Animals and Society Institute

DOG BITES:
PROBLEMS AND SOLUTIONS
(REVISED 2014)

POLICY PAPER

A contemporary perspective on incidence, risk factors and effective prevention

Janis Bradley

animals & society INSTITUTE

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The Animals and Society Institute is an independent research and educational organization that advances the status of animals in public policy and promotes the study of human-animal relationships. We are a think tank as well as a producer of educational resources, publications and events. Our objectives are to promote new and stricter animal protection laws, stop the cycle of violence between animal cruelty and human abuse, and learn more about our complex relationship with animals.

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1. Executive Summary

Notes for this second edition: Some aspects of the dog bite situation have changed since the first writing of this paper in 2006. Although the dog bite epidemiological studies discussed here have not been replicated or updated, more current statistical information about dog bite incidence is available and is included here. More is now known that both documents and explains the ineffectiveness of attempting to address this issue by prohibiting or regulating ownership of dogs on the basis of breed or appearance, and important new research has been done to identify the risk factors for serious dog bite injuries. Finally, the blossoming field of canine behavioral research is uncovering husbandry issues with strong implications for minimizing canine threat and bite behavior toward humans. This second edition is an attempt to include these findings to produce a more comprehensive discussion of dog bites and society.

Public concern with regard to dog bites has remained high for decades. Alarm often intensifies in response to a single fatality or medically serious dog bite-related injury. Many actions, both legislative and educational, have been proposed and some implemented in attempts to address this concern. In considering any public policy change in response to a perceived threat to the general welfare, however, it is important to consider not only the scope of the problem itself relative to other risks, but the costs and benefits of potential regulatory strategies. When a potential strategy is considered, we must still consider what detrimental side effects it might carry, what resources would be required to effect it, and whether such resources might have greater beneficial impact on public safety if directed toward other hazards. This paper is a brief attempt to address these questions insofar as current research allows.

Dog bite-related fatalities (DBRFs) are extremely rare. They account for about 1 in 92,000 (1/1,000 of 1 percent) of deaths in the United States annually. Nonfatal injuries are also relatively uncommon – only 1/10 of 1 percent of emergency room visits. Dog bite injuries are comparable in incidence but less severe than accidents involving many common household objects. Attempts have been made to reduce these small rates of injury still further by prohibiting or otherwise regulating dog ownership on the basis of breed or appearance, presuming some dogs

– absent any scientific evidence in support – to be disproportionately dangerous. So such legislation simply arbitrarily eliminates whole groups of dogs with no evidence that they would have ever harmed anyone.

Breed-specific legislation (BSL) sometimes stops short of outright bans, but regulates how certain dogs may be kept, including mandatory spay/neuter (MSN) regulations and requirements to muzzle dogs in public. However, follow-up studies show no impact on bite rates after BSL is enacted. Moreover, no credible evidence has been presented to demonstrate that any particular breeds should be considered as overrepresented among biting dogs.

Other attempts to identify and regulate high-risk dogs focus on prior biting. This has been shown to be effective with regard to prior injurious biting behavior. Threatening behavior, however, is too widespread among dogs, and too frequently misunderstood, to be sufficiently predictive of actual biting. Removing or regulating all threatening dogs would require enormous and unrealizable increases in enforcement personnel, which would draw resources away from other public safety issues affecting more people and would inevitably capture many dogs who never harm anyone. Casting such a wide net could even result in a significant decrease in the number of people keeping dogs, compromising both the demonstrated emotional and social benefits of dog companionship as well as the preventive effects on widespread chronic diseases.

Two types of solutions are proposed in this paper. First, regulatory penalties should focus on people who knowingly keep dogs in clear disregard for public safety, either through lack of appropriate supervision and confinement, mistreatment, or neglect likely to provoke warning signals and biting, or through a lack of precautions taken after an injurious bite has occurred. Second, information should be widely disseminated – especially to children and their parents – about safe ways to interact with dogs, and education for responsible dog guardians should include instruction on sound husbandry, to guide the range of decisions that each guardian makes regarding how to live with and care for a canine companion.

2. Scope of the Problem

2.1 Dog Bite-Related Fatality Incidence

Dog bite-related fatalities are extremely rare. For every 11 million people living in the United States, approximately one per year dies as a result of dog bite.[1,2] Only one in 91,558 deaths overall is attributable to this cause.[3] Most mortality modalities this rare are not regularly counted; however, a few other rare fatalities are studied occasionally. So we know that dog bite deaths occur at approximately half the rate of lightning fatalities.[4] An individual is about as likely to be killed by a forklift or a cow as by a dog bite, even though only a very small percentage of the population is exposed to either.[5,6] (The cattle figure is probably low, as the only counts available are for work-related injuries). Children under 10 are three times as likely to drown in a five-gallon bucket, and as likely to die on playground equipment, as from a dog bite.[7,8] This is not to say that these deaths are unimportant. But in considering allocating public resources to prevent such deaths, one must first establish that the same resources could not be used to save more lives at risk from other causes. An intervention, for example, that reduced automobile accident mortality by 0.005 percent would save as many lives as one that completely eliminated dog bite-related fatalities.[9]

Thus a reasonable decision to allocate resources to prevent a rare cause of death requires that the risk factors be clearly identifiable and need only modest expenditure to address. Some very rare mortality modalities can meet this standard. Grain bin fatalities, for example, have been substantially decreased by regulating safety standards for working conditions.[10,11] This is possible, however, because exposure to the hazard is limited to a relatively small number of sites that can be easily inspected, and because dangerous conditions are readily identified.

