ANIMAL BITE AND RABIES SURVEILLANCE IN ALLEGHENY COUNTY, PENNSYLVANIA, 2019

by

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Abstract

Background: Animal bites represent a public health concern because they may result in injury and infection. Of particular interest is rabies. The Allegheny County Health Department (ACHD) receives reports on animal bites and investigates them to prevent adverse outcomes, recommending treatment with post-exposure prophylaxis (PEP) if necessary and quarantining animals if possible.

Methods: Animal bite data gathered from healthcare providers and police officers are entered into an Oracle database. Data for bites occurring in 2019 were exported from the Oracle (Redwood Shores, CA) database to an Excel file and imported into SAS (Cary, NC) for data cleaning. SAS was used to generate descriptive statistics. Population data was obtained from the US Census Bureau to calculate incidence rates per 100,000 population. County license statistics were obtained from the Allegheny County Treasurer's Office to ascertain the dog breeds involved in bite reports. Rabies testing data from Rhode Island was obtained from the Rhode Island Department of Health.

Results: In 2019, there were 2,051 animal bites reported to the ACHD. Most reported bites involved dogs (72.2%) or cats (24.1%). The most common wild animals were bats (0.9%) and

raccoons (0.6%). Bite reports peaked in the spring and summer and nadired during the winter months. Victims ranged in age from less than one year to 99 years of age. Bite rates per 100,000 were highest in people between 20-29 years of age; 61% of victims were female. The majority of bites were to upper extremities (66%). Antibiotics were prescribed for 62.1% of bite victims and 4.2% received post exposure prophylaxis (PEP) for rabies. Most who received PEP (81.4%) did so because the animal could not be observed. 576 animals were submitted for rabies testing in Allegheny County; 28 (4.5%) tested positive. 688 animals were submitted for rabies testing in Rhode Island; 31 (4.9%) tested positive.

Conclusion: Ongoing rabies surveillance is essential to public health. The data collected from 2019 shows that state vaccination requirements work. The vector of greatest risk to humans is wild animals. Rabies prevention efforts should focus on wild animals in addition to rabies vaccination of domestic animals.

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1.0 INTRODUCTION

This report will describe the spectrum, morbidity and mortality of animal bites in Allegheny County, PA with some comparisons to similar data from Rhode Island. This analysis will provide the basis for public health recommendations and preventive strategies.

1.1 ANIMAL BITES BACKGROUND

Animal bites are a significant public health concern because they are associated with significant mortality and morbidity worldwide. Animal bites have the potential to cause both injury and infection. Globally, it is estimated that tens of millions of people annually are injured by dog bites alone. Children are at increased risk, as they are often commonly the victims injured by animal bites (WHO, 2018). Between 2 and 5 million animal bites occur annually in the US and account for 1% of all emergency department visits (Kannikeswaran & Kamat, 2009).

The vast majority (85-90%) of bite injuries in the US are caused by dogs. The next most common animal to cause bites is cats (5-10%) and rodents (2-3%). A much smaller percentage of the remaining bite injuries are caused by a mix of both wild and domestic animals (Kannikeswaran & Kamat, 2009).

Demographic differences among animal bite injuries are present in the US. Dog-bite related emergency department visits were highest in the Midwest (109.9 per 100,000 population) and lowest in the West (93.0 per 100,000 population), but hospitalizations related to dog bites were highest in the Northeast (3.9 per 100,000) and lowest in the West (2.5 per 100,000 population).

Animal bites are much more common in urban areas compared to rural areas (Holmquist & Elixhauser, 2010). Additionally, animal bites follow a temporal trend each year with more bites in spring and summer months when people are more likely to be outside and interacting with animals (Mason et al., 2019; Short et al., 2018).

1.2 RABIES OVERVIEW

The transmission of rabies is of particular concern for certain animal bites. Approximately 59,000 people worldwide die annually from rabies (WHO, 2018). However, in the US, only one to two rabies deaths are reported (CDC, 2020). The very low US mortality rate is attributed to the widespread availability of a post-exposure prophylaxis that can prevent rabies after a bite has occurred (CDC, 2019).

Rabies is a zoonotic virus that is transmitted by mammals. It is a Rhabdovirus of the genus *Lyssavirus.* Rhabdoviruses have a distinct bullet-like shape with spike-like glycoproteins covering the surface and are single-stranded, negative-sense RNA viruses. Five proteins are encoded in the genome: glycoprotein (G), polymerase (L), matrix protein (M), nucleoprotein (N), and phosphoprotein (P) (CDC, 2020).

Rabies is a disease that attacks the central nervous system. It is nearly always fatal once symptoms appear. However, the incubation period that may last for weeks or months, depending on how proximate the exposure site is to the central nervous system. Symptoms will initially present as flu-like symptoms such as weakness, fever, and headache. In later stages of the disease,

neurological symptoms such as delirium, abnormal behavior, hallucinations, and hydrophobia may appear (CDC, 2020).

While the disease is still in the incubation period, it can be successfully treated with post-exposure prophylaxis (PEP). PEP includes a dose of human rabies immune globulin (HRIG) given on the day of rabies exposure or as soon after as possible, as well as a dose of rabies vaccine (HDCV) given on days 0, 3, 7, and 14. Some people, such as veterinary technicians, may have already received a pre-exposure vaccination, and only need to be given the rabies vaccine (HDCV) and not HRIG. PEP should only be given to those who have been exposed to a rabid animal or an animal with a rabies status that could not be confirmed (CDC, 2019). In many cases, an animal can be observed because it is a domestic pet. In this instance, a 10-day quarantine can be instituted, and if the animal is observed to be healthy, PEP, which is costly for individuals if not mitigated by insurance coverage - is considered unnecessary. (WHO, 2020).

1.3 EPIDEMIOLOGY OF RABIES

Rabies occurs in more than 150 countries and territories. It causes tens of thousands of deaths annually, with 95% of these deaths occurring in Africa and Asia. It predominantly affects poor and rural areas. On a global level, dogs are responsible for up to 99% of human transmission (WHO, 2020). However, in the US, rabies is mostly found in wild animals such as bats, raccoons, skunks, and foxes and only two or fewer human rabies deaths occur each year (CDC, 2020). In fact, there has not been a human rabies case in Pennsylvania since 1984. Rabies is transmitted by the saliva of an infected animal, and while bites are the most common mode of transmission,

scratches and other contact between broken skin and infectious material such as brain matter can also transmit the virus (PA Department of Health, 2016).

Before 1960, most rabies cases occurred in domestic animals. This is no longer the case because of both robust surveillance programs and widespread vaccination of both dogs and cats (CDC, 2020). Cats are now the most common reported domestic animal with rabies, especially in Pennsylvania, which often reports more rabid cats than any other state (PA Department of Health, 2016). In Pennsylvania, dogs and cats are required by law to have an up-to-date rabies vaccination. To support the robust surveillance, all healthcare providers must report animal bites. Given that the most common vector for human rabies transmission is wild animals, it is recommended that people not handle wild animals (PA Department of Agriculture, 2020).

1.4 RACCOON VARIANT RABIES

Racoon variant rabies is of significant concern to Pennsylvania. Raccoons account for upwards of 30% of reported cases in wildlife, and rabies is endemic along the Atlantic coast. Allegheny County is of particular interest in Pennsylvania because of its participation in the US Department of Agriculture's Oral Rabies Vaccine (ORV) program. Allegheny County is located at the farthest west point of the area where raccoon variant rabies is endemic. Preventing rabies at the western edge of the endemic area may help to decrease rabies prevalence among racoons from west to east. Since 1995, the USDA has worked with local and PA state health departments to vaccinate raccoon populations against the rabies virus. Volunteers distribute satchels containing the RABORAL V-RG oral rabies vaccine in targeted areas. The vaccine is wrapped in a fishmeal polymer that attracts the animals. Once ingested, the animal becomes vaccinated against rabies.

