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Community Survey of Rabies Knowledge and Exposure to Bats in Homes – Sumter County, South Carolina, USA

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Summary

Subsequent to a human rabies death in Sumter County, South Carolina, we assessed the frequency of exposures to bats in homes and citizens' rabies knowledge. A self-administered survey was mailed to 6033 randomly selected Sumter County addresses. The survey inquired about household exposures to bats and respondents' rabies knowledge. Surveys were returned by mail for descriptive analysis. Of 597 respondents, 3.5% (21/597) reported having bats living in (2.8% or 17/597) or entering their homes (2.5% or 15/597) during 2010–2012. Respondents generally understood that mammals transmit rabies virus through bites, but were less aware of the severity of rabies illness and modern post-exposure vaccine administration. Respondents were unsure about how to exclude bats from homes and ranked highly both healthcare and non-healthcare entities as preferred resources for obtaining assistance with bat-related concerns. We found potential for human exposures to bats in Sumter County households and gaps in citizen knowledge of rabies and bat exclusion. Public health officials should engage non-healthcare partners in assistance disseminating rabies educational materials and for providing appropriate referral for persons potentially exposed to bats.

Keywords

Bats; prevention; rabies; survey; zoonotic disease

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Introduction

In the United States, wild mammals are the primary reservoirs for rabies virus and constitute the majority of human rabies virus exposures (Blanton et al., 2012). Rabies virus is transmitted by contamination of wounds or mucous membranes with saliva from an infected mammal. Typically, this occurs through bites. Although bats are the third most commonly reported laboratory-confirmed rabies-positive wild species (second to raccoons and skunks), most cases of human rabies in the United States are associated with bat exposures and/or bat rabies virus variants, particularly viral variants associated with silver-haired bats (*Lasionycteris noctivagans*), tri-coloured bats (*Perimyotic subflavus*) and Mexican free-tailed bats (*Tadarida brasiliensis*) (Blanton et al. 2012). During 1995–2011, more than 90% of domestically acquired human rabies cases in the US were linked epidemiologically to bats (CDC, 2013a). Cryptogenic rabies – cases where the available patient history does not contain a definitive transmission mechanism – constitutes a rising proportion of these bat-associated human rabies cases. Bat exposures can result in rabies virus transmission from seemingly minor or unrecognized bites (Messenger et al., 2002). For this reason, a complete risk assessment by healthcare providers or public health officials is recommended for anyone with a potential rabies virus exposure, even in the absence of a confirmed animal bite (CDC, 2008).

Several recent human rabies cases have been linked to rabid bat exposures that occurred in or around the home environment (e.g. CDC, 2009, 2010, 2011a,b, 2013b). In December 2011, one such case occurred in South Carolina – the first reported human rabies case in this state in over 50 years (CDC, 2013b). A 46-year-old woman from Sumter County, South Carolina, died from rabies after presumptively having been exposed to bats in her home. This patient with rabies noticed bats living in her attic the previous summer and had also awakened to find a bat in her bedroom, but she did not believe that direct contact with the animal occurred. She sought advice on bat removal from a local county service. However, she was not referred to public health officials for risk assessment and guidance on post-exposure prophylaxis. Approximately 3 months after finding a bat in her bedroom, she reported to a local hospital with shortness of breath, profuse sweating and tingling in her upper extremities. She died approximately 2 weeks later; she was confirmed infected with a North American Mexican free-tailed bat rabies virus variant shortly before her death (CDC, 2013b).

As part of the public health response to this case, the Centers for Disease Control and Prevention (CDC) and state partners in the South Carolina Department of Health and Environmental Control (SC-DHEC) decided to seek additional information on the frequency of bat exposures in homes and citizen knowledge, attitudes and practices concerning bats, bat removal and exclusion, and rabies. In May 2012, a survey was distributed by mail to a random sample of Sumter County households to collect this information to inform rabies prevention and control activities. Understanding public baseline knowledge of rabies and experiences with bats in the home is essential for targeting education campaigns and gaining a more comprehensive understanding of rabies virus exposure risks from bats in residential structures in this community. Documenting where citizens seek assistance for bat-related issues can identify partnership opportunities to target distribution of rabies information and to enhance appropriate referral to public health authorities in cases of human exposure to bats. We present the results of this survey and recommendations for applying these findings to enhance rabies prevention and control efforts.

