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# Epidemiological Analysis of the Occurrence of Tick-borne Diseases at the Independent Public Health Care Facility in Bielsk Podlaski

# Analiza epidemiologiczna występowania chorób odkleszczowych w Samodzielnym Publicznym Zakładzie Opieki Zdrowotnej w Bielsku-Podlaskim

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**Abstract**

**Introduction**. Ticks can infect people with numerous pathogens causing various infectious (viral, bacterial) or invasive (parasitic, fungal) diseases.
**Aim**. The main objective of the present work included the epidemiologic analysis of the occurrence of tick-borne diseases at the Independent Public Health Care Facility in Bielsk Podlaski.
**Material and Methods**. An analysis of medical documentation stored in the hospital's IT database of patients hospitalized in 2016, 2017 and 2018 was performed. Sixty-six patients admitted to the Observation and Infectious Disease Ward diagnosed with tick-borne diseases, were qualified for the study.
**Results**. Analysis of the data showed that Lyme disease was diagnosed most often. It affected mainly middle-aged and elderly men. The second most-often diagnosed illness was TBM characterized by its seasonality. No other tick-transmitted diseases were recorded. Although not all patients were aware of having been bitten by a tick, their symptoms allowed the diagnosis of tick-related illnesses. After treatment relevant to each ailment all patients were discharged in a good state of health.
**Conclusions**. The completed retrospective analysis of the documentation of hospitalized patients shows consistency with the work of other authors both with respect to the frequency of tick-borne disease diagnoses and the most often reported symptoms. It also confirms an upward trend with respect to tick-borne disease hospitalizations. **(JNNN 2020;9(2):51–58)**
**Key Words**: tick-borne diseases, epidemiology, various infectious, invasive diseases

**Streszczenie**

**Wstęp**. Kleszcze mogą zarażać ludzi wieloma patogenami wywołującymi różne choroby zakaźne (wirusowe, bakteryjne) lub inwazyjne (pasożytnicze, grzybicze).
**Cel**. Głównym celem niniejszej pracy była analiza epidemiologiczna występowania chorób odkleszczowych w Samodzielnym Publicznym Zakładzie Opieki Zdrowotnej w Bielsku Podlaskim.
**Materiał i metody**. Dokonano analizy dokumentacji medycznej przechowywanej w informatycznej bazie danych szpitala w 2016, 2017 i 2018 r. Do badania zakwalifikowano sześćdziesięciu sześciu pacjentów przyjętych na Oddział Obserwacji i Chorób Zakaźnych, u których zdiagnozowano choroby odkleszczowe.
**Wyniki**. Analiza danych wykazała, że najczęściej rozpoznawano boreliozę. Dotyczyło to głównie mężczyzn w średnim i starszym wieku. Drugą najczęściej diagnozowaną chorobą było kleszczowe zapalenie opon mózgowych, charakteryzujące się sezonowością. Nie odnotowano żadnych innych chorób przenoszonych przez kleszcze. Chociaż nie wszyscy pacjenci byli świadomi ukąszenia przez kleszcza, ich objawy pozwoliły na rozpoznanie chorób odkleszczowych. Po leczeniu związanym z każdą dolegliwością wszyscy chorzy zostali wypisani do domu w dobrym stanie zdrowia.
**Wnioski**. Przeprowadzona retrospektywna analiza dokumentacji pacjentów hospitalizowanych wykazuje spójność z pracami innych autorów zarówno pod względem częstości rozpoznawania chorób odkleszczowych, jak i najczęściej

zgłaszanych objawów. Potwierdza również tendencję wzrostową w zakresie hospitalizacji z powodu chorób przenoszonych przez kleszcze. **(PNN 2020;9(2):51–58)**
**Słowa kluczowe**: choroby odkleszczowe, epidemiologia, choroby zakaźne, choroby inwazyjne

