2005

Trends in Canine Lyme Disease on the Eastern Shore of Virginia, 2000-2005

Ellen Garrett Hillyer
Virginia Commonwealth University

Master of Public Health Research Project

Trends in Canine Lyme Disease on the Eastern Shore of Virginia, 2000-2005

by

Ellen G. Hillyer

Shelley Harris, PhD

Julia Murphy, DVM, MS, DACVPM

Department of Epidemiology and Community Health

Master of Public Health Program
MPH Research Project: EPID 691

Virginia Commonwealth University
Richmond, Virginia

December 2005

Submission Statement
Master of Public Health Research Project

This MPH Research Project report is submitted in partial fulfillment of the requirements for a Master of Public Health degree from Virginia Commonwealth University's School of Medicine. I agree that this research project report be made available for circulation in accordance with the program's policies and regulations pertaining to documents of this type. I also understand that I must receive approval from my Faculty Advisor in order to copy from or publish this document, or submit to a funding agency. I understand that any copying from or publication of this document for potential financial gain is not allowed unless permission is granted by my Faculty Advisor or (in the absence of my Faculty Advisor) the Director of the MPH Program.

____

Student Signature

____

Date

Master of Public Health
Research Project Agreement Form
Department of Epidemiology and Community Health

Student name: Ellen G. Hillyer E-mail address:

Street address:

Home phone: Work phone: Fax:

Number of semester hours (3-6): 6 Semester: Fall Year: 2005

Please complete the following outline. **Do not exceed 2 pages (A-H).**
I WASN'T SURE ABOUT THE SPACING IN THIS SECTION. ARE YOU INDENTING OR IS EVERYTHING SUPPOSED TO LINE UP?

A. PROJECT TITLE:

Trends in Canine Lyme Disease on the Eastern Shore of Virginia, 2000-2005

B. PURPOSE (state research question):

Is there an increasing trend in the incidence of Lyme disease seen in dogs in the Eastern Shore health district between 2000 and 2005?

C. SPECIFIC OBJECTIVES (list major aims of the study):

Assess trends in Lyme disease incidence in dogs between 2000 and 2005
Compare veterinary practitioner case definitions of Lyme disease to study definitions

D. DESCRIPTION OF METHODS

D.1. Identify source(s) of data (eg, existing data set, data collection plans, etc):

This retrospective study will use information from small animal veterinary practices. These practices are located in the Eastern Shore Health District and will participate on a volunteer basis. Paper and/or computer medical records of veterinarians will be evaluated and entered into an Access database.

Veterinary practitioner case definitions of Lyme disease will be compared to the study's case definition. The definition is as follows:

Probable case: Fever (>103°) and lameness plus at least one of the following: articular swelling, lymphadenomegaly, anorexia or general malaise that showed improvement after antibiotic treatment.

Confirmed case: Fever (>103°) and lameness plus at least one of the following: articular swelling, lymphadenomegaly, anorexia or general malaise that showed improvement after antibiotic treatment and positive results using at least two of the following laboratory tests: ELISA or IFA, Western blot, PCR, spirochete identification on renal impression smears. Culture of spirochetes alone from specimens of those dogs meeting the clinical aspect of this case definition is sufficient to confirm a case.

D.2. State the type of study design (eg, cross-sectional, cohort, case-control, intervention, etc):

Five year retrospective study.

D.3. Describe the study population and sample size:

The study population will consists of all dogs that visit veterinary clinics in the Eastern Shore Health District. Eastern Shore Animal Hospital sees the majority of dogs in that health district. This hospital had 3,439 active canine patients in 2000, 3,824 active canine patients in 2001, 4,079 active canine patients in 2002, 4,111 active canine patients in 2003, 4,040 active canine patients in 2004, and 2,864 active canine patients through June 30, 2005. Accomac Animal Hospital will contribute records from 2004 and they had 653 active canine patients in that year. Greenbush Animal Hospital and Pocomoke Animal Hospital are expected to contribute summary data from 2004. Greenbush Animal Hospital is expected to have 500 active canine patients and Pocomoke is expected to see about 200 canine patients from the Eastern Shore Health District in 2004. Keith Privett, Environmental Health supervisor for the Eastern Shore Health district, will recruit veterinary clinics for volunteer participation through telephone communication.

D.4. List variables to be included (If a qualitative study, describe types of information to be collected)

Zip code of clients with dogs
Total number of dogs examined each year
Total number of dogs examined per year with Lyme disease as defined in the practice
Total number of dogs examined per year with Lyme disease as defined by study probable and confirmed case definitions
Total number of dogs testing positive with ELISA
If the Lyme ELISA test was used 1.) as a yearly screening 2.) as part of a routine sick dog exam 3.) when a veterinarian suspects Lyme disease

D.5. Describe methods to be used for data analysis (If a qualitative study, describe general approach to compiling the information collected)

Using appropriate statistical analysis, the incidence over time among dogs will be used to evaluate trends. This incidence will be compared with reported cases of Lyme disease in humans. The trend will also be mapped according to zip code of cases. Measures of agreement will be used to evaluate the case definitions with the practice definitions.

E. ANTICIPATED RESULTS:

An increasing trend in the incidence of Lyme disease seen in dogs in the Eastern Shore health district is anticipated for the period 2000 to 2005.

F. SIGNIFICANCE OF PROJECT TO PUBLIC HEALTH:

Veterinarians in Accomack and Northampton counties have expressed concern with regard to what they perceive as being an increase in the number of dogs they are diagnosing with Lyme disease. Dogs are thought to be sensitive indicators of Lyme borreliosis and prevalence of Lyme borreliosis has been shown to correlate with the infection in humans. Therefore an increased incidence in Lyme disease in dogs may indicate an increased present or future risk of Lyme disease in humans. Dogs are thought to be important sentinel animals to express the risk of *Borrelia burgdorferi* infection in humans.[1] (This originally read B. burgdorferi and was not underlined or italicized (the name should be spelled out, at least the first time you use it, and should either be italicized or underlined throughout the paper.)

A study by Sonenshine et al. indicated that Lyme disease was more prevalent in areas around the Atlantic Ocean as opposed to areas more inland. As a consequence, the risk of Lyme disease may be greater in the eastern regions of Virginia.[2] To determine Lyme disease status many veterinary clinics use an in house ELISA test. Levy et al. found this test to be a reliable indicator of infection status in dogs.[3]

1. Duncan AW, Correa MT, Levine JF, Breitschwerdt EB. "The dog as a sentinel for human infection: prevalence of Borrelia burgdorferi C6 antibodies in dogs from southeastern and mid-Atlantic states." Vector Borne Zoonotic Dis. 2004 Fall;4(3):221-9.
2. Sonenshine DE, Ratzlaff RE, Troyer J, Demmerle S, Demmerle ER, Austin WE, Tan S, Annis BA, Jenkins S. "Borrelia burgdorferi in eastern Virginia: comparison between a coastal and inland locality." Am J Trop Med Hyg. 1995 Aug;53(2):123-33.
3. Levy S, O'Connor TP, Hanscom JL, Shields P. "Utility of an in-office C6 ELISA test kit for determination of infection status of dogs naturally exposed to Borrelia burgdorferi." Vet Ther. 2002 Fall;3(3):308-15.

G. IRB Status:

1) Do you plan to collect data through direct intervention or interaction with human subjects? ___yes __X_no

2) Will you have access to any existing identifiable private information? ___yes __X__no

If you answered "no" to both of the questions above, IRB review is not required.
If you answered "yes" to either one of these questions, your proposed study must be reviewed by the VCU Institutional Review Board (IRB). Please contact Dr. Turf for assistance with this procedure.

Please indicate your IRB status:
___ to be submitted (targeted date____________)
___ submitted (date of submission _____________; VCU IRB # ________)
___ IRB exempt review approved (date____________)
___ IRB expedited review approved (date____________)
__X_ IRB approval not required

H. PROPOSED SCHEDULE: Start Date: June 2005_____ Anticipated End Date:__December 2005_________

I. INDICATE WHICH OF THE FOLLOWING AREAS OF PUBLIC HEALTH KNOWLEDGE WILL BE DEMONSTRATED:

1. Biostatistics – collection, storage, retrieval, analysis and interpretation of health data; design and analysis of health-related surveys and experiments; and concepts and practice of statistical data analysis. _X__yes ___no (if yes, briefly describe):

   An Access database will be used for collection, storage, and retrieval of data. The data will then be statistically analyzed using EpiInfo.

2. Epidemiology – distributions and determinants of disease, disabilities and death in human populations; the characteristics and dynamics of human populations; and the natural history of disease and the biologic basis of health. __x_yes ___no (if yes, briefly describe):

   The distribution of Lyme disease in dogs that have visited at least one of the participating vets in the Eastern Shore Health District will be mapped. This information can be correlated with information reported to local health departments regarded the human distribution of Lyme disease in the same district.

3. Environmental Health Sciences – environmental factors including biological, physical and chemical factors which affect the health of a community. _x__yes ___no (if yes, briefly describe):

   Lyme disease will be assessed in the environment via dogs as sentinels for an adequate indication of human risk.

4. Health Services Administration – planning, organization, administration, management, evaluation and policy analysis of health programs. ___yes __x_no (if yes, briefly describe):

5. Social/Behavioral Sciences – concepts and methods of social and behavioral sciences relevant to the identification and the solution of public health problems. ___yes _x__no (if yes, briefly describe):

Table of Contents

Acknowledgements ...………...…………………………………………………………..viii
Abstract ……….………………...……………………………………………...……ix
Introduction .……………………......……………………………………………….…..1
Methods ………………………...…………………………………………….………5
Results ………………………...……………………………………………………...8
Discussion ……………………………………………………………………...…....10
Tables and Figures ……………………………………………………….……………15
Appendix A ..……….…………………………..……………….……………………...28
Appendix B ……………………………………………………………………………31
Appendix C ……………………………..…………………………….………………33
References …..…………………………………………………………………………..53

Acknowledgements

This project would not have been possible without the support and encouragement from the doctors and staff at Eastern Shore Animal Hospital and Accomack Animal Hospital. I would like to thank them for the time and help that they gave me during the hours I was present.

I would especially like the thank Dr. Julia Murphy for the support, guidance, and the opportunity to be part of this project. I will be forever grateful for the things that she has taught me.

Thank you.

Abstract

Introduction: Lyme disease is caused by the tick-borne spirochete *Borrelia burgdorferi*. Research has shown that dogs can be used as sentinels for human infection of Lyme disease. The purpose of this 5-year, retrospective study was to determine if there was any evidence that the incidence of canine Lyme disease has increased between 2000 and 2005 in Accomack and Northampton counties. An increased incidence in Lyme disease in dogs may indicate an increased present or future risk of Lyme disease in humans.

Methods: Cases of canine Lyme disease were identified via practice invoicing systems and dogs that received doxycycline were entered into the database. Demographic information and the absence or presence of clinical signs such as fever, lameness, articular swelling, lymphadenomegaly, anorexia, general malaise and improvement after antibiotic use were collected. Testing history also was recorded.

Results: Cases of canine Lyme disease that met any definition were identified (n=1048). Over the 5-year period the number of positive ELISA test results increased and the frequency of clinical signs decreased. The incidence of disease meeting the practitioner's definition increased until 2004 when the incidence dropped from 105.33 cases per 1,000 dogs to 56.93 cases per 1,000. The incidence of disease based on the study probable definition remained fairly constant with a high in 2002 of 2.94 cases per 1,000 dogs.