A regulatory approach is unlikely to be practical when dealing with a U.S. dog population that current estimates place between 70 and 83 million.[12,13] Using even the lower estimate, this means that approximately one of every 2.6 million dogs is involved in a DBRF each year. This problem of scale is exacerbated by the fact that even if we could inspect them all, we have no established way to predict which dogs are dangerous. However, there is new evidence that a

variety of husbandry factors (detailed in section 2.2 below) co-occur in DBRFs, suggesting that solutions may be found in educating people with dogs about appropriate care and supervision, an approach much more likely to be practical than attempts to identify and remove potentially dangerous dogs.

2.2 Factors in Dog Bite-Related Fatalities

The most comprehensive study of dog bite-related fatalities to date covered all 256 incidents that occurred between 2000 and 2009. The study reliably identified seven factors potentially within the control of dog caretakers that co-occurred, in various combinations, in the overwhelming majority of the cases examined.[14] It is based on investigative techniques not previously employed in dog bite-related fatality studies, which had relied primarily on media reports.[15,16] This current study utilized sources more complete, verifiable and accurate than media reports.

The researchers identified a co-occurrence of multiple, controllable factors: no able-bodied person being present to intervene (87.1 percent); the victim having no familiar relationship with the dog(s) (85.2 percent); failure to neuter/spay the dog(s) (84.4 percent); a victim's compromised ability, whether based on age or physical condition, to manage interactions with the dog(s) (77.4 percent); the owner keeping dog(s) as resident animals rather than family pets (76.2 percent); prior mismanagement of the dog(s) (37.5 percent); and abuse or neglect of the dog(s) (21.1 percent).

Four or more of the factors identified co-occurred in 80.5 percent of the incidents during the 10-year period studied. Only rarely (in 2.5 percent of the cases) was there only one factor identified. Serious and fatal dog bite incidents were found to be complex, multifactorial events. The study's authors strongly recommend that coding for these factors be used to study serious but nonfatal dog bites as well, since this is likely to suggest sound prevention strategies.

Moreover, breed was not one of the factors identified. The study found no evidence that one kind of dog is more likely to injure a human being than another.

2.3 Dog Bite Injury Rates

There is considerable confusion about how many injuries result from dog bites every year and whether or not these numbers are changing. So the first question is to determine which data source is most useful for estimating incidence and looking for trends.

Yearly estimates for 1992-2003 (the date of the last major stand-alone study) range from 334,000 to 800,000 bite cases.[17,18,19,20] A number in the lower range is more statistically defensible, however. This lower estimate comes from an actual count of injuries treated in sampled hospital emergency departments, so the occurrences were documented by medical professionals.[21] The ED figures, moreover, are replicated annually by the Centers for Disease Control's (CDC) National Electronic Injury Surveillance System (NEISS) and made available to the public through the Web-based Injury Statistics Query and Reporting System (WISQARS) using the same methodology every year, allowing for reliable comparisons over time.[22]

The larger estimate number comes from a telephone survey, with all the reporting and sampling biases inherent in such a procedure.[23] And the emergency department study counted more actual bites as the basis of their estimate than did the phone survey, resulting in a narrower margin of error. This means that when the counted bites were extrapolated to national bite rates, the statistical margin of error was much narrower. In fact, the margin of error (technically, the "confidence interval") for the phone survey that produced the 800,000 estimate was so wide, it actually encompassed the 58 percent lower emergency department study figure. Thus, while the WISQARS numbers do not capture injuries treated by private physicians and clinics, they are the most valid count of dog bite-related injuries currently available.

2.3.1 Decreasing Rates of Injurious Dog Bites

Emergency department numbers, replicated every year by NEISS and published through WISQARS, show that dog bite injuries treated in emergency departments have been slowly declining. Between 1992 and 1994, an annual rate of 334,000 injurious bites was noted by a separate but similar emergency department survey system called the National Center for Health Statistics National Hospital Ambulatory

Medical Care Survey, which collected data on all emergency department visits arising from illnesses and injuries.[24] This works out to about 12.9 of every 10,000 people seeking emergency treatment for dog bite injuries, and can serve as a baseline for comparison. This rate remained stable through 2000, but the average for the last decade (2003-2012) has declined to 11 in 10,000 people, a 14 percent decrease.[25]

The NEISS system is the only one that gathers large samples and uses a consistent methodology. This consistency makes it much more likely to capture trends in occurrence rates, even though it will not capture injuries treated in physicians' offices or ones that are not treated at all; the actual total is likely higher. It is likely, however, that the most serious injuries go through this system, and the rate of those cases is decreasing.

2.3.2 Dog Bite Injuries Compared with Common Injuries

Nevertheless, it is safe to say that dog bite injury numbers are substantial, although they cannot be described as frequent relative to other common injuries. They currently account for 0.1 percent of all emergency department visits, and 1 percent of injury-related visits.[26, 27] These rates are far too low to ever appear on the CDC's lists of top 10 injuries for all age groups, even though the category "other bites and stings" (which includes primarily insect and bites from other animals) often does. Dog bite injuries are much rarer than the sorts of injuries that can be described as common. For every dog bite treated in an emergency department, for example, 25 falls and eight automobile accident injuries are treated.[28,]

When we consider the amount of contact Americans have with dogs, this is surprising. More than a third (36.5 percent) of American households include one or more dogs.[29] This means that at least 113 million people are in daily contact with dogs, if we include only the members of the dogs' own households. Almost anything with that kind of massive exposure is going to carry some hazards. In fact, many other ordinary artifacts of daily life, including tables and chairs, doors, beds, even sneakers and slippers, are associated with more accidental injuries.[30] For another example, roughly 217 million people of all ages in the U.S. participate in some kind of sport or physical activity at least occasionally,[31] roughly twice the number of people

who live with dogs. Yet emergency departments treat more than 13 times as many sports-related injuries as dog bites.[32]

