Animal-related injuries resulting in emergency department visits and hospitalizations in the United States, 2006–2008

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Abstract: This paper presents information on emergency department (ED) visits and hospitalizations resulting from an animal-caused injury from 2006 to 2008 using data collected from the Agency for Healthcare Research and Quality. Information on the number of ED visits and hospitalizations from adverse animal encounters, the types of injuries resulting from such encounters, and the therapeutic procedures performed to treat injured persons from bites or stings caused by various species of animals are presented. The economic costs of animal-caused injuries also are discussed. Over 1 million hospital ED visits and 48,000 hospitalizations were reported annually in the United States due to an animal-caused injury during this time period. Infections resulting from non-venomous animal bites were the major cause of hospital admissions. The estimated cost of these visits, excluding physician fees during hospitalization, exceeded $2 billion annually. Many animal-related injuries can be prevented if advice from wildlife agencies or the Centers for Disease Control and Prevention were heeded.

Key words: animal, bite, hospitalization, human–wildlife conflicts, injury, sting, trauma, venomous

Animal-related injuries are a significant public health concern. Each year in the United States, millions of people are injured by animals, including pets, farm animals, laboratory animals, and wild animals. These injuries result in human deaths, severe injuries, and illnesses. Fortunately, most injuries were nonfatal, but hundreds of thousands of people require treatment by health-care providers, and thousands of people are hospitalized.

Excluding fish, almost 226 million pets are owned in the United States (American Pet Products Association [APPA] 2010). It is estimated that 38.2 million households have a cat, 45.6 million households have a dog, 3.9 million have a horse or pony, 6 million have a pet bird, 4.7 million own a reptile, 5.3 million own a small animal (APPA 2010). The U.S. Department of Agriculture (USDA) estimated that there were 4,028,000 horses and ponies, 283,000 mules, burrows, or donkeys on U.S. farms; 266 million turkeys and 9 billion broilers are produced in the United States. As of July 1, 2009, there were about 102 million head of cattle, 67 million hogs, 7 million sheep, and 3.7 million goats on farms in the United States (USDA 2009). The American Horse Council (2005) estimated that there were 9.2 million horses in the United States in 2005. Additionally, of the millions of wild animals that humans may encounter, some are able to bite, sting, or cause extensive trauma to a person.

A survey conducted by the Centers for Disease Control and Prevention (CDC) from 2001 to 2003 estimated that dogs were responsible for 4.5 million bites to humans each year (Gilchrist et al. 2008). Of these, 885,000 bite victims required medical attention, 300,000 sought help in emergency departments, and 9,500 people were hospitalized (Gilchrist et al. 2008). Farm animals were the second leading cause of injuries on farms (Myers 2001, National Institute for Occupational Safety and Health [NIOSH] 2001). A study of animal-caused occupational deaths and injuries to humans from 1992 to 1997 found that cattle caused 4,600 injuries, horses 5,100 injuries, and swine 1,900 injuries. Of 375 occupational human deaths caused by animals, cattle caused 141 deaths, and horses caused 104 deaths. Fewer than 5 deaths were reported caused by sheep and swine (Druidi 2000). These data did not include workers who were self-employed or who worked on farms with <11 employees.

There have been only a few published studies that have evaluated the spectrum of injuries requiring hospital emergency department (ED) visits or hospitalizations due to various species of animals (Sinclair and Zhou 1995, Massara and Masini 2006, O'Neil et al. 2007, Steele et al. 2007). Even more lacking is information on the therapeutic procedures performed on the victims or the medical costs of such injuries. The objectives of this manuscript are to address

these shortcomings and inform policy makers, health-care workers, and researchers on the public health impacts from bodily injury and economic costs due to adverse animal encounters. This report utilizes data from the Agency for Healthcare Research and Quality (AHRQ) on the number of ED visits and hospitalizations from adverse animal encounters, the types of injuries resulting from such encounters, and the therapeutic procedures performed to persons who were injured by various species of animals.