Methods

Data collection

A simple random sample of 6033 addresses was drawn by computer algorithm from a complete list of all physical addresses located in Sumter County, obtained by South Carolina Department of Health and Environmental Control from the county municipal government. Residents' or property owners' names, occupancy status and current use (i.e. residential, business, vacant) of the address plots were not included in this database. In May 2012, surveys were mailed to all households with a letter requesting one adult (person ≥18 years of age) complete the paper-based survey and return it using the included prepaid envelope by mail. The survey was anonymous, but respondents were asked to indicate their zip code to allow for some understanding of the geographical distribution of responding households. Educational materials were not included to prevent bias in survey responses, but information about how to request additional information, as well as the rabies webpage addresses of the CDC and SC-DHEC websites, was included in the cover letter. This household survey was performed as part of a public health response to a recent human rabies death in Sumter County. Human subject procedures were reviewed by CDC and determined not to meet the definition of research on human subjects. All respondents gave implied informed consent by returning a completed survey.

Because survey information was anonymously collected, direct follow-up with respondents reporting any possible exposures to bats was not possible. For this reason, the section containing questions on bats colonizing or entering the home and potential for human exposures to these animals was followed by a bolded statement suggesting resources for public health follow-up that stated: 'If someone in your household had direct physical contact with a bat or was asleep in a room with a bat AND has NOT yet been evaluated by a medical professional, please contact your personal physician and call CDC information at 1.800.232.4636 for assistance'.

The survey was designed to collect information on respondent's (i) personal and household demographics, (ii) experience(s) with bats entering or living in their home in the past 3 years, (iii) knowledge about rabies transmission, illness and prevention and (iv) resources used for bats-related concerns (Table S1).

Completed surveys were divided into four equal stacks for entry by different individuals. Data entry was validated using a 10% random systematic hand-check for accuracy. The data entry error rate (total number of data entry errors/total number of data entry fields) was ≤0.5% in all stacks. The majority of entry errors noted were obvious errors, such as numerical entry in a free-text field or entries that did not match available data codes. All data were then cleaned to remove data entry errors of this type before completing data analysis.

Data analysis

All surveys received by 31 August 2012 were included in the analysis. All analyses were conducted using JMP (SAS Institute, version 10.0) and R (version 2.7.2; R Development Core Team, 2008). Unless otherwise noted, $N = 597$ was used as a static denominator throughout, although some respondents did not answer all questions. Thus, reported percentages may not add to 100%, and in such cases, a footnote indicates that missing values make up the remaining portion of responses.

In the rabies knowledge section, participants were asked: ‘If you were exposed to a rabid animal, please describe three things you would do. Describe these actions in the order you would perform them’; and were provided with three blank lines labelled ‘a’, ‘b’ and ‘c’. These free-text responses were coded by the use of keywords or concepts (e.g. wash, call, doctor, 911, shots) to allow for categorization of responses and numerical summary. Percentages provided in these analyses do not sum to 100% because some respondents included more than one type of action in a single ranked response and some respondents only provided their first or first and second planned actions, leaving the rest of the response fields blank.

As the order in which items are listed for questions concerning resource use or preference could influence the likelihood of respondents selecting a particular resource, two survey versions were used that reversed the order of the resources listed from alphabetical to reverse alphabetical. Survey version effects were evaluated as part of descriptive analyses (see Supplemental Materials).

Results

Respondent demographics

In total, 6 033 surveys were mailed, but 1 867 (31.0%) were returned for reasons such as incorrect address, incomplete address or vacancy. A large proportion of undeliverable mailings were expected due to the nature of the database from which the sample was drawn. Of the 4 166 surveys presumed delivered, 597 (14.3%) were completed and returned. Return-to-sender rates were similar across all zip codes, but response rate varied among zip codes (Table S2).

Most respondents had lived in South Carolina for ≥10 years (80%), were ≥46 years of age (74%), were female (65%) and had pursued at least some education beyond high school (74%; Table 1). The respondent population had a higher proportion of females and an older age distribution compared with Sumter County (51.9% female residents and approximately 48.5% ≥45 years of age), but had similar education levels (Table S3). Households ranged from 1 to 10 persons, with a mean household size of 2.45 persons/household, comparable to Sumter County’s average household size of 2.67 persons/household.