This program may reduce the chance of human exposure and thereby reduce PEP costs, burden on state services for animal diagnostic tests, and burden of livestock losses (USDA, 2020).

1.5 ALLEGHENY COUNTY AND RHODE ISLAND DEMOGRAPHICS

Allegheny County is located in southwestern Pennsylvania. It has a land area of 730.08 square miles and a population of 1,216,045. About 18.6% of the population is under the age of 18 ("QuickFacts: Allegheny County", 2019). Rhode Island is a state on the east coast with a land area of 1033.81 square miles and a population of 1,059,361. About 19.3% of the population is under the age of 18 ("QuickFacts: Rhode Island", 2019). These demographics demonstrate that Allegheny County and Rhode Island are similar in size, population, and age statistics. The age distributions are important because children are at particular risk for animal bites. The similarity in land area in square miles demonstrates that the population densities are similar. Rhode Island was chosen for comparison because importantly, while similar to Allegheny County in size and population, the state does not participate in the ORV program and is far enough away from Allegheny County to receive no benefit from the program. Therefore, these two locations are appropriate for comparison regarding the ORV program. Because Allegheny County has the ORV program and Rhode Island does not, this paper hypothesizes that Rhode Island will have a higher burden of animal rabies cases than Allegheny County.

1.6 ALLEGHENY COUNTY SURVEILLANCE

In Allegheny County, healthcare providers must report bites to the Allegheny County Health Department (ACHD). Additionally, police officers involved in an animal bite incident must report the incident to ACHD. Staff at the ACHD Immunization Clinic contact owners and victims to collect information that may be missing from the submitted reports, issue in-home quarantines of 10 days for animals that can be observed and provide recommendations for treatment. The ACHD can also request that a deceased animal be submitted to the Public Health Laboratory for rabies testing. If an animal cannot be observed for any reason or is found to be positive for rabies, the victim is advised to seek PEP treatment from an emergency department.

1.7 PUBLIC HEALTH SIGNIFICANCE

The very low rate of human rabies cases in the US is felt to be the result of robust surveillance and vaccination. Rabies is still present in the wild animal population across the country. Additionally, rabies is almost universally fatal, and can only be prevented after exposure via the use of PEP, so it is imperative that victims be contacted and recommended treatment if indicated. Rabies is also associated with animal bites, which carry their own public health significance due to the illness and injury they can cause. The number of bites reported to the ACHD in previous years includes 1,973 in 2018, 1,883 in 2017, 1,912 in 2016, and 1,810 in 2015 (Seresin et al., 2017; Short et al., 2018; Mason et al., 2019).

2.0 OBJECTIVES

The purpose of this project was to describe the characteristics of animal bite reports in Allegheny County, Pennsylvania for 2019. This essay will also examine some characteristics of animal bites in the state of Rhode Island for comparison. The analysis will inform public health recommendations and intervention strategies.

3.0 METHODS

3.1 DATA SOURCES

Data on 2019 animal bite reports was obtained from the Allegheny County Health Department's Oracle database. Bite reports are uploaded into the Oracle database by healthcare providers or by ACHD staff after a report form is faxed. Rabies test results for 2019 were reported by the health department laboratory. Age-group population data were obtained from the U.S. Census, using the most recent 1-year estimates from 2018, to calculate age-adjusted rates. Population data from 2018 was used because data from 2019 was not yet available (U.S. Census Bureau, 2019). Data for dog breeds licensed in Allegheny County were obtained from the Allegheny County Treasurer's Office. Historical bite data were pulled from previous surveillance reports on animal bites in Allegheny County (Seresin et al, 2017; Short et al., 2018; Mason et al., 2019). Data on animal rabies testing in Rhode Island were obtained from the Rhode Island Department of Health website (Rhode Island Department of Health, 2019; Rhode Island Department of Health, 2020).

3.2 DATA CLEANING

Bite data from 2019 was exported from the Oracle database to a Microsoft Excel file. These data were then imported to SAS version 9.4 for cleaning. Duplicate observations, identified by name, bite date, and bite description, were omitted. Any bite report with an animal other than a

mammal (e.g. snakes, birds) was omitted, as rabies is exclusive to mammals. When any data were unclear, comments on the bite incident were used to fill in missing or unclear information.

More extensive data cleaning was subsequently performed, including correcting misspelled or missing data as appropriate. Several existing continuous variables, such as age, were organized as categorical variables. Age was categorized in five-year intervals. Location of the exposure region on the body was described in six categories: upper extremity, lower extremity, trunk, face/head/neck, multiple regions, and unknown. Antibiotics were described with a singular, correct spelling (e.g., "doxycycline" was used if the report included "doxy") and if a brand name was used, the name was converted to generic (e.g., "Augmentin" was renamed as "Amoxicillin/Clavulanic acid"). Topical ointments were not included as antibiotics.

For instances of conflicting data (e.g., HRIG or HDCV marked "yes" but PEP marked "no") comments from the bite report were used to determine the true value of each field and coded appropriately. In any case of "rabies positive" being marked "yes", the report comments were read to ensure the correct number of animals involved in the bite reports was carried into analysis. PEP was only considered to be "yes" if the victim completed the full PEP series, which is a departure from methods of previous years that considered PEP to be "yes" if the victim received even one of the treatments.

The Allegheny County Treasurer's office includes both a "mixed breed" option, as well as "mix" options for many dog breeds. For the surveillance report, if two or more breeds were listed as a dog breed (e.g., pit bull + mastiff), breed was categorized as the first breed listed (pit bull). If a breed was listed as a single breed mix (e.g., pit bull mix), the breed was categorized as a single breed (pit bull). If a report only categorized a breed as "mixed breed", it was categorized as such for analysis.

3.3 DATA ANALYSIS

Descriptive statistics and frequencies were generated in SAS. Microsoft Excel was used to create tables and figures. Variables of interest included age, sex, month, exposure region, treatment (antibiotics, tetanus vaccine, PEP), animal type (pet, stray, feral, wild), animal species, bite circumstances, animal vaccination status, animal rabies test results, and dog breed. Breeds involved in 2019 bite reports were compared to breeds licensed by the county. Microsoft Excel was used to calculate z-scores and p-values for each breed involved in a bite report, and these values were confirmed by hand calculations. A p-value of 0.05 was used to establish statistical significance.

Note that the terms “bite” and “exposure” are used interchangeably and include both animal bites and scratches.

4.0 RESULTS

4.1 SPECIES INVOLVED IN REPORTED BITES, ALLEGHENY COUNTY

In 2019, there were 2,051 animal bites reported to ACHD (**Table 1**). This represents a 4.0% increase compared with bites reported in 2018 (Mason et al., 2019). Most reported bites involved dogs (72.2%) or cats (24.1%). Of these, 86.8% of dog bites and 79.6% of cat bites were attributed to domestic pets. On bite reports, 48.1% of dogs and 40% of cats were listed as vaccinated against rabies. However, 48.7% of dogs and 51.7% of cats did not have rabies vaccination status listed.

Bats (0.9%) and raccoons (0.6%) were the most common wild animals listed in bite reports. In thirteen instances (0.6%) the type of animal involved in the bite was unknown. There were 13 other species listed in bite reports, all with fewer than 10 reports attributed to them. There was missing species data for 13 of the reported bites.

