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Randolph L. Gordon, M.D., M.P.H., Commissioner
Grayson B. Miller, Jr., M.D., Epidemiologist

Elizabeth Barrett, D.M.D., M.S.P.H., Editor
Vickie L. O'Dell, Layout Editor



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Tick-Borne Diseases in Virginia

Rocky Mountain Spotted Fever

Introduction

Rocky Mountain spotted fever (RMSF) is a rickettsial infection that usually results from the bite of an infected tick, most commonly *Dermacentor variabilis* (American dog tick) in Virginia. The affected patient presents initially with a sudden onset of high fever (102° F or above), myalgia and headache. Gastrointestinal involvement may include nausea, vomiting, diarrhea, and abdominal pain and tenderness. The hallmark of the disease is a distinctive spotted rash occurring in 84%-91% of the patients within 3-5 days of exposure. The rash typically starts on the wrists and ankles. Involvement of the palms is characteristic of RMSF, however it only occurs in 36%-82% of the patients who develop a rash. With prompt recognition and

treatment, death is uncommon. Without treatment, death may occur 8-15 days after onset. In fulminant RMSF, death occurs within the first five days. Several factors contribute to the difficulty in diagnosing fulminant RMSF: the course is rapid; the rash develops shortly before death if at all; antibodies to *Rickettsia rickettsii* do not have time to develop; and

antibody titer to the spotted fever group antigen by immunofluorescent antibody (IFA), complement fixation (CF), latex agglutination, microagglutination or indirect hemagglutination test in acute- and convalescent-phase specimens, ideally taken ≥ 3 weeks apart; a single titer ≥ 64 by IFA or ≥ 16 by CF; demonstration of positive immunofluorescence of a skin lesion or organ tissue; or isolation of *R. rickettsii* from a clinical specimen.

Results

Results

A total of 231 confirmed cases of RMSF were reported in Virginia from 1988 to 1996, with a low of 14 cases in 1993 and a high of 54 cases in 1996 (mean=25.7 cases per year). The annual rate per 100,000 persons ranged from 0.2 in 1993 to 0.8 in 1996 with a mean of 0.4 (Figure 1). The majority (87%) of cases occurred in whites; 59% occurred

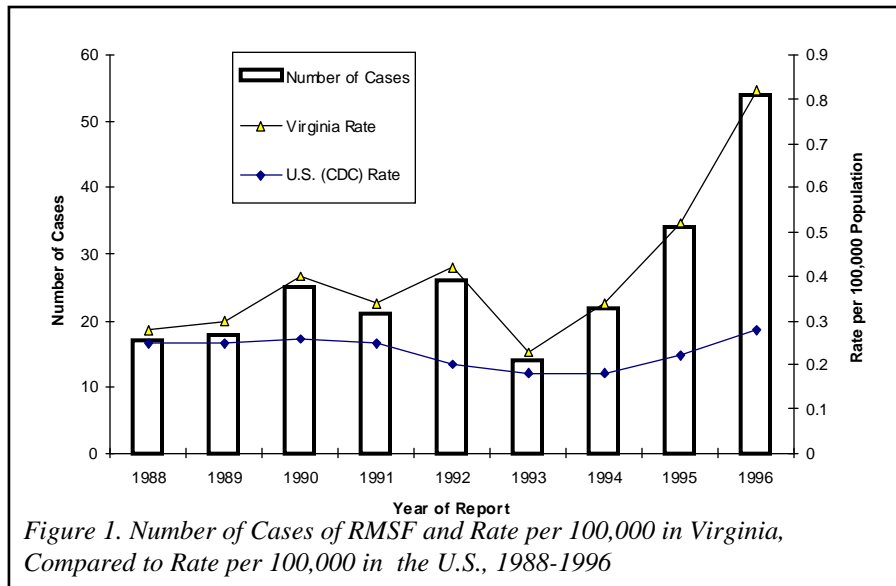


Figure 1. Number of Cases of RMSF and Rate per 100,000 in Virginia, Compared to Rate per 100,000 in the U.S., 1988-1996

the pathologic lesions appear different from those of classic RMSF, containing more thrombi and lacking the characteristic lymphohistiocytic component.

