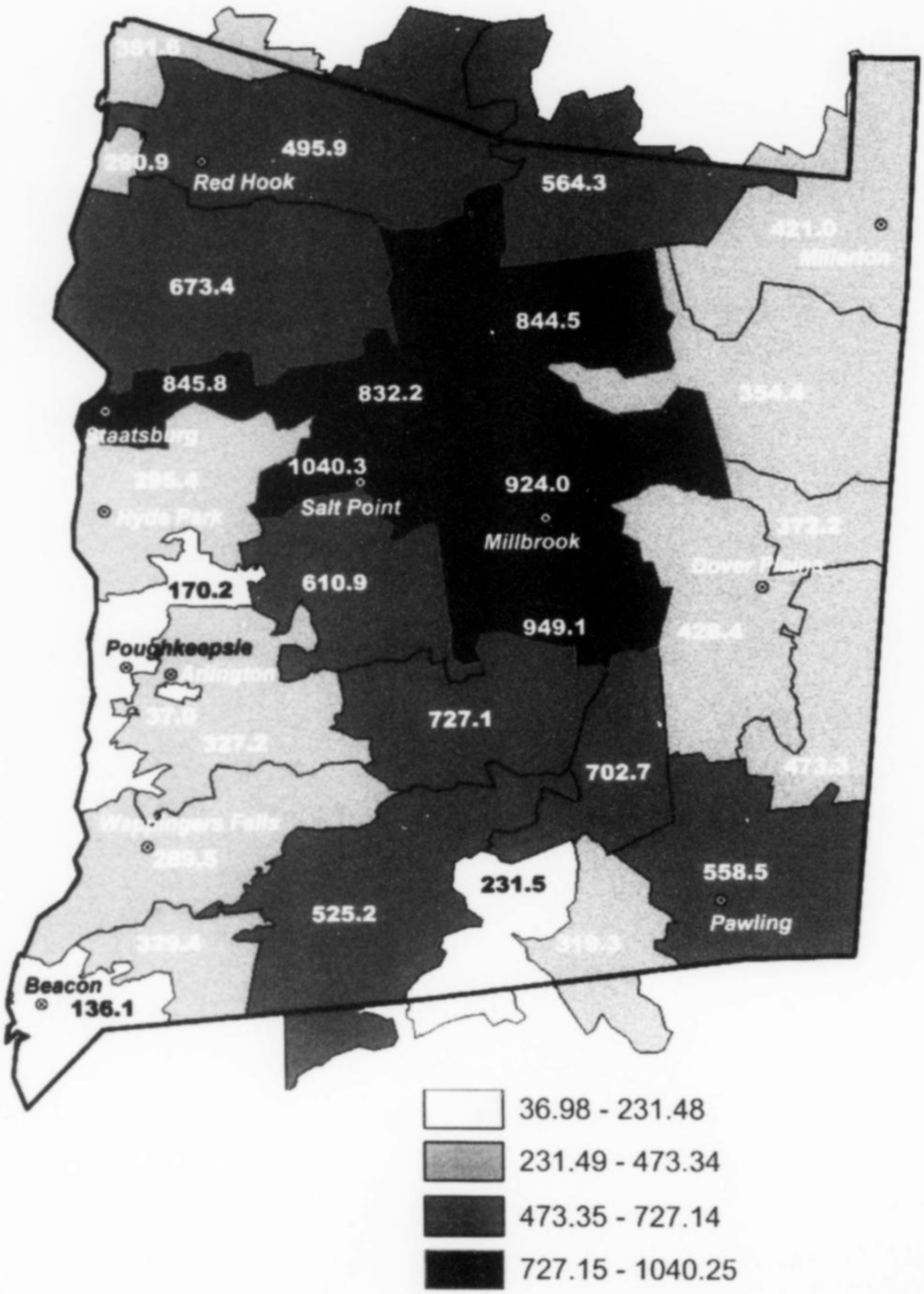

Fig. 5. Incidence rates of reported Lyme disease cases by ZIP codes — Dutchess County, New York, 1992 – 2000. The three ZIP code areas reporting the highest numbers of cases were within Poughkeepsie, Hopewell Junction, and Wappinger Falls, in the southwestern region of Dutchess county. Hopewell Junction, not shown above, is approximately 7 miles east of Wappinger Falls. The three ZIP code areas reporting the highest incidence rates of Lyme disease were in Millbrook, Verbank, and Salt Point, located in central Dutchess County. Verbank, not shown above, is approximately 4 miles south of Millbrook.