4.2 REPORTED BITES BY MONTH

The number of reported bites peaked in spring and summer and decreased in winter months (**Figure 2**). Reported bites peaked in August (216 bites) and May (195 bites) and the months with the fewest reported bites were January (110 bites) and February (121 bites).

4.3 VICTIM DEMOGRAPHICS

Nearly all bite victims (99.7%) were Allegheny County residents. Almost all bite locations (97.5%) and animal owner addresses (99.4%) were within Allegheny County (**Figure 1**). Bite victims ranged in age from younger than one year to 99 years of age. The median age was 36 years and the mean age was 39 years. Bite rates per 100,000 people were highest among individuals 20 through 29 years of age (**Figure 3**). Of the 2,021 victims with a documented sex, 61% were female and 39% were male. Male children were bitten more often than female children for all respective age groups up through ages 10-14 years (**Figure 4**). Females were bitten more often than males in all respective age groups for every other age, 15-19 years through 85+ years.

4.4 INCIDENT TYPE

The circumstances under which bites occurred are demonstrated in **Table 3**. Nearly two-thirds (66.2%) of bite reports did not have the circumstances noted. The most common incident types reported were “breaking up a fight” (5.5%), “playing with the animal” (5.3%), and “the animal got spooked” (5.0%). Situations where the bite was not provoked (e.g., “at a community area and animal came up and bit the victim” and “walking on the road”) accounted for 57 (2.8%) cases.

The data on circumstances are also shown separately for dogs and cats. Situations in which cat bites occurred more frequently than dog bites included “trying to capture the animal”, “performing a medical procedure”, “bathing or grooming the animal”, and “trying to put the animal in a crate”.

4.5 DOG BREED ANALYSIS

The dog breeds involved in bites are summarized in **Table 7**. Only breeds involved in 10 or more bites are listed. The most common breeds involved in dog bites, other than mixed breeds (14.0%), were pit bulls (20.9%), German Shepherds (9.8%), and Labrador Retrievers (7.1%). For 31.1% of dog bites, no breed was listed in reports. Some breeds were overrepresented in the data compared to county licensing statistics. Breeds that accounted for significantly higher percentage of bite involvement compared to county license percentages are shown in bold font, and include pit bulls, German Shepherds, and rottweilers.

4.6 BITE LOCATION ON BODY

Of bite reports that included body sites, the majority were to upper extremities (66%), followed by lower extremities (15%) and face/head/neck (11%) (**Figure 5**). Six percent of individuals were bitten in multiple locations. Only two percent of bites were solely on the trunk area. In 292 (14%) reports, the bite location was not listed, thus they are excluded from Figure 5.

4.7 ANIMAL BITE TREATMENT AND RABIES PROPHYLAXIS

Antibiotics were prescribed for 62.1% of all victims. Tetanus vaccine was administered to 31.8% of victims while only 4.2% received the full course of PEP. Just under one quarter (24.3%) received none of the above.

Among victims bitten by dogs, 62.2% were prescribed antibiotics, 33.2% received a tetanus vaccine, and 2.4% received the full course of PEP; 24.7% received none of the above. Among victims bitten by cats, 65.9% were prescribed antibiotics, 27.9% received a tetanus vaccine, and 5.3% received the full course of PEP; 22.4% received none of the above (**Table 4**).

The most common antibiotic was amoxicillin/clavulanate, prescribed for 59.9% of all bite victims. For 305 (23.9%) bites, the antibiotic given was not specified. With regard to antibiotic prescribing, amoxicillin/clavulanate comprised 75% of prescriptions, erythromycin 8%, cephalexin 8%, azithromycin 6%, ciprofloxacin 3%. The antibiotic data for dogs and cats is shown separately but no major differences were noted (**Table 5**).

A total of 86 victims received the full course of rabies PEP. The majority (81.4%) of victims who received the vaccine were exposed to an animal that could not be observed. Twelve victims received PEP because they were exposed to an animal known to be rabid. Four victims received PEP for an invalid reason; either they chose to get PEP in the face of no indications or an improper recommendation (**Table 6**).

4.8 ANIMAL RABIES TESTING: ALLEGHENY COUNTY

In 2019, 576 animals were submitted for testing to the ACHD laboratory (**Table 8**). Of these, 28 (4.9%) tested positive for rabies. This was an increase from 4.1% testing positive for rabies of 612 submitted in 2018 (Mason et al., 2019). The most common animals tested were cats (157), dogs (154), bats (122), and raccoons (96). Interestingly, not all animals submitted for testing were implicated in bite reports, as they may have been found in the county and submitted for testing. Of the 28 animals testing positive for rabies in 2019, 18 were raccoons, 5 were cats, and 5 were bats.

Of animals implicated in bite reports, 161 were known to have been tested for rabies in the ACHD laboratory (**Table 2**). These were largely dogs (106) and cats (51), many of which were pets. The remaining animals from bite reports submitted for testing were bats (1) and raccoons (3). A total of 7 animals involved in bite reports tested positive for rabies in 2019: five feral cats and two raccoons. No pets involved in bite reports tested positive for rabies in 2019.

4.9 ANIMAL RABIES TESTING: RHODE ISLAND

In 2019, a total of 688 animals were submitted to the Rhode Island Department of Health for rabies testing (**Figure 6, Figure 7**). Of these, 31(4.5%) tested positive for rabies. The most common animals tested were bats (326, 47%), cats (145, 21%), dogs (65, 9%), and raccoons (61, 9%). Of the 31 testing positive for rabies, 15 were raccoons, 8 were bats, 6 were skunks, one was a groundhog and one was a fox (**Table 9, Table 10**). The number of animals submitted for testing peaked in spring and summer and decreased in winter months (**Figure 6, Figure 7**). August was

the month during which the most animals were submitted for rabies testing (209) followed by July (73 animals) while the least animals submitted for rabies testing were in January (20 animals) and December (27 animals). There were almost twice the number of animals submitted for rabies testing in the second half of the year compared to the first half (Rhode Island Department of Health, 2019; Rhode Island Department of Health, 2020). While Rhode Island publishes animal rabies testing data similar to ACHD laboratory data, therefore suitable for comparison, there is no publicly available data on number of animal bites reported or related demographic data, and these aspects could not be compared.

5.0 DISCUSSION

5.1 TRENDS

In summary, there were 2,051 animal bites reported to the ACHD in 2019. The vast majority of bites were attributed to dogs, which were implicated in 72.2% of all bite reports and responsible for 1000 more reported bites than cats, the second most commonly reported animal. The most common wild animals involved in bites were bats, raccoons, and chipmunks. Of animals listed in bite reports, 161 were known to be tested for rabies, with 7 (4.4%) testing positive, 5 cats and 2 raccoons. All of the rabid cats were feral. Wild animals remain the main vector for the transmission of rabies in Allegheny County. Females were victims of bites more often than males for age groups 15-19 years and older. In younger children, males had a higher bite incidence rate than females. The difference in adults may be attributed to females seeking medical attention more often than males, since bite reports often rely on this.

Rabies vaccines are required for dogs and cats in Pennsylvania once the animal is three months of age, and must be maintained.[4] However, this is not enforced by the state.

The number of each dog breed licensed in the county can be obtained from the Allegheny County Treasurer's Office, as owners are required to have a license for their dog. This is not true of cats, so breed analysis was only possible for dogs. Certain dog breeds were overrepresented in bite reports compared to county licensing statistics in 2019, namely pit bulls, German Shepherds, bulldogs, and rottweilers. These figures are similar to previous years. This overrepresentation may

be because a bite from one of these animals is more likely to require medical attention, whereas a bite from a smaller dog may be treated at home and may not be reported.