## Introduction

The World Health Organization estimates that diseases of animal origin (zoonoses) make up approximately 61% of all human illnesses. Up to now, over 200 zoonoses, whose etiological factors include prions, viruses, bacteria, fungi and parasitic protozoa, have been recognized [1]. Zoonoses also encompass tick-borne diseases (TBDs) whose rate of occurrence is systematically rising. The role of ticks as dangerous external parasites for numerous vertebrates as well as people is quite substantial and next to mosquitoes they are the most important vector for human disease. In Poland, this mainly concerns the castor bean tick which is the most often encountered within the population of these arthropods [2]. Ticks are a vector of many germs obtained within the blood of infected animals on which they feed. A once-infected tick, as well as its offspring, becomes a permanent carrier [3].

Tick-borne diseases are transmittable with the pathogens passed on from the donor's organism to that of the recipient through the blood-feeding arthropod (vector) — the tick. Germs from its body are transferred along with its secretions (saliva, midgut gland secretions) or excretions (stool, gastric content). The tick is both a reservoir as well as a carrier of numerous pathogens. It is responsible for the transmission of such diseases as tick-borne meningitis and encephalitis, Lyme disease, granulocytic anaplasmosis, or babesiosis [4]. These illnesses occur more and more frequently and concern both people (aging of the population, the development of tourism, active recreation in the fresh air) as well as the ticks themselves (shorter developmental cycle, climate and ecological changes causing a rise in their numbers and an expansion of their range). An important role is also played by the growth of animal trading and the appearance of new pathogens [5]. Most at risk for contracting tick-borne diseases are people who are professionally involved with forestry or agriculture as well as veterinary workers. Tenders of urban green places, those who gather forest fruits or tourists are also in danger. Low social awareness regarding tick-borne diseases and possibilities for their prevention has additionally contributed to a rise in infections [6].

The most often occurring tick-borne diseases in Poland include Lyme disease and tick-borne meningitis and encephalitis. In accordance with the Act from December 5th of 2008 concerning "The prevention and counteracting of human infections and infectious diseases", they are subject to mandatory reporting and registration. Additionally, epidemiological supervision of tick-borne illnesses is carried out by the National Sanitary Inspection in cooperation with the National Institute of Hygiene. These institutions conduct diagnostic testing and keep statistics concerning the spread of diseases transmitted by ticks [7].

The work's main objective is the epidemiological analysis of the occurrence of tick-borne diseases at the Independent Public Health Care Facility in Bielsk Podlaski.

Specific objectives encompass:

— analysis of the frequency with which tick-borne diseases occur,
— demographic characteristic of patients,
— analysis of therapeutic treatment,
— analysis of tick-borne disease risk factors among examinees,
— prognoses for the considered group of patients.

## Material and Methods

The study included 66 patients hospitalized at the Observation and Infectious Disease Ward of the Independent Public Health Care Facility in Bielsk Podlaski and concerned the analysis of documentation gathered within the hospital's IT database for patients admitted in 2016, 2017 and 2018. Only patients diagnosed with tick-borne diseases were included in the study.

Permission for the verification of medical documents of patients hospitalized at the Observation and Infectious Disease Ward was obtained from the Director of the Independent Public Health Care Facility in Bielsk Podlaski.

Collected data has been subjected to statistical analysis carried out using Microsoft Office Excel. Results have been presented graphically and descriptively.

## Results

The research has been carried out on the basis of medical documentation analysis. From among all of the 2,461 patients admitted by the hospital, 66 of them (2.68%) hospitalized at the Observation and Infectious Disease Ward of the IPHCF in Bielsk Podlaski and diagnosed with tick-borne diseases were qualified for the study. Data from a period spanning 3 years, from 2016 to 2018, was evaluated.

