
A Study of Dog Bites on the Navajo Reservation

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Detailed analysis of 772 bite reports was made to determine the characteristics of biters and their victims. This included an assessment of the behavioral antecedents leading up to the bite incident; 98.4 percent of all cases for which a possible cause could be ascertained were provoked in some way.

Both dog control and public education measures need to be taken to reduce the frequency of dog bites.

Synopsis

Reservation-wide dog-bite statistics indicate a bite rate on the Navajo Reservation that is comparable to that of a large city.

PROBLEMS ASSOCIATED WITH THE INCREASING number of free-roaming dogs with unrestricted access to public property in the United States range from the deposition of feces and urine in the environment to the transmission of disease to the human populace (1,2). Bites are the most commonly known public health problem and with good reason: 90 percent of all animal bites in the United States, which exceed 1 million cases annually, are from dogs. Dog bites are rapidly becoming a major health problem (2) and this has, in turn, led to a number of studies examining urban dog-bite records (2-6). Yet dog bites in rural areas have been all but neglected, either because the data were too scattered or simply unavailable.

A considerable health problem on the Navajo Reservation, associated with the large number of free-ranging dogs, is that of bites, which result in about 1,000 outpatient hospital visits per year. The purpose of this paper is to examine the reservation dog-bite problem through an analysis of the data listed in dog-bite reports and to determine what, if any, patterns are present which might lead to a greater understanding of the phenomenon and subsequent reduction in the bite frequency. These questions needed to be answered:

- Is there a specific age group bitten more frequently?

- Is one sex more prone to be bitten than the other?
- Is there a predominance of biting at any one time period during the day?
- Is a specific body area most often the site of bite attacks?
- Do bites occur most frequently in any one geographical area of the community?
- Is a male or a female dog more likely to bite?
- Are biting dogs predominantly from one age group?
- What percentage of attacks involve mixed-breed dogs? (The remainder necessarily involve pure-breed dogs.)
- Are biters usually large animals?
- What behavioral antecedents on the part of both dog and victim might account for the bite?
- How many dogs are involved in the average bite case?

The Navajo Reservation is a large rural area that offered a unique opportunity to address these questions and compare the findings to those for urban areas. Health care is primarily localized in a limited number of Indian Health Service facilities throughout the reservation, and, thus, dog-bite reports are also localized. There is no significant private practice of medicine on the reservation, so there is little likelihood that a major portion of the reportable dog bite information was overlooked. Finally, because

there was no dog control ordinance in effect for the entire reservation and no place for offending dogs to be taken for the 10-day rabies observation period, most victims seeking medical attention had their cases forwarded to the Office of Environmental Health, Indian Health Service (IHS), so that a field technician could be dispatched to investigate the incident. This arrangement resulted in a reporting system that was probably comparable to that of many urban areas.

Methods

The data base. Data on the overall bite frequency for the entire reservation were obtained from the annual reports for fiscal years 1981, 1982, and 1983. These reports are published by the Navajo Area IHS and include the number of bites recorded for each service unit. The bite rate was calculated as the number of bites per 100,000 people in order to conform to standard reporting methods for these kinds of data.

All dog-bite reports on file in the Fort Defiance, AZ, Office of Environmental Health were examined for fiscal years 1980 through 1983, and for FY 1984 through June 30. Selection of the Fort Defiance service unit was made primarily on the basis of convenience. Additional data were collected, however, from the Kayenta, AZ (FY 1983), Tuba City, AZ (FY 1983, 1984), Gallup, NM (January 1 to June 30, 1984), and Chinle, AZ (January 1 to June 30, 1984) service units (fig. 1) to ensure that the Fort Defiance data were indicative of the reservation as a whole.

Dog-bite frequency data were extracted for the following 11 categories:

- Age of person bitten (0–5 years, 6–10, 11–25, 26–40, 41–60, over 61, and age unknown).
- Sex of victim.
- Time of day bite occurred (midnight–6:59 a.m., 7 a.m.–11:59 a.m., noon–5:59 p.m., 6 p.m.–11:59 p.m., and time unknown).
- Bite site (arm, leg, hand, foot, head/face, other sites, multiple sites, and site unknown).
- Geographic location (home, yard, field, street, other (commercial establishment, government area, school, playground, parking lot), and unknown).
- Dog's sex.
- Dog's age (less than 1 year, 1–5 yrs, over 5 yrs, and age unknown).
- Dog's breed (shepherd mix, other mix, pure-breed, and breed unknown).
- Dog's size (small, medium, large, and unknown; this is a subjective measure based on the victim's

assessment of size).

- Possible cause of attack (territoriality by the dog, teasing by the victim, unprovoked, other (for example, accidentally bitten while feeding the dog, dog is ordered to attack), or unclear (not enough information in the report to properly assess the cause)).
- Groups (size of the group involved, number of dogs that bit the victim, the relationship between dogs (that is, Do they live together? Are they familiar with one another?), sex of the victim, possible cause of attack).