Methods

Data were obtained from the 1988-1995 annual reports and individual case reports from 1988-1996. A case of Rocky Mountain spotted fever was defined as a clinically compatible illness with one of the following laboratory criteria: a fourfold or greater rise in

in males. Age ranged from less than one year to 87 years (median=37 years). Almost all (94%) of the cases had onset during April through September.

Approximately 56% of affected individuals reported being bitten by a tick, 18% had been in a tick infested area, and 6% claimed they had no known exposure to a tick. The tick exposure status was unknown for 19% of the cases. A rash was reported by 43% of the cases. Four persons died for a case-fatality rate of 2%. RMSF appears to occur sporadically throughout the state (see map on

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page 4). No obvious clusters or outbreaks were identified.

Discussion

Although there has been an increase in RMSF in the last three years, the overall trend fluctuates. When the twenty year trend was examined, it showed that RMSF has undergone a dramatic decrease since the late 1970s and early 1980s but now may be undergoing a resurgence. For the years 1988 to 1996, the annual incidence rate of RMSF in Virginia was above the national rate, for an average rate of 0.4 cases per 100,000 population compared to 0.2 cases per 100,000 nationally (Figure 1). Due to the ease of treatment in its early stage, and a strict case definition which requires immunologic testing or a biopsy, RMSF is probably significantly under reported.

Lyme Disease

Introduction

Lyme disease is a spirochetal infection usually transmitted by the tick *Ixodes scapularis* (deer tick). It is characterized by a highly variable clinical course ranging from a transient single system infection to chronic multi-system involvement of the skin, nerves, and joints over a period of years. The classic first symptom is erythema migrans (EM), a distinctive skin lesion occurring 3-32 days after the initial tick bite in approximately 60%-80% of patients. EM may be accompanied by fatigue, fever, headache, mild stiff neck, myalgia, and migratory arthralgias. These symptoms can also occur without EM. Within weeks to months after onset of the EM lesion, early neurologic abnormalities may occur, including cerebellar ataxia, facial palsy, and motor or sensory radiculoneuritis. Cardiac abnormalities may develop within a few weeks after onset of EM. Weeks to years after onset (mean=6 months) intermittent episodes of swelling and pain in large joints, particularly the knees, may develop. Of the patients suffering from joint pain, approximately 10% develop chronic Lyme arthritis. Chronic neurologic manifestations may also develop, including encephalopathy, polyneuropathy or leukoencephalitis, sometimes following long periods of latent infection.

Methods

Data from case reports from 1989 (the year Lyme disease became reportable in Virginia) through 1996 were reviewed. A case of Lyme disease was defined as a physician-diagnosed EM lesion of at least 5 centimeters in diameter; or, in the absence of EM, a clinically compatible illness with at least one late mani-

festation that had no alternative explanation and that was laboratory confirmed. Laboratory confirmation included isolation of the spirochete (*Borrelia burgdorferi*) from tissue or body fluid; detection of diagnostic levels of IgM or IgG antibodies to the spirochete in serum or cerebrospinal fluid; or detection of a change in antibody levels in paired acute- and convalescent-phase serum samples.

Information about the vector ticks was provided by state and military entomologists and academic researchers and summarized by the Centers for Disease Control and Prevention (CDC). A county or city with an "established" tick population was defined as a location where at least six *I. scapularis* or two of its three life stages were identified. A county or city with a "reported" tick population was defined as a location where at least one *I. scapularis* at any lifestage was identified. Data on vector and reservoir population and infection rates were provided by Old Dominion University and military entomologists.