Methods

Total hospitalizations and ED visits for the years 2006 to 2008 are based on estimates from the AHRQ Health Care Cost and Utilization Project (HCUP) of the Nationwide Inpatient Sample (NIS) and the Nationwide Emergency Department Sample (NEDS; HCUP 2011). The NIS reports community hospital inpatient stays on a nationwide basis and provides a representative sample of hospitals that comprises about 95% of all hospital discharges in the United States. The Nationwide Emergency Department Sample is a database that yields national estimates of ED visits. The Health Care Cost and Utilization Project provides data from community hospitals that are defined as short-term, general, and other hospitals, excluding hospital units of other institutions (e.g., federal prisons). The unit of analysis is the hospital discharge. Thus, if a person is admitted to the hospital multiple times for an animal injury in 1 year, that person will be counted each time as a separate discharge from the hospital.

The principal diagnosis is the condition established to be chiefly responsible for the patient's admission to the hospital. Secondary diagnoses are concomitant conditions that coexist or that develop during the patient's stay. The diagnoses are based on the International Classification of Diseases-Clinical Modification (ICD-CM), which assigns numeric codes to diagnoses. Injury hospitalizations or ED visits due to animals are based on external causes of injury (E-codes).

Both hospitalizations and ED visits are categorized by age group, sex, and region of country where the person was injured. Cases are categorized into the following age groups: <1, 1 to 17, 18 to 44, 45 to 64, 65 to 84, ≥85 years of age. The United States is divided into 4 regions defined by the U.S. Census Bureau as follows: Northeast (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania), Midwest (Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas), South (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas), West (Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii).

Most hospital admissions arise from ED visits. Hospitalization tables reflect all admissions that occur as the result of ED visits or direct admissions from urgent care facilities, physician offices, or other health care facilities. More detailed information for hospitalizations is available for the year 2008, which is more reflective of current costs (AHRQ 2011). This detailed information includes utilization characteristics, such as average costs per hospitalization, average length of stay in days, aggregate costs, and percentage of routine discharge. Hospital charges reflect the amount the hospital charged for the entire hospital stay and does not include physician fees.

Data are analyzed using standardized morbidity ratios. The observed:expected (O:E) ratio, the SE, and the 95% confidence interval are calculated. If the 95% confidence interval excludes 1, this is considered statistically significant at the 0.05 level. The AHRQ suppresses statistics based on national estimates with a relative SE > 0.30 or with SE = 0 and considers these statistics unreliable. These values are designated with an asterisk (*) in the tables.

Results

From 2006 to 2008, an annual average of 1,079,842 ED visits and ≥48,093 hospitalizations occurred from animal-caused injuries in the United States. This represents a rate of animal-caused visits to EDs of 358 per 100,000 population and 16 hospitalizations per 100,000 (based on a U.S. population average of 301.5 million people for 2006 to 2008). On average, every day there

Table 1. Average number of emergency department (ED) visits and hospital stays due to animal-caused injuries. NEC = not elsewhere classified; NOS = not elsewhere specified. (*Source: Agency for Healthcare Research and Quality*)

Animal	Average number of ED visits 2006–2008	Average number of total hospitalizations for 2006–2008[a]	ED visits (%) resulting in hospitalizations for 2006–2008
Venomous			
Venomous snake	8,249	2,528	27.7
Venomous spider	38,285	5,797	10.6
Scorpion	5,576	60	*
Hornet-bee-wasp	161,791	2,311	1.2
Centipede	1,307	*	*
Venomous arthropod NEC	30,164	865	2.8
Venomous sea animal	8,261	119	1.3
Venomous bite or sting NEC	602	*	*
Venomous bite or sting NOS	6,914	245	2.8
Nonvenomous			
Dog bite	310,902	8,695	2.3
Rat bite	3,696	73	2.8
Animal bite NEC	86,638	8,374	7.7
Nonvenomous arthropod	415,155	13,854	2.6
Animal bite NOS	8,383	51	2.6
Injury NEC caused by animal	72,365	4,658	5.3
Injury NOS caused by animal	4,332	167	2.3

[a] Total hospitalizations result from ED visits, urgent care clinics, physician offices, and direct admissions from other medical facilities.

were 2,958 ED visits and 132 hospitalizations for an animal-caused injury, primarily a bite or sting. For 2006–2008, the average number of animal-caused injuries was responsible for 0.88% of all ED visits and for 0.12% of all hospitalizations. For all injury-related ED visits and injury-related hospitalizations, those due to animal-caused injuries were responsible for 36% and 1.6% respectively in 2008.

