# Rabies in Man and Animals in the United States, 1946–65

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IN 1946 the Public Health Service established a national rabies control program in its newly formed Communicable Disease Center. As a part of this program, epidemiologic data pertaining to human and animal rabies have been collected from State health departments and other agencies that have rabies control responsibilities within the various States. This report reviews the epidemiologic characteristics of rabies in man and animals in the United States during the program's first 20 years, 1946–65.

The earliest references to rabies in this country are contained in the historical archives of Virginia for 1753 and of North Carolina for 1762 (*1*). An outbreak in dogs was reported in Boston in 1768. The disease appeared in Philadelphia in 1779. It was recognized throughout the northern States in 1785 and soon after that in the South Atlantic States. Thus, in a 30-year period rabies became widely recognized in the British-American colonies. During the 19th century, reports of rabies in dogs as well as wild animals became more numerous, and by 1909 rabies had been reported in all but nine States (*2, 3*).

In the past 20 years several significant advances have been made in the study and control of rabies. Among these are the development and improvement of new vaccines for immunizing both man and animals, the development of techniques for pre-exposure immunization of persons likely to be exposed to rabies, the discovery of rabies infections in insectivorous bats, the finding that the disease can be transmitted by aerosols, the development of the fluorescent antibody test with its wide application for rapid diagnosis of rabies, and the demonstration that effective communitywide rabies control programs can eliminate the disease from domestic animals in large urban areas. These advances have facilitated detection and control of urban rabies outbreaks and medical management of victims of animal bites. They have also revealed many unsolved problems in the control of sylvatic rabies.

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## Animal Rabies

With improved diagnostic techniques, rabies has been more accurately reported in recent years, and has been shown to be widespread in domestic and wild animals in the United States. By far the highest incidence among domestic animals has been in dogs and, among wild animals, in foxes and skunks (table 1). In 1965 rabies was reported in all but three States: Delaware, Nevada, and Hawaii. Hawaii is the only rabies-free State; the disease has never been reported there.

From 1946 through 1960 there was a steady decline in the overall incidence of rabies, from 10,883 cases to 3,457. Since 1960 there has been a slight increase, to 4,585 cases in 1965 (table 1). The general decrease is largely the result of a dramatic reduction in the number of cases in dogs, eloquent testimony to the success of canine vaccination and well-organized urban rabies control programs. On the other hand, rabies in wildlife species had been increasing steadily during this time and accounted for the overall increase since 1960 (fig. 1).

*Rabies in dogs.* In 1946 there were 8,384 laboratory-confirmed cases of rabies in dogs, but in 1965 there were only 412. Thus, dogs accounted for 75 percent of all cases of animal rabies in 1946, but only 9 percent of the total in 1965. Several factors are probably responsible for this decline. These factors include widespread immunization, stricter enforcement of stray-dog control, more extensive dissemination of public health information which has led to more frequent isolation or disposal of rabies suspects and exposed animals, and better pet care generally. The decline in dog rabies is even more significant in light of an increase in the population of owned dogs. In 1946 there were about 12 million dogs in the United States (*4*); in 1956 there were more than 25 million (*5*). After 1956 there was a downward trend in the dog population to an estimated 22.9 million in 1965 (*6*), still a substantial number over the estimated 1946 population.

*Rabies in wildlife.* Rabies among wildlife species is important not only because of the direct hazard to man, but also because wild animals constitute a large reservoir of infection for dogs. Dogs in turn are more likely to infect man. Wildlife also is a source of infection for livestock. Although rabies has been reported in cattle, sheep, swine, goats, and horses every year for which records are available, the number of cases has been relatively small. While it would be possible for these domestic animals to transmit the disease to other animals, epidemiologic evidence suggests that they are not important in maintaining the disease in nature.

Rabies in skunks and foxes is known to have been a problem in the United States since early