Results

From 1989 through 1996, a total of 795 cases of Lyme disease were reported in Virginia. None were diagnosed by isolation of the spirochete from tissue or body fluid. The annual number of cases ranged from a low of 54 cases in 1989 to a high of 151 in 1991 (mean=99.4) (Figure 2). The rate per 100,000 persons ranged from 0.8 in 1995 to 2.4 in 1991, with a mean of 1.6. The majority (84%) of cases were white; 51% were males. Age ranged from one year to 97 years with a median of 35 years. Onset of most (83%) cases occurred during the months of April through September.

The following statistics are for 1989 through 1993 only. The majority (75%) of the cases reported symptoms related to acute disease; 44% of the patients fit the case definition for chronic illness and both acute and chronic symptoms were reported for 19% of the cases. Of those who had only reported chronic symptoms, 69% had "recurrent, brief attacks of objective joint swelling"; 27% had neurological problems of which almost half were radiculoneuropathy. Only 5% of those with chronic symptoms reported signs of second or third degree heartblock.

Because exposure location data were rarely reported, the following data are based on county or city of residence. Fairfax County had the highest number of confirmed cases of Lyme disease, representing 13% (100/795) of the total cases. Prince William (81 cases) and Accomack (80 cases) counties had the second and third highest number of cases (see map on page 4).

Counties or cities with "established" tick populations included Accomack, Caroline, Fairfax, James City, Newport News, Stafford, and York. Counties or cities with reported tick populations included Charles City, Fauquier, Nelson, Prince George, and Virginia Beach. This should be considered incomplete information because many localities have not been adequately studied. Of the ticks examined from Accomack and York counties, 4% tested IFA positive for *B. burgdorferi*. The prevalence of *B. burgdorferi* serologically positive white-footed mice, the principle host of Lyme disease in the eastern United States, was 10% in York County and 26% in Accomack County. However, only 3%-4% of the white-footed mice tested were culture positive for *B. burgdorferi*.¹

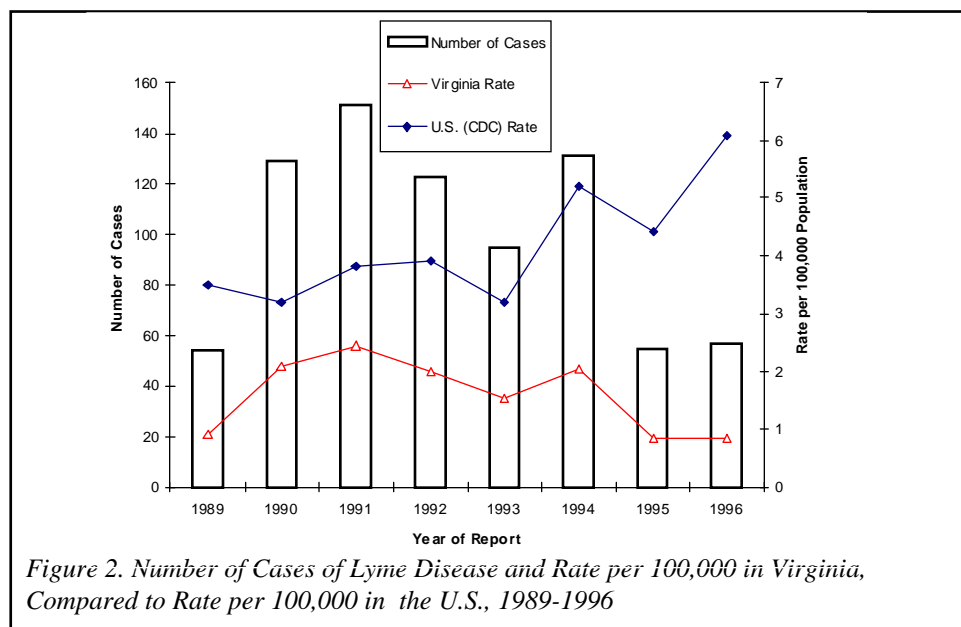
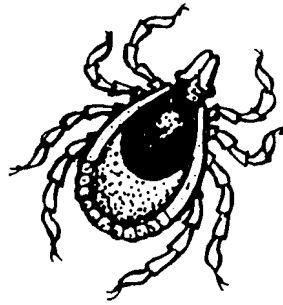