Animal type

Venomous animals caused an average of 261,149 (24%) ED visits from 2006 to 2008. The leading cause (38%) of ED visits was due to nonvenomous arthropod bites, followed by stings from hornets, bees, or wasp (15%). For hospitalizations, nonvenomous animals were responsible for an average of 38,006 (79%) hospital stays, and venomous animals were responsible for 10,087 stays (21%; Table 1).

Patient characterization by animal type for ED visits

For bites or stings by venomous animals, the 18 to 44 year age group comprises the largest group of victims, whereas, the age range is similar for non-venomous animals, except for dog bites and non-venomous arthropod bites, which are more common in the 1 to 17-year-old age groups (Table 2). Males were more likely the victim of venomous animals: snake (71%); spider (52%); hornet, bee, or wasp (H-B-W;

Table 2. Demographic characteristics of victims visiting to emergency departments for an animal bite or sting (external cause of injury [E-codes] 905–906) for 2006–2008.

	V[a] snake	V spider	Scorpion	H-B-W[b]	Centipede	V arthropod NEC[c]	V sea animal	V bite NEC	V NOS[d]	Dog bite	Rat bite	NV[e] snake	Animal NEC	NV arthropod	Animal bite NOS	Injury NEC caused by animal	Injury NOS caused by animal
Average annual number of cases	8,249	38,285	5,576	161,791	1,307	30,164	8,261	602	6,914	310,902	3,696	3,860	86,638	415,155	8,383	72,365	4,332
Age (%)																	
<1	*	0.5	*	0.6	*	1	*	*	1	0.5	2	*	0.4	2	1	0.7	*
1–17	22	17	30	26	17	35	30	28	32	38	37	30	15	40	28	24	24
18–44	46	58	39	39	39	35	49	43	40	35	38	44	38	35	37	37	37
45–64	26	20	19	24	27	19	18	19	19	19	17	19	31	16	25	25	25
65–84	6	4	10	10	*	9	3	*	8	6	6	6	15	6	9	11	12
≥85	<0.5	0.3	*	0.7	*	0.7	*	*	*	0.8	*	*	2	0.5	1	2	2
Sex (%)																	
Male	71	52	45	57	46	48	65	60	51	53	49	62	34	48	49	43	44
Female	29	48	55	43	54	52	35	40	49	47	51	38	66	52	51	57	56
Patient Residence (%)																	
Large metro	30	37	*	36	*	31	31	20	35	48	52	34	46	42	44	33	27
Medium and small metro	36	32	*	33	*	39	39	40	33	32	29	38	32	33	31	32	29
Rural	34	31	*	31	*	30	30	40	31	20	19	28	21	25	25	35	44
Region (%)																	
Northeast	1	4	*	21	*	11	5	15	13	19	22	10	25	24	22	19	16
Midwest	12	19	*	25	*	9	2	*	13	23	15	16	24	19	20	29	29
South	67	59	20	38	13	72	67	44	61	37	20	63	33	46	42	34.	39
West	20	19	79	16	*	8	25	15	12	20	22	12	18	12	15	18	16

Figures may not sum to 100% due to rounding to the nearest whole digit unless <1%, which is rounded to the nearest tenth percentile.
[a]V. = venomous.
[b]H-W-B = hornet, wasp, or bee
[c]NEC = not elsewhere classified.
[d]NOS = not elsewhere specified.
[e]NV = nonvenomous.
* Statistical estimates unreliable.

Table 3. Demographic characteristics of victims hospitalized for animal-caused injuries 2006–2008. NEC = not elsewhere classified; NOS = not otherwise specified. Totals may not sum to 100% due to rounding to the nearest whole digit unless <1%, which is rounded to nearest tenth percentile.

