Epidemiology of Antirabies Treatment In Georgia, 1967–71

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HUMAN RABIES in the United States decreased from 20–25 cases per year in the late 1940s to 1–3 cases a year in the early 1970s (*1–4*). This trend was influenced by a similar decline in the incidence of rabies in domestic animals after the introduction and widespread use of improved animal vaccines and the establishment of more effective animal control programs. During the same period, however, the incidence of wildlife rabies increased; it now accounts for most reported animal cases, and it has become the most serious source of exposure for man.

Despite the decline in rabies in domestic animals, there is still a threat of the disease for man because of the great numbers of animal bites that continue to be reported (*5–7*). Medical management of persons bitten by animals includes specific antirabies treatment, about which a quick decision must be made. When the offending animal is available, quarantine or laboratory studies, or both, provide the obvious answer. However, frequently the animal is not immediately available, and usually the decision is to treat the patient. Since the treatment—whether vaccine alone or vaccine and hyperimmune serum—is not without hazards, the decision to treat is difficult for the physician.

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The Georgia Department of Human Resources has a longstanding, organized program that offers assistance on animal bite cases and similar problems to State physicians. A description and evaluation of the Georgia program for the 5 years from 1967 through 1971 follow.

Description of Program

The Epidemiology Branch of the Georgia Department of Human Resources offers consultation to physicians regarding animal bites and their proper medical disposition. Biologics are also stored and furnished by this branch. Typically, biting incidents are reported directly by physicians, hospitals, county and local health departments, and occasionally patients themselves. Daily reports of laboratory examinations of animals for rabies are likewise screened to identify persons who may be seriously exposed to rabid animals. In addition, the epidemiology branch coordinates the management of incidents requiring quarantine of animals, emergency delivery of specimens or biologics, or both, and "after-hours" laboratory studies.

Investigation of a bite incident is facilitated by the use of a prepared form, which includes statements of date, time, and place of incident; name, age, sex, and weight of victim; and for the animal, species, sex, breed, whether wild, pet, or stray, and vaccination status. A short narrative account of the biting incident is recorded, as well as the followup disposition of the animal, that is, apprehended and confined, unable to locate, head submitted to the laboratory, and so on. Additional information is often available from a local veterinarian on history of vaccination, disease, and temperament of animals. Physicians are asked to note the severity and location of the bites. Environmental health and law enforcement personnel are often dispatched to locate animals and to insure their proper confinement.

A recommendation regarding specific antirabies treatment is made by the epidemiology branch staff, after considering all known circumstances of the particular exposure incident. The recommendations for treatment generally follow those of the Public Health Service Advisory Committee on Immunization Practices (*8*) and World Health Organization guidelines (*9*). The attending physician has the option of altering or disregarding the advice; vaccine with or without hyperimmune serum is supplied if requested, regardless of the recommendations. The overall goal of this program is to suppress unnecessary treatment, minimize cost of treatment for patients, and reduce the incidence of possible postvaccinal reaction.

Results of Evaluation

Antirabies treatment regimens were given to 445 persons in Georgia during 1967–71; a mean of 89 persons received treatment each year. In Georgia, the annual treatment rate was 1.94 per 100,000, whereas the U.S. average was 14.76. The number of persons given antirabies treatment and the rate per 100,000 per year in Georgia, the United States, and other selected States were as follows:

Location	*Population (1970 census)*	*Number persons treated*	*Rate per year*
Georgia, 1967–71	4,589,575	445	1.94
United States, 1970 estimate (*8*)	203,211,926	[1]30,000	14.76
Illinois, 1967–68 (*10*)	11,113,976	1,063	4.78
North Dakota, 1971 (*11*)	617,761	180	29.14
Texas, 1972 (*12*)	11,196,730	634	5.66

[1]Estimated

The epidemiology staff was consulted directly for 233 or 52.4 percent of the 445 persons who received treatment. The treatments that were initiated without consultation were ordered by physicians who did not ask the epidemiology staff to investigate, and information concerning many of these cases was not sent to the epidemiology branch; this lack of data accounts for some of the "unknown" factors in this review.

As shown in the following table, males under 10 years old had the highest rate of antirabies treatment, whereas females age 10 or over had the lowest. The sex and age of 33 patients were unknown; therefore, the overall total adjusted rate for these 33 plus the 412 shown in the table comes to 1.98 per 100,000 per year rather than the 1.80 shown.