A total of 2,461 people were hospitalized at the facility during the period covered by the study — 826 patients in 2016, 775 in 2017 and 860 in 2018. Among them, there was a group of 66 patients (2.68%) suffering from tick-borne diseases. In 2016 there were 8 cases of Lyme disease (0.97%) and 7 cases of tick-borne meningitis (TBM) (0.85%) making up 1.82% of all hospitalized patients that year. In 2017 there were 11 cases of Lyme disease (1.42%) and 14 cases of TBM (1.81%) constituting 3.23% of all admitted patients for that year. In 2018, 20 cases of Lyme disease (2.33%) and 6 cases of TBM (0.70%) were recorded, adding up to 3.03% of all hospitalization for that time period. An analysis of hospitalizations for individual months shows a seasonal occurrence of TBM, from May to October. No cases have been recorded in the remaining months of the year. Cases of Lyme disease, on the other hand, were treated nearly throughout the entire year. Within the considered 3 year period they did not occur only in February, March and June (Table 1).

An analysis of the patients' age showed that the greatest number of people, 29 (43.94%) fell into the 51–65 age group. Within this group, there were 8 women (32.00%) and 21 men (51.22%). The least numerous age group with 8 patients was the 20–35 year-olds (12.12%). The other age classifications consisted of 11 patients (16.67%) who were 36–50 years old and 18 people (27.27%) above 66 years of age. The largest number of people fell into the various occupations group — 29 people (43.94%) followed by farmers — 20 people (30.30%) and retirees — 15 people (22.73%). Within the group considered by the study, only 2 people were connected with forestry (Table 2).

People from the study group resided both in cities as well as the surrounding villages. Their numbers are comparable with 35 people (53.03%) living in urban areas and 31 people (46.97%) coming from rural regions. There is a significant differentiation among city dwellers with 25 men (60.98%) and only 10 women (40.00%). The numbers concerning women and men from the country are similar.

Ticks are vectors of numerous infectious diseases and the patients, therefore, were divided into categories according to the tick-borne disease they were diagnosed with. Cases of Lyme disease were the most common at 39 (59.09%). 20 patients were diagnosed with TBM (30.30%) while co-infection was determined for 8 patients (10.60%). Patients who were hospitalized because of TBM were also diagnosed at various times with Lyme disease. There were, however, no incidences of infections by pathogens causing anaplasmosis, babesiosis, tularemia, bartonellosis or rickettsiosis.

The study also considered the patient's time of diagnosis with a tick-borne disease and considered whether it occurred during their hospital stay or prior to admittance. The majority of Lyme disease cases were identified before hospitalization. In only one case (2.56%) a Lyme disease spirochete infection was confirmed during

Table 1. Number of patients hospitalized during each month with a breakdown of patients into those with lyme disease and TBM

| Considered period | 2016 | | | | | 2017 | | | | | 2018 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| number of hospitalized patients | * | lyme disease | | TBM | | * | lyme disease | | TBM | | * | lyme disease | | TBM | |
| | | N | % | N | % | | N | % | N | % | | N | % | N | % |
| January | 64 | 1 | 1.56 | 0 | 0.00 | 91 | 0 | 0.00 | 0 | 0.00 | 84 | 4 | 4.76 | 0 | 0.00 |
| February | 84 | 0 | 0.00 | 0 | 0.00 | 79 | 0 | 0.00 | 0 | 0.00 | 90 | 0 | 0.00 | 0 | 0.00 |
| March | 86 | 0 | 0.00 | 0 | 0.00 | 67 | 0 | 0.00 | 0 | 0.00 | 101 | 0 | 0.00 | 0 | 0.00 |
| April | 55 | 1 | 1.82 | 0 | 0.00 | 54 | 0 | 0.00 | 0 | 0.00 | 63 | 0 | 0.00 | 0 | 0.00 |
| May | 67 | 1 | 1.49 | 1 | 1.49 | 63 | 1 | 1.59 | 1 | 1.59 | 59 | 0 | 0.00 | 1 | 1.69 |
| June | 72 | 0 | 0.00 | 3 | 4.17 | 64 | 0 | 0.00 | 2 | 3.13 | 66 | 0 | 0.00 | 0 | 0.00 |
| July | 69 | 0 | 0.00 | 2 | 2.90 | 65 | 1 | 1.54 | 3 | 4.62 | 72 | 1 | 1.39 | 4 | 5.56 |
| August | 66 | 1 | 1.52 | 0 | 0.00 | 52 | 0 | 0.00 | 2 | 3.85 | 83 | 1 | 1.20 | 0 | 0.00 |
| September | 59 | 1 | 1.69 | 1 | 1.69 | 62 | 1 | 1.61 | 2 | 3.23 | 50 | 3 | 6.00 | 0 | 0.00 |
| October | 53 | 0 | 0.00 | 0 | 0.00 | 49 | 0 | 0.00 | 4 | 8.16 | 70 | 5 | 7.14 | 1 | 1.43 |
| November | 83 | 2 | 2.41 | 0 | 0.00 | 61 | 3 | 4.92 | 0 | 0.00 | 59 | 5 | 8.47 | 0 | 0.00 |
| December | 68 | 1 | 1.47 | 0 | 0.00 | 68 | 5 | 7.35 | 0 | 0.00 | 63 | 1 | 1.59 | 0 | 0.00 |
| Total of all patients hospitalized in a given year | 826 | 8 | 0.97 | 7 | 0.85 | 775 | 11 | 1.42 | 14 | 1.81 | 860 | 20 | 2.33 | 6 | 0.70 |