Frequency of bat encounters in homes

Of 597 respondents, 21 (3.5%) reported experiences with bats in the home environment between January 2010 and survey completion during June–September 2012. These 21 respondents lived in zip codes located in Sumter (n = 14) and Dalzell (n = 3) (both cities located in central Sumter County). Seventeen (2.8%) reported bats living in their homes in areas such as the attic, gables or eaves, and 15 (2.5%) reported having a bat enter the human-occupied living spaces of their homes (Table 2). Eleven (1.8%) respondents reported both bat colonization and a bat entering the living spaces of their home.

Of 17 respondents reporting bats living in their homes, over half indicated occurrences during spring or summer months (March–August); however, the colonization of homes by bats was reported during fall and winter months also (Table 2a). Eleven respondents (64.7%) attempted to remove bats from their home, but less than half of attempts were successful. Twelve households (70.6%) were seasonally or continuously colonized over a ≥2-year period (Table 2a).

Two of the 15 (13.3%) respondents that had found a bat inside the living spaces of their home indicated that someone in the home had direct physical contact with the animal (Table 2b). However, both respondents further explained that this contact was not with bare skin – in one case, a dead bat was picked up with plastic gloves for disposal, and in the second, a live bat was picked up with a towel for release outside. No one reported bat bites or scratches, but 2 of these 15 respondents (13.3%) indicated a person was asleep in the room where the bat was found (Table 2b). One of these respondents indicated that a bat was found inside the outside wall of the room, implying no opportunity for direct contact with the sleeping individual. The second respondent indicated that her daughter was asleep and the bat landed on her stomach, but this respondent had not previously indicated that anyone in the household had direct physical contact with the bat and did not indicate that any medical assistance was sought. Follow-up was not possible due to the anonymous nature of this survey. However, at the writing of this report, more than 6 months had passed since the survey reporting this incident was received and no report of human rabies related to this incident has been received. Most respondents reported that either the bat was captured and released (6/15, 40%) or escaped on its own (4/15, 26.7%), but none were captured and submitted for rabies testing (Table 2b). One-third (5/15) of these respondents sought additional assistance from a private wildlife or pest removal service (n = 3), animal control (n = 1) or landlord (n = 1).

Knowledge of bats and bat exclusion

Seventy percentage of respondents did not know how to prevent bats from living in or entering their homes ('No': 423/597, 70.1%;'Yes': 163/597, 27.3%; 'Don't know' or no answer provided: 11/597, 1.8%). Most respondents (85.3%) did not know whether South Carolina has specific laws concerning how or when bats can be removed ('Don't know': 509/597, 85.3%; 'Yes': 43/597, 7.2%; 'No': 29/597, 4.9%; 'Unanswered': 16/597, 2.7%). Most respondents (501/597 or 83.9%) were also unsure when bats breed in South Carolina (winter: 5/597, 0.8%; spring: 69/597, 11.6%; summer: 27/597, 4.5%; fall: 14/597, 83.9%; respondents could pick more than one answer).

Knowledge of rabies

Nearly all respondents reported they were aware of a disease called rabies before receiving the survey (565/597, 94.6%). Only 34.5% (206/597) understood that rabies illness in humans is usually fatal, while the remainder thought that rabies is survivable (Table 3). Respondents were familiar with animal reservoirs for rabies virus transmission to humans common to South Carolina. Raccoons, dogs and bats were each selected as likely transmission sources by more than 90% of participants. Respondents were less clear about the role of other mammal hosts in virus transmission, but generally understood that reptile and bird species do not transmit rabies virus to humans (Table 3). Nearly all respondents (97.3%) understood that rabies virus can be transmitted by a bite and 80.6% of respondents understood that rabies virus can be transmitted through saliva contamination of an open wound. However, many respondents also replied that other bodily fluids, such as blood, faeces and urine, can transmit rabies virus infection through contact with both open wounds and unbroken skin (Table 3).

Respondents were not knowledgeable about modern rabies vaccine administration for post-exposure prophylaxis – 38.2% of respondents indicated that >5 vaccine injections are required and 38.4% of respondents did not know how many vaccine doses are required (Table 3). Over half of respondents believed that rabies vaccine is delivered in the stomach region. Only 10.4% of respondents chose the upper arm as the appropriate administration site.