Discussion: Trends of canine Lyme disease coincided with the introduction and use of the in-house ELISA test. Practitioners could identify more dogs exposed to *Borrelia burgdorferi.* The areas with the highest frequency of canine cases of Lyme disease also had the highest frequency of human cases reported to the Virginia Department of Health. Further study could identify animals that tested positive and later developed clinical signs. Using dogs as sentinels for human infection allows public health workers to identify endemic areas regardless of human case reports

Introduction

Lyme disease or Lyme borreliosis is caused by the tick-borne spirochete *Borrelia burgdorferi* which is part of a large group of *Borrelia* species that affects mammalian and avian hosts. It is now the most commonly reported vector borne disease affecting humans in the United States. Data from the Centers for Disease Control and Prevention (CDC) indicate that ninety-five percent of cases have been reported from 12 states, with the bulk of those cases being reported from the coastal region between Massachusetts and Virginia.[1,2] The incidence in these 12 states was 23.5 cases per 100,000 people in 2004 compared to a median incidence rate of 0.44 per 100,000 people in the remaining states, including Washington DC.[3] The difficulty of confirming a diagnosis and the large number of borrelial spirochetes, makes determining an exact prevalence and geographic distribution controversial.

The vectors of Lyme disease are several species of hard ticks of the *Ixodes* complex, the distribution of which is associated with the prevalence of disease.[1] *Ixodes* are parasites of birds as well as large and small mammals. The distribution of these ticks is largely determined by the distribution of their hosts. Of the many *Ixodes* species found nationwide, the black legged or deer tick, *Ixodes scapularis*, is the most common carrier of Lyme disease in the eastern United States.[4] Populations of *Ixodes scapularis* tend to be clustered within geographic locations and are typically plentiful in areas with sandy soils and lower elevations that are a moderate distance from forests and water.[5] The coastal area of the Chesapeake Bay region is home to a relatively large number of *Ixodes scapularis* compared to Delaware, Maryland, New Jersey, Pennsylvania, and other regions of Virginia. *Borrelia burgdorferi* has been found to be more prevalent in areas along the Atlantic Ocean than at inland sites around Williamsburg and Yorktown.[6] The blacklegged ticks are maintained by a number of vertebrate hosts and favorable environmental conditions, such as sandy soil, lower elevation, and moderate distance from water and forests.[4]

Ixodes scapularis ticks can become infected with *Borrelia burgdorferi* throughout their two year life cycle. Adult ticks oviposit their eggs in the spring and the larvae that emerge feed once in the summer, usually on birds and small mammals. The larvae then overwinter and, if they have fed on an infected host, they will molt into an infected nymph. As nymphs typically feed on larger mammals such as dogs and deer, infected nymphs are believed to be primarily responsible for transmission of *Borrelia burgdorferi* to domestic animals and people.[1] Transmission from vector to host does not occur until the tick has been attached for more than twenty-four hours.[3] *Borrelia* species do not live free in the environment and they depend on a host for their nutritional requirements.[2]

In humans, Lyme disease patients are most likely to have illness onset beginning in the summer months, with a peak in June and July, but onset can occur throughout the year.[7] It is estimated that 90% of people exposed to *Borrelia burgdorferi* will manifest clinical symptoms. Early infections are often characterized by a distinct skin lesion, erythema migrans, which occurs at the site of the tick bite.[2] In addition, these patients will often have a fever and other symptoms including fatigue, headache and generalized achiness. Within several days to weeks of this first stage, patients may develop a disseminated infection that will affect multiple body systems resulting in, for example, a diffuse rash, migratory joint pain and neurologic abnormalities. Persistent infection can also be a feature of this disease with some patients experiencing cardiac, neurologic and/or musculoskeletal abnormalities for anywhere from a few weeks to years.

While Lyme disease is diagnosed based on symptoms, objective physical findings and a history of possible exposure to infected ticks, the diagnosis may be supported by serological tests. The CDC recommends a two-step process when testing blood for evidence of Lyme disease in which samples are first tested by either an enzyme-linked immunosorbent assay (ELISA) or an indirect immunofluorescent antibody test (IFA), with samples yielding positive or equivocal results then tested with a Western immunoblot.[2] These tests are poorly standardized and must be interpreted with caution. False negatives may occur in early infection and in people treated with antibiotics in the early stages of the disease. The IFA and ELISA may cross react in patients with syphilis, relapsing fever, leptospirosis, HIV infection, Rocky Mountain spotted fever, infectious mononucleosis, lupus or rheumatoid arthritis.[8] Lyme disease can be treated effectively with antibiotics such as doxycycline and amoxicillin, especially if treatment is initiated early in the course of the infection.

The most common clinical signs of Lyme disease in dogs are fever (103.1-104.9º F), shifting leg lameness, general malaise, anorexia, and local lymphadenopathy.[9] A severe protein-losing nephropathy with renal failure has been putatively associated with canine Lyme disease, but because this has not been seen in any Lyme disease study model to date, it may be that Lyme seropositivity is merely a marker for tick exposure.[6] In contrast to humans, clinical disease in dogs is only seen, on average, in five to ten percent of seropositive dogs. In endemic areas, 75 percent of the dog population may test positive.[1] Diagnostic tests for *Borrelia burgdorferi* readily available to veterinarians include indirect immunofluorescent antibody (IFA), polymerase chain reaction (PCR) and Western immunoblot. In addition, many veterinarians are now using an in-house, enzyme-linked immunosorbent assay (ELISA) test (SNAP 3Dx® ELISA test manufactured by IDEXX Laboratories, Westbrook, ME) to determine the antibody status of dogs. This test is useful in areas endemic to Lyme disease because it is convenient and reliable regardless of vaccine history.[10] According to IDEXX Laboratories, in regard to *Borrelia*

Burgdorferi, this test's sensitivity is 92% (95% CI 88-96%) and its specificity is 100% (95% CI 97%-100%).[11] The SNAP 3Dx® also tests for antibodies to canine heartworm antigen and *Erhlichia Canis.* Because the SNAP 3Dx® includes a heartworm test, many veterinarians use it routinely to assess dogs with no clinical signs of disease.

Research has shown that dogs can be used as sentinels for human infection of Lyme disease. A study by Lindenmayer *et al.* revealed that canine seroprevalence was highly predictive of the incidence in humans. This is an effective indicator of human risk of Lyme disease in the environment.[12,13] This does not mean that dog owners are at a high risk of contracting Lyme disease. Goossens *et al.* used hunting dogs to show that the seropositivity of a dog was not a significant indicator of increased risk of infection of Lyme disease for its owner. Direct transfer of ticks between dog and owner is not a substantial concern. Dogs are more likely to be exposed to ticks carrying *Borrelia burgdorferi* because of their behavioral patterns. It is expected that dogs will be bitten more often than humans because of this, although an interesting finding of this study was that seroprevalence of antibodies against *Borrelia burgdorferi* in hunters and hunting dogs was similar.[14]

As dogs are thought to be sensitive indicators of Lyme borreliosis and prevalence of Lyme borreliosis has been shown to correlate with the infection in humans, an increased incidence in Lyme disease in dogs may indicate an increased present or future risk of Lyme disease in humans. In early 2005, veterinarians in Accomack and Northampton counties approached local public health authorities expressing concern with what they perceived to be an increased incidence in the number of canine Lyme disease cases in the area. Local health authorities from the Eastern Shore Health District (ESHD) then contacted the Virginia Department of Health's Office of Epidemiology (OE) to discuss the situation. In response, the

OE, in cooperation with local health authorities, designed a study to investigate trends in canine Lyme disease in the ESHD. The purpose of this 5-year, retrospective study was to determine if there was any evidence that the incidence of canine Lyme disease has increased between 2000 and 2005 in Accomack and Northampton counties. An additional goal was to compare the study definition of Lyme disease with the veterinary practitioner definition. This information will be valuable to the public health community in that it may help target populations at increased risk for Lyme disease so that educational programs and prevention methods can be implemented.[1]

Methods

Local health authorities were asked to offer guidance concerning veterinary hospital selection. A representative from each predominantly small animal practice serving residents of Accomack and Northampton counties was contacted and asked to participate in a full chart review and hospital data analysis in regard to canine Lyme disease cases managed by his practice from January 1, 2000 through June 30, 2005. This representative was also asked about his practice's record keeping system and the ease with which individual charts meeting certain criteria could be identified for review. During this initial contact, veterinarians also were asked to complete a survey that was designed to elicit information concerning Lyme disease case identification, testing protocols and treatment. In addition, each practice also was asked to identify the antibiotic(s) that its veterinarians typically used when treating Lyme disease. The antibiotic of choice was identified as doxycycline and also was identified as the antibiotic that was used almost exclusively (~99%) for the treatment of tick-borne diseases in dogs in the practices surveyed. In light of this, the method by which charts were identified for review was via practice invoice database searches that identified animals receiving doxycycline during the time period being studied. A questionnaire was then developed and subsequently written into an Access® database into which data from each chart was entered and stored.

Cases were identified based on the first use of doxycycline for the treatment of Lyme disease during the study period. Dogs were immediately excluded from the study if they did not have an address in Accomack or Northampton counties. Dogs were also excluded if they were being treated with doxycycline for a condition other than Lyme disease. Each case was entered into the database only once. Based on the chart review, information pertaining to demographics and important clinical signs was collected for each dog including name, zip code, breed, age, month and year of initial diagnosis, antibiotic prescribed, length of antibiotic use, and whether there was improvement after antibiotics. Patients were said to have improved after antibiotic treatment if one of the following three conditions was met: there was written evidence in the record that the dog improved, there were no abnormalities noted during the physical exam subsequent to the clinically ill event or, in cases where a positive test result was the only abnormal finding, the subsequent test result was negative. The presence or absence of the following symptoms was also recorded: lameness, fever, articular swelling, lymphadenomegaly, anorexia, and general malaise. Fever was classified as none, any elevation (defined as >102º F up to and including 103º F), and greater than 103º F. Only Lyme antibody results were gathered for years subsequent to the initial case entry.

Lyme vaccine history also was recorded. This variable was categorized as: none, vaccine within one year (of entry into the database), only one vaccine greater than one year ago, and one or more vaccines greater than one year ago. Test results indicating co-infection with regards to Rocky Mountain Spotted Fever, *Ehrlichia*, and heartworm at the time of initial treatment with doxycycline also were recorded.

The date, result, and reason for treating with antibiotics also were included. Reason for treating was classified in one of three ways: practitioner case definition, probable case definition or confirmed case definition. A probable case was defined as any dog having a fever greater than 103º F and lameness with at least one of the following: articular swelling, lymphadenomegaly, anorexia, or general malaise that showed improvement after antibiotic treatment. A confirmed case was defined as any dog having a fever greater than 103º F and lameness with one of the following: articular swelling, lymphadenomegaly, anorexia, or general malaise that showed improvement after antibiotic treatment and positive results using at least two of the following tests: ELISA or IFA, Western blot, PCR, or spirochete identification on renal impression smears. Culture of spirochetes alone of those dogs meeting the clinical aspect of this case definition was sufficient to confirm a case. All other cases were categorized as practitioner definition if they were treated, but did not meet either the probable or confirmed case definition.

Results of any subsequent tests performed also were captured. The type of test, result, and reason for testing was recorded. In addition, two categories were added to the list of those used to classify the reason for subsequent testing. The response “annual test” was used if no treatment was initiated at that exam. If it was unclear why subsequent tests were performed, the category “no definition met” was used.

Descriptive statistical analyses were conducted using SPSS version13.0 (SPSS Inc, Chicago, IL). Proportions and percentages were calculated for the categorical variables of interest. Bar charts and histograms were used to provide a visual representation of trends in the data over the study period. ArcGIS version 9.1 (ESRI, Redlands, CA) was used to map canine and human cases of Lyme disease in the Eastern Shore Health District by zip code. The human

Lyme disease data were obtained from the Virginia Department of Health's database of reportable diseases.

Results

Two hospitals (Hospital A and Hospital B) volunteered to participate in the study. Chart review and data entry were conducted from June through August 2005. Hospital A contributed 907 records and Hospital B contributed 141 records. Hospital A contributed records for the entire study period and reported having 3,439 canine visits in 2000, 3,825 canine visits in 2001, 4,079 canine visits in 2002, 4,111 canine visits in 2003, 4,040 canine visits in 2004, and 2,864 canine visits through June 30, 2005. Hospital B contributed records from January 1, 2004 to June 30, 2005 and reported having 1,884 canine visits during that period.