* all patients hospitalized during a given month

Table 2. Data concerning the group of people considered by the study

| Variable | Women (N=25) | | Men (N=41) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Age | | | | | | |
| 20–35 years | 2 | 8.00 | 6 | 14.63 | 8 | 12.12 |
| 36–50 years | 7 | 28.00 | 4 | 9.76 | 11 | 16.67 |
| 51–65 years | 8 | 32.00 | 21 | 51.22 | 29 | 43.94 |
| 66 years and more | 8 | 32.00 | 10 | 24.39 | 18 | 27.27 |
| Place of residence | | | | | | |
| City | 10 | 40.00 | 25 | 60.98 | 35 | 53.03 |
| Country | 15 | 60.00 | 16 | 39.02 | 31 | 46.97 |
| Profession | | | | | | |
| Farmer | 8 | 32.00 | 12 | 29.27 | 20 | 30.30 |
| Forestry worker | 0 | 0.00 | 2 | 4.88 | 2 | 3.03 |
| Retiree | 8 | 32.00 | 7 | 17.07 | 15 | 22.73 |
| Other | 9 | 36.00 | 20 | 48.78 | 29 | 43.94 |

the patient's stay at the hospital. The longest period between diagnosis and hospital treatment, over 3 years, concerned 20 patients with Lyme disease (51.28%) and it was also the highest number of cases among patients with Lyme disease. The shortest time between diagnosis and hospitalization was recorded for TBM patients with the diagnosis occurring during their hospital stay and concerned all of the 27 (100%) people stricken with this illness (Table 3).

Table 3. Data concerning the time of diagnosis

| Time of diagnosis | Lyme disease (N=39) | | TBM (N=27) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| During hospitalization | 1 | 2.56 | 27 | 100.00 | 28 | 42.42 |
| During the same year as the hospitalization | 13 | 33.33 | 0 | 0.00 | 13 | 19.70 |
| A year before hospitalization | 3 | 7.69 | 0 | 0.00 | 3 | 4.55 |
| Two years before hospitalization | 8 | 20.51 | 0 | 0.00 | 8 | 12.12 |
| Three years before hospitalization | 20 | 51.28 | 0 | 0.00 | 20 | 30.30 |

Depending on the type of illness clinical symptoms vary. The assessment was made on the basis of the most frequently reported and observed problem at the moment the patient was admitted to the hospital. The most common complaints were joint pain — 38 patients (57.58% of all patients) and headache — 32 people (48.48%). 24 people (36.36%) had a fever and 20 patients (30.30%) had nausea and vomiting. During examination 26 people (39.39%) experienced meningeal symptoms, 14 examinees (21.21%) complained of muscle aches and 19 (28.79%) declared being dizzy. Characteristic is the fact that joint pain was primarily reported by people with Lyme disease — 33 patients (84.62%), with only 5 people (18.52%) suffering from TBM having the same problem. Fever and headaches on the other hand, troubled mainly TBM patients with fever occurring only for those with TBM — 24 people (88.89%). Headache was reported by 26 TBM patients (96.30%) and 6 people suffering from Lyme disease (15.38%). Meningeal symptoms were recorded only for the 26 patients with TBM (96.30%) (Table 4).