Actions that respondents might take if exposed to a rabid animal were categorized into four major response categories – performing wound care, seeking medical attention, actions concerning the rabid animal and who to call for help (for other than medical assistance; Table S4). Overall, 94.8% of the 537 respondents that completed this question included actions for seeking medical attention as one of their rank-ordered activities and 59.8% mentioned wound care activities. Wound care actions such as cleaning or washing the wound or contact area and bandaging were listed as the first action to take by 45.2% of respondents and 39.4% mentioned seeking medical attention first. Table S5 a–d provides a more detailed breakdown of the types of actions that were included in each summary category.

All of the 21 respondents reporting experiences with bats living in or entering the home reported being generally aware of a disease called rabies prior to receiving the survey mailing and all of these correctly identified bats as a possible animal exposure source for rabies.

Resources for assistance with bat-associated concerns

Respondents were asked to indicate from a list of possible resources those they might use for seeking assistance with removing bats from their home or if someone in their household was bitten by a bat (Table 4). The resources most commonly selected for assistance with bat removal were animal control (434/597, 72.7%), a private pest removal service (321/597, 53.8%) and a state or local public health office (244/597, 40.9%; Table 4). In contrast, the most commonly selected resources for assistance with a bat bite were a hospital, clinic or doctor (547/597, 91.6%), a state or local public health office (232/597, 38.9%), the Centers for Disease Control and Prevention (216/597, 36.2%), and animal control (180/597, 30.2%). Resource list order (i.e. survey version) did affect the absolute percentage of respondents that selected particular resources on both of these questions, particularly for resources located at the beginning and end of the alphabetized lists, but did not significantly alter the placement of each resource on a rankordered list (Table S6).

Discussion

The frequency of bat–human interactions in the home environment has not been well researched. Approximately 3.5% (21/597) of households in this survey reported experiencing bats living in or entering their home over an approximately 2- to 3-year period, and most of these 21 households experienced recurrent bat colonization in more than 1 year. Extrapolating these findings to the broader population of this county would suggest that nearly 1 400 of the approximately 40 000 households in Sumter County could have experienced bat-related incidents in the home environment that might have posed risks for human exposure to the rabies virus during 2010–2012. One case of human rabies was diagnosed and reported in a Sumter County resident during this time period (December 2011; CDC, 2013b).

Respondents that had bats living in their homes reported unsuccessful efforts to remove or exclude them and none submitted captured bats for rabies testing. Survey respondents generally reported a lack of knowledge concerning bat biology and bat removal methods and laws. These findings suggest a need to enhance public education concerning bats, bat biology and effective humane methods for excluding bats from homes. Citizens would also benefit from reminders of the health risks posed by contact with bats, including the importance of retaining bats for rabies testing when possible, especially in cases where persons were bitten or scratched by the bat during the encounter or in cases where bites and scratches cannot be definitively excluded (CDC, 2008).

Although residents had general knowledge of rabies as a disease and most respondents correctly identified dogs, bats and raccoons as rabies reservoir species, respondents were less sure about rabies risks from other mammal species. Furthermore, the majority of respondents were not aware that rabies in humans is nearly always fatal. Respondents understood that a bite from a rabid animal can transmit the virus, but were less certain about infectivity of other bodily fluids and types of contact.

Many respondents indicated that rabies vaccination requires many shots to be administered in the stomach region, and it is unclear whether such an outmoded understanding of rabies vaccine delivery might act as a deterrent for seeking care following exposure to a potentially rabid animal. Unlike early nerve tissue-derived rabies vaccines, which were delivered by a protracted series of injections in the abdomen, post-exposure prophylaxis utilizing modern cell culture-derived rabies vaccines requires four vaccine injections in the upper arm muscle over a 4-week period and a single dose of rabies immunoglobulin injected either at the site of a known wound or intramuscularly in regions such as the thigh or buttocks (CDC, 2008; Rupprecht et al., 2010).

Most respondents did indicate appropriate activities and priorities for response to being exposed to a rabid animal, in particular prioritizing wound washing and seeking urgent medical care. Immediate washing of the bite, scratch or exposure site with soap and water is highly recommended to remove potentially infectious saliva from the area as soon as possible (CDC, 2008). Subsequent follow-up with a doctor or public health office is necessary for complete risk assessment and post-exposure prophylaxis recommendations (CDC, 2008; Rupprecht et al., 2010).