Possible cause of attack needs some further clarification. Territorial behavior usually refers to the defense—either active, by threat, or passive, by scent-marking of an area against conspecifics. It is characteristic of the domestic dog (*Canis familiaris*) that this behavior is often generalized to non-species members, such as humans, and indeed, this relative anomaly is often what the layman considers territoriality. Therefore, the generalized use of the term will be applied here also. In this study, territoriality was inferred if the bite reports described any of the following incidents: the dog bit as the victim entered or left the owner's home or yard, the victim leaned over the owner's fence, the victim "walked by" a home in which the dog had access to the street, the dog chased children who were riding on bikes as they passed the owner's home (there is functionally no difference to a dog between chasing a car or a bike, except for the possible outcome), a sheepdog was herding and an intruder approached the flock, a nursing female bit as her pups were handled or approached, a dog was approached while eating. The underlying characteristic of each of these situations is the dog's defense of some resource.

Teasing by the victim is also a very broad term, characterized by a variety of situations in which the dog perceives the action of the victim as a threat. The following incidents described in the bite reports were classified as teasing: the victim chased the dog, attempted to pick the dog up, tried to stop a dog fight, tried to interfere with mating attempts (this could technically fit into the category of territoriality), fell on the dog, tried to pet or play with the dog (particularly an unfamiliar one), tried to free the dog from a trap, tried to extract potentially harmful objects such as chicken bones from the dog's mouth, or tried to move the dog after it had been hit by a car. While these last three situations could be considered attempts to help the dog, they must still be classified as teasing, because the motive of the victim, however noble, is not understood

Table 1. Dog bites listed in the Navajo Area Indian Health Service annual reports, fiscal years 1981-83

Service unit	1981	1982	1983
Chinle	270	322	87
Crownpoint	90	200	50
Fort Defiance	173	118	120
Gallup	83 (mean)	88	78
Kayenta	65	95	98
Shiprock	79	136	234
Tuba City	96	33	108
Winslow	24	45	34 (mean)
Total	880	1,037	809
Bite rate (per 100,000 people)	586	691	539

by the dog. Generally, the dog at these times is in pain or is being manhandled, or both, which results in a defensive reaction the victim does not expect.

The term "unprovoked" was commonly seen on the bite reports, but for the incident to be listed as such in this paper required that no alternative explanation apply.

The study area. The Navajo Reservation covers approximately 25,000 square miles of land surface in Arizona, New Mexico, and Utah, and is divided into 8 service units within the Navajo Area Indian Health Service system.

The Fort Defiance, AZ, service unit covers approximately 3,000 square miles and extends eastward almost to the community of Mexican Springs and Gallup, NM, westward to a line just east of the Navajo-Apache County, AZ, border, northward to Nazlini, AZ, and just south of the Canyon de Chelly area, and southward to an area just north of the Painted Desert National Monument and the south-east extension of the adjoining Gallup service unit (fig. 1). The Fort Defiance service unit encompasses two of the more highly populated communities on the reservation, Fort Defiance and Window Rock, AZ, with a combined population of approximately 6,230 people, according to a personal communication from Ron Faich, Navajo Tribe statistician, in July 1984. The remainder of the service unit is dotted with about 15 smaller communities separated by large expanses of open or mountainous terrain. However, isolated family groups, whose primary occupation is sheep herding, inhabit the open areas, though at a much lower density.

Preliminary surveys indicate that 60 to 75 percent of all families within a community provide shelter or food, or both, to at least one dog. Virtually every

family in the more isolated sheep camps has more than one dog, with as many as five being common. The vast majority of reservation dogs are free-ranging, and there is no enforced leash law restricting pet activities.

Results

Overall bite rate. The number of dog bites reported by each of the 8 Navajo Area service units for the past 3 fiscal years is listed in table 1. The figures for Gallup in 1981 and Winslow in 1983 are means of the other 2 years because no figure was reported in the annual report.

Based upon a 1983 IHS population estimate of 150,000 people on the reservation, the reservation-wide bite rates were 586 bites per 100,000 people in 1981, 691 bites per 100,000 people in 1982, and 539 bites per 100,000 people in 1983. The mean bite rate for the 3-year period was 605 bites per 100,000 people.

Profile of dog-bite incidents. A total of 772 dog-bite reports were reviewed for this study (501, Fort Defiance; 60, Kayenta; 123, Tuba City; 57, Gallup; 31, Chinle). However, the following results are exclusively from the Fort Defiance service unit unless stated otherwise.

