

AN ABSTRACT OF THE THESIS OF

Holly R. Sherburne for the degree of Master of Science in Environmental Health Management presented on October 23, 1995. Title: A Bite Out of the Budget? Costs and Characteristics of Animal Bites in Benton County, Oregon.

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In 1993 and 1994 total, there were 247 people reported to have been bitten by animals in Benton County, Oregon. Of the 243 biting animals, 70 percent were dogs, 25 percent cats, and 5 percent other animals such as ferrets, mice, rats, bats, and skunks. Fifty-four percent of all bites occurred in Corvallis, a district of Benton County that contains 62 percent of Benton County's population. Over 50 percent of the animal bites were reported to the Benton County Health Department by local medical centers treating the wounds and by the local police department. Of the 247 animal bites investigated, 79 percent of the animals were quarantined. The average time for a health department official to investigate a bite was estimated to be 0.52 hours/bite and the average cost was \$39/bite. The average cost of investigating animal bites was estimated to be \$4789 per year (1.2 percent of the Environmental Health Division's total direct expenditures).

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**A Bite Out of the Budget? Costs and Characteristics
of Animal Bites in Benton County, Oregon.**

by

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/ / Holly R. Sherburne, Author

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A Bite Out of the Budget? Costs and Characteristics of Animal Bites in Benton County, Oregon.

1 INTRODUCTION

Animal bites are an important but often overlooked public health issue. Each year in Benton County, between 100 and 150 people report being bitten by animals susceptible to rabies. These animals include, but are not limited to: cats, dogs, bats, foxes, raccoons, ferrets, and skunks. All occurrences in Oregon are reported by law to the county health department for a rabies investigation (1). Rabies is the primary health concern of animal bites since the virus can be transmitted in the saliva of an infected animal. Rabies fatalities continue to occur in the United States today due to animal bites (2-12). Other health problems include bacterial infections, disfigurement, scarring, and emotional stress.

Previous studies in Benton County have shown that approximately 66 percent of animal bites are from dogs, 25 percent from cats, 6 percent from other domestic animals, and less than 3 percent from wild animals (Benton County Health Department). These statistics are comparable with those from other studies of animal bite characteristics (13-19). All dogs in Benton County are required to be licensed and vaccinated against rabies; this law, however, is difficult to enforce. Vaccinations for cats and other domestic outdoor animals, such as horses, are highly recommended but unenforceable, and it is not possible in most cases to vaccinate wild animals. Therefore, when a bite from a rabies susceptible animal occurs, it must be reported to the county health department for a rabies investigation (1).

Animal bites may be reported to the county health department from several different sources. These sources may include: the victim, the animal owner, the city police, the county animal control officer, or the medical center where treatment occurred. A standard animal bite report is filled out and information about the victim, the attack, and the animal is recorded. In all cases of bites by domestic animals, whether the animal was immunized against rabies or not, the animal must be observed (quarantined) for 10 days

following the bite. There is an exception if the incident was an unprovoked bite to the face by an unvaccinated animal. In this case, the animal may be destroyed and its head submitted for testing. Home quarantine usually occurs if the animal was immunized and the bite was provoked; in other cases, the humane society or veterinarian's office may quarantine the animal. Important considerations for evaluating a bite include the type of animal (wild or domestic), the nature of the bite (provoked or unprovoked) and whether or not it displayed symptoms typical of rabies, such as: aggressive behavior; irritability; or frothing at the mouth.

Numerous studies have been done that examine the animal, bite, attack and victim characteristics of animal bites (13-26). However few, if any, studies have examined the impact of animal bites on the local health department's resources. The health department is responsible for coordinating and following through the investigation until it has been determined that the victim is not in danger of contracting rabies. Other parties potentially involved in an animal bite case include the victim who may need to seek treatment, the animal owner who may have to quarantine the animal, and various agencies which are required to report the bite incident to the health department.

The objective of this study was to examine the impact of animal bites in Benton County, and specifically, to estimate time spent and costs incurred by the county health department. Animal bite information recorded for the years 1993 and 1994 was obtained and the following factors were examined: the time spent by county health department officials to investigate bite incidences and subsequent costs; the characteristics of animal bites in Benton County including victim, attack, bite, animal, and investigation characteristics; and the animal bite rate of Benton County.

It was hypothesized, a priori, that a substantial amount of time and money is spent investigating animal bites - an occurrence that is largely preventable. In addition, many parties in a community are ultimately involved by contributing services and time to the reporting and investigation. The goal of this study was to bring new insight into this common yet often overlooked health problem in a community and specifically to examine its time and monetary impact on the local health department.

2 REVIEW OF LITERATURE

2.1 ANIMAL BITE REPORTING

In Oregon, all animal to human bites must be reported, by law, to the local health department if the wound was inflicted by an animal susceptible to rabies (1). Contraction of rabies from an animal bite is the main concern of the health department and thus the reason for reporting. There are five categories of animal bites with varying degrees of risk for transmission of rabies: 1) animals highly susceptible to infection - major transmitters of rabies, 2) animals susceptible to infection - but do not commonly transmit rabies, 3) animals susceptible to infection - but unlikely to transmit rabies, 4) animals resistant to infection that rarely transmit rabies, and 5) animals not susceptible to infection - unable to transmit rabies (27).

Since rabies transmission is the ultimate concern, 'rabies susceptible animals' have been defined as mammals which include, but are not limited to bats, cats, dogs, cows, horses, coyotes, foxes, raccoons, and skunks (28). These animals comprise categories #1 and #2 listed above. Other animals which are susceptible to infection but do not commonly transmit rabies are badgers, wildcats, wolves, large domestic animals (sheep, pigs, etc.) and large wild animals (deer, elk, antelope, etc.). Properly administered rabies vaccine in dogs and cats is judged to be 98 percent effective; therefore, the risk of rabies transmission is greatly reduced in these vaccinated animals (27). When an animal bite occurs from a unvaccinated animal, the circumstances surrounding the incident must be carefully evaluated to determine risk of rabies infection or transmission. Factors to take into consideration include the health of the animal, the location of the bite and whether or not the bite was provoked.

2.2 RABIES

Rabies, meaning “rage” or “madness” in Latin, is an acute viral disease of the central nervous system. It has been present for centuries and is typically depicted as a disease whose victims display crazy behavior with a fear of water (hydrophobia) and a frothing at the mouth.

Human rabies infection usually results from a bite by a rabid animal. Contamination of an open wound or mucous membrane by infected saliva could introduce enough virus to cause an infection, however, virtually all patients with rabies who recall contact with an animal report that they were bitten (29, 30). In fact, “[c]ases of rabies after scratches, abrasions, or the licking of open wounds or mucous membranes are extremely rare”(31, 32, 33) and the risk of contracting rabies after a bite by a rabid animal is 50 times higher than the risk from scratches (31, 34). Rabies infection also has been documented to occur from inhalation of heavy infected materials such as bat droppings in caves, although this method of transmission is rare (33, 35).

The rabies virus is a bullet-shaped, enveloped, single-stranded RNA virus of the rhabdovirus group. The virus replicates in the local striated muscle of the wound and then enters the peripheral nervous system and spreads up the nerves to the central nervous system. Here, the virus replicates further in the gray matter of the brain and then spreads to other tissues of the body such as the salivary glands, adrenal medulla, kidneys, and lungs. Transmission into the saliva helps to ensure further transmission of the virus (36).

Rabies begins with encephalitis and subsequent hallucinations, combativeness, muscle spasms and seizures. Because the brain stem is infected, double vision, facial palsies, and difficulty in swallowing results. Excess saliva production with swallowing difficulty causes the traditional “foaming at the mouth.” Hydrophobia, or fear of water, occurs due to involuntary contractions of the diaphragm and other respiratory muscles. Respiratory paralysis tends to be the major cause of death (36).

An early, definitive diagnosis of a rabies infection is difficult since the initial neurological symptoms are typical of other viral diseases of the nervous system. Therefore, unless the patient reports being recently bitten by an animal susceptible to

rabies and likely to be infected, rabies may only be a possibility of several types of infections. To positively determine that a rabies infection has occurred, brain tissue must be examined for Negri bodies, or eosinophilic cytoplasmic inclusions. However, Negri bodies are not seen in at least 20 percent of rabies victims so their absence cannot rule out a diagnosis of rabies (36).

After onset of rabies symptoms, the median survival rate is 4 days. Recovery is rare and has only been seen in partially immunized individuals. The rabies virus can incubate in the body from 10 days to 1 year depending on the amount of virus introduced, the amount of tissue involved, host immune mechanisms, and the distance the virus must travel from the site of inoculation to the central nervous system. Therefore, a bite to the neck or face from a rabid animal is more critical than a bite to the leg. If an immunization is given early in the incubation period, it will usually prevent a rabies infection (36).