AVImark® veterinary management software was used by both practices. Through this software, reports were generated for animals that received doxycycline between January 1, 2000 and June 30, 2005, inclusive for Hospital A and January 1, 2004 through June 30, 2005 for Hospital B. During this time 1,048 cases of Lyme disease, meeting any definition, were diagnosed. Hospital A reported 907 (86.3%) canine cases and Hospital B reported 141 (13.5%) cases. Figure 1 shows the total number of cases that met any definition per year. The most cases were seen in 2003 (n=433) followed by 2004 (n=349), 2002 (n=114), 2001 (n=49), 2000 (n=28). The majority of cases over the five year period were seen during the summer months, as shown in Figure 2.

Table 1 shows the frequencies of selected variables including lameness, fever, articular swelling, lymphadenomegaly, anorexia, general malaise, improvement after antibiotics, and vaccine history over the entire five year period. All dogs in the study met the practitioner's definition because the treatment of Lyme disease was the basis on which cases were selected. A small subset of cases met the other study case definitions as well.

In Table 2, the frequency of clinical signs, test results, and dogs that meet the study probable definition per year for Hospital A are shown. In 2000, Hospital A reported 28 cases of Lyme disease that met any definition, and from 2001 through June 2005 Hospital A reported 44 cases, 114 cases, 433 cases, 230 cases, and 53 cases respectively. The highest percentage of dogs met the study probable definition in 2001 and in 2002. In 2000 lameness was seen in 64.3% of dogs, in 2001 73.5%, and in 2002 50.9%. In 2000 32.1 % of dogs exhibited fever greater than 103º F, in 2001 32.8%, and in 2003 9.0%. The percentage of dogs having a fever of any elevation remained fairly constant. The percentage of dogs having lymphadenomegaly was low throughout the study period with 18.4% in 2001 and 3.9% in 2004. In 2000 32.1% of dogs showed signs of anorexia, 2001, 24.5%, and in 2002, 22.8%. In 2000, 50% of dogs had general malaise and in 2003, 7.6%. The highest percentage of dogs showed improvement after antibiotic use in 2000 and in 2001. A high percentage of positive tests was seen in all years. In Figure 3, the trends of animals testing positive are compared to the clinical signs used in the study case definitions and animals meeting the study probable definition over the study period. Over the years the number of positive tests increased as the number of animals showing fever >103º F, lameness, improvement after antibiotics, and meeting the study probable definition decreased.

The incidence of Lyme disease over the study period was calculated using the number of cases that meet the practitioner's definition and the number of cases meeting the study probable definition for hospital A. The number of canine visits per year to hospital A was used as the denominator. The incidence (practitioner's definition) in 2000 was 8.14 cases per 1,000 dogs, in 2001 was 12.81 per 1,000, in 2002 was 27.95 per 1,000, in 2003 was 105.33 per 1,000, in 2004 was 56.93 per 1,000, and in 2005 was 18.51 per 1,000. The incidence of dogs meeting the study probable definition in 2000 was 1.16 per 1,000, in 2001 was 1.83 per 1,000, in 2002 was 2.94 per 1,000, in 2003 was 1.22 per 1,000, in 2004 was 0.50 per 1,000, and in 2005 was 1.05 per 1,000. In Figure 4, the incidence of cases meeting the study probable definition and cases meeting the practitioner's definition is graphically illustrated.

Table 3 illustrates the frequency of clinical signs, test results, and dogs that met the study probable definition from 2004 though June 2005 for Hospital B. In 2004 there were 230 cases of Lyme disease that met any definition and in 2005 there were 53 cases. None of these cases met the study probable definition. In 2004 87.4% (n=104) of cases tested positive and in 2005 86.4% (n=19) tested positive.

In Table 4, the zip codes for the home address of cases that meet any definition are presented. The highest percentage of cases was seen in Cape Charles, 23310 (9.83%), Onancock, 23417 (9.45%), Exmore, 23350 (7.92%), Belle Haven, 23306 (5.34%), and Eastville, 23347 (5.15%). Table 5 shows where the cases meeting the study probable definition were located. Belle Haven, 23306 and Cape Charles, 23310 both had 12.12% of the cases that meet the study probable definition. Figure 5 maps the human cases of Lyme disease on the Eastern Shore health district between 2000 and 2004. There were 2 cases with unknown zip codes. Figure 6 maps the cases of canine Lyme disease that meet any definition between 2000 and 2005. Figure 7 maps the distribution of dogs testing seropositive to *Borrelia burgdorferi* on the Eastern Shore in 2004.

Discussion

The purpose of this 5-year, retrospective study was to determine if there was any evidence that the incidence of canine Lyme disease increased between 2000 and 2005 in Accomack and Northampton counties. An additional goal was to compare the study definition of Lyme disease with the veterinary practitioner definition. The hospitals that volunteered to participate in this study are both predominately ($\geq$ 85%) small animal practices. Hospital A employs five veterinarians and reports having approximately 4,000 canine visits per year throughout the study period. Hospital B is a solo practice that reports having over 1,000 canine visits per year.

The number of dogs meeting the practitioner's definition increased between 2000 and 2003. There was a slight decrease in number beginning in 2004 which continued through 2005. It is important to remember that the 2005 data includes only cases through June 30, 2005. Since Lyme disease varies by season, with more cases identified in the summer months, the decrease in incidence for this time period should be interpreted with caution. The incidence of Lyme disease in dogs meeting the study probable definition increased until 2002 and began to decrease in 2003. This coincides with Hospital A's use of the in-house ELISA test. The hospital started using this test in April 2001; however, testing of all dogs became standard practice protocol in June 2002. Hospital B began using this same test in 2004 as a routine part of canine exams. The ELISA test made it possible to capture more dogs that were exposed to *Borrelia burgdorferi*.

Over the 5 year period lameness, fever, articular swelling, lymphadenopathy, general malaise, anorexia, and improvement after antibiotics were seen in a small percentage of cases. Dogs having lameness and improvement after antibiotics were the highest percentages seen, 24.6% and 27.5%, respectively. As use of the ELISA test became more prevalent the number of positive test results per year of dogs that were treated for Lyme disease increased until 2004 when the number decreased slightly. The ELISA test has been shown to be useful in highly Lyme-endemic areas because it is convenient and reliable. Vaccination history does not affect the reliability of this test.[9] In this study 89.9% of dogs had no history of vaccine. Over this period there was a sharp decrease in the number of dogs exhibiting clinical signs and meeting the study probable definition. In 2003 84.5% of cases from Hospital A tested positive compared to only 18.7% showing signs of lameness. At this time only 1.2% of cases met the study probable definition.

There seems to be an increasing trend in the decision to treat dogs with doxycycline on the basis of a positive test results regardless of clinical signs. It is the practitioner's clinical impression that those animals left untreated will return to the clinic with clinical disease. While prophylactic treatment is not unfounded, it may be necessary to determine the true number of dogs that have clinical disease in order define practice protocol. It would be helpful to determine the percentage of dogs that will manifest clinical Lyme disease in this area to asses whether the percentage exceeds the national average to a point where prophylactic treatment is indicated.

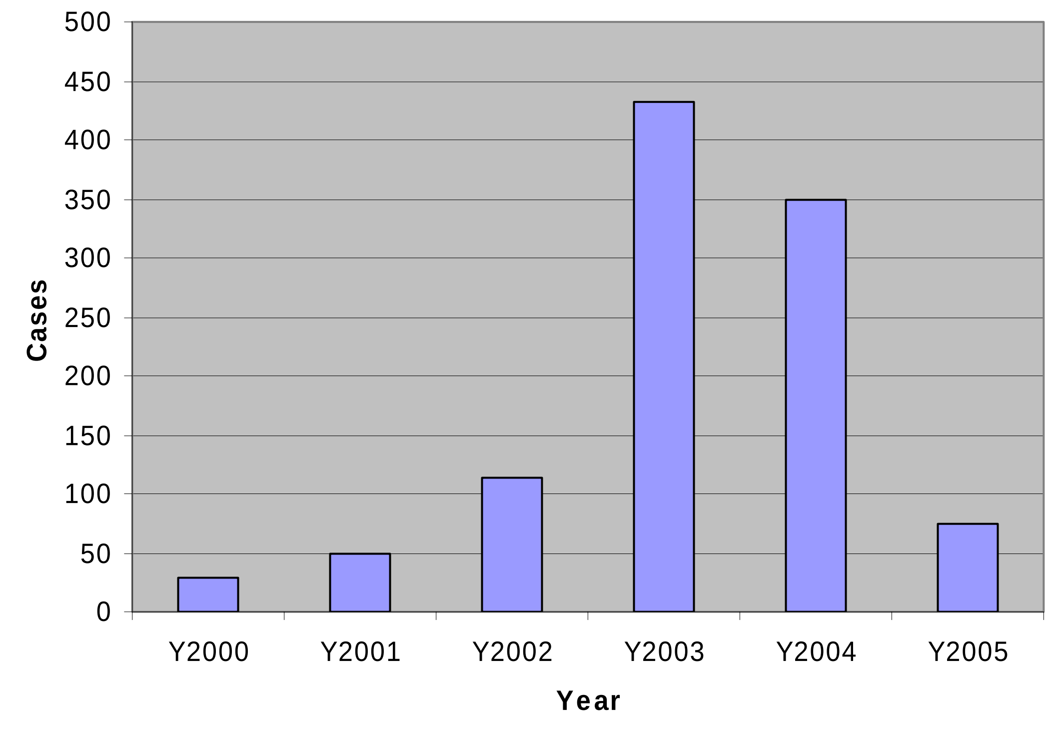
The human and canine cases of Lyme disease were mapped to see the similarities and differences between the two. Since the geographic distribution of Lyme disease is believed to be clustered in certain locations mapping the canine cases might show where human cases are underreported or under diagnosed. For example no human cases of Lyme disease were reported in the southern most tip of the Eastern Shore Health District, but there was high density of canine cases. Glavanakov *et al*. showed a consistent pattern of spatial dependence in the state of New York.[15] Similarities have been seen in the Eastern Shore health district. Figure 5, 6, and 7 depict a high frequency of cases located at 23350 and 23417. These areas had a high frequency of human cases, canine cases that meet any definition, and dogs testing seropositive in 2004.

Since this was a volunteer study, some cases of Lyme disease may have been missed because those dogs visited other clinics. Not all hospitals in the area were able to participate because the limitations of computer software and record keeping systems did not allow those dogs prescribed doxycycline to be identified. Dogs that never visited an animal hospital were also missed and so the data collected may not be completely representative of the population. Using canine visits per year as the dominator for the incidence data was a further limitation. In some years dogs will visit the animal hospital more than once which may create a false impression of the number of dogs each hospital considers as patients. The number had to be used because there was no way to determine the total number of canines that were seen for any reason per year. Since Lyme disease is believed to be underreported, there could be more human cases than were reported to the Virginia Department of Health. This would affect the map of human cases of Lyme disease on the Eastern Shore of Virginia between 2000 and 2004.

To further assess trends in canine Lyme disease a prospective study needs to done to determine the percentage of dogs that go on to develop clinical signs. Having an appreciation for the percentage of dogs in this endemic area that tested positive to *Borrelia burgdorferi* and later developed clinical signs would be important in assessing prophylactic doxycycline use. This information would be more valuable in locating areas where humans are at a greater risk or human cases are underreported.

Even though it is difficult to standardize canine Lyme disease testing protocols because of the lack of a widely recognized clinically defined case definition, canines are still effective predictors of the level of *Borrelia burgdorferi* in an area.[14] Using dogs as sentinels for human infection allows public health workers to identify endemic areas regardless of human case reports. This information will help public health officials pinpoint areas in which surveillance should be increased to lessen the risk of human infection.