Animal bites are at risk for infection.[3] Antibiotics are often prescribed, as seen for 62.1% of bites in Allegheny County in 2019. Amoxicillin/clavulanate was the antibiotic most often prescribed (more than half of bite reports).

In Allegheny County in 2019, 31.8% of victims received a tetanus vaccine. This is recommended if the victim received tetanus vaccine more than ten years prior.[3]

The HRIG/HCDV post-exposure prophylaxis regimen is recommended if someone is exposed to a rabid animal, and the animal cannot be quarantined for observation, or is an animal that cannot be tested for rabies. Rabies testing can only be performed on deceased animals. Despite these guidelines, 4 people in bite reports completed the PEP regimen unnecessarily. The 2018 bite report included people who started PEP but did not finish it, and so this element of management is not comparable.

5.2 COMPARISON OF ALLEGHENY COUNTY AND RHODE ISLAND

A total of 576 animals were submitted for rabies testing in Allegheny County in 2019, as compared to 688 submitted for rabies testing in Rhode Island. Allegheny County had 28 (4.5%) positive animals, as compared to 31 (4.9%) in Rhode Island. The burden of animal rabies cases does seem to be slightly higher in Rhode Island than in Allegheny County, though it does not represent a significant difference ($p=0.76$). Interestingly, Allegheny County had more raccoon rabies cases than Rhode Island. There was a more diverse spread of animals that tested positive

for rabies in Rhode Island, including animals that did not test positive for rabies in Allegheny County at all such as skunks, a groundhog, and a fox. While the ORV program does target raccoons, it is conceivable that other animals may ingest the vaccine satchels and become vaccinated against rabies.

5.3 LIMITATIONS AND STRENGTHS

Data published in the annual ACHD surveillance report on animal bites is comprehensive and has the benefit of several years of historical reports to track trends over time. The data reviewed for this report are limited to animal bite reports that are submitted to the ACHD and animal rabies testing reported by the state of Rhode Island. As bite reports are completed only when a victim seeks medical attention or when police are involved in an animal bite incident, many animal bites may go unreported. Animal rabies testing data was very similar in both Allegheny County and Rhode Island, lending to an appropriate comparison. However, Rhode Island does not publish data on number or description of animal bites, and these could not be compared. Additionally, many of the bite incidents had missing data in at least one of the fields, making analysis incomplete. While ACHD Immunization Clinic staff are vigilant, much of this information is collected through phone investigations with owners and victims, and therefore information may be limited. Finally, notation of missing data by ACHD staff is inconsistent and may affect data cleaning and analysis. Even with these limitations, sufficient data was present for a complete and informative surveillance report.

5.4 RECOMMENDATIONS

Several recommendations can be made, based on ADHD guidelines and data analyses performed for this essay:

1. **Avoid contact with wild animals**. Wild animals may be rabid. Do not attempt to feed, touch, or take in wild animals as pets. Avoid contact with dead wild animals to prevent rabies exposure.

2. **Pet owners should comply with Pennsylvania's rabies vaccine regulations for pets**. All pet owners should have their pets vaccinated by three months of age. This will protect pets and their owners from rabies virus. Pets should also not be unsupervised in situations where they could come in contact with wildlife.

3. **Health care providers should be familiar with the protocol for animal bites and rabies PEP**. Health care providers should only recommend/provide the PEP vaccine series for rabies if the victim was exposed to an animal that had rabies, could not be observed during a quarantine period, or could not be tested for rabies. Health care providers should check Pennsylvania Statewide Immunization Information System (PA-SIIS) for information on tetanus vaccinations. Additionally, they should continue to report bites to the health department.

4. **Animals responsible for a bite should be submitted for rabies testing whenever possible**. If pets involved in bites are euthanized during the quarantine period, the animal should be submitted for rabies testing. Bats found in homes should be captured and submitted for testing at the ACHD laboratory.

5. **Pennsylvania should enforce rabies vaccinations of dogs**. In order for a dog to be licensed, pet owners should be required to show proof of rabies vaccination. This will provide a mechanism to increase vaccination rates of dogs, protecting both dogs and owners from rabies virus.

6. **Pennsylvania should consider licensing of cats.** Licensing of cats may provide a mechanism to mandate rabies vaccination, which will protect cats and owners from rabies virus.

5.5 CONCLUSIONS

While there have been no human rabies cases in Pennsylvania in decades, rabies remains a significant public health concern and a threat to both domestic and wild animal populations. Prevention is key to protecting the health of the community, and ongoing rabies surveillance is critical to ensuring proper treatment is administered and no unnecessary treatment is recommended. The largest threat to humans comes from wild animals, and new prevention efforts should focus on them rather than domestic animals to reduce the risk of human rabies cases further. The annual report on animal bite and rabies data is important for policymakers and public health professionals to inform recommendations and guide policy updates for the continued prevention of rabies. Robust surveillance of animal bites and prevention programs are paramount to protect the public against the public health threat of rabies.

APPENDIX A TABLES

Table 1. Bites reported by animal type, Allegheny County, 2019

Species	N	%
Dog	1480	72.2
Pet	1285	62.7
Stray/Feral	33	1.6
Unknown	162	7.9
Cat	495	24.1
Pet	394	19.2
Stray/Feral	78	3.8
Unknown	23	1.1
Bat	18	0.9
Raccoon	12	0.6
Mouse	9	0.4
Chipmunk	5	0.2
Primate	5	0.2
Guinea Pig	2	<0.1
Hamster	2	<0.1
Rabbit	2	<0.1
Rat	2	<0.1
Squirrel	1	<0.1
Groundhog	1	<0.1
Beaver	1	<0.1
Fox	1	<0.1

Opossum	1	<0.1
Zebra	1	<0.1
Unknown	13	0.6
Total	2051	100

Table 2. Number of animals tested for rabies and number positive among animals listed on bite reports, Allegheny County, 2019

Species	Number Known to be Tested for Rabies N	Number Positive n(%)
Dog	106	0
Pet	85	0
Stray	1	0
Unknown/Missing	20	0
Cat	51	5 (9.8)
Pet	28	0
Stray/Feral	15	5 (33.3)
Unknown/Missing	8	0
Bat	1	0
Raccoon	3	2 (66.7)
Total	161	7 (4.3)

Table 3. Type of incident for reported bites, Allegheny County, 2019

Incident Type	All (N=2051)		Dog (N=1480)		Cat (N=495)	
	n(%)		n(%)		n(%)	
Breaking up a fight	112	(5.5)	100	(6.8)	10	(2.0)
Playing with the animal	109	(5.3)	94	(6.4)	15	(3.0)
The animal got spooked	103	(5.0)	72	(4.9)	30	(6.1)
Trying to pet the animal	48	(2.3)	37	(2.5)	11	(2.2)
At a community area and animal came up and bit the victim	41	(2.0)	35	(2.4)	5	(1.0)
Trying to capture the animal	26	(1.3)	8	(0.5)	17	(3.4)
Performing a medical procedure	23	(1.1)	9	(0.6)	13	(2.6)
Taking something from the animal	22	(1.1)	21	(1.4)	0	(0)
Trying to feed the animal	20	(1.0)	11	(0.7)	7	(1.4)
Bathing/ Grooming the animal	18	(0.9)	7	(0.5)	11	(2.2)
Entering the owner's house	17	(0.8)	17	(1.1)	0	(0)
Walking on the road	16	(0.8)	16	(1.1)	0	(0)
Trying to put the animal in a crate	15	(0.7)	6	(0.4)	9	(1.8)
Greeting a new animal	11	(0.5)	10	(0.7)	1	(0.2)
Delivering the mail	9	(0.4)	9	(0.6)	0	(0)
Giving medication to or cleaning a wound on the animal	9	(0.4)	5	(0.3)	4	0.8
Walking into the owner's yard	9	(0.4)	9	(0.6)	0	(0)
Touching a wound or painful spot on the animal	5	(0.2)	3	(0.2)	1	0.2
Bitten by a bat	3	(0.1)	N/A	N/A	N/A	N/A
Waking up in a room with a bat	3	(0.1)	N/A	N/A	N/A	N/A
Bitten by a wild animal	2	(0.1)	0	(0)	0	(0)