If we look specifically at injuries to children in the single age group (5- to 14-year-olds) where dog bites sometimes appear ranked ninth or tenth in injury frequency, they are always outnumbered by injuries from falls, sharp and blunt objects, insect stings and bites, automobile accidents, overexertion, bike accidents and choking on foreign objects.[33] For all children under 14, playground equipment alone accounts for 50 percent more injuries than dog bites.[34, 35] Moreover, dog bite injuries affecting children decreased between 1994 and 2003.[36] NEISS data show this trend has continued, showing a 23 percent decline in the 12 years between 2001 and 2012 for which there is continuous data.[37]

2.4 Injury Severity

Dog bites, on average, are less severe than any of the more common injury categories. Ninety-nine percent of dog bites treated in emergency rooms are rated as level 1, the least serious of six levels on the accepted measurement (called an injury severity scale).[38] (A level 1 injury is one from which the person recovers quickly with no lasting impairment; a level 6 is one likely to be fatal.) Treated fall injuries, on the other hand, average around a 4.[39] A level 4 is a moderate injury, meaning one that either requires weeks to months to fully heal or results in lasting minor impairment.

Injuries from falls are six times more likely to result in hospitalization than dog bite injuries.[40,41] Pennsylvania Department of Health studies conducted in 1994 and 1995 found that the average treatment for dog bites costs less than the average fall injury, results in hospitalization less frequently, and that hospital stays (when they occur) are shorter, although such stays may be more expensive than for injury inpatient stays in general.[42]

Similar disparities in magnitude exist between dog bites and other unusual injuries. For example, almost half (45 percent) of playground injuries are severe, including internal injuries, concussions, and dislocated, fractured and amputated limbs.[43] Most dog bite injuries are minor punctures and lacerations. More than 3 percent of patients in emergency departments for playground accidents are hospitalized,[44] twice the rate of hospitalizations for ED-treated dog bites.

One indicator, the annual total of reconstructive plastic surgeries for dog bite injuries, suggests that the severity of these injuries may be decreasing. The American Society of Plastic Surgeons reported a 35 percent decrease in reconstructive plastic surgeries for dog bite injuries between 2000 and 2012, even with the considerable increase in the populations of both people and dogs.[45]

2.5 Public Perception of Dog Bite Risk

It's appropriate to make note of the apparent hyperbole in common descriptions of dog bite incidence, among the general public as well as the media, and even in some of the research literature, where references to the "dog bite epidemic" are routine. The CDC defines an epidemic as "an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area."[46] As demonstrated above, dog bites do not meet any aspect of this definition, particularly since there has been no increase in the incidence – sudden or otherwise – but rather a decrease in per capita rates over the last few decades. And yet, this is the most common term used to describe dog bite frequency.

As events, however, dog bites meet a number of criteria documented by psychologists to lead people to have an exaggerated perception of a risk. Such perception typically becomes elevated when the risk exposure feels involuntary or beyond the person's control, is simply unfamiliar, or arises from something that taps into ancient fears, such as predators with big teeth. The most effective trigger for inflated fear is a perceived risk to children.[47] Dog bites stimulate all of these emotional triggers.

The idea persists, for example, that dog bites represent a large proportion of injuries to children, when in fact they have accounted for a remarkably consistent 1-2 percent of injury-related emergency room visits for children under 14 over the last several decades.[48,49] So it becomes less surprising that the injury severity data described above shows that people respond by seeking medical attention for dog bites that are ignored or treated informally when the injury results from another source, particularly if the injury is to a child.

The children themselves, however, seem to be able to take a clearer-eyed view of the matter. The only large-scale study of dog bites to children yet completed showed that although a large percentage of

the children (almost half) reported having experienced dog bites, few had needed medical treatment, and, most interestingly, the children who had been bitten were no more likely to be afraid of dogs than those who had not.[50]

3. Existing and Proposed Legal Remedies: Efficacy and Costs

3.1 Attempts to Identify and Control High-Risk Animals

News reports of dog bite-related fatalities and serious injuries often imply that the dog or dogs involved were purebred members of one recognized breed or another. The effect on the public consciousness is amplified by the imbalance in press coverage of dog bite events depending upon the breed descriptor assigned. One researcher tracked four incidents of severe dog bite injury during a four-day period in 2007. One of these incidents resulted in a human death. The one case attributed to two "pit bulls," which was not the fatal incident, generated 230 newspaper articles. The other three incidents were attributed to other types of dogs: the two nonfatal injuries generated one story each and the fatality was covered in two articles.[51] This enormous variance in media coverage has led to a widely held perception that some groups of dogs present a greater risk of injuring people than others and therefore should be eliminated from the population, or be subject to ownership restrictions as a public health risk.

Such conclusions have not held up under scientific scrutiny, however. A 2013 large-scale study of dog bite-related fatalities found that media identification of the breeds of dogs involved was extremely unreliable.[52] Evidence of pedigree or reliable documentation of mixed-breed ancestry were almost never available, and even after including expert identification of photographic evidence, a reliable breed attribution could be made in only 18 percent of the cases; among that small percentage, 20 different recognized breeds were represented.

We now know that attempts at visual breed identification of mixed-breed dogs, even by people in dog-related professions, rarely conform to DNA analysis and that knowledgeable people seldom agree with

one another on breed identification.[53,54] The best estimates place the percentage of mixed-breed dogs in the United States at about half,[55] yet 90.1 percent of the dogs in the fatality study described above were reported in the media with a single breed descriptor. The researchers considered it highly unlikely that purebred dogs were heavily overrepresented among these incidents, particularly since the photographic evidence did not support the single breed identifications. This is further evidence that media reports of dog breed identification should not be relied upon, particularly in making decisions about identifying dangerous dogs.

