

**THE ETIOLOGY AND CONSEQUENCES OF INJURIES TO VETERINARY
TECHNICIANS**

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Dedication

This work is dedicated to Khara, Paige, Izzy, and my mother, all of whom have expressed their belief in me in so many ways. Let this book be a reminder that all things can be accomplished by putting one determined foot in front of the other, and that one must trust the process.

Abstract

Background: Approximately 53,000 Certified Veterinary Technicians (CVTs) are at risk of traumatic occupational injuries (Bureau of Labor Statistics, 2004) that are costly in terms of medical expenses, lost work time, and career loss. A two-phase study, using mailed questionnaires, identified total injury experience and consequences and risk factors for animal bites among all 1,427 Minnesota CVTs.

Methods: Phase 1 comprehensive data were collected on injury events, consequences, and exposures from the previous 12 months (74% response) to identify annual injury rates and potential risk factors. Phase 2, a nested case-control study, examined relations between exposures and animal bites in small animal clinics that CVT cases (n=176) reported in the previous 12 months; controls (n=313) reported no bites. Exposure data were collected from cases (month prior to the bite injury) and controls (randomly selected months) (61% response) to facilitate multivariate analyses, based on Directed Acyclic Graphs.

Results — In Phase 1 (873 respondents), 1,827 injury events were reported by 445 CVTs. Injury rates (95% Confidence Intervals) per 100 persons per year included all injuries, 236.8 (226.2 – 247.9) and bites, 77.7 (71.7 – 84.2). Increased rates involved: <6 years handling animals; ≤ 3 years working as a CVT; working in small animal clinics. Primary injury types were bites, cuts/lacerations/scratches, and contusions, and leading sources were cats and dogs involving animal restraint or treatment. Consequences included: treatment, restricted work, and lost work time. Multivariate modeling identified a decreased risk for working <40 hours/week and increased risks for: handling >6 types of

animals per day; handling animals <6 years; and working in emergency clinics; or small animal clinics. Phase 2 multivariate analyses indicated increased risks of bite injury for: age <35 years versus 35+; <5 versus 10+ years experience; “frequently” and “infrequently to never” versus “always,” having adequate help; handling 5+ versus <3 animal types per day; and decreased risks for no prior bite injury history) and handling <10 versus 20+ animals per day.

Conclusions: The CVTs’ environment places them at risk of injuries with serious consequences. In addition to documented risks, further examination of relevant exposures is integral to the development of relevant interventions.

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Organization

The organization of this thesis provides initial chapters including an introduction, a comprehensive literature review, and a comprehensive presentation of the research design and methods. These chapters are followed by two major papers (Chapters 4 and 5) that report the important findings from the study; because these papers are prepared for publication in peer-reviewed journals, there is some redundancy with the first three chapters, pertinent to the literature cited and the methods presented.

CHAPTER 1

INTRODUCTION

A study of National Health Interview Survey data found that, of the annually estimated 19.4 million medically treated injuries to working age adults, 29% occurred at work (Smith et al., 2005). For the state of Minnesota, in 2003, there were an estimated 111,600 recordable occupational injury and illness cases involving workers' compensation costs approaching \$1.5 billion (Zaidman, 2005). One of the occupational groups at potential risk is that of Certified Veterinary Technicians (CVTs). A CVT who is employed in a veterinary clinic or veterinary hospital has many of the same responsibilities as a nurse working in a hospital or a physician's clinic. CVTs are referred to as 'Veterinary Nurses' in some countries. The CVTs will have direct contact with animals when collecting specimens, providing specialized nursing care, preparing animals for surgery, assisting in diagnostic surgical and medical procedures, exposing radiographs, and providing dental prophylaxis. They also are exposed to other potential hazards in the environment while performing laboratory procedures, preparing instruments and equipment for surgery, and performing other miscellaneous responsibilities of their job.

There are approximately 53,000 CVTs across the United States at potential risk of traumatic occupational injuries (Bureau of Labor Statistics, 2004) that can be costly in terms of medical expenses, lost time from work, or loss of a career due to disability. While a limited number of studies have been conducted on injuries to CVTs, one study was found that studied a convenience sample of Australian Veterinary Nurses about their

work-related injury experience and resulting consequences (vanSoest and Fritschi, 2004). Very few studies exist on factors associated with injuries to veterinarians, and no studies have been found pertaining to the potential risk or protective factors associated with specific work-related injuries to CVTs. Developing appropriate injury prevention and control measures requires a better understanding of the risks specific to this occupational group. The findings from the current study are essential to enhance this knowledge and provide a foundation for developing efforts to control these injuries.

