

Public Veterinary Medicine: Public Health

Rabies surveillance in the United States during 2009

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Summary—During 2009, 49 states and Puerto Rico reported 6,690 rabid animals and 4 human rabies cases to the CDC, representing a 2.2% decrease from the 6,841 rabid animals and 2 human cases reported in 2008. Approximately 92% of reported rabid animals were wildlife. Relative contributions by the major animal groups were as follows: 2,327 (34.8%) raccoons, 1,625 (24.3%) bats, 1,603 (24.0%) skunks, 504 (7.5%) foxes, 300 (4.5%) cats, 81 (1.2%) dogs, and 74 (1.1%) cattle. Compared with 2008, numbers of rabid raccoons and bats that were reported decreased, whereas numbers of rabid skunks, foxes, cats, cattle, dogs, and horses that were reported increased.

Fewer rabid raccoons, compared with 2008, were reported by 12 of the 20 eastern states where raccoon rabies is enzootic, and number of rabid raccoons decreased by 2.6% overall nationally. Despite a 10% decrease in the number of rabid bats that were reported and a decrease in the total number of bats submitted for testing, bats were the second most commonly submitted animal, behind cats, during 2009. The number of rabid skunks that were reported increased by 0.9% overall. The proportion of rabid skunks in which infection was attributed to the raccoon rabies virus variant decreased from 47.3% in 2008 to 40.9% in 2009, resulting in a 12.7% increase in the number of rabid skunks infected with a skunk rabies virus variant. The number of rabid foxes increased 11.0% overall from the previous year.

Four cases of rabies involving humans were reported from Texas, Indiana, Virginia, and Michigan. The Texas case represented the first presumptive abortive human rabies case, with the patient recovering after the onset of symptoms without intensive care. The Indiana and Michigan cases were associated with bat rabies virus variants. The human rabies case in Virginia was associated with a canine rabies virus variant acquired during the patient's travel to India.

The present report provides an update on rabies epidemiology and events in the United States during 2009.

Rabies is a zoonotic disease caused by viruses of the *Lyssavirus* genus. Rabies has the highest case fatality ratio of any infectious disease if prompt intervention is not initiated; PEP for individuals exposed to the rabies virus consists of wound washing, passive immunization with rabies immunoglobulin, and a series of 4 doses of rabies vaccine.^{1,2}

Rabies was likely present in the New World before European colonization. Reports of Spanish conquistadors dying after being bitten by vampire bats exist as early as 1514.³ However, canine rabies was most likely introduced after colonization, and rabies epizootics as-

ABBREVIATIONS

ED	Emergency department
PEP	Postexposure prophylaxis

sociated with dogs were not reported until the early 18th century. The limited genetic diversity among New World canine rabies virus isolates supports the theory that canine rabies was not introduced to the New World until relatively recently.⁴ Enzootic canine transmission remained the primary source of rabies in the United States until the mid 20th century, resulting in much public anxiety and fear. After World War II, following advancements in vaccine production and potency determination, large-scale control programs focusing on canine vaccination were initiated to prevent human rabies. Animal rabies was added as a nationally notifiable disease in 1938. The earliest example of a successful mass canine vaccination campaign is Memphis in 1948.⁵ Such control efforts laid the framework for elimination of canine rabies virus variants and dog-to-dog rabies transmission from the United States in the late 1970s. However, as canine rabies was controlled, rabies in the United States shifted to primary circulation and maintenance in wildlife.

Wildlife have accounted for > 80% of reported rabid animals in the United States since 1975. The pri-

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mary reservoir species responsible for maintaining rabies are raccoons, bats, skunks, foxes, and mongooses (in Puerto Rico). Rabies involving distinct rabies virus variants associated with nonchiropteran hosts occurs in geographically definable regions, where transmission is primarily between members of the same species (Figure 1). The spatial boundaries of these geographic regions are temporally dynamic, and affected areas may expand or contract as a result of virus transmission and animal population interactions.⁶ Natural and anthropomorphic factors directly impact animal population dynamics. Moreover, geographic features may act as barriers or corridors for the spread of rabies.⁷ Additionally, unusual animal-dispersal patterns and human-mediated translocation of infected animals have resulted in the unexpected introduction of rabies into new areas and remain a threat to national control programs, both internally and from the perspective of importation of foreign animals.⁸⁻¹¹

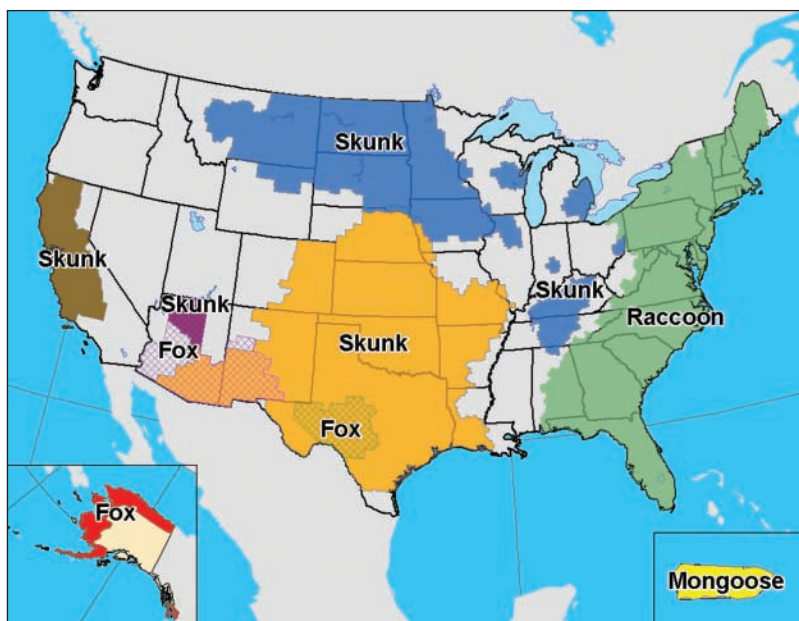


Figure 1—Distribution of major rabies virus variants among nonchiropteran reservoirs in the United States and Puerto Rico, 2008.

Spillover infection of distinct rabies virus variants to nonmaintenance species occurs, but does not typically result in sustained transmission.¹² Occasional switching of rabies virus variants to new hosts can perpetuate regionally, and these variants can become enzootic in new reservoir species. Phylogenetic analysis of circulating rabies virus variants has supported the concept that canine virus variants were the probable origins of variants found in foxes (Texas and Arizona) and skunks (California and north central United States). This scenario likely represents a process that began with the introduction of canine rabies virus variants during historical colonization periods, followed by spillover and adaptation of Old World rabies virus variants to New World wildlife.¹³ The remaining extant rabies virus variants in the United States (ie, raccoon, south central skunk, and Flagstaff rabies virus variants) have been associated with viral switching from bats to carnivores. Overall, such findings suggest that the diversity of nonbat rabies virus variants in the United States developed over the last few centuries.

Circulating independently of rabies virus variants associated with the order Carnivora are multiple variants associated with bats. More than 30 bat species have been reported with rabies in the United States, with multiple virus lineages associated with different bat species.¹⁴ In contrast to circulation of rabies in carnivores, the greater mobility of bats precludes definitive determination of the geographic distribution of bat rabies virus variants, other than the delineated ranges of the implicated host bat species. For this reason, every state in the United States, with the exception of Hawaii, is considered enzootic for rabies.

Ongoing public health activities, including vaccination of companion animals and wildlife, education of the public and health professionals, and institution of rabies PEP, have dramatically reduced the burden of rabies in humans in the United States. Over the past 2

decades, human rabies has become associated primarily with exposure to rabid bats. Investigations of these human rabies cases over the past 2 decades have identified a history of known or suspected contact with a bat, yet a history of a bite has not been reported. These investigations are frequently limited by recall bias (exposures typically occurred several months before the patient became ill) and rely on reports from family and friends. A bite from a rabid bat remains the most parsimonious explanation for these human rabies cases in the absence of known exposure. These findings are the foundation for current Advisory Committee on Immunization Practices recommendations regarding rabies exposure evaluation of persons with direct contact with bats as well as persons who may have had unacknowledged contact with bats (eg, an unattended child sleeping in a room with a bat or a mentally disabled or intoxicated person finding a bat in a room). If a person can be reasonably certain a bite, scratch, or mucous membrane contact did not occur, or the bat is available for testing and is negative for the presence of rabies virus after laboratory evaluation, PEP is not necessary.¹ Rabies control in bats by conventional methods is not currently feasible. Prevention of human rabies infection with bat rabies virus variants will continue to rely on health education to avoid exposure, proper exclusion of bats from human living quarters, careful assessment in the event of exposure, and judicial administration of PEP.