These findings call into question the often-cited 2000 study attributing more fatalities to dogs identified as "pit bull type" dogs during the period studied than to any single breed.[56] The study relied on news reports as the data source. In addition to the likely unreliability of those sources, the resulting data table excluded 27 percent of the fatalities occurring during the study period, as no breed descriptors were available from media sources concerning the dogs involved in those incidents.[57]

Nevertheless, and in spite of the fact that the authors of the 2000 study mentioned above specifically cautioned against it, many municipalities still maintain statutes that prohibit or regulate ownership of any dog designated, according to a wide range of definitions, as a "pit bull." This is made more problematic by the fact that "pit bull" is not a breed at all, but rather a descriptor applied to a heterogeneous group whose membership may include purebred dogs of various breeds, plus dogs presumed (usually incorrectly) to be mixes of those breeds based on physical resemblances.

Breed-specific legislation, along with discrimination by landlords and homeowners insurers, has been extended to other breeds as well, including many among the large and diverse number of breeds that have ever been mentioned in any study of dog bites. Rottweilers and Chow Chows are among the most common, but discriminatory regulation and commercial practices have been applied to breeds ranging from German Shepherds to Doberman Pinschers to Boxers. What this means is that any breed can potentially be targeted, limiting the choice of canine companion for even the most responsible guardian.

3.1.1 Genetics and Aggression: Purebred Dogs

Some discussion of the heritability of aggression should be included here since breeds are, by definition, groups of genetically related individuals that can be expected to have traits in common. No one disputes that lines of animals in most species can be selectively bred for higher- or lower-than-average levels of particular behavior traits. Such genetic behavioral modification can even be done with wild animals, as has been dramatically demonstrated by the Russian Institute of Cytology and Genetics' rapid transformation of captive, aggressive foxes into endearing, affiliative companion animals, and behaviorally normal lines of rats into either cuddly companions or ferocious attackers.[58,59] And certainly references to relative levels of aggression and amiability are rife in the popular lore about dogs, including the descriptions of the primary purebred dog registry in the United States, the American Kennel Club.[60]

However, in order to significantly enhance the likelihood of a single trait, selection must focus on that trait to the exclusion of others. Since dog shows became popular in the late 19th century, selective breeding in dogs has primarily sought to influence appearance rather than behavior.[61] And looks, to put it simply, don't equal behavior. Modern selective breeding of purebred dogs concentrates on the one quarter of one percent of the canine genome that determines physical appearance. These are not the same genes as the much larger percentage of the genome that influences brain function and development.[62] This focus on appearance has all but eliminated any behavioral tendencies that may have been selected for before the 20th century. One large-scale behavior evaluation study (13,000 dogs of 31 breeds) confirmed that aptitudes for the specialized work associated with traditional groupings of breeds (e.g., terriers, herding dogs, sporting dogs, working dogs, etc.) occur no more frequently in modern purebreds from those breed groups than among dogs in general. [63]

Moreover, the common idea of the genome as inflexibly determinative is a misconception. Many factors, from diet and health to environment and socialization, profoundly affect whether and to what extent a specific gene that can potentially affect behavior or appearance is actually expressed.* It is unsurprising, then, that when the behavior

* See section 5.2.1 on family versus resident dogs for a discussion of one of the most important of these.

of dogs from one group of breeds banned or regulated as presumably dangerous was tested, the dogs were no more likely to demonstrate inappropriate aggression than were a control group of Golden Retrievers.[64,65] In 2010, a team of veterinary behaviorists used the same methodology to test Bull Terriers specifically, and found no significant differences between these dogs and those in the two earlier studies, concluding instead that differences in behavior could be correlated with owner behavior toward the dogs. The study recommended owner education as the most promising safety intervention.[66]

3.1.2 Genetics and Aggression: Mixed-Breed Dogs

With mixed-breed dogs, it is not possible to make predictions about the likelihood of traits related to the parent breeds with regard to physical appearance, behavior or any attributes of an individual animal, cumulatively called the phenotype. Any aspect of either parent's genome may find expression in the offspring, even if that characteristic was not actually expressed in the parent. The canine genome is now well enough studied to explain why this is so, but the reality has been demonstrated for decades, going back to the foundation work on canine genetics in the 1960s, which found that even in matings of two purebred dogs of different breeds, the puppies consistently bore no significant resemblance to either breed, even in physical appearance.[67]

In sum, modern purebreds are not diligently selected for behavioral traits. Many environmental factors affect the expression of behavior traits, and mixed-breed dogs cannot be expected to exhibit the traits of their parents in any predictable ways. Thus all the scientifically credible evidence argues against any physiological or behavioral traits making the group of largely mixed-breed dogs that might be designated as "pit bulls," or any specific breed of dog, more dangerous than other dogs. Careless and inhumane husbandry practices, ranging from overt cruelty and neglect to keeping dogs isolated from normal positive interactions with people to failure to supervise dogs and children, are much more likely to affect behavior in relevant, predictable ways.

