Epidemiology of Rabies Vaccinations of Persons in Illinois, 1967–68

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RABIES is usually considered a fatal disease in mammals. For this reason prophylactic measures are initiated when a human being has been exposed to a suspected rabid animal. The rabies prophylaxis consists of thorough cleansing of the bite wound, administration of rabies vaccine, and occasionally antirabies serum. Each year an estimated 30,000 persons in the United States receive postexposure prophylactic rabies vaccine (*1*). The surveillance program described delineates the circumstances in Illinois which lead to the administration of rabies vaccine.

Materials and Methods

Ultraviolet irradiated rabies vaccine of rabbit brain origin is prepared by the Illinois Department of Public Health, division of laboratories, and supplied without cost for administration to Illinois residents.

Each physician requesting State-supplied rabies vaccine in 1967 and 1968 was sent a coded punchcard. The card contained spaces for the following information.

Date of exposure
Species of animal
Status of animal:
  Dead-brain tissue submitted to laboratory for examination
  Dead-brain tissue not submitted
  Under veterinarian's observation
  Not located
Total number of persons exposed
Age and sex of vaccinated person
Anatomic site of exposure
Type of exposure:
  Multiple bite
  Single bite
  Nonbite

The interval between exposure and administration of vaccine was calculated, using the date of exposure and the date the vaccine was mailed or delivered to the physician plus the addition of 1 day to compensate for any shipment delay. When available, the actual date vaccination was initiated was used in calculating the interval. The data for each year were tabulated separately, compared, and combined.

The data obtained from this surveillance program were compared with the findings from routine investigations of animal rabies cases (*2*).

Results

The 1967 and 1968 data were similar for the seven factors previously listed.

Rabies vaccine was dispensed to Illinois physicians on 1,063 occasions in 1967 and 1968. The coded cards were returned by attending physi-

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cians in 937 instances (88 percent). These 937 animals (fig. 1) had exposed 1,011 vaccinees. In 884 instances the animal exposed only one person; 38 animals exposed two or more persons. The number of persons exposed to the other 15 animals was not recorded. The 38 animals exposing two or more persons represented all classifications of species except the bat.

Sex. Of the persons receiving vaccine, 652 (64 percent) were male, 352 (35 percent) were female, and in seven instances (1 percent) the sex was not stated. The number of males was significantly greater ($P=0.00001$) than the number of females. Sex was not associated with any of the other variables studied.

Age. The under-5-year age group contained 132 (13 percent) of the 1,011 vaccinees; 249 (25 percent) were between 5 and 9 years. Thirty-eight percent were 15 or older (table 1). Age was not stated for 67 vaccinees (7 percent).

Type of exposure. A total of 249 patients (25 percent) received two or more bites, and 625 patients each received a single bite (table 1). Nonbite exposures were recorded for 96 persons, and type of exposure was not recorded for 41.

Of the patients less than 5 years old, 36 percent had multiple bites.