Checking the animal for a collar and tags	2	(0.1)	2	(0.1)	0	(0)
Repairing/ Installing an item on the owner's property	1	(0.0)	1	(0.1)	0	(0)
Other	69	(3.4)	51	(3.4)	13	(2.6)
Missing	1358	(66.2)	957	(64.7)	348	(70.3)
Total	2051	100	1480	100	495	100

Table 4. Type of treatment received for animal bites, Allegheny County, 2019

Treatment Type	All (N=2051)		Dog (N=1480)		Cat (N=495)	
	n(%)		n(%)		n(%)	
Antibiotic	1274	(62.1)	920	(62.2)	326	(65.9)
Wound Cleansed	1176	(57.3)	907	(61.3)	242	(48.9)
Tetanus Vaccine	653	(31.8)	492	(33.2)	138	(27.9)
Rabies PEP	86	(4.2)	36	(2.4)	26	(5.3)
Other Treatment	155	(7.6)	126	(8.5)	24	(4.9)
No Treatment	498	(24.3)	366	(24.7)	111	(22.4)

Table 5. Type of antibiotic prescribed for animal bites, Allegheny County, 2019

Antibiotic	All (N=1274)		Dog (N=920)		Cat (N=326)	
	n(%)		n(%)		n(%)	
Augmentin (Amoxicillin/Clavulanic acid)	763	(59.9)	570	(62.0)	189	(58.0)
Doxycycline	51	(4.0)	25	(2.7)	23	(7.1)
Unasyn (Ampicillin/Sulbactam)	38	(3.0)	30	(3.3)	8	(2.5)
Amoxicillin	30	(2.4)	16	(1.7)	3	(0.9)
Clindamycin	16	(1.3)	12	(1.3)	4	(1.2)
Multiple	45	(3.5)	30	(3.3)	15	(4.6)
Other	26	(2.0)	14	(1.5)	9	(2.8)
Not Specified	305	(23.9)	223	(24.2)	75	(23.0)

Table 6. Reason for getting rabies post-exposure prophylaxis, Allegheny County, 2019

Reason	**N=86**	
	n(%)	
Exposed to Rabid Animal	12	(14.0)
Exposed to Unobservable Animal	70	(81.4)
Invalid Reason	4	(4.7)

Note: individuals who started PEP but stopped for any reason were not included in this analysis.

Table 7. Dog breeds involved in bites and dog breeds licensed, Allegheny County, 2019

Breed	Total Bites* (N=1020) n(%)		Licensed in Allegheny County (N=85,086) n(%)		p-value
Pit Bull	213	(20.9)	3348	(4.0)	<0.01
Mixed Breed	143	(14.0)	10470	(12.5)	0.15
German Shepherd	100	(9.8)	4316	(5.2)	<0.01
Labrador Retriever	72	(7.1)	10424	(12.5)	<0.01
Bulldog	30	(2.9)	1033	(1.2)	<0.01
Rottweiler	30	(2.9)	869	(1.0)	<0.01
Boxer	28	(2.7)	2393	(2.9)	0.82
Chihuahua	22	(2.2)	3288	(3.9)	<0.01
Golden Retriever	22	(2.2)	4024	(4.8)	<0.01
Beagle	20	(2.0)	3967	(4.8)	<0.01
Husky	20	(2.0)	1035	(1.2)	0.04
Shih-Tzu	19	(1.9)	3000	(3.6)	<0.01
Mastiff	16	(1.6)	499	(0.6)	<0.01
Boston Terrier	12	(1.2)	796	(1.0)	0.46
Doberman Pinscher	12	(1.2)	458	(0.5)	<0.01
Jack Russell	12	(1.2)	281	(0.3)	<0.01
Poodle	12	(1.2)	1830	(2.2)	0.03
Terrier	11	(1.1)	1603	(1.9)	0.05
Yorkshire Terrier	11	(1.1)	2808	(3.4)	<0.01
Labradoodle	10	(1.0)	581	(0.7)	0.27
Breed with <10 bites	205	(20.1)			

*Missing for 460 bites. Percentages are based off 1020 instead of 1480.

Breeds shown in bold fonts are **significantly** overrepresented in animal bite reports compared to county license data from 2019.

Note: if two or more breeds were listed as a dog breed (e.g. pit bull + mastiff), breed was categorized as the first breed listed (pit bull). If a breed was listed as a single breed mix (e.g. pit bull mix), the breed was categorized as a single breed (pit bull).

Table 8. Number of animals tested for rabies at the ACHD lab and number positive for rabies, Allegheny County, 2019

	Number Tested for Rabies in ACHD Lab N	Number Positive N(%)	
Cat	157	5	(3.2)
Dog	154	0	
Bat	122	5	(4.1)
Raccoon	96	18	(18.8)
Groundhog	20	0	
Squirrel	11	0	
Skunk	6	0	
Rabbit	2	0	
Chipmunk	1	0	
Deer	1	0	
Flying Squirrel	1	0	
Fox	1	0	
Goat	1	0	
Mink	1	0	
Opossum	1	0	
Rat	1	0	

Table 9. Positive Rabies Test Results in Animals by Species, January-June 2019, RI (Rhode Island Department of Health, 2019).

Species	# Positive	% Positive By Species (Number of this species positive/ number of this species tested) x 100	% Positive Overall (Number positive for this species / Number of all positive tests) x 100
Bat	4	4.7%	44.4%
Raccoon	2	5.4%	22.2%
Skunk	2	15.4%	22.2%
Fox	1	16.7%	11.1%

Table 10. Positive Rabies Test Results in Animals by Species, July-December 2019, RI (Rhode Island Department of Health, 2020).

Species	# Positive	% Positive By Species (Number of this species positive/ number of this species tested) x 100	% Positive Overall (Number positive for this species / Number of all positive tests) x 100
Bat	4	1.7%	18.2%
Raccoon	13	54.2%	59.1%
Skunk	4	15.4%	18.2%
Woodchuck	1	5.9%	4.5%

APPENDIX B FIGURES

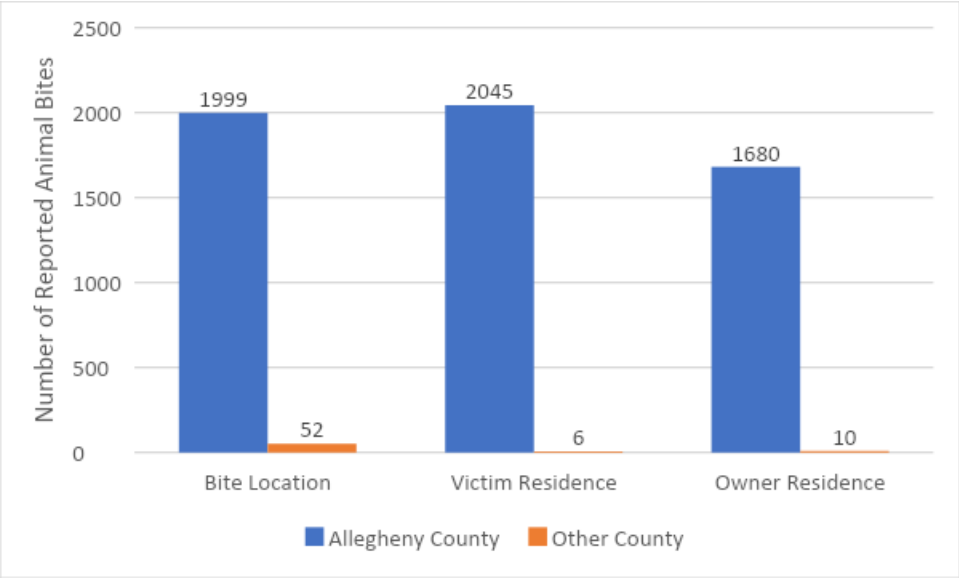

Figure 1. County of bite location, victim residence, and owner residence for reported animal bites, Allegheny County, 2019

Note: only bite incidents involving "pets" were associated with an owner residence.