Reporting and Analysis

Human and animal rabies are notifiable conditions throughout the United States. Laboratory-confirmed cases of animal rabies are reported to either the health or agricultural department in all states, which notify the CDC on a regular (ie, weekly) basis. Rabies cases involving imported animals or human patients who contracted rabies abroad are reported to the CDC immediately (ie, notifi-

cation within 24 hours).^{15,16} Animal rabies surveillance is laboratory based, comprising 126 state health, agriculture, and university pathology laboratories performing the standard direct fluorescent antibody test for rabies diagnosis.¹⁷ In addition, targeted enhanced surveillance is carried out by more than 25 wildlife biologists engaged by USDA Wildlife Services to work with oral rabies vaccination programs; the direct rapid immunohistochemical test is used in these surveillance programs.¹⁸

During 2009, 5 states (Georgia, Idaho, Massachusetts, Vermont, and West Virginia) transmitted laboratory data for rabies diagnostic activity exclusively by use of the Public Health Information Network Messaging System. In addition, 7 states (Arkansas, Maryland, Michigan, North Dakota, South Carolina, South Dakota, and Virginia) submitted partial data or were preparing to send data via this system during 2009. The Public Health Information Network Messaging System uses a secure messaging protocol to transmit an ASCII-delimited data file consisting of enhanced animal rabies data to the CDC on a routine basis, as described.¹⁹ Other states submitted animal rabies data on a monthly or annual basis directly to the CDC Poxvirus and Rabies Branch. In addition, diagnostic activity conducted as part of the enhanced surveillance activities carried out by USDA Wildlife Services was reported directly to the CDC. During 2009, a total of 122,109 samples were submitted to diagnostic laboratories for rabies testing. Of these, 119,645 were considered adequate for testing, representing a 1.7% decrease in the number of animals tested for rabies, compared with the number tested during 2008. A total of 9,353 animals were submitted by USDA Wildlife Services personnel for testing with the direct rapid immunohistochemical test, accounting for 7.8% of all animals tested in 2009.

The CDC program currently requests that enhanced data on animals submitted for rabies testing be submitted.¹⁹ All states provided data on species, county, and date of testing or collection for all animals submitted for rabies testing, with the exception of Oklahoma, which provided only aggregate numbers by species for negative rabies test results. All states are encouraged to determine the species of bats that are submitted for rabies testing. Twenty-seven states and the District of Columbia provided some level of bat speciation during 2009. Six states provided information on rabies vaccination status of domestic animals submitted for testing, and 19 states and the District of Columbia provided information on human exposure to submitted animals (11 states and the District of Columbia also included information on domestic animal exposure to submitted animals). Fourteen states provided a coordinate or street address for the animal collection location.

For the present report, percentages of rabid animals are calculated on the basis of total number of animals tested for rabies. Because most animals submitted for testing are selected on the basis of abnormal behavior or signs of illness, percentages provided in the present re-

port are not representative of the incidence of rabies in the general population. In addition, because of differences in protocols and submission rates among species and states, direct epidemiological comparisons of percentages of rabid animals between species or states are inappropriate. Geographic areas for various nonbat reservoirs of rabies in the United States were produced by aggregating data from 2005 through 2009, and all maps were produced as described.¹⁹ The process for generating reservoir regions (Figure 1) was modified slightly to include counties adjacent to those counties where rabies cases were identified if < 15 of the reservoir species had been tested from those counties during the previous 5 years.

Submission rate calculations were based on 2009 estimated populations available from the US Census Bureau. Animal rabies data for 2009 for Canada were obtained from the Terrestrial Animal Health Division, Canadian Food Inspection Agency, and data for Mexico were obtained from the Pan American Health Organization Epidemiological Information System.^a

Rabies in Wild Animals

Wild animals accounted for 6,185 (92.5%) of the rabid animals reported during 2009, representing a 2.9% decrease in the number of rabid wild animals reported, compared with 2008 (Figure 2). Raccoons continued to be the most frequently reported rabid wildlife species (34.8% of all rabid animals during 2009), followed by bats (24.3%), skunks (24.0%), foxes (7.5%), and other wild animals including rodents and lagomorphs (1.9%). Seasonal trends for wildlife species were similar to trends for previous years, with peaks in numbers of rabid raccoons, skunks, and foxes reported during March to May and a second higher peak among raccoons and skunks during August and September. Number of rabid bats reported peaked sharply during August.

Raccoons—The 2,327 rabid raccoons reported during 2009 represented a 2.6% decrease, compared with the number reported during 2008, continuing a declining trend since 2006 (Table 1). The proportion of raccoons submitted for rabies testing that were rabid

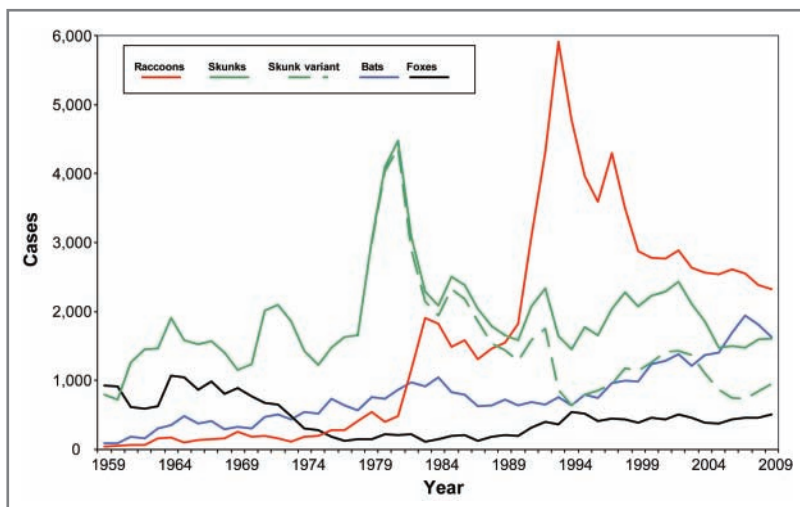


Figure 2—Cases of rabies among wildlife in the United States, by year and species, 1959 to 2009.

Table 1—Cases of rabies in the United States, by location, during 2009.

