Animal Bite Surveillance and Treatment for Animal Bite Infections

Allegheny County, Pennsylvania – 2018

by

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Abstract

Background: Animal bites are an important public health problem as they can result in injury and infection. Animal bites are treated prophylactically for infection with antibiotics, tetanus vaccinations, and/or rabies post-exposure prophylaxis (PEP) if indicated. The objective of this surveillance report was to compile animal bite data for 2018 from bites reported to the Allegheny County Health Department (ACHD) and to summarize animal bite treatment for bites reported in 2018 and previous years.

Methods: Data from bite reports were extracted from an Oracle database to an Excel file. SAS was used to remove duplicate records and obtain descriptive statistics. Population data estimates were obtained from the U.S. Census to calculate bite incidence rates per 100,000 population. ArcMap™ was used to display bite incidence rates by zip code.

Results: In 2018, 1,973 bites were reported to ACHD. Dogs (74.9%) and cats (22.2%) made up the majority of animals involved in bites. The most common wild animals involved were bats (0.7%) and raccoons (0.4%). Bites were reported more frequently during the summer months and were more likely to involve the upper extremities (52%). The age groups 25-29 years and 30-34

years had the highest bite incidence rates. Females accounted for 58% of bite victims. The most common bite incident types were playing with the animal, the animal got spooked, and breaking up a fight. Of 70 animals tested for rabies, three were positive (feral cat, bat, fox). All persons exposed to these rabid animals received rabies PEP. Of all bite victims, 58.3% had their wound cleansed, 61.7% were prescribed antibiotics, and 28.6% received a tetanus shot. Augmentin was the most common antibiotic prescribed to victims. Of 103 victims that received the rabies PEP, 19.4% did so unnecessarily. Animal bite treatment was similar to previous years, although there was a decline in antibiotic prescriptions and tetanus vaccinations from 2015 to 2018.

Conclusion: Animal bites remain an important public health problem in Allegheny County, PA, so continued surveillance is needed to mitigate rabies risk. ACHD and medical providers should continue to follow animal bite protocol and make proper recommendations for rabies PEP to victims.

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Preface

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1.0 Introduction

Animal bites may cause severe morbidity, and even mortality, and are an important public health problem. Animal bites may be a source of infection. Bacterial infections are fairly common; and, in rare circumstances, animal bites may transmit the rabies virus (Ellis & Ellis, 2014). If not treated, rabies is nearly always fatal (CDC, 2019). Animal bites are a reportable condition in Pennsylvania, so medical facilities are required to report animal bites to health departments (Pennsylvania Department of Health, 2019a). Health departments, such as the Allegheny County Health Department (ACHD), then follow up with the animal bite victim and the animal owner to ensure of the health of the animal involved and to make proper treatment recommendations to the victim (Short, Brungo, & Mertz, 2018).

1.1 Animal Bites

1.1.1 Animal Bite Epidemiology

The incidence of animal bites in the United States is difficult to estimate because animal bites are under-reported (Patronek & Slavinski, 2009). However, it is estimated that up to 2% of the population are bitten by animals each year (Looke & Dendle, 2010). In the U.S., animal bites account for 1% of emergency department visits, though the prevalence of dog bite emergency department visits decreased from 2010 to 2014 (Holzer, Vaughn, & Murugan, 2019). Of those who visit the emergency department for an animal bite, 2% require hospitalization (Ellis & Ellis,

2014). However, because animal bites are under-reported, those who visit the ER for an animal bite likely represent only a small fraction of the number of persons bitten. Still, because of the number of emergency department visits that are due to animal bites, animal bites remain a serious problem.

Children more frequently visit the emergency department (ED) with dog bites than adults, with male children more commonly seeking ED care for bites than female children (Holzer et al., 2019). Among adults, males more commonly report to the emergency department with dog bites than females (Holzer et al., 2019). Dog bites are more likely to occur by a dog the victim knows or owns (Beck & Jones, 1985). Additionally, the incidence of dog bite emergency visits is highest in Northeastern United States hospitals, among non-Medicare insurance holders, and among individuals with higher median-household income (Holzer et al., 2019). In a study that examined animal bite data from Indiana, animal bite rates in urban counties were higher than they were in rural counties (Sinclair & Zhou, 1995).

Different types of animals are involved in reported bites. Globally, dogs are the most common species involved in bites, with about 80% of all yearly bites being from dogs (Patronek & Slavinski, 2009). Cats are the second most common, accounting for nearly 20% of all bites (Patronek & Slavinski, 2009). Wildlife, other pets, and farm animals account for the remainder, which is few bites in comparison to dogs and cats (Patronek & Slavinski, 2009).

1.1.2 Morbidity from Animal Bites

Animal bites can cause significant injury. Crush wounds, lacerations, and abrasions can result from dog bites as a dog's teeth are designed to crush and tear into their prey (Dendle & Looke, 2008). On the other hand, cat bites tend to be puncture wounds as a cat's teeth are long,

thin incisors; the resulting puncture wound may be deep and thus difficult to clean and disinfect (Dendle & Looke, 2008). Animal bites may also cause damage to tendons or bones (CDC, 2019). The treatment for animal bites will thus likely depend on the type of bite and the species of the biting animal.

Animal bites can also be a source of infection. Infected dog and cat bite wounds have a complex microbiologic mix, containing a mixture of both aerobic and anaerobic species (Abrahamian & Goldstein, 2011; Goldstein et al., 1978; Talan, Citron, Abrahamian, Moran, & Goldstein, 1999). The organisms that colonize the dog's mouth are often affiliated with infection (Abrahamian & Goldstein, 2011), but not always. One study that swabbed the oral and nasal cavities of fifty dogs frequently recovered human pathogens *S. aureus*, IIj, EF-4, and *P. multocida* (Bailie, Stowe, & Schmitt, 1978). However, in another study, only two EF-4, three M-5, and no IIj isolates were found in 29 dog bite wounds (Goldstein et al., 1978).

Pasteurella species are commonly isolated from both dog and cat bite wounds. In one prospective study that examined bacteriologic makeup of 107 infected bite wounds, Pasteurella species were most common in both dog and cat bites; the most common Pasteurella isolate was of the *canis* genus for infected dog bite wounds and *multocida* genus for infected cat bite wounds (Talan et al., 1999). Additionally, in another study that examined bacteriologic makeup of infected dog and cat bite wounds, *P. multocida* was isolated from nine of 39 infected bite wounds (Goldstein et al., 1978). In another prospective study examining the microbiologic makeup of infected cat bite wounds, *P. multocida* was isolated from 70% of 64 patients. Anaerobes were isolated with *P. multocida* 16% of the time and *S. aureus* was only isolated from two patients. Pasteurella species were also isolated from 80% of biting cats' pharynxes (Westling et al., 2006). While different organisms are affiliated with animal bite wound infection, it seems Pasteurella

species, namely *P. multocida* for cats, is the predominant species involved in infected dog and cat bite wounds.

Clostridium tetani spores may also enter non-intact skin as a result of animal bites (Kretsinger et al., 2006). Deep puncture wounds can result from animal bites, especially from cat bites (Dendle & Looke, 2008). When the spores enter into these oxygen-poor sites, they can germinate to vegetative bacilli, which then multiply and produce a potent neurotoxin: tetanospasmin. The result is tetanus disease, which is a neurological disease that involves symptoms such as lockjaw, painful contractions of skeletal muscles that can result in generalized rigidity, and respiratory dysfunction. Death can ultimately result from respiratory failure, glottis spasm, and autonomic instability (Kretsinger et al., 2006). While the rate of tetanus after animal bites is not known (Looke & Dendle, 2015), tetanus remains a valid concern after animal bites due to how fatal the disease is.

Animal bites may also transmit the rabies virus, a fatal pathogen that kills 59,000 people per year worldwide and one to three people per year in the United States (CDC, 2019; Ellis & Ellis, 2014; WHO, 2019).

1.2 Rabies Virus

1.2.1 Structure of Rabies Virus

The rabies virus is a member of the Rhabdoviridae family and the *Lyssavirus* genus. Rabies is a rod-shaped, enveloped virus. The genetic material of rabies is single-stranded, negative-sense RNA, which encodes five proteins: the L (transcriptase), N (nucleoprotein), NS (transcriptase-

associated), M (matrix), and G (glycoprotein). The M and G proteins make up the lipid envelope of the virus. The L, N, and NS proteins, along with the genetic material of the virus, comprise the ribonucleoprotein (RNP) complex. The RNP complexes aggregate in the cytoplasm of neurons upon infection of the host, forming Negri bodies. The presence of Negri bodies is the histopathologic mark of rabies virus infection (Charles E. Rupprecht, 1996).