The long-range goal of this research is to develop injury control efforts among veterinary health professionals. The objective of this particular study, which is the next step in the pursuit of the long-range goal, is to characterize the injury experiences of CVTs, to identify various types of injuries and associated consequences. Through a follow-up case-control survey, the risk factors associated with animal bites, based on relevant exposures, can be identified. The National Occupational Safety and Health, National Occupational Research Agenda priority objectives of research on traumatic injuries, consequences of workplace (illness and) injury, and exposure assessment will be addressed through this study. The rationale for the proposed research is that, once the risks of injury to veterinary CVTs are understood, the risks associated with a variety of work-related injuries can be decreased through new and innovative injury prevention and control approaches to training, environmental design, or work process design.

At the completion of this study, the expectation is that the injury events incurred by Veterinary Technicians certified in the state of Minnesota will be successfully characterized by identifying the various types of injuries, as well as the consequences of

these injuries. Important risk and protective factors associated with animal bite injuries will also be determined. Collectively, these outcomes will help establish the role of various characteristics of the employers, the CVTs, and the work environment that contribute to work-related injuries among CVTs. This is expected to positively affect the safety of CVTs, because it will allow the development of new safety strategies designed to prevent work related injuries. At the same time, the fundamental new knowledge obtained about risk and protective factors associated with work-related injuries to CVTs is expected to advance the general field of work-related injury research, prevention, and control.

Thousands of CVTs nationwide are at potential risk of traumatic occupational injuries with associated financial and other losses. It is difficult to estimate the number of CVTs who are injured each year, because most veterinary practices employ less than 11 full-time employees, exempting them from the Occupational Safety and Health Administration (OSHA) reporting requirements. A limited number of studies have found that the greatest number of injuries to veterinarians is due to animal bites and other animal-induced trauma, needle sticks, and ergonomic injuries (Hill et al., 1998; Poole et al., 1999; Gabel and Gerberich, 2002). The work environment of CVTs places them at risk of similar injuries (Bureau of Labor Statistics, 2004); however, the tasks performed by CVTs differ from veterinarians in scope and frequency. There is a critical gap in the knowledge base that centers on the sources, the costs, and the risk/protective factors associated with work-related injuries among CVTs.

Three aims are identified for the current investigation. With the first aim, the frequencies and sources of work-related injuries to CVTs will be determined, as well as the attendant severity and consequences. With the second aim, the association will be determined between the support of the CVTs' employers, with regard to proper animal restraint, and the risk of animal bite injuries. And finally, with the third aim, the risk for animal bites associated with the CVT being less likely to use proper animal restraint in the presence of the owners of the animals during examinations and procedures will be determined. The research proposed is significant, because it will provide a basis for future research, as well as provide the necessary information about associated risk and protective factors to reduce the risk of animal bites. As an outcome of this study, it is expected that work-related injuries to CVTs could ultimately be reduced through the use of the study findings in safety training courses, in veterinary facility work processes, and improvements to the facility environments. This is expected to have a significant positive impact on injury prevention to CVTs and, as a consequence, decrease the amount of lost time from work and Workers' Compensation claims and insurance costs due to work-related injuries. Therefore, the positive impact of the proposed research is expected to be significant.

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CHAPTER 2

BACKGROUND AND SIGNIFICANCE

Prevalence of Work-Related Injuries

To date, some studies have used injury data from Workers' Compensation claims. The limitation of these studies is that they only detect the most serious injuries, resulting in extended loss of work time. For example Thigpen and Dorn (1973) analyzed the American Veterinary Medical Association (AVMA) Group Insurance Trust (GIT). These authors found an average work-related injury rate of 22.7/1,000 insured veterinarians per year, with an average of 14.3 days lost per injury during the three-year period for injuries occurring in the clinic environment. Gabel (2000) reported a work-related injury rate of 23.2 injured persons per 100 in a population-based survey of all Minnesota veterinarians. Nienhaus et al. (2005), studied insurance claims data for German veterinarians and their staff, using the equivalent of the U.S. Worker's Compensation insurance data. The observed annual incidence rate for work-related injuries was found to be 10 per 100 full-time veterinarians and their staff.