3.2 Breed-Specific Legislation

As a result of the considerable cumulative data demonstrating the ineffectiveness of this approach, the institution and continuation of breed-specific legislation (BSL) is quickly decreasing; municipalities have been rejecting and repealing BSL much more often than they are enacting it. Since the first edition of this paper was published in 2006, the trend away from BSL and toward breed-neutral laws that hold all guardians accountable for their dogs' behavior has continued. Six more states have passed legislation making it illegal for local governments to pass or retain breed-specific ordinances and regulations, bringing the total number of states with such pre-emptions to 18. And at the time of this writing, Maryland has passed a bill rescinding breed-specific strict liability in bite cases. BSL results in no decrease in dog bite injuries, confirming the findings regarding breeds and aggression discussed above. The earliest study on pre- and post-BSL dog bite rates was completed in the United Kingdom in the mid 1990s.[68] The study concluded that the breed-specific provisions of the Dangerous Dogs Act of 1991 had had no effect whatever on the incidence of dog bite injuries. The Aberdeen Royal Infirmary researchers did find, however that "human bites were as common as those from the most implicated dog breed." People bite and injure as often as any single breed of dog.

Since this first study, more evidence has accumulated regarding the ineffectiveness of breed-specific legislation. The Netherlands repealed its 15-year "pit bull" ban in 2008, having concluded that it had done nothing to reduce dog bites.[69] Denver, Colorado, continues to record a higher rate of hospitalizations from dog bite-related injuries since it enacted a breed ban in 1989 than do breed-neutral Colorado counties.[70] A study of dog bites in Aragon, Spain, comparing the five years before and five years after the enactment of BSL similarly found no impact on dog bite incidence.[71]

The Toronto Humane Society reported in 2010 that after a five-year, province-wide breed ban, "the BSL aspects of the Dog Owners Liability Act has not worked to decrease the incidents of dog bites."[72]

Finally, an analysis published in the *Journal of the American Veterinary Medical Association*, using the evidence-based methodology developed to assess the effectiveness of preventative measures in medicine, concluded that the rarity of dog bite-related

hospitalizations makes the entire approach impractical. The authors calculated that even if assumptions of differential breed-specific bite rates were accurate, it would require the removal of 100,000 dogs of the targeted breed from the jurisdiction in order to be certain that one had prevented a single dog bite-related hospitalization.[73]

For all these reasons, the BSL approach to dog bite prevention has been consistently condemned by national governmental and professional organizations. "Research shows that bans on certain types of dogs are largely ineffective and often a waste of public resources,"[74] according to the White House, adding its opposition to that of the Centers for Disease Control, the American Veterinary Medical Association, National Animal Control Association, and the American Bar Association, all of which have affirmed the long-standing positions of all the major national animal welfare organizations.[75,76,77]

3.3 "Dangerous Dog" Laws

The second common legislative approach to removing dangerous dogs from the population targets the behavior of the individual dog, designating dogs with labels such as "potentially dangerous," "dangerous" or in some cases "vicious" based on actual incidents. It then provides for either eliminating the dogs or limiting the conditions under which they may be kept, such as requiring sterilization of the animal, microchipping for permanent identification, training, consultation with a certified animal behaviorist, muzzling when off the custodian's property, and being walked only by a person over the age of 18. Such laws increasingly also specify elevated civil and criminal liability incurred by people whose dogs injure subsequent to such a designation.

There is some evidence that a prior behavior approach to the dangerous dog designation may decrease injurious bite incidence and general nuisance incidence caused by irresponsible owner behavior, particularly where the dangerous dog label is applied specifically to dogs who have already bitten and injured.** A 1991 study of a program in Multnomah County, Oregon, showed a decrease from 25 percent to 7 percent in repeat incidents involving the same dog after

** Multnomah County's code 8.10(1989) does include a "potentially dangerous dog" designation "level 1" that applies to dogs running loose that behave in a threatening manner, but have not bitten. These cases carry confinement restrictions only.

the implementation of a program restricting conditions of ownership of dogs who had injured or who had "menaced" people while running loose.[78] Follow-up data in the same community showed significant reductions between 2004 and 2011 in calls to animal control for service regarding bites and loose aggressive dogs (down approximately 39 percent) and in reported dogs bites (down approximately 25 percent).[79] No such reduction has ever been documented, however, absent previous injurious behavior on the part of the dogs monitored.

Such an approach has the benefit of specifically targeting demonstrably dangerous animals, but is much more likely to be effective when paired with incentives for responsible animal guardianship, the keystone of enhanced safety as described in section 4.1.1 below.

3.4 Predicting Future Injurious Bites

Many "dangerous dog" laws try not only to control dogs who have already injured people, but to predict which ones will do so in the future and attempt to prevent this. Typical legal descriptions of dog behavior include "approaches in a vicious or terrorizing manner," or "in a menacing fashion," or having "a known disposition, tendency, or propensity to attack," or "engages in any behavior that requires a defensive action by any person to prevent bodily injury."[80,81] Aside from the subjectivity of these descriptions, the main difficulty with such an approach is that the best research to date indicates the likelihood that a majority of dogs engage in threatening behavior, but that few among these bite, and far fewer actually injure when they bite.

One groundbreaking study found that 41 percent of the dogs studied had growled, snarled or snapped at a familiar person at some time in the dog's life. A smaller proportion of all the dogs, 15 percent, had actually bitten.[82] Of those who had bitten, fewer than 10 percent of the bites had injured.[83] This means that a net cast to identify the 1.5 percent of dogs who will injure based on whether they had growled, snarled, snapped or lunged would actually capture at least 41 percent of the dog population. In other words, at least 93 percent of the dogs identified in this way as "dangerous" would never actually injure anyone. And since these studies only included behavior toward family members and other people well known to the dog, and only included guardians responsible and caring enough to provide veterinary care for their pets, the percentages of dogs that growl, snarl and snap

within the entire dog population must certainly be considerably higher.