Figure 1. Annual Cumulative Cases of Lyme Disease per Year Meeting Any Definition from Hospital A and B



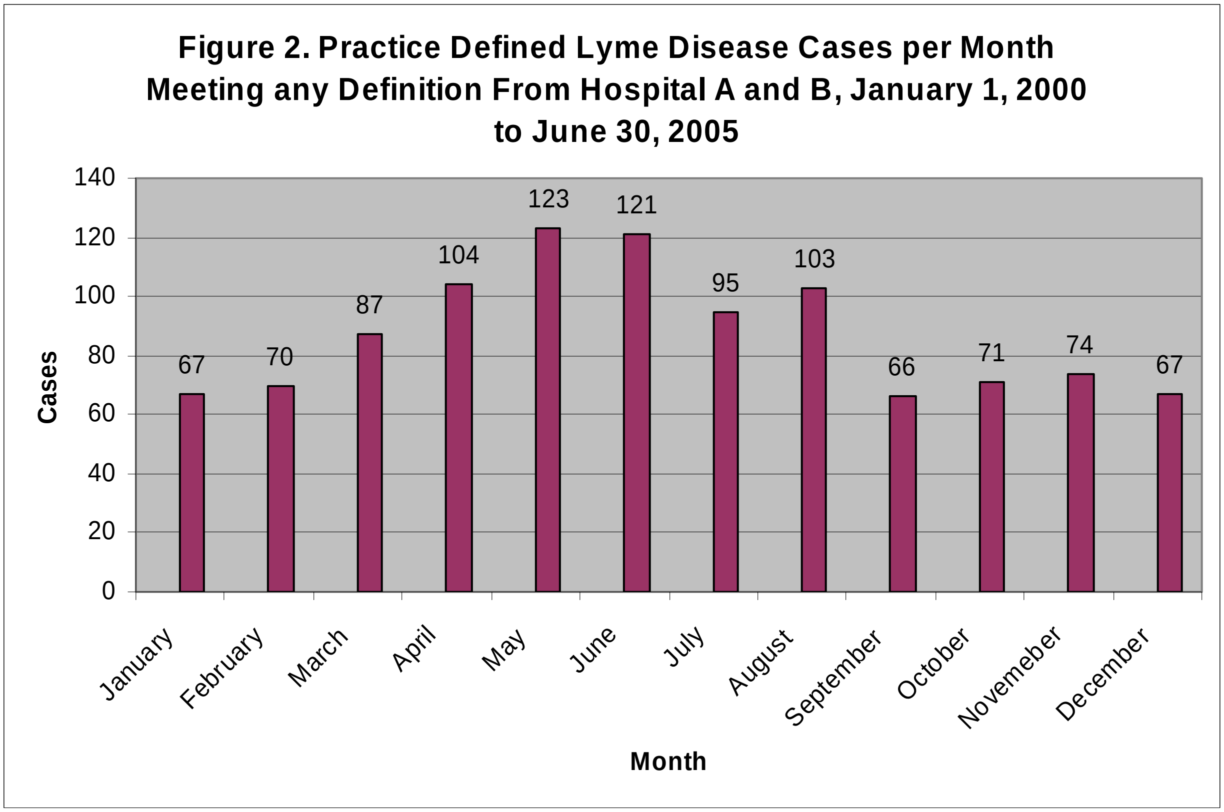


Figure 2. Practice Defined Lyme Disease Cases per Month Meeting any Definition From Hospital A and B, January 1, 2000 to June 30, 2005
Cases
Month
0
20
40
60
80
100
120
140
67
70
87
104
123
121
95
103
66
71
74
67
January
February
March
April
May
June
July
August
September
October
Novemeber
December

Table 1. Frequencies of Selected Variables From Hospital A and B, 2000-2005

Variable		Total N	Percentage %
Lameness			
	No	790	75.3
	Yes	250	24.6
Fever			
	None	776	74.0
	Any Elevation	157	15.0
	> 103	115	11.0
Articular Swelling			
	No	1037	98.9
	Yes	11	1.0
Lymphadenomegaly			
	No	995	94.9
	Yes	53	5.1
Anorexia			
	No	956	91.9
	Yes	92	8.8
General Malaise			
	No	911	86.8
	Yes	137	13.1
Improvement after Antibiotics			
	No	760	72.1
	Yes	288	27.5
Vaccine			
	None	939	89.9
	Within 1 year	79	7.6
	> 1 year once	8	0.8
	> 1 year Multiple	21	2.0

Table 2. Frequency of Clinical Signs and Test Results per Year for Hospital A, 2000-2005

Year	2000	2001	2002	2003	2004	2005
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Total Cases	28	44	114	433	230	53
Study probable	4 (14.3)	7 (14.3)	12 (10.5)	5 (1.2)	2 (0.9)	3 (5.7)
Lameness	18 (64.3)	36 (73.5)	58 (50.9)	81 (18.7)	41 (17.8)	20 (37.7)
Fever >103	9 (32.1)	19 (32.8)	28 (24.6)	39 (9.0)	12 (5.2)	8 (15.1)
Any Fever	6 (21.4)	11 (22.4)	24 (21.1)	64 (14.8)	39 (17.0)	11 (20.8)
Lymphadenomegaly	2 (7.1)	9 (18.4)	8 (7.0)	19 (4.4)	9 (3.9)	4 (7.5)
Anorexia	9 (32.1)	12 (24.5)	26 (22.8)	21 (4.8)	14 (6.1)	7 (13.2)
Articular Swelling	1 (3.6)	1 (2.0)	2 (1.8)	4 (0.9)	1 (0.4)	3 (3.8)
Malaise	14 (50.0)	14 (28.6)	36 (31.6)	33 (7.6)	23 (10.0)	11 (20.8)
Improvement after Antibiotics	22 (78.6)	36 (73.5)	50 (43.9)	119 (27.5)	46 (20.0)	4 (7.5)
Positive test	9 (32.1)	24 (49.0)	88 (77.2)	366 (84.5)	189 (82.2)	43 (81.1)

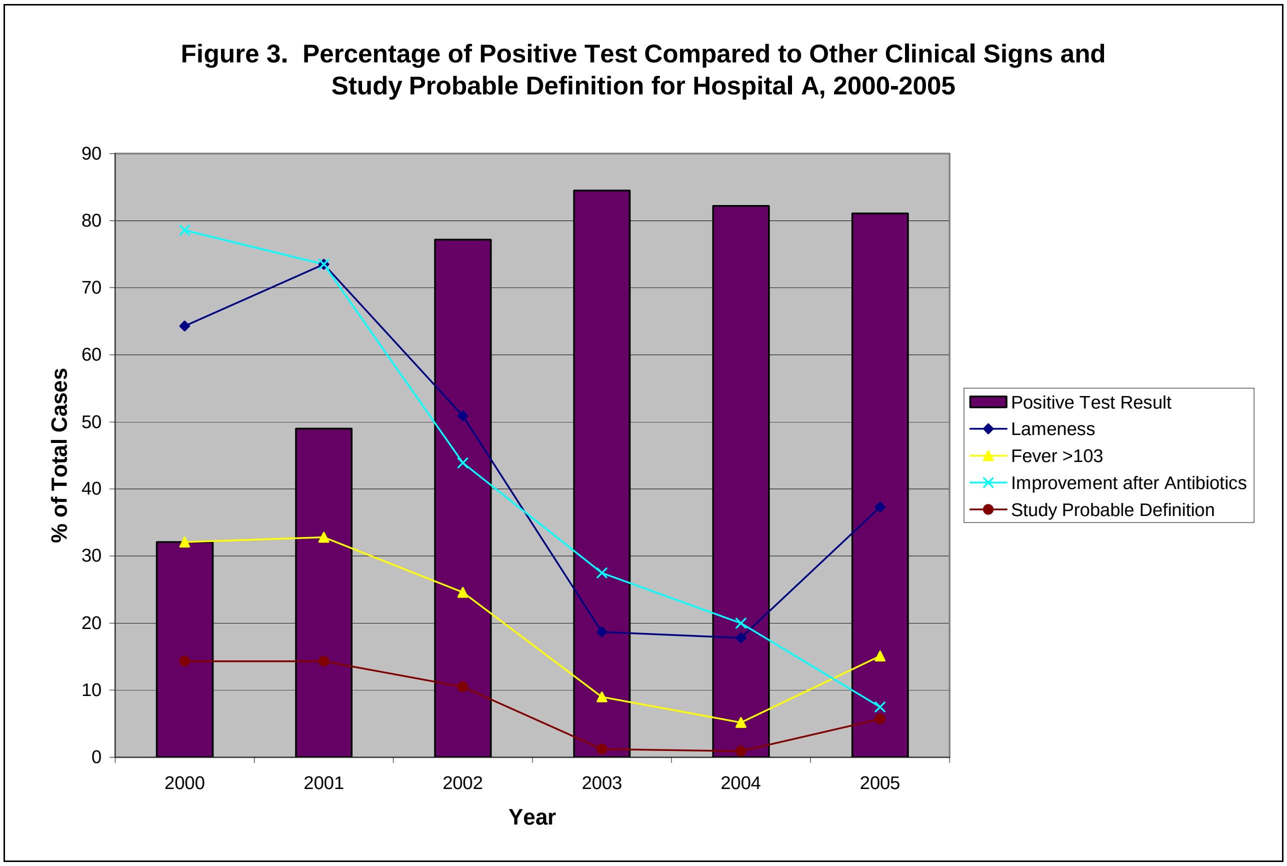


Figure 3. Percentage of Positive Test Compared to Other Clinical Signs and Study Probable Definition for Hospital A, 2000-2005
% of Total Cases
90
80
70
60
50
40
30
20
10
0
2000
2001
2002
2003
2004
2005
Year
Positive Test Result
Lameness
Fever >103
Improvement after Antibiotics
Study Probable Definition

Figure 4. Incidence of Cases Meeting the DVMs Definition and Study Probable Defintion For Hospital A, 2000-2005

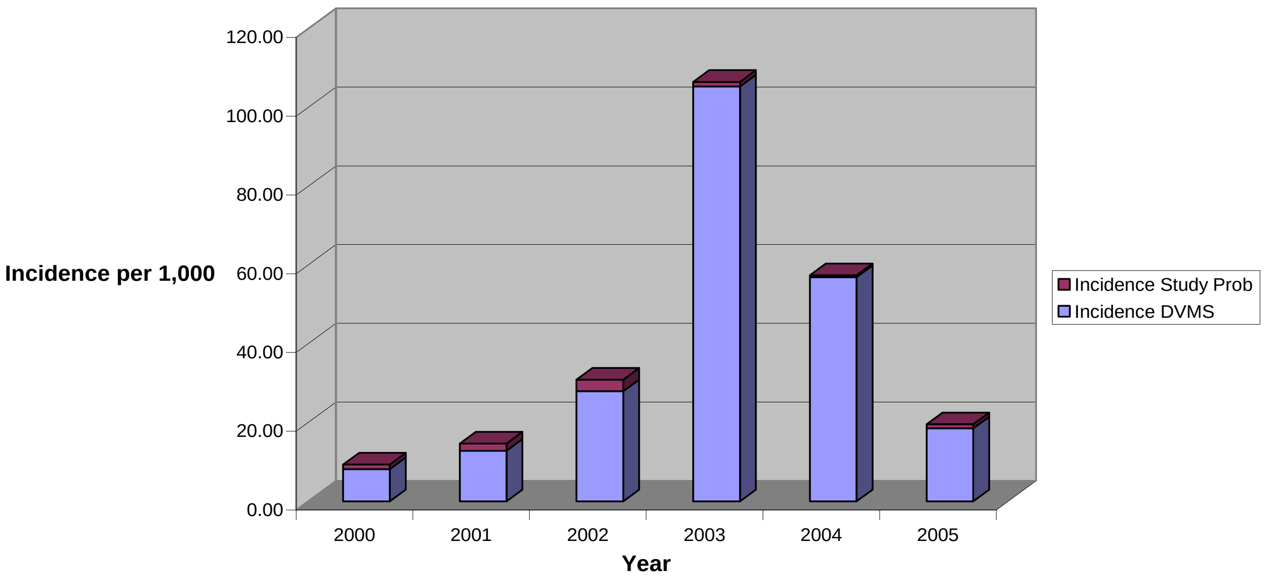


Table 3. Frequency of Clinical Signs and Test Results per Year for Hospital B for 2004-2005 (no data for 2000-2003)