1.2.2 Rabies Disease

Rabies is a uniformly fatal infectious disease, transmitted via the saliva of an infected mammal. In humans, the incubation period for rabies is usually three to eight weeks. However, rabies disease can manifest in as short as one week or as long as nine years. Initial symptoms of rabies include fever, headache, and irritability. The exposure site may also be painful or itchy. Eventually, the disease progresses to paralysis, delirium, seizures, and spasms of the throat muscles. By the time these symptoms appear, rabies is nearly always fatal, and can rarely be treated. Rabies can, however, be successfully treated before symptoms appear with the rabies post-exposure prophylaxis vaccine series (Pennsylvania Department of Health, 2016).

1.2.3 Epidemiology of Rabies in the United States

In the U.S., the incidence of human rabies is very low, with only about one to three human cases reported each year (CDC, 2019; Pennsylvania Department of Health, 2018). Two rabies deaths in humans were reported in 2017 (Ma et al., 2018). No deaths from rabies were reported in 2016 (Ma et al., 2018). In Pennsylvania, there has not been a human case of rabies since 1984 (Pennsylvania Department of Health, 2018).

The incidence of animal rabies is, however, much higher. There are about 5,000 rabid animals reported to the CDC each year in the United States, with 90% of these animals being wild (Ma et al., 2018). In 2017, 52 jurisdictions reported 4,454 cases of animal rabies to the CDC. Of these rabid animals, 276 (6.2%) were cats and 62 (1.4%) were dogs. Bats (32.2%), raccoons (28.6%), and skunks (21.1%) made up the majority of rabid animals. The number of animal rabies cases reported in 2017 represented a 9.3% decrease from the previous year (Ma et al., 2018).

Rabies incidence (in animals) was not always highest in wild animals in the United States. Before the year 1960, most cases occurred in domestic animals (CDC, 2019). The low incidence rate of human rabies and domestic animal rabies cases in the United States is a result of public health efforts such as eliminating stray dogs and the vaccination of pets, as well as medical advancements in post-exposure prophylaxis for rabies. Additionally, health departments, such as the Allegheny County Health Department in Pennsylvania, may vaccinate raccoons by encasing a vaccine in a desirable bait and distributing the baits throughout the county. The control of rabies is, however, very costly. It is estimated that the United States spends close to 300 million dollars a year on rabies prevention, with dog vaccinations being the greatest financial burden (CDC, 2019). These efforts are not without results; it is fair to say that rabies is a controlled infectious disease in the United States.

1.2.4 Epidemiology of Rabies in the World

The global burden of rabies disease is much more substantial than it is in the United States. Worldwide, rabies causes nearly 59,000 human deaths in over 150 countries. Most (95%) of these cases occur in Africa and Asia. Because of underreporting of disease, these numbers are likely to be an underestimation of the true impact of rabies disease (WHO, 2019).

Globally, 90% of human rabies exposures and 99% of human rabies deaths are caused by rabid dogs. Post-exposure prophylaxis for rabies has been around for more than 100 years, so deaths due to rabies usually occur in countries where there is limited treatment and few public health resources (CDC, 2019). As seen in the United States, control of rabies in domestic animals and humans requires many public health resources and funding. Many developing countries where rabies is endemic do not have the resources to conduct rabies surveillance, eliminate stray dogs, or vaccinate dogs for rabies (CDC, 2019). As a result, deaths due to rabies remain common in the developing world.

1.3 Treatment for Animal Bite Infection

1.3.1 Wound Cleansing

Bite wounds are a source of infection, and therefore should be properly cleansed and irrigated (Ellis & Ellis, 2014). Irrigating the wound with tap water, normal saline, or 1% povidone-iodine solution helps to dislodge foreign bodies, such as teeth, and bacteria introduced during the bite (Ellis & Ellis, 2014; Morgan, 2005; Oehler, Velez, Mizrachi, Lamarche, & Gompf, 2009). A 20 mL syringe or larger should be used to irrigate the wound with high enough pressure to clean it adequately. If using a syringe smaller than 20 mL, a 20-gauge catheter can be connected to it to increase pressure (Ellis & Ellis, 2014). Irrigation also helps reduce the risk of infection with rabies virus (Oehler et al., 2009). The wound should be debrided gently along with irrigation to further decrease the risk for rabies infection (Morgan & Palmer, 2007). Despite the absence of

randomized controlled trials or other good studies testing the benefits of wound cleansing, wound cleansing is regarded as the standard of care for bite wounds (Looke & Dendle, 2010).

1.3.2 Antibiotics

Antibiotics may be used prophylactically to prevent infection that can result from an animal bite. The current first-line recommended antibiotic for prophylaxis for infection from bite wounds is Amoxicillin-clavulanic acid (Augmentin) (Ellis & Ellis, 2014), which is a penicillin antibiotic (Drugs.com, 2018). This antibiotic provides coverage against susceptible *S. aureus*, Pasteurella species, Capnocytophaga species, and anaerobes (Oehler et al., 2009). Antibiotics dicloxacillin, cephalexin, clindamycin, and erythromycin should not be used as a monotherapy as bite wound infection prophylaxis because they do not protect against Pasteurella species (Oehler et al., 2009), the predominant microbe affiliated with bite wound infection (Talan et al., 1999). If the patient is allergic to penicillin, doxycycline with or without metronidazole may be used. Additionally, clindamycin with either a fluoroquinolone or trimethoprim-sulfamethoxazole in children could be used. For pregnant women, ceftriaxone may be used, as well as cefuroxime and cefpodoxime as oral alternatives (Oehler et al., 2009).

There has been much debate on the effectiveness of antibiotics for prophylactic treatment for infection. One double-blind study looking at the effectiveness of Augmentin versus placebo in preventing infection from animal bites found that in those who presented with older bites (greater than nine hours old) the rate of infection was significantly decreased by a small amount with antibiotic use. No benefit of antibiotics was shown with wounds that were less than nine hours old (Brakenbury & Muwanga, 1989). In one meta-analysis of eight clinical trials, antibiotics conferred a relative risk for infection of 0.56 in those who received antibiotics compared to controls

who did not. This association was statistically significant. They found that 14 people needed to be treated with antibiotics to prevent one infection (Cummings, 1994). Yet a review speculated how valid this result was due to the inclusion of a trial that had an abnormally high infection rate (Morgan, 2005). In another Cochrane review of eight randomized controlled clinical trials, prophylactic antibiotics were not found to decrease infection rates of dog and cat bite wounds. However, antibiotics did reduce the rate of infection in bite wounds to the hand, with a statistically significant odds ratio of 0.1 (Medeiros & Saconato, 2001). The research is equivocal on the effectiveness of treating animal bite wounds prophylactically for infection with antibiotics.

Despite mixed findings on the benefit of prophylactic treatment for infection with antibiotics, antibiotics should still be considered for high-risk wounds – cat bite wounds to the hand and wrist, other hand bite wounds, deep puncture wounds, dirty wounds, crush wounds involving devitalized tissue, and after primary closure of the wound (Looke & Dendle, 2015; Morgan, 2005). Antibiotics should not be considered for low-risk wounds, such as scratches, abrasions, and epidermal stripping. It is unclear whether prophylactic antibiotics for low-risk wounds that are less than 24 hours old are beneficial (Looke & Dendle, 2015). Various conditions such as diabetes mellitus, mastectomy, prosthetic joints, splenectomy, cirrhosis, asplenia, and immunosuppression put victims at increased risk for infection, so antibiotics should be considered for persons with these conditions as well (Morgan, 2005).

1.3.3 Tetanus Vaccine

Bite wounds may also be treated prophylactically for tetanus with tetanus vaccination. For minor wounds where a tetanus vaccine is indicated, Tdap (tetanus-diphtheria-pertussis) or Td (tetanus-diphtheria) should be administered if the victim has had less than three doses of a tetanus

vaccine. Tdap is favorable to Td if the victim has never received Tdap. For other wounds where a tetanus vaccine is indicated, Tdap and Tetanus Immune Globulin (TIG) should be administered if the victim has had less than three doses of tetanus vaccine. A tetanus vaccination does not need to be administered for wound management if the victim has had three previous tetanus vaccinations, and their last tetanus toxoid-containing vaccine is less than 10 years old for clean, minor wounds or less than five years old for other wounds (Kretsinger et al., 2006). There is no evidence that tetanus vaccinations decrease risk for tetanus through RCTS or other cohort studies, but tetanus vaccinations remain standard of care for treatment of bite wounds (Looke & Dendle, 2010).