Table 4. Data concerning disease symptoms

| Symptoms | Lyme disease (N=39) | | TBM (N=27) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Fever | 0 | 0.00 | 24 | 88.89 | 24 | 36.36 |
| Headache | 6 | 15.38 | 26 | 96.30 | 32 | 48.48 |
| Muscle aches | 9 | 23.08 | 5 | 18.52 | 14 | 21.21 |
| Joint pain | 33 | 84.62 | 5 | 18.52 | 38 | 57.58 |
| Nausea and vomiting | 3 | 7.69 | 17 | 62.96 | 20 | 30.30 |
| Meningeal symptoms | 0 | 0.00 | 26 | 96.30 | 26 | 39.39 |
| Dizziness | 7 | 17.95 | 12 | 44.44 | 19 | 28.79 |
| Sensory problems | 0 | 0.00 | 2 | 7.41 | 2 | 3.03 |
| Being dazed | 1 | 2.56 | 4 | 14.81 | 5 | 7.58 |
| Other | 13 | 33.33 | 15 | 55.56 | 28 | 42.42 |

Assessment concerning the co-occurrence of other diseases was also performed with the consideration for the following systems of the body: circulatory, urinary, digestive, respiratory and others. No co-existing illnesses were recorded for 19 people (28.79%). All others reported having additional symptoms. Most often these related to the circulatory system — 33 people (50.00%). A considerably smaller number of patients complained about symptoms associated with the digestive system — 10 people (15.15%), respiratory system — 8 people (12.12%) and urinary system — 4 people (6.06%) (Table 5).

Additionally, an analysis of data concerning conducted diagnostic testing was also carried out. Its results show that all 66 patients (100%) were subjected to basic laboratory and imaging tests. 30 people (45.45%) required a lumbar puncture to obtain their cerebrospinal fluid for testing. 17 patients (25.76%) required microbiological

Table 5. Data concerning coexisting illnesses

| Coexisting illnesses in relation to individual body systems | Lyme disease (N=39) | | TBM (N=27) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Circulatory system | 23 | 58.97 | 10 | 37.04 | 33 | 50.00 |
| Urinary system | 1 | 2.56 | 3 | 11.11 | 4 | 6.06 |
| Digestive system | 7 | 17.95 | 3 | 11.11 | 10 | 15.15 |
| Respiratory system | 5 | 12.82 | 3 | 11.11 | 8 | 12.12 |
| Other systems | 9 | 23.08 | 11 | 40.74 | 20 | 30.30 |
| No coexisting illnesses | 10 | 25.64 | 9 | 33.33 | 19 | 28.79 |

testing. Only one person (1.52%) had an endoscopic exam performed.

During data analysis, the applied treatment was also assessed. Painkillers, 56 patients (84.85%), were administered the most often, followed by antibiotics — 40 people (60.61%) and water and electrolyte replenishment — 41 patients (62.12%). Antibiotics were much more often given to Lyme disease patients — 34 people (87.18%), than those suffering from TBM — only 6 patients (22.22%). 38 patients (57.58%) required anti-inflammatory medication and 27 (40.91%) anti-edematous drugs. The latter were only given to TBM patients — a total of 27 people (100%). Only one patient suffering from TBM (3.70%) required antiviral treatment. Table 6 presents a breakdown (with a division into Lyme disease and TBM patients) of patients in accordance with the administered treatment.