Injury Costs and Consequences

Thigpen and Dorn (1973) found that fractures resulted in more workdays lost than any other types of injuries. Sprains, torn ligaments, and dislocations comprised the second leading cause of days lost. A study of Minnesota and Wisconsin members of the American Veterinary Medical Association, in the 1980s, found that lost days from work due to an animal-related injury in the past year averaged 1.3 days; of those veterinarians reporting an animal-related injury in the past year, 17% had been hospitalized

(Landercasper et al., 1988). Jeyaretnam et al. (2000), reported a mean of 13.3 workdays lost over a 12-month period according to Workers' Compensation claims data for veterinary practices in Western Australia. Gabel (2000) reported that 84% of the veterinarians reporting work-related injuries did not lose any time from work, and 11% lost no more than seven days; 52% reported no restrictions of any activity, while 27% reported restrictions for up to three days, and 21% reported restrictions ranging from more than three days to 12 months.

Of the bite wounds reported in a study by Drobotz and Smith (2003), 42% were rated as mild, 41% were rated as moderate, and 17% were rated as severe. Medical attention was received by 69% of the case subjects reporting a bite injury. In 1996, animal bites accounted for nearly half of all Workers' Compensation claims, according to the data from one insurance carrier involving 2000 workers' claims from veterinary practices (Smith and Stilts, 1996).

Injury Types and Sources

Thigpen and Dorn (1973) found that injuries involving animals accounted for 74% of all work-related injuries to the veterinarians in the study, and cattle (37%), horses (17%), and dogs (17%) were the animals most often the source of an injury. In a study by Landercasper et al. (1988), the animals most commonly involved in work-related injuries to veterinarians were cattle (47%), horses (15%), and dogs (46%). Gabel and Gerberich (2002) found that cattle were sources of 28%, dogs, 22%, and cats, 19% of the work-related injuries reported by Minnesota veterinarians. According to Nienhaus et al. (2005), animals were the most frequent cause of occupational injuries (66%), with cats and dogs

the sources of most animal-related injuries in practices that treated small animals, and horses and cows prevailing in practices that treated large animals.

Thigpen and Dorn (1973) found that puncture wounds were one of the most common injuries to veterinarians. According to Landercasper et al. (1988), animal bites made up 34% of injuries to veterinarians during the previous 12 months; 92% sustained dog bites during their career, 81%, cat bites, 72%, cat scratches; 33%, horse bites, and 12%, pig bites. In a study by Poole et al. (1998), cat and dog bites were among the most common injuries to veterinarians. In a survey of veterinary practices in Australia by Jeyaretnam and Phillips (2000), the major sources of physical injuries to veterinarians and their staff, and resulting in the largest number of workdays lost, were dog and cat bites, cat scratches, and scalpel blade cuts. Bite punctures were reported in 31% of Minnesota veterinarians (Gabel, 2000). Cat bites accounted for 54% of the reported bite injury Workers' Compensation claims from veterinary practices in 1996 (Smith and Stilts, 1996). From insurance claims data, Nienhaus et al. (2005), found that the most frequent injuries to German veterinarians caused by animals were bites and scratches (48%), followed by minor injuries such as bruises (18%). Fritschi, et al. (2006), found that 48% Australian veterinarians experienced dog bites and scratches during the previous year and 67% reported cat bites and scratches. Dog and cat bites and scratches were experienced by 98% of Australian veterinary nurses during their careers; hands (48%) and arms (17%) were affected most often (vanSoest and Fritschi, 2004). This study found no difference between veterinarians and their staff regarding the sources of work-related injuries. In a study of bite wounds to veterinary hospital staff, Drobotz and

Smith (2003) found that 83% of the case subjects were bitten most frequently on the hand or finger.

