

# Incidence of Dog Bite Injuries Treated in Emergency Departments

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**Context.**—Dog bites that result in injuries occur frequently, but how frequently dog bite injuries necessitate medical attention at a hospital or hospital admission is unknown.

**Objective.**—To describe the incidence and characteristics of dog bite injuries treated in US emergency departments (EDs).

**Design.**—Emergency department survey from the National Center for Health Statistics National Hospital Ambulatory Medical Care Survey for 1992 to 1994.

**Patients.**—National probability sample of patients visiting EDs.

**Main Outcome Measure.**—Incidence of dog bites treated in EDs, defined as a cause of injury recorded as the E-code E906.0.

**Results.**—The 3-year annualized, adjusted, and weighted estimate of new dog bite-related injury visits to US EDs was 333 687, a rate of 12.9 per 10 000 persons (95% confidence interval [CI], 10.5-15.4). This represents approximately 914 new dog bite injuries requiring ED visits per day. The median age of patients bitten was 15 years, with children, especially boys aged 5 to 9 years, having the highest incidence rate (60.7 per 10 000 persons for boys aged 5 to 9 years). Children seen in EDs were more likely than older persons to be bitten on the face, neck, and head (73% vs 30%). We estimated that for each US dog bite fatality there are about 670 hospitalizations and 16 000 ED visits.

**Conclusions.**—Dog bite injuries are an important source of injury in the US population, especially among children. Improved surveillance and prevention of dog bite-related injuries, particularly among children, are needed.

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THE CLOSE ASSOCIATION between humans and domesticated dogs began at least 12 000 years ago.<sup>1</sup> Since then, people have been intimately involved in domesticating the wild dog into hunter,

guard, and companion. However, the domesticated dog retains many of its wild instincts, including behaviors that all too often lead to human attacks. This risk has always been present. Only now, however, are we beginning to gain a full understanding of the impact of dog bites on populations.<sup>2</sup>

Estimates of dog bite injuries have been reported from data derived from household surveys, hospital-based studies, school-based surveys, local animal shelter monitoring, police reports, and newspaper articles.<sup>2-8</sup> Because of lack of a national reporting system and variation of local reporting procedures, accurate national incidence rates for dog bite-related emergency department (ED) visits and hospitalizations have not

been well quantified. The reported incidence of ED-treated dog bite injuries in the United States ranges from 0.3% to 1.1% of all ED visits.<sup>3,9,10</sup>

With regard to overall morbidity, the annual number of total bites that occur in the US population has been estimated to range from 500 000 to 4.5 million.<sup>11,12</sup> It has been estimated that almost half of all children have been bitten by a dog at some point in their lives.<sup>5</sup> Among children, more than 50% of documented bites have been to the head, face, or neck.<sup>4,13,14</sup> Unfortunately, most of the studies that provided this descriptive information were limited because of small sample size and lack of consistent definitions, or they were not representative of the general population.

Recent work by Sacks et al<sup>2</sup> has improved the precision of national estimates for dog bite-related mortality and for dog bites receiving any medical attention. For the 10-year period, 1979 through 1988, an annual average of about 15 fatal dog attacks was documented in the United States, with extrapolated estimates suggesting that as many as 20 per year may have actually occurred.<sup>11</sup> Based on a random household survey, the Injury Control and Risk Survey conducted by the Centers for Disease Control and Prevention, it was estimated that about 800 000 bites occur annually that require medical attention.<sup>2</sup> However, this estimate was not able to break down the proportion of patients seen in hospitals owing to the small size of the sample. The only nationwide study from any country that examined both major morbidity and mortality from dog bite injuries was conducted in New Zealand.<sup>15</sup> This study predicted an incidence of hospitalization due to dog bites in the year 2000 of 9.6 per 100 000 persons, twice the incidence for 1979.<sup>15</sup>

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The purpose of the present study is to estimate the incidence and characteristics of dog bite injuries treated in US EDs using a 3-year population-based stratified random sample of US ED visits. This study also fills the gaps in our understanding of the patterns of medical care for dog bite victims. With such an understanding, the broad medical and public health impact of dog bite-related injuries can be better appreciated and targeted for preventive efforts.