	V[a] snake	V spider	H-B-W[b]	V arthropod NEC[c]	V sea animal	V bite NOS[d]	Dog bite	Rat bite[b]	NV[e] snake[f]	Animal bite NEC	NV arthropod	Animal bite NOS	Injury NEC by animal	Injury NOS by animal
Average annual number of hospital cases	2,528	5,797	2,311	865	119	245	8,695	73	96	8,374	13,854	251	4,658	167
Age (%)														
<1		*	*	*	*	*	0.8	*	*	*	2	*	*	*
1–17	22	9	*	20	*	30	24	*	*	5	26	*	12	*
18–44	42	48	*	32	51	27	28	*	*	25	34	32	24	*
45–64	26	31	*	31	*	35	29	*	*	37	26	36	34	37
65–84	8	9	*	13	*	*	15	*	*	27	11	*	24	*
≥85	*	2	*	*	*	*	3	*	*	6	1	*	5	*
Sex (%)														
Male	67	56	*	53	77	54	50	*	*	32	55	53	51	53
Female	33	44	*	47	*	46	50	*	*	68	45	47	49	53
Region (%)														
Northeast	*	5	*	9	*	*	24	*	*	24	21	36	16	*
Midwest	5	18	*	*	*	*	21	*	*	25	17	*	21	*
South	74	63	*	78	63	51	38	*	72	33	49	51	43	44
West	20	14	*	9	8	21	17	*	*	17	13	*	20	*

[a] V = venomous.
[b] H-W-B = hornet, wasp, bee.
[c] NEC = not elsewhere clarified.
[d] NOS = not elsewhere specified.
[e] NV = nonvenomous.
[f] Annual number of rat and nonvenomous (NV) snake bite hospital stays based on 2 years.
* Statistical estimate is unreliable and not reported.

(57%); sea animal (65%); and not elsewhere classified (NEC; 60%).

By region of the country, most of the victims were from the South, but regional differences reached statistical significance only for venomous arthropods not elsewhere classified (O:E = 1.98, SE = 0.44, CI = 1.10–2.85). While more scorpion stings were reported in the West, significantly fewer stings from hornets, bees, or wasps occurred in the West (O:E = 0.69, SE = 0.11, CI = 0.48–0.92), as did fewer bites from nonvenomous arthropods (O:E = 0.52, SE = 0.06, CI = 0.41–0.65). Bites from venomous snakes (O:E = 0.079, SE = 0.17, CI = -0.25–0.41), venomous spiders (O:E = 0.207, SE = 0.13, CI = -0.04–0.46), and venomous sea life (O:E = 0.27, SE = 0.32, CI = -0.35–0.89) occurred significantly less than expected in the Northeast.

Victims were more likely to be between the ages of 1 to 17 years of age for venomous snake bites (O:E = 1.21, SE= 0.019, CI = 1.17–1.24), dog bite (O:E = 1.66, SE = 0.13, CI = 1.41–1.91), and nonvenomous arthropod bite (O:E = 1.73, SE = 0.11, CI = 1.51–1.95).

Patient characteristics by hospital stays

Most people treated in EDs for animal-caused injuries were discharged home. However, 28% of venomous snakebite cases and 11% of venomous spider bite cases were admitted to a hospital (Table 1). For dog bites, 2% of victims were hospitalized. For venomous animal attacks, the 18- to 44-year age group was the predominant age range of the victims hospitalized (Table 3). For the latter, the age range 45 to 64 was predominant. Males were more likely overall to be hospitalized than females. By urban-rural classification, most hospitalized people were from rural areas, but results were not statistically significant.

Hospital utilization characteristics for 2008

The rate of hospitalization from an animal-related injury was highest for nonvenomous arthropod bites at 44.7 cases/million population (Table 4). The mean length of hospital stay was longest for the category injury not otherwise specified (NOS) at 5 days. The cost for the average hospital admission in 2008 ranged from approximately $13,000 to >$46,000, with the cost being greatest for a venomous snake bite. The aggregate costs for hospital stays in the United States (excluding physician charges) for 2008 was estimated at $943,800,000. Most individuals were routinely discharged home after their hospital stay.

Diagnosis and procedures for animal-related hospitalizations for 2008

Skin or subcutaneous tissue infections were the most common diagnosis in 8 of the 11 categories (Table 5). For dog-bite-related injuries, approximately 42% of the hospital stays had a principal diagnosis of skin or subcutaneous tissue infections, 22% were for open wounds of the extremities, and 11% for open wounds of the head, neck, and torso. Poisoning by non-medicinal substance (i.e., envenomation) was ranked number one for venomous snake bite, hornet, bee, or wasp sting, and venomous bite NOS.

