

# Comparative analysis of the infectivity rate of both *Borrelia burgdorferi* and *Anaplasma phagocytophilum* in humans and dogs in a New Jersey community

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**Abstract:** Ticks are important vectors of disease and transmit an extensive array of bacterial, viral and protozoan diseases to both humans and dogs within a community. *Borrelia burgdorferi*, the causative agent of Lyme disease, has been extensively studied within both the human and veterinary population. *Anaplasma phagocytophilum*, an intracellular rickettsial pathogen also transmitted by ixodid ticks, has emerged as an important zoonotic infection with significant veterinary and medical implications, and is responsible for both canine granulocytic anaplasmosis and human granulocytic anaplasmosis. Multiple surveys exist in the international literature referencing infectivity rates of both of these diseases separately in both the dog and human populations. This is the first study to simultaneously examine the infectivity rate of both anaplasmosis and Lyme disease in humans and dogs in a community endemic for tick-borne diseases.

**Keywords:** Lyme disease, anaplasmosis, dogs, humans

## Introduction

Vector-borne diseases constitute a large percentage of emerging infectious diseases in both human and animal populations.<sup>1</sup> Lyme disease, a spirochetal infection transmitted by the blacklegged *Ixodes* tick, is the most common tick-borne disease in the United States. In recent years, a growing number of additional pathogens, both viral and bacterial, have been found to be present in the tick population.<sup>2</sup> *Anaplasma phagocytophilum*, an intracellular rickettsial pathogen, also transmitted by ixodid ticks, has been shown to have increasing prevalence in the tick population worldwide.<sup>3</sup> Many studies to date have analyzed the prevalence rate of anaplasmosis and Lyme disease in the tick population of dogs, humans, and ticks themselves.<sup>4,5</sup> Some studies have even sought to analyze the percentage of dogs infected with *Borrelia burgdorferi* and *Anaplasma* in a specific community in an attempt to project a potential infectivity risk for humans living within that community.<sup>6</sup> In any static environment, dogs and humans are exposed to the same tick population and therefore have similar risks of infection for the pathogens which those ticks may carry. The purpose of this study was to compare the prevalence rates of both Lyme disease and anaplasmosis in dogs and humans in the same community over a given time period. Comparative analysis of these results would subsequently be beneficial to both medical and veterinary personnel in establishing a relative risk of infection for other members of that community subsequent to a tick bite, and aid those practitioners in selecting proper tests and treatment for their respective patient populations.

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**Table 1** Infectivity rates of Lyme disease and anaplasmosis in dogs and humans

	Infectivity rate	
	Dogs (n=202)	Humans (n=202)
Lyme disease only		
Positive	10 (4.95%)	31 (15.34%)
Anaplasmosis only		
Positive	19 (9.40%)	33 (16.33%)
Lyme disease and anaplasmosis		
Negative	165 (81.68%)	117 (57.92%)
Positive	8 (3.96%)	21 (10.39%)

**Note:** Data are presented as number and percentage.

## Methods

Blood samples from 202 dogs and 202 humans were tested for both Lyme disease and anaplasmosis from February through October, 2013. The 202 dogs were tested as part of a routine wellness screening at Bernardsville Animal Hospital (Somerset County, NJ, USA) using the SNAP® 4Dx® Plus Test (IDEXX Laboratories, Inc., Westbrook, ME, USA). The SNAP 4Dx Plus Test simultaneously screens dogs for *Dirofilaria immitis* (the causative agent of heartworms), and for antibodies to *B. burgdorferi*, *A. phagocytophilum*, *Anaplasma platys*, *Ehrlichia canis*, and *Ehrlichia ewingii*. For the purpose of this study, test results for *A. phagocytophilum* and *B. burgdorferi* were used. The 202 human patients were screened for both *B. burgdorferi* and *A. phagocytophilum* as part of an evaluation for Lyme disease at a private medical practice (Somerset County, NJ, USA). Lyme disease antibodies were tested via