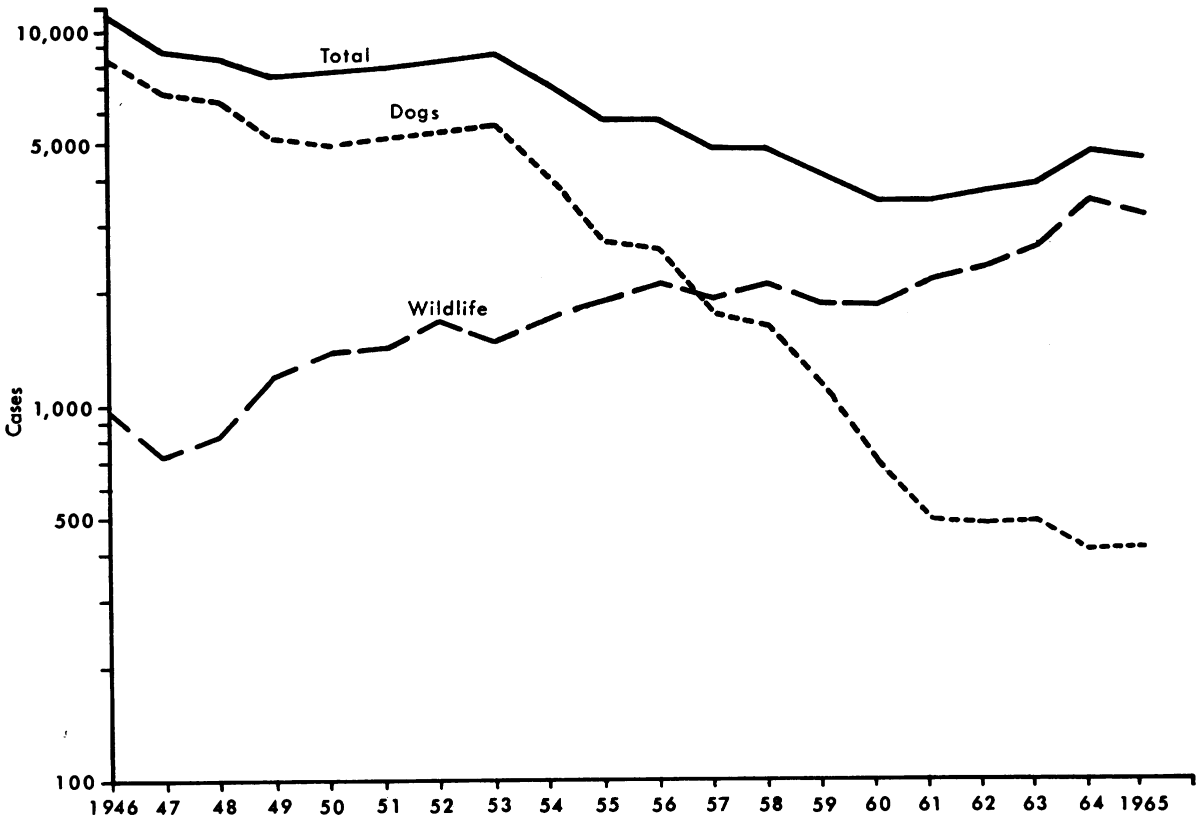
**Table 1. Incidence of rabies in the United States, 1946–65, by type of animal**

| Year | Dogs | Cats | Farm animals | Foxes [1] | Skunks [1] | Bats | Other animals | Man | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1946 | 8, 384 | 455 | 1, 055 | ------ | ------ | ------ | 956 | 33 | 10, 883 |
| 1947 | 6, 949 | 393 | 850 | ------ | ------ | ------ | 728 | [2] 27 | 8, 947 |
| 1948 | 6, 610 | 378 | 688 | ------ | ------ | ------ | 819 | 24 | 8, 519 |
| 1949 | 5, 237 | 413 | 745 | ------ | ------ | ------ | 1, 192 | 10 | 7, 597 |
| 1950 | 4, 979 | 428 | 1, 119 | ------ | ------ | ------ | 1, 375 | [2] 18 | 7, 919 |
| 1951 | 5, 194 | 480 | 947 | ------ | ------ | ------ | 1, 387 | 23 | 8, 031 |
| 1952 | 5, 261 | 486 | 1, 011 | ------ | ------ | ------ | 1, 674 | 26 | 8, 458 |
| 1953 | 5, 688 | 538 | 1, 118 | 1, 033 | 319 | 8 | 119 | 14 | 8, 837 |
| 1954 | 4, 083 | 462 | 1, 032 | 1, 028 | 547 | 4 | 118 | 15 | 7, 289 |
| 1955 | 2, 657 | 343 | 924 | 1, 223 | 580 | 14 | 98 | 5 | 5, 844 |
| 1956 | 2, 592 | 371 | 794 | 1, 281 | 631 | 41 | 126 | 11 | 5, 847 |
| 1957 | 1, 758 | 382 | 714 | 1, 021 | 775 | 31 | 115 | 6 | 4, 802 |
| 1958 | 1, 643 | 353 | 737 | 845 | 1, 005 | 68 | 157 | 6 | 4, 814 |
| 1959 | 1, 119 | 292 | 751 | 920 | 789 | 80 | 126 | 7 | 4, 090 |
| 1960 | 697 | 277 | 645 | 915 | 725 | 88 | 108 | [2] 2 | 3, 457 |
| 1961 | 594 | 217 | 482 | 614 | 1, 254 | 186 | 120 | 3 | 3, 470 |
| 1962 | 565 | 232 | 614 | 594 | 1, 449 | 157 | 114 | 2 | 3, 727 |
| 1963 | 573 | 217 | 531 | 622 | 1, 462 | 303 | 224 | 1 | 3, 933 |
| 1964 | 409 | 220 | 594 | 1, 061 | 1, 909 | 352 | 238 | 1 | 4, 784 |
| 1965 | 412 | 289 | 625 | 1, 038 | 1, 582 | 484 | 153 | [2] 2 | 4, 585 |

[1] Included with "other animals" for 1946–52.
[2] Includes 1 person exposed outside the United States.

SOURCES: Animal data—1946–59, U.S. Department of Agriculture; 1960–65, National Communicable Disease Center, Public Health Service. Data on man—National Office of Vital Statistics, Public Health Service, and reports from State health departments to the National Communicable Disease Center.

