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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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Epidemiology of Rabies in Dogs and Cats, Virginia, 1988 - 1996

Background

The first documented case of canine rabies occurred in the United States in Virginia in 1753. Although wildlife species are now the most commonly reported animals with rabies in the nation, as well as in Virginia, dog rabies has not been eliminated. In addition, rabid cats now outnumber rabid dogs in Virginia and the United States. Virginia Department of Health records dating back to 1943 show that rabid dogs outnumbered rabid cats prior to 1966 (Figure 1). In 1966, during a time when fox rabies was endemic in Virginia, 12 dogs and 17 cats were reported as rabid. Cats continued to outnumber dogs until the late 1970s when zero to four rabid cats and dogs were reported each year. In some of those years, rabid dogs outnumbered rabid cats by a small margin. In 1980, with the raccoon rabies outbreak well underway in Virginia, cats became firmly established as the most commonly reported rabid domestic animal. Since then, two to 13 times as many rabid cats as dogs have been reported each year.

Human rabies cases in Virginia and the nation dropped dramatically in the 1950s because transmission of rabies from dog to dog (and then to humans) was controlled with effective canine rabies vaccines and enforcement of stray dog regulations. However, now rabies among cats presents a new challenge. The control of domestic animal rabies is considered an essential public health measure for protecting humans from rabies exposure. Despite the preponderance of rabid wild animals, domestic animals with rabies are more likely to expose humans than are wild animals. A first step in such control requires an understanding of the epidemiology of rabies in these species.

Materials and Methods

Since 1988, the Office of Epidemiology has used a standardized reporting form based upon one developed by the Centers for Disease Control and Prevention (CDC). This form was sent to each health district from which a cat or dog was confirmed with rabies. The health department employee most familiar with the case was asked to complete the form. The data from these forms were entered and analyzed using Epi-Info software (version 5.0, CDC).

Rabies testing on brain material was performed at three state Division of Consolidated Laboratory Services and two local health department rabies laboratories. Specimens were sent to the CDC rabies laboratory for further testing when the results were equivocal. An animal was considered confirmed if a sample of brain material was positive in a state or local laboratory by fluorescent antibody (FA) or mouse inoculation (MI) testing. CDC testing included repeat FA and reverse transcription-polymerase chain reaction (RT/PCR).

Results

Between January 1, 1988 and December 31, 1996, a total of 29,090 animals was tested for rabies in Virginia. Dogs and cats accounted for 13,221 (45%) of these animals. Of the 8,306 cats that were tested, 164 (2%) were positive; 29 (1%) of the 4,915 dogs were positive. The ratio of rabid cats to rabid dogs was 6:1.

The number of rabid dogs and cats increased during the study period (Figure 2). Each year, one to seven rabid dogs were reported compared to seven to 29 rabid cats. Rabid dogs were reported in every month except January and November. Rabid cats were reported in every month with a peak in the warm weather months (Figure 3).

Rabid cats and dogs have been reported from all parts of the state in which wildlife rabies is either endemic or epidemic. The localities reporting the highest numbers of rabid dogs and cats during the study period were Augusta County (13), Rockingham (9), Fairfax (8), Northumberland (8), and Loudoun (7).

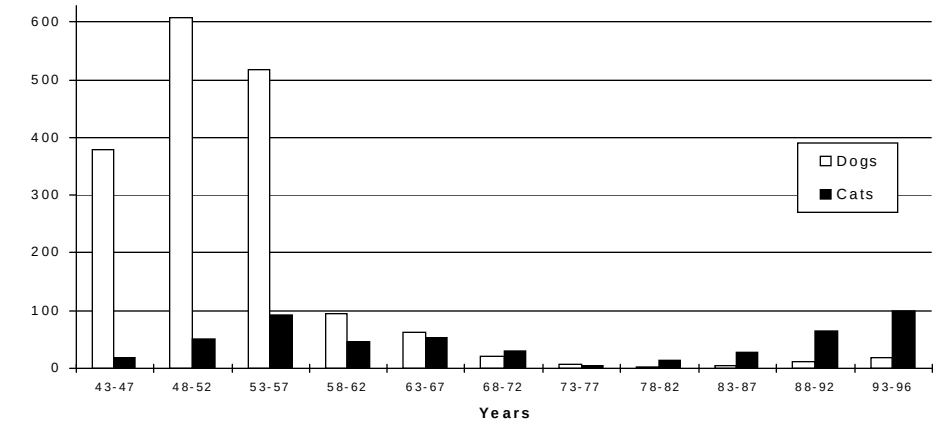

Figure 1. Number of Rabid Dogs and Cats by Five Year Increments, Virginia, 1943-1996*
***Data for 1944 are missing**

