# Human Rabies Post-Exposure Treatment in Arkansas, 1994-2000

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## Abstract

The Arkansas Department of Health recorded 118 incidents where humans in Arkansas were treated following exposure to confirmed rabid animals from 1994-2000. Domestic species accounted for 64% of incidents and 76% of total human exposures with the ratio of human exposures per rabid animal 17 times higher for domestic animals than wild animals. Records of 218 cases of human exposure to potentially rabid wild animals during this period were also examined to determine method of contact. While 72% of cases involving raccoons (*Procyon lotor*), skunks (*Mephitis mephitis* and *Spilogale putorius*), and foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*) were initiated by humans, bats initiated 64% of contacts in which post-exposure treatments were given. However, 75% of contacts with rabid bats in which the instigator is known were provoked by the human. Though recent rabies-related human deaths in the United States have resulted from apparent exposures to rabid wild animals, the higher rate of human exposure to rabid domestic animals indicates that continuing efforts to prevent the spread of this disease in pet populations are necessary.

## Introduction

During the last half-century in Arkansas and the United States rabies has changed from a disease primarily found in domestic animals such as dogs (*Canis familiaris*), cats (*Felis catus*), and cattle (*Bos taurus*) to one that is now more often diagnosed in wild animals, primarily raccoons (*Procyon lotor*), red and gray foxes (*Vulpes vulpes, Urocyon cinereoargenteus*), striped skunks (*Mephitis mephitis*) and bats of all species. In 2000, over 93% of animals with confirmed rabies were wild species and only 7% were domestic (Krebs et al., 2001; Heidt et al., 1991). As the occurrence of rabies in domestic animals declined so did human deaths associated with the disease, though there was a resurgence in the number of reported human cases during the 1990s (Messenger et al., 2002). Most of this decline is attributed to the vaccination of dogs and cats and more effective human post-exposure treatments (Rupprecht et al., 1995).

Domestic animals are generally infected with rabies through contact with rabid terrestrial wildlife with only occasional transmission of bat variants to domestic species (Rupprecht et al., 1995). Public health agencies have attempted to reduce the amount of rabies in wild animals through oral baiting vaccination programs targeted at vaccinating raccoons in the northeastern United States and gray foxes, dogs, and coyotes (*Canis latrans*) in southern Texas. From 1990-2000 there were 26 cases of human rabies acquired in the United States, 24 of which were attributed to strains of the virus associated with bats (Krebs et al., 2001). Unlike the bites of larger animals, bat bites or contacts are often not presented for medical treatment and may not be recognized as a potential rabies exposure (Messenger et al., 2002; Gibbons, 2002; Gibbons et al., 2002). In Arkansas, human cases have been rare; in 1991 a Clark County man died of rabies that was probably transmitted by a bat and in 2004 four organ transplant patients died of rabies following receipt of tissues from an Arkansas man who was later determined to have been infected by this disease and had reported being bitten by a bat (Centers for Disease Control and Prevention, 1991, 2004a, 2004b). Due to the difficulty in determining animal population sizes, there is very little information on the overall prevalence of rabies in both wild and domestic animal populations. This lack of information makes it problematic to accurately assess the overall risk of human exposure to rabies through animal contact. The purpose of this study was to examine the types of animals involved in known exposures of humans to animal rabies and to document methods of contact between humans and potentially rabid wild animals to provide public health professionals with information necessary to design an effective rabies prevention program in Arkansas.

## Materials and Methods

Records of the Arkansas Department of Health (ADH) pertaining to animals tested for rabies and all human post-exposure prophylaxis treatments from 1994-2000 were examined to assess the number of contacts between humans and animals suspected or confirmed to have rabies. One incident in which four people were treated for exposure to a presumed rabid pet ferret was not included as it was not possible to confirm the ferret's rabies status with available documents. Bats submitted to the ADH were identified to species, but in some cases extant records were insufficient to positively link identified bats to specific cases of potential

| | Animals tested | Animals positive for rabies (%) | Rabid animals that exposed humans to rabies (%) | Human exposures to rabid animals | Human exposures per rabid animal |
|---|---|---|---|---|---|
| **Domestic animals** | | | | | |
| Dog | 2913 | 17 (0.6) | 17 (100) | 51 | 3.00 |
| Cat | 2260 | 16 (0.7) | 10 (63) | 15 | 0.94 |
| Cow | 249 | 7 (2.8) | 4 (57.1) | 12 | 1.71 |
| Horse | 130 | 3 (2.3) | 3 (100) | 10 | 3.33 |
| Total | 5552 | 43 (0.8) | 34 (79.1) | 88 | 2.05 |
| **Wild animals** | | | | | |
| Raccoon | 640 | 0 (0) | 0 (0) | 0 | n/a |
| Skunk | 538 | 183 (34) | 7 (3.8) | 13 | 0.07 |
| Bat | 472 | 49 (10.4) | 9 (18.4) | 14 | 0.29 |
| Fox | 128 | 4 (3.1) | 1 (25) | 1 | 0.25 |
| Total | 1778 | 236 (13.3) | 17 (0.7) | 28 | 0.12 |
| **Grand Total** | 7330 | 279 (3.8) | 51 (18.2) | 116 | 0.41 |

Table 1. Animals tested for rabies and human exposure to confirmed rabid animals, Arkansas, 1994-2000.

human exposure. ADH personnel do not identify fox or skunk specimens to species though two species of each are present in the state. Striped skunks and gray foxes probably represent the majority of these specimens as they are more common than spotted skunks (*Spilogale putorius*) and red foxes (Sealander and Heidt, 1990). These records represented the majority of post-exposure treatments given in Arkansas because physicians are required to report all rabies treatments, and the ADH served as a primary source for low-cost vaccines until the program was discontinued in 2001 due to budget cutbacks.