The frequency of bites on a monthly basis is listed in table 2. The data are complete for fiscal years 1980 through 1983 and indicate a higher incidence of bite cases from April through August, with a peak in late spring and summer. There were a total of 49 bites in June, 53 in July, and 51 in August. The data for FY 1984 stop on June 30, but results for these months were similar to the values for the corresponding months or previous years, suggesting that 1984 was a typical year for bite cases.

The mean number of bites per month was 8.0 for 1980, 10.5 for 1981, 11.3 for 1982, 6.4 for 1983, and 8.3 for 1984. Pairwise comparisons of the means, using the student's *t* test, indicate that the mean number of bites for 1983 is significantly lower than those reported for 1981 and 1982. All other comparisons indicate no significant difference between means at the $P = .05$ level. The results for FY 1983 are probably low and will be discussed later.

Frequency data for the 11 categories listed earlier are presented in table 3 for the Fort Defiance service unit. The percentages reported here are means for the 5 years of data unless stated otherwise. Year-to-year differences were not significant (Arcsine transformation) (7) so data were combined.

Age of person bitten. An average of 42.1 percent of all bites involved children 10 years old or less, with the 6–10 year group slightly more prone to being bitten than the 0–5 year group. However, the difference between the 2 groups was not significant ($t = .183, P = .857$, Arcsine transformation). Nearly three-fourths (71.7 percent) of all bites occurred to individuals 25 years of age and younger. On average, the age of the victim was unreported in 2.6 percent of the bite cases.

Sex of victim. On average, males were victims in 52.6 percent of all bite cases and females in 47.3 percent of the cases. The difference between sexes in the likelihood of being bitten was not significant ($t = 1.19, P = .234$, Arcsine transformation). Furthermore, there was no apparent tendency for one sex to be bitten more within a particular age group than the other sex.

Time of day. The single most active time period in terms of the bites reported was between noon and 5:59 p.m., during which time an average of 47.2 percent of the bites occurred. Both time periods bordering this one (7 a.m.–11:59 a.m. and 6 p.m.–11:59 p.m.) also accounted for a large number of bites (50.7 percent of the reports in which the time was reported). The early morning hours (midnight–6:59 a.m.) accounted for relatively few cases. A total of 17.8 percent of all reports did not list the time of the bite incident.

Bite site. Bites to the victims' legs accounted for a mean of 54.7 percent of all incidents in which the bite site was recorded, making the legs the most frequently bitten parts of the body. Bites to the hand were also common, occurring in 14.9 percent of all incidents. Bites to the head, face, and neck occurred in 10.7 percent of the cases, but were typically associated with children 10 years of age and under. The category "multiple" refers to incidents in which the victim was bitten in two or more areas of the body. This was relatively infrequent, being reported in only 2.9 percent of the bite cases. A typical biting incident would involve a single attack in which the dog bit quickly, released its hold, then left on its own or was driven away. It was not clear why a dog would be involved in a multiple bite attack.

Geographic location. Nearly one-half (mean of 47.5 percent) of the bites for which a location was recorded occurred on a street near the dog's home-site—that area where the primary shelter is located (8). Private homes and yards accounted for another

Table 2. Number of dog bites reported per month, Fort Defiance service unit

Month	Fiscal year ¹				
	1980	1981	1982	1983	1984
October	0	6	8	4	7
November	0	8	16	4	8
December	6	2	10	3	7
January	1	7	6	9	6
February	13	11	6	4	4
March	9	10	8	5	12
April	15	14	9	5	11
May	9	17	10	8	11
June	7	10	17	15	unavailable
July	15	13	11	14	unavailable
August	11	17	20	3	unavailable
September	10	11	14	3	unavailable
Total	96	126	135	77	67

¹ October 1 to September 30.

37.3 percent of all known locations. Nearly one-half of all reports (mean = 47.7 percent) did not provide enough information to determine the geographic location.

Dog's sex. On average, male dogs were involved in 73 percent of all bite incidents in which the biter's sex was known. Thus, a victim was three times more likely to be bitten by a male than a female. The sex of the biter was unknown in 16.5 percent of the reports reviewed.

Dog's age. The majority of biting dogs fell into the young adult age group of 1–5 years (69.1 percent). Dogs less than 1 year of age and older than 5 years of age were equally likely to be involved in a biting incident, each averaging about 13 percent of the known-age cases. The ages were unknown in 29.1 percent of all cases ($N = 501$).

Dog's breed. Mixed-breed dogs were involved in a mean of 87.8 percent of all bite incidents in which the dog's breed was reported, with the remaining percentage representing purebred dogs. The breed was unreported in 32.2 percent of all cases ($N = 501$).

Dog's size. Approximately one-half (mean = 49.2 percent) of the biting dogs were reported to be "medium" body size, 31.6 percent were said to be "large," and 19.2 percent were "small" dogs. The estimates of body size are subjective, based on the victim's experience, and therefore not standardized. Body size was not reported in an average of 13.3 percent of the cases.