**Figure 1. Rabies in the United States, 1946–65**




SOURCES: U.S. Department of Agriculture, Animal Disease Eradication Branch, and National Communicable Disease Center, Public Health Service.

in the 19th century, with epizootics of the disease having been reported in these two species at various times (*1*). During 1946–65, skunks and foxes accounted for the majority of cases of rabies among wildlife species. Rabies in foxes has been a problem primarily in the southeast and the Gulf States, but also extending up the Appalachian Mountains into New York. Rabies in skunks, on the other hand, has been a problem mainly in the Great Plains States and in California (fig. 2). In the Great Plains epizootic, cases were first reported from Iowa in 1945. This epizootic has persisted and now it has spread throughout the Midwest, where it is a major problem. During the 20-year study period, geographic patterns changed from time to time; for example, Texas was at first primarily a fox rabies area, whereas during the latter part of the period it was primarily a skunk rabies area.

Bats and raccoons have emerged as two other species important in a consideration of wildlife rabies in the United States. Rabies in insectivorous bats was first recognized in Florida in 1953, and since then rabies virus has been isolated from bats in all States except Alaska, Hawaii, and Rhode Island. In 1965, 484 cases of bat rabies were reported. The incidence of rabies in bats is probably much higher than reported; however, the role of insectivorous bats in the epidemiology of rabies has not been fully determined. There is substantial evidence to indicate that they can transmit the disease to both man and animals not only by biting but also by aerosols (*7*).

Raccoon rabies has been reported sporadically from widespread areas of the United States, and an interesting epizootic is now in progress in the southeastern corner of the country. This epizootic, first recognized in 1955, began in the Everglades of south Florida and moved northward into southern Georgia. Remarkably, a well-defined wave of cases marked its advance all along a broad front. In 1965, 77 of the 99 cases of raccoon rabies reported in the United States occurred in Florida and Georgia.

*Seasonal incidence.* Most cases of animal rabies have been reported in the winter and spring. Incidence data have been reported by month since 1951, and this annual cyclic pattern was seen every year except in 1959, when there was a higher secondary peak of cases in July. Although there is no clear-cut explanation for the annual cyclic pattern, it may be the reflection of more contact between animals during the breeding season, particularly among wildlife species.

## Rabies in Man

During 1946–65, 236 deaths from rabies were reported. There was a general decline in incidence of rabies in man, from 33 cases reported in 1946 to one each for the years 1963 and 1964 and two cases in 1965 (table 1, fig. 3). This decline is undoubtedly a reflection of successful control programs which resulted in sustained reduction of the incidence of the disease in dogs, the greatest single source of infection for man in the United States. Also, distribution of public health information has probably made people more aware of the possibilities of rabies infection, causing them to seek prompt medical care following animal bites.

Before 1959, data on morbidity and mortality were reported to the National Office of Vital Statistics (NOVS). Since 1959 these data have been reported to the National Communicable Disease Center. This review includes information on 19 cases of rabies in man that occurred before 1959 but which were not on NOVS records. The NCDC obtained epidemiologic reports on these cases from the States. Four cases from the 1946–59 NOVS mortality records were eliminated because of subsequent epidemiologic reports from the States which indicated that these were not rabies: one in Louisiana in 1947, one in Maryland in 1956, and two in Texas in 1946. One 1947 case listed in the NOVS reports as from Tennessee, because the patient's usual