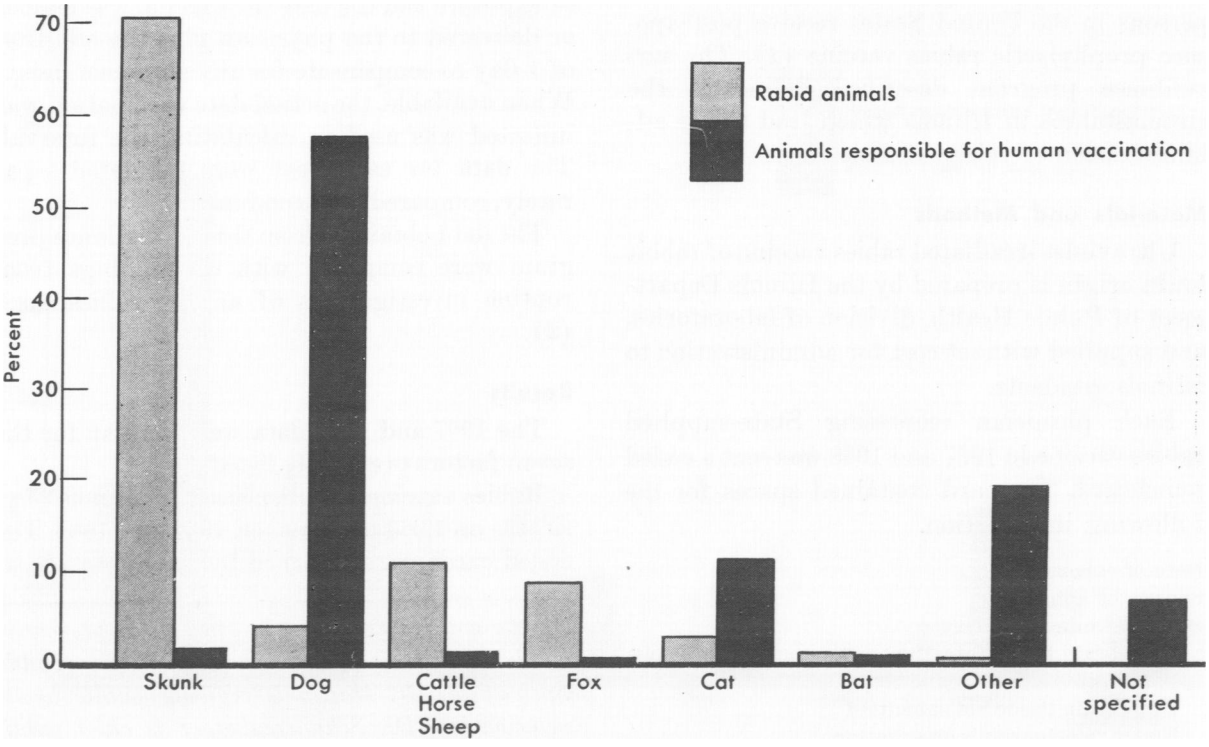
Anatomic site of exposure. Nearly a majority, 472 of the 1,011 vaccinees, reported exposure on hand or arm, and 221 patients were exposed on the head or neck (table 1). Of these 221, 154 were less than 10 years old; 88 had received multiple bites.

Species. Although skunks were only 2 percent (fig. 1) of the 937 animals responsible for human vaccination, this species accounted for 71 percent of the 347 rabid animals reported from Illinois in 1967 and 1968. Conversely, dogs made up 58 percent of the 937 exposing animals but only 4 percent of the State's reported rabies cases.

Of the 1,011 vaccinees, 55 percent were exposed to dogs while only 3 percent were exposed to skunks (fig. 2).

Dogs exposed 82 (62 percent) of the children

Figure 1. Comparison among species of 347 cases of reported animal rabies and 937 animals causing human rabies vaccine to be administered, Illinois, 1967–68



NOTE: Other includes squirrel, rat, mouse, raccoon, chipmunk, gopher, woodchuck, hamster, monkey, rabbit, unidentified rodent, beaver, guinea pig, mole, muskrat, opossum, and shrew.

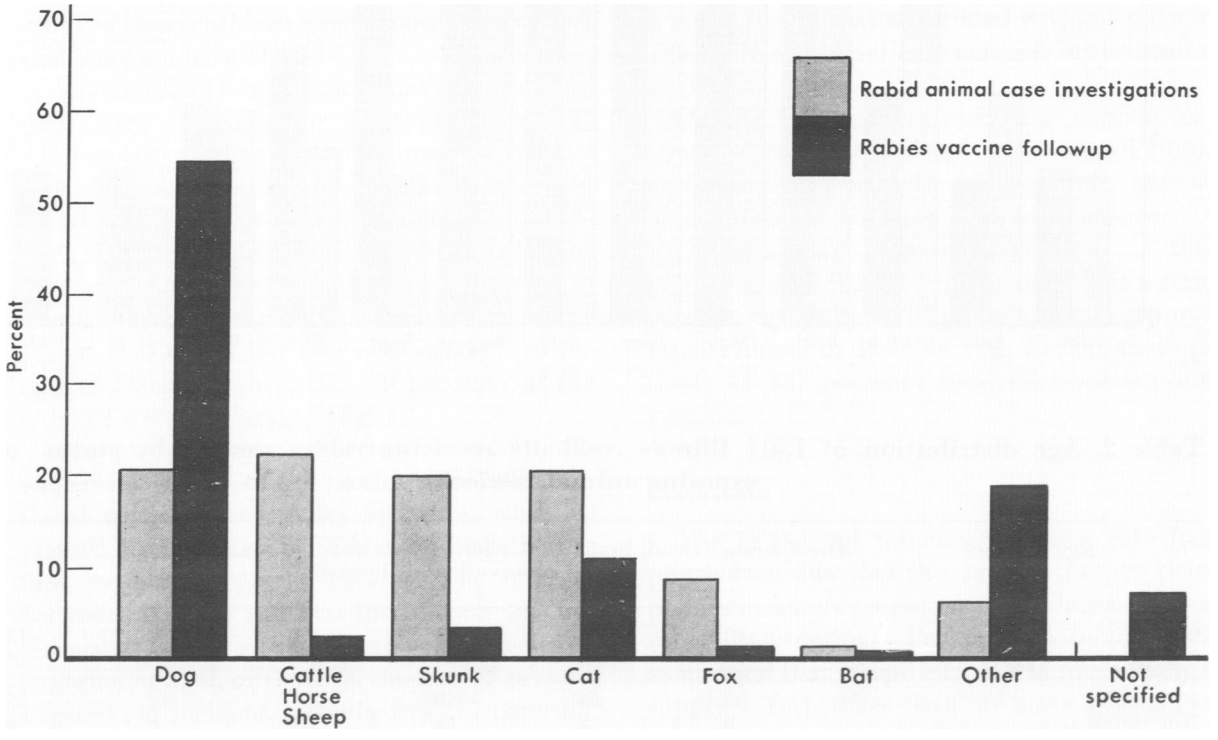
0–4 years of age and 155 (62 percent) of the 249 vaccinees with multiple bites. Also, 181 of the 221 persons exposed on the head or neck received vaccine because of contact with dogs.