Thigpen and Dorn (1973) reported that fractures were the second most common injury to veterinarians. According to Nienhaus et al. (2005), bone fractures were approximately 10 times more frequent when large animals such as cows and horses were involved in the injury than when cats and dogs were involved. Landercasper et al. (1988), reported that animal kicks made up 36% of injuries to veterinarians; of these, 87% sustained cattle kicks, and 63% were injured by horse kicks during their career. Sprains and strains were reported in 16% of Minnesota veterinarians (Gabel, 2000). Of the injured veterinarians, 20% were performing treatments, 16% were performing examinations, 16% were performing restraint, and 12% were lifting just prior to injury. A dose-response was identified for lifting animals, as follows: lifting 41-75 pounds (RR = 3.1, 95% CI = 1.6-5.9), lifting 79-100 pounds (RR = 3.2, 95% CI = 1.6-5.9), and lifting more than 100 pounds (RR = 6.1, 95% CI = 2.5-15.0). Jeyaretnam and Phillips (2000) found that one of the major sources of physical injuries to veterinarians and their staff, and resulting in a large number of workdays lost, were back injuries from lifting heavy animals. Among a convenience sample of Australian veterinary nurses, 52% suffered from chronic back or neck pain (vanSoest and Fritschi, 2004). Among Australian veterinarians, 49% reported chronic work-related musculoskeletal problems (Fritschi, et al., 2006).

In a study by Thigpen and Dorn (1973), lacerations were one of the most common injuries to veterinarians. Wilkins and Bowman (1997) studied needle stick injuries among

female veterinarians and reported a rate of 9.3 sticks per 100 person-years of practice. This rate was found to be comparable to reported rates among nurses. It was estimated that, due to under-reporting of the needle stick events, the actual injury rate was likely to be at least 20 sticks per 100 person-years of practice. In studies by Poole et al. (1998; 1999), needle punctures were one of the most common injuries reported. Only 6% of the injuries in the Nienhaus et al. (2005), study involving analysis of insurance claims data, were associated with needles and scalpels. In the study by vanSoest and Fritschi (2004), 71% of the veterinary nurses reported needle stick injuries and 43% experienced lacerations during their careers. Typically, needle sticks and lacerations from scalpels would not lead to a work time loss of more than three days and would, therefore, be underestimated when Workers' Compensation insurance claims data are used in the analysis.

Gabel and Gerberich (2002) reported that veterinarians who were not using anesthesia restraint were found to have a lower risk of work-related injury (RR = 0.5, 95% CI = 0.3-0.9), when compared to those who were using anesthesia restraint. According to Drobatz and Smith (2003), 11% percent of the bite injuries to hospital staff occurred during a physical examination, 11% while restraining the animal, and 8% while feeding the animal.

Of the California veterinarians reporting a history of atopic dermatitis, 61% reported work-related rhinitis and/or conjunctivitis; of those, 77% of the rhinitis symptoms were attributed to animal exposures (Susitaival et al., 2003). A specific animal contact was reported as a worsening factor for adult asthma symptoms in more than half

of the cases. Animal-related skin or respiratory symptoms were reported by 40% of the veterinarians, with cats and dogs being the most commonly reported source. Nienhaus et al. (2005), found that animals were the most frequent cause of allergic reactions (24% of all verified occupational diseases in veterinary practice). The second most important allergen was latex (10% of all Workers' Compensation claims). Diseases concerning the skin made up 39% of the occupational disease claims, followed by allergic respiratory diseases (31%), and infectious diseases (19%).

In conclusion, contact with dog bites, and cat bites and scratches are major sources of injuries to veterinarians and their staff in primarily small-animal clinics, while horse and cattle kicks are major sources of injuries in clinics that primarily care for large animals. Animals are also a major source of allergic reactions and infectious diseases.

Potential Risk Factors for Work-Related Injuries

Characteristics of veterinarians and veterinary staff

According to Thigpen and Dorn (1973), veterinarians 25 - 34 years of age had a much higher incidence of all types of injuries than any other age group. Veterinarians in that age group also were victims of a higher number of bite injuries. The 25 – 29 year age group had twice the number of lacerations of the hands, wrists, and fingers than any other age group. Minnesota veterinarians, under age 36, were found to have higher rates of work-related injuries than older age groups; those who had five or fewer years experience had an increased risk of work-related injury (RR = 3.1, 95% CI = 1.4-6.8), compared with older groups (Gabel and Gerberich, 2002). An increased risk of injuries was also observed for veterinarians who reported a history of prior injuries (RR = 1.7, 95% CI =

1.1-2.6); female, compared with male veterinarians, were at higher risk of work-related injury. The veterinarians' perceptions of being at a low, versus high, risk of injury were associated with a decreased risk of work-related injury. According to Drobotz and Smith (2003), there was no significant difference between cases and controls regarding previous bites by either cats or dogs; the percentages of veterinarians and their staff reporting previous cat or dog bites ranged from 61% to 80%.