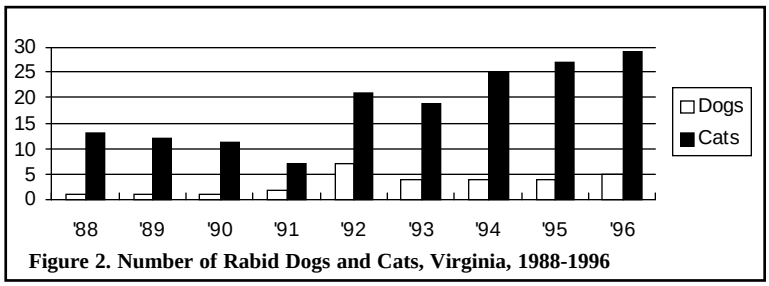

Figure 2. Number of Rabid Dogs and Cats, Virginia, 1988-1996

Dogs

Age was recorded for 25 of the 29 dogs confirmed with rabies. The average age was two years (range: 2 months-7 years). Fifteen (60%) were ≤2 years old. Sex was reported for 25 dogs; males outnumbered females 5:1. None of the 19 dogs for which neuter status was recorded had been neutered. Ten different breeds were represented among the rabid dogs; about half (54%) were described as mixed or cross breed. More pets (72%) than strays (28%) were confirmed rabid. None of the eight stray dogs was wearing a collar, four had been seen previously in the community, and six were regularly fed by someone.

The majority (72%) of rabid dogs came from farms or rural areas; 14% were from suburban areas, 7% from urban environments, and the remainder did not have a location reported. Wild animal contact during the six months prior to onset was reported for ten (34%) of the dogs. The wild animals included raccoons (6), skunks (3), and both (1). Wounds or cuts were observed on four (14%) dogs, two with wounds on the face and two on the legs. Of the 16 pet dogs for which time outdoors was reported, 12 (75%) spent 24 hours per day outdoors; one was out for 12 hours per day, two for ten hours and one for one hour per day. Only six dogs were in a pen or on a leash when outdoors and six spent the night in the house. One dog was used for hunting and none had been out of the country. Two had been missing for 24 hours.

The most commonly reported symptoms were unusual aggressiveness (55%), anorexia and ataxia (48% each), and excessive drooling (31%) (Table 1). Veterinarians examined 15 (52%) of the rabid dogs; an initial diagnosis of rabies was suggested for five (33%).

Seven (24%) of the dogs died naturally; the rest were euthanized or killed. The date of onset and the date of death were reported for five dogs that died naturally. The duration of disease ranged from two days for four dogs to three days for one. All cases were diagnosed by FA of brain material.

Rabies vaccination status was reported as current for two (7%) dogs, expired for four (14%) dogs, and unknown or unvaccinated for the remaining animals. Two different brands of vaccine had been administered to the currently vaccinated animals. Only one of the animals with an expired vaccine had the product name recorded and it was from a different manufacturer than those of the currently vaccinated dogs. One of the two currently vaccinated dogs had been bitten on the face by a raccoon approximately one month prior to the diagnosis of rabies and did not receive a postexposure booster. It was euthanized after it bit a child. The other vaccinated dog was killed while chasing livestock and was not handled as a routine rabies suspect. The head was removed in a non-health department laboratory and transported to another non-health department laboratory where the brain was removed. The brain was then transported to a regional state rabies laboratory where it tested positive for rabies by FA. One of two samples of brain that were subsequently shipped to the CDC was heavily contaminated with a fungal-like organism and was not tested. The other sample was negative by both FA and RT/PCR.