Location	Total cases	Domestic animals								Wild animals							% Pos 2009	2008 cases	Change (%)
		Domestic	Wild	Cats	Cattle	Dogs	Horses/mules	Sheep/goats	Other domestic*	Raccoons	Bats	Skunks	Foxes	Other wild†	Rodents and lagomorphs‡	Humans			
AK	14	1	13	0	0	1	0	0	0	0	0	12	1 ^a	0	0	26.9	15	-6.67	
AL	81	5	76	3	0	2	0	0	0	41	22	0	12	1 ^a	0	3.3	84	-3.57	
AR	47	2	45	0	0	2	0	0	0	0	9	36	0	0	0	5.5	49	-4.08	
AZ	273	5	268	1	1	0	3	0	0	0	69	136	52	11 ^d	0	10.6	182	50.00	
CA	227	0	227	0	0	0	0	0	0	0	142	44	41	0	0	3.4	179	26.82	
CO	104	1	103	0	0	0	1	0	0	0	61	39	2	1 ^a	0	9.9	65	60.00	
CT	153	4	149	2	0	1	1	0	0	83	11	44	7	1 ^f	3 ^y	7.1	202	-24.26	
DC	57	1	56	1	0	0	0	0	0	40	14	0	2	0	0	15.6	49	16.33	
DE	15	4	11	4	0	0	0	0	0	4	2	2	3	0	0	7.5	21	-28.57	
FL	162	13	149	11	0	1	1	0	0	100	23	2	21	3 ^y	0	4.8	151	7.28	
GA	404	25	379	16	4	3	2	0	0	226	21	81	45	6 ^b	0	17.5	389	3.86	
HI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0.00	
IA	35	10	25	3	5	2	0	0	0	0	11	13	0	0	1 ^w	2.2	27	29.63	
ID	8	0	8	0	0	0	0	0	0	0	8	0	0	0	0	1.8	10	-20.00	
IL	83	0	83	0	0	0	0	0	0	0	83	0	0	0	0	1.4	103	-19.42	
IN	40	0	39	0	0	0	0	0	0	0	39	0	0	0	0	3.3	13	207.69	
KS	78	11	67	3	3	4	1	0	0	1	5	58	1	2 ^e	0	6.2	67	16.42	
KY	46	8	38	1	0	5	2	0	0	1	6	29	2	0	0	3.7	46	0.00	
LA	5	1	4	1	0	0	0	0	0	0	4	0	0	0	0	0.8	6	-16.67	
MA	130	10	120	9	0	0	0	1	0	60	21	21	11	0	7 ^x	5.5	154	-15.58	
MD	384	21	363	19	0	0	2	0	0	239	64	20	35	1 ⁱ	4 ^v	8.7	420	-8.57	
ME	62	1	61	1	0	0	0	0	0	29	6	19	7	0	0	9.1	65	-4.62	
MI	69	1	67	1	0	0	0	0	0	0	53	11	3	0	0	2.0	79	-12.66	
MN	69	13	56	5	3	4	1	0	0	0	29	27	0	0	0	2.9	70	-1.43	
MO	66	1	65	1	0	0	0	0	0	0	50	15	0	0	0	2.0	66	0.00	
MS	4	0	4	0	0	0	0	0	0	0	4	0	0	0	0	1.1	7	-42.86	
MT	24	1	23	1	0	0	0	0	0	0	10	13	0	0	0	5.4	14	71.43	
NC	492	34	458	19	5	7	2	1	0	270	35	63	85	5 ^k	0	12.7	474	3.80	
ND	16	3	13	1	1	1	0	0	0	0	1	12	0	0	0	4.1	34	-52.94	
NE	90	22	68	9	7	1	4	0	1 ^a	0	14	53	1	0	0	8.5	43	109.30	
NH	34	4	30	2	0	0	0	2	0	12	6	8	4	0	0	6.2	59	-42.37	
NJ	288	20	268	20	0	0	0	0	0	189	32	37	5	1 ^l	4 ^z	8.4	285	1.05	
NM	26	1	25	0	1	0	0	0	0	0	5	9	8	3 ^m	0	7.0	25	4.00	
NV	12	0	12	0	0	0	0	0	0	0	12	0	0	0	0	2.9	16	-25.00	
NY	439	33	406	27	3	0	1	2	0	225	79	72	24	3 ⁿ	3 ^{aa}	6.3	496	-11.49	
NYC	29	0	29	0	0	0	0	0	0	28	1	0	0	0	0	4.9	19	52.63	
OH	47	0	47	0	0	0	0	0	0	1	43	3	0	0	0	1.1	64	-26.56	
OK	50	17	33	7	6	1	3	0	0	0	12	20	1	0	0	4.0	43	16.28	
OR	12	0	12	0	0	0	0	0	0	0	12	0	0	0	0	4.6	13	-7.69	
PA	453	65	388	57	1	6	1	0	0	258	41	55	28	1 ^o	5 ^{bb}	3.4	431	5.10	
PR	43	9	34	4	0	4	1	0	0	0	0	0	0	34 ^p	0	29.1	58	-25.86	
RI	45	0	45	0	0	0	0	0	0	19	10	13	1	1 ^q	1 ^{cc}	11.2	34	32.35	
SC	153	14	139	8	1	5	0	0	0	85	10	21	19	4 ^r	0	7.0	166	-7.83	
SD	53	18	35	4	4	7	2	1	0	0	4	31	0	0	0	7.4	24	120.83	
TN	88	6	82	0	0	5	1	0	0	12	11	55	3	1 ^s	0	3.3	128	-31.25	
TX	830	45	784	15	9	14	7	0	0	20	443	312	2	6 ^t	1 ^{dd}	6.3	1,022	-18.79	
UT	13	0	13	0	0	0	0	0	0	0	13	0	0	0	0	2.2	14	-7.14	
VA	572	55	516	40	10	4	1	0	0	273	23	153	60	2 ^u	5 ^{ee}	13.0	622	-8.04	
VT	67	9	58	0	8	0	1	0	0	32	2	23	1	0	0	16.9	75	-10.67	
WA	14	0	14	0	0	0	0	0	0	0	14	0	0	0	0	2.5	17	-17.65	
WI	25	1	24	0	0	1	0	0	0	0	24	0	0	0	0	1.0	24	4.17	
WV	123	7	116	4	2	0	0	1	0	79	8	19	6	0	4 ^{ff}	4.4	96	28.13	
WY	40	3	37	0	0	0	3	0	0	0	3	34	0	0	0	6.2	28	42.86	
Total	6,694	505	6,185	300	74	81	41	8	1	2,327	1,625	1,603	504	88	38				
% 2009	100.00	7.54	92.40	4.48	1.11	1.21	0.61	0.12	0.01	34.76	24.28	23.95	7.53	1.31	0.57	0.06			
% Pos 2009	5.59	0.88	9.97	1.04	6.06	0.32	4.00	1.47	0.37	11.71	5.82	23.88	26.13	3.57	1.22	—			
Total 2008	6,843	471	6,369	294	59	75	30	12	1	2,389	1,806	1,589	454	97	34	2			
% Change	-2.18	7.22	-2.89	2.04	25.42	8.00	36.67	-33.33	0.00	-2.60	-10.02	0.88	11.01	-9.28	11.76	100.00			

*Other domestic includes: *1 ferret. †Other wild includes: †1 wolf; †1 coyote; †8 bobcats, 2 coyotes, 1 ringtail; †1 cougar; †1 deer; †2 bobcats, 1 otter; †6 bobcats; †1 bobcat, 1 coyote; †1 opossum; †2 bobcats, 1 coyote, 1 opossum, 1 otter; †1 coyote; †2 bobcats, 1 coyote; †1 bobcat, 2 fishers; †1 deer; †34 mongooses; †1 fisher; †3 bobcats, 1 coyote; †1 bobcat; †3 bobcats, 3 coyotes; †1 bobcat, 1 opossum. ‡Rodents and lagomorphs include: ‡3 groundhogs; ‡1 squirrel; ‡5 groundhogs, 1 muskrat, 1 rabbit; †1 beaver, 3 groundhogs; ‡4 groundhogs; ‡3 groundhogs; ‡5 groundhogs; ‡1 groundhog; ‡1 squirrel; ‡5 groundhogs; †1 beaver, 3 groundhogs.

% Pos = (Total number positive/total number tested) X 100. — = Not calculated.

decreased from 14.5% in 2008 to 11.7% in 2009. Decreases of ≥ 50% in the number of rabid raccoons identified during 2009 were reported by 3 of the 20 eastern states in which raccoon rabies was enzootic (New Hampshire, Ohio, and Tennessee). New York City and Rhode Island both reported increases in the number of rabid raccoons > 100%. States in the northeast and

mid-Atlantic in which raccoon rabies was enzootic accounted for 67.5% (1,571 cases; 2.5% decrease) of the 2,327 rabid raccoons reported in 2009 (Figure 3). The southeastern states of Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee in which raccoon rabies was enzootic reported 31.5% (734 cases; 3.4% decrease) of all rabid raccoons. Rabid raccoons

reported by Texas (n = 20), Kansas (1), and Kentucky (1) accounted for the remaining cases reported in 2009. All rabid raccoons in Texas and the rabid raccoon from Kansas were infected with the south central skunk rabies virus variant. The rabid raccoon in Kentucky was infected with the north central skunk rabies virus variant.

Excluding Tennessee and Ohio, for which rabid raccoons represent a small proportion of all rabid animals reported, states in which raccoon rabies was enzootic reported 61.9% (4,143/6,690) of the national total of rabid animals and 73.3% (3,712/5,065) of all rabid animals other than bats. Overall, these states submitted 47.2 animals/100,000 persons for rabies testing during 2009.