Year	2004 N (%)	2005 N (%)
Total Cases	119	22
Study probable	0 (0.0)	0 (0.0)
Lameness	3 (2.5)	1 (4.5)
Fever >103	0 (0.0)	0 (0.0)
Any fever	2 (1.7)	0 (0.0)
Lymphadenomegaly	2 (1.7)	0 (0.0)
Articular Swelling	0 (0.0)	0 (0.0)
Anorexia	3 (2.5)	0 (0.0)
Malaise	5 (4.2)	1 (4.5)
Improvement after antibiotics	10 (8.4)	1 (4.5)
Positive test	104 (87.4)	19 (86.4)

Table 4. Cases Meeting Any Definition Stratified by Zipcode, 2000-2005

Zipcode	Total N	Percentage %
23301	48	4.58
23302	4	0.38
23303	6	0.57
23306	56	5.34
23307	15	1.43
23308	14	1.34
23310	103	9.83
23313	7	0.67
23316	42	4.01
23336	29	2.77
23337	4	0.38
23341	8	0.76
23347	54	5.15
23350	83	7.92
23354	29	2.77
23356	4	0.38
23357	4	0.38
23358	6	0.57
23359	4	0.38
23389	3	0.29
23395	3	0.29
23398	22	2.10
23399	1	0.10
23401	18	1.72
23404	4	0.38
23405	51	4.87
23407	1	0.10
23408	6	0.57
23409	1	0.10
23410	51	4.87
23413	36	3.44
23414	1	0.10
23415	5	0.48
23416	1	0.10
23417	99	9.45
23418	43	4.10
23420	49	4.68
23421	24	2.29
23422	31	2.96
23423	23	2.19
23427	3	0.29
23429	2	0.19
23441	1	0.10

23442	5	0.48
23443	13	1.24
23480	21	2.00
23483	1	0.10
23486	9	0.86

Table 5. Canine Cases Meeting the Study Probable Definition by Zipcode, 2000-2005

Zipcode	Total N	Percentage %
23301	2	6.06
23306	4	12.12
23310	4	12.12
23316	2	6.06
23336	1	3.03
23347	3	9.09
23350	1	3.03
23398	1	3.03
23401	2	6.06
23405	3	9.09
23417	3	9.09
23418	2	6.06
23420	3	9.09
23422	1	3.03
23423	1	3.03
Total	33	100

Figure 5.

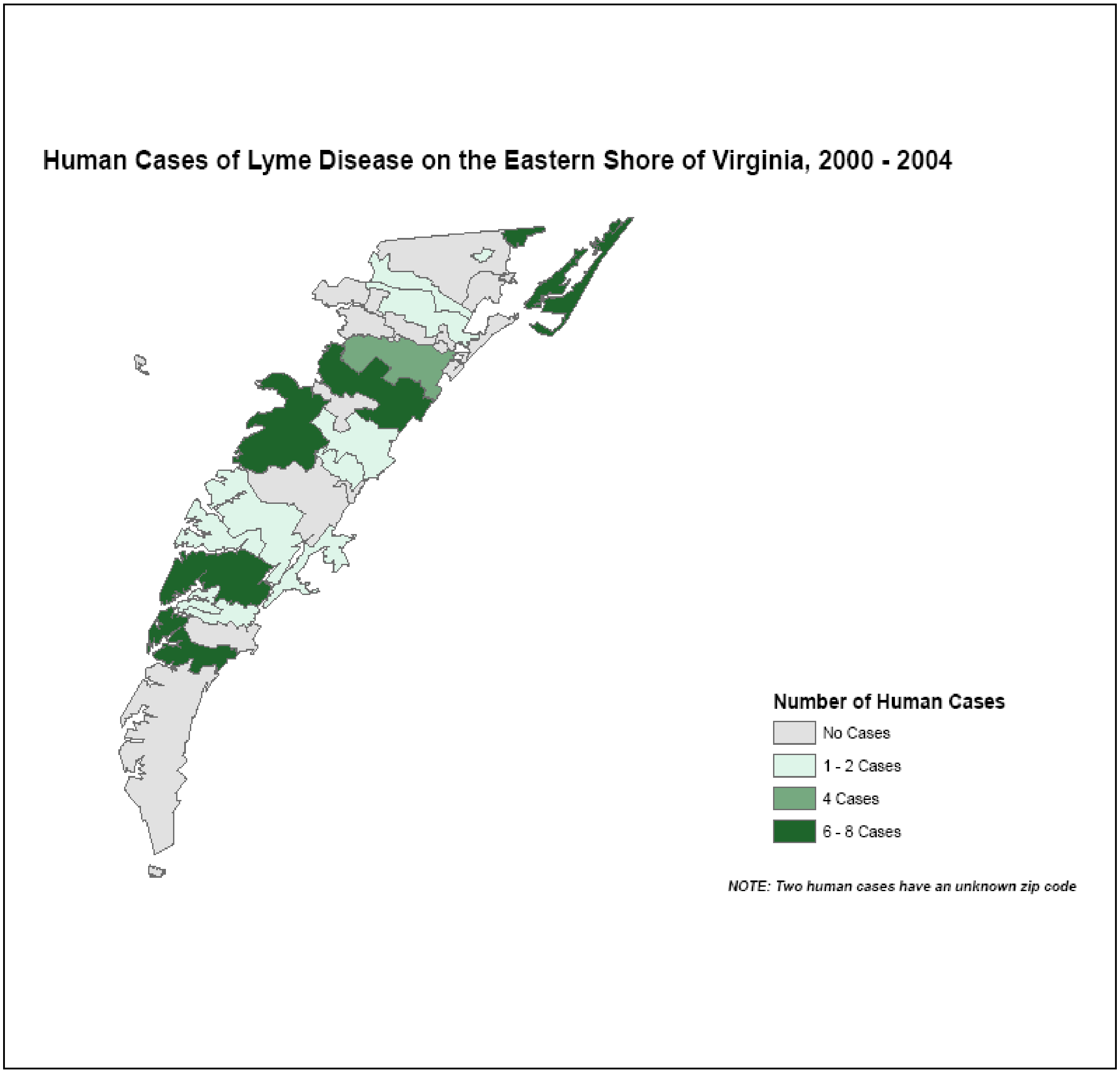

Human Cases of Lyme Disease on the Eastern Shore of Virginia, 2000 - 2004
Number of Human Cases
No Cases
1 - 2 Cases
4 Cases
6 - 8 Cases
NOTE: Two human cases have an unknown zip code

Figure 6.

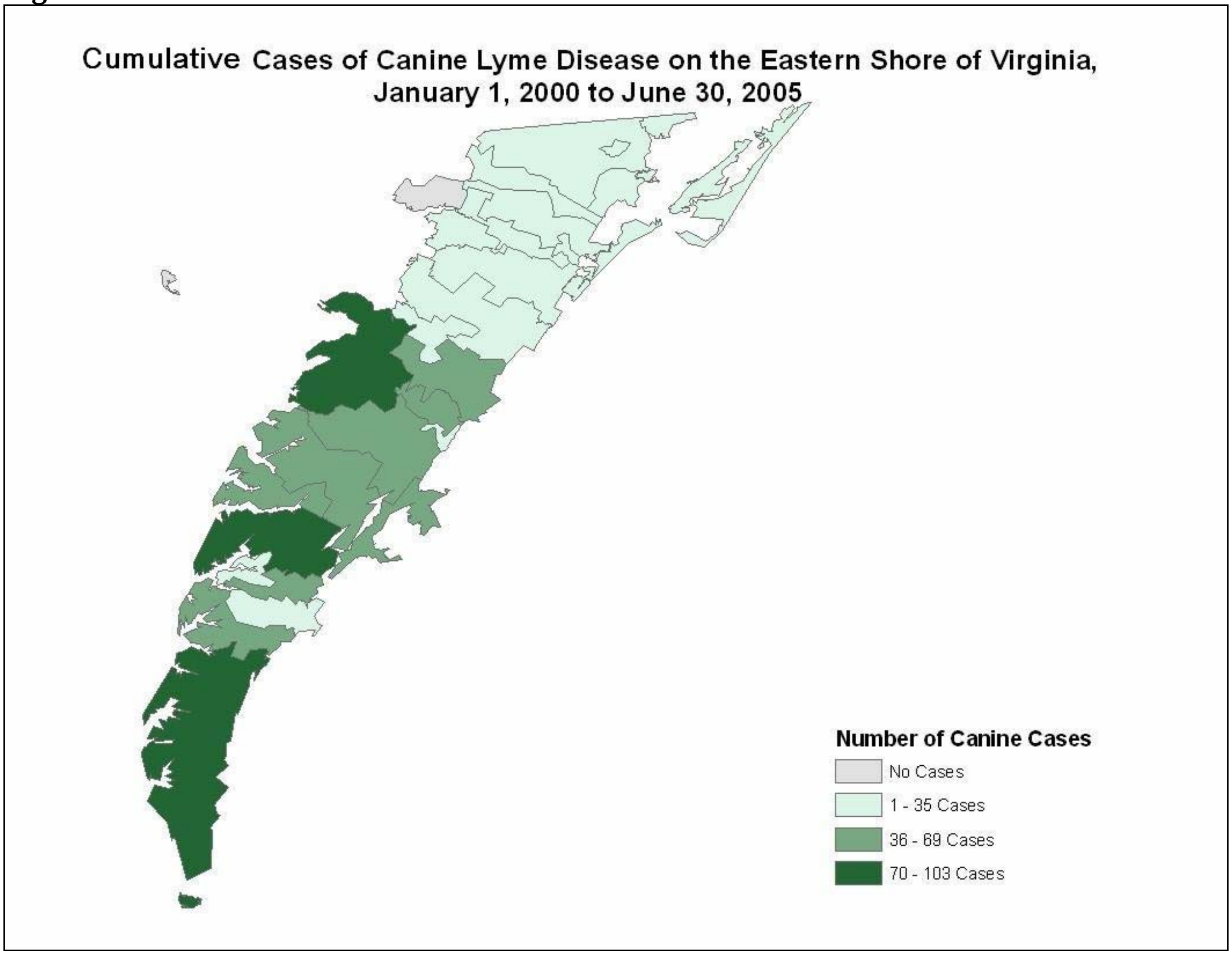
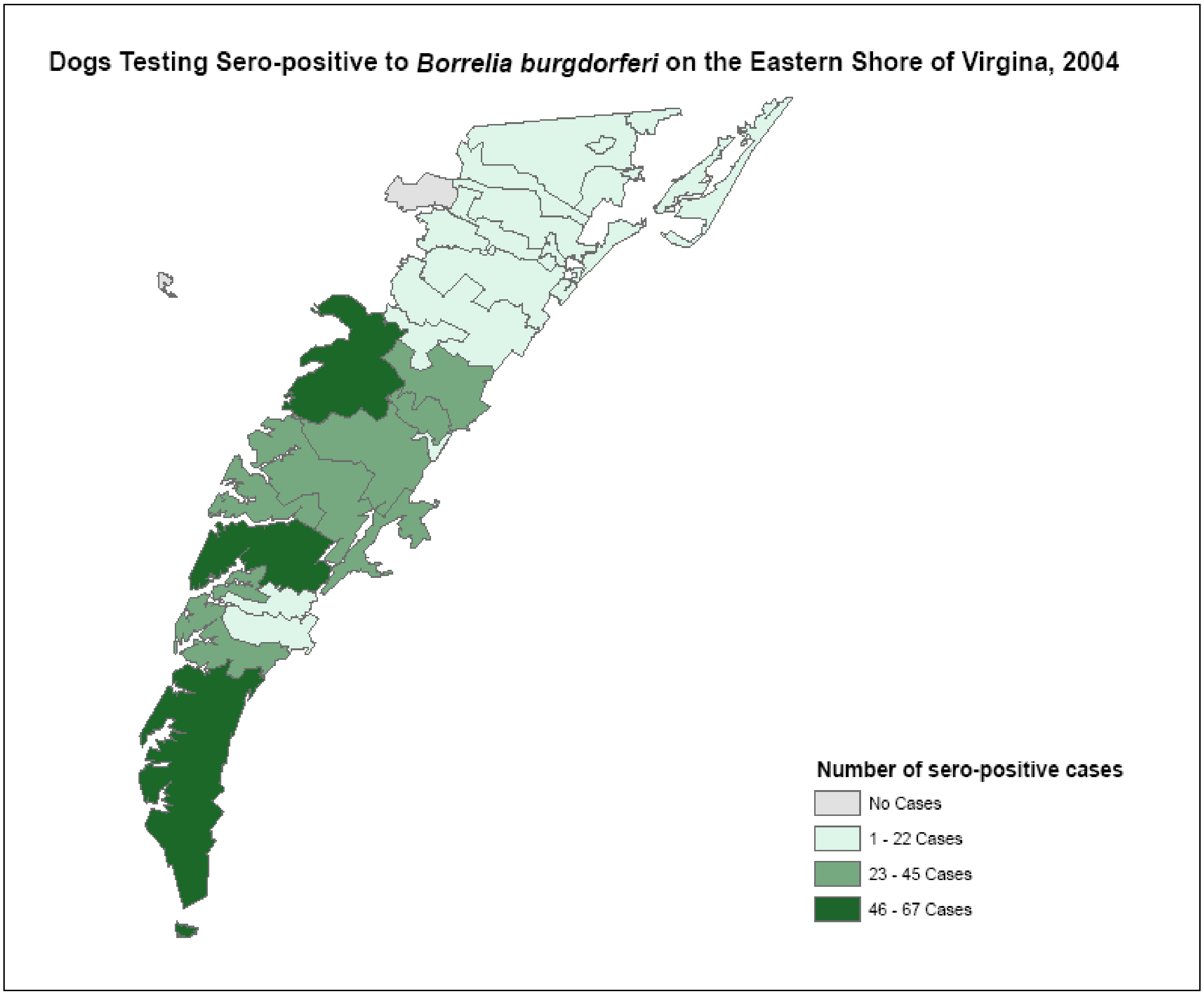