2.3 BENTON COUNTY HEALTH DEPARTMENT REGULATIONS

The Environmental Health Division at the Benton County Health Department is responsible for coordination of the investigation after the initial report is received. For every animal bite that occurs, an animal bite report is filled out which contains information on the victim, the bite, body location of occurrence, animal and attack incident (Appendix A). Exposure to possible rabies infection must be evaluated in each bite case. Two categories of exposure should be considered: bite - any penetration of the skin by teeth; and nonbite - scratches, abrasions, open wounds, or mucous membranes contaminated with saliva or other potentially infectious brain tissue from a rabid animal (37). "Casual contact only such as petting a rabid animal does not constitute exposure and is not an indication for prophylaxis" (37).

In all cases of bites by domestic animals, whether immunized against rabies or not, the animal must be observed for 10 days following the bite (quarantine). The only exception to this rule occurs when an unvaccinated animal has inflicted a severe or

unprovoked bite to the face, head, or neck of an individual and/or the animal appears ill or unusually aggressive. In this case, the Oregon State Health Division's veterinarian should be consulted for possible immediate euthanasia and testing (27).

The animal owner is responsible for either quarantining the animal or paying the boarding fee if it is necessary that the observation take place at a humane society or with a veterinarian. Animals with proof of rabies vaccination are normally quarantined at home. Stray animals may be quarantined at a humane society and, in some cases, the health department may assist with the cost.

During the 10 day observation period, several rules apply. The animal must not be killed nor disposed of nor should it receive a rabies vaccine (1). It must not be allowed to contact other animals or people, nor can it be removed from the premises of quarantine without authorization from a health official. If the animal becomes ill, dies, or exhibits unusual behavior during the quarantine period, the Environmental Health Division must be notified immediately. At the end of the quarantine period, the animal must be observed to be healthy before it may be released or euthanized (27). The quarantine policy is intended to minimize the considerable taxpayer expense of rabies testing at the State Public Health Laboratory (38).

When a rabies-susceptible wild animal bites a human in an unprovoked incident, the animal will be considered potentially rabid. If it can be captured, the animal will be euthanized and the head submitted for testing to the Oregon State Health Division.

Before post-exposure prophylaxis is administered to a human, several factors must be taken into consideration: the species and type of animal involved; whether exposure sufficient to transmit rabies virus occurred; and the current disposition of the animal (39). In the event of a bite by a low-risk animal such as a domestic dog, cat or farm animal, prophylaxis treatment is recommended under the following circumstances: the animal has been tested positive for rabies infection; or, the animal exhibited abnormal behavior and the attack was unprovoked and the animal is not available for observation or testing. For wild animal bites, post-exposure prophylaxis is recommended for wild carnivore and bat bites when the animal cannot be captured. It should be taken into consideration whether

or not rabies is endemic in the wild animal population in that area. Prophylaxis treatment is not administered if the animal is captured and tests negative for rabies (39).

2.4 RECENT HISTORY OF RABIES IN OREGON AND U.S.

Prior to the 1940s and 1950s, canine rabies was endemic in the United States. There were about 0.2 cases per million of human rabies reported per year (50 cases/year), mostly from dog bites (29, 31). Later, as canine rabies was brought under control, the number of human rabies cases also decreased to an average of less than two per year in the 1960's and 1970's (29, 30). Canine rabies in the United States today is not a serious public health threat, and human rabies acquired from dogs has largely originated from cases in developing countries where canine rabies is still endemic.

From 1980 to 1994, there were 21 cases of human rabies reported in the United States. Eleven of these cases were acquired inside of the U.S. and nine of these attributed to a bat-associated virus. Bat rabies is enzootic in the U.S. and has been reported in the 48 continental states (10). The most recently reported case of bat-associated rabies occurred in Lewis County, Washington in March 1995 when 4-year-old girl died nearly one month after a bat was found in her bedroom (12). The bat was subsequently determined to have a rabies virus variant associated with small bats in the Western United States. In 1992 alone, 647 rabies-positive bats were reported from 46 states (9). However, because reduction of bat populations is neither feasible nor desirable as a means of controlling rabies, the Center for Disease Control (CDC) recommends, "the exclusion of bats from human dwellings to minimize direct contact with humans and companion animals" (10).

In Oregon, the last case of human rabies occurred in 1989 in a migrant farm worker from Mexico. The specific source and site of the infection were unknown but antigenic typing of the virus was performed which helped to determine the geographic source of the infection. This monoclonal antibody testing by the CDC determined that the

antigenic pattern of the virus was the one found in areas of Latin America with enzootic canine rabies and in areas of California with enzootic skunk rabies (2). Therefore, it is likely the migrant worker contracted rabies in Mexico. Only two other cases of human rabies have occurred in Oregon since 1960.

In 1994, a bat-rabies case was diagnosed in Benton County after a bat bit a human. Post-exposure prophylaxis was given immediately thereby preventing a human rabies infection. Between 1980 and 1992, 10 laboratory-diagnosed rabies in bats were found in Benton County, the last having occurred in 1989. Rabies cases in animals other than bats in Oregon have been rare. The last case of cat rabies occurred in 1991 and prior to that, in 1984. The last case of dog rabies also occurred in 1991 but from an unvaccinated dog taken to Mexico and later returned to the state. Other recent cases of rabies in animals in Oregon include fox rabies cases in 1991 and 1981 and skunk rabies in 1979.

2.5 ANIMAL BITE CHARACTERISTICS

Many studies have been done in the United States to examine the rates and characteristics of animal bites. By understanding the circumstances under which animal bites occur, it is hoped that bites can be prevented, as well as any related trauma and morbidity. Prevention of animal bites also would reduce the time and money spent by health departments on follow-up rabies investigations. The following studies illustrate the numerous characteristics that have been learned about animal bites in the United States.

Bites come from domestic and wild animals alike. "Although human rabies cases resulting from exposure to rabid animals within the United States are now predominantly of wildlife origin, the administration of post exposure prophylaxis (PEP) to human beings is currently more likely to be a result of exposure to a rabid or potentially rabid domestic pet" (39). In the United States, the most reported types of animal bites come from dogs, and secondly, cats.

In Indiana, for the years 1991 and 1992, 78 percent of reported bites were dog bites and 16 percent cat bites (18). The remaining 6 percent of bites came from miscellaneous animals such as wild and pet rodents, raccoons, bats, foxes, skunks, and farm animals. In 1971, the Center for Disease Control conducted a nationwide animal bite study involving 20 states and found similar results. Of all the persons bitten, 84 percent were bitten by dogs, 10 percent by cats, 4 percent by rodents, and less than 1 percent by foxes and skunks, and 2 percent by other animals (16). Another study examining characteristics of animal bite incidents at two Air Force bases found that 76 percent of bites were inflicted by dogs, 19 percent by cats, and the remaining 5 percent by various pet and wild rodents (14). These animal bite studies, conducted over a span of 20 years, show a consensus of the type and frequency of biting animal.

Additional characteristics typically examined in animal bite studies include the victim, attack, and bite characteristics. Victim characteristics include age and gender. Several studies involving dog bite characteristics have found that males tend to be bitten at a higher rate than females (13, 21, 23-26). In contrast, a study examining cat bites in Dallas, Texas, found that the majority of the victims were female (19).

Studies examining the age of the victims have found that children are bitten more frequently than persons in other age groups (18, 21, 23-26). Children also are more likely to receive facial injuries from dog bites than any other age group (13, 21-26). For example, in a study of severe attacks by dogs, 10 of the 16 victims severely attacked by dogs were 10 years old or younger and 11 of the 16 victims were bitten on the head, neck, or shoulders. Similar results were seen in a study of cat bites that found children five years old and under were bitten on the neck and face more than persons in any other age group (19). Incidents of facial injuries from dog bites (and from all animal bites) may suggest that, “[t]he high rates of facial injuries from dog bites in children [can be] attributed to children’s small stature and increased exposure of the face, their lack of experience with dogs, and their willingness to bring their faces within the area perceived as ‘intimate distance’ by dogs” (22).

The location of the bites inflicted on victims follows a pattern in dog bite injuries. The majority of bites are inflicted on the legs and lower extremities (40 to 50 percent) and

secondly on the arms (25 to 37 percent). Head, face and neck extremities are the third most common location of dog bite injuries (9 to 16 percent) and tend to occur most frequently in children. (21, 24-26).

Characteristics of animal attacks are also important factors in a study such as the relationship of the animal to the victim. Many studies have found that in the majority of dog bite cases, the dog was known to the victim (13, 23, 25) and in approximately 20 percent of animal bite cases, the victims were bitten by their own pet or were a member of the owner's family (14, 19, 25).