Bats—The 1,625 rabid bats reported during 2009 represented a 10.0% decrease, compared with the number reported during 2008. The proportion of bats submitted for testing that were rabid decreased from 5.9% in 2008 to 5.8%. Rabid bats were reported from all 48 contiguous states (Figure 4). Eight states (Idaho, Illinois, Indiana, Mississippi, Nevada, Oregon, Utah, and Washington) reported rabies only in bats. A $\geq 50\%$ increase in the number of rabid bats was reported by 8 states (Arkansas, Indiana, Maryland, North Carolina, New Hampshire, New Mexico, Oklahoma, and West Virginia). Nearly 41% (11,398/27,915 tested) of the bats submitted for rabies testing were identified beyond the taxonomic level of order (Table 2). Overall, states where bats are the only recognized reservoir for rabies submitted 12.9 animals/100,000 persons for rabies testing during 2009.

Skunks—The 1,603 rabid skunks reported during 2009 represented a 0.9% increase, compared with the number reported during 2008. However, the proportion of skunks submitted for testing that were rabid decreased from 26.6% in 2008 to 23.9% in 2009, possibly attributable to the 12.2% increase in the number of skunks submitted for rabies testing overall. Ten of the 23 states where skunk rabies virus variants are enzootic reported a $\geq 50\%$ increase in the number of rabid skunks during 2009 (Arizona, Colorado, Iowa, Michigan, Missouri, Montana, Nebraska, New Mexico, South Dakota, and Wyoming). No rabid skunks have been reported from Illinois or Wisconsin since 2006 or from Indiana since 2007.

During 2009, 42.3% of the rabid skunks were reported from states where the south central skunk rabies virus variant is enzootic (8.5% increase, compared with 2008), 14.0% from states where the north central skunk rabies virus variant is enzootic (22.3% in-

crease, compared with 2008), 2.7% from California (41.9% increase, compared with 2008), and 40.9% from states where the raccoon rabies virus variant is enzootic (12.4% decrease, compared with 2008; Figure 5). Ohio reported more rabid skunks in the counties where raccoon rabies is enzootic than rabid raccoons. Overall, states where skunks are the primary reservoir for rabies submitted 35.8 animals/100,000 persons for rabies testing during 2009. However, when stratified by skunk rabies virus variants, south central (including the Flagstaff rabies virus variant in Arizona) and north central states had similar overall animal submission rates, at 40.8 and 40.2 animals/100,000 persons, respectively, compared with 17.9 animals/100,000 persons in California.

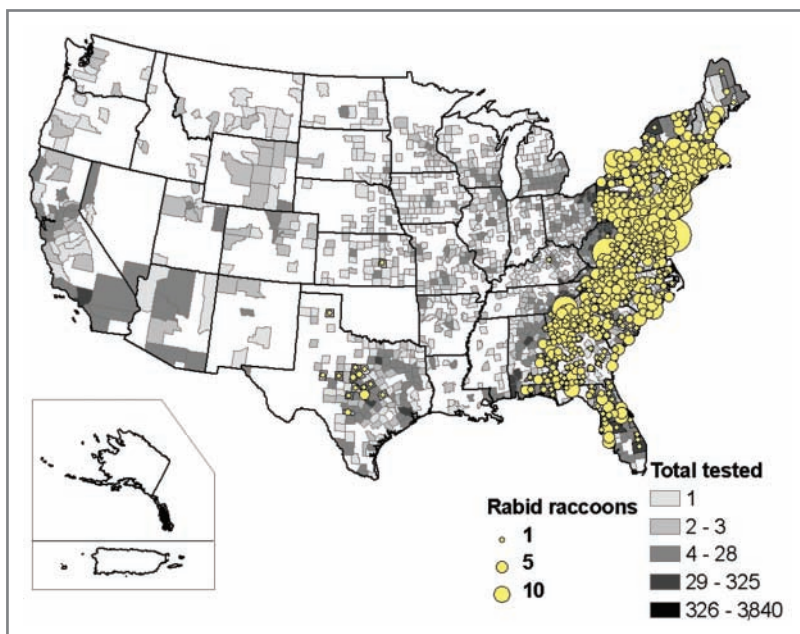


Figure 3—Reported cases of rabies involving raccoons, by county, 2009.

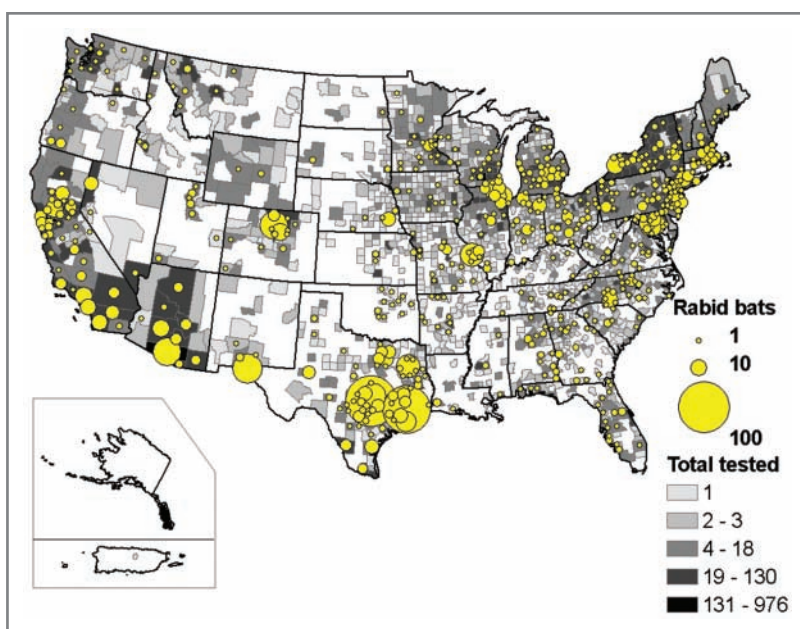


Figure 4—Reported cases of rabies involving bats, by county, 2009.

Table 2—Species of bats submitted for rabies testing in the United States during 2009.

Species (common name)	No. tested	No. positive	Percentage positive
Unspecified	16,517	1,131	6.8
<i>Eptesicus fuscus</i> (big brown bat)	9,116	339	3.7
<i>Myotis lucifugus</i> (little brown bat)	1,161	21	1.8
<i>Tadarida brasiliensis</i> (Mexican free-tailed bat)	232	45	19.4
<i>Lasiurus borealis</i> (red bat)	151	25	16.6
<i>Lasionycteris noctivagans</i> (silver-haired bat)	148	7	4.7
<i>Nycticeius humeralis</i> (evening bat)	86	1	1.2
<i>Parastrellus hesperus</i> (canyon bat)	78	19	24.4
<i>Antrozous pallidus</i> (desert pallid bat)	46	4	8.7
<i>Lasiurus cinereus</i> (hoary bat)	45	10	22.2
<i>Myotis evotis</i> (long-eared myotis)	42	2	4.8
<i>Myotis californicus</i> (California myotis)	41	1	2.4
<i>Myotis yumanensis</i> (Yuma myotis)	39	1	2.6
<i>Myotis keenii</i> (Keen's myotis)	37	2	5.4
<i>Myotis septentrionalis</i> (northern long-eared myotis)	31	2	6.5
<i>Lasiurus seminolus</i> (Seminole bat)	25	2	8.0
<i>Perimyotis subflavus</i> (tricolored bat)	23	5	21.7
<i>Lasiurus intermedius</i> (northern yellow bat)	13	1	7.7
<i>Lasiurus ega</i> (southern yellow bat)	10	3	30.0
<i>Leptonycteris curasoae</i> (southern long-nosed bat)	10	0	0.0
<i>Choeronycteris mexicana</i> (Mexican long-tongued bat)	8	0	0.0
<i>Lasiurus blossevillii</i> (western red bat)	6	0	0.0
<i>Myotis sodalis</i> (Indiana myotis)	6	1	16.7
<i>Macrotus californicus</i> (California leaf-nosed bat)	5	0	0.0
<i>Myotis auriculus</i> (southwestern myotis)	5	0	0.0
<i>Myotis grisescens</i> (gray bat)	5	0	0.0
<i>Myotis</i> spp, not further speciated	5	0	0.0
<i>Nyctinomops macrotis</i> (big free-tailed bat)	5	1	20.0
<i>Corynorhinus townsendii</i> (Townsend's big-eared bat)	7	1	14.3
<i>Myotis ciliolabrum</i> (western small-footed bat)	4	0	0.0
<i>Eumops glaucinus</i> (Wagner's mastiff bat)	2	0	0.0
<i>Corynorhinus rafinesquii</i> (Rafinesque's big-eared bat)	1	0	0.0
<i>Eumops perotis</i> (western mastiff bat)	1	0	0.0
<i>Myotis leibii</i> (eastern small-footed myotis)	1	0	0.0
<i>Myotis thysanodes</i> (fringed myotis)	1	1	100.0
<i>Pteropus giganteus</i> (Indian flying fox*)	1	0	0.0
<i>Rousettus lanosus</i> (long-haired rousette*)	1	0	0.0
Total	27,915	1,625	5.8

*Exotic species submitted by zoos.