Figure 2. Number of Cases of Lyme Disease and Rate per 100,000 in Virginia, Compared to Rate per 100,000 in the U.S., 1989-1996

Tips on Preventing Tick-Borne Disease

Ticks do not jump or fly onto people or animals (hosts). They wait on low vegetation, attach to hosts as they pass by, and crawl upward. The following steps can protect you against ticks and the diseases they carry:



- Avoid tick-infested areas such as tall grass and dense vegetation.
- Walk in the center of mowed trails to avoid brushing against vegetation.
- Keep grass cut and underbrush thinned in yards. Follow directions carefully if chemicals are used for tick control or hire a professional.
- Eliminate the living places of small rodents.
- Wear light colored clothing so that ticks are easier to see and remove.
- Tuck pant legs into socks and boots. Wear long-sleeved shirts buttoned at the wrists.
- Conduct tick checks on yourself, your children and your pets every four to six hours.
- Apply tick repellent to areas of the body and clothing that may come in contact with grass and brush. Select repellents specifically for ticks; ones containing approximately 30% DEET or 0.5% permethrin are effective in repelling ticks. Follow directions carefully and do not overuse. Lower DEET concentrations may be safer for children. Some tick repellents can cause toxic or allergic reactions. Permethrin products only work on clothing, not on skin.

Discussion

Over the past three years the number of cases of Lyme disease in Virginia has declined from 131 cases in 1994 to 55 cases in 1995 and 57 cases in 1996. This decrease may be due to a true decrease in Lyme disease or a change in reporting of the disease. Even during years when more cases were reported, the incidence rate for Virginia was well below that of the rest of the nation. Virginia does not appear to have as high a proportion of infected vectors and hosts as the New England area which reports approximately 92% of the human cases of Lyme disease in the United States. The percentage of mice from southern Connecticut that had positive cul-

tures of *B. burgdorferi* (47%) is much higher when compared with similar hosts in Virginia (3%-4%). The same data showed that 38% of small mammals in New England were serologically positive for *B. burgdorferi* compared to 10%-26% in Virginia. Studies in the northeastern and north central regions of the United States demonstrated that 20%-100% of ticks were IFA positive for *B. burgdorferi* compared to 4% in Virginia. Research has demonstrated that the *I. scapularis* density in white-footed mice in Connecticut is 90% greater than the density in Virginia.¹ Of the Virginia counties where the greatest number of cases of Lyme disease have been reported, Fairfax and Accomack have established *I. scapularis* populations according to CDC.

The age, sex, and race distributions of Lyme disease patients in Virginia were compatible to those reported for the rest of the country. The seasonality of onset and presentation of clinical symptoms were also similar to those reported for the nation.