## Results

During this seven-year period 279 of 7,330 (4%) of the eight animal species most commonly tested were found to be rabid with wild animals accounting for 85% of all rabid individuals (Table 1). Domestic animals accounted for 64% of the incidents of contact between humans and confirmed rabid animals. Domestic animals were also responsible for 76% of total human exposures to rabid animals. Only 0.7% of rabid wild animals came into contact with people while 79% of rabid domestic animals resulted in a human exposure. Despite the greater number of rabid wild animals the ratio of human exposures per rabid animal was 17 times higher for confirmed rabid domestic animals.

During this study 218 people were treated for exposure to potentially rabid wild animals. Two hundred and one cases representing 92% of all post-exposure treatments were for contact with bats (42%), raccoons (32%), skunks (16%), and foxes (2%) (Table 2). While 72% of cases involving raccoons, skunks, and foxes were initiated by humans, bats initiated 64% of contacts resulting in human post-exposure treatments. About 42% of exposures to potentially rabid raccoons and 31% of exposures to potentially rabid skunks were brought about by an attempt to capture a live animal or by handling a wild animal kept as a pet. Twenty percent of exposures to potentially rabid raccoons occurred while a human was attempting to feed a wild raccoon (Table 2).

From available records it was possible to determine the species involved in 11/14 (79%) cases of contact between confirmed rabid bats and humans. One 25 September 1998 incident at a school in Garland County involved a six-year old child that was bitten while attempting to capture a rabid Brazilian free-tailed bat (*Tadarida brasiliensis*) outside the building, a 40 year-old woman that suffered a non-bite exposure while attempting to handle the captured animal, and two other six-year old children that had non-bite

Table 2. Method of contact between humans and potentially rabid bats, raccoons, skunks, and foxes in Arkansas, 1994-2000. The total number of exposures includes incidents in which the animal involved was negative for rabies, destroyed, escaped, or the results of the rabies test were not available.

| Encounter Type | Bat | | Raccoon | | Skunk | | Fox | |
|---|---|---|---|---|---|---|---|---|
| | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures |
| **No intentional contact by human** | | | | | | | | |
| Bat landed on person while outside | 2 | 30 | n/a | n/a | n/a | n/a | n/a | n/a |
| Bat found in living area of house, no contact | 0 | 12 | n/a | n/a | n/a | n/a | n/a | n/a |
| Person touched or was bitten by hidden animal | 1 | 7 | 0 | 2 | 0 | 2 | 0 | 0 |
| Person awoke to find bat in room | 0 | 1 | n/a | n/a | n/a | n/a | n/a | n/a |
| Person handled pet that had wild animal in its mouth or was fighting with wild animal | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 |
| Bat flew into car window and into person | 0 | 1 | n/a | n/a | n/a | n/a | n/a | n/a |
| Unprovoked attack by animal not related to feeding | 0 | 1 | 0 | 5 | 0 | 3 | 0 | 0 |
| Unspecified circumstances | 1 | 6 | 0 | 0 | 0 | 1 | 0 | 0 |
| Other circumstances | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Total | 4 | 59 | 0 | 7 | 3 | 10 | 0 | 0 |

| Encounter Type | Bat | | Raccoon | | Skunk | | Fox | |
|---|---|---|---|---|---|---|---|---|
| | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures | Confirmed Rabid | Total Exposures |
| **Intentional contact by human** | | | | | | | | |
| Person attempted to touch or capture animal outdoors | 5 | 7 | 0 | 14 | 0 | 3 | 0 | 0 |
| Person handled captured wild animal or was careless around caged animal | 1 | 3 | 0 | 14 | 3 | 3 | 0 | 0 |
| Person feeding animal | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Person bitten separating wild animal from a pet | 0 | 2 | 0 | 4 | 0 | 2 | 0 | 1 |
| Animal provoked into attacking human, no details | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 1 |
| Person bit or exposed to wild animal pet | 0 | 1 | 0 | 1 | 4 | 5 | 0 | 0 |
| Person tried to remove animal from indoors | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 0 |
| Person exposed during hunt | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 |
| Person attempted to kill or capture animal acting rabid | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| Person handled dead animal | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Person attacked the animal | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| Unspecified circumstances | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 0 |
| Person handled captured wild animal as job duty | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 8 | 22 | 0 | 52 | 9 | 22 | 0 | 4 |
| **Not known whether** incident was result of intentional human contact | | | | | | | | |
| Other circumstances | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Unknown circumstances | 2 | 11 | 0 | 10 | 0 | 2 | 1 | 1 |
| Total | 2 | 11 | 0 | 10 | 1 | 3 | 1 | 1 |
| **Grand Total** | **14** | **92** | **0** | **69** | **13** | **35** | **1** | **5** |

exposures suffered in an unspecified manner. On 22 August 1997, 1 October 1997, and 30 July 1998 rabid red bats (*Lasiurus borealis*) in Greene, Faulkner, and Lawrence counties bit individuals that were attempting to touch or capture the animal while outdoors.