Characteristics of the work environment

Wilkins and Bowman (1997) found that small-animal and mixed-practice veterinarians had the highest rates of needle stick injuries, in contrast to large animal practitioners. The reasons stated by the authors for the lower rates of needle sticks in large-animal practices, was that large-animal veterinarians may be more likely to restrain their large animal patients compared to small-animal veterinarians. In regard to other physical injuries, a greater rate of trauma was experienced by large-animal compared to small animal practitioners. According to Nienhaus et al. (2005), there was an increased risk (2.1) of injuries in large-animal practices than in small-animal practices. In a study by Gabel and Gerberich (2002), an increased risk (1.8, 95% CI = 0.9-3.9) was found for veterinarians who did not report that they always had assistance when working with animals.

Potential Risk Factors for Animal Bite Injuries to Veterinary Hospital Support Staff

A study by Drobotz and Smith (2003) was conducted to identify factors associated with increased risk of auxiliary caregiver veterinary staff being bitten by a cat or dog in a veterinary teaching hospital. There was a higher likelihood of being bitten by dogs or cats

that had warning signs on their cages, indicating the potential to bite (OR = 5.0), after adjusting for other covariates. Caregiver staff who handled cats were at a higher risk of bite injuries (OR = 2.4), after adjusting for potential confounders. Staff that reported animal bites were more likely to believe that the dog or cat had the potential to bite (OR = 4.2, 95% CI = 2.1-8.2). They were also more likely to report believing they were rushed in their responsibilities (OR = 2.2, 95% CI = 1.0-4.7). Fatigue may also have been a contributing factor. The median number of hours (4.5 hours) the cases worked during the day before the actual interaction for the cases, compared with controls, was greater (3.0 hours), during a randomly selected interaction. One might expect that muzzles would be used on animals showing a tendency to be aggressive; but, only 1/3 to 1/5 of dogs and cats that appeared aggressive, high strung, anxious, or difficult to handle, were muzzled.

Gap in the Knowledge Base

Although the work cited above provides evidence concerning the injury sources and severity, this information has not been available for CVTs. To resolve this problem, this research will identify associated injury sources and their consequences, along with the risk and protective factors, through the use of comprehensive and case-control surveys of CVTs. Only limited efforts have been made to investigate potential risk factors within a population. Two studies (Drobatz and Smith, 2003; Gabel and Gerberich, 2002), measured exposures for both subjects with reported injuries (cases) and a comparison group (controls). The remaining studies were primarily limited to cross-sectional study designs. These deficiencies in the current knowledge base limit the understanding of

occupational injuries to CVTs and the ability to develop effective prevention and control strategies.

In conclusion, a comprehensive analytic effort is needed that will enable the identification of specific risk factors, to identify the relation between exposures to CVTs and work-related injuries. Without such a comprehensive effort, the development of appropriate and efficacious prevention and control strategies cannot be initiated.

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Table 1
Previous Studies Investigating Injuries to Veterinarians and Veterinary Staff

<i>Author(s) Title, Journal</i>	<i>Year</i>	<i>Research Question/Goal</i>	<i>Population</i>	<i>Method</i>	<i>Design</i>	<i>Analyses</i>	<i>Conclusions</i>
Gabel and Gerberich, <i>Risk factors for injury among veterinarians</i> , Epidemiology	2002	To identify risk factors for job-related injuries	Licensed and practicing veterinarians in Minnesota in 1996	Written surveys	Case-control	Univariate and multivariate logistic regression	<ul style="list-style-type: none"> *Age 36-45 years, RR = 0.6 (CI, 0.4-0.9) compared to referent age, 24-35 *5 or less years Experience, RR = 3.1 (CI, 1.4-6.8) compared to 21 and more years *Male, RR = 0.5 (CI, 0.3-0.8) compared to Female *Prior injury, RR = 1.7 (CI, 1.1-2.6) compared to no prior injury * Perception of no risk, RR 0.04 (CI, 0.0-0.1) and perception of low risk RR = 0.4 (CI, 0.2-0.9), compared to high risk *Hydraulic lifts "Not Applicable," RR = 5.9 (CI, 2.3-14.9), compared to used hydraulic lift *Anesthesia restraint "Not Applicable," RR = 2.3 (CI, 1.3-4.0) and "No" RR = 0.5 (CI, 0.3-0.9), compared to "used anesthesia restraint" *Sharps boxes present "Not Applicable," RR = 4.7 (CI, 2.2-10.4) compared to "Yes" *Current smoker, RR = 4.1 (CI, 1.8-9.1), compared to Non-smoker *Current Alcohol use RR = 0.6 (CI,