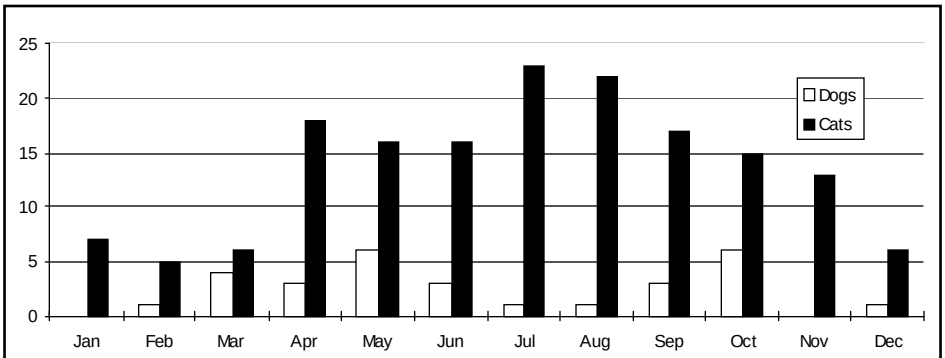

Figure 3. Number of Rabid Dogs and Cats by Month, Virginia, 1988-1996

Postexposure prophylaxis was administered to an average of six (range: 0-21) people per rabid dog for a total of 177 persons treated. Seventeen (10%) persons were bitten by the rabid dogs and 78 (44%) were scratched or licked. The reason for prophylaxis of the other individuals is unknown.

Cats

Age was recorded for 111 of the 164 cats confirmed with rabies. The average age was two years (range: 1 month-6 years). Eighty-eight (79%) were ≤ 2 years of age. Sex was reported for 102 cats; females outnumbered males almost 2:1. Eleven (13%) of the 82 animals for which neuter status was recorded had been neutered, four females and seven males; nine were pets and two were strays. Overall, more strays (67%) than pets (29%) were confirmed rabid. None of the stray cats was wearing a collar; 52 (47%) had been seen previously in the community and 34 (31%) had been fed regularly by someone.

The majority (74%) of rabid cats came from farms or rural areas; 13% were from suburban areas, 9% from urban environments, and the remainder did not have a location recorded. Two rabid cats had reportedly had contact with raccoons and two with skunks during the six months prior to onset. Wounds or cuts were reported on 20 (12%) cats; mostly on legs or feet. Nine cats had an unexplained lameness. Of the 39 pets for which time outdoors was reported, 24 (62%) spent 24 hours per day outdoors. Four more were out for at least 12 hours and eight for between 3 and 9 hours. Twelve cats had been missing for at least 24 hours. Three cats reportedly never went outside. One had been purchased from a pet shop and there was no history on the other two. Each of the three indoor cats had bitten one to three persons.

The most commonly reported symptoms were unusual aggressiveness (73%), irritability (25%), and excitability (23%) (Table 1). Veterinary care was sought for 46 (28%) of the rabid cats. An initial diagnosis of rabies was suspected for 18 (39%) of these cats, five were initially diagnosed with a neurologic disorder, and four were thought to have a urinary and/or respiratory infection. Three cats were reportedly normal.

Twenty-five (15%) cats died naturally; 131 (80%) were euthanized, one was killed on a road, and the remaining seven did not have an explanation for how they died. The duration of disease for the 18 cats that died naturally and for which date of onset was available ranged from one to seven days with an average of three days. Confirmation was made by FA on 161 cats and MI on three.

Rabies vaccination status was reported as current for one cat, expired for two, and unknown or unvaccinated for the remaining cats. The name of the vaccine was recorded for the currently vaccinated animal and one of the cats with an expired vaccination; two different vaccine products had been used. The currently vaccinated animal had a history of

two vaccinations 13 months apart, although the initial vaccination was not documented. Onset of disease was 13 months following the second vaccination. In the six months prior to onset the cat had two possible rabies exposures: contact with a raccoon and an unexplained wound. Postexposure boosters were not administered for either incident.