Possible cause of attack. Territoriality exhibited by the dog and teasing of the dog by the victim accounted for 94.1 percent ($N = 255$) of all bite cases in which the cause could be determined. "Other" causes were responsible for 4.3 percent of the incidents. Only 1.6 percent of the cases could be reliably placed in the "unprovoked" category, given the information provided by the victim. A total of 246 of the reports (49.1 percent, $N = 501$) did not have enough information to make a determination of the possible cause.

Group size. Fourteen (2.8 percent) of the cases involved more than one dog (table 4), but only in 3 of the 14 incidents did more than one dog (in these cases, both members of a pair) bite the victim. Group size was unknown in 4 cases, but it seems likely that more than two dogs were involved. In

eight (57.1 percent) of the groups, all of the dogs involved lived together, while the relationship between dogs was unknown in 6 cases. Males and females were equally likely to be the victim of a group attack. A possible cause of attack could only be determined in 4 (28.5 percent) of the 14 cases, and all involved territoriality.

Other service units. A review of the 271 bite reports obtained from four other service units indicated that the same factors influence dog bites throughout the reservation. That is, there was no statistical difference between the results presented for the Fort Defiance service unit and the other service units in regard to any of the 11 classes of information examined. The Fort Defiance data were therefore representative of the reservation as a whole.

Table 3. Summary of Fort Defiance, AZ Service Unit dog bite information, fiscal years 1980-84.

Category	Frequency of bite cases by fiscal years					Category	Frequency of bite cases by fiscal years				
	1980	1981	1982	1983	1984 ¹		1980	1981	1982	1983	1984 ¹
Age of person bitten:						Where occurred—continued					
0-5 years	13	20	25	16	8	Unknown	38	60	73	38	30
6-10	18	18	24	26	12	Percent in					
11-25	28	36	44	23	20	street	43.1	36.4	50.0	56.4	51.4
26-40	18	23	22	5	11	Dog's sex:					
41-60	13	17	15	6	13	Male	38	83	91	52	45
61 or older	2	3	3	1	3	Female	25	22	32	17	14
Percent under 25	64.1	63.2	69.9	84.4	76.9	Unknown	33	23	13	8	8
Sex of victim:						Percent male	60.3	79.0	74.0	75.4	76.3
Male	41	60	71	49	38	Dog's age:					
Female	55	66	64	28	29	Less than 1 year	4	15	15	5	7
Percent male	42.7	47.6	52.6	63.6	56.7	1-5 years	33	58	70	44	37
Time of day:						5 or older	12	18	21	7	9
Midnight-6:59 a.m.	3	2	3	0	1	Unknown	47	37	30	21	14
7 a.m.-11:59 a.m.	12	25	21	8	13	Percent 1-5 years	67.3	63.7	66.0	78.6	69.8
Noon-5:59 p.m.	40	52	46	32	24	Dog's breed:					
6 p.m.-11:59 p.m.	25	32	34	23	16	Shepherd mix	12	16	17	5	4
Unknown	16	15	31	14	13	Other mix	30	49	75	46	44
Percent noon-5:59 p.m.	50	46.8	44.2	50.8	44.4	Pure	8	12	12	2	7
Bite site:						Unknown	46	51	32	24	12
Arm	7	9	10	7	6	Percent mixes	84.0	83.2	88.5	96.2	87.3
Leg	40	58	62	41	31	Dog's size:					
Hand	16	14	23	8	8	Small	16	22	26	14	8
Foot	3	2	5	3	2	Medium	40	41	55	38	34
Face or head	6	14	11	10	5	Large	12	28	17	6	8
Other	5	2	4	1	3	Unknown	12	28	17	6	8
Multiple	4	1	3	2	2	Percent medium	47.6	41.0	46.2	53.5	57.6
Unknown	15	26	16	5	11	Cause of attack:					
Percent leg	49.4	58.6	52.5	58.6	54.4	Teasing	20	31	35	15	14
Percent face or head	7.4	14.0	9.3	13.9	8.8	Territorial	28	29	31	15	23
Where occurred:						Unprovoked	2	1	0	0	1
Home	7	18	3	2	6	Other	3	1	2	2	2
Yard	17	15	20	8	6	Unclear	43	64	67	45	27
Field	4	3	4	3	5	Percent teasing	37.7	50.0	51.5	46.9	35.0
Street	25	24	31	22	19	Percent territorial	52.8	46.8	45.6	46.9	57.5
Other	5	6	4	4	1						