**Figure 2. Principal sylvatic rabies areas in the United States, 1946–65**

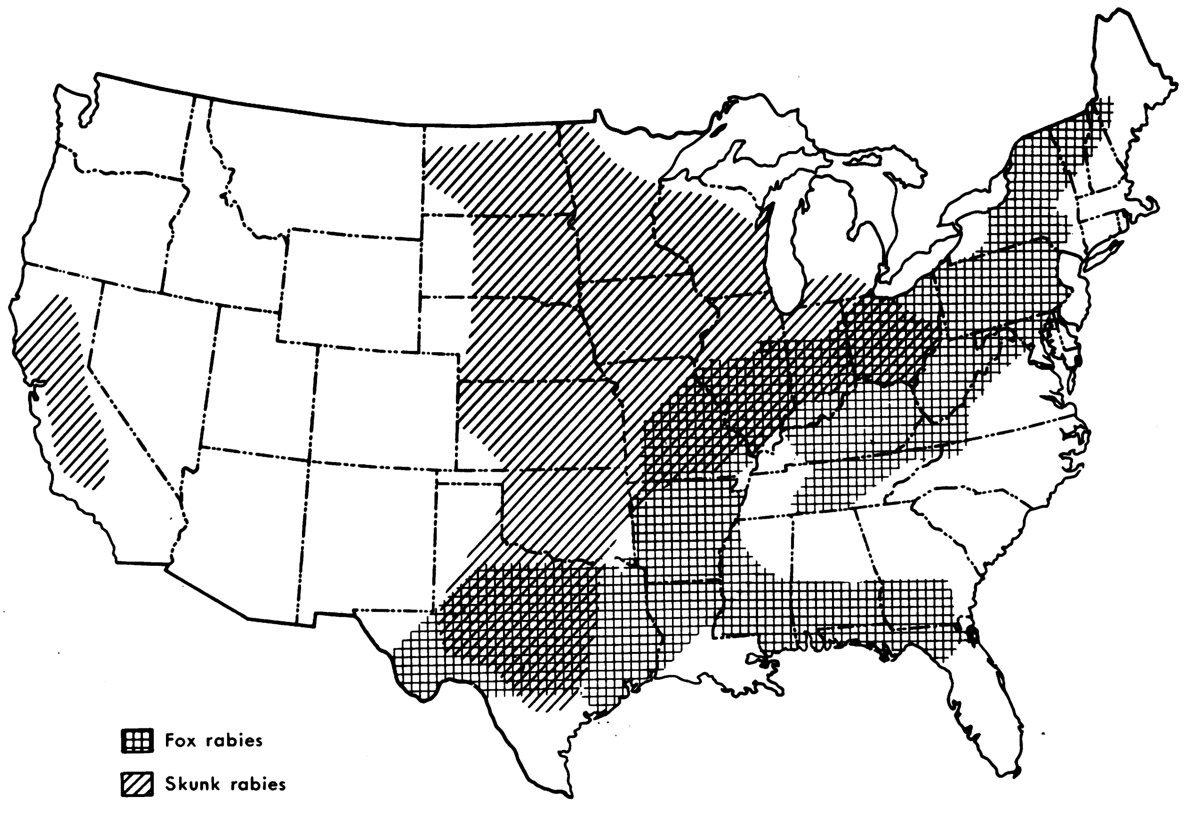
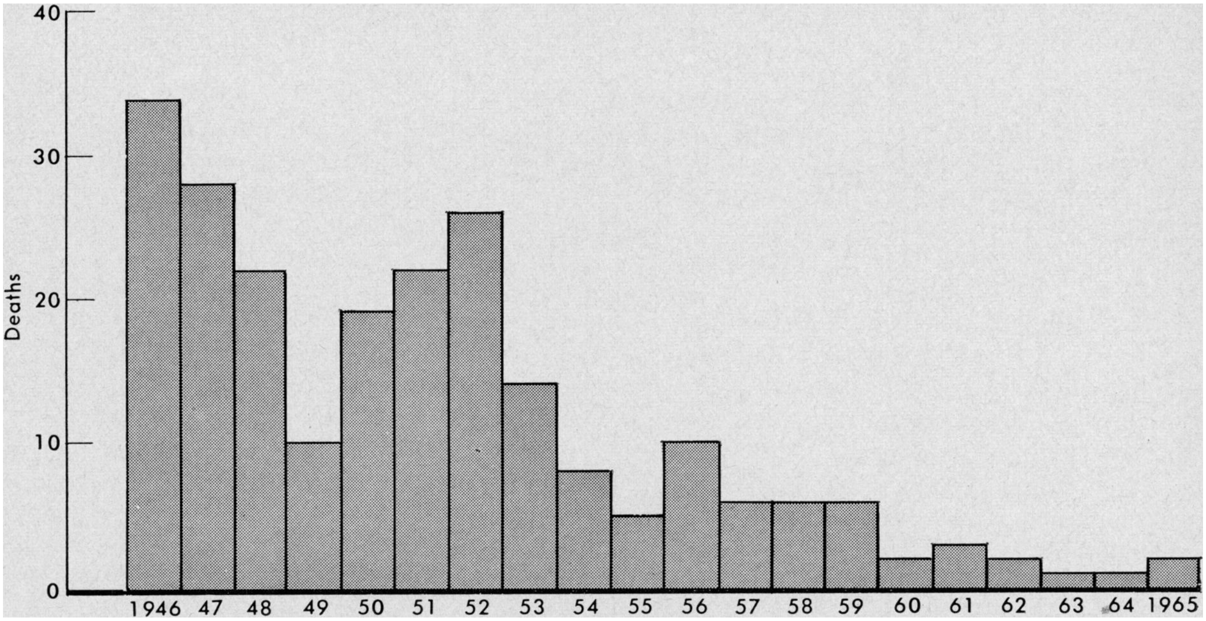


**Figure 3. Number of cases of rabies in man, by year, United States, 1946–65**




SOURCES: National Communicable Disease Center and National Office of Vital Statistics, Public Health Service.

residence was Tennessee, is included in Alabama since exposure and death occurred in that State.

*Geographic distribution.* The greatest number of human deaths occurred in the Southern States (fig. 4). This may be a reflection of sizable urban epizootics of dog rabies that occurred early in the 20-year period and were brought under control. Notable among these epizootics were those in Houston, Memphis, Birmingham, and Atlanta. At the end of the study period, dog rabies continued to be a problem of epizootic proportions in the United States only in the urban areas along the Mexican border.