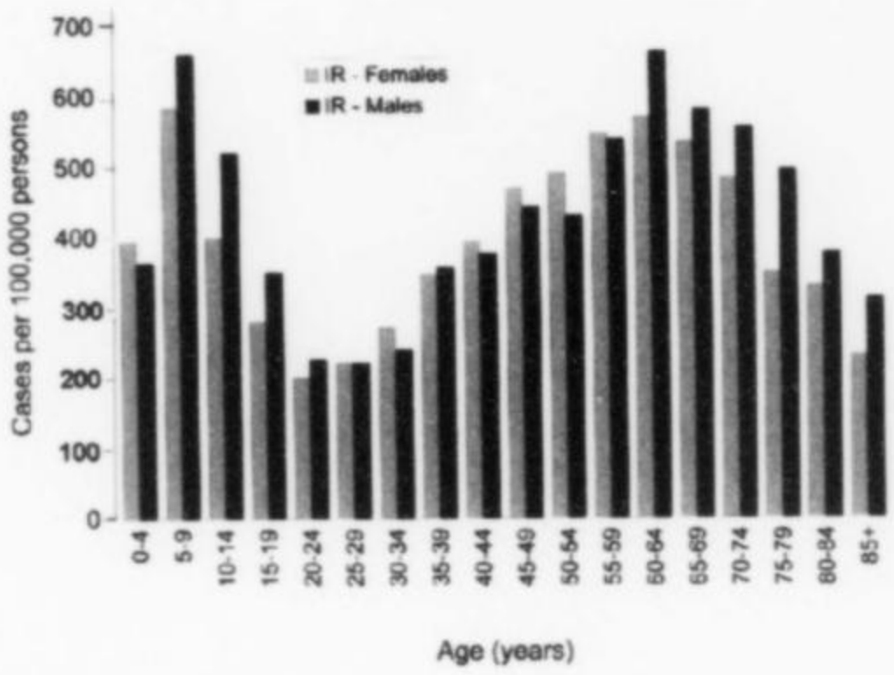

Fig. 6. Mean annual incidence rate (IR) of Lyme disease cases by age group and sex — Dutchess County, New York, 1992–2000.

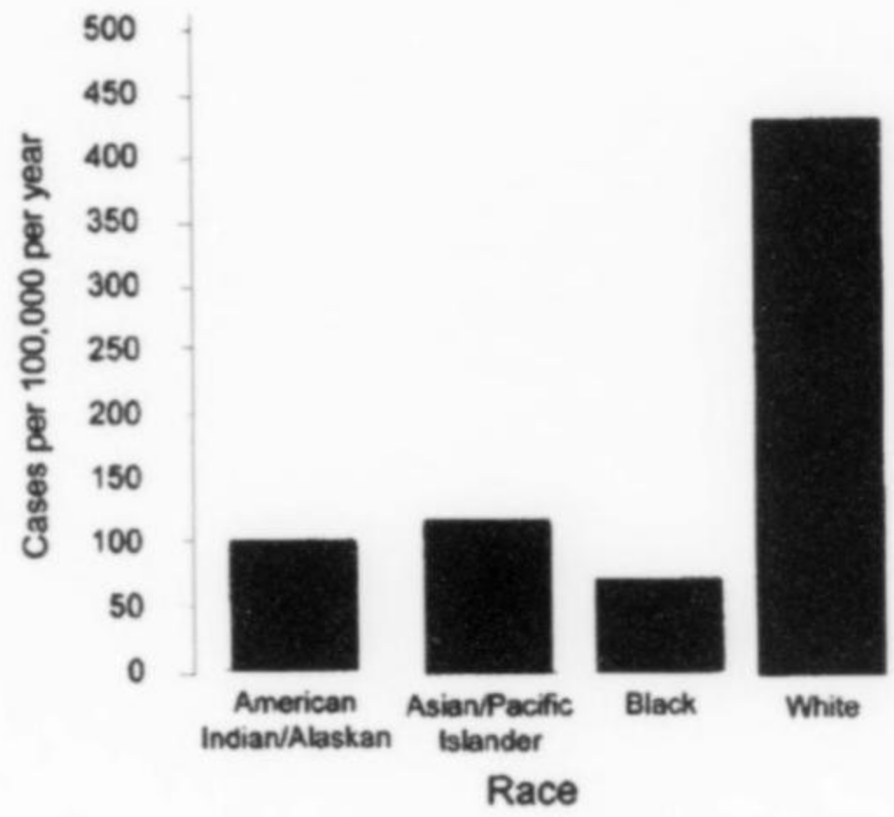

Fig. 7. Mean annual incidence rates of reported Lyme disease cases by race — Dutchess County, New York, 1992–2000.