Foxes—The 504 rabid foxes reported during 2009 represented an 11.0% increase, compared with the number reported during 2008, and the most rabid foxes reported since 2002. This increase coincided with an increase in the proportion of foxes submitted for testing that were rabid from 24.9% in 2008 to 26.1%. Most (376; 74.6%) of the rabid foxes were reported from states where raccoon rabies is enzootic (Figure 6). Epizootics in fox populations attributable to the California skunk rabies virus variant (355.6% increase in number of rabid foxes) and the Flagstaff and Arizona gray fox variants in Arizona (147.6% increase) were responsible for the fact that these 2 states accounted for nearly 20% of the rabid foxes reported during 2009.

Other wild animals—Puerto Rico reported 34 rabid mongooses during 2009, a 19.0% decrease from the 42 cases reported during 2008. Other reported rabid wildlife included 32 groundhogs (*Marmota monax*), 3 bobcats (*Lynx rufus*), 11 coyotes (*Canis latrans*), 3 fishers (*Martes pennanti*), 3 opossums (*Didelphis virginiana*), 2 beavers (*Castor canadensis*), 2 white-tail deer (*Odocoileus virginianus*), 2 river otters (*Lontra canadensis*), 2 squirrels (most likely *Sciurus carolinensis*), 1 cougar (*Puma concolor*), 1 muskrat (*Ondatra zibethicus*), 1 rabbit (species not identified), 1 ringtail (*Bassariscus astutus*), and 1 wolf (*Canis lupus*). With the exception of the 2 rabid squirrels, all rodents and lagomorphs were reported from states where raccoon rabies is enzootic. The rabid squirrels in Iowa and Texas were identified as being infected with a bat rabies virus variant and with a south central skunk rabies virus variant, respectively. There was insufficient tissue for confirmation and typing of infective virus variant for the rabid muskrat reported from Massachusetts.

For 4 of the 11 rabid coyotes, the virus variant was typed. Virus variant information was not reported for rabid coyotes in Alabama (1 rabid coyote), Arizona (2), North Carolina (1), New Jersey (1), New Mexico (1), and South Carolina (1). All rabid coyotes for which variant typing was reported were infected with the predominant carnivore reservoir for the geographic region where the animal was found (1 rabid coyote in Kansas and 2 in Texas were infected with the south central skunk rabies virus variant, and 1 coyote in Texas was infected with the Texas gray fox rabies virus variant).

For 4 of the 11 rabid coyotes, the virus variant was typed. Virus variant information was not reported for rabid coyotes in Alabama (1 rabid coyote), Arizona (2), North Carolina (1), New Jersey (1), New Mexico (1), and South Carolina (1). All rabid coyotes for which variant typing was reported were infected with the predominant carnivore reservoir for the geographic region where the animal was found (1 rabid coyote in Kansas and 2 in Texas were infected with the south central skunk rabies virus variant, and 1 coyote in Texas was infected with the Texas gray fox rabies virus variant).

Rabies in Domestic Animals

Domestic animals accounted for 7.5% of all rabid animals reported during 2009, representing a 7.2% increase in the number of rabid domestic animals, compared with 2008. Number of reported cases of rabies increased for all domestic species with the exception of goats and sheep. Six states reported more than half of all rabid domestic animals reported during 2009: Pennsylvania (65), Virginia (55), Texas (45), North Carolina (34), New York (33), and Georgia (25). Seasonal distribution of reported rabid domestic animals was similar to that for previous years, with a slight peak during June and July observed for rabid cats, but no strong seasonal pattern observed for other domestic animals.

Cats and dogs—Rabid cats continue to represent the majority (59.4%) of rabid domestic animals reported. Most (81.0%) of the 300 cases of rabies involving cats were reported from states where raccoon rabies is enzootic, with 2 states (Pennsylvania and Virginia) accounting for nearly a third of all rabid cats reported during 2009 (Figure 7).

During 2009, 81 rabid dogs were reported, an 8.0% increase compared with the number reported during 2008. Texas (14 rabid dogs), North Carolina (7), South Dakota (7), Pennsylvania (6), Kentucky (5), and Tennessee (5) reported the largest numbers of rabid dogs. No other states reported > 4 rabid dogs during 2009. None of the rabid dogs were reported to be infected with an imported canine rabies virus variant. Twenty-nine states, the District of Columbia, and New York City did not report any rabid dogs during 2009.

Excluding dogs from Puerto Rico, which were presumably infected with the mongoose rabies virus variant, information on the infecting rabies virus variant was provided for 23 of the 77 rabid dogs reported during 2009. Variant information was not reported for dogs from Alabama (1 rabid dog), Arkansas (2), Connecticut (1), Florida (1), Iowa (2), Kentucky (5), Minnesota (4), North Carolina (7), North Dakota (1), Oklahoma (1), Pennsylvania (6), South Carolina (5), South Dakota (6), Virginia (4), Wisconsin (1), Georgia (3), and Tennessee (4). Among rabid dogs for which the rabies virus variant was reported, 18 were infected with the south central skunk rabies virus variant (4 from Kansas, 1 from Nebraska, and 13 from Texas), 2 were infected with the north central skunk rabies virus variant (1 each from Tennessee and South Dakota), 1 was infected with the raccoon rabies virus variant (Alabama), and 1 was infected with the Texas gray fox rabies virus variant (Texas).

The legislative framework for requiring rabies vaccination of cats and dogs

varies from state to state. Currently, 38 states, the District of Columbia, and New York City have state or district laws requiring the vaccination of dogs. In comparison, 30 states, the District of Columbia, and New York City have state or district laws requiring vaccination of cats (Figure 8). Where state laws do not enforce dog and cat vaccination, many counties and municipalities have developed and enforce more stringent laws requiring vaccination. Vaccination of cats and dogs is recommended, regardless of state legislation, because vaccinated domestic animals serve as a primary level of protection from rabid wildlife.²⁰

Other domestic animals—The number of rabid cattle reported increased 25.4% from 59 in 2008 to 74

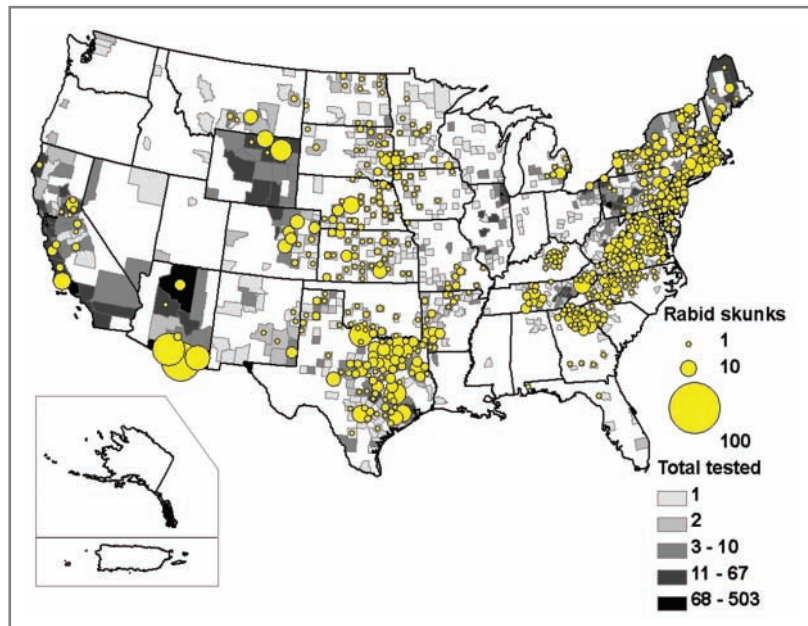


Figure 5—Reported cases of rabies involving skunks, by county, 2009.