Sex and age	*Population, 1970*		*Treated*		
	Number	*Percent*	*Number*	*Percent*	*Rate*
Males:					
Under 10	453,664	9.9	69	16.7	3.04
10 or over	1,777,032	38.7	220	53.4	2.47
Females:					
Under 10	438,356	9.6	36	8.7	1.64
10 or over	1,920,523	41.8	87	21.1	0.91
Total	4,589,575	100.0	412	99.9	1.80

The following figures on the circumstances of exposures to rabid animals show that unprovoked incidents (victims did not initially interact with the offending animals) outnumbered provoked incidents (victims deliberately interacted with the offending animals); a large number of the "not applicable" exposures were nonbite contacts:

Exposure	*Patients*	
	Number	*Percent*
Unprovoked	180	40.4
Provoked	161	36.2
Unknown	43	9.7
Not applicable	61	13.7
Total	445	100.0

Concerning types of exposure, more than one-third of the wounds were single punctures of the extremities, which are relatively mild. The most severe exposures—multiple punctures of the head, neck, or trunk—were seen in 7 percent of the patients. Twenty percent of the patients were treated for "nonbite" ex-

posures—the majority of these had had contact with a laboratory-confirmed rabid animal. The breakdown on types of exposure was as follows:

Type of exposure	*Patients*	
	Number	*Percent*
Single puncture of extremity	157	35.3
Single puncture of head, neck, or trunk	31	7.0
Multiple puncture of extremity	103	23.1
Multiple puncture of head, neck, or trunk	32	7.1
Nonbite exposure	89	20.0
Unknown	33	7.4
Total	445	99.9

Treatments were successful, as evidenced by absence of any deaths from rabies or permanent sequelae to vaccination. Of the 445 persons treated, 77 received hyperimmune serum—these were the most seriously exposed patients. Treatments for 11 patients were discontinued because of reactions, but the reactions were mild. Of some concern was delay between exposure and initiation of treatment. Treatment was given to 46.4 percent of the patients within 3 days after exposure, but for the remaining patients there was a delay of 4 or more days. Of the patients exposed by rabid animals, only a slightly higher percentage (49.5) were treated within 3 days.

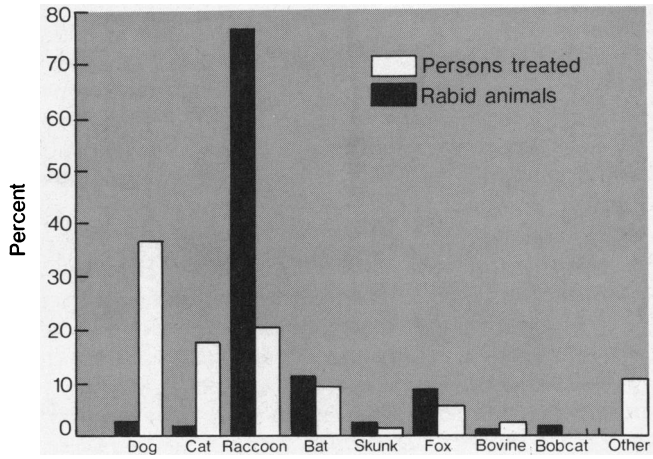
The disposition of the animals associated with the antirabies treatment of the 445 patients was as follows:

Responsible animal	*Patients*	
	Number	*Percent*
Not located	241	54.2
Disposed of without laboratory examination	45	10.1
Laboratory examination positive	104	23.4
Laboratory examination negative	9	2.0
Observed negative	18	4.0
Unknown	12	2.7
Laboratory examination unsatisfactory	16	3.6
Total	445	100.0

Dogs led the list of biting animals, 36.2 percent, followed by raccoons, 20.2 percent, and cats, 17.5 percent. The percentages of rabid animals, by species, and of persons given antirabies treatment are shown in figure 1. More than half of the human treatments, 55 percent, resulted from exposure to domestic animals—dogs, cats, and bovines—that in turn had the lowest incidence of rabies, 2.8 percent. Wild animals—raccoons, bats, skunks, foxes, and bobcats—accounted for 35.2 percent of the treatments, as well the highest incidence of rabies, 97.2 percent. Miscellaneous species, predominantly caged animals, rodents, and lagomorphs, were negative for rabies yet accounted for 9.7 percent of the treatments.