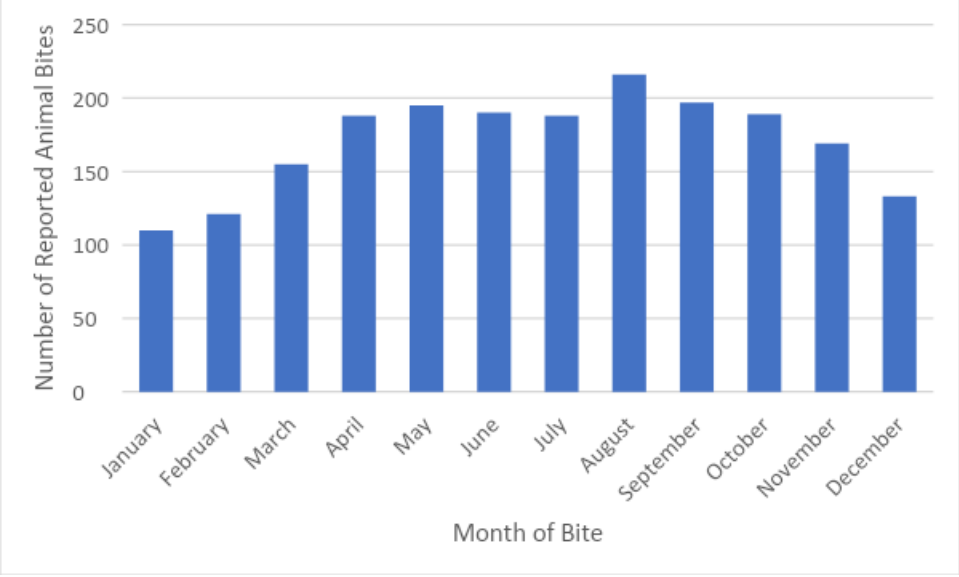

Figure 2. Distribution of reported animal bites by month, Allegheny County, 2019

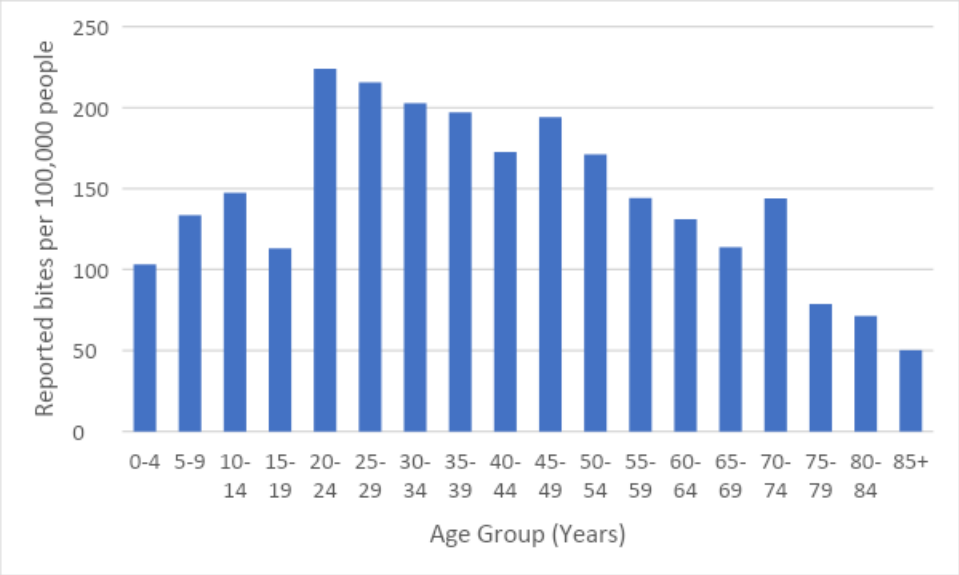

Figure 3. Reported bite rate per 100,000 people by age group of victim, Allegheny County, 2019

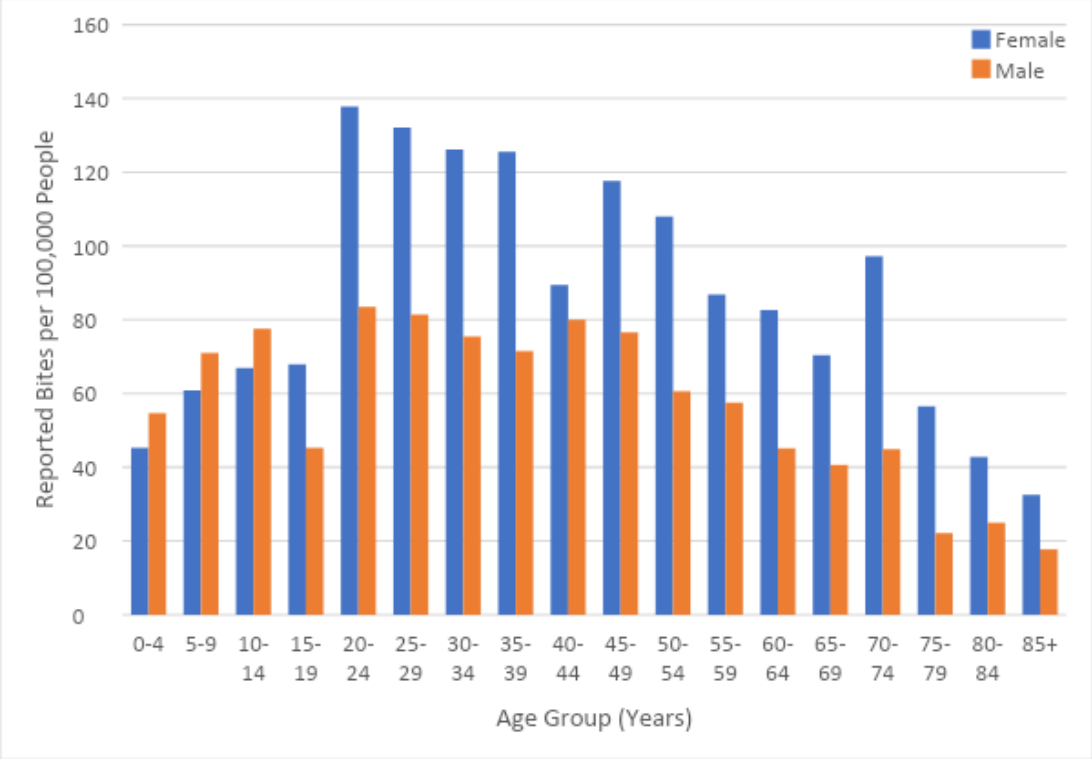

Figure 4. Reported bite rate per 100,000 people by age group and sex of victim, Allegheny County, 2019