Fifty-five percent of the vaccinees were exposed from May through September (fig. 3). When the data were tabulated by month of exposure and species, 79 percent (26 persons) of

Table 1. Age distribution and type of exposure, by anatomic site, of 1,011 Illinois residents receiving rabies vaccine, 1967–68

Age and type of exposure	Legs	Trunk	Head and neck	Arms	Not stated	Total
Age group (in years)	210	33	221	472	75	1, 011
0–4	11	5	75	38	3	132
5–9	44	10	79	100	16	249
10–14	41	10	29	93	8	181
15–19	21	1	10	45	3	80
20–29	18	3	5	42	2	70
30–39	18	1	4	44	5	72
40–49	17	0	2	36	2	57
50–59	21	0	5	25	2	53
60 or older	14	2	3	31	0	50
Not stated	5	1	9	18	34	67
Type of exposure	210	33	221	472	75	1, 011
Multiple bite	48	7	88	102	4	249
Single bite	152	25	123	306	19	625
Nonbite	6	1	6	61	22	96
Not stated	4	0	4	3	30	41

Figure 2. Species of animal exposing Illinois residents to rabies—1,011 persons reported on physicians' followup and 175 persons found in rabies cases investigations, 1967–68



NOTE: Other includes squirrel, rat, mouse, raccoon, chipmunk, gopher, woodchuck, hamster, monkey, rabbit, unidentified rodent, beaver, guinea pig, mole, muskrat, opossum, and shrew.

the exposures to skunks occurred May through July. Twenty-two (67 percent) of the 33 persons exposed to skunks were 15 years of age or older.

Of the animals causing human rabies vaccine to be administered, 20 percent (fig. 1) belonged to other species (squirrel, rat, mouse, raccoon, chipmunk, gopher, woodchuck, hamster, monkey, rabbit, unidentified rodent, beaver, guinea pig, mole, muskrat, opossum, and shrew). Only one animal, a raccoon, was reported rabid from this species list in 1967–68.

Status of exposing animal. Of the 1,011 vaccinees 211, or 21 percent, were exposed to animals that later were under the observation of a veterinarian; 583 (58 percent) were exposed by animals that were not located (table 2). Animals exposing 68 (52 percent) of the 132 vaccinees in the less-than-5-year age group were placed under observation, and only 44 (33 per-

Figure 3. Monthly distribution of 347 reported animal rabies cases and administration of rabies vaccine to 1,011 human beings, Illinois, 1967–68