¹ As of June 30

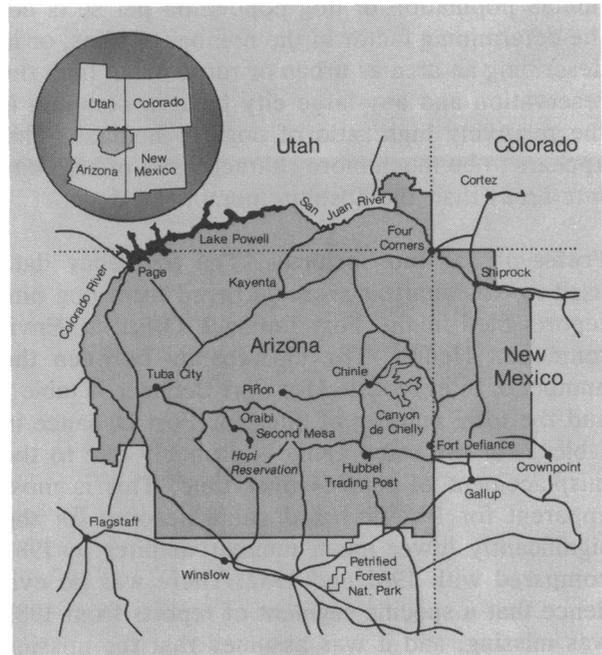
Discussion

The data base. The significance of frequency data concerning dog bites is unclear (2). It has been estimated that only about one-half of the dog bites occurring in urban areas are reported (9). There are a number of factors that influence the victim's decision to report a bite and these, consequently, will affect the data base.

On the Navajo Reservation possible reasons for not reporting a dog bite included: (a) the victim was bitten by his or her own dog and felt there was no health problem, (b) the bite was not serious and did not require medical attention, or (c) the victim was at a remote area of the reservation, such as a sheep camp, without easy access to medical facilities. In addition, some minor bites may have been seen and treated at an IHS facility, but the attending physician did not feel the case warranted further investigation. There is no way of knowing the number of cases that go unreported, but it is quite possible that it exceeds one-half of the total bites. However, the assumption that must be made is that the data represent an unbiased sample of all dog-bite incidents.

Overall bite rate. The reservation-wide bite rates for 1981–1983 are comparable to rates reported for urban areas, such as Baltimore (425 bites per 100,000 people in 1970; 737 bites per 100,000 people in 1971) (2), and St. Louis (396 bites per 100,000 people in 1972; 448 bites per 100,000 people in 1973) (6). This would be quite an unexpected finding if one looked simply at the mean human population density on the reservation, which is about six people per square mile. However, this is misleading because the population is not uniformly distributed throughout the reservation, but clumped in small communities ranging in size from several hundred

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to a few thousand residents. The net effect of community living is the creation of small, isolated urban-like areas despite a reservation-wide density that is typical of a rural area.

For instance, in a small community of 500 people, in which 5 people live in each home (100 homes), 60 percent of the homes will have at least one dog. This indicates a dog to human ratio of at least 60 to 500, or 1 dog to 8.3 humans. A ratio of 1 dog to 7 people was calculated for Baltimore (2), so that in relative terms the two areas are no different. In effect, the reservation, which must be considered a rural area in most ways, is mimicking large cities in its dog-

Table 4. Summary of group dog attacks, Fort Defiance, AZ, service unit, fiscal years 1980–84

Fiscal year	Group size	Number that bit	Dogs' relationship with each other	Sex of victim	Reason
1980	2	1	Live together	Female	Unknown
1980	4	Unknown	Live together	Female	Unknown
1980	"Bunch"	1	Unknown	Male	Unknown
1981	2	2	Live together	Female	Territoriality
1981	2	2	Unknown	Male	Unknown
1982	2	2	Live together	Male	Territoriality
1982	2	1	Live together	Male	Unknown
1982	"Pack"	1	Unknown	Female	Unknown
1982	3	1	Unknown	Female	Unknown
1982	2	1	Live together	Female	Unknown
1982	"Pack"	1	Unknown	Male	Unknown
1983	2	1	Live together	Male	Territoriality
1983	"Group"	1	Live together	Female	Territoriality
1984	3	1	Unknown	Male	Unknown

bite problems. It is important to realize that a large human population or dog population per se is not the determining factor in the number of bites, or in describing an area as urban or rural. What both the reservation and any large city have in common is the relatively high ratio of dogs to humans. This appears to be much more characteristic of high bite rate areas than the absolute number of dogs.

Profile of dog bite incidents. The frequency data used in this analysis were gathered from dog bite reports filed in the Fort Defiance Office of Environmental Health. The discrepancy between the number of bites reported for Fort Defiance in table 1 and the total number of bites for Fort Defiance in table 2 for the same years is probably due to the misplacement of reports over time. This is most apparent for FY 1983 and could account for the significantly lower mean number of bites in 1983 compared with 1981 and 1982. There was no evidence that a specific segment of reports from 1983 was missing, and it was assumed that the missing reports for all 5 years represented a random sample of all reports.