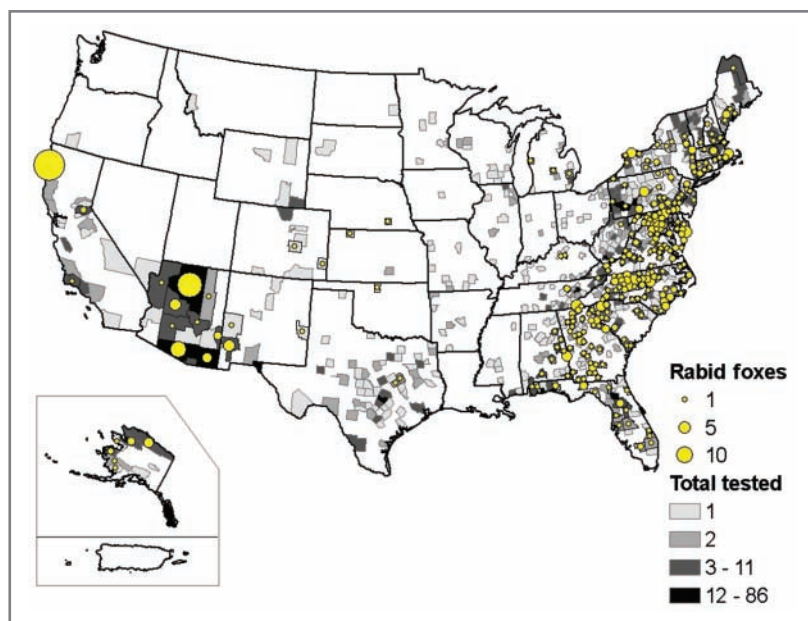


Figure 6—Reported cases of rabies involving foxes, by county, 2009.

in 2009. Virginia (10 rabid cattle), Texas (9), Vermont (8), Nebraska (7), Oklahoma (6), Iowa (5), and North Carolina (5) reported the largest numbers of rabid cattle. No other state reported > 4 rabid cattle during 2009. The 41 rabid horses and mules reported during 2009 represented a 36.7% increase, compared with the number reported during 2008. The number of rabid goats and sheep reported decreased 33.3%. A rabid ferret was reported from Nebraska.

Rabies in Humans

During 2009, samples from 48 human patients in the United States were submitted to the CDC for rabies testing, representing a 6.7% increase from the number submitted during 2008. Four cases of human rabies were reported (Table 3). On February 25, 2009, a 17-year-old girl presented at a community hospital ED in Texas with severe frontal headache, photophobia, emesis, neck pain, dizziness, and paresthesia of the face and forearms. The headaches had begun approximately 2 weeks before. An initial examination revealed nuchal rigidity and fever, and cytologic examination of a CSF sample obtained by lumbar puncture revealed lymphocytosis. The patient was treated in the hospital, but was discharged after 3 days when symptoms resolved. However, her headaches returned approximately 1 week later, and she presented to another local hospital before being transferred to a tertiary-care children's hospital where a diagnosis of possible infectious encephalitis was made.

During an extensive workup to identify potential etiologies, the patient reported a history of bat exposure. Approximately 2 months before the onset of clinical signs, she had been camping in Texas and had entered a cave where she had direct contact with flying bats. Serum and CSF samples were submitted to the CDC, and rabies virus antibodies were detected by means of an indirect fluorescent antibody test. This represented the first reported case in which clinical and serologic findings supported a diagnosis of abortive human rabies infection.²¹

On October 5, 2009, a 43-year-old man in Indiana visited an employee health clinic because of a fever and cough. A presumptive diagnosis of bronchitis was made, and the patient was sent home with antimicrobials. Two days after the initial onset of clinical signs, the patient presented to an ED with worsening fever, left arm numbness, and akathisia. The patient returned home, but came back to the ED the next day because of a progressive worsening of his condition and was admitted to the hospital. After

admission, his mental status deteriorated rapidly. He was intubated and transferred to a neighboring hospital in Kentucky. Antemortem samples were submitted to the CDC for rabies diagnosis on October 19, but the patient died the following day. Postmortem collection of CNS specimens was facilitated by CDC pathologists following unsuccessful attempts to identify willing personnel and local facilities to perform an autopsy. Rabies virus antigen was detected in CNS tissues by means of the direct fluorescent antibody test, and phylogenetic analysis identified a tricolored bat (*Perimyotis subfla-*

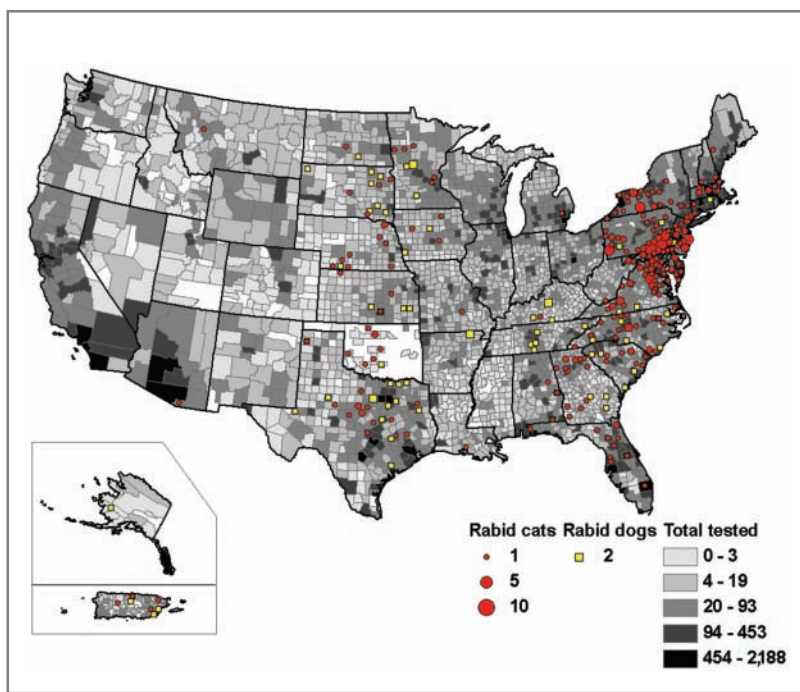


Figure 7—Reported cases of rabies involving cats and dogs, by county and municipio (Puerto Rico), 2009.

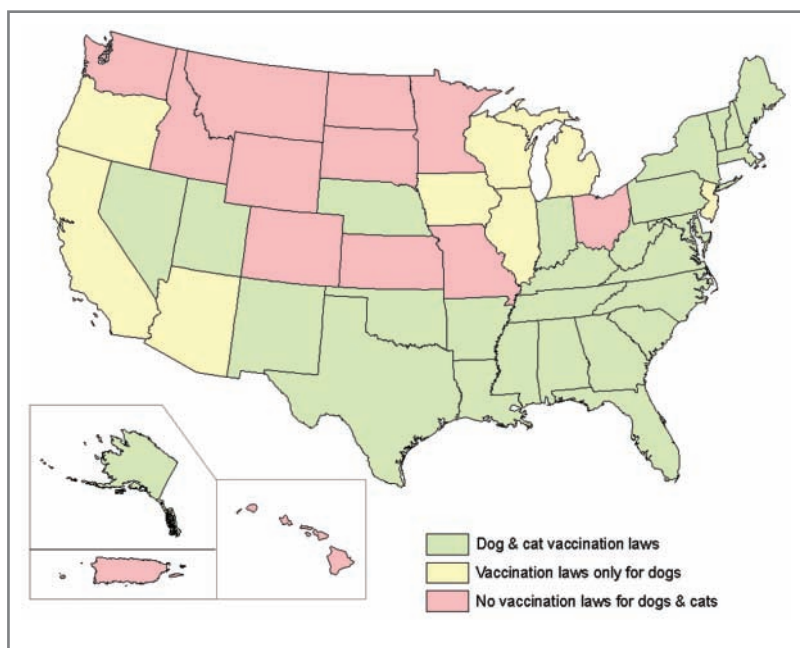


Figure 8—State legislation requiring rabies vaccination of cats and dogs, 2009.