The geographical location of where an animal bite occurred is important as it may indicate whether or not a bite was provoked. A bite inflicted by an animal exhibiting territoriality or protectiveness would be considered provoked and thus behavior typical of a dog (21). In these cases, it would be assumed that the animal was acting normally and not displaying behavior characteristic of rabid animals. In fact, it has been determined that the majority of dog bites occur on the owner's property or around their home indicating that the bite was provoked (13, 14, 21, 23).

Other factors seeming to influence animal bites include the time of day and the season of the year. A study of dog bites on a Navajo Indian Reservation found that nearly 50 percent of bites occurred between noon and 6 PM (21). It was suggested that, "this was the time of day when most people were active, resulting in a higher rate of dog-human encounters than at other times" (21). The majority of the bites in this time were concentrated between 3 PM and 6 PM, indicating a correlation between the number of bites and the time children and adults returned home from school and work (21).

The season of the year, and thus the temperature, has also been implicated in the increased incidence of animal bites. Several studies have reported a peak in the spring and summer months ranging from April to September (13, 18, 24). "Whenever the weather is conducive to outdoor activities, there is a potential for dog bite injury" (24) suggesting more animal-human interaction and thus more bites.

Although human beings stand the greatest chance of being infected with rabies from their domestic pets, the main reservoir of the disease in the United States and Canada is wildlife (39). In 1993, wildlife accounted for nearly 94 percent of all cases of rabies

reported to the Centers for Disease Control and the most commonly reported rabid wild animals were skunks, raccoons, bats, and foxes (40). Currently, there is a raccoon rabies epizootic in the southeastern and mid-Atlantic states which is largely responsible for the 43 percent increase in the total number of reported cases of animal rabies in the United States (41).

Although human's greatest risk of contracting rabies may not be directly from wildlife bites, domestic pets can serve as the link in transmission to humans, therefore supporting the need for continued surveillance and reporting of all types of animal bites. In 1993, domestic species accounted for only 6.4 percent of all rabid animals reported in the United States, a decrease of 17.2 percent from 1992 (40). Cats were the most frequently reported rabid domestic animal (48%) and most of these cases came from states experiencing epizootics of rabies in raccoons (40). It has been suggested that the high rate of cat rabies may be, "attributable to lack of legislation in some states requiring that cats be vaccinated against rabies as well as difficulty with enforcement in areas where laws requiring vaccination of cats exist" (40).

2.6 ANIMAL BITE RATE

The incidence rate of animal bites in communities is determined in studies and reported as the number of animal bites per 100,000 people. Animal bite rates differ from state to state and community to community depending on such factors as age and gender distribution, population density, animal population, and the bite reporting methods. The following studies illustrate the variability seen in animal bites rates due to these factors.

A recent study conducted in Indiana in 1991-92, reported incidence rates by age groups for all types of animal bites (18). The rates ranged from a low of 81 animal bites/100,000 in the over 60 year old age group to a high of 613 animal bites/100,000 in the 5-9 year old age group. The next highest incidence rates occurred in the age groups: under five years of age (rate = 475); and 10-14 years of age (rate = 462). Animal bites

evaluated in this study were those reported, by law, to the Indiana State Department of Health by health care providers who treated wounds.

A study of dog bites on a Navajo Indian Reservation found the mean incident rate of the reservation to be 605 bites per 100,000 people over the years 1981-83 (21). Because health care on the reservation is mostly localized to Indian Health Service facilities and there is no significant private practice of medicine, there is little likelihood that a major portion of the reportable dog bite information was overlooked (21). The incident rate determined can be considered a relatively accurate estimate of the true rate of dog bites on the reservation. However, it still likely only includes those bites for which medical attention was sought.

The CDC initiated a study in 1971-72 to determine incidence rates for animal bites in 15 states. The highest rates reported were 927 bites/100,000 (Arizona in 1971) and 913 bites/100,000 (Trenton, New Jersey in 1971). It was noted that, "In 1972, the highest rate of reported disease in the United States was for gonorrhea (372 cases per 100,000 persons), which was exceeded by the reported rate of animal bites in four areas (Trenton, Arizona, Illinois, and the District of Columbia)." The lowest incidence rates ranged from 20 bites/100,000 to 39 bites/100,000 in Georgia, Kentucky, Massachusetts, New Hampshire, North Dakota, South Carolina, and South Dakota. (16)

A study of animal bite incidents at two different United States Air Force bases was conducted in 1976 and 1977 (14). The incidence rates of animal bites reported in this study was thought to be one of the most accurate estimates of the actual rate because medical care is available at no cost to the victims on the base and the Air Force routinely keeps records on each reported bite occurrence. Animal bite incident rates were reported by age group and gender. The highest rate, 2419 bites/100,000, was for males up to the age of 18 and secondly, 1883 bites/100,000 for the same aged females. The incident rates for ages 19 and older were lower: males - 830 bites/100,000; and females - 448 bites/100,000. These rates are significantly higher than the previously reported rates (16, 18, 21) It was suggested in the study that, "[t]he high incidence rates of animal bites in this study were partly attributable to more complete reporting in this military setting" (14).

In addition, “[e]valuation of these rates suggests a somewhat greater magnitude of animal bites as a public health problem than previous estimates would indicate.”

In the evaluation of animal bite cases, underreporting is a problem. Usually, animal bite cases examined are those reported to a local or state health department either directly by the victim or by the medical facility where they received treatment. One study found that about 90 percent of their animal bite reports originated from hospitals and/or police (25). But, in fact, “[m]ost bite injuries are minor, self-treated, and greatly underreported” (14, 20) indicating that only the more severe bites would ultimately be reported. A study of animal bites in Indiana notes that,

Bites that come to the attention of health care providers in Indiana (and many other states) are reportable to the State health department. Reporting bias would tend to favor bites inflicted by large dogs and wildlife as well as unusually vicious or traumatic attacks. Such injuries are more likely to be treated by a physician and reported to the public health authorities (18).

Therefore, in studies examining animal bite characteristics and rates, the source of the reports and issues of underreporting must be taken into account.

A study of unreported dog bites in children was conducted in Pennsylvania in 1981 (20). Over 3200 children ages 4 to 18 years were surveyed about their dog bite histories and this information was compared to rates normally reported by health authorities. Results of this study showed that 46.1 percent of children reported having been bitten in their lifetime. In addition, 15 percent of the children reported being bitten in the year 1980, a number which is 36 times the reported rate for that age groups which was 0.47 percent. This study, in addition to the study of animal bites on two Air Force bases shows that the actual rate of animal bites is much higher than that which is normally reported to health departments. Underreporting of animal bites to health departments must be noted when conducting studies because results may ultimately influence public health and public policies in such matters as leash laws, the impounding of strays, the amount of money spent on animal control, and rabies vaccination programs for both pets and people (20).

2.7 MONETARY IMPACT OF ANIMAL BITES

Though the characteristics of animal bites have been well documented, there are few studies that have determined the actual costs associated with these bites, and specifically of costs associated with the animal bite investigations. A small number of studies, however, have examined the medical costs of animal bites and rabies prevention including pre- and post- exposure prophylaxis. A study conducted in 1974 in Baltimore, Maryland examined dog bite victims medical costs (25) and found that 56 percent of victims incurred direct medical expenses between \$11 and \$50. Five percent incurred medical expenses of more than \$50, and 30 percent could not be determined since they had been paid by medical assistance or an insurance plan. The average medical bill for a dog bite was found to be \$38.50. The average total cost of a dog bite, which includes accessory expenses such as damaged clothing, veterinary bills, travel expenses, and loss of salary, was found to be \$49.

An “economic evaluation” was conducted in two counties in New Jersey that were being affected by the raccoon rabies epizootic (42). Specific expenditures of the county health departments included animal bite investigations, confinement of domestic animals suspected of having been exposed to rabies, and consultation. In 1988, before the epizootic, the county health department expenditures totaled \$7690. There were 203 bite investigations/100,000 population and no animal confinements. In 1990, after the epizootic had begun, the total county health department expenditures rose to \$101,618. There were 261 bite investigations/100,000 population and 260 animal confinements/100,000 population. In only 2 years, the raccoon rabies epizootic in these New Jersey counties increased the county health department expenditures for rabies related animal bites by 13 times.

In a study examining rabies prevention in primary care it was reported that, “[h]uman rabies in the United States is so uncommon that direct costs cannot be calculated” (43). The cost of rabies prevention, however, was determined in Georgia. It

was reported that the “largest single component of the cost in Georgia was the vaccination of dogs and cats, accounting for 81% of the total” (43). Notably, the second and third largest components of expense were the salaries of the animal control workers (14%) and the cost charged for the quarantine of animals (3%)” (43).