1.3.4 Post-Exposure Prophylaxis for Rabies

If a person is exposed to a rabid animal, rabies disease can be entirely prevented in humans with the post-exposure prophylaxis vaccine series (PEP) for rabies. Rabies PEP consists of one dose of Human Rabies Immune Globulin (HRIG) and a series of four vaccinations with the Human Diploid Cell Vaccine (HDCV). Individuals should receive the first dose as soon as possible (day 0), and then doses on days 3, 7, and 14 thereafter. Individuals who are at increased risk for rabies, such as veterinarians, may have had the pre-exposure prophylaxis rabies vaccine series already. If such individuals are exposed to a rabid animal they only require two doses of the HDCV as rabies PEP. If administered correctly, rabies PEP is 100% effective at preventing rabies disease in humans (C. E. Rupprecht et al., 2010).

Valid reasons to administer rabies PEP include a victim was bitten by an animal that had rabies or the victim was bitten by an animal that could not be observed for rabies symptoms during a quarantine period, which is for 10 days if the animal is a dog or cat. The 10-day quarantine

period for biting dogs and cats is relevant because these animals would show rabies symptoms or die during that period if the animal had rabies at the time of the bite (CDC, 2019). The health of these animals after the 10-day quarantine period is, therefore, a good indication of whether or not the victim should receive rabies PEP. Rabies PEP does not need to be administered immediately for biting dogs and cats available for observation during this quarantine period. In the United States, no person has contracted rabies from these animals that were quarantined for 10 days (CDC, 2019). Other animals have quarantine periods that are too long, or unknown, so it is requested they are euthanized and tested for rabies to determine the rabies status at the time of the bite (CDC, 2019). Rabies testing can only occur on deceased animals as the brain tissue is examined histologically for rabies infection. Additionally, fluorescent antibody testing is performed (Moore, Sischo, Hunter, & Miles, 2000). Therefore, another valid reason to receive rabies PEP would be when the biting animal was not available for rabies testing. All other reasons for rabies PEP administration are considered invalid. It is important to minimize the amount of rabies PEP that is given out unnecessarily, as rabies PEP is very expensive costing anywhere from 1,200 to 6,500 dollars (an average of 3,800 dollars) (CDC, 2019). Rabies PEP is an important prophylactic treatment for rabies, but should only be used appropriately as with any other medical treatment.

The four-dose rabies PEP is effective at preventing rabies in humans if given appropriately. Previous recommendations by the Advisory Committee On Immunization Practices (ACIP) for rabies PEP called for five doses of the HDCV. In 2009, the recommendation was reduced to four doses. The four doses of the vaccine, along with the HRIG, were found to elicit an appropriate protective response against rabies and the addition of a fifth vaccine did not confer any more benefit (C. E. Rupprecht et al., 2010). There have been no cases of human rabies where proper wound cleansing, HRIG infiltration, and four doses of timely rabies PEP were administered. For

example, out of 1,132 persons who received rabies PEP that were exposed to a rabid animal in New York 1998-2000, 147 persons received less than five doses and none of these people acquired rabies (C. E. Rupprecht et al., 2010). If given according to recommendations, the four-dose rabies PEP is highly efficacious in preventing rabies disease.

1.4 Gaps in Knowledge

Because of ethical reasons, randomized controlled trials cannot assess the efficacy of prophylactic tetanus vaccinations or wound cleansing. There is limited research in these areas. Wound cleansing and tetanus vaccinations are done for animal bites based on clinical guidelines and experience.

There is mixed research on the effectiveness of prophylactic antibiotics. Previous randomized controlled clinical trials have been conducted with smaller sample sizes (Looke & Dendle, 2015). Systematic reviews and meta-analyses have generated conflicting evidence (Cummings, 1994; Medeiros & Saconato, 2001). Additionally, these studies and reviews are older. There has been no recent, large, prospective study that examines prophylactic treatment for animal bite wound infections with antibiotics. Larger trials are needed in the future to examine this topic.

1.5 Public Health Significance

Treatment for animal bites has important personal health significance. Much of the initial treatment for animal bites is prophylactic. Antibiotic prescriptions, tetanus vaccinations, and

rabies PEP are all administered prophylactically. Despite it being difficult to understand how effective the current standard of treatment for antibiotics and tetanus is, abiding by the current standard is important to decrease morbidity and mortality until research can provide evidence against so. It is gravely important that victims of animal bites are assessed for rabies risk and given the rabies PEP appropriately to decrease mortality from rabies. An implication of this work is that unnecessary treatment for animal bites will be highlighted, providing incentive to adhere to proper animal bite treatment protocol by practitioners and health department staff.

Animal bites have important public health significance because they affect a large percentage of the population and result in morbidities that need adequate treatment to prevent further morbidity and mortality. The number of bites reported to the Allegheny Health County Health Department in previous years includes 1,883 in 2017, 1,912 in 2016, and 1,810 in 2015 (Seresin, Brungo, & Mertz, 2017; Short et al., 2018). Continued surveillance is important to control the spread of rabies from biting animals and to ensure victims are connected to treatment.

2.0 Objective

The objective of this surveillance report was two-fold. The first objective was to compile and analyze the animal bite data for the year 2018 from bites reported to the Allegheny County Health Department. The second objective was to summarize animal bite treatment for bites reported in the year 2018 and compare the results to treatment from previous years. I chose to focus this report on treatment for animal bites to provide a more detailed synopsis on animal bite treatment, as well as to summarize how this treatment data fits in with the current recommendations for animal bite treatment.

3.0 Methods

The animal bite and animal rabies testing data from the year 2018 were obtained from the Allegheny County Health Department (ACHD), Pennsylvania. Data on the number of bites reported and treatment received by bite victims in 2015 through 2017 were obtained from previous bite reports (Seresin et al., 2017; Short et al., 2018). The data are subject to a data-use agreement.

3.1 Data Collection and Animal Bite Reporting at ACHD

Animal bites are a reportable condition in Allegheny County, Pennsylvania, so medical facilities are required to report animal bites to the Allegheny County Health Department (Pennsylvania Department of Health, 2019a). Animal bites are reported by either filling out an online form linked to an Oracle database or by faxing a bite report form to ACHD. Along with medical facilities, these reports are filled out by police agencies or bite victims and animal owners themselves. Clerks at the Immunization Clinic of ACHD receive the reports and then follow up with the bite victim and the animal owner, if applicable, to collect more information on the incident. The clerks may also contact veterinarians of biting animals to collect information on rabies vaccinations. If the bite incident involved a domestic animal, the health department places the animal in quarantine for a period of time (usually 10 days) to monitor for rabies symptoms. Testing of the biting animal for rabies is requested if the animal is deceased. The ACHD laboratory uses a direct fluorescent antibody test to test for rabies. The laboratory performs rabies tests on deceased animals reported in bites to the county, as well as on other animals found around the

county that may or may not have been involved in a bite. ACHD makes recommendations for rabies PEP to victims. Rabies PEP is recommended if the animal is not able to be observed during a quarantine period, if the animal cannot be tested for rabies, or if the animal tested positive for rabies. ACHD monitors the rabies PEP vaccine course to ensure the victim completes the necessary treatment (Short et al., 2018).

3.2 Description of Data

For each bite report, information on the victim, biting animal, the animal owner (if applicable), and bite incident are available. The name, age, sex, birth date, contact information, and address are documented for the victim. If the victim is a child, the database lists the name of the parent or guardian. The name and address are documented for the animal owner, if applicable.

Various information on the biting animal is available, including the species, breed (if applicable), and whether the animal was feral, a pet, a stray, wild, or unknown. Information on whether the animal is available for observation, the current location of the animal, rabies vaccination status of the animal, and neurologic symptoms of the animal are also documented. The name of the veterinarian and contact information is documented if applicable, as well as the dates and expirations of rabies vaccinations.

Each bite report documents the part of the victim's body that was bitten and what kind of wound resulted. The treatment received and the medical facility visited are listed for each bite report if the victim received treatment. Each bite report documents if the victim's wound was cleansed, if they received a tetanus vaccine, if they were prescribed antibiotics, or if they received

rabies post-exposure prophylaxis. Information pertaining to rabies PEP, such as if the HRIG and/or HDCV were administered, are also available for each bite report.

The date and time of the bite incident are available for each bite report. Each bite report includes a description and the location of the incident. The reporting entity, such as a medical facility or police agency, is available as well. Bite reports also contain a comments field, where clerks at the Immunization Clinic wrote comments pertaining to the incident.