Postexposure prophylaxis was administered to an average of two people (range: 0-20) per rabid cat for a total of 362 persons treated. One hundred thirty-two persons (36%) were bitten by a rabid cat and 199 (55%) were scratched or licked. The reason for prophylaxis of the remaining individuals is unknown.

Discussion

Although the number of rabid cats has exceeded the number of dogs with rabies nationally for a decade, and in Virginia for most of the last 30 years, little has been written comparing the epidemiology of rabies in these two species. The Virginia data showed some characteristics of rabid cats and dogs that were similar for both species, i.e., both rabid cats and dogs were likely to be young, found in rural areas, and have spent large amounts of time outdoors. This can be explained because the proportion of young animals in the population is larger than that of older animals, and young, rural animals are more likely to be unvaccinated and to run free. In rural areas leash laws are less likely to exist or be enforced and it is more common for animals to be outdoors giving more opportunities for interactions with wildlife that could result in rabies transmission.

The major difference between rabid dogs and cats was the high number of cats compared to dogs. This probably reflects several demographic and behavioral differences between the species: 1) There are more cats than dogs (57 million cats vs. 52.5 million dogs in the US according to the American Veterinary Medical Association); 2) Cats are less likely to be vaccinated and more likely to spend time outdoors and be unsupervised when not confined; and 3) The nocturnal and feeding behavior of cats may offer more opportunities for contact with wild animals, especially raccoons.

Rabid cats were also more likely than rabid dogs to be unowned and female. Populations of stray cats are probably much larger than stray dog populations due to more standardized licensing requirements for dogs, greater willingness by animal control authorities to attempt to control stray dog populations, and less tolerance by the public for dogs running at large. The differences in sex distribution between rabid dogs and cats may reflect a larger female cat population or suggest that male dogs are more likely to confront and fight with larger mammals, such as raccoons. None of the rabid dogs was neutered compared to 13% of the rabid cats.

The most frequently reported symptom for both cats and dogs was unusual aggressiveness. This may mean that most rabid cats and dogs will show signs of aggressiveness or could be a result of aggressive animals being more likely to be tested for rabies. Cats were more likely than dogs to be irritable and excitable and to have a change in voice. Dogs were more likely to lose coordination and appetite, drool excessively, have seizures, be afraid of light and have paralyzed limbs. The variety of symptoms and the fact that rabies was suspected in only about a third of the rabid dogs and cats seen by veterinarians should emphasize the need to suspect rabies in any animal that is sick or acting abnormally until the diagnosis can be ruled out.

The duration of disease for cats and dogs in this study was short (one to seven days for cats and two to three days for dogs) compared with reports in the literature of zero to 14 days. Much of the data on duration of illness is derived from experimental situations where animals were more closely observed under controlled conditions. It is possible that the animals in this study could have exhibited signs at an earlier time than recorded, but that the signs were not recognized.

Table 1. Percentage of Rabid Cats and Dogs with the Following Symptoms, Virginia, 1988 - 1996

Symptom	Cats (n=164)	Dogs (n=29)
Unusual aggressiveness	73	55
Irritability	25	7
Excitability	23	7
Ataxia	4	48
Lethargy	18	17
Anorexia	15	48
Restlessness	14	10
Change in voice	11	0
Excessive drooling	10	31
Dysphagia	8	10
Limb paralysis	8	17
Lameness	7	10
Seizures	4	17
Sensitivity to touch	4	3
Drooping jaw	2	7
Fever	1	3
Photophobia	1	10
No symptoms	2	3

The occurrence of rabies in animals whose rabies vaccination status was current serves as a reminder that absolute protection cannot be guaranteed by any preexposure vaccination. When an exposure is known or suspected, a currently vaccinated animal should receive an immediate booster vaccination. If this recommendation had been followed, rabies may have been prevented in at least two of the animals.

The possibility of laboratory error was raised by the history of one of the dogs that was currently vaccinated. This dog lacked a history of exposure to a rabid animal and may have been engaged in normal activity for that dog, chasing livestock. A possible explanation is that cross contamination occurred either in the laboratory that removed the brain or the one that did the initial FA test. Both laboratories had handled other rabid animals the same day as the dog. It is also possible that there was no rabies virus in the single piece of brain tested at CDC. Laboratories prefer to sample from at least three to four parts of the brain before calling an animal negative.