Table 3—Cases of rabies in humans in the United States and Puerto Rico, 2000 through 2009, by circumstances of exposure and rabies virus variant.

Date of death	Reporting state	Exposure history*	Rabies virus variant†
20 Sep 00	CA	Contact	Bat, Tb
9 Oct 00	NY	Bite-Ghana	Dog, Africa
10 Oct 00	GA	Contact	Bat, Tb
25 Oct 00	MN	Bite	Bat, Ln
1 Nov 00	WI	Contact	Bat, Ps
4 Feb 01	CA	Unknown-Philippines	Dog, Philippines
31 Mar 02	CA	Unknown	Bat, Tb
31 Aug 02	TN	Contact	Bat, Ps
28 Sep 02	IA	Unknown	Bat, Ln/Ps
10 Mar 03	VA	Unknown	Raccoon, eastern United States
5 Jun 03	PR	Bite-Puerto Rico	Dog/mongoose, Puerto Rico
14 Sep 03	CA	Bite	Bat, Ln
15 Feb 04	FL	Bite-Haiti	Dog, Haiti
3 May 04	AR	Bite (organ donor)	Bat, Tb
7 Jun 04	OK	Liver transplant recipient	Bat, Tb
10 Jun 04	TX	Kidney transplant recipient	Bat, Tb
10 Jun 04	TX	Arterial transplant recipient	Bat, Tb
21 Jun 04	TX	Kidney transplant recipient	Bat, Tb
Survived 04	WI	Bite	Bat, unknown
26 Oct 04	CA	Unknown-El Salvador	Dog, El Salvador
27 Sep 05	MS	Contact	Bat, unknown
12 May 06	TX	Contact	Bat, Tb
2 Nov 06	IN	Bite	Bat, Ln
14 Dec 06	CA	Bite-Philippines	Dog, Philippines
20 Oct 07	MN	Bite	Bat, unknown
18 Mar 08	CA	Bite-Mexico	Fox, Tb related
30 Nov 08	MO	Bite	Bat, Ln
Survived 09	TX	Contact	Bat, unknown
20 Oct 09	IN	Unknown	Bat, Ps
20 Nov 09	VA	Contact-India	Dog, India
11 Nov 09	MI	Contact	Bat, Ln

*Data for exposure history are reported when plausible information was reported directly by the patient (if lucid or credible) or when a reliable account of an incident consistent with rabies exposure (eg, dog bite) was reported by an independent witness (usually a family member). Exposure histories are categorized as bite, contact (eg, waking to find bat on exposed skin) but no known bite acknowledged, or unknown (ie, no known contact with an animal was elicited during case investigation). †Variants of the rabies virus associated with terrestrial animals in the United States and Puerto Rico are identified with the names of the reservoir animal (eg, dog or raccoon), followed by the name of the most definitive geographic entity (usually the country) from which the variant has been identified. Variants of the rabies virus associated with bats are identified with the names of the species of bats in which they have been found to be circulating. Because information regarding the location of the exposure and the identity of the exposing animal is almost always retrospective and much information is frequently unavailable, the location of the exposure and the identity of the animal responsible for the infection are often limited to deduction.
Ln = *Lasionycteris noctivagans*. Ps = *Perimyotis subflavus*. Tb = *Tadarida brasiliensi*.

vus) rabies virus variant. A public health investigation did not identify any recognized exposure to bats. The patient had mentioned to friends that he had seen a bat in late July after removing a tarp from a tractor adjacent to his residence.²²

On October 26, 2009, a 42-year-old Virginia man presented to an ED because of chills, leg discomfort, and spontaneous ejaculation that had developed over the previous 3 days. He was discharged and advised to follow up with his primary care physician. That evening, the patient developed symptoms consistent with hydrophobia. The patient, a physician, raised concerns about the possibility of rabies with his primary care physician and returned to the ED on October 27. Over the next 24 hours, the patient became febrile, anxious, and combative; exhibited hypersalivation; and was unable to fol-

low commands. The patient had recently traveled to India, and his family reported that he had told them of an encounter with a dog while jogging. Samples were submitted to the CDC, where rabies was confirmed on October 30 and a canine rabies virus variant associated with Indian dogs was identified. The Milwaukee rabies treatment protocol was initiated, but the patient did not improve, and he died on November 20 (day 24 of hospitalization).²³

In late October 2009, a 55-year-old Michigan man presented to an ED complaining of numbness and tingling in his left arm for the past 10 days, pain in his upper back, and increasing weakness in his left arm. At the time of presentation, he exhibited ataxia and difficulties in swallowing and speaking. His condition rapidly deteriorated at the ED, and he was transferred to a

tertiary-care hospital, where he was connected to a mechanical ventilator. Over the next few days, the patient's condition deteriorated and he developed quadriplegia and became comatose. Antemortem clinical specimens were sent to the CDC, where rabies was confirmed and a silver-haired bat (*Lasiorycteris noctivagans*) rabies virus variant was identified. On November 11, the patient died after a 22-day illness. The patient had had no known history of a recent animal bite, but a family member recalled that in spring 2009, the patient told him that a bat had landed on him during the night. He had disposed of the bat and did not seek medical care.

Rabies in Canada and Mexico

Canada reported 145 laboratory-confirmed cases of rabies involving animals during 2009, a 38.3% decrease compared with the number reported during 2008. A decrease in total number of rabid animals has been reported in 8 of the past 9 years. Eighty-four percent (n = 122) of the cases involved rabid wildlife, 7.6% (11) involved rabid livestock, and 8.3% (12) involved rabid cats and dogs. The overall number of animals submitted for diagnostic testing decreased 24.8% from 7,336 in 2008 to 5,515 in 2009. The Canadian Food Inspection Agency continued to focus on mandated samples involving human and domestic animal involvement, which may have contributed to the decrease in submission numbers. No rabid raccoons were reported in Canada during 2009, compared with 27 in 2008. Increases in number of rabid animals were reported for wolves (2 in 2008 and 5 in 2009) and sheep (0 in 2008 and 3 in 2009). Numbers of rabid bats, skunks, foxes, dogs, and cattle reported decreased by 9.8% (61 to 55), 50.5% (99 to 49), 13.3% (15 to 13), 25.0% (12 to 9), and 33.3% (12 to 8), respectively. Number of rabid cats reported remained unchanged, with 3 cases reported in 2008 and 2009. No human cases of rabies were reported in Canada during 2009.

Mexico reported 171 rabid animals during 2009, a 26.3% decrease compared with the number reported during 2008. Seventy-eight percent (134/171) of rabid animals reported were cattle. Other rabid livestock included 12 equids, 7 sheep, and 1 goat. Twelve rabid dogs were reported in addition to 5 rabid wild animals. Four human rabies cases were reported from Mexico during 2009.