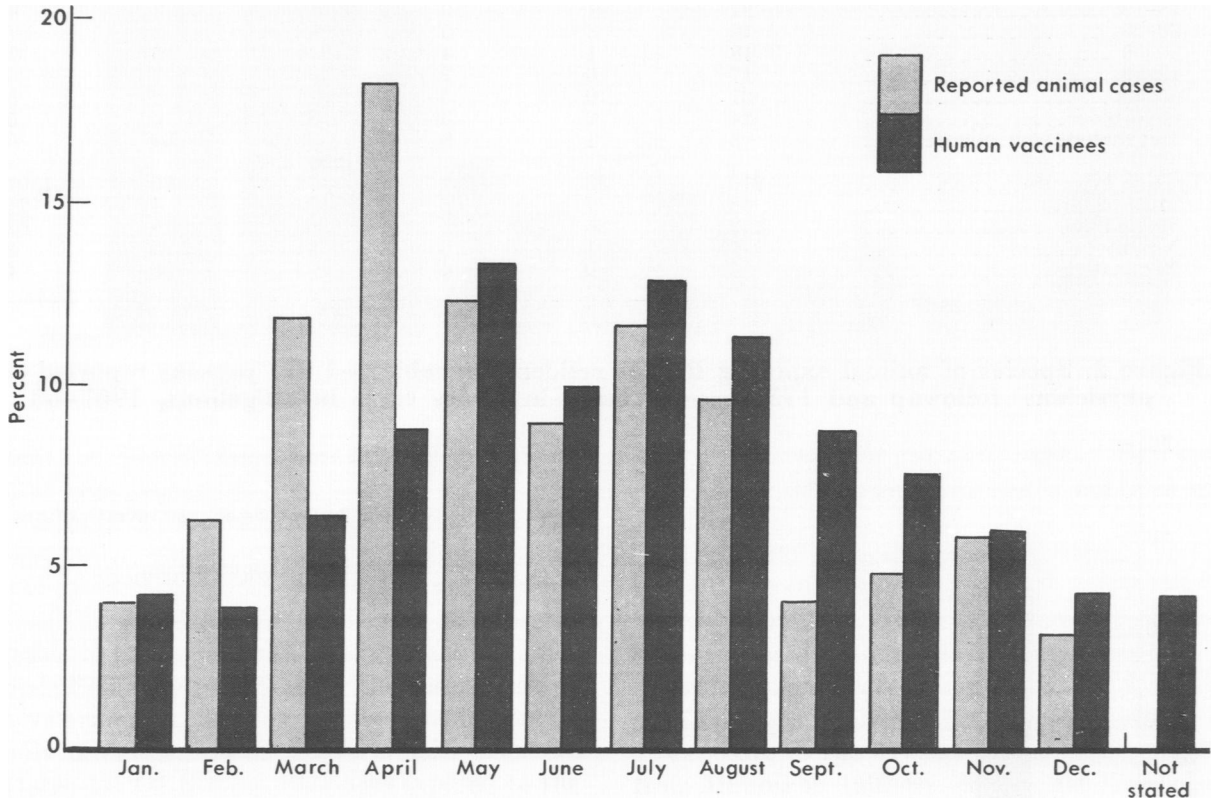
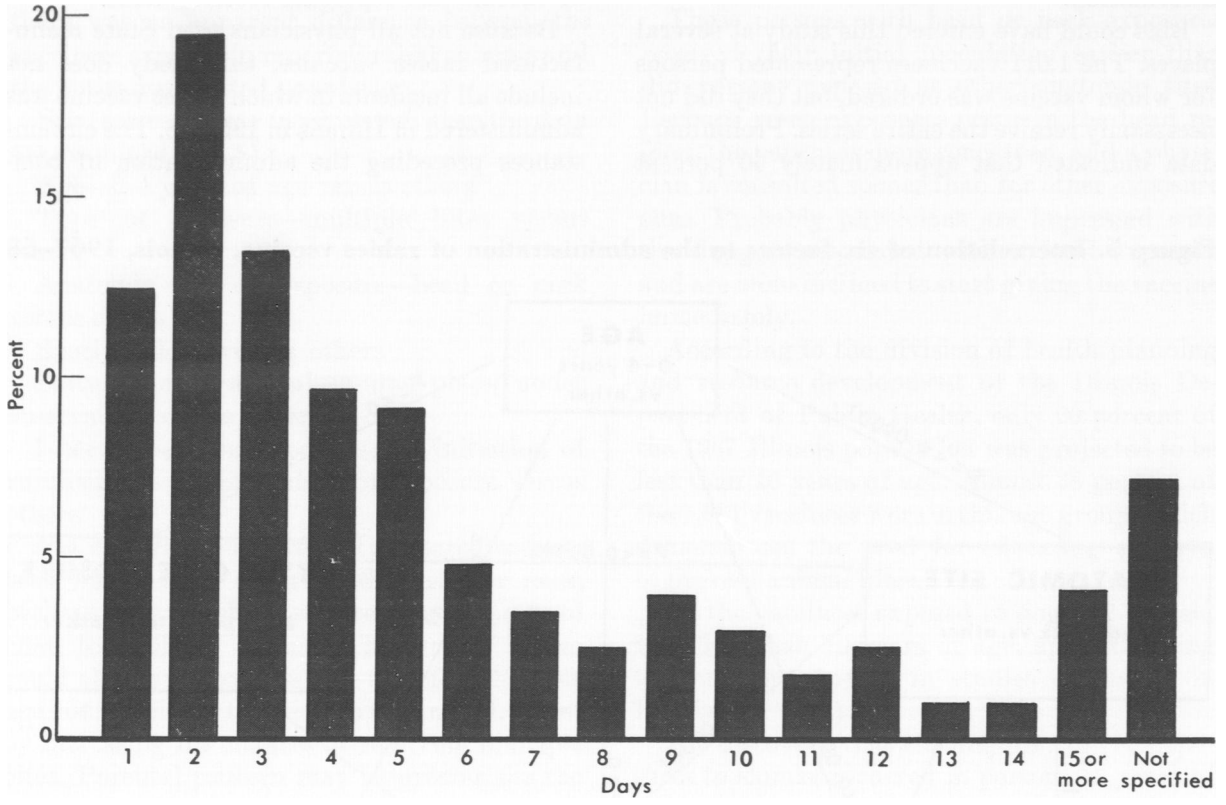