Ehrlichiosis

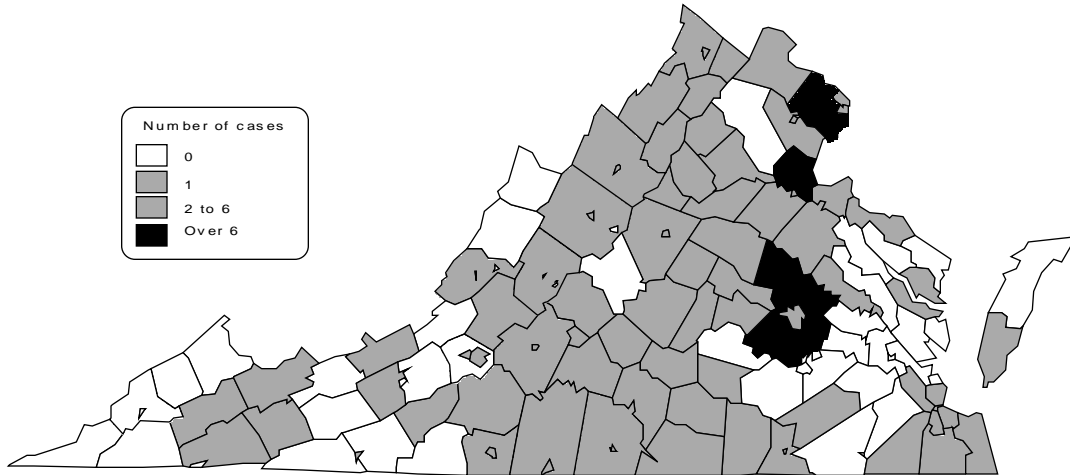
Introduction

Ehrlichiosis is caused by a group of small gram negative pleomorphic bacteria that are transmitted via the bite of an infected tick. Ehrlichiosis was considered an animal disease in the United States until 1986 when the first human case was diagnosed. To date, two species of *Ehrlichia* have been identified in humans in the United States. *E. chaffeensis*, which has been observed primarily in monocytes and macrophages in peripheral blood smears, causes a systemic illness called human monocytic ehrlichiosis (HME). The disease is characterized by an early onset of fever, chills, headache, myalgia, and malaise. Later symptoms include nausea, anorexia, and weight loss. Less than half of the patients present with a maculopapular rash. Respiratory and renal insufficiency, central nervous system abnormalities, gastrointestinal hemorrhage, and possibly death represent the severe complications of ehrlichiosis. Prominent laboratory findings include leukopenia, thrombocytopenia, and elevated liver function tests. The tick vector for *E. chaffeensis* is *Amblyomma americanum* (Lone Star tick). Human granulocytic ehrlichiosis (HGE) is caused by an unnamed species of *Ehrlichia*, originally observed in a peripheral blood smear in human granulocytes. The clinical appearance of HGE is similar to that of HME. Definitive proof of the tick vector for HGE is lacking, but *Ixodes scapularis* (deer tick) is suspected. For both types of ehrlichiosis, additional tick vectors, especially *Dermacentor variabilis* (American dog tick), could be involved. Natural reservoirs for *Ehrlichia* are unknown, but may be deer for *E. chaffeensis*.

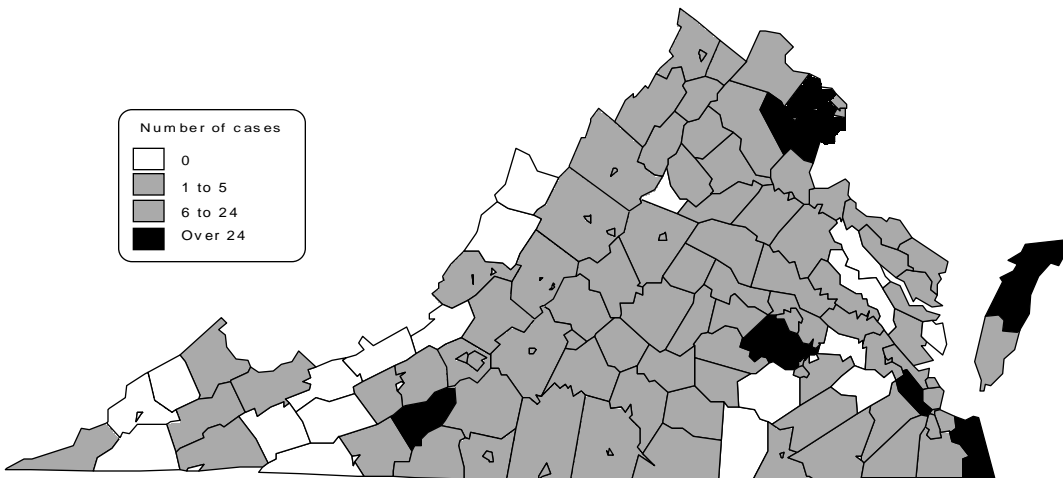
Methods

Data obtained from individual case reports collected by the Office of Epidemiology from 1986 through 1996 were reviewed and analyzed. A case of ehrlichiosis was defined as a clinically compatible illness with one of the following laboratory criteria: a fourfold or greater difference in antibody titer to *Ehrlichia* spp. antigen by immunofluorescence antibody (IFA) test in acute- and convalescent-phase serum specimens ideally taken ≥ 4 weeks apart (currently, HME diagnosis requires *E. chaffeensis* and HGE requires *E. equi* or HGE-agent antigen); a single