Respondents indicated they would seek assistance with bat-related concerns from both public health and non-healthcare entities. In particular, respondents more commonly selected animal control and private pest removal services for help with bat removal. A local or state public health office was the third most commonly selected resource. In South Carolina, removal of nuisance wildlife, such as bats, from private residences is an individual responsibility and is not under the authority of local or county animal control services, which are primarily tasked with handling issues concerning stray dogs and cats (SC State Code of Laws, Section 47-3-20, 40). For bat bites, respondents most commonly indicated that they would reach out to healthcare entities – a hospital, clinic or doctor; a local or state public health office; or the Centers for Disease Control and Prevention. These entities can all directly provide appropriate risk assessment and post-exposure prophylaxis recommendations. However, it is important to note that many respondents also indicated that they might consider non-healthcare entities such as animal control or wildlife agencies for assistance with a bat bite. Thus, strong partnerships among these entities is vital to ensure that citizens seeking assistance with bat-related concerns receive rabies education and appropriate referral for rabies virus exposure assessments, regardless of the initial point of contact.

Limitations

This study has several limitations that may limit capacity to extrapolate survey findings to the broader community. First, only households in Sumter County in which a household member responded to the survey are included in this analysis. Because survey responses were collected anonymously, it is not possible to further characterize non-responders, so any response bias in these data cannot be assessed. Response rate was relatively low, resulting in a moderate sample size that may not be fully representative of the diversity of knowledge and experiences of Sumter County citizens. Further, survey respondent demographics differed by gender and age distribution from most recent census of Sumter County, which limits the generalizability of these findings.

This survey was paper-based and thus may also be biased towards persons more likely to return a paper-based, versus electronic- or social media-based survey. Data concerning primary language in the household and socioeconomic status were not collected, so these data cannot be assessed for potential biases from these issues.

It is important to note that self-reported experiences of bats colonizing or entering homes cannot be verified and it is not uncommon for citizens to confuse bat colonies with other nuisance wildlife infestations, such as chimney swifts or rodents. One respondent who indicated that they had bats in their home during all seasons of 2012 remarked that they had 'recapped [the] chimney top after [the bats] flew out'. Given this description, this home might have been colonized by chimney swifts, rather than bats. Similarly, a second respondent indicated that to attempt removal '[They] built a fire – [the bats] were in the chimney'. Citizens may also not be aware that bats are colonizing their homes, especially in the case of small colonies or solitary species living in unoccupied areas of the house where they may not be directly seen or heard. Finally, it is unclear whether citizens who have experienced issues with bats in homes would be more or less likely to complete a self-administered survey to report their experiences. Thus, these self-reported experiences of bat interactions in the home could equally over- or underestimate of the true extent of this problem.

Conclusions

This study contributes data on the baseline risk of bat exposure in the home, knowledge gaps about rabies risks and understanding of where citizens may look for assistance with bat-related concerns. Human rabies is preventable by avoiding contact with wildlife reservoirs or by receiving prompt and appropriate post-exposure prophylaxis following a suspected rabies virus exposure. These data suggest the need for continued public education efforts concerning rabies and risks of rabies virus exposures in the home. The public should also be educated on effective and humane methods for exclusion of bats from human dwellings.

Citizens may reach out to a diversity of non-healthcare sources such as animal control, law enforcement or wildlife agencies as initial points of contact for bat-associated concerns or bat exposures. For this reason, public health partners should evaluate referral processes with non-healthcare partners to enhance understanding of rabies risks and consistent referral of citizens with potential bat exposures to public health or healthcare providers for risk assessment and post-exposure prophylaxis recommendations. Strong partnerships with non-healthcare partners increase the likelihood that, regardless of where citizens initially seek assistance for bats or other wildlife concerns, they will be connected with appropriate public health resources and information, when these concerns involve potential exposure to rabies virus or rabies reservoir species.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Impacts

- A household survey of South Carolina residents revealed knowledge gaps concerning health risks from bats occupying homes and general rabies knowledge.
- Survey respondents indicated reliance on both healthcare and non-health-care entities when seeking assistance with bat-related concerns.
- Strong partnerships between healthcare and non-healthcare entities are critical for ensuring that citizens are connected with appropriate public health resources for rabies education and post-exposure prophylaxis recommendations when seeking assistance with bats occupying homes or bat exposures.