## Methods

**Data Source.**—Data were obtained from the ED component of the 1992-1994 National Hospital Ambulatory Medical Care Survey (NHAMCS), a population-based stratified sample of US ED visits. This survey, conducted annually since 1992, is directed by the Centers for Disease Control and Prevention National Center for Health Statistics. The combined 1992-1994 data set represented estimates applying to approximately 274 million ED visits<sup>16-18</sup> (about 91 million visits per year). The NHAMCS is a national probability sample of non-institutional general and short-stay hospitals (excludes federal, Veterans Affairs, and military hospitals). It uses a 4-stage probability sample that covers geographic primary sampling units, hospitals within primary sampling units, EDs within hospitals, and patients within EDs. Data collection takes place during a randomly assigned 4-week data period for each of the sampled hospitals. The US Bureau of the Census regional staff oversees the data collection process, while actual data collection is the responsibility of hospital staff. A separate data collection form is filled out at or close to the time of visit for each sampled patient. A full report of the methods used in this survey is available from the National Center for Health Statistics (NCHS).<sup>16</sup>

After the forms are completed, they are sent to NCHS where *International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM)* coding takes place by experienced nosologists. A maximum of 3 E-codes are assigned to each case. The nosologists work from the data collection form, not the original medical record. For 1992-1994, a total of 91 935 patient forms were collected.

**Definition and Case Selection.**—A dog bite injury was defined as any ED visit with an *ICD-9-CM* E-code of E906.0 (“dog bite”) in the primary, secondary, or tertiary E-code field. More than 99% of the cases were identified from the primary E-code field. To obtain incidence estimates (ie, new cases) records from the 1992 data set were excluded if they were not marked as “Injury, first visit” in the data set to pre-

vent counting follow-up visits. This excluded 17.9% of the dog bite-related injuries from the 1992 data. The 1993 and 1994 data collection instruments did not contain information on whether the visit was a first visit for injury or follow-up visit. Therefore, the sample weights from each of these latter 2 years were reduced by 17.9% based on the percentage of follow-up visits found in 1992. All 3 years were then combined and averaged to produce mean annual national estimates. The NCHS suggests the minimum reliable estimate for this combined data set is 30 000 visits (Catherine W. Burt, EdD, Ambulatory Care Statistics Branch, NCHS, oral communication, August 30, 1996). Place of injury (home, work, school, street, etc) was only collected in 1993 and 1994. An addition was made to the NHAMCS data set by imputing an Injury Severity Score from the primary and secondary diagnosis fields. The Injury Severity Score ranks injury severity mainly in terms of threat to life. In this study the Injury Severity Score was derived by automated translation of the *ICD-9-CM* diagnoses using Tricode software (Tri-Analytics Inc, Bel Air, Md).

**Data Analysis.**—Data were obtained from NCHS on floppy diskettes in ASCII format and combined for analysis on a desktop computer using SPSS software (SPSS Inc, Chicago, Ill). Rates were computed by dividing incidence estimates by the appropriate population estimate. The 1993 total US population estimates were used as enumerated by the NCHS. The results are presented using weighted values to produce annual national estimates. Approximate relative standard errors in percentages used for calculating 95% confidence intervals (CIs) for reported aggregate estimates and rates are based on a model suggested by NCHS (Catherine W. Burt, EdD, Ambulatory Care Statistics Branch, NCHS, oral communication, August 30, 1996).

## Results

The annualized weighted estimate of the incidence of new dog bite-related injuries seen in US EDs was 333 687 (95% CI, 269 950-397 424) for a rate of 12.9 (95% CI, 10.5-15.4) per 10 000 persons. These injuries comprised about 0.4% of all ED visits during the study period. (Numbers and rates for race, sex, age, age and sex, geographic region, season, and day of month are available from the authors on request).

Ages of victims of dog bite-related injuries ranged from younger than 1 year to 91 years (median age, 15 years). Incidence rates were significantly higher among children aged 0 to 9 years, especially among boys. The 5- to 9-year-old male age group had the highest rate, 60.7

ED visits per 10 000 persons (95% CI, 34.8-86.6). The estimated 57 580 dog bite-related visits for boys aged 5 to 9 years represent 3.6% of all injury-related ED visits in this age and sex group.

Among the cases in which body part area could be determined (about two thirds of the cases), the face, neck, and head (combined) were the leading body part sites affected (29%), followed by the upper limbs and lower limbs. Among children aged 0 to 9 years, 73% of the injuries with attributed injury site were to the face, head, and neck, while all other ages had only 30% of the injuries occur to the face, head, and neck. There was a nonsignificant trend toward a seasonal distribution of the incidence of dog bite injuries, with the highest rates being observed during the summer months. Although the highest number of cases was seen in the southern region of the United States (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia), the population-adjusted rates were similar by geographic region and not significantly different from one another.