In another study, human post-exposure prophylaxis (PEP) was estimated to be the major proportion of direct prevention of rabies (44). A study in 1983 estimated that approximately 20,000 people receive PEP for rabies annually in the United States and that about 61 percent of these individuals received PEP for exposures or suspected exposures to pets (45). Estimating an average cost of \$100 for physician administration of PEP, “the total cost of PEP due to suspected exposure to rabid pets is approximately \$6 million annually” (44). As shown by the growing wildlife epizootic, medical and accessory expenses of animal bites, and the number of administered PEP, the costs to the public and private sector associated with animal bites are substantial.

2.8 CONCLUSION

Animal bites are byproducts of human society living in close proximity with wild and domestic animals. Problems that animal bite victims may suffer from include bacterial infections, disfigurement, scarring and emotional stress. However, it is the concern for animal-to-human rabies virus transmission that prompts local public health officials to investigate animal bites.

The cost of rabies prevention varies widely depending on geographical location in the United States. With the recent rabies epizootic in raccoons in the mid-Atlantic states, the cost of rabies prevention has risen considerably (42). In Oregon and the Pacific Northwest, the likelihood of rabies transmission to humans is small having only occurred once in the last five years (12). This study will examine the costs and characteristics of animal bites in Benton County so that well-informed and cost efficient decisions can be made to prevent rabies transmission to the human population.

3 METHODS

3.1 ANIMAL BITE CHARACTERISTICS

To determine the characteristics and impact of animal bites in Benton County, animal bite data recorded for the years 1993 and 1994 was transferred from the Benton County Health Department animal bite reports (Appendix A) to a computer database program (Excel 5.0). The data from the animal bite reports was then sorted to obtain information about the victim, bite, attack, animal, and investigation characteristics. The characteristics and their subcategories are shown in Appendix B.

Information was entered directly into the computer as reported on the animal bite forms. However, in some cases, due to more than one bite report per victim or other inconsistencies in the way information was reported, rules and definitions were developed to ensure consistency and accuracy of results. They are discussed below.

3.1.1 GENDER

The victim's gender was not reported on the animal bite form, therefore, an assumption of sex was made according to the first name of the victim or else reference to the victim as either "he" or "she". If the name was such that an obvious assumption could not be made, or there were no other indications "unknown" was entered.

3.1.2 RELATIONSHIP

A positive relationship indicates that the victim lives on the same property or in the same house with the animal on a daily basis. A visiting relative would not be considered a relation to the biting animal.

3.1.3 DISTRICT

There are six possible districts: N.W. Benton, N. Benton, Corvallis, Mid-Benton, Alsea, and S. Benton. The district was determined according to the street address where the bite occurred and an illustrated map of the districts. In addition, the following assumption was made - if the city police responded to the bite, the district was assumed to be within the Corvallis city limits. If the county animal control responded, it was assumed to be outside the Corvallis city limits and the proper district was determined. In some cases, the street address and map were not sufficient to distinguish between two districts the bite might have occurred in and the district was reported as unknown.

3.1.4 SEVERITY OF BITE

Severity of bite is recorded on the bite form as skin unbroken, scratch, puncture, or severe laceration. When entering these data, the information was taken directly from the animal bite reports. In some cases, separate reports for the same incident indicated different severities and data from both reports were used. It should be noted that the bite severity reported was each person's own opinion of the wound. In the few instances where severity was not indicated, an assessment may have been made if a thorough description of the wound was given in the report.

3.1.5 PHYSICIAN CONSULTED

Data was entered as “yes” if it was clearly stated on the bite report form that the victim had consulted a physician or if the report came from a medical center where medical treatment had been received.

3.1.6 VACCINATION STATUS

Within the category of animal characteristics, the following guidelines were used when reporting the vaccination status of an animal. A “yes” was recorded if the report stated that a vaccination was proven or if the owner indicated that the animal was current on its vaccination. A “no” was recorded if it was clearly stated on the report that the animal was not vaccinated. Wild animals were considered unvaccinated. An “unknown” was recorded if the owner was unsure of the vaccination status, it was not reported, or if the animal was a stray and vaccination status was unknown.

3.1.7 ANIMAL OWNERSHIP

An animal was considered stray if no owner could be located. It was considered owned if an owner could be located or if it was in the possession of a pet store or humane society. Exceptions to these cases were animals which had recently been brought into the humane society as strays or wild animals and the bite occurred before a rabies vaccination was given.

3.1.8 REPORT ORIGINATION

Report origination indicates from where the bite information originated or from where the animal bite report was received. In the case that there were multiple sources of report origination, such as city police, victim, animal owner, etc., all were listed. If it could not be deduced from where the bite report or information originated, none was listed. Only those reports whose originations were clear were recorded; therefore, there may be some underestimation in this category due to unknown. When an animal bite occurred at the Heartland Humane Society and a bite report was received, the report origination was listed as the victim because it was the victim who usually filled out the report.

3.1.9 QUARANTINE STATUS

A broad definition of quarantine is ‘observation for a period of 10 days.’ An animal was considered quarantined in this study if it was confined to its home or yard for 10 days. Stray animals, or those animals of uncertain ownership, may have been considered quarantined and marked as “observed” because they were observed to be normal and healthy after 10 days, but had not been confined during that period of time.

3.1.10 QUARANTINE LOCATION

When an animal was quarantined at its place of residence, the quarantine location was considered at “home.” An animal owned by a pet store and quarantined there would be considered at “home.” However, if an animal resided at the humane society and it was quarantined there, it was marked as “humane society.”

3.1.11 NUMBER OF CALLS/ENTRIES MADE BY THE HEALTH OFFICIAL

The number of calls or entries made by the health official for a report was considered the number of separate calls made, actions performed or calls or messages received.

3.2 MONETARY IMPACT OF ANIMAL BITES

3.2.1 TIME

To determine the impact of animal bites on the Environmental Health Division of the Benton County Health Department, the number of hours spent per week on animal bite investigations was evaluated. The weekly time logs of the health official in charge of animal bites were examined and the time spent each week on investigations was recorded.

In 1993 and 1994 total, only 10 weekly time sheets (out of 104) were unaccounted for. They had either been misplaced or the health official in charge of animal bite investigations was on vacation. The following methods were used to estimate missing data from the months with partially incomplete time logs (two to ten workdays of time unaccounted for in a month). For each month with complete time logs, the total number of hours spent on bites for those months was summed and divided by the total number of bites in those months. When 1993 and 1994 were combined together, the calculation gave the average time spent to investigate each animal bite in the months when all animal bite time was accounted for. Then, for the months with missing time logs, the number of bites occurring that month was multiplied by the average time it took to investigate a bite according to the months with complete time sheets.

The estimated total hours spent investigating animal bites for the years 1993 and 1994 was calculated by adding the known number of hours from months with complete

time logs and the estimated number of hours for the months with incomplete time logs. This number, divided by two, resulted in the average number of hours per year the health official spent investigating animal bites.

A complete year of full time work for one individual is 2080 hours and considered 1.0 full-time equivalent (FTE). Productivity studies in the health department have shown that approximately 60 percent of that time, or 1248 hours, is available for direct service work (personal communication). This value is used in the health department for annual unit cost determinations. Direct service includes inspections, investigations, plan reviews and other direct client services and contacts. Investigating animal bites is an example of direct service. The remaining 40 percent of the time is spent in training, preparation, travel, meetings, paperwork, vacation, or sick time. To determine the percentage of direct service time that a health official spends on animal bites, the average hours per year spent on animal bites was divided by the number of direct service hours per year (1248).

3.2.2 COSTS OF INVESTIGATING ANIMAL BITES

To determine the costs of investigating animal bites each year, the average hourly cost of one direct service hour of an employee's time was calculated. Financial data used were for the fiscal year 1993/94. The total yearly expenditures for the Environmental Health Division of Benton County was calculated by summing the following: Environmental Health Division expenditures; departmental overhead (County Health Department); and county overhead.

The Environmental Health Department direct expenditures included salaries for 4.8 direct service employees, 0.7 supervisor/administrator employees, support (secretaries, billing, records), and materials such as supplies, training, travel and building space. Departmental overhead included employees such as the Health Administrator and Fiscal Analyst. The county overhead is the cost allocation of central administration and includes the Board of Commissioners, finance, personnel, and computer supplies/use.

The above monies add up to the total yearly expenditures of the Environmental Health Division. This sum was then divided by the number of employees available to do direct service work to determine the cost per full-time equivalent (FTE). The cost per FTE divided by the number of direct service hours available resulted in the cost per hour of direct service work. Ultimately, the cost per hour of direct service work was multiplied by the average number of hours spent per year on animal bite investigations to determine the Environmental Health Division's yearly cost.

3.3 ANIMAL BITE RATE

The animal bite rate in Benton County was calculated for the years 1985 through 1994 and in Corvallis for the years 1993 and 1994. Population figures for these years were obtained from the Center of Population, Research, and Census at Portland State University. The number of bites occurring each year were obtained from records in the Benton County Health Department dating back to 1985. Rates were calculated per 100,000 person-years.