*Type of animal exposure.* The species of animal responsible for exposure was known in 149 of the 236 cases of rabies in man between 1946 and 1965 (table 2). Dogs were responsible in 122 of the deaths, cats in nine, foxes in seven, skunks in six, and bats in five. All of the human deaths due to exposure to wild animals during the 20-year period were reported after 1951. Possibly such deaths did occur earlier but were overlooked because investigators of cases in human beings were not conditioned to consider anything but exposure to dogs and cats. Also, the reported increase of cases in wildlife may be a real increase possibly because of an increase in the wild animal population, thus affording more opportunity for exposure of man to wildlife rabies. The cases traceable to wildlife have increased steadily since 1951. Nearly half the cases that occurred in the 8 years from 1958 through 1965 were attributed to exposure to wildlife.

Among the five persons exposed to bats, all circumstances relating to the transmission were confirmed in only one case in California in 1958 (*8*). In the other four cases there was strong epidemiologic evidence that bats were the source of infection, but no laboratory examination was made of the biting animal. A sixth case possibly resulted from exposure to bats in Idaho in 1960, but the evidence was not as conclusive as in the previous cases and its cause is categorized as "unknown."

Ownership of the biting animals responsible for the exposure of the 236 rabies victims was as follows.

| *Ownership* | *Number* | *Percent* |
|---|---|---|
| Not reported or unknown | 155 | 65. 7 |
| Stray | 43 | 18. 2 |
| Owned by patient's family | 30 | 12. 7 |
| Owned by family other than patient's | 8 | 3. 4 |

Four of the patients were exposed in a foreign country but died in the United States.

Three were bitten by dogs and one by a cat. Two other reported cases in U.S. citizens who were exposed and died of rabies abroad are not considered in this report.

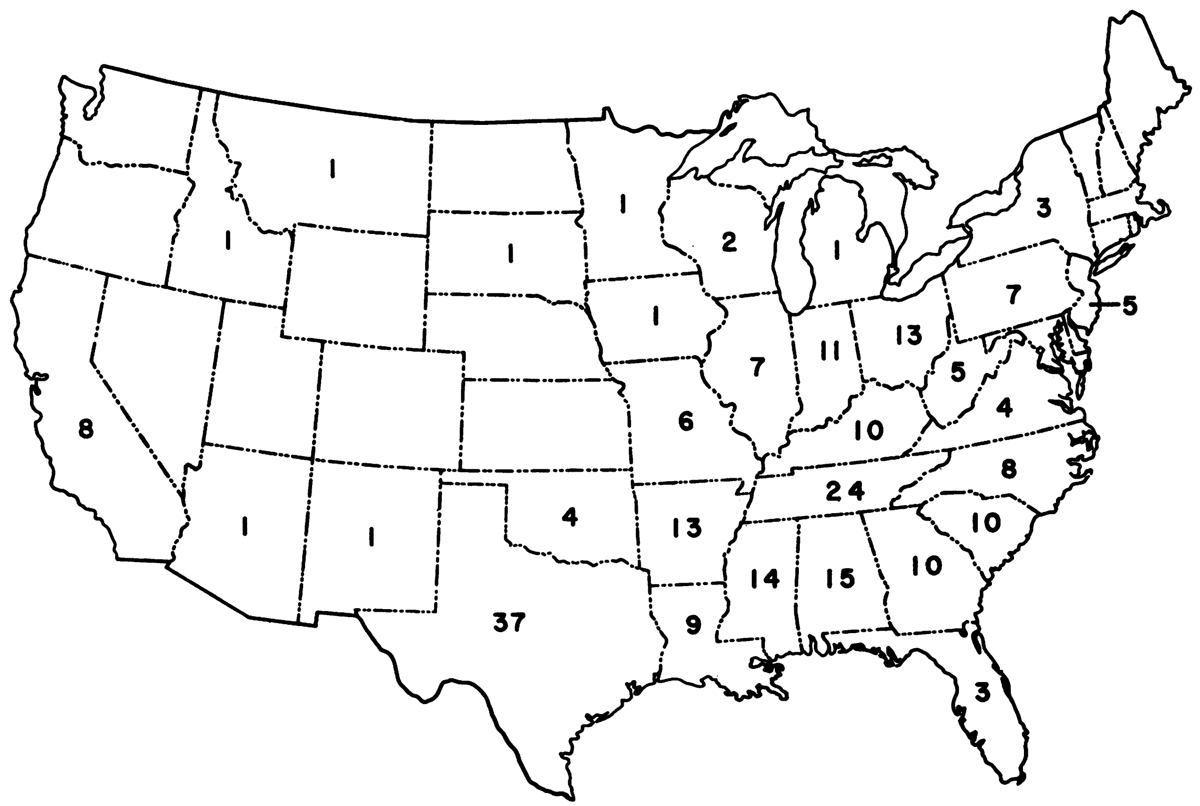
*Month of exposure.* The month of exposure was reported for 104 of the 236 human cases. The seasons with the highest numbers of exposures are those with the lowest number of animal cases reported, that is, spring, summer, and fall. This seasonal distribution is probably due to man's greater outdoor activity in warm months, resulting in a greater opportunity for exposure, and is not directly related to the number of cases in animals. An additional factor may be that heavy clothing worn in cold months provides protection.