Over half the dog bite injuries (58.0%) were reported to have occurred at a home. Dog bite-related ED visits were more likely to occur on the weekends. Dog bite injuries were triaged in the ED as urgent-emergent in 46.1% of the visits and nonurgent for the remainder. Ninety-six percent of patients making dog bite-related ED visits were treated and released from the ED; the remainder were admitted to the hospital or transferred to another facility. Among the 94% of the cases assigned a calculated ISS score, 99% were of low severity (Injury Severity Score, 1).

## Comment

This study extends previous work in dog bite epidemiology by adding more precise quantitative information about ED visits and incidence. It fills the remaining gap in our understanding of where people go for medical treatment of dog bites, thereby more clearly defining their burden on the medical care system. Using the (rounded) NCHS survey data reported here of 334 000 dog bite-related ED visits with a 4% hospitalization rate, Centers for Disease Control and Prevention household survey estimates of 757 000 medically treated and 3.73 million nonmedically treated dog bites,<sup>2</sup> and averaged mortality data reporting about 20 deaths per year,<sup>11,19</sup> it appears that, for each US dog bite fatality, there are about 670 hospitalizations, 16 000 ED visits, 21 000 other medical

**Comparison of the Frequency of Annual US Emergency Department Visits for Injuries Associated With Selected Activities and Products**

Selected Activity	Estimated Annual No. of Emergency Department Visits
Baseball/softball*	404 364
Dog bites	333 687
Playground*	266 810
All-terrain vehicles, mopeds, etc*	125 136
Volleyball*	97 523
Inline skating*	75 994
Horseback riding*	71 162
Baby walkers†	28 000
Skateboards*	25 486

\*Data from US Consumer Product Safety Commission.<sup>20</sup>

†Data from US Consumer Product Safety Commission.<sup>21</sup>

visits (office and clinic), and 187 000 non-medically treated bites. Consistent with the results of other reports, males were more likely than females to be bitten by dogs, children had the highest rate of ED visits for dog bite injuries, and young children were more likely than adults to be bitten in the head, neck, and face area.

The Table presents some interesting comparisons between the incidence of the dog bite-related ED visits and ED visits for selected injury types reported by the US Consumer Product Safety Commission (CPSC).<sup>20</sup> The CPSC does not currently collect or report dog bite-related injuries.

We also applied a limited but useful payment model to the data. This model was based on averaging a non-NCHS/NHAMCS sample of actual ED visit reimbursements for each of several broad body part-based diagnosis code groupings (details available from authors on request). This conservative model excluded indirect costs (such as pain and suffering or lost work, either by parents or the victim), charges for ED follow-up visits and inpatient visits, and non-ED-

related charges. Also, given the risk of infection,<sup>22</sup> the ragged nature of many bite-related lacerations, and the large number of dog bites treated by at least an initial course of rabies prophylaxis, the average payment for a dog bite-related injury might be much higher than the diagnostic group average used in the model. Nevertheless, using this model we estimate the average dog bite results in a payment to the hospital of \$274 and a national annual total payment for ED services for new dog bite-related injuries of \$102.4 million. Children and adolescents younger than 20 years accounted for over half these payments (\$58.7 million), and Medicaid, Medicare, and other government sources were mentioned as payers in 26% of the visits.

Regarding study limitations, some undercounting was possible since the NHAMCS data set had no cause of injury text-string field available to search for dog bite-related visits that were not E-coded. Therefore, some bites may not have been identified on account of missing or incorrect coding. However, a single, unambiguous E-code for dog bites limits the false positives likely in the ICD-9-CM coding scheme used in this data set.

The NHAMCS provides the ongoing ability to quantify nationally the magnitude of the incidence of hospital-treated dog bite injuries. This data set is a representative sample of the US population from which trends can eventually be followed for the nation as a whole and to set realistic goals for local programs. However, sample size issues result in large 95% CIs for many subgroup distributions, limiting the data set's usefulness. Most animal control programs are administered locally and require local and more specific data, such as breed type and

more specificity about the incident, for which the NHAMCS national ED survey is not suited.