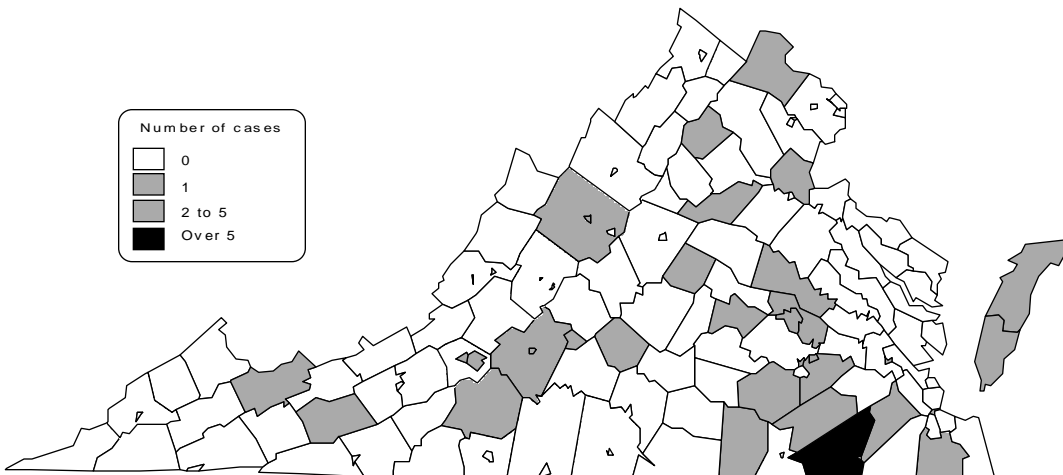
Number of Cases of RMSF by Locality Virginia, 1988-1996



Number of Cases of Lyme Disease by Locality Virginia, 1989-1996



Number of Cases of Ehrlichiosis by Locality Virginia, 1986-1996



IFA ≥ 64 ; positive polymerase chain reaction assay; or intracytoplasmic morulae identified in blood, bone marrow, or cerebrospinal fluid leukocytes.

Results

The number of confirmed cases of ehrlichiosis reported in Virginia ranged from zero in 1993 to 13 in 1989, for a total of 46 cases for the years 1986 through 1996 (mean=4.2 cases per year) (Figure 3). The rate per 100,000 persons ranged from a low of 0.0 in 1993 to a high of 0.2 in 1989 and 1996, with a mean of 0.1. The majority (83%) of cases occurred in whites; males represented 74% of all confirmed cases. Age ranged from five to 87 years with a median 55 years. Ninety-three percent of cases had onset during May through September. To date, no cases of HGE have been reported in Virginia.

Fever (93%), malaise (72%), headache (63%), shaking chills (48%), and myalgias (33%) were the most commonly reported symptoms. Only eight (17%) persons reported a rash. No deaths were reported.

A tick bite or tick attachment was reported by 33 (73%) persons; another four (9%) had been in a tick-infested area. Two (4%) persons reported no known tick exposure and the tick exposure status was unknown for the remainder.

The coastal plain and piedmont physiographic provinces of Virginia accounted for 89% of the ehrlichiosis cases, six of which were from Southampton County. Only five cases were reported from the mountain region (see map on page 4).