Age of person bitten. The commonly held conception that children are the most frequently bitten age group was supported in this study: 71.7 percent of the reported bites occurred to individuals 25 years old or less. Furthermore, an average of 42.1 percent of all bites occurred to individuals 10 years of age or less, although this age group constitutes only 26.4 percent of the population, according to Ron Faich, Navajo Tribe statistician. Thus, children under 10 were bitten significantly more often than expected ($P = .001$, Arcsine transformation). A similar trend was noted in Baltimore, where 60 percent of the victims were under 15 years of age, although they represented less than 30 percent of the population (5).

The fact that most bites were reported in the summer months may be related to the age structure of the human population. Because school is out, the average number of children outside, and therefore the number of potential bite victims, is higher. Besides the greater number of children on the streets, other factors, such as the tendency for children to associate more with dogs than adults do (4) may play a role in increasing their susceptibility to bites.

The first consideration is the relative inexperience children have in dealing with dogs, which, in turn, may lead to inappropriate behavior by the child in a potential bite situation. The natural reaction of a child is to turn and flee from a threatening

dog, and the dog typically responds by chasing the retreating object. This reaction by the dog is nearly guaranteed if the encounter takes place within its territory. Even if both parties are on neutral ground—and few are (see possible cause of attack)—the exhibition of fear by the child will often be sufficient to nullify any ambivalence the dog may have about acting aggressively in an unfamiliar setting. It has also been noted (10) that the natural defense reactions of flailing, kicking, and screaming by the victim may actually escalate the attack.

Second, the smaller body size of children may increase their bite-proneness because of the increased risk of establishing eye contact with the dog, which may in turn be interpreted by the dog as a threat. The result is liable to depend on other contextual cues, such as the location of the encounter with respect to the dog's homesite.

Sex of the victim. Both males and females were bitten in equal numbers on the reservation, indicating that one sex was not more likely to instigate dog attacks than the other. The Navajo population sex ratio was statistically even, so the relative frequency of being bitten further indicates that the dogs were not showing any sex preference. These findings are in contrast to those for Pittsburgh, PA (4), and St. Louis, MO (6), where males were bitten twice as often as females. The sex bias in these cities has been attributed to a higher level of aggression in male victims (4) and the possibility that males spend more time in contact with dogs than do females (4,6) although neither point was investigated further.

Time of day. There are probably two main reasons why the highest bite rate was recorded between the hours of noon and 6 p.m. First, this was the time of day when most people were active, resulting in a higher rate of dog-human encounters than at other times. Further analysis revealed that the majority of bites during this time occurred between 3 p.m. and 6 p.m., which corresponds to times when children return home from school and adults from work. Second, dog activity tends to follow a crepuscular pattern, with early morning and late evening hours being the prime activity periods (8). Conversely, most dogs are relatively inactive and at the homesite during the "high-bite" times people are likely to be there also. The two reasons given are complementary: bites were highest when the dog-human encounter rate was highest.

Bite site. The high proportion of bites to the victims' legs can be interpreted simply as the result of a dog attacking the most accessible part of the body. In addition, the movement of the legs, which may or may not be used to threaten the dog or defend against its advances (4), might also be an added attraction: movement is a key stimulus initiating the attack activities of many predators, and movement away from the dog (resulting from leg movement) is known to stimulate a chase reaction.

The frequency of bites to the head and face area of children is also consistent with an interpretation that the dog is biting an accessible part of the body. In the case of smaller children, the face is nearer to the dog. More than 35 percent of the bites received by children in the St. Louis study (6) were face bites. Vocalizations by the child may also stimulate the dog to bite at their source. Finally, it has been suggested that face biting may be part of a dog's play or fight behavior repertoire (6) and thus should not be considered unusual once the appropriate stimulus has been presented to the dog.

Bites to other areas of the body are probably also the result of the dog opportunistically biting the nearest appendage. Multiple bites were rare, occurring in a mean of 2.9 percent of the incidents. No special stimulus for attack was apparent in these cases, and the additional bites (usually just one additional bite) were often near the original site, such as the arm, then the hand. It is possible that the second bite resulted from the inability of the victim to get away from the dog, and therefore the stimulus remained present. On the other hand, the dogs involved might have been more prone to bite for any reason, independent of the victims' responses. Because multiple bites are an anomaly, further information that might prove useful in preventing them will be slow in coming.

Geographic location. The majority of bites occurred on or near the dog's homesite, implying a territorial cause for the attack. These areas (home, yard, street) are also where people can frequently be found, so the high frequency of bites there is to be expected. It has been noted that 45 percent of the 2,538 bite cases investigated in St. Louis, MO (6), occurred on or near the dog's property.