Stray or ownerless pets accounted for 53 percent of the treatments resulting from exposures to cats and dogs; this finding suggests that such animals contribute significantly to the rabies problem. Complementing this factor is the observation that for more than half of the treatment incidents the animals were not located.

Figure 1. Species of 584 animals responsible for antirabies treatment of 445 patients, in percentages, Georgia, 1967–71



Additionally, all factors concerning the 445 antirabies treatments were arranged in tabular form and then individually compared in two-way tables. Several interesting associations were observed, beginning with an age association in which persons over 10 were most likely to have contact with a wild species, sustain single punctures or nonbite exposures of the extremities, and experience a delay in treatment. Children under 10 were most likely to have contact with a domestic species, sustain more head, neck, or trunk bites with multiple punctures, but their treatment was started earlier. Also, persons over 10 tended to provoke more incidents than children under 10. The incidence of provoked animal attacks on human males was greater than provoked attacks on females. Males over 10 years were also the group most likely to encounter or be bitten by a rabid animal.

In 90 incidents of treatment for exposure to raccoons, 59 or 65 percent of the animals were found positive by laboratory examination; however, more than half of these exposures stemmed from provocation. By comparison, less than half of the bat exposures resulted from provocation.

Delay in initiation of treatment was observed most often with exposures by pets and to a lesser degree with exposures by strays—the least delay observed was with exposures by wild animals. Severe wounds, laboratory-positive animals, and quarantined animals were associated with prompt treatment.

For all treatments advised by the epidemiology staff, 65.3 percent of the biting incidents occurred in counties in which there were cases of rabies in the preceding year. For treatments initiated without consultation, however, only 33.8 percent occurred in counties that reported cases of rabies in the preceding year; this finding suggests that when consultation was sought, the epidemiology staff advised treatment for the more seriously exposed persons.

Discussion

Estimates and limited data suggest that the U.S. incidence of animal bites ranges from 215 to 809 per 100,000 population per year (*6, 7, 11–13*). These figures indicate that animal bites are the most frequently reported "disease," with the possible exception of gonorrhea and streptococcal infections. The cost of animal bites in terms of medical care and drugs, public health staff time and effort, and suffering of patients is high.

Our interest focuses on one of the most vexing problems associated with animal bites, that of antirabies prophylaxis. This treatment is costly and painful and presents the hazard of adverse reactions. The attendant risks of this type of treatment can be minimized if only persons with a serious threat of exposure are treated. Sellers, in an early review of rabies treatment records of Georgia, pointed out the risks of treatment in a study of seven reported cases of reactions (*14, 15*), four of which were fatal. Of particular interest was the observation that only two of the seven reactors were bitten by rabid animals; the possibility of exposure for the other five was remote.

Fortunately, the medical community now has available duck embryo vaccine (DEV), which has a lower rate of reaction than nervous tissue vaccine (*16*). However, the DEV can also produce serious reactions and should be cautiously administered only when needed. Hyperimmune equine serum is even more likely to produce sequelae, such as serum sickness and anaphylaxis, especially in older patients.

Our age and sex data indicate that males under 10 years old were more likely to be treated, possibly because of the more adventurous and aggressive behavior of boys, as has been noted in other studies (*10–13*). The males under 10 also sustained more bites on the head, neck, or trunk than males over 10 and females of all ages. Males as a group also received a larger proportion of severe bites than did females.

As for the circumstances of biting incidents, 36 percent were provoked and males over 10 years most frequently provoked animals to bite, as shown earlier in this paper. A provoked bite, at least from domesticated animals, is considered less of a threat of rabies exposure because the animal often is behaving in a natural, protective fashion.

Since domestic animals were responsible for more than half of the biting incidents, it is interesting that they accounted for less than 3 percent of the animal rabies cases; this suggests that some overtreatment may exist in the group exposed by these animals. Martin and co-workers demonstrated similar relationships in Illinois (*10*), and the combined results show how serious rabies in domestic animals could be for human populations. Also of significance was that nearly 10 percent of the treatments resulted from exposures by rodents, lagomorphs, and caged animals, a group presenting little risk of rabies (*17*). This treatment group would have been even larger without the department's efforts to counsel against the necessity of treatment for exposures by these species.