Analysis of the NHAMCS data set has shown that each year US EDs treat about 334 000 new cases of dog bites with associated ED treatment payments of over \$100 million. With more than one third of American households owning a dog, the number of dogs in the United States is over 50 million.<sup>23</sup> Clearly, the popularity of the dog as both friend and protector will not soon disappear. Considering the risk to large parts of the population, especially to children, it is necessary that effective preventive strategies be developed and applied to reduce the painful and costly burden of dog bites. We know little about which strategies work or do not work, however.<sup>11</sup> More knowledge is needed through a combination of enhanced and coordinated dog bite reporting systems, expanded population-based surveys, and implementation and evaluation of preventive trials. Particularly for the more severe episodes, information needs to be obtained regarding high-risk situations, high-risk dogs, and what leads to successful preventive interventions.

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**References**

1. Davis SJM, Valla FR. Evidence for domestication of the dog 12,000 years ago in the Natufian of Israel. *Nature*. 1978;276:608-610.
2. Sacks JJ, Kresnow M, Houston B. Dog bites: how big a problem? *Inj Prev*. 1996;2:52-54.
3. Aghababian RV, Conte JE. Mammalian bite wounds. *Ann Emerg Med*. 1980;9:79-83.
4. Brogan TV, Bratton SL, Dowd D, Hegenbarth MA. Severe dog bites in children. *Pediatrics*. 1995;96:947-950.
5. Beck AM, Jones BA. Unreported dog bites in children. *Public Health Rep*. 1985;100:315-321.
6. Gershman KA, Sacks JJ, Wright JC. Which dogs bite: a case-control study of risk factors. *Pediatrics*. 1994;93:913-917.
7. Beck AM, Loring H, Lockwood R. The ecology of dog bite injury in St. Louis, Missouri. *Public Health Rep*. 1975;90:262-267.
8. Pickney LE, Kennedy LA. Traumatic deaths from dog attacks in the United States. *Pediatrics*. 1982;69:193-196.
9. Avner JR, Baker MD. Dog bites in urban children. *Pediatrics*. 1991;88:55-57.

10. Sokol AB, Houser RG. Dog bites: prevention and treatment. *Clin Pediatr*. 1971;10:336-338.
11. Sacks JJ, Lockwood R, Hornreich J, Sattin RW. Fatal dog attacks, 1989-1994. *Pediatrics*. 1996;97(6, pt 1):891-895.
12. Scarcella J. Management of bites: early definitive repair of bite wounds. *Ohio State Med J*. 1969;65:25-31.
13. Chin Y, Berkelhamer JE, Herold TE. Dog bites in children less than 4 years old. *Pediatrics*. 1982;69:119-120.
14. Kizer KW, Town M. Epidemiologic and clinical aspects of animal bite injuries. *J Am Coll Emerg Phys*. 1979;8:134-141.
15. Langley J. The incidence of dog bites in New Zealand. *N Z Med J*. 1992;105:33-35.
16. McCaig LF. *National Hospital Ambulatory Medical Care Survey: 1992 Emergency Department Summary*. Hyattsville, Md: National Center for Health Statistics; 1994. Advance Data From Vital and Health Statistics, No. 245.
17. Burt CW. *Injury-Related Visits to Hospital Emergency Departments: United States, 1992*. Hyattsville, Md: National Center for Health Statistics; 1995. Advance Data From Vital and Health Statistics, No. 261.
18. Stussman BJ. *National Hospital Ambulatory Medical Care Survey: 1993 Emergency Department Summary*. Hyattsville, Md: National Center for Health Statistics; 1996. Advance Data From Vital and Health Statistics, No. 271.
19. Sacks JJ, Sattin RW, Bonzo SE. Dog bite-related fatalities from 1979 through 1988. *JAMA*. 1989;262:1489-1492.
20. US Consumer Product Safety Commission. Injuries associated with selected sports and recreation equipment treated in hospital emergency departments, calendar year 1994. *Consumer Product Safety Review*. Summer 1996;1:5.
21. US Consumer Product Safety Commission. *Stair Steps and Baby Walkers Don't Mix*. Washington, DC: US Consumer Product Safety Commission; 1992. Consumer Product Safety Alert No. 009207.
22. Peel MM. Dog-associated bacterial infections in humans. *Pathology*. 1993;25:379-384.
23. Wise JK, Yang JJ. Dog and cat ownership, 1991-1998. *J Am Vet Med Assoc*. 1994;204:1166-1167.