Table 6. Data concerning applied treatment

| Applied treatment | Lyme disease (N=39) | | TBM (N=27) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Antibiotics | 34 | 87.18 | 6 | 22.22 | 40 | 60.61 |
| Antiviral | 0 | 0.00 | 1 | 3.70 | 1 | 1.52 |
| Painkillers | 29 | 74.36 | 27 | 100.00 | 56 | 84.85 |
| Anti-inflammatory | 13 | 33.33 | 25 | 92.59 | 38 | 57.58 |
| Anti-edematous | 0 | 0.00 | 27 | 100.00 | 27 | 40.91 |
| Water and electrolyte replenishment | 14 | 35.90 | 27 | 100.00 | 41 | 62.12 |
| Other | 30 | 76.92 | 17 | 62.96 | 47 | 71.21 |

Figure 1 presents the prognoses of treatment. All 66 patients (100%) hospitalized during the period considered by the study due to tick-borne diseases were sent home after an improvement in their overall state. There were

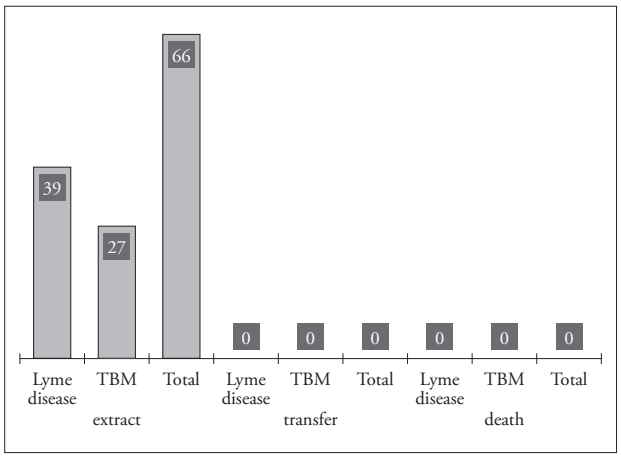


Figure 1. Treatment prognoses (N=66)

no mortalities. Additionally, patients did not require treatment at medical facilities with a higher referral level.

Patients were discharged from the hospital after the improvement of their state but received recommendations regarding further treatment or out-of-hospital control visits. All 66 patients (100%) were given a referral to an Infectious Disease Clinic. Nearly half of all the people considered by the study, 32 patients (48.48%) should have visited a Neurology Clinic, 11 people (16.67%) were given a referral to go to a Cardiology Clinic and 20 patients (30.30%) should have made appointments to other specialists (Table 7).

Table 7. Data concerning continuation of treatment

| Continiuation of treatment | Lyme disease (N=39) | | TBM (N=27) | | Total (N=66) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Infectious Disease Clinic | 39 | 100.00 | 27 | 100.00 | 66 | 100.00 |
| Neurology Clinic | 10 | 25.64 | 22 | 81.48 | 32 | 48.48 |
| Cardiology Clinic | 10 | 25.64 | 1 | 3.70 | 11 | 16.67 |
| Others | 15 | 38.46 | 5 | 18.52 | 20 | 30.30 |

Table 8 contains data concerning the number of people who have been hospitalized for treatment both in the entire Podlasie Voivodeship as well as at the IPHCF in Bielsk Podlaski subjected to statistical analysis within the present work. Patients were divided into those who have been diagnosed with Lyme disease and those with TBM. As can be seen in the table, the number of patients hospitalized at IPHCF in Bielsk Podlaski due to tick-borne diseases has increased significantly between 2016 (15 people) and 2018 (26 people). In respect to the entire Voivodeship, within the period of time covered by the study, the situation is reversed and in 2016 its hospitals treated 396 tick-borne disease related patients while in 2018 that number fell to "only" 251 patients. Considering the three year period covered by the study,