Data entered by ACHD staff based on their investigation is also available for each bite report, such as the rabies vaccination status of the animal, whether the animal was tested for rabies, rabies status of the animal, and if a quarantine notice was given.

The terms "bite" and "exposure" are used interchangeably here and consist of both animal bites and scratches.

3.3 Data Management

Data on bites occurring between January 1, 2018, and December 31, 2018, were exported from the Oracle database into a Microsoft Excel document. SAS, version 9.4, was used for data management and cleaning. Duplicate observations were identified by name and date and then deleted. Bite reports were deleted if the owner's residence, victim's residence, and bite location were all outside of Allegheny County. Bite reports not involving mammals were excluded as well. Bite reports were deleted if the bite did not occur in the year 2018. If the bite date was missing, a report date occurring in the year 2018 was acceptable. If any data were unclear, the comments left by the clerks were read to determine what the data should be, and data corrections were made to

the Microsoft Excel document as necessary. If data were unclear as to rabies PEP vaccination status of the victims, PA-SIIS was utilized to determine vaccination status.

Population data by age group in Allegheny County were obtained from American Fact Finder at the United States Census for the year 2018 to calculate bite incidence rates per 100,000 population by age group. Population data by zip code in Allegheny County were obtained from the 2010 U.S. Census to calculate bite incidence rates per 100,000 population by zip code. This rate was calculated using the number of reported bites in that zip code divided by the total population of that zip code. Because rates were calculated using the number of bites reported in Allegheny County zip codes only, bites occurring in border zip codes may be an under-estimation of the true bite rate by zip code since border zip codes may be only partially in the county.

3.4 Data Analysis

SAS version 9.4 was used to compile descriptive statistics. Frequencies and/or percentages were calculated. Tables and figures depicting results were created using Microsoft Excel. ArcMap 10.5.1 was used to show bite incidence rates per 100,000 population by victim zip code on a map of Allegheny County. Quartiles were used to display an equal number of zip codes per category in ArcMap. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license.

4.0 Results

4.1 Animal Bites, Allegheny County – 2018

4.1.1 Species Involved in Reported Bites

There were 1,973 bites reported to ACHD in 2018 (**Table 1**). This represented a 4.8% increase from the bites reported in 2017 (Short et al., 2018). The most common animal involved in reported bites was dogs, representing 74.9% of bites reported. Most of the dog bites involved pets (85.6%). The second most common animal was cats, accounting for 22.2% of reported bites; 67.8% of these cats were pets. The most common wild animals reported in bites to ACHD were bats (0.7%) and raccoons (0.4%). There were 14 other animal types reported in bites, all of which represented a small minority of reported bites. There was one bite report where the species could not be identified by the victim. There was missing animal type data for five of the reported bites.

4.1.2 Bite Incidence Rates by Victim Zip Code

A map of bite incidence rates per 100,000 population by victim zip code can be seen in **Figure 1**. The highest bite incidence rate of 865.8 per 100,000 population was for zip code 15020. There were a few zip codes, such as for 15047 and 15006, that had bite incidence rates per 100,000 population of zero. No particular pattern was noted.

4.1.3 Reported Bites by Month

The number of reported bites peaked in the spring and summer months as temperatures became warmer (**Figure 2**). The number of reported bites decreased during the fall and winter months as temperatures became cooler. Bite numbers were highest in June (216 bites) and July (214 bites), and lowest in February (96 bites) and November (123 bites).

4.1.4 Bite Victims

Most of the bite victims were female (58% of bite victims with known sex). The median age of bite victims was 35 years and the mean age of bite victims was 37.3 years. The age of bite victims ranged from less than one year old to 96 years old (**Figure 3**). The highest bite incidence rate per 100,000 population was for age groups 25-29 and 30-34 years, followed by age groups 60-64 and 20-24 years. Male children had higher bite incidence rates per 100,000 population than female children up through age group 10-14 years (**Figure 4**). Females had higher bite incidence rates per 100,000 population than males thereafter until age group 70-74 years. Male and female individuals ages 70 and older had similar bite incidence rates per 100,000 population.

4.1.5 Animal Rabies Testing

Of 612 animals brought into the ACHD laboratory for rabies testing, 25 tested positive (**Table 2**). This was an increase from the 17 animals testing positive for rabies out of 708 tested in 2017 (Short et al., 2018). Note that not all of these animals were involved in reported bites, but may have been found in the county and submitted for testing. The most common animals tested

were cats (144 tested), bats (143 tested), raccoons (133 tested), and dogs (107 tested). Of 25 testing positive for rabies, 12 were raccoons, nine were bats, two were cats, one was a groundhog, and one was a fox.

Of animals involved in bite reports, 70 were tested for rabies in the ACHD laboratory (**Table 3**). These consisted of mostly dogs (38 tested) and cats (24 tested). The remaining animals were bats, a fox, a squirrel, a groundhog, and a vole. A total of three animals tested positive for rabies that were involved in reported bites: a feral cat, a bat, and a fox. No pets involved in reported bites tested positive for rabies in 2018.

4.1.6 Bite Incident Type

The most common incident types reported in bites were "Playing with the animal" (6.7%), "The animal got spooked" (6.0%), and "Breaking up a fight" (5.7%) (**Table 4**). Bite incidents in which the bite was not provoked ("at a community area and animal came up and bit the victim" and "walking on the road") accounted for 5.7% of bites. Almost half (48%) of reported bites did not have an incident type listed.

The most common incident type for reported dog bites was "Playing with the animal" (7.5%). For reported cat bites, the most common incident was "The animal got spooked" (9.1%). Bite incident types for which cat bites occurred more frequently than dog bites included "Performing a medical procedure", "Trying to capture the animal", and "Giving medication to or cleaning a wound on the animal."

4.1.7 Bite Location on Body

Of victim bite locations on the body, 46% were to the upper extremities, 13% were to the lower extremities, 12% were to the face, head, neck, or ear, and 3% were to the trunk (**Figure 5**). About 12% were bitten on multiple regions. About 11% of bites did not have information on bite location.

4.2 Animal Bite Treatment, Allegheny County – 2018

Of all reported bite victims, 1,314 (66.6%) individuals received treatment and 659 (33.4%) received no treatment.

4.2.1 Wound Cleansing

In 2018, 58.3% of reported bite victims were documented as having their wound cleansed (**Table 5**). Of dog bite victims, 62.1% were reported to have their wound cleansed. Of cat bite victims, 47.9% were reported to have their wound cleansed.

4.2.2 Antibiotics

Antibiotics were prescribed to 61.7% of reported bite victims. Antibiotics were prescribed to 62.1% of reported dog bite victims and 64.6% of reported cat bite victims (**Table 5**). Augmentin was the most common antibiotic prescribed, with 50.1% of those prescribed antibiotics taking Augmentin (**Table 6**). Augmentin was prescribed for 50.4% of reported dog bite victims and

48.4% of reported cat bite victims. Other antibiotics prescribed include doxycycline (3.7%), Unasyn (2.6%), and amoxicillin (2.0%). Doxycycline was prescribed for 3.2% of reported dog bite victims and 5.7% of reported cat bite victims. Unasyn was prescribed for 2.4% of reported dog bite victims and 3.5% of reported cat bite victims. Amoxicillin was prescribed for 2.2% of reported dog bite victims and 1.4% of reported cat bite victims. About 33% of victims who were prescribed antibiotics did not have the type specified.

4.2.3 Tetanus Vaccination

A tetanus vaccine was administered to 28.6% of reported animal bite victims. Tetanus vaccines were given to 28.6% of dog bite victims and 28.8% of cat bite victims (**Table 5**).

4.2.4 Rabies PEP

A total of 103 (5.2%) bite victims received rabies PEP (**Table 5**). Rabies PEP was administered to 3.6% of dog bite victims and 6.4% of cat bite victims.

Only three of the 103 individuals received the rabies PEP because they had been exposed to an animal that tested positive for rabies (**Table 7**). Eighty of the 103 bite victims received the vaccine series because they had been exposed to an animal that could not be observed during a quarantine period or tested for rabies. Twenty of the 103 individuals received the rabies PEP for an invalid reason. Invalid reasons could include that these individuals received an improper recommendation to get the rabies PEP, or they chose to get the vaccine series despite the animal being healthy.

4.3 Animal Bite Treatment, Allegheny County – 2015-2018

The percent of victims receiving wound cleansing following an animal bite in 2018 (58.3%) was lower compared to previous years (**Table 5**). In 2016, 70.6% were reported to have their wound cleansed. In 2015, 68.4% were reported to have their wound cleansed. Data were not available for the year 2017.