*Sex and age group distribution.* Of the 236 persons with rabies, 165 (70 percent) were males and 71 (30 percent) were females. We can conjecture that the preponderance of cases in males reflects the fact that men and boys spend more time outdoors in activities that are more likely to bring them in contact with rabid animals. Interestingly, this relationship holds for nearly all age groups.

By far the highest incidence was in the age groups 0–4, 5–9, and 10–14. Of the 205 victims whose ages were known, 51.3 percent were under 15 years of age. The predominance of deaths among children may be due to several factors, such as the frequency with which children handle animals, particularly dogs; possibly a greater susceptibility to rabies at younger ages; and a greater opportunity for head bites, by far the most dangerous, because of their short stature. A survey of dog bite cases in Pittsburgh showed that 76 percent of the victims were less than 20 years of age, again suggesting that this group is more likely to be exposed (*9*).

*Length of illness and incubation periods.* Length of illness was reported in 154 cases. The median was 4 days, and the range 1 to 20 days.

**Figure 4. 236 cases of rabies in man, by State, 1946–65**




Sources: National Communicable Disease Center and National Office of Vital Statistics, Public Health Service.

Incubation periods, reported for 138 of the 236 cases, ranged from 6 days to 23 months. The reported incubation period of 23 months occurred in 1965 in a man from West Virginia who was bitten by a rabid dog and given postexposure immunoprophylactic therapy. This man may have suffered a subsequent exposure from a rabid fox 6 months before his death, in which case the incubation period would have been shorter. For the remaining 137 cases the incubation periods ranged from 6 to 270 days, with a median of 37 days (table 3). Persons with severe exposures (those characterized by multiple bites, exceptionally deep lacerating bites, or face and head bites) generally had shorter incubation periods than those whose exposures were less severe. Thus, 53 of the 137 persons suffered severe exposures, and their incubation periods ranged from 6 to 156 days with a median of 22 days. Among the 18 persons with reportedly superficial exposures (single bites below the neck, scratches, or licks on fresh wounds) incubation periods ranged from 20 to 270 days with a median of 58.5 days. Among

**Table 2. Species of animal responsible for exposure in 236 cases of rabies in man, by 4-year periods, United States, 1946–65**

| Years | Exposing species reported | | | | | | | | | | Subtotal | Exposing species unreported | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dog | | Cat | | Fox | | Skunk | | Bat | | | | |
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent | Number | Percent | | | |
| 1946–49 | 43 | 89.6 | 5 | 10.4 | 0 | ---- | 0 | ---- | 0 | ---- | 48 | 46 | 94 |
| 1950–53 | 47 | 87.0 | 2 | 3.7 | 3 | 5.6 | 1 | 1.9 | 1 | 1.9 | 54 | 27 | 81 |
| 1954–57 | 23 | 79.3 | 1 | 3.4 | 1 | 3.4 | 3 | 10.3 | 1 | 3.4 | 29 | 8 | 37 |
| 1958–61 | 7 | 46.7 | 1 | 6.7 | 3 | 20.0 | 1 | 6.7 | 3 | 20.0 | 15 | 3 | 18 |
| 1962–65 | 2 | 66.7 | 0 | ---- | 0 | ---- | 1 | 33.3 | 0 | ---- | 3 | 3 | 6 |
| Total | 122 | 81.9 | 9 | 6.0 | 7 | 4.7 | 6 | 4.0 | 5 | 3.4 | 149 | 87 | 236 |

NOTE: Percentages are based on the subtotal of cases with exposing species reported.

SOURCE: National Communicable Disease Center, Public Health Service.

**Table 3. Incubation periods related to severity of exposure and postexposure immunoprophylactic treatment in 137 patients who died of rabies, United States, 1946–65 [1]**

| Treatment | Severe exposure [2] | | | Superficial exposure | | | Unknown or not reported exposure | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of patients | Incubation period (days) | | Number of patients | Incubation period (days) | | Number of patients | Incubation period (days) | | Number of patients | Incubation period (days) | |
| | | Median | Range | | Median | Range | | Median | Range | | Median | Range |
| No treatment | 22 | 32 | 11–156 | 17 | 60 | 20–270 | 44 | 54.5 | 7–240 | 83 | 50 | 7–270 |
| Less than 14 doses of vaccine | [3] 7 | 15 | 6–56 | 0 | ---- | ------ | [4] 9 | 30 | 10–240 | 16 | 26 | 6–240 |
| 14 or more doses of vaccine | [5] 24 | 18.5 | 13–150 | [6] 1 | 57 | ------ | 7 | 40 | 21–90 | 32 | 21 | 13–150 |
| Unknown or not reported | 0 | ---- | ------ | 0 | ---- | ------ | 6 | 42 | 24–75 | 6 | 42 | 24–75 |
| Total | 53 | 22 | 6–156 | 18 | 58.5 | 20–270 | 66 | 44.5 | 7–240 | 137 | 37 | 6–270 |