Incision and drainage of skin-subcutaneous tissue, debridement of wound, and other therapeutic procedures on muscles or tendons were the most common ones performed for animal-caused injuries (Table 6). Almost 58% of dog-bite-related hospital stays involved a surgical procedure. Respiratory intubation and mechanical ventilation were the most common procedures reported for H-B-W stings.

Discussion

I found that an annual average of approximately 1.1 million people were seen and treated in hospital EDs for animal-related injuries, of which 310,000 cases were due to dog bites. Although deaths are not reported here, a study of fatalities from animal attacks in the United States found that approximately 177 people are killed each year from an adverse encounter with an animal (Langley 2005). Venomous animals were responsible for 39% of these deaths, compared to 24% of ED visits in the current study. Human fatalities from dog attacks are low (about 30 per year) despite of the number of attacks. However, the frequency of deaths from dogs has been slowly increasing across time (Langley 2009). Approximately 200 additional deaths occur annually from motor vehicle crashes involving animals, primarily deer (*Odocoileus* spp.; Centers for Disease Control [CDC] 2004). These fatality numbers are

Table 4. Characteristics of animal-caused injury hospital stays, 2008.

	Dog bite	NV[a] snake	Animal bite NEC[b]	NV arthropod bite	Animal bite NOS[c]	Injury NEC caused by animal	Injury NOS caused by animal	V[d] snake	V spider	Scorpion	V animal NEC	H-B-W[e]	V sea animal	V bite or sting NOS
Total number discharges	9,503	83	9,557	13,603	307	4,780	173	2,613	5,197	*	833	2,157	146	243
Average # hospitalizations per day	26	0.23	26.2	37.3	0.84	13	0.47	7.2	14.2	*	3.14	5.9	0.4	.67
Rate per 1,000,000 population	31.3	0.27	31.4	44.7	1.0	15.7	0.6	8.7	17.1	*	2.7	7.1	0.48	0.8
Mean length of stay (days)	3.3	2.3	3.3	3.7	2.9	4	5	2.1	4	*	3.2	2.3	3.4	2.8
Average cost per hospitalization	18,200	34,887	14,398	16,591	14,925	26,712	30,039	46,136	18,080	15,937	15,760	14,179	13,625	12,923
Average cost per day ($)	5,515	15,168	4,363	4,484	5,146	6,678	6,008	21,969	4,520	*	4,925	6,164	4,007	4,615
Aggregate cost (in millions $)	173	2.9	138.5	226.2	4.6	127.6	5.2	120.2	93.9	2.8	13.1	30.7	2	3.1
Percentage routine discharge	84.9	*	86.8	84.7	96.9	77.3	63.2	94.7	82.3	*	83.5	89.9	86.5	83.3

[a] NV = nonvenomous.
[b] NEC = not elsewhere classified.
[c] NOS = not otherise specified.
[d] H-B-W = hornet, bee, or wasp.
[e] V = venomous.

Table 5. Rank order of principal diagnoses for hospitalizations due to animal-caused injuries, 2008. Numbers are the numbers of patients.

Principal Diagnosis	Dog bite	Animal bite NEC[a]	NV[b] arthropod bite	Animal bite NOS[c]	Injury NEC caused by animal	V[d] snake	V spider	H-B-W[e]	V arthropod NEC	V sea animal	V bite or sting NOS
Open wound of extremity	2	2			10						
Open wound of head, neck, trunk	3				11						
Other injuries and conditions due to external causes	7										
Crushing injury or internal injury	9				3						
Other connective tissue disease	5	3	5				4				
Fracture of lower limb	10				2						
Fracture of upper limb	4				7						
Fracture of neck of femur					4						
Skull and facial fracture					5						
Intracranial injury					6						
Other fractures					8						
Skin or subcutaneous tissue infection	1	1	1	1	1	2	1	2	1	1	2
Infective arthritis and osteo myelitis	6	4									
Septicemia	8	5	4				3				
Bacterial infection unspecified site		6									
Superficial injury contusion		7	2		9						
Inflammation/infection of eye			6								
Pneumonia			7								
Other infection including parasites			8								
Fever unknown origin			9								
Viral infection			13								
Meningitis			17								
Chronic skin ulcer			18								
Diabetes mellitus with complications			10								
Fluid and electrolyte disorder			15								
Nonspecific chest pain			12								
Cardiac dysrhythmia			16								
Asthma			14								
Allergic reaction			11								
Mood disorders			3								
Poisoning by non-medicinal substances						1	2	1	2		1

[a] NEC = not elsewhere classified.
[b] NV = nonvenomous.
[c] NOS = not otherise specified.
[d] V = venomous.
[e] H-B-W = hornet, bee, or wasp.