The percentage of bite victims receiving antibiotic prescriptions was lower in 2017 and 2018 compared to 2015 and 2016. The percentage of antibiotic prescriptions for reported bites are as follows: 74.9% in 2015, 78% in 2016, 60.1% in 2017, and 61.7% in 2018 (**Table 5)**.

Tetanus vaccinations administered to reported bite victims have declined since 2015. Of reported bites, 39% received a tetanus shot in 2015, 38.1% received one in 2016, 31.2% in 2017, and 28.6% in 2018 **(Table 5)**.

Rabies PEP has remained a low percentage of reported bites. The number of reported animal bite victims receiving rabies PEP were 94 (4.9%) in 2015, 119 (6.5%) in 2016, 117 (6.2%) in 2017, and 103 (5.2%) in 2018 **(Table 5)**. The number of victims receiving the rabies PEP because they were exposed to an animal that tested positive for rabies was five (5.3%) in 2015, eight (6.7%) in 2016, four (3.8%) in 2017, and three (2.9%) in 2018 (**Table 7**). The number of victims receiving the rabies PEP because they were exposed to an animal that could not be observed or tested was 67 (71.3%) in 2015, 92 (77.3%) in 2016, 87 (83.7%) in 2017, and 80 (77.7%) in 2018. The number of victims receiving the rabies PEP for an invalid reason was 22 (23.4%) in 2015, 19 (16%) in 2016, 13 (12.5%) in 2017, and 20 (19.4%) in 2018.

5.0 Discussion

In summary, most bites reported to ACHD involved pets, with dogs being the most common species involved. A majority of bite victims received antibiotics as part of treatment for the bite, a third received a tetanus vaccination, and a small percentage received rabies PEP. Apart from a decline in antibiotic prescriptions and tetanus immunizations, treatment for animal bites has remained fairly consistent from 2015-2018.

Pets were the most common type of animal reported in animal bites to ACHD. Dogs encompassed the majority of bites, which is consistent with the literature (Patronek & Slavinski, 2009). No rabid pets were involved in bites reported. Thus, wild animals remain the predominant risk for rabies exposure to humans in Allegheny County. Bites by month followed trends exhibited in 2017, 2016, and 2015, with bites peaking in the summer months during warmer weather (Seresin et al., 2017; Short et al., 2018). However, in 2018, bites in months January and December did not follow this trend. This may be the result of people spending more time at home or visiting friends/relatives where there are pets during the holidays.

In contrast to what is presented in the literature, young adults had the highest rates of bites compared to children for Allegheny County in 2018 (Holzer et al., 2019; Quirk, 2012; Weiss, Friedman, & Coben, 1998). Among children, males had higher rates compared to females, which is consistent with the literature (Holzer et al., 2019; Quirk, 2012). However, adult females exhibited higher rates of bites compared to adult males, which is not consistent with the literature (Holzer et al., 2019) (Sinclair & Zhou, 1995). Despite these results not being consistent with the literature, perhaps adult females had higher rates of reported bites compared to males due to greater care-seeking behavior in this population.

Cat bite wounds are considered to be higher risk wounds than dog bite wounds, and thus cat bite victims should be prescribed antibiotics more often (Ellis & Ellis, 2014). Yet the percentage of cat bite victims receiving antibiotics, however, was similar to that of dog bite victims, with cat bite victims receiving antibiotics about 65% of the time and dog bite victims receiving antibiotics about 62% of the time in 2018. Because cat bite wounds, especially to the hand and wrist, are one of the high-risk criteria that suggest antibiotic prophylaxis (Looke & Dendle, 2015; Morgan, 2005), cat bite victims should be receiving antibiotics much more often than dog bite victims; yet this was not seen in the 2018 animal bite data. In comparison to antibiotics, the percentage of cat bite victims receiving rabies PEP in 2018 was roughly double that of dog bite victims. Another study similarly found cat bite victims received rabies PEP more often than dog bite victims (Moore et al., 2000). In contrast, a study estimating the national use of rabies PEP estimated that about 16.5% of all rabies PEP usage involved exposure to a cat, while 33% of all rabies PEP usage involved exposure to a dog. However, this data was gathered based on only 12 health department respondents of 53 contacted (Christian, Blanton, Auslander, & Rupprecht, 2009).

Treatment for reported animal bite victims has remained fairly consistent over the years, although there was a decline in tetanus vaccinations and antibiotic prescriptions from 2015 to 2018. From 2015 to 2018, tetanus vaccinations declined by 17.6% and antibiotic prescriptions declined by 26.7%. Antibiotic prescriptions could have declined due to the acceptance that research on the effectiveness of prophylactic antibiotics for infection from animal bites is equivocal. Perhaps tetanus vaccinations declined due to increased use of the Pennsylvania Statewide Immunization Information System (PA-SIIS) to identify individuals that need the vaccine. In Pennsylvania, if the tetanus immunization status of a bite victim is not known, PA-SIIS can be used to determine

previous tetanus vaccinations. PA-SIIS is managed by the Pennsylvania Department of Health and provides a registry of immunizations for people in the state. This system allows providers to check the vaccine history of a patient, facilitating an appropriate treatment decision (Pennsylvania Department of Health, 2019b). Medical staff should consult PA-SIIS before vaccinating the victim prophylactically for tetanus if the vaccination status of the victim is unknown.

The percentage of victims reported as receiving cleansing for their wound was different than in previous years, with fewer victims having their wound cleansed in 2018 compared to 2016 and 2015. It seems unlikely that only 58% received wound cleansing in 2018, compared to about 71% and 68% in 2016 and 2015, respectively. Perhaps this was not reported as often as antibiotic prescriptions, tetanus vaccinations, or rabies PEP as wound cleansing is very standard of care (Ellis & Ellis, 2014). The reasons for administering rabies PEP over the years are somewhat variable, although being exposed to an animal that could not be observed or tested is always the most common reason and being exposed to an animal that tested positive for rabies is always the least common.

Despite conflicting research on the effectiveness of prophylactic treatment for infection with antibiotics, physicians should continue to prescribe antibiotics as indicated. Antibiotics should be considered for high risk wounds such as puncture wounds, crush wounds involving devitalized tissue, cat bite wounds to the hand and wrist, other hand bite wounds, and after primary closure of the wound (Looke & Dendle, 2015; Morgan, 2005). Antibiotics should also be considered for patients with various underlying conditions such as diabetes mellitus, mastectomy, prosthetic joints, splenectomy, cirrhosis, asplenia, and immunosuppression, as these conditions put individuals at increased risk for infection (Morgan, 2005). There is no strong evidence that antibiotics confer protection against infection for low-risk bite wounds, so antibiotic prophylaxis

should generally not be given (Looke & Dendle, 2015). Because animal bite infections are polymicrobial, Augmentin should be prescribed as it provides protection against many aerobic and anaerobic bacteria isolated from bites (Morgan, 2005). Augmentin was prescribed to about 50% of bite victims who were prescribed antibiotics in 2018.

Rabies PEP should be administered to bite victims if they are exposed to an animal that tested positive for rabies, if they were exposed to an animal that could not be observed during a quarantine period, or if they were exposed to an animal that could not be tested for rabies. Other reasons for receiving rabies PEP are invalid (Short et al., 2018). The victim may have received an improper recommendation by a healthcare provider or government official to receive the rabies PEP, or the victim may have chosen to get the vaccine series despite the animal being healthy after a quarantine period or negative by a rabies test.

Due to how deadly the rabies virus is (Ellis & Ellis, 2014), it is imperative all individuals exposed to a rabid animal receive the rabies PEP. In 2018, all three individuals who were exposed to an animal that tested positive for rabies received the rabies PEP. It is crucial individuals follow the protocol so that death can be avoided. Additionally, prophylactic tetanus vaccination is important, as tetanus can cause a great deal of morbidity and mortality (Kretsinger et al., 2006). Of course, with the current anti-vaccination movement, there may be individuals who are vaccine-hesitant or who refuse to get the vaccines necessary for prophylactic treatment for animal bites. Because individuals exposed to rabies, and most likely tetanus, will die if they do not get the necessary vaccines, anti-vaccination beliefs may not be a future issue in the treatment of animal bites.