[1] Excludes 1 patient from West Virginia in 1965.
[2] Includes severe, multiple, deep, and head or face bites.
[3] Vaccine was discontinued for 4 persons because of onset of symptoms in less than 14 days. The person with an incubation period of 56 days received hyperimmune serum followed by 7 doses of vaccine; treatment was then discontinued because of mistaken identification of the biting dog.
[4] Vaccine was discontinued for 3 persons because of the onset of symptoms.
[5] Person with an incubation period of 150 days received hyperimmune serum but no booster doses of vaccine. Excluding this person the range for this group would have been 13–39 days and the median 18 days.
[6] Patient received 3,000 units antiserum late on the third day after bite; 14-dose vaccine treatment was started on fourth day after bite.

the remaining 66 persons for whom the severity was not reported or was unknown, the incubation periods ranged from 7 to 240 days with a median of 44.5 days.

The data suggest that postexposure immunoprophylactic treatment prevented the occurrence of cases which would have had longer incubation periods. No treatment was given 83 persons, and their incubation periods ranged from 7 to 270 days with a median of 50 days. Of those who received 14 or more doses of vaccine, 32 had incubation periods ranging from 13 to 150 days with a median of 21 days. Those receiving less than 14 doses of vaccine had a median incubation period of 26 days, and for seven of the 16 patients in this category vaccine was discontinued because of the onset of symptoms. Those with unknown or not reported histories of immunoprophylactic treatment history had a median incubation period of 42 days.

Among the persons who received 14 or more doses of vaccine, two were also given hyperimmune serum (one of these was the only patient with a superficial exposure who received 14 doses of vaccine). These two patients had incubation periods of 57 and 150 days. Recent evidence suggests that hyperimmune serum possibly interferes with the antigenic effect of the vaccine unless booster doses of vaccine are subsequently administered (*10*, *11*). Neither of

**Table 4. Data on antirabies immunization in 50 cases of rabies in man in which postexposure vaccine was administered, United States, 1946–65 [1]**

| Incubation period (days) | Doses of nervous tissue vaccine | | | | Doses of duck embryo vaccine | |
|---|---|---|---|---|---|---|
| | Less than 14 | 14 or more | 14 plus serum | Less than 14 plus serum | 14 or more | 14 plus serum |
| 0–29 | 8 | 21 | ----- | ----- | 2 | ----- |
| 30 or more | 7 | [2] 4 | [2] 1 | 1 | [2] 3 | [2] 1 |
| Not reported | ----- | 2 | ----- | ----- | ----- | ----- |

[1] Excludes 1 patient from West Virginia in 1965.
[2] Potential treatment failures (see table 5).

SOURCE: National Communicable Disease Center, Public Health Service.

**Table 5. Data on antirabies immunization in 9 cases of rabies in man in which 14 or more doses of vaccine were administered and incubation period was 30 days or more [1]**

| Type of vaccine | Number of doses | Days between exposure and treatment | Hyper-immune antiserum | Incubation period (days) |
|---|---|---|---|---|
| Nervous tissue [2] | 14 | 0 | No | 44 |
| Nervous tissue [2] | 21 | 1 | No | 30 |
| Duck embryo [2] | 14 | 1 | No | 52 |
| Nervous tissue [2] | 21 | 2 | No | 40 |
| Nervous tissue | 14 | 3 | [3] Yes | 150 |
| Nervous tissue [2] | 14 | 3 | No | 90 |
| Duck embryo | 14 | 4 | [3] Yes | 57 |
| Duck embryo | 14 | [4] 6 | No | 31 |
| Duck embryo | 14 | [4] 18 | No | 39 |

[1] Excludes 1 patient from West Virginia in 1965.
[2] Treatment failures.
[3] Eliminated as treatment failures because hyperimmune serum was given without subsequent booster.
[4] Eliminated as treatment failures because of delay between exposure and treatment and a period of less than 30 days between initiation of treatment and onset of symptoms.

SOURCE: National Communicable Disease Center, Public Health Service.

**Table 6. Annual distribution of human antirabies vaccines, number of cases among persons treated, and number of treatment failures, United States, 1946–65**

| Type of vaccine and year | Estimated number of 14-dose treatments [1] | Number of deaths | Treatment failures [2] |
|---|---|---|---|
| Nervous tissue | 569,300 | 44 | 4 |
| 1946 | 53,600 | 3 | 1 |
| 1947 | 49,600 | 4 | 0 |
| 1948 | 49,100 | 7 | 0 |
| 1949 | 41,500 | 3 | 0 |
| 1950 | 39,200 | 3 | 0 |
| 1951 | 41,300 | 4 | 0 |
| 1952 | 40,400 | 3 | 1 |
| 1953 | 38,200 | 5 | 1 |
| 1954 | 37,200 | 3 | 0 |
| 1955 | 30,900 | 1 | 0 |
| 1956 | 30,600 | 2 | 0 |
| 1957 | 23,800 | 2 | 0 |
| 1958 | 22,100 | 1 | 0 |
| 1959 | 16,800 | 1 | 1 |
| 1960 | 15,300 | 1 | 0 |
| 1961 | 12,400 | 0 | 0 |
| 1962 | 6,400 | 0 | 0 |
| 1963 | 8,900 | 0 | 0 |
| 1964 | 6,100 | 0 | 0 |
| 1965 | 5,900 | 1 | 0 |
| Duck embryo | 172,100 | 7 | 1 |
| 1957 | 5,700 | 0 | 0 |
| 1958 | 9,000 | 2 | 0 |
| 1959 | 13,400 | 0 | 0 |
| 1960 | 15,500 | 0 | 0 |
| 1961 | 16,600 | 3 | 1 |
| 1962 | 21,900 | 0 | 0 |
| 1963 | 24,500 | 0 | 0 |
| 1964 | 32,600 | 1 | 0 |
| 1965 | 32,900 | 1 | 0 |
| Total | 741,400 | 51 | 5 |