Table 2. Age distribution of 1,011 Illinois residents receiving rabies vaccine by status of exposing animal, 1967–68

Age in years	Dead, brain submitted	Dead, brain not submitted	Under observation	Not located	Status not given	Total
0–4	10	8	68	44	2	132
5–9	13	6	58	154	18	249
10–14	21	15	31	110	4	181
15 or older	65	25	39	241	12	382
Not stated	8	2	15	34	8	67
Total	117	56	211	583	44	1, 011

Figure 4. Interval in days between exposure and first injection of vaccine, 1967–68



cent) of these children were exposed by animals that were not located.

Among the 211 vaccinees whose exposing animals were placed under observation were 73 (35 percent) multiple bite victims and 169 dog bite victims. Also, 157 of the 221 persons exposed in the head or neck had contact with animals that were placed under the observation of a veterinarian. The animal was not located in only 13 (14 percent) of the 96 nonbite instances (table 1). Of the 193 vaccinees exposed to the species listed as other, 153 (79 percent) of the animals were not located (fig. 1).

Interval from exposure to vaccination. Only 46 percent (fig. 4) of the vaccine series were initiated within 3 days after exposure, while 20 percent had a delay of 8 days or more before first inoculation of the vaccine. The interval between exposure and first inoculation was not associated with the type of exposure, species of exposing animal, or the total number of persons exposed per incident. Seventy-five (57 percent) of the 132 vaccinees less than 5 years of age had vaccination initiated within 3 days of exposure. Vaccination was also initiated within 3 days for 136 of those 221 patients exposed in the head or neck.

Of the 211 persons receiving vaccine as a result of exposure that led to placing an animal under observation, 144 (68 percent) had the series initiated within 3 days of exposure.

Rabid animal case investigations. A total of 175 persons received rabies vaccine as a result of exposure to the 347 rabid animals reported from Illinois in 1967–68 (fig. 2). Of these patients 64 (37 percent) received State-supplied vaccine.