The number of people receiving rabies PEP for an invalid reason should be as low as possible to decrease unnecessary medical treatment and to save money. Rabies PEP, as mentioned

previously, is very expensive, costing between $1,200 and $6,500 per person (an average of $3,800) (CDC, 2019). In 2018, 20 victims chose to get the vaccine series for an invalid reason. This indicated that in Allegheny County in 2018, an unnecessary $76,000 was spent on rabies PEP. Apart from the year 2016, about 20 victims chose to get the rabies PEP for an invalid reason each year since 2015. This somewhat consistent trend needs to be interrupted to decrease unneeded treatment and cost.

Various strategies should be employed to continue to treat animal bites appropriately. Health department employees, as well as medical care providers, should remain current on the proper recommendations for rabies PEP. Training should also be provided on how to educate bite victims on rabies PEP. Pamphlets written for a lay audience could be provided to victims when they receive treatment for bites to educate them on proper treatment to avoid unnecessary steps.

Additionally, people receiving rabies PEP because the animal could not be observed or tested should be minimized. Rabies PEP was administered nearly 80% of the time because the victim was exposed to an animal that could not be observed or tested for rabies. There are circumstances where it is not possible to find the animal involved in the bite, such as if the animal is wild, a stray, or a pet whose owner cannot be located or contacted. Medical care providers and health department staff, however, should encourage victims to look for the biting animal if it is a pet to avoid unnecessary treatment, especially if the biting animal is a dog. A dog has not tested positive for rabies at the ACHD lab since 2011, and before that since 2001 (S. Gibbs, personal communication, September 30, 2019), so it is unlikely victims bitten by dogs are at risk for rabies in Allegheny County, PA. Rabies PEP does not need to be administered immediately for dogs and cats that appear healthy and can be observed (CDC, 2019). It is important to take time to locate the animal if it is a pet to decrease unnecessary treatment and cost in the event the animal is healthy.

There are some limitations to this study. First, there were missing data for some fields, as about 33% of antibiotics prescribed and about 48% of the bite incident types were not specified for the year 2018. Second, these data represent bite victims who seek treatment. As mentioned previously, animal bites are under-reported (Patronek & Slavinski, 2009). It is likely the bites analyzed here are only a fraction of the actual number of bites that occurred in Allegheny County in 2018. Because hospitals are required to report animal bites by law (Pennsylvania Department of Health, 2019a), the data here largely consists of reports of victims who received treatment. Because animal bites are under-reported here, one must keep in mind that the true percentage of victims that receive treatment for animal bites is actually much lower than the estimates reported here. Nonetheless, a relatively consistent number of bites are reported each year, so this analysis still provides a good indication of how treatment may be changing, which is a strength of this work. Another strength is that for the first time, treatment for animal bites by year for Allegheny County was analyzed. Previous recent reports only examined the treatment received for that year.

In conclusion, treatment for reported bite victims in 2018 was similar to previous years, except for a marked decline in antibiotic prescriptions and tetanus vaccinations. Medical staff should continue to follow animal bite protocols and treat patients as necessary. The Allegheny County Health Department should continue to quarantine animals and make proper rabies PEP recommendations to avoid unnecessary treatment and mitigate the spread of rabies. Animal bites remain an important public health problem that can result in infection; animal bite protocols should continue to be followed to ensure adequate treatment to victims and decrease unnecessary treatment.

Appendix A Tables

Table 1: Species involved in reported bites – Allegheny County, PA – 2018

Species	N (%)
Dog	1477 (74.9)
Pet	1264 (64.1)
Stray	23 (1.2)
Unknown/Missing	190 (9.6)
Cat	438 (22.2)
Pet	297 (15.1)
Stray/Feral	82 (4.2)
Unknown/Missing	59 (3.0)
Bat	14 (0.7)
Raccoon	8 (0.4)
Groundhog	5 (0.3)
Squirrel	5 (0.3)
Rat	5 (0.3)
Mouse	3 (0.2)
Vole	2 (0.1)
Rabbit	2 (0.1)
Skunk	1 (<0.1)
Chipmunk	1 (<0.1)
Hamster	1 (<0.1)
Muskrat	1 (<0.1)
Horse	1 (<0.1)
Pig	1 (<0.1)
Fox	1 (<0.1)
Primate	1 (<0.1)
Unknown	1 (<0.1)
Missing	5 (0.3)
Total	1973 (100)

Table 2: Number of animals tested for rabies in ACHD laboratory and number positive – Allegheny County, PA – 2018

	Number Tested for Rabies in ACHD Lab N	Number Positive n (%)	
Cat	144	2	(1.4)
Bat	143	9	(6.3)
Raccoon	133	12	(9.0)
Dog	107	0	
Groundhog	55	1	(1.8)
Squirrel	8	0	
Fox	8	1	(12.5)
Skunk	6	0	
Chipmunk	2	0	
Rat	2	0	
Rabbit	1	0	
Mouse	1	0	
Possum	1	0	
Vole	1	0	
Total	612	25	(4.1)

Table 3: Number of animals tested for rabies in bite reports and number positive – Allegheny County, PA – 2018

	Number Known to Be Tested for Rabies N	Number Positive n (%)
Dog	38	0
Pet	30	0
Stray	1	0
Missing	7	0
Cat	24	1 (4.2)
Pet	14	0
Stray/Feral	7	1 (14.3)
Unknown/Missing	3	0
Bat	4	1 (25.0)
Fox	1	1 (100.0)
Squirrel	1	0
Groundhog	1	0
Vole	1	0
Total	70	3 (4.3)

Table 4: Type of incident for reported bites – Allegheny County, PA – 2018

Incident Type	All (N=1973) n (%)		Dog (N=1477) n (%)		Cat (N=438) n (%)	
Playing with the animal	132	(6.7)	111	(7.5)	20	(4.6)
The animal got spooked	119	(6.0)	78	(5.3)	40	(9.1)
Breaking up a fight	113	(5.7)	103	(7.0)	9	(2.1)
Trying to pet the animal	76	(3.9)	53	(3.6)	22	(5.0)
At a community area and animal came up and bit the victim	68	(3.4)	65	(4.4)	2	(0.5)
Performing a medical procedure	50	(2.5)	21	(1.4)	28	(6.4)
Walking on the road	44	(2.2)	42	(2.8)	2	(0.5)
Trying to capture the animal	36	(1.8)	14	(1.0)	21	(4.8)
Entering the owner's house	32	(1.6)	30	(2.0)	2	(0.5)
Trying to feed the animal	26	(1.3)	20	(1.4)	5	(1.1)
Bathing/Grooming the animal	24	(1.2)	13	(0.9)	11	(2.5)
Taking something from the animal	19	(1.0)	19	(1.3)	0	(0)
Trying to put the animal in a crate	17	(0.9)	9	(0.6)	8	(1.8)
Walking into the owner's yard	16	(0.8)	16	(1.1)	0	(0)
Delivering the mail	14	(0.7)	14	(0.9)	0	(0)
Touching a wound or painful spot on the animal	12	(0.6)	10	(0.7)	2	(0.5)
Bitten by a bat	9	(0.5)	N/A		N/A	
Giving medication to or cleaning a wound on the animal	9	(0.5)	3	(0.2)	6	(1.4)
Greeting a new animal	9	(0.5)	7	(0.5)	2	(0.5)
Bitten by a wild animal	6	(0.3)		N/A	1	(0.2)
Yelling at or hitting the animal	6	(0.3)	6	(0.4)	0	(0)
Checking the animal for a collar and tags	4	(0.2)	4	(0.3)	0	(0)
Repairing/Installing an item on the owner's property	2	(0.1)	2	(0.1)	0	(0)
Waking up in a room with a bat	2	(0.1)	N/A		N/A	
Worker from phone/cable company that is on or near the owner's property	2	(0.1)	2	(0.1)	0	(0)
Other	178	(9.0)	135	(9.1)	38	(8.7)
Missing	948	(48.0)	700	(47.4)	219	(50.0)
Total	1973	(100)	1477	(100)	438	(100)

Table 5: Treatment type for reported bites – Allegheny County, PA – 2015 - 2018

Treatment Type	2018 Bites (N=1973) n (%)		2017 Bites (N=1883) n (%)		2016 Bites (N=1835) n (%)		2015 Bites (N=1901) n (%)	
Antibiotic	1218	(61.7)	1188	(60.1)	1432	(78.0)	1423	(74.9)
Wound Cleansed	1151	(58.3)	-	-	1295	(70.6)	1301	(68.4)
Tetanus Vaccine	565	(28.6)	588	(31.2)	699	(38.1)	741	(39.0)
Rabies PEP	103	(5.2)	117	(6.2)	119	(6.5)	94	(4.9)
Other Treatment	74	(3.8)	-	-	74	(4.0)	67	(3.5)
No Treatment	659	(33.4)	559	(29.7)	195	(10.6)	257	(13.5)