Discussion

The Virginia data presented in this report are consistent with national statistics for ehrlichiosis in that the median age of those affected is higher than that for other tick-borne diseases and that males are more likely to be diagnosed with ehrlichiosis than females. The preponderance of cases from the coastal plain and piedmont physiographic provinces may be due to the distribution of the vector.

HGE has not been confirmed in Virginia but has been documented in areas of the U.S. with a high prevalence of Lyme disease, suggesting that the first cases of HGE in Virginia may be expected from the Eastern Shore or other coastal area. In general, physicians and the public are less aware of ehrlichiosis compared with other tick-borne diseases. There is no way to know if the recent increase in reported cases is real or due to increased awareness and reporting. Ehrlichiosis is not a reportable condition in

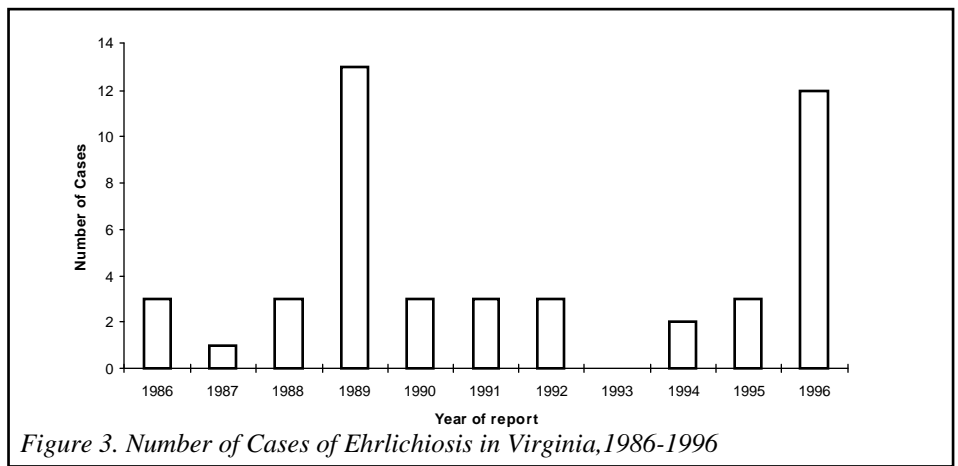


Figure 3. Number of Cases of Ehrlichiosis in Virginia, 1986-1996

Treatment for Tick-Borne Diseases

The treatments of choice for the three most common tick-borne diseases in Virginia, RMSF, Lyme disease, and ehrlichiosis, are agents in the tetracycline family (tetracycline, 25-50 mg/kg/day in 4 divided doses or doxycycline, 100 mg twice daily). For children under 8 or pregnant women with RMSF or ehrlichiosis, chloramphenicol is preferred (although there are reports that chloramphenicol is not ehrlichicidal in cell culture). The oral antibiotics should be continued for at least 5 to 7 days and for at least 48 hours once the patient is afebrile.

Lyme disease treatment depends on the stage of the disease. For adults, the EM stage can usually be treated effectively with doxycycline (100 mg twice daily) or amoxicillin (500 mg four times daily). For localized EM, 2 weeks of therapy is usually sufficient; for early disseminated infection, 3-4 weeks of therapy should be given. Children less than 9 years of age can be treated with amoxicillin (50 mg/kg/day in divided doses) for the same duration as for adults. Cefuroxime axetil (500 mg twice daily) or erythromycin (250 mg four times daily) are alternatives for those who are allergic to penicillin or who cannot take tetracyclines. Lyme arthritis can usually be treated successfully with 4-week courses of the oral agents. However, objective neurologic abnormalities, with the possible exception of facial palsy alone, are best treated with IV ceftriaxone, 2 g once daily, or IV penicillin, 20 million units in six divided doses, for 3-4 weeks. Treatment failures may occasionally occur with any of these regimens and retreatment may be necessary.

Virginia; however, it is requested that the Virginia Department of Health be notified of all suspected cases so that we may learn more about the characteristics and distribution of this disease in our state.