Discussion

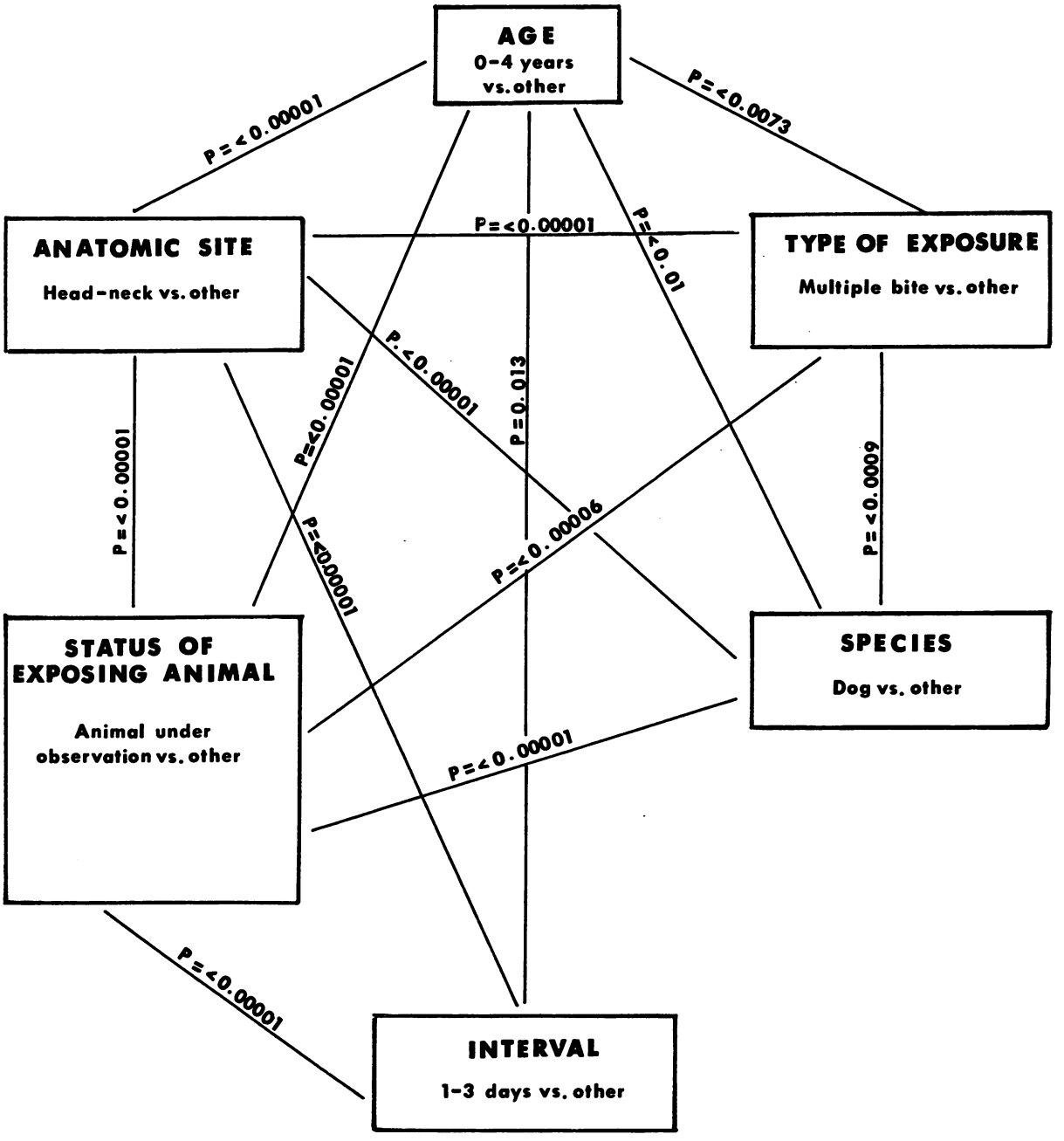
The 88 percent punchcard return rate from physicians indicated the concern the practicing physician has for a patient receiving a series of rabies vaccinations. Perhaps the incident was so unusual that the physician was more likely to supply information than on more routine, reportable diseases or conditions. This high return rate was especially gratifying because in 1967

it was obtained with only a single request for information.

Bias could have entered this study at several places. The 1,011 vaccinees represented persons for whom vaccine was ordered, but they did not necessarily receive the entire series. Preliminary data indicated that approximately 60 percent of the vaccinees received 14 or more inoculations of vaccine and 3 percent received none.

Because not all physicians used State manufactured rabies vaccines, this study does not include all incidents in which rabies vaccine was administered in Illinois in 1967–68. The circumstances preceding the administration of com-

Figure 5. Interrelation of six factors to the administration of rabies vaccine, Illinois, 1967–68



NOTE: *P* values determined by chi-square test.

mercial rabies vaccine possibly might differ from the ones described in this paper, although there was no apparent difference between the vaccinees exposed to reported rabid animals and the entire vaccinated population.

Six factors appear interrelated when the data are examined (fig. 5):

Age—0–4 years of age versus others

Type of exposure—multiple bites versus others

Anatomic site of exposure—head or neck versus others

Species—dogs versus others

Status of biting animal—animal placed under observation versus others

Interval between exposure and initiation of vaccination—within 3 days of exposure versus others

The children 0–4 years old appeared to have been bitten more often on the head or neck, perhaps because short stature places the head close to a biting animal. This young victim could also have been less able to defend himself against the bite or to flee from the animal, thereby increasing his chances of receiving multiple bites. Parental concern may be greater for the young bite victim, thus increasing the likelihood that a physician would be consulted for wound treatment and possible vaccination.

Usually children less than 5 years old are under the supervision of a responsible person who limits their mobility. Further, they are more likely to be exposed to the family pet or the pet of a relative or friend than to a stray animal. These facts would all increase the likelihood that animals exposing small children would be located, identified, and placed under the observation of a veterinarian.