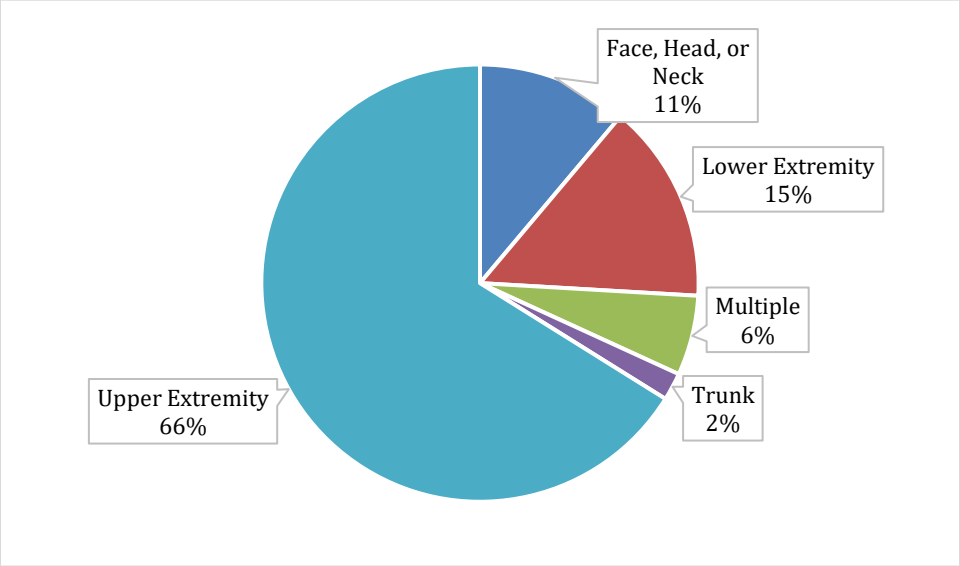

Figure 5. Location of exposure for bites reported with known site, Allegheny County, 2019

Note: upper extremity was defined as shoulder, arm, wrist, finger, and hand. Lower extremity was defined as leg, foot, hip, ankle, and toe. Face/head/neck was defined as face, head, neck, and ear. Trunk was defined as abdomen, chest, buttocks, and back. Multiple locations was defined as any incident that included more than one location on the body.

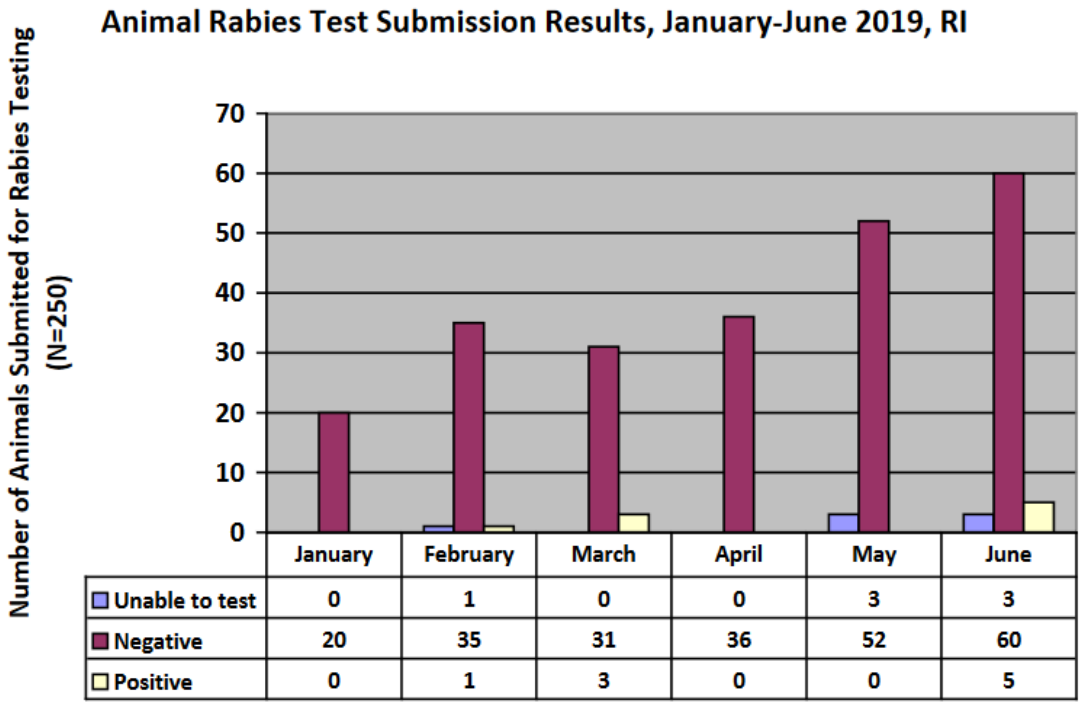

Figure 6. Animal Rabies Testing Submission Results, January-June 2019, RI (Rhode Island Department of Health, 2019).

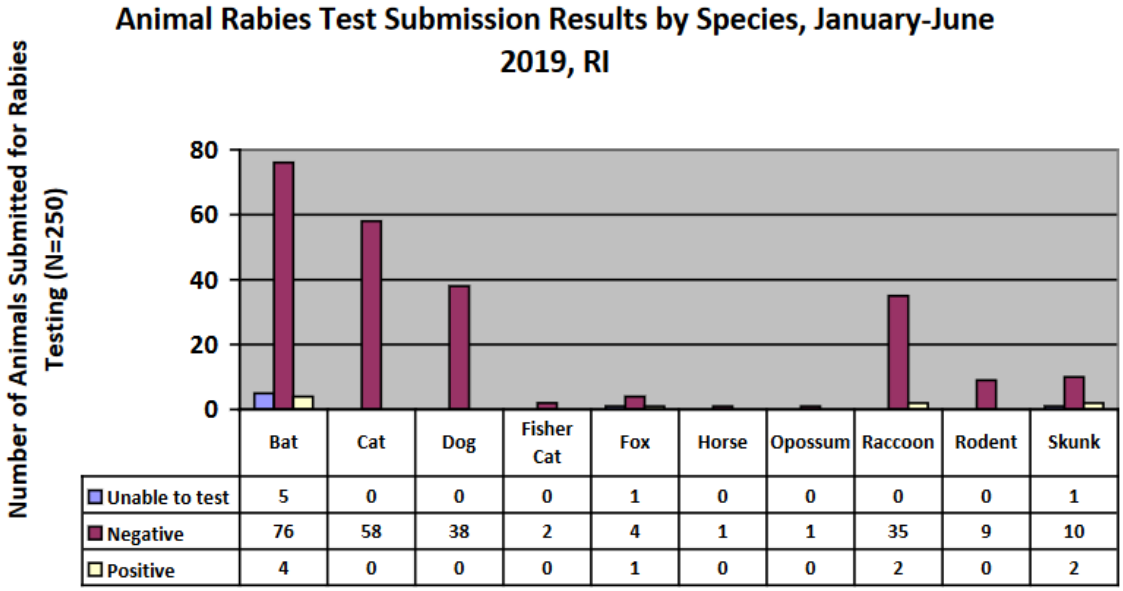

Figure 7. Animal Rabies Test Submission Results by Species, January – June 2019, RI (Rhode Island Department of Health, 2019).