4 RESULTS

4.1 ANIMAL BITE CHARACTERISTICS

4.1.1 VICTIM CHARACTERISTICS

4.1.1.1 *Gender*

In 1993 and 1994 combined, a total of 247 people were bitten by animals. An average of 54 percent of victims were female and 46 percent were male. Results of the two years were virtually identical. When dog bites and cat bites were separated, the results were very different. Of dog bite victims, 58 percent were male and 42 percent were female. Of cat bite victims, 15 percent were male and 85 percent were female. There was a statistically significant difference between men and women in terms of being bitten by cats or dogs ($P < 0.001$).

4.1.1.2 *Age*

Animal bite victims were categorized according to age in order to evaluate and compare the distribution of bites. The percent population in each age group in Benton County was estimated for 1994 from the 1990 U.S. Census and birth records and vital statistics (Center for Population, Research and Census at Portland State University).

(*Note: not all age groups are of equal size. The age groupings are the ones used by the

Center for Pop., Res. and Census). The percent of people bitten in Benton County was divided into the same age groupings for easy comparison. Table 4.1 shows the percent of animal bites according to age group as compared with population distribution. The five-year age groupings less than 15 years made up 40 percent of the bites but only 18 percent of the population. In age groups 18-19, 20-24, 25-29, and 60+, a smaller proportion of people were bitten than were living in the county. But, in the age groups 30-59 years, the proportion of people bitten was nearly equal to the proportion living in the county.

Table 4.1 Percent of animal bites per age group in Benton County in 1994.

Age group in years	Percent of populat. in Benton County	Percent bitten in Benton County
0 to 4	6%	15%
5 to 9	6%	13%
10 to 14	6%	12%
15 to 17	4%	5%
18 and 19	6%	2%
20 to 24	14%	7%
25 to 29	10%	6%
30 to 34	7%	6%
35 to 39	8%	7%
40 to 44	8%	6%
45 to 49	6%	7%
50 to 59	8%	6%
60+	13%	6%

Table 4.2 shows the animal bite rate by age group. The rates calculated are for the number of bites per 100,000 person-years in Benton County in 1994. The age groups from 0 to 17 years have the highest reported bite rate, approximately four to five times those rates in the 18 to 29 year age groups.

Table 4.2 Animal bite rates per 100,000 person-years in different age groups for the year 1994.

Age group in years	Animal bite rate per 100,000 person-years
0 to 4	272
5 to 9	231
10 to 14	253
15 to 17	218
18 and 19	45
20 to 24	64
25 to 29	55
30 to 34	138
35 to 39	105
40 to 44	140
45 to 49	202
50 to 59	124
60+	73

4.1.1.3 Relationship

In 1993, 19 percent of victims were related to the animal, 81 percent were unrelated. In 1994, 24 percent of the victims were related to the animal and 76 percent were unrelated. Figure 4.1 shows the percentage of victims related and unrelated to the biting animals for 1993 and

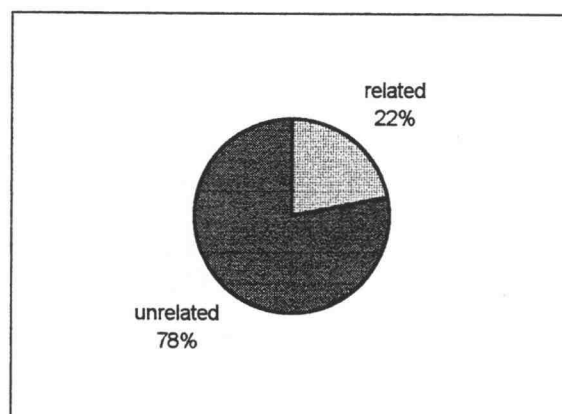


Figure 4.1 Percent of victims related and unrelated to the biting animal.

the biting animals for 1993 and 1994 total. There was no statistically significant difference between cats and dogs in terms of being related to the person whom they bit ($P=0.05$).

4.1.2 ATTACK CHARACTERISTICS

4.1.2.1 *Month of animal bite attacks*

Figure 4.2 shows the number of animal bites that occurred each month for the years 1993 and 1994. When both years were averaged together, the frequency of animal bites seems to peak twice during the year - in March and in the late summer months of July through October.

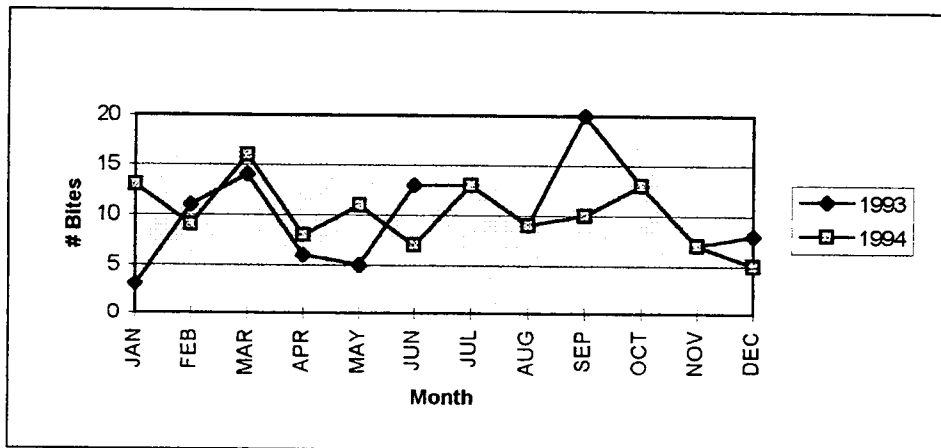


Figure 4.2 Number of animal bites per month in 1993 and 1994.

4.1.2.2 *Time of day*

Table 4.3 shows the percent of bites that occurred at different time intervals during the day. Each time interval is 3 hours except of the first interval which is composed of 6 hours. For 1993 and 1994 combined, nearly one quarter of the bites occurred between 1500 and 1759 (3:00pm and 5:59pm). Just over half of all bites occurred in the afternoon hours of 12 pm to 6 pm.

Table 4.3 Percent of animal bites occurring at different time intervals.

Time interval	Percent
001 - 559*	3%
600 - 859	7%
900 - 1159	15%
1200 - 1459	20%
1500 - 1759	24%
1800 - 2059	20%
2100 - 2400	10%
Total	99%

4.1.2.3 *District bite occurred in*

Benton county is divided into six districts: Northwest Benton; North Benton; Corvallis; Mid-Benton; Alsea; and South Benton. Figure 4.3 shows the percent of total bites that occurred in each district for the combined years 1993 and 1994. Fifty-four percent of all bites occurred in Corvallis. This number is less than would be expected because Corvallis contains 62 percent of Benton County's population. Mid-Benton and North Benton accounted equally for another 34 percent of the bites. The fewest number of bites, 2 percent, occurred in Northwest Benton. The local humane society is located in the South Benton district and accounted for 12 of the 20 bites in the district (5 percent of the total bites in 1993-94).

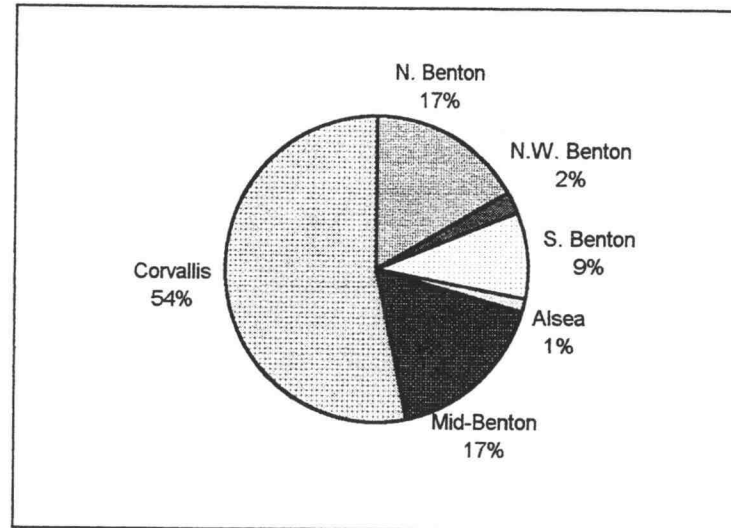


Figure 4.3 Percent of animal bites per district in 1993 and 1994 total.

4.1.3 BITE CHARACTERISTICS

4.1.3.1 Severity of bite

The severity of the animal bite could be reported as one or more of four different types: skin unbroken, scratch, puncture, severe laceration. The most frequently reported type of wound was a puncture wound (78 percent of bites). Twelve percent reported a severe laceration and 38 percent reported wounds of scratch or skin unbroken. (These percentages do not add up to 100 percent because victims could report more than one type of wound). Interestingly, fifteen percent of all bite victims reported wounds of either “skin unbroken” or “scratch” only.