Table 1

Summary of survey respondents' personal and household demographics

	Number	Percentage[a]
Respondent sex		
Female	383	64.2
Male	204	34.2
Respondent age		
18–25	12	2.0
26–45	133	22.3
46–65	281	47.1
≥66	161	27.0
Years respondent has lived in South Carolina		
≤2 years	36	6.0
3–9 years	73	12.2
≥10 years	476	79.7
Respondent education level		
Less than high school	25	4.2
High school graduate or equivalent	120	20.1
Some college	156	26.1
College degree	159	26.6
Graduate school or professional degree	123	20.6
Total number of people in household		
1–2	359	60.1
3–5	204	34.1
≥6	12	2.0

[a]Denominator for all calculations is 597; however, not all respondents completed all questions. Thus, percentages may not add to 100%. Missing values make up the remainder in such case but are not explicitly included in the table for simplicity.

Table 2

Summary of respondent experiences with bats living in or entering their homes

	Number	Percentage[a]
(a) Experiences reported concerning one or more bats living (visiting repeatedly and spending time inside the structure during the daytime) in locations such as the attic, gables or eaves of respondents' homes		
Had bats living in his/her home during 2010–2012		
Yes	17/597	2.8
No	537/597	89.9
Don't know	37/597	6.2
Season(s) during which bats were living in his/her home (by year)[b]		
2010 (Total)	9/17	52.9
Winter (Dec, Jan, Feb)	2/9	22.2
Spring (Mar, Apr, May)	3/9	33.3
Summer (Jun, Jul, Aug)	7/9	77.8
Fall (Sept, Oct, Nov)	5/9	55.6
2011 (Total)	13/17	76.5
Winter (Dec, Jan, Feb)	6/13	46.2
Spring (Mar, Apr, May)	6/13	46.2
Summer (Jun, Jul, Aug)	7/13	53.8
Fall (Sept, Oct, Nov)	6/13	46.2
2012 (Total)	9/17	52.9
Winter (Dec, Jan, Feb)	4/9	44.4
Spring (Mar, Apr, May)	4/9	44.4
Summer (Jun, Jul, Aug)	3/9	33.3
Fall (Sept, Oct, Nov)	NA[c]	NA[c]
Total number of years during 2010–2012 reported bats living in his/her home		
1	3/17	17.6
2	8/17	41.2
3	4/17	29.4
No year/season reported	2/17	11.8
Attempted to remove bats living in his/her home during 2010–2012		
Yes, but did not succeed in removing bats	6/17	35.3
No/No answer provided	6/17	35.3
Yes, successfully removed the bats	5/17	29.4
(b) Experiences reported concerning a bat entering a human-occupied area of the respondent's home		
Found a bat inside the home during 2010–2012		
No	570/597	95.5
Yes	15/597	2.5
Don't know	8/597	1.3
Someone in household had physical contact with the bat		
No	13/15	86.7
Yes	2/15	13.3

	Number	Percentage[a]
Someone in the household was bitten or scratched by the bat		
No	15/15	100
Yes	0/15	0.0
Someone was asleep where the bat was found while the bat was present		
No	10/15	66.7
Yes[d]	2/15	13.3
Don't know	2/15	13.3
Capture and disposition of the bat		
Captured the bat and released it outside	6/15	40.0
The bat escaped/left on its own	4/15	26.7
Captured the bat and submitted it to the health department for rabies testing	0/15	0.0
Other[e]	5/15	33.3
Sought additional assistance after finding the bat in his/her home		
No	10/15	66.7
Yes	5/15	33.3

[a]Not all respondents completed all questions. Thus, percentages may not add to 100%. Missing values make up the remainder in such case but are not explicitly included in the table for simplicity.

[b]Respondents could choose more than 1 year and more than one season per year, so percentages will not sum to 100%.

[c]Returned surveys were received during June–August, 2012. No additional surveys were received after 15 September 2012. Respondents could not provide information about colonization during the late summer or fall of 2012.