[1] Calculated from information received from vaccine producers. Information received varied from numbers of doses of vaccine produced, to numbers sold, to numbers distributed, and did not necessarily indicate that all the vaccine was used in the United States or that all the material was used for complete 14-dose treatments.
[2] See table 5.

these patients received booster doses of vaccine after the completion of their primary series of 14 doses.

*Antirabies vaccination history.* Antirabies vaccination history was available for 159 of the 236 persons. None had been vaccinated before the exposure, with the possible exception of the West Virginia man discussed previously. For 51 patients, or 50 excluding this man, vaccine was given after exposure.

Assuming that treatment failure occurs only in patients who have an incubation period of 30 or more days and who receive 14 or more doses of vaccine, treatment failures occurred in only nine of the 50 patients (table 4). Five of the nine patients received nervous tissue vaccine and four received duck embryo vaccine. Delays between exposure and treatment and also administration of hyperimmune antiserum without booster doses of vaccine following the initial series of 14 doses should be considered in judging whether or not treatment failed for the nine patients (table 5).

For six patients there was a delay of 3 days or less between exposure and treatment. One of the six patients received hyperimmune antiserum without boosters. Thus, five may be considered to have suffered true treatment failures: four received nervous tissue vaccine and one received duck embryo vaccine.

Since information is not available on the numbers of persons actually at risk and treated with the two types of vaccine, it is not possible to compare their efficacy or to determine whether either is beneficial. The data available, however, do suggest that immunoprophylactic therapy prevents at least some cases of rabies in man. A crude indication of the numbers of persons at risk was obtained from a survey of producers of vaccine used in the United States during the 20-year period (table 6). Information received varied from numbers of doses of vaccine produced, to numbers sold, to numbers distributed, and did not necessarily indicate that all of the vaccine was used in the United States, nor did it indicate that all of the material was used for complete 14-dose treatments. However, the information was used to calculate an estimated number of 14-dose treatments given during this period. Duck embryo vaccine, available since 1957, is listed separately from nervous tissue vaccine in table 6 because of basic differences in these products.

Interestingly, there was a general decline in the amount of vaccine treatment, coincident with the decline of rabies in animals in the 1950's. Since 1962 there has been a gradual rise in the use of vaccine, especially the duck embryo vaccine. Also of interest is the indication that possibly more than 30,000 persons receive immunoprophylactic treatment for rabies annually in the United States, during a period of relatively low incidence of animal and human rabies, an indication that the presence of rabies and its effects on the human population cannot be measured solely by the number of persons who die of rabies. No doubt today vaccine is given to many persons who have no history of a bona fide exposure to rabies virus. Perhaps the generally accepted concept that duck embryo vaccine is less hazardous than nervous tissue vaccine in producing neuroparalytic accidents has increased the likelihood that proportionately more persons without a bona fide exposure would be treated than heretofore.

## Summary

During the 20-year period 1946–65 the incidence of dog rabies in the United States declined markedly, with a concomitant decline in the number of persons who died of rabies. In the same period, however, there was an increase of cases of rabies in wildlife, principally in skunks, foxes, bats, and raccoons. Wildlife species are now responsible for half the cases in man. The presence of wildlife rabies makes it imperative to continue rabies control programs for dogs. More information on the epidemiology of wildlife rabies and better methods of controlling the disease among these species are needed.

Among human beings, although all ages of both sexes were affected, the majority of cases were in males and in children, presumably because of a greater chance of exposure and possibly greater susceptibility and likelihood of more severe exposure among children.

There is evidence that postexposure immunoprophylactic therapy prevents some cases of the disease in man, particularly in persons for whom longer incubation periods would have been expected. There is no evidence that nervous tissue vaccine is more or less effective than duck embryo vaccine. Pre-exposure immunization of persons in situations where there is a high risk of exposure to rabies should be considered.

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## Examination for American Board of Dental Public Health

The American Board of Dental Public Health has announced that its examination for 1968 will be held June 12–14 in Ann Arbor, Mich., at the School of Public Health. Inasmuch as the date has been advanced from that of the usual fall examination, requests for applications should be made promptly to the executive secretary. The cutoff date for receipt of applications will be April 1, 1968.