4.1.3.2 *Physician consultation*

Figure 4.4 shows the percent of animal bite victims who reported consulting a physician about their wound. In 1993 and 1994 combined, 58 percent of victims reported consulting a physician, 17 percent did not consult a physician and 25 percent were unknown. When restricting the analyses to either cat or dog bite, there was no significant difference between dog bite and cat bite victims consulting a physician ($P=0.06$).

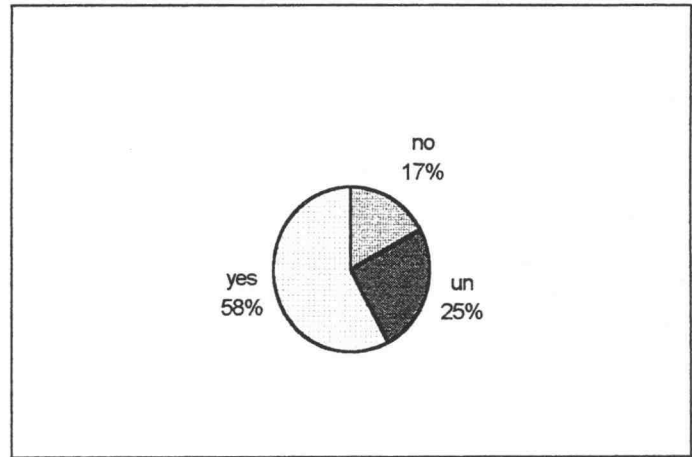


Figure 4.4 Percent of victims seeking medical consultation for reported animal bites in 1993 and 1994 total.

4.1.3.3 *Body location of bite*

Table 4.4 shows the percent of bites inflicted on different areas of the body. Over 50 percent of victims had bites inflicted on the upper extremities (hand/arm) and 26 percent on the lower extremities (leg/foot). Twenty percent of the victims received wounds on the face or neck.

Table 4.4 Location of bites inflicted on victims.

Bite location	Percent
hand	35%
leg/foot	26%
face/neck	20%
arm	16%
torso	2%
multiple	1%
Total	100%

Evaluation of the incidents of facial injuries in children 10 years and younger showed the following:

1993

73 percent of all face, head, or neck injuries were inflicted on children 10 years and younger.

1994

56 percent of all face, head, or neck injuries were inflicted on children 10 years and younger.

4.1.4 ANIMAL CHARACTERISTICS

4.1.4.1 Animal type

Figure 4.5 shows the types of animal bites in Benton County in 1993-94. Dog bites accounted for 70 percent of the total reported animal bites in Benton County. Cats accounted for 25 percent, ferrets for 2 percent, and “other” for 3 percent of the total animal bites. “Other” includes of rats, bats, skunks, and mice.

Results for Corvallis showed a similar distribution. Seventy-two percent of animal bites were dog bites, 20 percent were cat bites, 5 percent ferret bites, and 3 percent “other”.

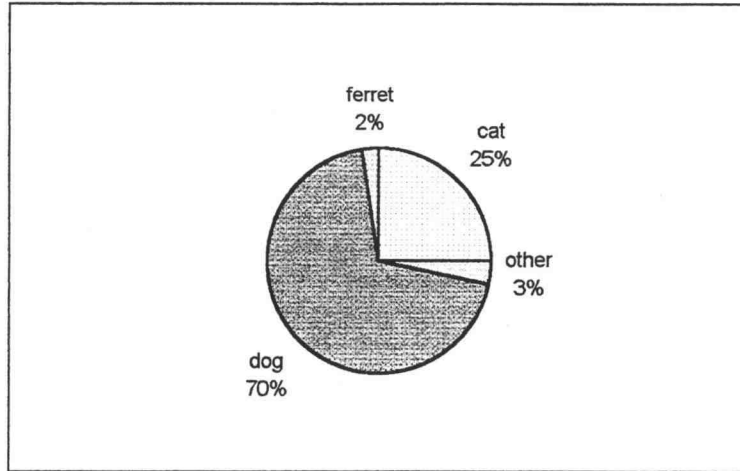


Figure 4.5 Types of animal bites reported in Benton County in 1993 and 1994 total.

4.1.4.2 Vaccinated

In 1993 and 1994 total, only 16 percent of the cats that bit people were vaccinated, 28 percent were unvaccinated, and 56 percent were of unknown vaccination status.

For dogs, 66 percent were vaccinated, 11 percent were unvaccinated and 23 percent were of unknown vaccination status. There was a statistically significant difference between dogs and cats in terms of being vaccinated against rabies ($P < 0.001$).

4.1.4.3 Ownership

Table 4.5 Ownership status of biting dogs and cats in Benton County 1993 and 1994.

ownership status	dogs		cats	
	1993	1994	1993	1994
owned	99%	98%	41%	52%
stray	1%	2%	59%	48%
total	100%	100%	100%	100%

An owner could be located for nearly all of the reported biting dogs. For the reported biting cats, however, an owner could be located in an average of only 54 percent of the cases. Results are shown in Table 4.5.

4.1.5 INVESTIGATION CHARACTERISTICS

4.1.5.1 Report Origination

Table 4.6 Animal bite report originations in Benton County for 1993 and 1994 total.

Report Origination	Percent
Medical center	28%
Police	26%
Victims	23%
County Animal Control	14%
Humane Societies + Clinics	5%
Animal owner	3%
Other Health Dept.'s	1%
Total	100%

Animal bites were reported most often from medical centers and police departments. Victims of animal bites accounted for 23 percent of animal bite reports and were the third highest source of report originations. Table 4.6 shows the results of the animal bite report originations for the years 1993 and 1994.

4.1.5.2 *Quarantined*

In 1993 and 1994, 243 animals were reported to have bitten people. Of these animals, 79 percent were quarantined and 21 percent were not quarantined.

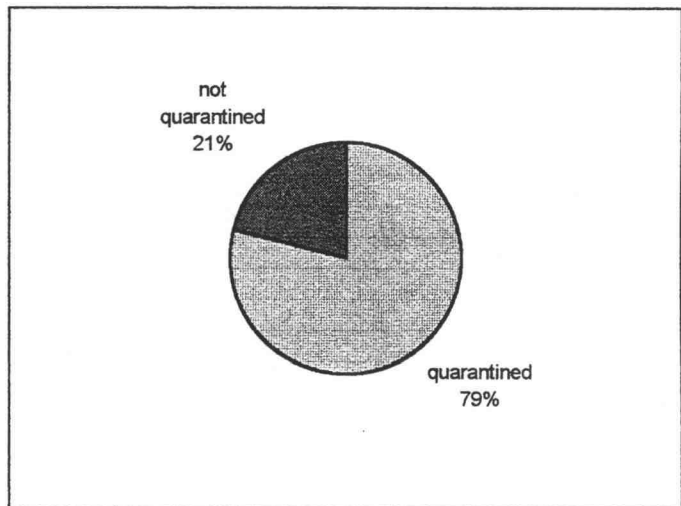


Figure 4.6 Quarantine status of biting animals in Benton County in 1993 and 1994 total.

4.1.5.3 *Quarantine location*

Figure 4.7 shows the quarantine location of animals in 1993-94. Sixty-nine percent of the animals were home quarantined and 20 percent were quarantined at the Heartland Humane Society. Five percent of the animals were “observed” indicating that they did not meet the technical definition of quarantine (i.e. they were not confined for 10

days). The quarantine location denoted as “other” includes humane societies other than Heartland, animal hospitals, or a veterinarian’s clinic.

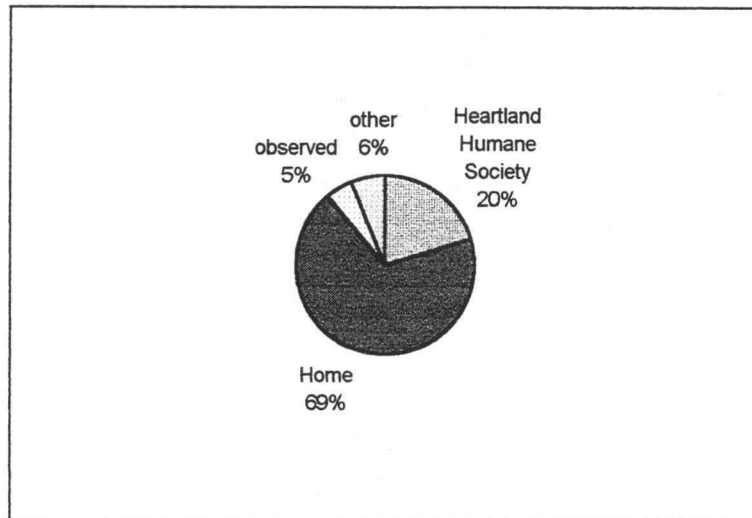


Figure 4.7 Quarantine location of biting animals in Benton County for 1993 and 1994 total.