Table 8. Number of patients hospitalized due to Lyme disease and TBM in the Podlasie Voivodeship and at the IPHCF in Bielsk Podlaski

| Considered period of time | 2016 | | | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|---|---|---|
| data origin | Podlasie Voivodesship | IPHCF in Bielsk Podlaski | | Podlasie Voivodeship | IPHCF in Bielsk Podlaski | | Podlasie Voivodeship | IPHCF in Bielsk Podlaski | |
| | | N | % | | N | % | | N | % |
| Lyme disease | 236 | 8 | 3.39 | 169 | 11 | 6.51 | 178 | 20 | 11.24 |
| TBM | 160 | 7 | 4.38 | 160 | 14 | 8.75 | 73 | 6 | 8.22 |
| Total | 396 | 15 | 3.79 | 329 | 25 | 7.60 | 251 | 26 | 10.36 |

it is possible to see a systematic increase in the share of patients with tick-related diseases admitted at the IPHCF in Bielsk Podlaski in the overall number of such patients within the Voivodeship. In 2016 it was 3.79% while in 2018 it rose to 10.36% (Table 8).

## Discussion

Ticks, especially Ixodes ricinus, are common throughout the entire area of Poland. The area considered in the study, located in the North-Eastern part of the country, is considered to be endemic. Despite the fact that not every tick is infected, the risk of becoming infected occurs after every contact with this parasite. They are a bigger danger to people than other blood-drinking arthropods like mosquitoes or gnats [8].

A completed document analysis of patients hospitalized at the IPHCF in Bielsk Podlaski has shown that tick-borne diseases made up some part of diagnoses. Within a three year period (2016–2018) 2,461 patients were hospitalized at the Observation and Infectious Disease Ward of the above-mentioned facility. Illnesses passed on by ticks were discovered 66 times (2.86%). There were 39 cases of Lyme disease which made up the majority of tick-borne illness diagnoses (59.09%). This confirms reports made by authors of works analyzing the epidemiology of diseases carried by ticks. Grzeszczuk points to this particular leptospirosis as the most frequently diagnosed infection spread by these arthropods. The occurrence of Lyme disease grows systematically and since 1996 it has been monitored by sanitary and epidemiological services. Their reports show the Podlasie Voivodeship as the region of Poland which has the largest incidence rate of this illness [9]. According to Chief Sanitary Inspectorate and the National Institute of Hygiene in 2016, the average incidence of Lyme disease in Poland was at a level of 55.2 occurrences per 100 thousand of population. In the Podlasie Voivodeship, however, it was calculated to be 134.9 people per 100 thousand of population. Data is similar for 2017 with incidences in Poland reaching 56.0 cases per 100 thousand of the population while for Podlasie it was 130.1 per 100 thousand people. The report for 2018 is more of the same with the national incidence of Lyme disease being at a level of 52.5 cases per 100 thousand of population while for Podlasie it is 108.8 per 100 thousand people [5]. Analysis of patient documentation from that period confirms a systematic rise in Lyme disease hospitalizations with 8 treated cases in 2016, 11 patients in 2017 and 20 in 2018.

Ticks are vectors of numerous diseases but some, with the exception of the most frequent ones mentioned above, are diagnosed much less as single recorded infections. The first Polish case of human granulocytic anaplasmosis was described in 2001. Since this illness is not subject to epidemiologic inspection it is difficult to assess the frequency of its occurrence. Its symptoms are non-specific and make recognition difficult [10]. Research conducted in Lubelskie Voivodeship confirmed the presence of antibodies for Anaplasma phagocytophilum in 21% of forestry workers [11]. Babesiosis concerns mainly people with immunodeficiency or those after a splenectomy. To date, 28 cases of human babesiosis have been reported in Europe. Rickettsiosis is often misdiagnosed on account of its uncharacteristic symptoms. When it comes to tularemia and bartonellosis the vector role of ticks is only one of all possible factors for the transmission of these diseases [12]. It is confirmed by data concerning the analyzed documentation and no incidence of these illnesses has been recorded among the considered hospital patients.