Another problem associated with animals is the inability to locate the offending creature after the incident. This is especially true for feral species that have a high incidence of rabies and are difficult to locate and identify after exposure. In this study raccoons, bats, skunks, and foxes were involved in 157 of the incidents, and in this high-risk rabies group 54 or 34 percent were not located. Interestingly, 79 of the 157 in this group were laboratory-confirmed as being rabid. Generally, more than half of the exposure incidents involved an unapprehended animal; this indicates an area for additional improvement in reducing unnecessary treatment.

Also of concern was delay in beginning treatment—more than 53 percent of the treatments were initiated 4 or more days after the incident. This time lag is especially serious when hyperimmune serum should be administered, because its ability to neutralize virus has been determined experimentally to be most effective within 24 hours after exposure (*18*). Delay in initiation of treatment is largely due to lack of concern by older victims with mild exposures. Severe bites, feral species, and young victims were associated with less delay in initiating treatment.

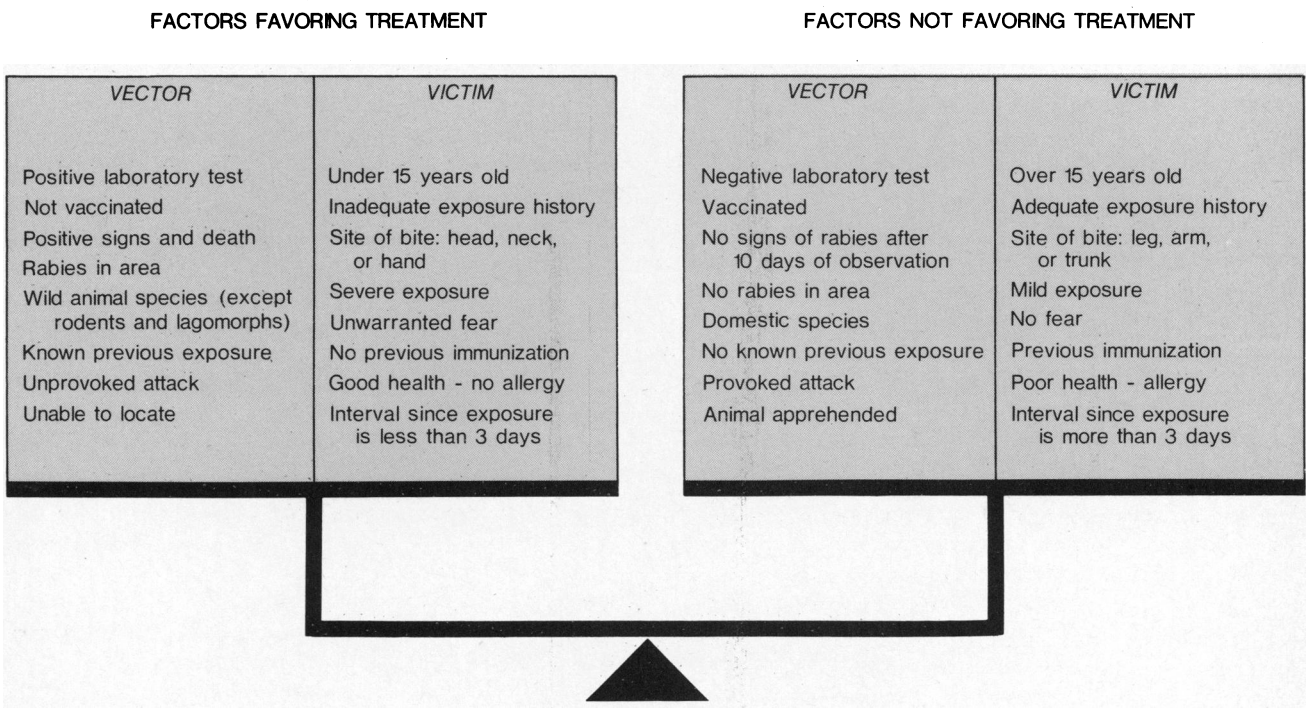
It is especially noteworthy that consultation-investigation of biting incidents reduced the number of treatments that might have ensued without this service. In 1970, the national rate of antirabies treatment was more than seven times higher than Georgia's rate for 1967–71. In the pool of 445 patients treated, 104 were exposed by laboratory-confirmed rabid animals; thus, there was a definite selection of severe exposures for treatment and elimination of unnecessary treatment.