Head or neck exposures were associated with the other five factors (fig. 5). Dogs were more frequently implicated in head or neck exposures than other species. Sixteen percent of the dogbite victims received head or neck bites in a study by Parrish and co-workers (*3*); in another study Brobst and co-workers (*4*) observed such bites in 14 percent of the victims. However, because bites in these areas are considered extremely dangerous (*1*), it is logical to assume that persons bitten in the head or neck are more likely to receive vaccine than persons bitten in other parts of the body; a larger number of persons in this study were bitten in the head or neck than in other studies.

Those persons with head or neck exposures received their initial inoculation earlier than did persons exposed at other anatomic sites. Perhaps when exposures occur in the head region, the person is more concerned, and a physician is consulted sooner than for other exposure sites. Probably physicians are impressed with the dangers associated with a head exposure and are more inclined to start giving the vaccine immediately.

According to the division of health planning and resource development of the Illinois Department of Public Health, only 20 percent of the 1967 Illinois population was projected to be less than 10 years of age. Almost 38 percent of the 1,011 vaccinees were in this age group, which demonstrates the need for educating children to prevent animal bites.

Of the vaccinees exposed to dogs, 42 percent were less than 10 years of age, approximating the number exposed in studies conducted in Pittsburgh (*3*, *4*).

The discovery that the majority of the exposures to skunks occurred in persons 15 years of age or older probably indicates that this age group is more likely to encounter this species during work or recreation.

Because time is an important factor in determining the success or failure of rabies prophylaxis (*1*), it is disturbing to see that more than 50 percent of the series were not started until 4 or more days after exposure. The data do not indicate whether this delay was caused by the patient or physician. Obviously prophylaxis cannot be initiated until the physician is consulted; therefore, educational programs stressing the importance of immediate action are definitely indicated for the general public. The critical need for starting the vaccinations promptly should be stressed in courses on infectious diseases in medical colleges.

The fact that 682 (67 percent) of the exposures were on the extremities probably shows that arms and legs are used to ward off attacking animals and that they provide a better biting surface than does the trunk.

Since 583 persons were exposed to animals that were not located, the number of vaccinations could possibly be reduced by stressing the

importance of identifying and capturing biting animals and intensifying local stray animal control programs.

Nonbite exposures occurred in 66 percent of the 64 vaccinees exposed to reported rabid animals, whereas only 9 percent of the total vaccinated population reported nonbite exposures. The ratio of vaccinee to exposing animal also was higher in the group exposed to rabid animals (64 to 27 = 2.37) as compared with the total vaccinated population (1,011 to 937 = 1.08). This difference supports the suggestion that emotion may prevail over logic when the exposing animal is known to be rabid (*2*). A thorough search for exposed persons is indicated whenever a rabid animal is discovered, but transmission of the disease cannot occur unless the saliva of the animal contacts exposed nerves.

Although 71 percent of the reported rabid animals were skunks in 1967–68 in Illinois, this species formed only 2 percent of the animals causing persons to be vaccinated. This low percentage indicates that there is little danger of a person contacting a rabid skunk. Although dogs accounted for only 4 percent of the rabid animals in 1967–68, they represented 58 percent of the animals causing rabies vaccine to be administered. A similar but smaller difference also is seen in the exposures to cats.

Unfortunately, 19 percent of the vaccinees received rabies vaccine because of exposure to animals classed in the other species. Since 79 percent of these persons had been bitten by animals that were not located, there appeared to be a tendency to vaccinate when the animal in question was not located even though that species is seldom infected with rabies. One exception is the raccoon in sections of Georgia and Florida.

The temporal distribution of the reported rabid animals peaks in the early spring months because of rabid skunks, while the monthly distribution of the human vaccinees peaks during the summer months. These are the months when most animal bites occur (*4*). It is interesting that 79 percent of the persons receiving rabies vaccine as a result of exposure to skunks were exposed May through July. Similar time results are reported for vaccinees exposed to reported rabid wildlife (*2*). These are the months during which recreational and agrarian activities take place in environments where skunks are likely to be encountered.

Regardless of the circumstances surrounding the bite, immediate, thorough scrubbing of the wound is indicated. Current recommendations stress that if circumstances indicate vaccination, it should commence immediately. If the biting animal is apprehended, its clinical status will be important in determining whether vaccination should be initiated. Examination of brain tissue of the animal by using the fluorescent antibody technique is rapid and reliable; therefore, if the animal must be killed, test results can be obtained within 24 hours.