The category of "other" locations included areas that often had large congregations of people, such as school grounds. Relatively few bites occurred in these areas and it is likely that the number of incidents remained low because of the dogs' tendency to avoid prolonged stays in neutral or unfamiliar areas.

The large number of people in a particular spot may also have been a deterrent. However, when dogs are present, there is generally a great deal of concern for the people in the area, which could be justified, given the age of those people and their reactions to dogs. For instance, more attention should be paid to dogs present in schoolyards than to those roaming a department store parking lot.

Dog's sex. The predominance of male biters, a ratio of 3 to 1 over females, is in direct proportion to the reservation dog population sex ratio, according to my unpublished data. Thus, one sex was not prone to bite more than the other. This is in contrast with the Pittsburgh, PA, study (4), in which it was observed that females showed a higher bite rate than males. However, no explanation for the difference in tendencies to bite was given (4). Since no correlation was found between a dog's sex and the cause of attack, such as territoriality, it would appear that females are as territorial as males; the idea that males are better watchdogs and more aggressive was not supported here.

Dog's age. In some instances, younger animals, aged 6–11 months, appear to be more likely to bite than other age groups (4), but this was not the case on the reservation. The percentage of biting dogs in each age category is representative of their proportion in the dog population, indicating that all age groups are equally likely to bite. It is likely that the specific causes of attack vary among age groups, however, but this was not examined. For example, adults and old adults are more liable to exhibit territoriality than juveniles, and, conversely, young dogs may be teased more often or treated less cautiously than adults, resulting in higher bite rates for that age group under those particular conditions.

Dog's breed. Most dogs observed on the Navajo Reservation were mixed-breeds, and the bite frequency by mixes and pure-breeds reflected their occurrence in the population. Although one-half of all bites reported in Baltimore were from mixed-breeds (2), which were less likely to be supervised, both mixes and pure-breeds were likely to be unsupervised on the Navajo Reservation and therefore might enter a bite situation. There was no evidence to suggest that mixes were more likely to bite than pures, or vice versa.

Dog's size. Observations indicate that most dogs on the reservation are medium-large in size, weighing 40–50 pounds (18.1–22.7 kg). It is likely that this

size dog was described in the bite reports as medium, and therefore no particular sized dogs were doing a disproportionate amount of biting.

Possible cause of attack. The most important point to be made here is that nearly every bite incident investigated can be explained logically if the biter's perspective is considered. This finding contrasts with that in the Pittsburgh study (4) in which it was concluded that bites were provoked and unprovoked with equal frequency. It should be kept in mind that an unprovoked attack, or any unprovoked action, is an anomaly, and the average dog, by definition, does not behave in an anomalous way. The victims' perceptions of attacks as unprovoked probably resulted from not understanding the implications of their actions. In fact, the four cases classified as unprovoked might prove to be otherwise if further details were available. Unfortunately, even if the victim behaves in a socially acceptable manner during encounters with dogs (6) it may not be enough to negate any unintentional provocation. However, because the underlying causes of attack can often be ascertained, it is possible to take preventive measures to avoid entering into a bite situation.

Groups. Most bites involved a single dog, just as most community dogs were observed singly and not in groups. However, the proportion of bite cases involving groups of dogs (2.8 percent, $N = 501$) was twice the proportion reported in St. Louis (6) and may indicate a trend toward greater sociality on the reservation. Surveys of two communities on the reservation (Window Rock, AZ, and Navajo, NM) indicated that a relatively high number of homes were sheltering two or more dogs, according to my data, which could be expected to engage in territorial defense during an intrusion. Therefore, groups involved in dog bites will typically be composed of familiar dogs reacting to the same situation in a predictable way. Such situations lend themselves to preventive measures.

Conclusions

The profile of dog-bite cases on the Navajo Reservation is similar to that of the urban areas for which data are available, indicating that both rural and urban areas, though different in most respects, are comparable in the underlying factors that influence dog bites. It is suggested that the ratio of free-ranging dogs to the human populace is similar in urban areas and the reservation, and therefore

the frequency of potential bite situations is high. Particular differences between the urban dog-bite profiles reported by other authors and these data include the sex of the victim, the dog's sex, and the dog's age, as well as the frequency with which groups of dogs are involved in the bite case. Reasons for these differences remain unclear, with the Navajo dogs acting only in proportion to their presence and that of their victims.

The fact that nearly all of the bites can be explained as a logical reaction by the dog to some stimulus is important because it leads to a measure of predictability concerning the times, places, and circumstances under which bites might occur. Related to this is the fact that most free-ranging dogs are owned (2,8); therefore, one obviously effective step toward reducing the number of bites would be greater leash law enforcement and restriction of dog activities.