Discussion

Undoubtedly, the report of abortive rabies infection in a human was the most important finding during 2009. Although abortive infection and recovery after the onset of clinical signs has been observed in animals experimentally infected with field strains of the rabies virus,²⁴ this marks the first documented human rabies case in which clinical and serologic findings were indicative of rabies and no alternate etiology for the illness was determined despite an extensive investigation. Compared with other documented cases involving human patients that survived rabies infection, this patient experienced a shorter clinical course, less severe neurologic abnormalities, and less stimulation of the immune

system (the patient did not develop rabies virus neutralizing antibodies until after receiving a dose of rabies vaccine > 30 days after the onset of symptoms). The relatively mild signs at the time of initial examination support the contention that viral dose, route, and type may have resulted in more limited viral replication and less apparent stimulation of the immune system.²¹

Rabies should be included in the differential diagnosis for any patient with unexplained, acute, rapidly progressive encephalitis, especially in combination with autonomic instability, dysphagia, hydrophobia, paresis, or paresthesia.²⁵ If experimental treatment is to be considered, an early diagnosis of potential rabies is critical. To date, no single drug or specific treatment of rabies in humans has been documented to be efficacious after clinical signs of rabies are present. The documentation of a case of abortive human rabies infection continues to challenge preconceived notions of rabies as an invariably fatal disease as well as traditional guidelines for submitting samples for rabies diagnosis. Clinicians treating possible cases of human rabies—as indicated by acute, progressive infectious encephalitis; a compatible exposure history; and serologic evidence of a specific lyssavirus response—should, even in the absence of fulminant neurologic decline, contact their state health department for engagement with the CDC.²¹

Although supplies of rabies vaccine were limited throughout 2007 and 2008, an increased availability during the first half of 2009 resulted in a stop to temporary measures to restrict rabies vaccine use to PEP only and with direct consultation with a state or local health official.¹⁹ During June 2009, evidence on the number of doses of rabies vaccine required for PEP was presented to the Advisory Committee on Immunization Practices, and a change in the PEP guidelines was approved.²⁶ Under the new guidelines recommended for PEP in the United States, immunocompetent persons not previously vaccinated against rabies should receive human rabies immunoglobulin (20 IU/kg; day 0) and 4 doses (1 mL, IM) of the rabies vaccine (days 0, 3, 7, and 14). Persons who are immunocompromised should still receive the 5-dose PEP protocol, with serologic testing to confirm adequate response to the vaccine.²

The raccoon rabies virus variant continues to be responsible for most cases of rabies in the United States. States in which raccoon rabies is enzootic accounted for > 70% of the rabid animals other than bats reported during 2009 and had a higher rate of animals submitted for rabies testing, compared with the rate for states in which skunk rabies is enzootic. The cause of this higher submission rate was difficult to determine on the basis of available information, but may have been due in part to higher contact rates between raccoons and other animals, including humans; greater awareness of the need to submit animals for rabies testing; a differential allocation of public health resources; or some combination thereof. Cross-sectional studies have also found discrepancies related to the incidence of PEP administration. A recent study²⁷ estimated that the average incidence of rabies PEP in states in which raccoon rabies is enzootic is 13.1/100,000 persons, compared with an incidence of 7.8/100,000 persons in states where skunk rabies is enzootic.²⁷ Oral rabies

vaccination programs targeted at raccoons have been associated with significant reductions in the number of rabid raccoons reported in some areas, but continue to primarily focus on preventing any additional westward spread of the raccoon rabies virus variant.^{18,28} Ongoing development of novel oral rabies vaccines shows promise in improving immune response and efficacy in critical reservoir species (eg, skunks).^{29,30}

During 2009, Arizona reported 273 rabid animals, a record number for that state. Although increases in the number of rabid animals were reported across the state, including the southern part of the state, a substantial proportion (15.7%) of cases involving animals other than bats were reported from Coconino County and attributed to the Flagstaff rabies virus variant. This rabies virus variant was first recognized in 2001, following what is now recognized as a host switch from big brown bats to enzootic transmission among skunks in Flagstaff, Ariz. Attempts to prevent the establishment of this variant by use of oral rabies vaccination programs and trap, vaccinate, and release programs have not shown success to date, despite periodic decreases in the number of reported cases. The most recent resurgence of cases attributed to this variant began in late 2008. Unlike previous increases, most cases (78.1%) reported in 2009 involved gray foxes, suggesting another potential host switch may be underway.

Small mammals, such as insectivores and rodents, have never been documented as rabies virus reservoirs in the United States. Rabies among rodents and lagomorphs reflects spillover infection from regional reservoir species. Among rodents, rabies occurs primarily in groundhogs in states where raccoon rabies is enzootic. Rabies is occasionally reported in other large-bodied rodents (eg, beavers) and captive rabbits in outdoor cages or pens. During 2009, a rabid muskrat and 2 rabid squirrels were reported to the CDC. Despite these reports, rodent bites represent a very low risk for rabies transmission. Including the 2 cases reported here, only 4 rabid squirrels have been reported since 2000, despite a mean of 1,232 squirrels tested each year. Only 1 other rabid muskrat has been reported since 2000, from South Dakota during 2004.

Knowledge regarding the impact of host, pathogen, and environment on the circulation of rabies virus variants in bats remains less developed than knowledge regarding viruses associated with carnivores. Most human rabies cases in the past 20 years have been associated with bats. This trend has been highly publicized and resulted in major public health recommendations for potential rabies exposures involving bats.^{31,32} These recommendations have included a focus on submitting bats for rabies testing when a potential exposure may have occurred. Since 1996, when these recommendations began to be formalized, the number of bats submitted for rabies testing has increased from < 10,000 a year to nearly 30,000 a year. If such trends continue, bats will likely become the most frequently submitted animal for rabies testing within the next few years.

Thirty-one cases of human rabies involving patients in the United States have been reported to the CDC since 2000, including the 4 cases reported during 2009. Eight of these 31 (25.8%) patients were infected

outside the continental United States (7 abroad and 1 in Puerto Rico). All human rabies infections originating outside the continental United States occurred in countries where dog rabies is enzootic and involved regional canine rabies virus variants, with the exception of the 2008 case from Mexico, which was associated with a novel bat rabies virus variant. The remaining 23 (74.2%) patients were infected with rabies virus variants indigenous to the United States. Phylogenetic analysis indicated that 18 of these 23 (78.3%) persons were infected with bat rabies virus variants, and epidemiological investigations implicated a bat as the most likely source of exposure in 4 additional cases. Only 1 human rabies case since 2000 was not associated with bats: a 2003 Virginia case was associated with a raccoon rabies virus variant. Excluding 4 human rabies cases associated with organ transplantation and arterial grafting from a donor infected with bat-associated rabies virus, there have been a total of 18 bat-associated human rabies cases since 2000. In 15 of the 18 (83.3%), there was a report of a bite or direct contact with a bat (eg, waking to find a bat on the body or handling a bat with bare hands). Only 3 (16.7%) patients with bat-associated rabies were reported to have no known exposure to a bat. By comparison, 40% of bat-associated human rabies cases during the 1990s included a report of a bite or direct contact and 60% included no history of direct contact. Even in the absence of a documented bite, the most likely route of infection with rabies virus remains a bite that was ignored or went unnoticed during an interaction with a bat. Although infection of humans following exposure to bats remains a rare occurrence, rabies prevention remains an important public health concern.

2010 Rabies Update

No human rabies cases were reported during the first 7 months of 2010. A substantial increase in the number of rabid raccoons reported from New York City occurred during the first half of 2010 because of an epizootic in raccoons in Central Park. At least 116 rabid raccoons were reported from Manhattan as of June. A trap, vaccinate, and release program was initiated in February to attempt to control this epizootic.

Following the abortive human rabies case in 2009, an amendment to the human rabies case definition was submitted to and approved by the Council of State and Territorial Epidemiologists.³³ The revised human rabies case definition clarifies the definition of a case to include detection of lyssavirus-specific antibodies in CSF and serum from unvaccinated individuals by means of specific binding antibody (ie, rabies virus-specific IgM or IgG) and indirect fluorescent antibody staining, in addition to detection of rabies neutralizing antibody. The previous human rabies case definition restricted cases to detection of neutralizing antibody only.

World Rabies Day events occurred throughout 2009, with events in > 100 countries. More than 20 events are already planned for September 28, 2010, including a global Webinar by international rabies experts. The need for improved global advocacy, increased international awareness, and renewed collaborative out-

reach has resulted in the creation of the Partners for Rabies Prevention, a newly formed group of international stakeholders focused on rabies prevention and control and multidisciplinary research. This group has developed a blueprint for rabies control that was released to the public in July 2010. The blueprint was developed to serve as a guide for countries to prevent human rabies by eliminating canine rabies within their borders. The blueprint is intended to be a living document bringing together the latest information on canine rabies elimination and is available online at www.rabiesblueprint.com.

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