4.1.5.4 Rabies tested

Only 4 percent of all animals were tested for rabies. Six tested negative and one bat tested positive.

4.1.5.5 Number of actions per animal bite case

For all cat bites reported, 45 percent of the cases required at least two calls or actions by the health department official. Sixteen percent of cat bite cases required four actions and 15 percent required three actions. Stray cats, which accounted for 55 percent of all cat bites, required an average of 3.5 actions per investigation and owned cats required an average of 2.8 actions.

For dog bite cases, 41 percent required two actions, 23 percent three actions, and 17 percent four actions. Results are shown in Figures 4.8 and 4.9.

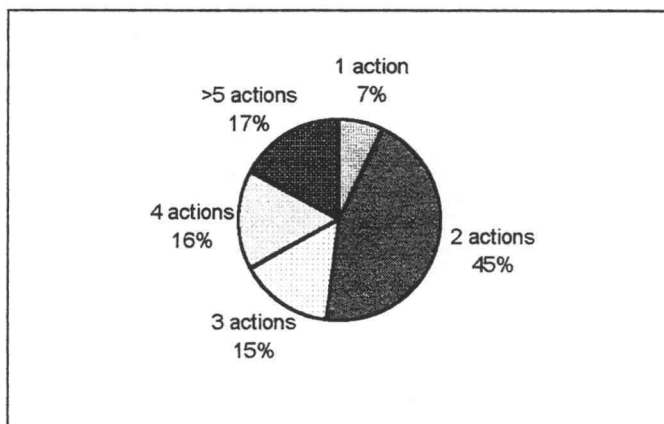


Figure 4.8 Number of actions/calls required per cat bite in 1993 and 1994 total.

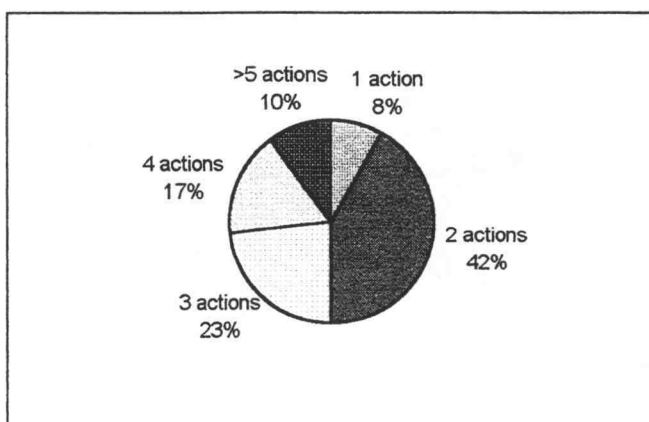


Figure 4.9 Number of actions/calls required per dog bite in 1993 and 1994 total.

4.2 TIME AND MONETARY IMPACT OF ANIMAL BITES

4.2.1 TIME

Six weekly time logs were missing in 1993 (11.5 percent) and four were missing in 1994 (7.7 percent). Either they had been misplaced or the health official was on vacation at that time. When the time from months with complete time logs was divided by the number of bites that occurred in those months, it was found that an average of 0.52 hours were spent per animal bite case in 1993 and 1994 combined.

The total number of hours recorded spent on animal bites was 61.75 hours in 1993 and 56.5 hours in 1994. When the missing data were replaced (as described in the methods section), it was determined that 65.75 hours were spent investigating animal bites in 1993 and 61.94 hours in 1994. Averaging the 2 years, 63.85 hours per year were spent investigating animal bites. Since the average employee spends 60 percent of his or her time doing direct service work, or 1248 hours, results show that in Benton County, 5.1 percent of one health official's direct service time is spent investigating animal bites.

4.2.2 COSTS OF INVESTIGATING ANIMAL BITES

For the fiscal year 1993-94, the total direct expenditures for the Benton County Environmental Health Division were \$385,768. Adding in department overhead (\$24,613) and cost allocation (\$39,366) the total yearly expenditures came to \$449,747. There is a total of 4.8 full time equivalents (FTE) available to do direct service work for the Environmental Health Division. Therefore, the total cost per FTE is \$93,697/year and the cost per hour of direct service work is \$75.

Considering that the average animal bite case takes approximately 0.52 hours to investigate, the cost of the investigation would be \$39. The cost of animal bite investigations in 1993 is estimated to have been \$4931 for 65.75 hours and \$4647 in 1994 for 61.94 hours. The average total cost for 1993-94 was \$4789. This figure is 1.1 percent of the total yearly expenditures and 1.2 percent of the total direct expenditures of the Environmental Health Division.

4.3 ANIMAL BITE RATE

Table 4.7 shows animal bite rates in Benton County for the years 1985 through 1994. In 1988, there appears to be a dramatic increase in the animal bite rate. This increase is thought to be the result of the local health official making contact with various agencies in the community (such as the police departments, medical centers, and humane societies) to remind them that all animal bites must be reported, by law, to the county health department. Table 4.8 shows the animal bite rate in Corvallis for the years 1993 and 1994.

Table 4.7 Animal bite rates per 100,000 person-years in Benton County for the years 1985 to 1994.

Year	Animal bite rate per 100,000 person-years
1985	67
1986	72
1987	53
1988	150
1989	155
1990	175
1991	143
1992	156
1993	173
1994	172

Table 4.8 Animal bite rates per 100,000 person-years in Corvallis for the years 1993 and 1994.

Year	Animal bite rate per 100,000 person-years
1993	132
1994	123

5 CONCLUSION

5.1 ANIMAL BITE RATE

In Benton County, Oregon, a total of 247 people were bitten by animals in the years 1993 and 1994. Benton County (population 75,000) is a mostly rural community and is divided into six districts. The district of Corvallis (population 46,000) had the highest percentage of animal bites (54 percent). This number is lower than expected since Corvallis contains approximately 62 percent of Benton County's population. The districts of North Benton and Mid-Benton comprised the remaining majority of animal bites with approximately 15 percent each. Both districts encompass either a portion of an outlying city or else a small community which contributes to the population of the area and thus the higher percentage of bites.

The animal bite rate of Benton County averaged 173 bites per 100,000 person-years for the years 1993 and 1994. The rate was even lower for the city of Corvallis: 132 bites per 100,000 person-years in 1993; and 123 bites 100,000 person-years in 1994. These rates are much lower than those rates reported in the literature (14, 16 , 21, 25). The low animal bite rates are likely due to the rural nature of the county and patrolling by the county animal control officer.

The rate of reporting from the medical centers, police departments and county animal control officers is judged to be high. In 1988, a county health official contacted the agencies and groups likely to come in contact with animal bites and reminded them that all animal bites must be reported to the county health department by law. This action resulted in an immediate and notable increase in the number of animal bites reported (see Figure 5.1). A large increase began in 1988 and the number of bites reported has remained nearly constant since that time. Over 50 percent of the animal bites reported to the health department came from medical centers and police departments. Twenty-three percent came from victims, and 14 percent came from the county animal control officer.

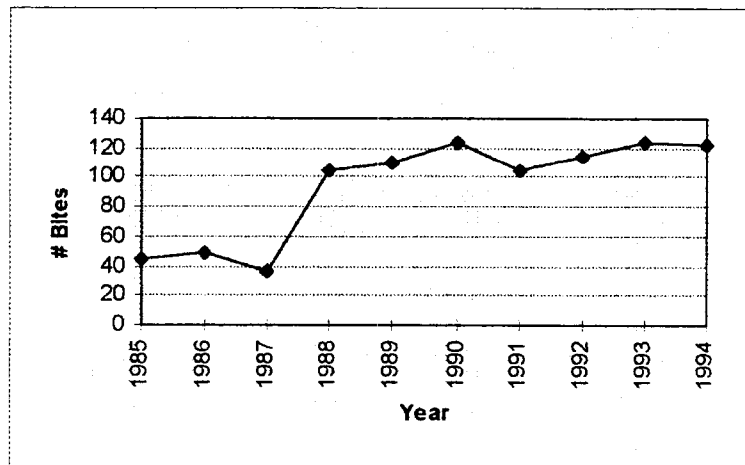


Figure 5.1 Number of animal bites reported for the calendar years 1985 - 1994.

5.2 TIME AND COSTS OF ANIMAL BITES

Every animal bite reported to the health department must be investigated for possible rabies transmission. In the years 1993 and 1994, an average of 123 animal bites per year were reported to have occurred, and an average of 64 hours were spent investigating these bites. At a calculated cost of \$75/hour for a health official's direct service time, the cost of investigating animal bites each year was approximately \$4800.