The greatest risk for human rabies exposure comes from domestic animals that contract the disease. Although hundreds of rabid raccoons and skunks were reported in 1996, human exposure to these animals was relatively rare; far less than one person per rabid animal was exposed. On the other hand, for each rabid dog and cat in this study an average of six and two persons, respectively, received postexposure treatment. Reducing dog and cat rabies would decrease the number of persons receiving costly postexposure treatment.

Several important issues have been raised by this summary of data on rabid dogs and cats in Virginia. The statistics on cats make it clear that more efforts need to be directed toward controlling stray cats and improving vaccination rates for all cats. Currently vaccinated animals that experience a possible exposure to a rabid animal should receive an immediate booster vaccination. Veterinarians and others involved in animal care should have a heightened awareness for rabies so the animals and the humans who may be exposed to them can be managed appropriately.

Submitted by Suzanne R. Jenkins, VMD, MPH, Assistant State Epidemiologist, and Kathy Watson, Virginia Maryland Regional College of Veterinary Medicine, student clerk.

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, February 1997						Total Cases Reported Statewide, January through February		
	State	Regions					This Year	Last Year	5 Yr Avg
		NW	N	SW	C	E			
AIDS	95	11	12	15	17	40	185	146	156
Campylobacteriosis	30	5	6	11	4	4	32	55	54
Giardiasis	48	13	19	7	3	6	50	20	36
Gonorrhea	774	44	115	91	213	311	1544	1538	2038
Hepatitis A	12	1	4	4	3	0	24	11	22
Hepatitis B	11	1	3	5	1	1	11	17	21
Hepatitis NANB	1	0	1	0	0	0	1	1	3
HIV Infection	117	12	29	8	26	42	171	110	150
Influenza	13	0	0	7	0	6	270	296	448
Legionellosis	0	0	0	0	0	0	0	2	1
Lyme Disease	0	0	0	0	0	0	0	0	5
Measles	0	0	0	0	0	0	0	0	1
Meningitis, Aseptic	13	6	0	1	0	6	21	15	25
Meningitis, Bacterial†	6	1	2	1	1	1	9	8	14
Meningococcal Infections	5	1	2	0	1	1	7	11	10
Mumps	1	0	0	0	0	1	1	2	7
Pertussis	4	3	0	0	0	1	4	0	2
Rabies in Animals	46	17	10	8	4	7	64	56	47
Rocky Mountain Spotted Fever	0	0	0	0	0	0	0	0	0
Rubella	0	0	0	0	0	0	0	0	0
Salmonellosis	78	4	22	17	18	17	89	103	114
Shigellosis	54	8	13	20	8	5	61	44	42
Syphilis, Early‡	45	1	10	4	16	14	102	153	178
Tuberculosis	21	0	6	2	6	7	40	25	32

Localities Reporting Animal Rabies: Accomack 1 cat; Albemarle 1 skunk; Alexandria 1 cat, 4 raccoons; Appomattox 1 raccoon; Augusta 1 raccoon; Caroline 1 skunk; Chesterfield 2 raccoons; Fairfax 1 raccoon; Fauquier 2 raccoons; Fluvanna 1 skunk; Franklin County 1 raccoon; Fredericksburg 1 raccoon; Goochland 1 raccoon; Greene 2 raccoons; Greensville 1 skunk; Loudoun 3 raccoons; Newport News 1 raccoon; Northampton 5 raccoons; Orange 1 raccoon; Page 1 raccoon, 1 skunk; Patrick 1 raccoon; Prince William 1 raccoon; Rockbridge 1 skunk; Rockingham 2 raccoons; Russell 1 horse, 1 skunk; Shenandoah 1 skunk; Spotsylvania 1 raccoon; Tazewell 1 horse; Washington 1 skunk; Wythe 1 raccoon.

Occupational Illnesses: Asbestosis 17; Carpal Tunnel Syndrome 4; Mercury exposure 1; Pneumoconiosis 3.

*Data for 1997 are provisional.

†Other than meningococcal.

‡ Includes primary, secondary, and early latent.

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