Reference

1. Sonenshine DE, Ratzlaff RE, Troyer J, et al. *Borrelia burgdorferi* in eastern Virginia: comparison between a coastal and inland locality. *Am J Trop Med Hyg* 1995; 53:123-133.

Submitted by: Steven Brandt, Fourth year veterinary student, Virginia-Maryland Regional College of Veterinary Medicine; Suzanne Jenkins, VMD, MPH, Assistant State Epidemiologist.

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, March 1997						Total Cases Reported Statewide, January through March		
	State	Regions					This Year	Last Year	5 Yr Avg
		NW	N	SW	C	E			
AIDS	104	9	20	5	30	40	290	249	306
Campylobacteriosis	18	7	3	5	3	0	50	127	94
Giardiasis	27	1	14	5	4	3	77	57	58
Gonorrhea	736	51	49	134	171	331	2280	2387	2929
Hepatitis A	15	1	7	2	4	1	39	37	37
Hepatitis B	5	0	3	0	0	2	16	38	34
Hepatitis NANB	3	1	0	1	0	1	4	3	7
HIV Infection	90	7	19	8	31	25	258	208	266
Influenza	5	0	0	5	0	0	299	345	618
Legionellosis	1	1	0	0	0	0	1	6	3
Lyme Disease	0	0	0	0	0	0	0	0	7
Measles	0	0	0	0	0	0	0	0	2
Meningitis, Aseptic	9	0	2	2	1	4	30	34	40
Meningitis, Bacterial†	7	3	0	2	1	1	16	18	25
Meningococcal Infections	4	2	1	0	1	0	13	15	17
Mumps	0	0	0	0	0	0	1	3	10
Pertussis	10	7	1	1	0	1	14	0	4
Rabies in Animals	77	27	14	14	15	7	141	115	79
Rocky Mountain Spotted Fever	0	0	0	0	0	0	0	0	0
Rubella	0	0	0	0	0	0	0	0	0
Salmonellosis	42	11	9	5	6	11	131	224	177
Shigellosis	43	3	5	25	7	3	104	100	74
Syphilis, Early*	95	0	9	6	26	54	197	250	311
Tuberculosis	36	4	6	7	10	9	86	43	73

Localities Reporting Animal Rabies: Albemarle 1 raccoon; Alexandria 1 cat, 8 raccoons; Alleghany 1 skunk; Amelia 1 raccoon; Augusta 1 raccoon; Bath 1 raccoon; Bedford 1 cat; Campbell 1 skunk; Chesterfield 1 raccoon; Cumberland 1 skunk; Dinwiddie 1 raccoon; Fairfax 3 raccoons; Fauquier 3 raccoons, 1 skunk; Floyd 1 raccoon; Fluvanna 1 skunk; Frederick 1 dog; Goochland 1 raccoon; Halifax 1 cat, 1 raccoon; Henrico 1 raccoon, 1 skunk; Hopewell 1 raccoon; Isle of Wight 1 raccoon; King and Queen 1 raccoon; Louisa 1 raccoon, 1 skunk; Lunenburg 1 raccoon; Mathews 1 raccoon; Mecklenburg 1 raccoon; Montgomery 1 raccoon; Nelson 1 fox, 1 skunk; Northampton 3 raccoons; Orange 1 raccoon, 1 skunk; Page 1 raccoon; Patrick 1 raccoon; Pittsylvania 3 skunks; Powhatan 1 raccoon; Prince George 1 raccoon; Prince William 2 raccoons; Rockbridge 1 raccoon; Rockingham 4 raccoons, 2 skunks; Russell 5 skunks; Shenandoah 1 skunk; Stafford 2 raccoons; Sussex 1 raccoon; Virginia Beach 1 raccoon; Warren 1 fox.

Occupational Illnesses: Asbestosis 30; Carpal Tunnel Syndrome 6; Hearing Loss 3; Pneumoconiosis 4.

*Data for 1997 are provisional. †Other than meningococcal. ‡Includes primary, secondary, and early latent.

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