							0.3-0.9), compared to no current use * <1 hour spent sitting, RR = 3.4 (CI, 1.6-6.3), compared to 4 or more hours
Gabel CL Doctoral Thesis	2000	To identify the magnitude of the injury problem among Minnesota practicing veterinarians	Licensed and practicing veterinarians in Minnesota in 1996	Written survey	Population	Frequencies	<p>Source of injury: Small animal 50% Dog (22%), Cat (19%) Large animal 40% Cattle (28%)</p> <p>Type of injury: Bite puncture, 31%; Sprain/Strain, 16%</p> <p>Activity engaged in when injured: Treatment, 20%; Examination, 16%; Restraint, 16%; Lifting, 12%</p> <p>Locale working when injury occurred: Clinic, 57%; Laboratory, 20%; Examination room, 17%; On the farm, 26%; Farmyard, 15%; Other areas, 17%</p> <p>Who treated injury: Self, 55%; MD, 37%</p> <p>Anatomical location of injury: Finger/thumb, 18%; hand, 29%; back/neck, 17%</p> <p>Injury rates: Small animal practice, 20%; Large animal practice, 32%</p>
Poole AG, et al., <i>Survey of occupational hazards in large animal practices,</i>	1999	To determine prevalence and causes of injuries experienced by personnel employed by	All U.S. veterinary practice staff insured by the AMVA Group Life and Health	Written surveys	Descriptive	Frequencies by practice and percentages of total for employee categories	<p>*Needle punctures, kicks, and crushing were most common injuries</p> <p>*Dairy practices accounted for 7.7% of the practices and 21.5% of all reported incidents</p>

J.A.V.M.A.		private predominantly equine and predominantly bovine vet practices in the U.S.	Insurance Trust during 1994 – 1996; 394 surveys returned				
Wilkins JR, Bauman ME, <i>Needlestick injuries among female veterinarians: frequency, syringe contents and side-effects</i> , Occupational Medicine	1997	To estimate the rate of occurrence of needlestick events among female veterinarians and to examine the relation between syringe contents and the nature of any resultant side-effects	All women graduating from all U.S. veterinary colleges during the 11-year period 1970-1980 using American Veterinary Medical Association membership files and U.S. veterinary school graduation rosters	Written survey with telephone survey of non-responders	Descriptive	Rates using person years of work time in the denominator	*The all-small-animal and mixed-practice veterinarians exhibited the highest rates, with the large animal practitioners exhibiting a rate about 40% lower than other practice types *Side effects were reported in 16.4% of the needlestick events *50% of all reported needlestick resulted from vaccines *52.6% of anthelmintic (worming agents) needlestick events caused side-effects *41.6% of euthanasia needlestick events caused side-effects *38.5% of anesthetic needlestick events caused side effects *85.8% of the side-effects were mild in severity or localized in extent (87.2%).
Jeyaretnam, et al. <i>Disease and injury among veterinarians</i> , The Journal of	2000	To identify occupational causes of disease and injury in veterinarians and their staff	All of the 160 registered veterinary practices in Western	Written surveys	Descriptive	Frequencies and univariate analysis	*71% of the veterinarians had average physical injuries of 10 years, with an average of 2.6 injuries per veterinarian *Work days lost were mainly due to dog and cat bites, cat scratches, scalpel blade cuts (requiring sutures) and