Simply put, growling, snarling and snapping at humans is normal among domestic dogs. Biting is common; inflicting injurious bites is not. A history of threatening behavior has not been shown to predict that a dog will bite, much less that she will injure if she bites, so targeting threat behavior is unlikely to do much to decrease dog bite injuries, which is the goal of any public health and safety intervention. One could make the argument that it is prudent to spay and neuter even such a large percentage of dogs as ever engage in threatening behavior, thus limiting the population entirely to consistently friendly individuals. The effectiveness of even such draconian genetic selection is questionable, however, aside from its impracticality.

In stressful situations, dogs react primarily to protect themselves. Behaviors directed toward self-defense are so adaptive as to be almost universal across species, so it would be unsurprising to find that the primary variables influencing whether a domestic dog ever threatens a human being are simply the quality of relationships he has had the opportunity to form with humans and whether or not he is exposed to stimuli that canines commonly perceive as dangerous.

Choices made by guardians regarding how to live with and supervise their companion animals, however, may provide better indicators of risk for injurious bites, according to the study of dog bite-related fatalities described above. The factors identified related primarily to supervision of interactions between dogs and vulnerable individuals, basics of humane treatment and control, and providing the dog with opportunities to live as a true family dog with regular positive interactions with people. These are choices that are likely to be easily incentivized in the majority of dog guardians who want to foster safe, humane communities, and suggest an educative rather than punitive approach to further decreasing injurious bite incidents.

3.5 Enforcement Resources

There are currently 14,000 animal control officers in the U.S.[84] This is one for every 5,900 dogs. The conservative estimate of a 41 percent incidence rate of growling, snarling, and snapping behavior among dogs described in the previous section would indicate that at least 2,435 out of the average 5,900 dogs per officer jurisdiction are likely to meet criteria for dangerous dog designation, according to any

of the statutes that try to eliminate or regulate dogs presumed on this basis to be at high risk for biting, but who have not yet bitten and injured. And no one knows what percentage of dogs bear a physical resemblance to any regulated or prohibited breeds, and who, in a jurisdiction with BSL in force, would have to be added to the total of dogs presenting presumably threatening behavior. In some communities, this may well be a majority of the dogs.

In addition, animal control officers have many other duties beyond policing dangerous dogs. It would be impractical for these officers to identify, much less enforce, proscriptions on owners for such a large number of dogs. This would require an enormous commitment of additional officers. Animal control departments are already underfunded to meet their mandates across the country. So a commitment to actually enforce dangerous dog statutes would have to draw resources from other areas of public services. Community officials might well have to make choices between animal control officers and crossing guards, public pool lifeguards, emergency services dispatchers, or any of a number of other public employees who safeguard the public against much more common hazards than dog bites.

Breed bans, in particular, have proved costly. In 2003, for example, a task force study in Prince George's County, Maryland, recommended repealing the community's breed ban because it was ineffective and had cost the county $570,000 over two years in kenneling and maintenance costs alone. This figure did not include direct enforcement costs.[85] In the U.K., attempts to enforce the breed ban have proved expensive, with kenneling costs for confiscated animals alone totaling more than 3 million pounds in the first four years (1992-95) of implementation.[86] Best Friends Animal Society in Utah has developed a formula to project the annual costs for animal control enforcement, kenneling, euthanasia costs and defending litigation that can be applied at the city, county, and state level.[87] A state as large as California, for example, would have to spend as much as $66 million for a statewide breed ban. These are very serious resource commitments, particularly since, as mentioned above, a follow-up study indicates no change in dog bite injury rates.

4. Benefits of Dogs vs. Risks

4.1 Health Benefits of Dog Companionship

Both of the legislative remedies described above attempt to address the problem of dog bites by regulating or prohibiting segments of the dog population alleged to be at elevated risk for inflicting bites. Apart from whether this perception is accurate, only a small minority of the animals eliminated would have injured anyone, and the net result could be a smaller population of pet owners. One large study conducted in Australia, where per capita dog ownership has decreased by almost 15 percent over the last two decades, concluded that the decline was attributable to both lifestyle changes and restrictive public policies and regulations.[88] BSL, housing restrictions and insurance exclusions certainly number among such policies. Some researchers assume that everyone who is prevented from owning a dog of a particular breed or appearance would simply acquire another type of dog.[89] This is by no means established, however, and given the number of companion dogs, it is prudent to consider the possible unintended consequences of even a small percentage decline in the dog-keeping population. Thus it is important to evaluate such a strategy by considering the potential loss of the health benefits of dog companionship.

A growing body of research supports the contention that canine companions enhance human health across the lifespan. For example, a study in Sweden showed a dramatically lower incidence of allergies among children who lived with a dog (and even better with two) as infants.[90]

Several large-scale studies (including one looking at almost 6,000 people in a heart health screening clinic) have documented a correlation between animal companionship and decreased risk of cardiovascular disease, either in terms of lower risk factors for developing disease or of survival rates following a heart attack.[91] One study found living with dogs to be comparable to heart-healthy dietary changes in its correlation with decreased heart attack risk.[92]

Among the elderly, dog guardians spend an average of 1.4 hours a day outside playing or walking with their dogs, and less sedentary

time, than their peers without pets.[93] This level of activity is known to contribute to extending the time older people can live independently.

Common health complaints, including backaches, headaches and contracting the flu, decreased a few months after adopting a dog or a cat, according to a 1991 study in the U.K.[94] This improvement held true whether or not the new dog guardian increased his or her walking activity.