Time logs were filled out weekly by the health official investigating bites. The health official believes that his weekly time recordings are underestimates compared to the true amount of time he spends investigating bites daily (personal communication). The average animal bite has been conservatively estimated to take 0.52 hours of time to investigate. Converted into dollars, each animal bite reported costs the Environmental Health Division approximately \$39 to investigate.

Averaging the time and costs for 1993 and 1994, animal bites are estimated to have taken 5.1 percent of one health official's direct service time and 1.2 percent of the Environmental Health Division's total direct expenditures per year. These figures are a

significant part of the yearly budget and personnel considering that animal bites are largely preventable incidents.

5.3 ANIMAL BITE CHARACTERISTICS

The animal bite characteristics of Benton County were consistent with the characteristics reported in the literature. Dogs were the highest reported biting animal for Benton County (70 percent) and cats were the second highest (25 percent). The remainder of biting animals were ferrets, rodents, and wildlife. The type of animal biting in Corvallis was consistent with Benton County and also with results reported in the literature (14, 16, 18).

Some noteworthy features of animal bites in Benton County are mentioned below. Ninety-eight percent of the biting dogs were of known ownership as compared to an average of only 47 percent of cats. Fifty-three percent of the biting cats in Benton County were considered stray or unowned upon investigation because no owner could be located. This percentage is consistent with a study of cat bites in Dallas, Texas (19). The number of animal bites seemed to peak twice in the year. The first peak was in early spring (March) and then again in June through October. This pattern is typical of animal bites and seems to follow the seasonal changes in weather. Since Oregon's spring season begins in March and the summer season often goes until October, the prolonged high incidence of animal bites during this time is not surprising.

Thirty-two victims over two years reported bite wounds no more than "skin unbroken" or "scratch". Although studies have shown that, "[c]ases of rabies after scratches, abrasion, or the licking of open wounds or mucous membranes are extremely rare," (31-33) 26 of the 32 animals inflicting these injuries (81 percent) were quarantined. If animals inflicting no more than scratches could be exempt from investigation and quarantining, over \$600 or 0.16 percent of the Environmental Health total direct expenditures could possibly be saved per year.

In addition, nearly 60 percent of biting cats and dogs were either unvaccinated or of unknown vaccination status. Only 16 percent of biting cats were reported to be vaccinated as compared to 66 percent of dogs. The variability in this number could be due to the law requiring dogs in Benton County to be licensed, and thus vaccinated. Perhaps a similar licensing law for cats would increase the number of rabies vaccinations and decrease the risk of rabies infection and transmission. Any steps to prevent rabies infection to and among domestic animals would lower the risk of transmission to humans. With a lower risk of rabies transmission, perhaps investigation of animal bites could be limited to wild animals and the few domestic animals with unknown vaccination status.

5.4 STRENGTHS AND WEAKNESSES

The major strengths of this study were the animal bite reports and daily time records kept by the Environmental Health Division of the Benton County Health Department. The animal bite reports allowed for detailed information to be gathered about animal, bite, victim, and attack characteristics. The daily time records kept by each health official allowed for the average amount of time spent on animal bite investigations to be evaluated for the first time. These time figures, along with the yearly budget statistics, allowed for detailed calculation of the average time and cost of one animal bite and the total yearly costs of animal bite investigations to the Environmental Health Division.

The major weakness of this study was the lack of detail in recording the time spent on animal bites. Time was reported in a general daily format (i.e. one-quarter hour Tuesday and one-half hour spent Thursday on animal bites), but it often was not reported until the end of the week. This method of time keeping likely resulted in estimations only and increased the potential for significant recall errors.

It was also impossible to determine the amount of time spent on any particular animal bite case. It would have been extremely useful to know the amount of time a particular animal bite investigation took so that it could be determined if cat bites versus dog bites or vaccinated vs. unvaccinated animal bites took more time to investigate. The

closest piece of data to determine that information in this study was the “number of actions” recorded by the health official on the animal bite report. That data may not have always been complete and it did not indicate any amount of time expenditure.

Another major weakness of the study was that specific data was not collected on the animal bite reports. For example, it was rarely reported if the biting dog was licensed or not. It is pertinent to know if a dog is licensed versus unlicensed because licensing requires proof of rabies vaccination. If it had been discovered that the majority of biting dogs were unlicensed and unvaccinated, there would be justification of a stricter licensing law. As it was for the reported bites, 56 percent of biting cats and 23 percent of dogs were of unknown vaccination status.

5.5 FUTURE STUDIES

Ideal future studies should more thoroughly examine the time and money spent on animal bites. The Environmental Health Division is only one of many agencies involved in the investigation and reporting of animal bites. Oftentimes, it is the County Animal Control Officer or the local police department conducting the original animal bite investigation. The time spent by these two entities should be determined and the average yearly costs of investigations calculated. They likely spend significant amounts of money, as well, dealing with animal bites in the community. Finally, future studies should focus on distinguishing the characteristics and amount of time spent on particular types animal bite cases. Knowing the characteristics of the biting animals (licensed vs. unlicensed, vaccinated vs. unvaccinated, stray vs. owned) and the amount of time spent investigating each type will help to determine what types of preventative measure might help reduce animal bites in a community.

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APPENDICES

APPENDIX A

Date received _____
 Received from _____
 Taken by _____

ANIMAL BITE REPORT FORM

Interviewer _____
 Date of interview _____
 EH File Number _____

PERSON BITTEN

Name _____ Age _____
 if minor, name of parents or guardian _____
 Address _____ Phone _____
 Date of incident _____ Time _____ am/pm Location _____
 In City/County Location of bite on body _____
 Severity of bite: (Skin Unbroken) (Scratch) (Puncture) (Severe Laceration) *X those applicable.*
 How did incident happen? _____

UNPROVOKED ATTACK: _____ PROVOKED ATTACK: _____

First Aid given? Yes/No Type _____
 Tetanus immunization? Yes/No Date: _____ Physician consulted? Yes/No
 Dr. Name _____ Medication prescribed? Yes/No Type: _____
 Other comments: _____

ANIMAL OWNER: _____ **ADDRESS** _____ **PHONE** _____

Type of animal _____ Description _____
 Age _____ Sex _____ Location of animal now _____
 Quarantine location _____

Animal Behavior (before/during/following incident): *X those applicable.*

Condition	Before	During	Following
Loss of appetite	_____	_____	_____
Restless & Excitable	_____	_____	_____
Paralysis	_____	_____	_____
Slobbering	_____	_____	_____
Sagging jaw	_____	_____	_____
Unusual Viciousness	_____	_____	_____
Other _____	_____	_____	_____

RABIES VACCINE: Yes/No Vaccine Expires _____ Veterinarian _____

Observed by veterinarian: Yes/No Comments: _____

FOLLOW UP Date of contact with animal owner _____ Time _____ am/pm

Quarantine required: Yes/No Date begun _____ Results after 10 days _____

Testing: Date killed _____ Date submitted to Lab _____ Lab name _____

Results: Positive/Negative Recontact with victim: Date _____ Time _____

Copies sent to: City animal control County animal control Health Nurse Date sent _____

APPENDIX B

Animal bite characteristics and categories as recorded during data collection.

- Victim characteristics - sex: (male) (female) (unknown)
 age: (<1, 1, 2, 3, etc.) (unknown)
 relationship (does victim live in same house with animal on a daily basis?):
 (yes) (no) (- if wild) (unknown)
- Attack characteristics - month: (1, 2, 3, etc.) (unknown)
 time of day: (0-24 hours) (unknown)
 district bite occurred in: (N.W. Benton) (N. Benton) (Corvallis) (Mid-Benton)
 (Alsea) (S. Benton) (unknown)
 provoked: (yes) (no) (unknown)
- Bite characteristics - severity of bite: (skin unbroken) (scratch) (puncture)
 (severe laceration) (unknown)
 first aid given: (yes) (no) (unknown)
 physician consulted: (yes) (no) (unknown)
 body location of bite: (arm) (upper leg - includes buttocks) (lower leg -
 includes ankle) (hand) (foot) (face) (multiple) (other-specify)
 (unknown)
- Animal characteristics - type: (dog) (cat) (other - specify type)
 Benton County resident: (yes) (no) (unknown)
 sex : (male) (female) (unknown)
 vaccinated: (yes) (no) (no if wild) (unknown)
 ownership: (owned) (stray) (wild) (unknown)
- Investigation characteristics - report origination: (victim) (owner) (humane society) (county animal control)
 (city police) (sheriff's office) (medical center) (other-specify)
 (unknown)
 quarantined: (yes) (no) (unknown)
 where quarantined: (home) (humane society) (veterinarian's office) (other)
 (unknown)
 head tested for rabies: (yes) (no)
 number of calls or entries made by health official for that report: (1) (2) etc.