[d]Details of these two cases are described in the Results section.

[e]Four of these respondents indicated that they killed the bat (method unspecified in two cases, with a broom in one case and with boiling water in one case) and disposed of the carcass. One of these four indicated that they also called animal control but did not provide information on any additional follow-up. One of these five respondents indicated that the bat continues to come and go, presumable from the access point in the outside wall indicated in previous free-text answers.

Table 3

Respondent's self-reported knowledge of rabies transmission and prevention

	Number	Percentage[a]
Had heard of rabies before receiving this survey		
Yes	565	94.6
No	11	1.8
Outcome for MOST people who become ill with rabies		
Death	206	34.5
Recovery after a hospital stay	177	29.6
No hospital stay, but need a doctor visit	119	19.9
Resolves without doctor visit	2	0.3
Don't know	31	5.2
Thought that this animal could transmit rabies virus to humans		
Bat	574	96.1
Dog	570	95.5
Raccoon	563	94.3
Fox	529	88.6
Opossum	473	79.2
Cat	434	72.7
Squirrel	426	71.4
Skunk	425	71.2
Deer	136	22.8
Horse	120	20.1
Cow	108	18.1
Bird	83	13.9
Snake	35	5.9
Turtle	32	5.4
Indicated that this type of contact with an animal can give someone rabies[b]		
Being bitten by the animal	581	97.3
Contact with saliva on open wound	481	80.6
Contact with blood on open wound	435	72.9
Contact with faeces or urine on open wound	369	61.8
Contact with saliva on unbroken skin	158	26.5
Contact with blood on unbroken skin	139	23.3
Contact with faeces or urine on unbroken skin	134	22.4
Contact with skunk spray	59	9.9
Number of vaccines that would be given if exposed to a rabid animal		
Don't know	229	38.4
>15	67	11.2
10–15	93	15.6
6–9	68	11.4
4–5	46	7.7

	Number	Percentage[a]
1–3	78	8.0
Location where respondent indicated that rabies vaccinations are given[c]		
Stomach	317	53.1
Buttocks	72	12.1
Upper Arm	62	10.4
Leg	21	3.5
Don’t know	165	27.6

[a] Denominator for all calculations is 597; however, not all respondents completed all questions. Thus, percentages may not add to 100%. Missing values make up the remainder in such case but are not explicitly included in the table for simplicity.

[b] Number and percentage indicate those that answered affirmatively (‘Yes’) to the exposure as a potential route for infection with rabies virus. Alternative answers available were ‘No’ or ‘Don’t know’. Some individuals left one or more rows of this question blank. These three alternatives (‘No’, ‘Don’t know’ or blank) make up the remainder.

[c] Respondents could choose more than one option, so percentages will not sum to 100%.

Table 4

Resources respondents would use to seek assistance with bats or bat exposures

	Number	Percentage[a]
Would seek assistance with removing bats from his/her or preventing bats from entering the home (N=yes, would use)		
Animal control	434	72.7
Private pest removal service	321	53.8
State or local public health office	244	40.9
US Centers for Disease Control	194	32.5
Internet	162	27.1
Department of Natural Resources	158	26.5
Police or sheriff	135	22.6
Friends or family members	105	17.6
US Fish and Wildlife Service	88	14.7
Veterinarian	63	10.6
Wildlife charity or organization	62	10.4
Hospital, clinic or doctor	41	6.9
Book or the library	34	5.7
Would not seek assistance	16	2.7
Would seek assistance if a bat bit him/her or someone in his/her family (*N* = yes, would use)		
Hospital, clinic or doctor	547	91.6
State or local public health office	232	38.9
US Centers for Disease Control	216	36.2
Animal control	180	30.2
Police or sheriff	95	15.9
Department of Natural Resources	52	8.7
Private pest removal service	48	8.0
Internet	47	7.9
Veterinarian	34	5.7
Friends or family members	33	5.5
US Fish and Wildlife Service	22	3.7
Wildlife charity or organization	18	3.0
Book or the library	6	1.0
Would not seek assistance	1	0.2

[a]Denominator for all calculations is 597; however, not all respondents completed all questions. Numbers and percentages represent the total number of respondents that selected each resource over the total number of surveys completed (i.e. 597). Respondents could mark more than one resource, so percentages do not sum to 100%.