A large majority of the biting animals cannot be captured, however, and the physician faces the question "to vaccinate or not to vaccinate?" Each exposure must be evaluated individually, considering (*a*) species of biting animal, (*b*) provocation (or lack of provocation) for the bite, (*c*) location and severity of the bite wound, and (*d*) presence (or absence) of rabies in animals in the region. Because the administration of rabies vaccine can be dangerous, this evaluation should be weighed against the probability that the patient was actually exposed to the rabies virus.

Summary

Illinois physicians receiving State-manufactured rabies vaccine in 1967–68 were requested to supply information delineating the circumstances which led to the administration of vaccine. Vaccine was dispensed on 1,063 occasions; information was returned in 937 instances involving 1,011 patients. Males comprised 64 percent of the vaccinees. Thirty-eight percent of the vaccinees were less than 10 years of age. Twenty-five percent of the vaccinees received two or more bites, 62 percent received a single bite, and nonbite exposures were recorded for 9 percent. Sixty-seven percent of the persons reported exposures on the extremities, 22 percent, exposures on the head or neck.

Dogs exposed 55 percent of the persons vaccinated, skunks exposed 3 percent, and 19 percent of the vaccinees reported exposure to a species not usually infected with rabies. Fifty-eight percent of the vaccinees were exposed to animals that were not located, while 21 percent

were exposed to animals that later were under the observation of a veterinarian. Only 46 percent of the vaccine series were initiated within 3 days after exposure; 20 percent had a delay of 8 days or more.

REFERENCES

(*1*) U.S. Public Health Service Advisory Committee on Immunization Practices: Rabies prophylaxis. Morbidity and Mortality Weekly Report 16: 152–155, May 13, 1967.

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(*3*) Parrish, H. M., Clack, F. B., Brobst, D., and Mock, J. F.: Epidemiology of dog bites. Public Health Rep 74: 891–903, October 1959.

(*4*) Brobst, D., Parrish, H. M., and Clack, F. B.: The animal bite problem. Vet Med 54: 251–256, May 1959.

Tearsheet Requests

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Hill-Burton Program, Progress Report, July 1, 1947–June 30, 1968. *PHS Publication No. 930–F–3; revised 1968; 68 pages; 70 cents.* Presents national and State statistics on more than 9,500 projects which have been approved for the construction, modernization, and replacement of voluntary nonprofit hospitals and other health facilities throughout the country. Shows, in tabulations, the progress of the program over the past 5 years rather than the cumulative picture since the beginning of the program.

Kidney Disease Services Facilities and Programs in the United States. *PHS Publication No. 1942; May 1969; 229 pages; $1.* Presents information collected on a State-by-State basis by the staff of the Kidney Disease Control Program in collaboration with the nine Public Health Service Regional Offices, the State health departments, and a variety of other organizations and sources. Provides information on such resources as official kidney disease advisory and study groups, kidney disease voluntary agencies, State and local health planning groups, educational and training programs, screening programs, special (research) studies and projects, chronic and acute dialysis facilities in operation, transplantation facilities, tissue typing laboratories, special State legislation to assist end-stage patients, anatomical gifts legislation relative to renal homotransplantation. Includes a summary of various official and private sources of financial assistance which may contribute to supporting hemodialysis and kidney transplantation services.

Some Physical Factors Affecting Radiographic Image Quality: Their theoretical basis and measurement. *PHS Publication No. 999–RH–38; by Lloyd M. Bates; August 1969; 101 pages.*

Presents data resulting from a project carried out under contract between the Johns Hopkins University and the Bureau of Radiological Health, Public Health Service. Reviews the medical diagnostic process involved in determining the pathological condition of a patient made on the basis of available roentgenological information. In diagnostic roentgenology, information relating to the patient is made available through X-rays and is displayed in the form of a visual image.

Several years ago, a program on the physics of diagnostic roentgenology was established at the Johns Hopkins University to carry out fundamental study of the parameters of an imaging system that affect image quality, to devise methods to measure these parameters, and to make available to the field of radiology the results of these measurements on the apparatus currently available in the United States.

Includes details on the manner in which the measurements were analyzed and a summary of the characteristics of radiographic films and screens currently available. Also provides a set of tables and curves in the appendix of this report which indicate the format in which detailed data from measurements will be published in a separate report.

State-Interstate Solid Waste Planning Grants and Agencies, January 1969. *PHS Publication No. 1912; 1969; 17 pages.* Lists the names and addresses of the solid waste planning agencies for all States, Territories, and the District of Columbia. Gives certain additional information for the State and interstate agencies with solid waste planning grants.

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