Only 36% of the rabid bat contacts for which the species is known were the result of contact that the human did not initiate. On 30 August 1994 a rabid hoary bat (*Lasiurus cinereus*) landed on or flew into a three-year old child who was outside in Washington County. In separate 1999 incidents a nine-year old child in Chicot County and a 65 year-old man in Yell County were bitten by rabid red bats that were hidden from them or that they inadvertently touched. On 22 August 2000 a 48-year old man was bitten by a rabid eastern pipistrelle bat (*Pipistrellus subflavus*) in an unspecified manner that was not the result of intentional contact by the human.

## Conclusions

Although the majority of rabies cases in Arkansas during this period were found in wild animals, people were more likely to be exposed to rabid domestic animals. This scenario is consistent with previous research in New York that found the number of human post-exposure cases per rabid domestic animal was 20 times higher than for rabid wild animals and in Kentucky where 11/13 (85%) exposures to known rabid animals in 1994 were to domestic animals (Wyatt et al., 1999; Auslander and Kaelin, 1997). Similarly to Arkansas, Illinois reported that from 1963-1968 rabid skunks accounted for 62% of all rabid animals but for only 12% of the human exposures. They also reported that nine times as many humans were exposed per rabid domestic animal as per each rabid wild animal (Schnurrenberger et al., 1969).

While close contact between humans and domestic animals is to be expected, opportunity for human contact with rabid skunks is also present. Over half (63%) of the interactions between humans and rabid skunks in Arkansas from 1977-1979 occurred around buildings in the country or within city limits. Seventy-five percent were observed and killed during daylight hours (Ferguson and Heidt, 1980). Since most contacts with terrestrial wildlife resulting in postexposure treatment were initiated by the human the most effective way to reduce the risk of rabies transmission from wildlife is to increase educational efforts to prevent people from attempting to touch or capture live wild animals. Current state law, which allows individuals to capture by hand and keep as pets wild animals such as raccoon, red fox, coyote, and most nongame animals, sanctions such contact and may need to be revised (Arkansas Game and Fish Commission, 2004). Feeding of wild animals, which is also legal in most cases, should be discouraged, especially at communal sites such as deer feeders or dumps near human dwellings where high contact rates between raccoons may accelerate the spread of rabies (Cooper and Ginnett 2000; Totton et al., 2002).

Most rabid domestic animals expose at least one human and usually multiple humans to rabies. The most efficient way to reduce the threat to humans and the high economic cost of treatment is to reduce the number of rabid domestic animals. Yearly vaccination of dogs and cats is required in Arkansas but actual vaccination rates are probably low (Arkansas Department of Health, 1999-2000), which may account for the large number of dogs and cats tested in Arkansas each year. Arkansas tested 5,193 dogs and cats from 1994-2000 compared to 439 tested in New York during a period of similar length (Chang et al., 2002). Some reduction in rabies control costs could be achieved through quarantining more animals instead of administering rabies tests.

Untreated contact with rabid bats is the primary cause of recent human rabies fatalities. Educational efforts that encourage people to seek medical advice after bat bites or other physical contact are warranted (Messenger et al., 2002; Gibbons et al., 2002; McQuiston et al., 2001). However, since most contacts between bats and humans resulting in post-exposure treatment are initiated by bats of unknown rabies status it will be difficult to significantly lower the potential risk posed by these species (Pape et al., 1999). It should be noted that while avoiding all contact with bats is not possible, in this study 8 of 12 (67%) contacts with known rabid bats resulting in treatment in which the instigator is known were provoked by the human. Educational efforts focused on educating people to the dangers of picking up bats found outdoors, handling captured bats, or attempting to remove bats from indoors are warranted and would significantly reduce the risk of exposure to rabid bats. Rabies in domestic animals remains a significant danger due to high contact rates between rabid domestic animals and humans. It has been suggested by some researchers that because of the low rate of positive rabies tests in domestic animals that post-exposure treatment may not always be necessary, especially in areas where rabies in wild animals is rare (Moran, 2002; Moran et al., 2000). This conclusion may be premature given the recent discovery of an outbreak of a rabies variant associated with bats in a skunk population in Arizona. If transmission from bats to terrestrial animals is more common than previously thought, areas of low endemic rates in wildlife may not remain so for extended periods of time, and it would not be advisable to forgo post-exposure treatment following contact with domestic animals (Krebs et al., 2001; McQuiston et al., 2001).

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