Cumulative Cases of Canine Lyme Disease on the Eastern Shore of Virginia,
January 1, 2000 to June 30, 2005
Number of Canine Cases
No Cases
1 - 35 Cases
36 - 69 Cases
70 - 103 Cases

Figure 7.


Dogs Testing Sero-positive to *Borrelia burgdorferi* on the Eastern Shore of Virgina, 2004
Number of sero-positive cases
No Cases
1 - 22 Cases
23 - 45 Cases
46 - 67 Cases

Appendix A

Lyme Disease Case Definition Survey

Name:____________________________________

Practice name:______________________________

Date:_____________________________________

1. Please choose the statement that represents the **least** amount of information that you would need to have before initiating treatment for what you suspected was acute canine Lyme disease:

a. Fever (any elevation) and lameness.

b. Fever (>103°) and lameness.

c. Fever (>103°) and lameness plus at least one of the following: articular swelling, lymphadenomegaly, anorexia or general malaise.

d. Fever (>103°) and lameness plus at least one of the following: articular swelling, lymphadenomegaly, anorexia or general malaise and positive results using any one serologic test.

e. Fever (>103°) and lameness plus at least two of the following: articular swelling, lymphadenomegaly, anorexia or general malaise and positive results using any one serologic test.

f. Fever (>103°) and lameness plus at least one of the following: articular swelling, lymphadenomegaly, anorexia or general malaise and positive results using at least two of the following laboratory tests: ELISA or IFA, Western blot, PCR, spirochete identification on renal impression smears or culture of spirochetes.

g. Other:____
____
____

2. Does your practice offer a Lyme ELISA test? Yes No

If **no skip to** question **#7**

3. How long has you practice been using this type of test? (Circle the first year a test like this was offered)

a. 2000
b. 2001
c. 2002
d. 2003
e. 2004
f. 2005
g. Other:_________________

4. What is the brand name of the Lyme ELISA test your practice currently uses?

____

5. When do you typically use the Lyme ELISA test? (choose all that apply)

a. During routine physical exams on dogs whether or not any clinical signs of Lyme disease are found.

b. If clinical signs compatible with Lyme disease are found on physical exam.

c. I rarely or never use this test eventhough my practice offers it.

d. Other:____
____
____

6. If a dog tests positive using the Lyme ELISA, which statement below represents your most common clinical response: (please choose only one)

a. I initiate treatment whether compatible clinical signs of Lyme are present or not as it has been my experience that many dogs will develop signs if I do not.

b. I discuss Lyme disease and its clinical signs with the owner and tell the owner that the dog will need to be rechecked if those signs develop.

c. I recommend further testing, especially if clinical signs are not present.

d. Other:____
____
____

7. If you do not use the Lyme ELISA or often recommend some other testing, what tests do you initiate? (choose all that apply)

a. IFA

b. Western Blot

c. PCR

d. spirochete identification on renal impression smears

e. culture of spirochetes

f. Other:____
____

Appendix B

SPSS Syntax

```
**To label test_result 1-5, to make values numeric rather than string**

COMPUTE result_1= 0.
If test_res_1='Positive' result_1=1.
If test_res_1='Weak Positive' result_1=1.
If test_res_1='Negative' result_1=2.
EXECUTE.
freq var result_1.

COMPUTE result_2= 0.
If test_res_2='Positive' result_2=1.
If test_res_2='Weak Positive' result_2=1.
If test_res_2='Negative' result_2=2.
EXECUTE.
freq var result_2.

COMPUTE result_3= 0.
If test_res_3='Positive' result_3=1.
If test_res_3='Weak Positive' result_3=1.
If test_res_3='Negative' result_3=2.
EXECUTE.
freq var result_3.

COMPUTE result_4= 0.
If test_res_4='Positive' result_4=1.
If test_res_4='Weak Positive' result_4=1.
If test_res_4='Negative' result_4=2.
EXECUTE.
freq var result_4.

COMPUTE result_5= 0.
If test_res_5='Positive' result_5=1.
If test_res_5='Weak Positive' result_5=1.
If test_res_5='Negative' result_5=2.
EXECUTE.
freq var result_5.

**mult_positive variable created to capture patients with 1 or more positive or weak positive test results
(vars result_1 thru result_5)**

COMPUTE mult_positive = 0.
EXECUTE.
If result_1=1 and result_2=1 or result_3=1 or result_4=1 or result_5=1 mult_positive=1.
EXECUTE.
freq var mult_positive.
VALUE LABEL mult_positive 0 'Negative' 1 'Positive'.

**New variable, criteria met/not met for study prob def**

COMPUTE study_prob_def = 0.
EXECUTE.
```

```
If ((fever_str='>103') and (lameness_str='Yes') and (abx_str='Yes') and (other_signs=1))
study_prob_def=1.
EXECUTE.
freq var study_prob_def.


COMPUTE other_signs=0.
EXECUTE.
If articular_str='Yes' or lymph_str='Yes' or anorex_str='Yes' or malaise_str='Yes' other_signs=1.
EXECUTE.
freq var other_signs.

*Frequncies*

FREQUENCIES
VARIABLES=Lameness Fever Articular Lymph Anorex Malaise Vac_ID abx_Improve Month_id Zipcode
/ORDER ANALYSIS.

*Signs by year*

CROSSTABS
/TABLES=Lameness Fever Articular Lymph Anorex Malaise Vac_ID abx_Improve Month_id Zipcode
study_prob_def BY YEAR_id
/FORMAT=AVALUE TABLES
/CELLS=COUNT ROW
/COUNT ROUND CELL.

CROSSTABS
/TABLES=Lameness Fever Articular Lymph Anorex Malaise abx_Improve abx_Improve study_prob_def
result_1 BY YEAR_id by Practice_id
/FORMAT=AVALUE TABLES
/CELLS=COUNT COLUMN
/COUNT ROUND CELL.

CROSSTABS
/TABLES=Lameness Fever abx_Improve result_1 study_prob_def BY YEAR_id by Practice_id
/FORMAT=AVALUE TABLES
/CELLS=COUNT COLUMN
/COUNT ROUND CELL.

CROSSTABS
/TABLES=abx_Used BY study_prob_def
/FORMAT=AVALUE TABLES
/CELLS=COUNT ROW
/COUNT ROUND CELL.
```

Appendix C
SPSS Output

Frequencies

Statistics

result_1

N	Valid	1048
	Missing	0

result_1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Missing	68	6.5	6.5	6.5
	Positive	952	90.8	90.8	97.3
	Negative	28	2.7	2.7	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

result_2

N	Valid	1048
	Missing	0

result_2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	578	55.2	55.2	55.2
	1.00	345	32.9	32.9	88.1
	2.00	125	11.9	11.9	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

result_3

N	Valid	1048
	Missing	0

Frequencies

Statistics

result_4

N	Valid	1048
	Missing	0

result_4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1028	98.1	98.1	98.1
	1.00	10	1.0	1.0	99.0
	2.00	10	1.0	1.0	100.0
	Total	1048	100.0	100.0	

Frequencies

result_3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	917	87.5	87.5	87.5
	1.00	79	7.5	7.5	95.0
	2.00	52	5.0	5.0	100.0
	Total	1048	100.0	100.0	

Statistics

result_5

N	Valid	1048
	Missing	0

result_5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1047	99.9	99.9	99.9
	2.00	1	.1	.1	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

mult_positive

N	Valid	1048
	Missing	0

mult_positive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	700	66.8	66.8	66.8
	Positive	348	33.2	33.2	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

study_prob_def

N	Valid	1048
	Missing	0

study_prob_def

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Does Not meet Study Probable	1015	96.9	96.9	96.9
	Meets Study Probable	33	3.1	3.1	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

other_signs

N	Valid	1048
	Missing	0

other_signs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	835	79.7	79.7	79.7
	1	213	20.3	20.3	100.0
	Total	1048	100.0	100.0	

Frequencies

Statistics

		Lameness	Fever	Articular	Lymph	Anorex	Malaise	Vac_ID	abx_Improve	Month_id	Zipcode
N	Valid	1048	1048	1048	1048	1048	1048	1048	1048	1048	1048
	Missing	0	0	0	0	0	0	0	0	0	0

Frequency Table

Lameness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	790	75.4	75.4	75.4
	Yes	258	24.6	24.6	100.0
	Total	1048	100.0	100.0	

Fever

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	776	74.0	74.0	74.0
	Any Elevation	157	15.0	15.0	89.0
	>103	115	11.0	11.0	100.0
	Total	1048	100.0	100.0	

Articular

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1037	99.0	99.0	99.0
	Yes	11	1.0	1.0	100.0
	Total	1048	100.0	100.0	

Lymph

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	995	94.9	94.9	94.9
	Yes	53	5.1	5.1	100.0
	Total	1048	100.0	100.0	

Anorex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	956	91.2	91.2	91.2
	Yes	92	8.8	8.8	100.0
	Total	1048	100.0	100.0	

Malaise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	911	86.9	86.9	86.9
	Yes	137	13.1	13.1	100.0
	Total	1048	100.0	100.0	

Vac_ID

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	> 1 Year Mulitple	1	.1	.1	.1
	> 1 Year Multiple	20	1.9	1.9	2.0
	> 1 Year Once	8	.8	.8	2.8
	NONE	939	89.6	89.6	92.4
	With in 1 year	1	.1	.1	92.5
	With in 1 Year	79	7.5	7.5	100.0
	Total	1048	100.0	100.0	

abx_Improve

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	760	72.5	72.5	72.5
	Yes	288	27.5	27.5	100.0
	Total	1048	100.0	100.0	