Table 6: Antibiotic type prescribed for reported bites – Allegheny County, PA – 2018

Antibiotic	All Bites (N=1218) n (%)		Dog Bites (N=917) n (%)		Cat Bites (N=283) n (%)	
Augmentin	610	(50.1)	462	(50.4)	137	(48.4)
Doxycycline	45	(3.7)	29	(3.2)	16	(5.7)
Unasyn	32	(2.6)	22	(2.4)	10	(3.5)
Amoxicillin	24	(2.0)	20	(2.2)	4	(1.4)
Clindamycin	11	(0.9)	9	(1.0)	2	(0.7)
Keflex	6	(0.5)	7	(0.8)	3	(1.1)
Bactrim	5	(0.4)	3	(0.3)	2	(0.7)
Topical Only	10	(0.8)	9	(1.0)	1	(0.4)
Other	15	(1.2)	5	(0.5)	5	(1.8)
Multiple	62	(5.1)	43	(4.7)	17	(6.0)
Not Specified	398	(32.7)	308	(33.6)	86	(30.4)

Note: categories in the table are mutually exclusive

Table 7: Reason for rabies PEP administration – Allegheny County, PA – 2015 - 2018

Reason	2018 N=103		2017 N=104		2016 N=119		2015 N=94	
	n	%	n	%	n	%	n	%
Exposed to an animal that had rabies	3	(2.9)	4	(3.8)	8	(6.7)	5	(5.3)
Exposed to an animal that could not be observed or tested	80	(77.7)	87	(83.7)	92	(77.3)	67	(71.3)
Invalid Reason	20	(19.4)	13	(12.5)	19	(16.0)	22	(23.4)

Appendix B Figures

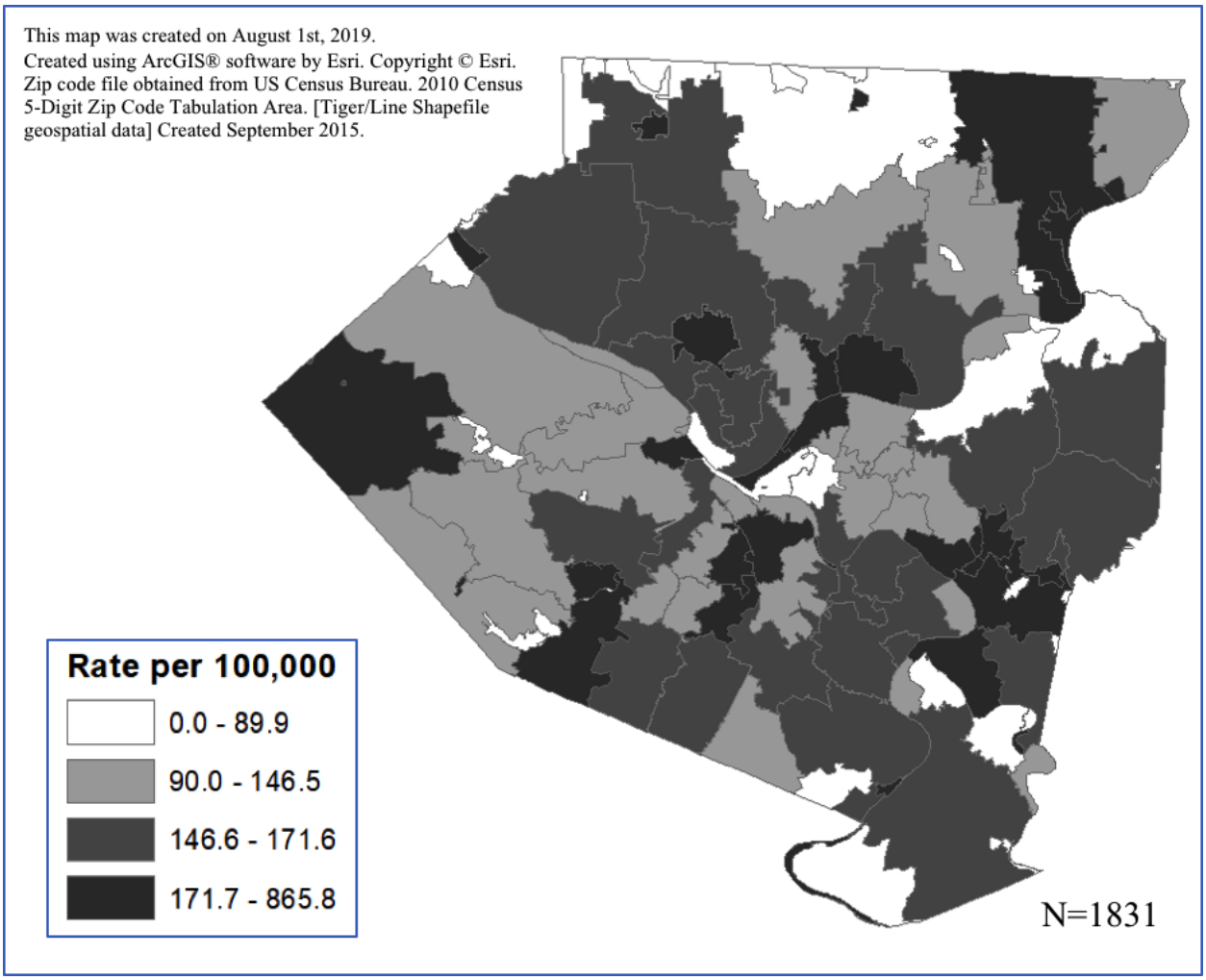

Figure 1: Reported bite incidence rates per 100,000 population by victim zip code – Allegheny County, PA – 2018

Bite incidence rates per 100,000 population are shown by victim zip code on a map of Allegheny County for bites reported to the Allegheny County Health Department in 2018. Bite incidence rates were calculated based on total bites reported by zip code of victim's residence and the total population in each zip code from the 2010 U.S. Census. The zip code of the victim's residence was available for 1952 (98.9%) of the reported bites. Here 1831 of these zip codes can be visualized on this map. Bite rates for zip codes not entirely within Allegheny County may be an under-estimation.

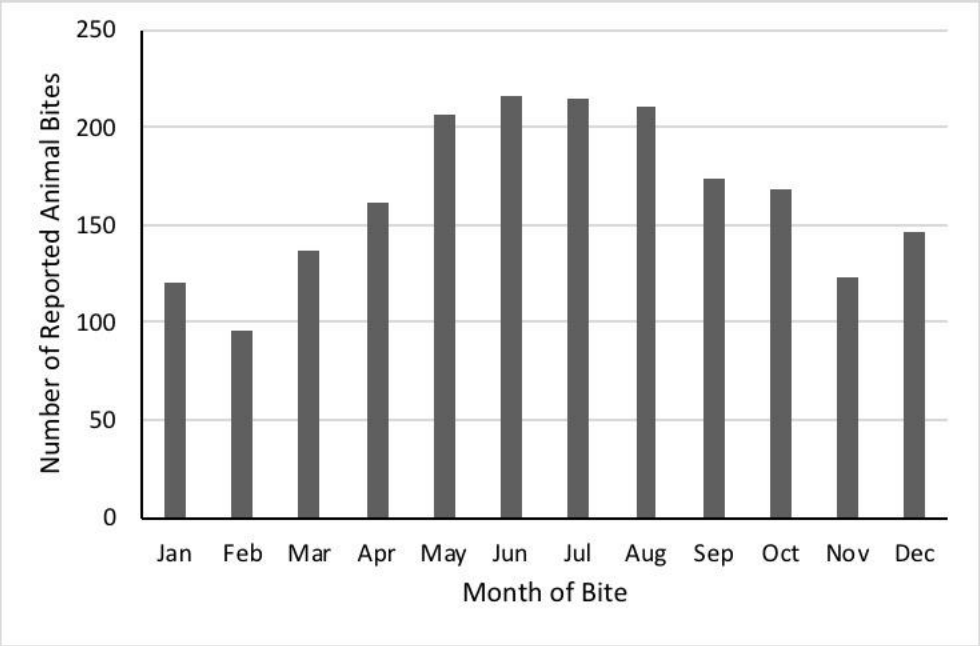

Figure 2: Reported bites by month – Allegheny County, PA – 2018

Reported bites are shown by month for bites reported to the Allegheny County Health Department in 2018.