Until recently ticks could be found only in forests and pastures but currently, they are more and more frequently encountered in the green spaces of cities. There are also reports about pigeon ticks populating attics in the vicinity of human habitats [13]. This causes the endangerment of people living both in rural areas as well as in urban agglomerations. Studies carried out throughout the country have shown a 6–15% Borrelia spirochete infection rate for tick populations both in rural spaces as well as in urban areas [14]. This fact is also confirmed by the data of the present study. Patients within the study group were comparably split into those

from rural areas — 31 patients (46.97%) and cities — 35 patients (53.03%).

Lyme disease and TBM are seasonal illnesses. Within the climate zone of Poland, ticks become active as early as March, and nowadays, as a result of climate change, continue being so even until November. Ticks wake from diapause when the temperature of the environment reaches 5–7°C [15]. Analyzing data concerning the time during which patients were hospitalized clearly showed a relation between TBM diagnoses and the season. These diseases were discovered between May and October, the period during which the arachnids feed most intensively.

The risk of infection with tick-borne diseases is influenced by peoples' model of behavior. The popularity of spending time outdoors has greatly increased. Older people are currently much more active than those who are still working. They travel, garden, gather forest fruit and take walks in parks and green spaces. Additionally, their immune system is not as efficient as before making them more prone to become infected with a tick-borne disease [16]. This is confirmed by data concerning the study group's patients' age. Most affected were people falling into the 51–65 age group — 29 people (43.94%). There were also 18 patients who were 66 and over (27.27%), bringing the total to 47 people (71.21%).

The course of Lyme disease and TBM differs. The first is a disease that is infectious, chronic and affects numerous organs. It concerns the skin, mobility, heart and the nervous system. It's most frequent form affects the joints with patients complaining of bone and joint pain. Symptoms start occurring from several weeks to even several years after infection. This form concerns 20 — 60% of Lyme disease patients [17]. This was also the case in the present study with most of Lyme disease sufferers, 33 people (84.62%), complaining about problems with the joints. TBM, on the other hand, is an infectious disease that attacks the central nervous system. Its typical clinical course is characterized by two phases. Symptoms of the primary, precursory phase are non-specific. They often stop on their own and are often mistaken for a respiratory infection. This happens in 13 — 26% of cases. The secondary, neurological phase, however, progresses with clearly pronounced symptoms like fever, headache, nausea and vomiting as well as distinct meningeal symptoms. Patients require hospitalization [18]. These facts also find confirmation within the completed study. Patients with TBM had all the characteristic symptoms. 26 patients (96.30%) complained of a headache, 24 (88.89%) had a fever and 17 (62.97%) reported having nausea and vomiting. Within the present study 26 patients (96.30%) had meningeal symptoms.

Tick-borne diseases are a serious and growing danger both in Poland as well as throughout the entire continent of Europe. Dangerous is the possibility for the transmission by ticks of various pathogens (bacteria, viruses, protozoa) resulting in the diagnosis of, among others, Lyme disease and TBM. The completed retrospective analysis of the documentation of hospitalized patients shows consistency with the work of other authors both with respect to the frequency of tick-borne disease diagnoses and the most often reported symptoms. It also confirms an upward trend with respect to tick-borne disease hospitalizations.

## Conclusions

1. The most often occurring illnesses transmitted by ticks were Lyme disease and tick-borne meningitis which more frequently affected middle-aged and older men regardless of their place of residence.
2. Hospitalization of patients with TBM during the greatest activity of ticks is consistent with the seasonal character of diseases transmitted by ticks.
3. Not all patients were aware of having been bitten by a tick, their symptoms, however, confirmed a tick-borne disease infection.
4. Patients with Lyme disease were treated with antibiotics while people with TBM were treated to alleviate their symptoms and all hospitalizations ended with discharge after the improvement of the patient's state of health.

## Implications for Nursing Practice

Tick-borne diseases are a serious and growing threat both in Poland and throughout the European continent. The possibility of transmission of various pathogens by ticks is dangerous. The vast majority of cases of Lyme disease manifests itself as erythema migrans, which is why this disease must be known to nurses and GPs. Clinical practice guidelines have a huge impact on the medical services market and therapeutic decisions, thus their primary goal should be to improve patient care.

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