Month_id

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	January	67	6.4	6.4	6.4
	February	70	6.7	6.7	13.1
	March	87	8.3	8.3	21.4
	April	104	9.9	9.9	31.3
	May	123	11.7	11.7	43.0
	June	121	11.5	11.5	54.6
	July	95	9.1	9.1	63.6
	August	103	9.8	9.8	73.5
	September	66	6.3	6.3	79.8
	October	71	6.8	6.8	86.5
	Novemeber	74	7.1	7.1	93.6
	December	67	6.4	6.4	100.0
	Total	1048	100.0	100.0	

Zipcode

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	23301.00	48	4.6	4.6	4.6
	23302.00	4	.4	.4	5.0
	23303.00	6	.6	.6	5.5
	23306.00	56	5.3	5.3	10.9
	23307.00	15	1.4	1.4	12.3
	23308.00	14	1.3	1.3	13.6
	23310.00	103	9.8	9.8	23.5
	23313.00	7	.7	.7	24.1
	23316.00	42	4.0	4.0	28.1
	23336.00	29	2.8	2.8	30.9
	23337.00	4	.4	.4	31.3
	23341.00	8	.8	.8	32.1
	23347.00	54	5.2	5.2	37.2
	23350.00	83	7.9	7.9	45.1
	23354.00	29	2.8	2.8	47.9
	23356.00	4	.4	.4	48.3
	23357.00	4	.4	.4	48.7
	23358.00	6	.6	.6	49.2
	23359.00	4	.4	.4	49.6
	23389.00	3	.3	.3	49.9
	23395.00	3	.3	.3	50.2
	23398.00	22	2.1	2.1	52.3
	23399.00	1	.1	.1	52.4
	23401.00	18	1.7	1.7	54.1
	23404.00	4	.4	.4	54.5
	23405.00	51	4.9	4.9	59.4
	23407.00	1	.1	.1	59.4
	23408.00	6	.6	.6	60.0
	23409.00	1	.1	.1	60.1
	23410.00	51	4.9	4.9	65.0
	23413.00	36	3.4	3.4	68.4
	23414.00	1	.1	.1	68.5
	23415.00	5	.5	.5	69.0
	23416.00	1	.1	.1	69.1
	23417.00	99	9.4	9.4	78.5
	23418.00	43	4.1	4.1	82.6
	23420.00	49	4.7	4.7	87.3
	23421.00	24	2.3	2.3	89.6
	23422.00	31	3.0	3.0	92.6
	23423.00	23	2.2	2.2	94.8
	23427.00	3	.3	.3	95.0
	23429.00	2	.2	.2	95.2
	23441.00	1	.1	.1	95.3
	23442.00	5	.5	.5	95.8
	23443.00	13	1.2	1.2	97.0
	23480.00	21	2.0	2.0	99.0
	23483.00	1	.1	.1	99.1
	23486.00	9	.9	.9	100.0
	Total	1048	100.0	100.0	

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Lameness * Year_id	1048	100.0%	0	.0%	1048	100.0%
Fever * Year_id	1048	100.0%	0	.0%	1048	100.0%
Articular * Year_id	1048	100.0%	0	.0%	1048	100.0%
Lymph * Year_id	1048	100.0%	0	.0%	1048	100.0%
Anorex * Year_id	1048	100.0%	0	.0%	1048	100.0%
Malaise * Year_id	1048	100.0%	0	.0%	1048	100.0%
Vac_ID * Year_id	1048	100.0%	0	.0%	1048	100.0%
abx_Improve * Year_id	1048	100.0%	0	.0%	1048	100.0%
Month_id * Year_id	1048	100.0%	0	.0%	1048	100.0%
Zipcode * Year_id	1048	100.0%	0	.0%	1048	100.0%
study_prob_def * Year_id	1048	100.0%	0	.0%	1048	100.0%

Lameness * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Lameness	No	Count	10	13	56	352	305	54	790
		% within Lameness	1.3%	1.6%	7.1%	44.6%	38.6%	6.8%	100.0%
	Yes	Count	18	36	58	81	44	21	258
		% within Lameness	7.0%	14.0%	22.5%	31.4%	17.1%	8.1%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Lameness	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Fever * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Fever	None	Count	13	19	62	330	296	56	776
		% within Feve	1.7%	2.4%	8.0%	42.5%	38.1%	7.2%	100.0%
	Any Elevatior	Count	6	11	24	64	41	11	157
		% within Feve	3.8%	7.0%	15.3%	40.8%	26.1%	7.0%	100.0%
	>103	Count	9	19	28	39	12	8	115
		% within Feve	7.8%	16.5%	24.3%	33.9%	10.4%	7.0%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Feve	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Articular * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Articular	No	Count	27	48	112	429	348	73	1037
		% within Articula	2.6%	4.6%	10.8%	41.4%	33.6%	7.0%	100.0%
	Yes	Count	1	1	2	4	1	2	11
		% within Articula	9.1%	9.1%	18.2%	36.4%	9.1%	18.2%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Articula	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Lymph * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Lymph	No	Count	26	40	106	414	338	71	995
		% within Lymph	2.6%	4.0%	10.7%	41.6%	34.0%	7.1%	100.0%
	Yes	Count	2	9	8	19	11	4	53
		% within Lymph	3.8%	17.0%	15.1%	35.8%	20.8%	7.5%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Lymph	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Anorex * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Anorex	No	Count	19	37	88	412	332	68	956
		% within Anore	2.0%	3.9%	9.2%	43.1%	34.7%	7.1%	100.0%
	Yes	Count	9	12	26	21	17	7	92
		% within Anore	9.8%	13.0%	28.3%	22.8%	18.5%	7.6%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Anore	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Malaise * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Malaise	No	Count	14	35	78	400	321	63	911
		% within Malaise	1.5%	3.8%	8.6%	43.9%	35.2%	6.9%	100.0%
	Yes	Count	14	14	36	33	28	12	137
		% within Malaise	10.2%	10.2%	26.3%	24.1%	20.4%	8.8%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Malaise	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Vac_ID * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Vac_ID	> 1 Year Mulitp	Count	0	0	0	0	1	0	1
		% within Vac_	.0%	.0%	.0%	.0%	100.0%	.0%	100.0%
	> 1 Year Multip	Count	1	0	2	3	13	1	20
		% within Vac_	5.0%	.0%	10.0%	15.0%	65.0%	5.0%	100.0%
	> 1 Year Once	Count	0	0	3	2	2	1	8
		% within Vac_	.0%	.0%	37.5%	25.0%	25.0%	12.5%	100.0%
	NONE	Count	26	45	96	405	299	68	939
		% within Vac_	2.8%	4.8%	10.2%	43.1%	31.8%	7.2%	100.0%
	With in 1 year	Count	1	0	0	0	0	0	1
		% within Vac_	100.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	With in 1 Year	Count	0	4	13	23	34	5	79
		% within Vac_	.0%	5.1%	16.5%	29.1%	43.0%	6.3%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Vac_	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

abx_Improve * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
abx_Impr	No	Count	6	13	64	314	293	70	760
		% within abx_I	.8%	1.7%	8.4%	41.3%	38.6%	9.2%	100.0%
	Yes	Count	22	36	50	119	56	5	288
		% within abx_I	7.6%	12.5%	17.4%	41.3%	19.4%	1.7%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within abx_I	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Month_id * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Month_ic	January	Count	1	3	1	27	24	11	67
		% within Month	1.5%	4.5%	1.5%	40.3%	35.8%	16.4%	100.0%
	February	Count	4	2	5	21	22	16	70
		% within Month	5.7%	2.9%	7.1%	30.0%	31.4%	22.9%	100.0%
	March	Count	0	1	4	28	33	21	87
		% within Month	.0%	1.1%	4.6%	32.2%	37.9%	24.1%	100.0%
	April	Count	3	6	6	43	37	9	104
		% within Month	2.9%	5.8%	5.8%	41.3%	35.6%	8.7%	100.0%
	May	Count	4	3	3	53	48	12	123
		% within Month	3.3%	2.4%	2.4%	43.1%	39.0%	9.8%	100.0%
	June	Count	3	10	15	48	39	6	121
		% within Month	2.5%	8.3%	12.4%	39.7%	32.2%	5.0%	100.0%
	July	Count	3	6	10	37	39	0	95
		% within Month	3.2%	6.3%	10.5%	38.9%	41.1%	.0%	100.0%
	August	Count	6	3	6	60	28	0	103
		% within Month	5.8%	2.9%	5.8%	58.3%	27.2%	.0%	100.0%
	Septembei	Count	0	2	8	32	24	0	66
		% within Month	.0%	3.0%	12.1%	48.5%	36.4%	.0%	100.0%
	October	Count	0	3	8	39	21	0	71
		% within Month	.0%	4.2%	11.3%	54.9%	29.6%	.0%	100.0%
	Novemebe	Count	3	4	25	24	18	0	74
		% within Month	4.1%	5.4%	33.8%	32.4%	24.3%	.0%	100.0%
	December	Count	1	6	23	21	16	0	67
		% within Month	1.5%	9.0%	34.3%	31.3%	23.9%	.0%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within Month	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

study_prob_def * Year_id Crosstabulation

			Year_id						Total
			2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
study_prob_de	Does Not meet Stud Probable	Count	24	42	102	428	347	72	1015
		% within study_prob_d	2.4%	4.1%	10.0%	42.2%	34.2%	7.1%	100.0%
	Meets Study Probab	Count	4	7	12	5	2	3	33
		% within study_prob_d	12.1%	21.2%	36.4%	15.2%	6.1%	9.1%	100.0%
Total		Count	28	49	114	433	349	75	1048
		% within study_prob_d	2.7%	4.7%	10.9%	41.3%	33.3%	7.2%	100.0%

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Lameness * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Fever * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Articular * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Lymph * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Anorex * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Malaise * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
abx_Improve * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
study_prob_def * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
result_1 * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%

Lameness * Year_id * Practice_id Crosstabulation

Practice_id				Year_id						Total
				2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	
Accomack Animal Hosp	Lamenes	No	Count					116	21	137
			% within Yea					97.5%	95.5%	97.2%
		Yes	Count					3	1	4
			% within Yea					2.5%	4.5%	2.8%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	Lamenes	No	Count	10	13	56	352	189	33	653
			% within Yea	35.7%	26.5%	49.1%	81.3%	82.2%	62.3%	72.0%
		Yes	Count	18	36	58	81	41	20	254
			% within Yea	64.3%	73.5%	50.9%	18.7%	17.8%	37.7%	28.0%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Fever * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	Feve	None	Count					117	22	139
			% within Ye					98.3%	100.0%	98.6%
		Any Eleva	Count					2	0	2
			% within Ye					1.7%	.0%	1.4%
	Total		Count					119	22	141
			% within Ye					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	Feve	None	Count	13	19	62	330	179	34	637
			% within Ye	46.4%	38.8%	54.4%	76.2%	77.8%	64.2%	70.2%
		Any Eleva	Count	6	11	24	64	39	11	155
			% within Ye	21.4%	22.4%	21.1%	14.8%	17.0%	20.8%	17.1%
		>103	Count	9	19	28	39	12	8	115
			% within Ye	32.1%	38.8%	24.6%	9.0%	5.2%	15.1%	12.7%
	Total		Count	28	49	114	433	230	53	907
			% within Ye	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Articular * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hos	Articul	No	Count					119	22	141
			% within Ye					100.0%	100.0%	100.0%
	Total		Count					119	22	141
			% within Ye					100.0%	100.0%	100.0%
Eastern Sh Animal Hos	Articul	No	Count	27	48	112	429	229	51	896
			% within Ye	96.4%	98.0%	98.2%	99.1%	99.6%	96.2%	98.8%
		Yes	Count	1	1	2	4	1	2	11
			% within Ye	3.6%	2.0%	1.8%	.9%	.4%	3.8%	1.2%
	Total		Count	28	49	114	433	230	53	907
			% within Ye	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Lymph * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hospita	Lymph	No	Count					117	22	139
			% within Year_					98.3%	100.0%	98.6%
		Yes	Count					2	0	2
			% within Year_					1.7%	.0%	1.4%
	Total		Count					119	22	141
			% within Year_					100.0%	100.0%	100.0%
Eastern Shore Animal Hospita	Lymph	No	Count	26	40	106	414	221	49	856
			% within Year_	92.9%	81.6%	93.0%	95.6%	96.1%	92.5%	94.4%
		Yes	Count	2	9	8	19	9	4	51
			% within Year_	7.1%	18.4%	7.0%	4.4%	3.9%	7.5%	5.6%
	Total		Count	28	49	114	433	230	53	907
			% within Year_	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Anorex * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	Anore	No	Count					116	22	138
			% within Yea					97.5%	100.0%	97.9%
		Yes	Count					3	0	3
			% within Yea					2.5%	.0%	2.1%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	Anore	No	Count	19	37	88	412	216	46	818
			% within Yea	67.9%	75.5%	77.2%	95.2%	93.9%	86.8%	90.2%
		Yes	Count	9	12	26	21	14	7	89
			% within Yea	32.1%	24.5%	22.8%	4.8%	6.1%	13.2%	9.8%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Malaise * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	Malais	No	Count					114	21	135
			% within Yea					95.8%	95.5%	95.7%
		Yes	Count					5	1	6
			% within Yea					4.2%	4.5%	4.3%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	Malais	No	Count	14	35	78	400	207	42	776
			% within Yea	50.0%	71.4%	68.4%	92.4%	90.0%	79.2%	85.6%
		Yes	Count	14	14	36	33	23	11	131
			% within Yea	50.0%	28.6%	31.6%	7.6%	10.0%	20.8%	14.4%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