Table 6. Rank order of all listed procedures for animal-caused hospitalizations, 2008. OR = operating room. (*Continued on next page.*)

Procedure	V[a] snake	V spider	H-B-W[b]	V arthrpod NEC[c]	Dog bite	Animal bite NEC	NV arthropod	In-jury
Debridement of wound, infection, or burn	3	2		2	1	4	2	13
Other therapeutic procedure on muscles or tendons	2	4			3	2	5	7
Incision and drainage skin, subcutaneous tissue		1		1	4	1	1	3
Suture of skin, subcutaneous tissue		5			2	11		2
Other therapeutic procedure	1				5	6	4	
Skin graft			2		7			
Other fracture and dislocation procedure					8			15
Other OR therapeutic procedure on joints					9	5		
Other vascular catheterization, not heart		3			6	3	3	4
Treatment, fracture or dislocation of lower extremity other than hip and femur								1
Treatment fracture or dislocation of hip, femur								5
Other non-OR therapeutic procedure on nose, mouth, and pharynx					10			18
Other therapeutic procedure on eyelids, conjunctiva, cornea					11			
Other OR therapeutic procedure on nose, mouth and pharynx					19			
Treatment, fracture or dislocation of radius and ulna					18			9
Treatment facial fracture or dislocation								10
Prophylactic vaccination and inoculation					12	7	14	
Traction, splints, and other wound care					13	10		12
Blood transfusion		6			14	9	7	6

[a] V = venomous.
[b] H-B-W = hornet, bee, or wasp.
[c] NEC = not elsewhere classified.

Table 6 (*continued*). Rank order of all listed procedures for animal-caused hospitalizations, 2008. Numbers are the number of patients.

Procedure	V[a] snake	V spider	H-B-W[b]	V arthropod NEC[c]	Dog bite	Animal bite NEC	NV[d] arthropod	Injury NEC caused by animal
Other OR therapeutic procedure on skin and breast					15			
Other non-OR therapeutic procedure on skin and breast						8	8	
Other therapeutic ear procedures					16			
Plastic procedure on nose					17			
Diagnostic spinal tap							6	
Diagnostic cardiac catheterization, coronary arteriography			3				10	
Respiratory intubation and mechanical ventilation		8	1		20		9	14
Upper gastrointestinal endoscopy, biopsy		7					11	
Magnetic resonance imaging							12	
Diagnostic ultrasound of heart							13	
Other diagnostic procedure on skin and subcutaneous tissue							15	
Excision of skin lesion							16	
Incision of pleura, thoracentesis, chest drainage								11
Other OR therapeutic nervous procedure								16
Other therapeutic procedure on bone								17
Hip replacement, partial or total								19

[a] V= venomous.
[b] H-B-W = hornet, bee, or wasp.
[c] NEC = not elsewhere classified.
[d] NV= nonvenomous.

likely to be undercounts, as some unwitnessed highway deaths may have been to avoid a collision with an animal, but were not recorded as such, and some unexplained deaths may be due to anaphylactic reactions to insect stings (Schwartz et al. 1988, Schwartz et al. 1995).

The costs related to an animal-caused accident are significant, but rarely reported. This study found that the cost of hospitalization alone, excluding professional charges from physicians was close to $1 billion. While costs for ED visits were not available, if one assumes that the average cost for an ED visit for 2008 was $1,265 (Kashihara and Carper 2010), then, this would be an additional $1.36 billion in health-care costs. This does not include costs for visits to private medical offices for initial or follow-up care or continued care at rehabilitation facilities, such as for physical therapy. The average cost for a physician's office visit in 2004 was estimated to be $155 (Machlin and Carpenter 2007). If the roughly 550,000 victims of dog attacks seeking non-ED treatment were seen at this cost, it would add another $85 million dollars per year in health-care costs for dog bites alone. Additional costs would be for medications and dressings.