There is a need for further reduction of rabies treatments, even in Georgia. More than half the domestic animal exposures were by stray or ownerless animals, a group amenable to some control. Also, improved enforcement of rabies vaccination of pets would protect citizens with a buffer zone of immune animals. Animal control coupled with improved animal vaccination levels have been demonstrated to control rabies and reduce the number of antirabies treatment series administered in the community (*19*).

Factors to be considered before post-exposure antirabies prophylaxis is initiated are shown in figure 2.

The future for post-exposure treatment of rabies in indeed bright—a tissue culture vaccine is being evaluated (*20*) and human-origin rabies antiserum is now marketed commercially (*21*). Both products will significantly reduce immunologic reactions in treated persons. Two disadvantages will be high cost and limited supply. These disadvantages will create a need for thorough investigation and appraisal of biting incidents to screen for likelihood of rabies exposure and indications for treatment such as described in the Georgia program.

Figure 2. Factors affecting post-exposure antirabies prophylaxis



References

1. Center for Disease Control: Rabies annual summary 1972. Atlanta, Ga. 1973.
2. Held, J.R., Tierkel, E.S., and Steele, J.H.: Rabies in man and animals in the United States. An epidemiologic review. Public Health Rep 82: 1009–1018, November 1967.
3. Winkler, W.G.: Rabies in the United States, 1951–1970. J Infect Dis 125: 674–675, June 1972.
4. Rubin, R.H., Gregg, M.B., and Sikes, R.K.: Rabies in citizens of the United States, 1963–1968: epidemiology, treatment and complications of treatment. J Infect Dis 120: 268–273, August 1969.
5. Berzon, D.R., Farber, R.E., Gordon J., and Kelley E.B.: Animal bites in a large city — a report on Baltimore, Maryland. Am J Public Health 62: 422–426, March 1972.
6. Beck, A. M., Loring, H., and Lockwood, R.: The ecology of dog bite injury in St. Louis, Missouri, Public Health Rep 90: 262–267, May–June, 1975.
7. Harris, D., Imperato, P.J., and Oken, B.: Dog bites — an unrecognized epidemic. Bull. NY Acad Med 50: 981–1000, October 1974.
8. Center for Disease Control: U.S. Public Health Service Advisory Committee on Immunization Practices: Rabies prophylaxis. Morbidity and Mortality Weekly Rep 21 (supplement): June 1972.
9. World Health Organization: Fifth report of the Expert Committee on Rabies. WHO Tech Rep Ser No 321, Geneva, 1966, pp. 16–20.
10. Martin, R.J., Schnurrenberger, P.R., and Rose, N.J.: Epidemiology of rabies vaccinations of persons in Illinois, 1967–68. Public Health Rep 84: 1069–1077, December 1969.
11. Center for Disease Control: Zoonoses surveillance—rabies, June 1972. Atlanta, Ga., 1972, pp. 7–9.
12. The Texas State Health Department: Texas Health Bull 26: 11, June 1973.
13. Brobst D., Parrish, H.M., and Clack, F.B.: The animal bite problem. Vet Med 54: 251–256, May 1959.
14. Sellers, T.F.: Limitations of antirabic treatment. J Med Assoc Ga 35: 132–133, April 1946.
15. Sellers, T.F.: Rabies, the physician's dilemma. Am J Trop Med 28: 453–456, May 1948.
16. Rubin, R.H., Hattwick, M.A.W., Jones, S., Gregg, M.B., and Schwartz, V.D.: Adverse reactions to duck embryo rabies vaccine. Ann Intern Med 78: 643–649, May 1973.
17. Winkler, W.G.: Rodent rabies in the United States. J Infect Dis 126: 565–567, November 1972.
18. Johnson, H.N.: Rabies virus. *In* Viral and rickettsial infections of man, edited by F.L. Horsfall and I. Tamm. J.B. Lippincott Company, Philadelphia, 1965, pp. 814–840.
19. Glosser, J.W., Hutchinson, L.R., Rich, A.B., Huffaker, R.H., and Parker, R.L.: Rabies in El Paso, Texas, before and after institution of a new rabies control program. J Am Vet Med Assoc 157: 820–825, Sept. 15, 1970.
20. Wiktor, J.J., Plotkin, S.A., and Grella, D.W.: Human cell culture rabies vaccine. JAMA 224: 1170–1171, May 21, 1973.
21. Center for Disease Control: Statement of the Advisory Committee on Immunization Practices on the use of human rabies immune globulin. Morbidity and Mortality Weekly Reports 23: 291, Aug. 17, 1974.