Trauma			Australia				<p>lifting of heavy dogs</p> <ul style="list-style-type: none"> *24% of the veterinarians believed that radiation exposure is a major occupational health and safety issue *37% of the clinics were not equipped with extractor fans or scavenging systems to extract waste anesthetic gases and vapor; 45% of the veterinarians reported using scavenger systems *21.8% of the veterinarians reported headache and nausea due to halothane anesthesia exposure
Susitaival et al. <i>Atopic symptoms among California veterinarians,</i> American Journal of Industrial Medicine	2003	To determine the prevalence of atopic symptoms, especially animal-related respiratory and skin symptoms (asthma, rhinitis, dermatitis), and to evaluate possible risk factors for adult asthma among California veterinarians	A stratified sample of 2,000 active members of the California Veterinary Medical Association	Written survey	Descriptive	Chi-square and multivariate logistic regression	<ul style="list-style-type: none"> *66% reported a history of respiratory atopy (ARD) or AD *Of those reporting AD, 61% reported work related rhinitis and/or conjunctivitis *29% of the respondents reported animals as the cause of symptoms *47% of those reporting adult asthma were on regular asthma or allergy medication *Altogether, 40% of the veterinarians reported animal-related skin or respiratory symptoms *Almost 2/3 of those with animal related skin symptoms reported symptoms appearing in minutes after contact with, in most cases, just one animal species: Cats (26%); dogs (19%); horses (7%); and cattle (7%)

							*Veterinarians with a history of asthma in childhood (95) had a 6.4 (CI, 3.98-10.3) greater risk of adult asthma than those with no childhood asthma (1,258)
Drobatz K, Smith G, <i>Evaluation of risk factors for bite wounds inflicted on caregivers by dogs and cats in a veterinary teaching hospital</i> , J.A.V.M.A.	2003	To identify factors associated with increased risk of being bitten by a dog or cat in a veterinary teaching hospital	Animal caregivers at a veterinary teaching hospital	Written survey	Case-control	Multivariate logistic regression	* The odds of being bitten by a dog or cat with a warning sign on the cage were 5.0 times greater than the odds of being bitten by a dog or cat with no warning sign, after controlling for the other covariates (CI, 1.9-13.0) * Difficult to handle OR = 3.9 (CI, 1.8-8.5) * Cat versus dog, OR = 2.4 (CI, 1.2-4.8) * 93% of the wounds were on the hand, finger, or wrist * Only 37% of dogs and cats that were considered difficult to handle were muzzled
Thigpen CK, Dorn CR. <i>Nonfatal accidents involving insured veterinarians in the United States, 1967-1969</i> , J.A.V.M.A.	1973	To identify work and non-work related injury frequencies by type and characteristics of the environment and to identify the consequences of the injury in terms of duration of disability	Male veterinarians in the 50 states of the U.S. and insured by the AVMA Group Insurance Trust	Secondary analyses of insurance claims data	Descriptive	Injury rates and frequencies	*19.2 days work loss per injury for the 3-year period *Lacerations and puncture wounds most frequent injury *Fractures second most common injury and resulted in more work days lost than other injuries *Sprains-torn ligaments-dislocations – second leading cause of days lost *Most of injuries from direct action of animals or failure to avoid them *Most often associated with cattle, horses, and dogs

							<p>*Highways and motor vehicles were involved in approximately 10% of injuries</p> <p>*Veterinarians in the 25-34 year age group experienced a higher number of bites</p>
Poole, et al. <i>Survey of occupational hazards in companion animal practices</i> , J.A.V.M.A.	1998	To determine the prevalence and causes of accidents and injuries experienced by owners, employees, and clients of companion, mixed, and exotic animal practices	Veterinarians designated as owners or operators of practices participating in the Professional Liability Insurance Trust workers compensation program including 5 employee categories	Written mailed survey	Descriptive	Frequencies and Spearman's rank correlation coefficients	*For all 5 employee categories, cat and dog bites and needle punctures were the most frequent incidents
Landercasper, et al. <i>Trauma and the veterinarian</i> , The Journal of Trauma	1988	To document the incidence and severity of animal-related injuries	All American Veterinary Medical Association members in Minnesota and Wisconsin	Written mailed survey	Descriptive	Frequencies	<p>*Kicks – 35.5%</p> <p>*Bites – 34.0%</p> <p>*Most common animals were bovine, canine, and equine</p> <p>*Lost days from work for animal related injury = 1.3 days for the year, 1986, and 8.5 days for the veterinarian's career</p> <p>*Self-treatment – 4% reduced own</p>