Talking to or simply being in the presence of their dogs allows people to lower their blood pressure to their resting heart rate level, even in stressful situations. The effect is more significant than that attained through meditation.[95]

Petting one's dog increases calming neurochemicals, including serotonin, prolactin and oxytocin, and decreases the main neurochemical connected with stress (cortisol).[96] Chronically elevated levels of this stress hormone have been tied to many health risks, from high blood pressure to immunosuppressant ailments. These stress-reducing functions may explain the recent finding that military veterans with post-traumatic stress disorder report improvement when they adopt a dog.[97]

4.2 Numbers of People Benefiting vs. Harmed

With growling, snarling, and snapping demonstrated to be normal (meaning exhibited by most individuals) and with at least 15 percent of dogs actually biting, albeit seldom injuriously, at some time in their lives,[98] it is likely that if we keep dogs, we will continue to have dog bites. A very small percentage of those bites will injure. Nearly all authorities agree that the most effective way to minimize the injurious bites is to educate people in safe husbandry practices. Any approach to preventing dog bite injuries that reduces the number of companion dogs would risk removing the preventive effect of the presence of these animals on ailments that cause exponentially more loss of life and health than even the highest estimates of dog related risks. This is made clear by considering only the two most common ailments that are ameliorated by living with dogs.

Allergy reduction could cancel out the risk to children from dog bites many times over. Asthma, the most severe common manifestation of allergies, afflicts 10.5 million children, and more than 3,000 people die of the ailment each year in the U.S.[99] Alluding to the cultural shift from semi-rural to more urban lifestyles and the accompanying decrease in contact with dogs in daily life, the authors of the Swedish study on childhood allergies discussed in 4.1 above concluded that "changing patterns of animal exposure may have contributed to the current increase of allergic diseases in the western society.[100]

Cardiovascular disease kills approximately 600,000 Americans every year.[101] The American Heart Association recently reviewed the substantial body of studies on pets and cardiovascular disease and concluded that "pet ownership, particularly dog ownership, is probably associated with decreased CVD [cardiovascular disease] risk," and "may have some causal role in reducing CVD risk."[102]

If only a very small percentage of the more than 43 million American households that now include dogs[103] were to stop keeping these companions, the detrimental impact on public health could be considerable. In order to prevent this, any legal proscriptions that attempt to prevent dog bites must be accurately and narrowly targeted only at people who permit their animals to present a very high risk. This means people whose dogs have already bitten and injured, and those who have otherwise allowed their dogs to be a threat or a nuisance. Thus, again, a more effective approach that maintains the protective health benefits of living with dogs is likely to be one that incentivizes safe husbandry practices on the part of owners, rather than one that tries to identify and eliminate at-risk animals.

5. Recommendations

5.1 Effective Legislation

Simply encouraging the basics of responsible dog guardianship has been shown to lead to dramatic decreases in bite incidents. When communities decide to go beyond this, legislation should target only people who willfully disregard public safety in the keeping of their dogs (almost certainly a small minority).

5.1.1 Responsible Dog Guardianship

Effective lowering of dog bite rates can be accomplished by creating community-wide support for the most basic responsible behaviors, including humane care (providing proper diet, veterinary care, socialization and training), humane custody (licensing and permanent ID) and humane control (following leash laws and not allowing dogs to become threats or nuisances to the community).

Calgary, Alberta, is one example of such policies in practice. From 1985 to 2008, although the population increased, reported dog bites decreased from 621 in 1985 to approximately 200. Complaints about dogs chasing and biting people or damaging property also decreased significantly. All of this was accomplished with an agency that clearly specified acceptable behavior on the part of dog, provided services in order to facilitate owner compliance, and reserved enforcement for those who failed or refused to comply. Calgary's bylaws (ordinances) and service policies are completely breed-neutral.[104]

5.1.2 Enforcement of Existing Dog Regulations

There is consensus among researchers that the majority of dog bites occur to people they know well in the dogs' own homes. Yet much of the public concern is directed at bites to strangers in public places. This statistically misplaced focus may occur because the victims of such bites often have not consented to the dog having access to them. The most direct approach to this concern is to more stringently enforce leash laws. A study of 36 Canadian municipalities found that the communities with the highest rates of ticketing for animal control violations (primarily leash law and confinement infractions) had the lowest rates of reported dog bites.[105] One European study of dog

bites to children found that all of the cases involving bites from dogs unknown to the child that occurred outside a home could have been prevented by simply leashing the dog.[106]

5.1.3 Limit Injury Prevention Rules to Dogs Who Have Bitten Injuriously

Beyond encouraging the basics of responsible animal care, it is possible to have a law that identifies people who disregard the leash and confinement laws and whose dogs present a demonstrable threat to humans. These are the dogs with a history of injuring, and whose owners then continue to allow them access to people who might be injured. Incidents of repeat injurious bites should carry heavy penalties. An effective law of this type would include a clear definition of serious injury. Such a law could be equitably enforced if medically treated bites were consistently reported. However, dog bite reporting protocols do not often record clear bite severity information. Calgary, again, is one community that has collected such data, finding that in 2012 more than 75 percent of confirmed bite incidents reported caused only minor puncture wounds.[107]

5.1.4 Tracking Dogs with One Injurious Bite

The only program with any evidence of preventing repeat bites has provided restrictions on those whose dogs had injured others, and then monitored the guardians for compliance.[108] If a community decides to delegate increased law enforcement resources to this issue, this would be a productive place to put them. At a rate of 337,000 documented injurious bites per year (the average emergency-treated dog bite injuries from 2001-2012),[109] this would make a maximum average load of 24 follow-up cases for each of the 14,000 animal control officers nationwide, a more efficient use of resources than any of the proposals that target much larger numbers of dogs.

5.1.5 Bites in the Context of Other Negligent Infractions

Owners should also be subject to serious penalties if their dogs bite and injure (even on a first occurrence) if the bite occurs in the context of another infraction, particularly violation of leash laws. One version of this is the approach of Multnomah County, Oregon (described in section 3.3) where a dog left loose and behaving in a “menacing” manner is designated as “potentially dangerous,” and the guardian

is subject to specific restrictions and penalties.[110] Similar penalties would also apply when the guardians have a history of animal cruelty or neglect violations, particularly since these have been identified among the co-occurring factors present in the most serious bite incidents.[111] Fines assessed for such violations could then be used to fund animal control services.