abx_Improve * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	abx_Impro	No	Count					109	21	130
			% within Yea					91.6%	95.5%	92.2%
		Yes	Count					10	1	11
			% within Yea					8.4%	4.5%	7.8%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	abx_Impro	No	Count	6	13	64	314	184	49	630
			% within Yea	21.4%	26.5%	56.1%	72.5%	80.0%	92.5%	69.5%
		Yes	Count	22	36	50	119	46	4	277
			% within Yea	78.6%	73.5%	43.9%	27.5%	20.0%	7.5%	30.5%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

study_prob_def * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hos	study_prot	Does Not mee Probable	Count					119	22	141
			% within Ye					00.0%	00.0%	00.0%
	Total		Count					119	22	141
			% within Ye					00.0%	00.0%	00.0%
Eastern Sh Animal Hos	study_prot	Does Not mee Probable	Count	24	42	102	428	228	50	874
			% within Ye	85.7%	85.7%	89.5%	98.8%	99.1%	94.3%	96.4%
		Meets Study F	Count	4	7	12	5	2	3	33
			% within Ye	14.3%	14.3%	10.5%	1.2%	.9%	5.7%	3.6%
	Total		Count	28	49	114	433	230	53	907
			% within Ye	00.0%	00.0%	00.0%	00.0%	00.0%	00.0%	00.0%

result_1 * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hospi	result_1	Missing	Count					4	2	6
			% within Yea					3.4%	9.1%	4.3%
		Positive	Count					115	20	135
			% within Yea					96.6%	90.9%	95.7%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Shor Animal Hospi	result_1	Missing	Count	12	20	10	6	9	5	62
			% within Yea	42.9%	40.8%	8.8%	1.4%	3.9%	9.4%	6.8%
		Positive	Count	13	25	98	421	217	43	817
			% within Yea	46.4%	51.0%	86.0%	97.2%	94.3%	81.1%	90.1%
		Negativ	Count	3	4	6	6	4	5	28
			% within Yea	10.7%	8.2%	5.3%	1.4%	1.7%	9.4%	3.1%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Lameness * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
Fever * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
abx_Improve * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
result_1 * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%
study_prob_def * Year_id * Practice_id	1048	100.0%	0	.0%	1048	100.0%

Lameness * Year_id * Practice_id Crosstabulation

				Year_id						
Practice_id				2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	Lamenes	No	Count					116	21	137
			% within Yea					97.5%	95.5%	97.2%
		Yes	Count					3	1	4
			% within Yea					2.5%	4.5%	2.8%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Sho Animal Hosp	Lamenes	No	Count	10	13	56	352	189	33	653
			% within Yea	35.7%	26.5%	49.1%	81.3%	82.2%	62.3%	72.0%
		Yes	Count	18	36	58	81	41	20	254
			% within Yea	64.3%	73.5%	50.9%	18.7%	17.8%	37.7%	28.0%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Fever * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hospi	Fever	None	Count					117	22	139
			% within Yea					98.3%	100.0%	98.6%
		Any Elevat	Count					2	0	2
			% within Yea					1.7%	.0%	1.4%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Shor Animal Hospi	Fever	None	Count	13	19	62	330	179	34	637
			% within Yea	46.4%	38.8%	54.4%	76.2%	77.8%	64.2%	70.2%
		Any Elevat	Count	6	11	24	64	39	11	155
			% within Yea	21.4%	22.4%	21.1%	14.8%	17.0%	20.8%	17.1%
		>103	Count	9	19	28	39	12	8	115
			% within Yea	32.1%	38.8%	24.6%	9.0%	5.2%	15.1%	12.7%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

abx_Improve * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	abx_Impr	No	Count					109	21	130
			% within Ye					91.6%	95.5%	92.2%
		Yes	Count					10	1	11
			% within Ye					8.4%	4.5%	7.8%
	Total		Count					119	22	141
			% within Ye					100.0%	100.0%	100.0%
Eastern Shc Animal Hosp	abx_Impr	No	Count	6	13	64	314	184	49	630
			% within Ye	21.4%	26.5%	56.1%	72.5%	80.0%	92.5%	69.5%
		Yes	Count	22	36	50	119	46	4	277
			% within Ye	78.6%	73.5%	43.9%	27.5%	20.0%	7.5%	30.5%
	Total		Count	28	49	114	433	230	53	907
			% within Ye	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

result_1 * Year_id * Practice_id Crosstabulation

Practice_id				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hosp	result_1	Missing	Count					4	2	6
			% within Yea					3.4%	9.1%	4.3%
		Positive	Count					115	20	135
			% within Yea					96.6%	90.9%	95.7%
	Total		Count					119	22	141
			% within Yea					100.0%	100.0%	100.0%
Eastern Shoi Animal Hosp	result_1	Missing	Count	12	20	10	6	9	5	62
			% within Yea	42.9%	40.8%	8.8%	1.4%	3.9%	9.4%	6.8%
		Positive	Count	13	25	98	421	217	43	817
			% within Yea	46.4%	51.0%	86.0%	97.2%	94.3%	81.1%	90.1%
		Negativ	Count	3	4	6	6	4	5	28
			% within Yea	10.7%	8.2%	5.3%	1.4%	1.7%	9.4%	3.1%
	Total		Count	28	49	114	433	230	53	907
			% within Yea	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

study_prob_def * Year_id * Practice_id Crosstabulation

Practice_i				Year_id 2000.00	2001.00	2002.00	2003.00	2004.00	2005.00	Total
Accomack Animal Hc	study_prc	Does Not me Probable	Count					119	22	141
			% within Y					00.0%	00.0%	00.0%
	Total		Count					119	22	141
			% within Y					00.0%	00.0%	00.0%
Eastern S Animal Hc	study_prc	Does Not me Probable	Count	24	42	102	428	228	50	874
			% within Y	85.7%	85.7%	89.5%	98.8%	99.1%	94.3%	96.4%
		Meets Study	Count	4	7	12	5	2	3	33
			% within Y	14.3%	14.3%	10.5%	1.2%	.9%	5.7%	3.6%
	Total		Count	28	49	114	433	230	53	907
			% within Y	00.0%	00.0%	00.0%	00.0%	00.0%	00.0%	00.0%

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
abx_Used * study_prob_def	1048	100.0%	0	.0%	1048	100.0%

abx_Used * study_prob_def Crosstabulation

			study_prob_def		Total
			Does Not meet Study Probable	Meets Study Probable	
abx_ Used	Amoxicil	Count	1	0	1
		% within abx_Used	100.0%	.0%	100.0%
	Doxycycl	Count	1014	33	1047
		% within abx_Used	96.8%	3.2%	100.0%
Total		Count	1015	33	1048
		% within abx_Used	96.9%	3.1%	100.0%

References

1 Greene C E, Appel M, Straubinger R K. Lyme Borreliosis. Infectious Diseases of the Dog and Cat 2nd Ed. 1998;(45)282-91
2 Steere, Allen C. Borrelia burgdorferi (Lyme disease, Lyme Borreliosis). Principles and Practices of Infectious Disease 5th Ed. 2000;(231)2504-14
3 Center for Disease Control and Prevention. Lyme Disease-United States, 2001-2002. MMWR. 2004 May; 53(17);365-369
4 Virginia Department of Health. Preventing Tick-borne Diseases in Virginia. 2005 May.
5 Bunnell JE, Price SD, Das A, Shields TM, Glass GE. Geographic information systems and spatial analysis of adult Ixodes scapularis (Acari: Ixodidae) in the Middle Atlantic region of the U.S.A. J Med Entomol. 2003 Jul;40(4):570-6.
6 Sonenshine DE, Ratzlaff RE, Troyer J, Demmerle S, Demmerle ER, Austin WE, Tan S, Annis BA, Jenkins S. Borrelia burgdorferi in eastern Virginia: comparison between a coastal and inland locality. Am J Trop Med Hyg. 1995 Aug;53(2):123-33.
7 Center for Disease Control and Prevention. "Reported Cases of Lyme Disease by Month of Illness Onset-United States Lyme Disease Cases, 1992-2003" Available at: www.cdc.gov/ncidod/dvbid/lyme/ld_rptmthofill.htm
8 Heymaan, David. Lyme Disease. Control of Communicable Disease Manual. 2004;315-320
9 Littman M P. Canine borreliosis. Vet Clin Small Anim. 2003 (33)827-862.
10 Levy S, O'Connor TP, Hanscom JL, Shields P. Utility of an in-office C6 ELISA test kit for determination of infection status of dogs naturally exposed to Borrelia burgdorferi. Vet Ther. 2002 Fall;3(3):308-15
11 IDEXX Laboratories. Canine Heartworm Antigen/Borrelia Burgdorferi/Ehrlichia Canis Antibody Test Kit. 2002.
12 Linenmayer JM, Marshal D, Onderdonk AB. Dogs as sentinels for Lyme disease in Massachusetts. Am J Public Health. 1991 Nov;81(11):1448-55
13 Duncan AW, Correa MT, Levine JF, Breitschwerdt EB. The dog as a sentinel for human infection: prevalence of Borrelia burgdorferi C6 antibodies in dogs from the southeastern and mid-Atlantic states. Vector Borne Zoonotic Dis. 2005 Summer;5(2):101-9.
14 Goossens H A, van den Bogaard A E. Dogs as Sentinels for Human Lyme Borreliosis in The Netherlands. J Clin Microbiol. 2001 March; 39(3): 844–848
15 Glavanakov S, White DJ, Caraco T, Lapenis A, Robinson GR, Szymanski BK, Maniatty WA. Lyme disease in New York State: spatial pattern at a regional scale. Am J Trop Med Hyg. 2001 Nov;65(5):538-45.
16 Oliver JH Jr, Magnarelli LA, Hutcheson HJ, Anderson JF. Ticks and antibodies to Borrelia burgdorferi from mammals in Cape Hatteras, NC and Assateague Island, MD and VA. J Entomol. 1999 Sep;36(5):578-87.
17 Daniels TJ, Fish D, Levine JF, Greco MA, Eaton AT, Padgett PJ, LaPointe DA. Canine exposure to Borrelia burgdorferi and the prevalence of Ixodes dammini (Acari: Ixodidae) on deer as a measure of Lyme disease risk in the northeastern United States. J Med Entomol. 1993 Jan;30(1):171-8.