Frequency of Erythema Migrans

Computerized data regarding the presence or absence of EM were available after 1997. Of the 5,021 Lyme disease reports entered between 1997 and 2000, 4,962 (98.8%) contained data regarding EM. EM was reportedly present in 4,039 (81.2%) of these cases. A higher percentage of EM was noted among reported Lyme disease cases in 2000 (90.4%) than in the preceding years (77.1% in 1999, 80.4% in 1998, 79.8% in 1997). More than 50% of cases with month of onset from May through December had EM, and more than 90% of those with month of onset in June and July had EM. Among cases reporting the month of onset as December through March, the percentage of EM ranged from 23.4–30.5%.

Data regarding both date of symptom onset and date of diagnosis were available for 9,399 (98.4%) reported cases. Of these, 5 cases had obvious errors, reporting dates of diagnosis that preceded dates of symptom onset. Among the remaining cases, the median interval between onset of symptoms and diagnosis was 3 days, with a range of 0 to 8,783 days. The reported delay in diagnosis from the date of symptom onset was greater than five years in 5 (0.05%) of these cases; the case with the longest duration of delay reported symptom onset in 1972 and diagnosis of Lyme disease in 1996. Data regarding symptom onset, date of diagnosis, and EM were available for 4,957 (98.7%) of the 5,021 Lyme disease reports from 1997 to 2000. The median interval between onset of symptoms and diagnosis was 2 days (range 0–1,382 days) for cases with EM, versus 5 days (range 0–1,616 days) for cases without EM. The proportion of cases with EM decreased as the interval from symptom onset to diagnosis increased (Fig. 8).

Discussion

Whereas the annual incidence rate for Lyme disease in Dutchess County peaked in 1996 and then declined from 1998 to 2000 (prior to the initiation of the community prevention program), the incidence rate for the remainder of New York State stayed relatively stable through 2000, and the incidence rate in the United States increased slightly in 2000. These differ-

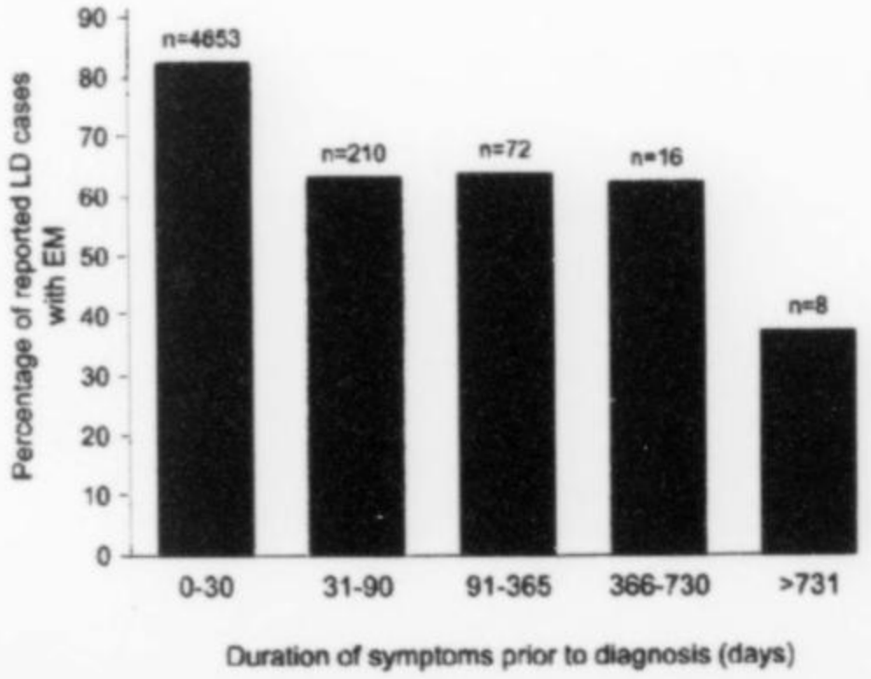

Fig. 8. Presence of erythema migrans by duration of symptoms prior to diagnosis.

ences may reflect real differences in Lyme disease incidence, but could also be largely or partially due to changes in local and state surveillance practices. There were personnel changes and minor modifications of surveillance practices at both state and local levels during this time. Awareness and reporting of Lyme disease in Dutchess County might have increased in 1996 as the result of a Lyme disease vaccine trial (7). The outbreak of West Nile virus in New York was first recognized in late August of 1999 (8). The emergence of this new public health threat shifted limited local personnel resources away from Lyme disease surveillance, and may have decreased or delayed the reporting of 1999 and 2000 Lyme disease cases.