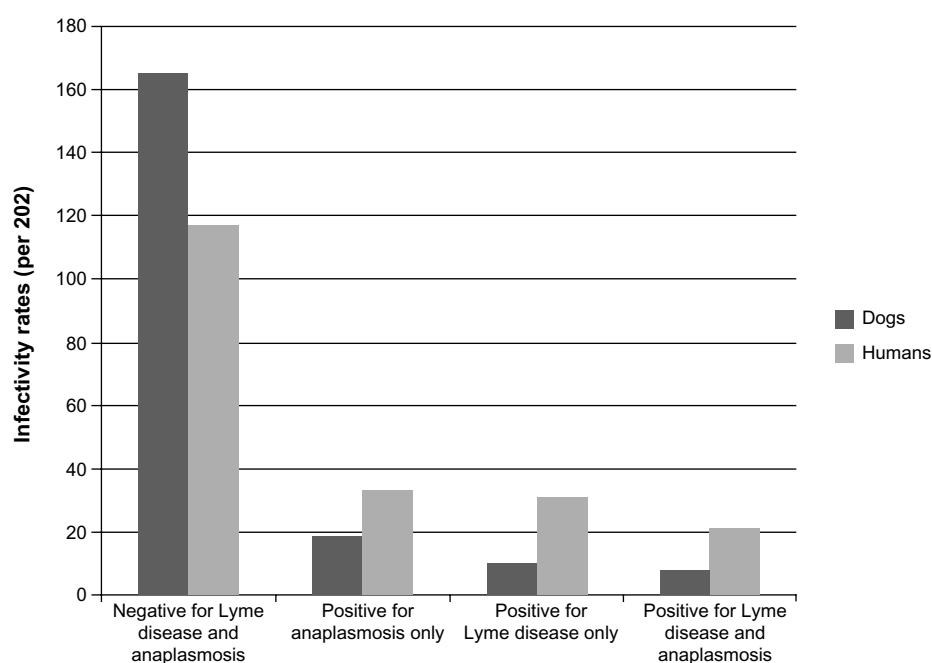
Lyme Western blot analysis (IgM/IgG) and Lyme C6 peptide enzyme-linked immunosorbent assay (ELISA), and tests for *A. phagocytophilum* by IgG/IgM ELISA.

## Results

Infectivity rates were categorized as either negative for both infections, positive for Lyme disease only, positive for anaplasmosis only, or positive for both Lyme disease and anaplasmosis based on antibody testing (Table 1). The majority of dogs and humans tested were negative for antibodies for both infections (Figure 1). Among those dogs and humans which were antibody positive, antibodies to anaplasmosis alone were the most common in both groups; 9.40% in dogs and 16.33% in humans. The presence of antibodies for Lyme disease was the second most common finding in both groups, 4.95% in dogs and 15.34% in humans. Antibody positivity for both Lyme disease and anaplasmosis was the least common finding in both groups, 3.96% in dogs and 10.39% in humans. Both humans and dogs were more likely to show antibodies to *A. phagocytophilum* than antibodies to *B. burgdorferi*, the causative agent of Lyme disease.

## Discussion

There is increasing concern regarding the incidence of coinfections in areas highly endemic for Lyme disease. Many studies have quantified the prevalence rate of various tick-borne pathogens separately in humans and animals within various communities. This is the first study to date

**Figure 1** Infectivity rates of Lyme disease and anaplasmosis in dogs and humans.

to simultaneously examine the incidence rate of two tick-borne diseases, *A. phagocytophilum* and *B. burgdorferi* in dogs and humans in the same community during a single tick season. Of clinical significance, the concordance rates for anaplasmosis, Lyme disease and coinfections for both diseases were remarkably similar in both groups. Antibodies to *A. phagocytophilum* had a higher incidence than antibodies to *B. burgdorferi* in both the dogs and humans tested. Other studies comparing the prevalence of *A. phagocytophilum* and *B. burgdorferi* in dogs in Russia and ticks in Belgium showed similar higher incidences for *Anaplasma* compared to *Borrelia*.<sup>7,8</sup> This observational study has important veterinary and medical implications for the public health of those members, both animal and human, living within the community. The availability of the SNAP 4Dx Plus Test affords dogs a convenient and reliable assay for diagnosis. Conversely, many human patients reporting a tick bite in endemic areas are only screened for Lyme disease. Since antibodies to anaplasmosis were higher in both dogs and humans in this observational study, routine screening for anaplasmosis in humans would be highly advisable and would aid physicians in diagnosis and treatment recommendations.

## Disclosure

The authors have no conflicts of interest in this work.

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