It is true that too much emphasis in past reviews has been put on "assuming victim provocation" led to the bite (6), and that consequently the owner of the dog was often left blameless. However, labeling an incident as unprovoked is not helpful either. It simply shifts any responsibility for bite prevention away from the victim and entirely onto the dog and its owner. Although pet owners are the primary contributors to the problem by allowing their dogs to range freely, potential victims also have a responsibility to minimize their own chances of being bitten.

Education of the public, particularly of children and their parents, should be a priority not only on the reservation but anywhere dog bites pose a serious problem. Future attempts to curb the reservation's high dog-bite rate will be less effective and more costly over the long term if dog control measures alone are instituted without educating residents about basic dog behavior and ways to avoid encounters that could result in a bite. For example, children should be taught not to tease, run from, or play near strange dogs; not to threaten (stare or shout at) dogs; and to leave dogs home rather than take them to the bus stop or to school. Adults should be reminded of a dog's territorial inclinations, of safe ways to handle injured pets, and of the need to institute dog control measures, such as turning in unwanted pets to a humane shelter for disposal.

The issue of a dog control program on the reservation is one that has been debated for nearly 30 years. Several programs were instituted, only to be phased out when operating funds were withdrawn. In addition, there are cultural factors that limit the

effectiveness of some control measures which might work in other regions.

First, the dog is a utilitarian part of Navajo life and is therefore desirable; in the more rural areas of the reservation the dog is typically used for herding sheep, while in the more populous community areas it functions as a household protector. The question then becomes "How many dogs are needed to carry out the job?", not "Should there be any dogs at all?". Many Navajos readily agree that they have too many dogs, and, unfortunately, abandonment has become a major control practice, my data show. Second, there may be an aversion to spaying or neutering dogs on the reservation for three reasons: (a) it may be too costly; (b) it is often believed that castration alters a dog's behavior, making it less likely to be protective; and (c) it eliminates any choice on the part of the owner to supplement his or her own dog population as the situation warrants.

Each of these reasons needs to be and can be addressed within the framework of an effective dog control program. For instance, given the ratio of males to females, spay programs should receive a higher priority than neutering males. Although a single spay operation is more expensive than a single castration, spaying will be more cost effective. As an example, one male can inseminate any number of females in the area of his homesite, and, unless all the males in that area are neutered, the probability of the female becoming pregnant remains high. Since neutering every male is practically impossible, targeting the fewer females makes more sense.

In all, the dog-bite problem is not insurmountable, and reasonable steps can be taken to reduce the health impact on the human population.

References

1. Hull, T. G., editor: Diseases transmitted from animals to man. Ed. 5. Charles C Thomas, Springfield, IL, 1965.
2. Beck, A. M.: The ecology of stray dogs: a study of free-ranging urban animals. York Press, Baltimore, 1973.
3. Brobst, D., Parrish, H. M., and Clack, F. B.: The animal bite problem in selected areas of the U.S. Vet Med 54: 251-256, May 1959.
4. Parrish, H. M., Clack, F. B., Brobst, D., and Mock, J. F.: Epidemiology of dog bites. Public Health Rep 74: 891-903, October 1959.
5. Berzon, D. R., Farber, R. E., Gordon, J., and Kelly, E. B.: Animal bites in a large city—a report on Baltimore, Maryland. Am J Public Health 62: 422-426, March 1972.
6. Beck, A. M., Loring, H., and Lockwood, R.: The ecology of dog bite injury in St. Louis, Missouri. Public Health Rep 90: 262-267, May-June 1975.
7. Sokal, R., and Rohlf, R.: Biometry. John Freeman and Sons, San Francisco, 1969.
8. Daniels, T. J.: The social organization of free-ranging urban dogs: I. Non-estrous social behavior. Appl Animal Ethology 10: 341-363, March-April 1983.
9. Crawford, K. L.: A survey of animal control activities in Maryland, 1964. Bureau of Preventive Medicine, Maryland State Department of Health, 1964.
10. Borchelt, P. L., Lockwood, R., Beck, A. M., and Voith, V. L.: Attacks by packs of dogs involving predation on human beings. Public Health Rep 98: 57-66, January-February 1983.

Incorporating Outcome Standards into Perinatal Regulations

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Synopsis

State and local governments license and monitor hospitals to ensure that a minimum acceptable level of care is present as one means of improving the outcomes and health status of patients served.

Standards developed to achieve these purposes, however, have focused almost exclusively on the inputs and processes believed to be necessary for quality care and optimal services. Even when the overwhelming consensus of professionals and providers is that such standards impact positively on outcomes, direct evidence of such causal relationships is often lacking.

In 1983, the Chicago Department of Health began incorporating direct measurement of outcomes into its mandated regulatory functions for one operating unit of hospitals—the maternity and newborn services. Crude perinatal and neonatal mortality rates for Chicago hospitals are adjusted using an indirect standardization process that controls for both race and birth weight. This process allows for the calculation of adjusted mortality