The highest Lyme disease incidence rates in Dutchess County were reported in the central region, whereas the lowest incidence rates were reported in the southwestern area. The reason for this distribution of incidence is not clear. The incidence of Lyme disease at the state and regional levels in Connecticut has been shown to parallel the abundance of *Ixodes scapularis* nymphs and *Borrelia burgdorferi*-infected nymphs (9). Local variations in tick densities and tick infection rates may play a role in the distribution of Lyme disease in Dutchess County, but detailed data on entomologic indices to assess such effects are not currently available. The factors that influence the annual abundance of *Ixodes scapularis* are not well understood (9), but environmental variables postulated to affect tick habitat suitability include presence of forested areas, proximity to watersheds, soil types, and residential setting (10). Spatial analyses of Lyme disease incidence rates in New York State have indicated that Lyme disease has spread northward and westward in an advancing wave from a high-incidence area in Westchester County, most likely due to movement of vector hosts (11). Local human behaviors that affect the level of exposure to ticks may also play a part in the geographic distribution of Lyme disease. Finally, as discussed above, local variations in case reporting and other surveillance biases may influence the observed distribution of the disease.

The highest reported incidence rate of Lyme disease in Dutchess County occurred among the white, non-Hispanic population. The reason for the disparate rates among different age groups, genders, races and ethnicities is not clear, but may be explained by differential tick exposure, differential access to health care, diagnostic bias or reporting bias. The large number of cases reported with unknown ethnicity limits the certainty about differences in ethnic-specific incidence rates.

The seasonal trend for reported Lyme disease cases from Dutchess County was consistent with results extracted from the national Lyme disease surveillance data collected from 1992–1998, as well as results from other epidemiologic studies (6). The months of June, July, and August pose the highest risk for Lyme disease, since this is when both seasonal feeding activity of nymphal *Ixodes scapularis* and human outdoor activity are highest (12).

While some prevention programs could be broadly targeted to the entire Dutchess County population, other interventions might be most effective if special emphasis were given to the high-risk population groups and areas defined in this report. Educational strategies advocating personal protective measures might be most effective if focused on young children and older adults, especially the older male population. Such strategies should be timed to precede the peak transmission season in late spring and early summer. Ecological interventions to reduce tick densities might have the greatest impact if targeted to the central areas, where incidence is highest and to the southwest areas, where the greatest numbers of cases occur.

In a study of the residents of Great Island, Massachusetts, conducted from 1979–1983, EM was found to occur in 61–86% of those with the disease (13). More recent studies suggest that nearly 90% of people with Lyme disease develop EM (14–16). In Dutchess County, EM was diagnosed in 80–90% of reported Lyme disease cases.

Most cases of Lyme disease are acquired during the summer months, and this is reflected in the high proportion of cases that are reported with EM during the summer (17). The diagnosis of Lyme disease cases that do not have EM may be delayed until fall or winter months, even though the infection was acquired during the summer. However, the proportion of Lyme disease cases reporting EM in Dutchess County remained above 50% well into November and above 20% between December and March. While EM may be misdiagnosed in some of these cases (17), this finding supports previous studies indicating that adult ticks, which may be active in colder months, play a minor yet noticeable role in the transmission of Lyme disease to humans (18–20). Educational interventions to prevent Lyme disease may need to stress the potential for year-round transmission of Lyme disease.

Other than the outliers in whom diagnosis was extensively delayed, most Lyme disease cases were diagnosed in a timely manner. The high proportion of cases reported with EM in Dutchess County indicates that most cases of Lyme disease in that area are diagnosed in the early stages. Not surprisingly, patients without EM tended to be diagnosed later than those with EM, as recognition of early-stage Lyme disease in the absence of EM can be difficult. The timely diagnosis and treatment of patients with early Lyme disease is an important tertiary prevention strategy that can prevent late-stage complications of Lyme disease. This fact should be emphasized in prevention messages to health care providers and the general public.

Conclusion

Dutchess County, where Lyme disease is most prevalent, experienced an increase in incidence rate in the early 1990s. Despite a decline in the incidence rate between 1998 and 2000, the high number of cases that continue to be reported in Dutchess County remains a concern. Analysis of Dutchess County Lyme disease surveillance data revealed that the highest incidence rates were reported in the summer, among white, non-Hispanic males in early childhood and late adulthood, with a focal distribution in central Dutchess County. While some prevention programs could be broadly targeted to the entire Dutchess County population, other interventions might be most effective if special emphasis were given to the high-risk population groups and areas defined in this report. The high proportion of cases with EM suggests that tertiary prevention through early diagnosis and treatment should be effective in reducing late-stage complications of Lyme disease in Dutchess County. Surveillance data for other counties where Lyme disease is endemic can be analyzed similarly to enhance and monitor local prevention programs.

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