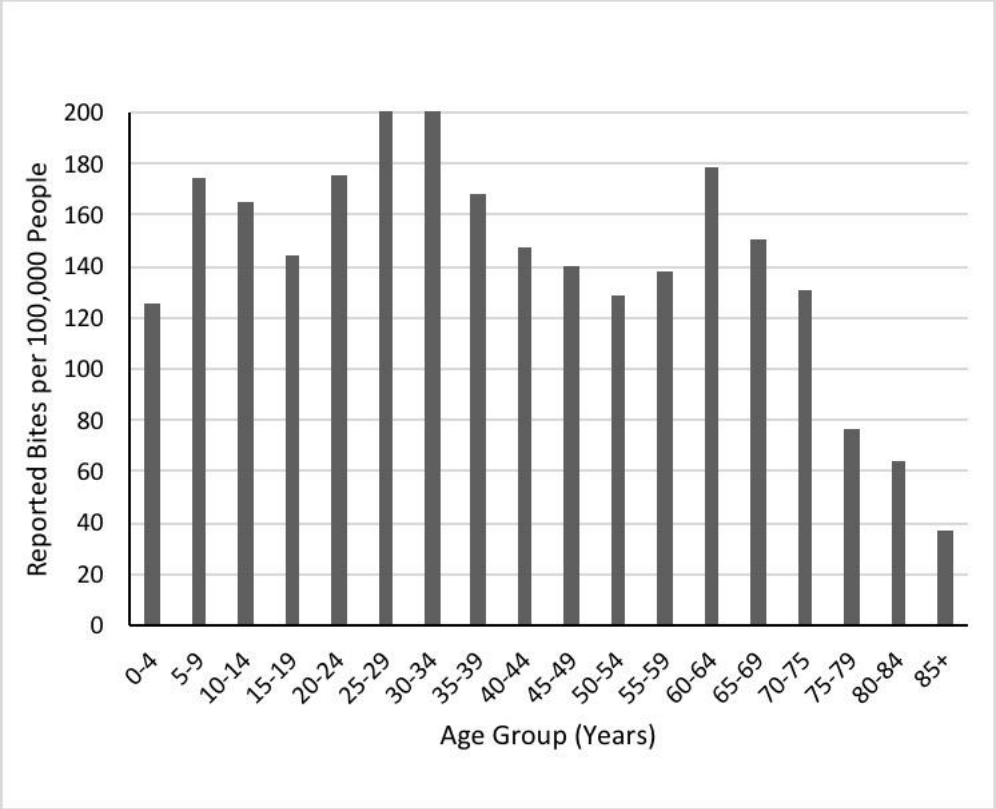

Figure 3: Reported bite incidence rates per 100,000 population by age group – Allegheny County, PA – 2018

Bite incidence rates per 100,000 population are shown by age group for bites reported to the Allegheny County Health Department in 2018. Bite incidence rates were calculated based on total bites reported in each age group and the total population in each age group from American Fact Finder (2018) with the U.S. Census.

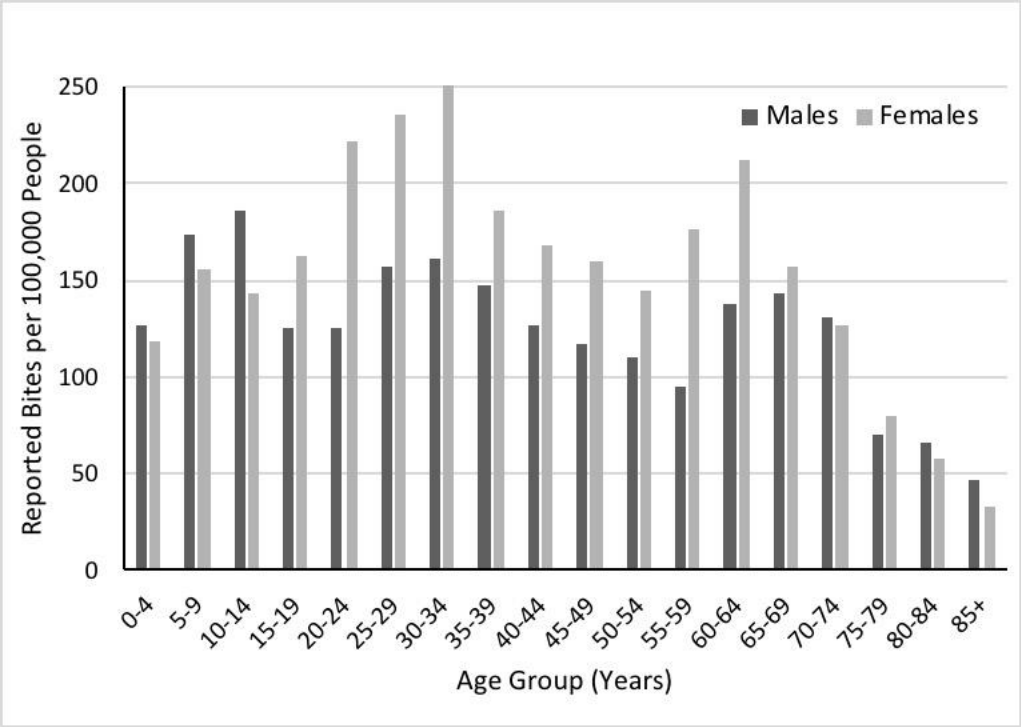

Figure 4: Reported bite incidence rates per 100,000 population by age group and sex – Allegheny County, PA – 2018

Bite incidence rates per 100,000 population are shown by age group and sex for bites reported to the Allegheny County Health Department in 2018. Bite incidence rates were calculated based on total bites reported in each age group by sex and the total population in each age group by sex from American Fact Finder (2018) with the U.S. Census.

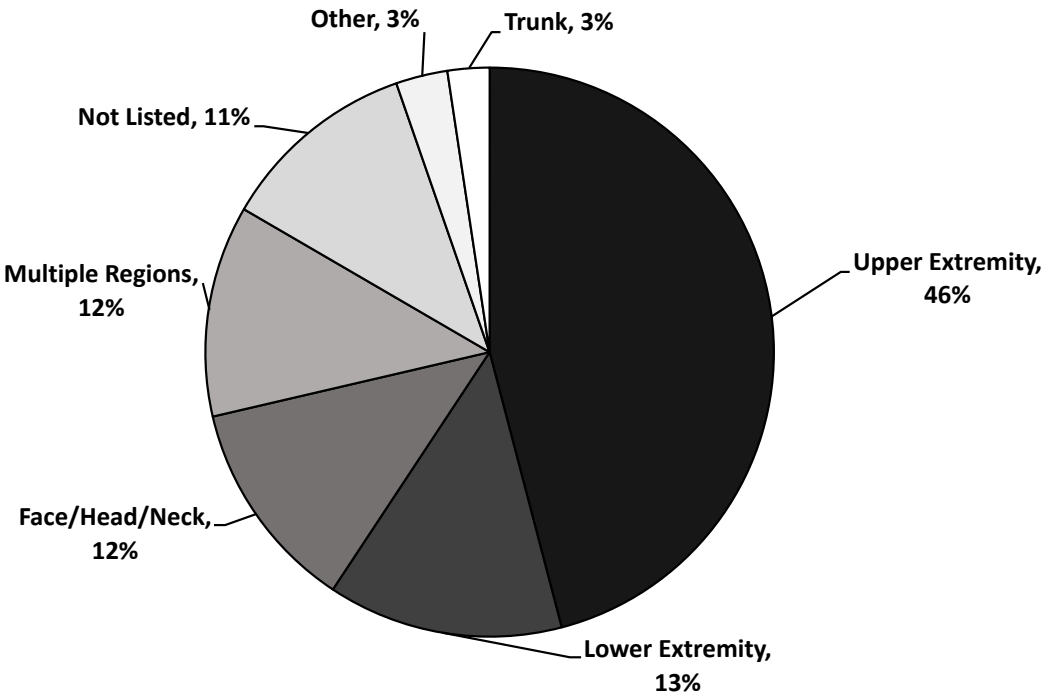

Figure 5: Location on body of reported bites – Allegheny County, PA – 2018

The location on the body of the bites reported to the Allegheny County Health Department in 2018 is shown. Upper extremities include shoulders, arms, wrists, fingers, and hands. Lower extremities include legs, hips, feet, ankles, and toes. Face/head/neck includes the face, head, and neck, but also the ears. The buttocks, abdomen, chest, and back make up the trunk. If a bite location did not fit in any of these categories, the location was described as "Other." Multiple locations was defined as greater than one location on the body.

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