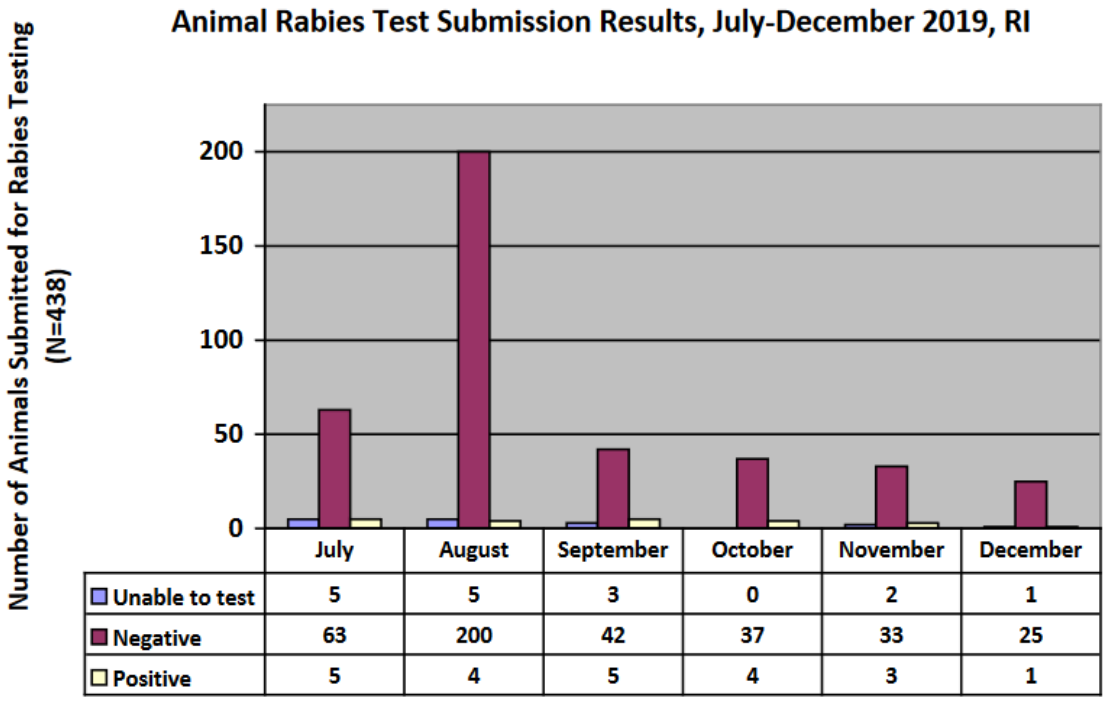

Figure 8. Animal Rabies Testing Submission Results, July-December 2019, RI (Rhode Island Department of Health, 2020).

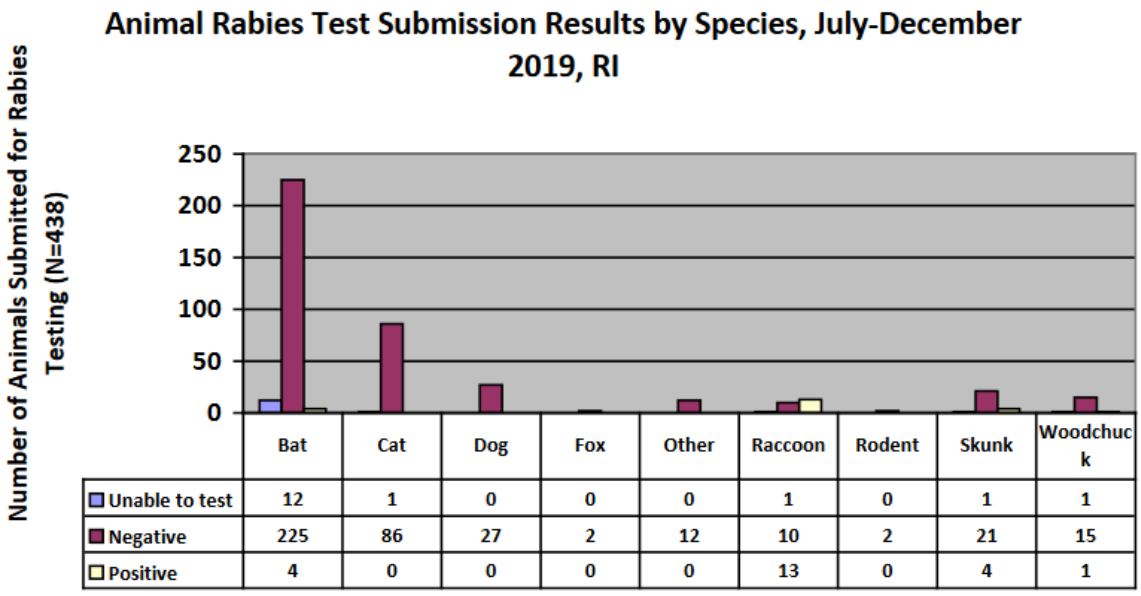

Figure 9. Animal Rabies Test Submission Results by Species, July-December 2019, RI (Rhode Island Department of Health, 2020).

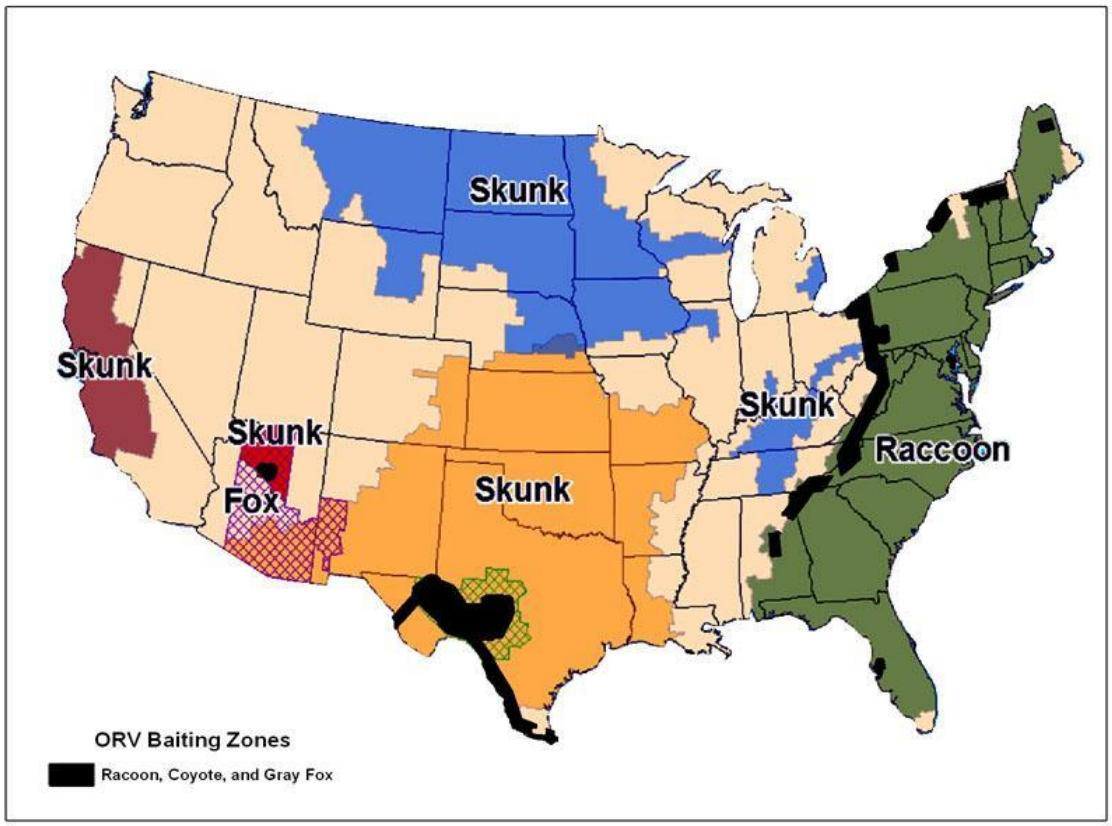

Figure 10. Wildlife rabies reservoirs within the US and the current baiting zones (USDA, 2020).

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