5.2 Focus Prevention Resources on Education

Much of the exposure to dog bite injury risk can be mitigated by providing appropriate education to well-intentioned but misinformed guardians and to the public at large. Targeting high-risk human behavior toward dogs is much more likely to decrease growling, snarling, snapping and biting behavior than is any attempt to identify and weed out at-risk animals. The husbandry factors found to co-occur in dog bite-related fatalities offer a place to start, particularly with regard to informed supervision of children and others whose ability to manage their interaction with dogs is compromised.

5.2.1 "Family" vs. "Resident" Dogs

Karen Delise, who founded the National Canine Research Council and has investigated dog bite-related fatalities for several decades, first articulated the concept of a *family* versus a *resident* dog, one of the factors coded for in the 2013 study of DBRF as "a dog, whether confined within the dwelling or otherwise, whose owners isolated them from regular, positive human interactions." This is in contrast with a "family dog," defined as "dog[s] whose owners kept them in or near the home and also integrated them into the family unit, so that the dogs learned appropriate behavior through interaction with humans on a regular basis in positive and humane ways."[112] This dichotomy between family dogs and those who are simply resident on the property is one of the most striking factors found in the recent study of dog bite-related fatalities. The vast majority (76.2 percent) of the 256 cases investigated involved dogs that met the researchers' criteria for resident dogs.[113] This is an important educational concept for individuals concerned about how best to give their dogs opportunities to be safe companions.

In 1997, a group of Hungarian ethologists who were studying dog behavior for completely different purposes and from a different

perspective, made strikingly similar findings. In comparing a group of dogs on their ability to perform a problem-solving task, they found that the biggest difference among the dogs rested upon whether they lived in close contact with their owners and were considered family members (called "companion dogs" by the researchers) or lived relatively separated from people. The companion dogs were found to be much more likely to look to their people to help them solve the task than were those who lived outside (in kennels or unconfined) and were considered to be primarily working or guarding animals.[114] Moreover, these family dogs were much friendlier to humans in general. Breed, on the other hand, seemed to have no role in differences regarding how the dogs related to people.

Another study by researchers at the same university in Hungary found that people whose dogs lived closely with them reported their companion animals to be much less aggressive than their resident dog counterparts.[115] This is consistent with the recent finding discussed above that family dogs – those who have opportunities for frequent, positive interactions with people – are much less likely to be involved in dog bite-related fatalities than those who are merely resident on the property.[116]

These strikingly similar results from such varied kinds of studies strongly suggest that the most effective way to decrease dog aggression in general may be simply to educate people on the importance of making sure that their dogs have ample opportunities to form bonds with human beings.

5.2.2 Educating Children and Adults to Behave Safely Around Dogs

Sixty-seven percent of injurious dog bites to children have been shown to be preventable by changing the child's or the caregiver's behavior in interacting with the dog.[117] And as simple an intervention as a single 30-minute lesson incorporated into a regular school day, taught by a dog handler, has been shown to dramatically reduce high-risk behaviors toward unfamiliar dogs in both very young (kindergarten age) and middle school children.[118,119]

It is just as important to educate adults about safety with dogs. One study about dog bites to children found that there was no adult present in 69 percent of the cases studied.[120] In addition, a study published in *Journal of the American Veterinary Association* in 2008

found that parents generally lacked knowledge of factors that were likely to increase the risk of dog bites to children, even when they were supervising the child/dog interactions.[121]

Education on these topics is a strategy worth pursuing if we want to direct resources toward preventing dog bite injuries. Moreover, much of this work could be done by volunteers, minimizing the impact on fiscal resources that are needed to address more widespread public health dangers. Many dog professionals would volunteer their time for such an endeavor, and many humane organizations have education departments staffed with people well qualified to teach. There are also national humane organizations that could be tapped to develop appropriate curricula, so school programs could be implemented with very little impact on public resources.

6. Conclusion

Current research on human/canine relationships and statistics regarding rates of serious dog bite incidents continue to support the conclusions put forward in the first edition of this paper, and as noted in the previous section. A review of the ongoing public health records shows that dog bite-related fatalities remain extremely rare, and new research has uncovered co-occurring factors in these events that are under the control of dog guardians. None of these factors relates to the demographics of the dogs.

During a period where people increasingly consider and treat their dogs as family members, injurious bites have gradually declined, including a decrease in the percentage of injuries sustained by children. Current behavioral studies offer possible insight into why this is so, documenting profound differences in the behavior of family dogs – who have opportunities for daily, positive interactions with people – and resident dogs who simply live on the property in relative isolation, without integration into the family social unit. Public policies that educate people about and otherwise facilitate these relationships provide the most promising approach to developing safer and more humane communities.

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Additional resources for those addressing BSL in their communities:

Selected agencies with public statements opposing BSL

The White House: https://petitions.whitehouse.gov/petition/ban-and-outlaw-breed-specific-legislation-bsl-united-states-america-federal-level/d1WR0qcl

The American Bar Association:
http://www.abanow.org/2012/06/2012am100/

The American Veterinary Medical Association:
http://www.avma.org/public_health/dogbite/dogbite.pdf

The American Society for the Prevention of Cruelty to Animals:
http://www.aspca.org/fight-cruelty/dog-fighting/breed-specific-legislation

The Humane Society of the United States: http://www.humanesociety.org/issues/breed-specific-legislation/fact_sheets/breed-specific-legislation-flaws.html

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