There are additional expenses for injuries that are often overlooked, such as lost earnings due to work absences, as well as potential legal and insurance costs. The insurance industry found that homeowners' insurance claims from dog bites totaled $412 million in 2009 (Insurance Information Institute, 2010*a*). The insurance industry estimates that there are currently 1.6 million motor vehicle collisions with deer annually with costs of $3.6 billion dollars to motor vehicles and an additional $1 billion in costs for medical payments for injuries to people in the car, as well as out of pocket expenses (Insurance Information Institute 2010*b*). The CDC estimates that programs for rabies prevention cost about $300 million annually in the United States (CDC 2010).

I found that males were more likely to be injured by animals than were females. This was noteworthy for snake bites; hornet, bee or wasp stings; venomous sea life injuries; and dog bites. Males spend more time out of doors than do females, and, thus, the potential for exposure is increased (Graham and McCurdy 2004). However, females were more likely to be injured from some animals, including scorpions, centipedes, and arthropods. Other studies have shown that females are more likely to be involved in injuries from horses (Wright 1990, Patrick and O'Rourke et al. 1998, MacBean et al. 2007).

The risk of injury from different species of animals differs by age group. I found that people <18 years of age are more likely to be injured by venomous snakes, dogs, and nonvenomous arthropods. Similar findings have been noted in other U.S. studies (Hanna and Selby 1981, Steele et al. 2007, O'Neil 2007), but not necessarily in other countries (Massari and Masini 2006). Injuries, especially fatalities, have been reported to occur most often in older male farmers in some studies (Brison and Pickett 1992, Pratt et al. 1992), but other studies report younger age as a risk factor for nonfatal injuries (Zhou and Roseman 1994, Sprince et al. 2003). Cat bites are more likely to occur in adults, especially females (Ostanello et al. 2005, O'Neil et al. 2007). Females are reported to prefer cats as pets, increasing their exposure to possible injury from cats (Wright 1990).

Due to limitations of E-codes, the specific animal species involved in causing an injury often is not reported. However, a recent study of noncanine bites and stings reported that about 90,000 people were treated annually in EDs for mammal bites. Cats caused 66,000 injuries, and rodents (excluding rats) caused 10,000 injuries (O'Neil 2007). These would be included under the nonvenomous category "Injury NEC caused by Animal" (Table 1).

Infections resulting from animal bites are common (Goldstein 1992, Talan et al. 1999, Oehler et al. 2009); it is estimated that 15 to 20% of dog bites and >50% of cat bites become infected (Goldstein 1992). I found that the most common diagnosis at hospital admission was skin or subcutaneous tissue infection in all categories of injuries except for bites or stings by venomous animals.

Poison control centers in the United States reported that during 2001 to 2005 there were 23,676 people treated for exposures to native venomous snakes, and 3,894 (17%) cases received antivenom (Seifert et al. 2009). I found that 8,250 venomous snake bites annually were reported, based on data from EDs. However, the data I used did not provide information on

the number of people that received antivenom.

Many state and federal agencies, as well as professional societies, have guidelines or recommendations to prevent injuries and infections from encounters with animals. The American Veterinary Medical Association (AVMA) and CDC have developed guidelines on preventing dog bites (AVMA 2001, CDC 2009). The CDC also has developed guidelines to prevent infections from petting zoos and reptiles (CDC 2005, 2007). The Florida Fish and Wildlife Conservation Commission (FFWCC) developed recommendations to prevent injuries from alligators, and the Florida Museum of Natural History has recommendations for decreasing shark attacks (Burgess 2010, FFWCC 2010). Those who work in research institutions, zoos, and aquariums, as well as, wildlife officials, veterinarians, and veterinary staff should have protocols on proper animal handling procedures and responses to make if a person is injured by an animal (Herreo 1985, Langley and Loomis 2001, O'Brien et al. 2004, Hunt et al. 2008, Vohra et al. 2008, Wright et al. 2008). Although injuries from animals will continue, following the advice of these organizations should reduce the frequency of such injuries.

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