							fractures and dislocations, 20% sutured own lacerations, 68% self-administered antibiotics
Fritschi et al. <i>Injury in Australian veterinarians, Occupational Medicine</i>	2006	To identify the prevalence of self-reported work-related injuries, and dog and cat bites by practice type, gender and year of graduation	All veterinarians who graduated from any of the four Australian veterinary schools between 1960 and 2000	Written mailed survey	Population; observational	Frequencies, chi-square; multivariate regression	<p>*51% reported a significant work-related injury during career</p> <p>*26 % had at least on injury in previous 12 months.</p> <p>*49% reported chronic musculoskeletal problems</p> <p>*48% reported dog bites and scratches in previous 12 months; 67% reported cat bites or scratches Odds ratios were 1.48 and 1.35 for males for dog bites and scratches and cat bites and scratches, respectively.</p> <p>*The ORs for significant and chronic injuries, respectively, were 1.19 and 1.2 (approaching statistical significance). Large animal veterinarians were most likely to report significant and chronic injuries: 1.54 and 2.84, respectively.</p> <p>*48% of the respondents were <40 years old</p> <p>*58% reported working in small animal practices, 33% in mixed practices, 6% in large animal practices, and 3% were in specialist practices</p> <p>*Vets in large animal and mixed practices were >10 times more likely to have had a recent injury. Graduates from the previous 10 years were more</p>

							likely to report a recent injury than earlier graduates.
Van Soest, EM, Fritschi L, <i>Occupational health risks in veterinary nursing: an exploratory study</i> , Australian veterinary journal	2004	To survey the prevalence of certain exposures and health problems among a group of veterinary nurses	Veterinary nurses who attended the International Veterinary Nurses Conference in Brisbane, Australia	Written surveys given at conference	Descriptive	Frequencies	*Frequencies were based on the number of injuries during their career *24% were 24 years old or younger; *50% were 25 - 35 years old; *20% were over 35 years of age *Mean years working as a Veterinary Nurse = 7.6 years *98% experienced acute injuries *98% experienced dog/cat bites scratches *Types of injuries: 71% - needle sticks; 43% - lacerations; 52% suffered from chronic back pain
Nienhaus, et al. <i>Work-related accidents and occupational diseases in veterinarians and their staff</i> , International Archives of Occupational and Environmental Health	2005	To identify the most important health risks to veterinarians and their staff	Approximately 10,000 German veterinary practices comprising about 27,500 veterinarians and their staff	Secondary analyses of insurance claims data	Analyses of insurance claims data	Frequencies; Rates	*Incidence rate = 105.4 per 1,000 full-time workers *66% reported injuries were due to scratches, bites, and kicks from animals *Cats and dogs caused most animal-related injuries in practices that treated small animals

CHAPTER 3

RESEARCH DESIGN AND METHODS

Specific Aims

The purpose of this two-phase study was to characterize the injury experiences of Certified Veterinary Technicians (CVTs) to identify various types of injuries and attendant consequences. The long term goal was to determine the nature of injuries among veterinary health professionals and identify associated exposures and risk factors. Through a follow-up case-control survey, the risk factors associated with animal bites, based on relevant exposures, were identified. The National Occupational Safety and Health, National Occupational Research Agenda priority objectives of traumatic injuries, consequences of workplace (illness and) injury, and exposure assessment were addressed through this study.

The hypotheses for the proposed research were:

- The risk of specific injuries is related to characteristics of the animals, the veterinary technicians and other staff, and the clinical environment.
- Inadequate training and experience in proper animal restraint is associated with an increased risk of bite-related injuries to veterinary technicians.
- Risk of animal bite injuries in veterinary technicians is associated with being less likely to use effective restraint safety precautions while in the presence of the owner.

To address the hypotheses, the following specific aims were to:

Aim #1: Identify the frequency and consequences of and potential risk factors for injuries to veterinary technicians.

Aim #2: Identify the risk/protective factors associated with animal restraint training and experience in proper restraint techniques on the risk of animal bite injury to veterinary technicians.

Aim #3: Identify the risk/protective factors associated with use of bite prevention precautions in the presence of the owner on the risk of animal bite injury to veterinary technicians.

Research Overview

The self-reported frequency and consequences of work-related injuries specific to an entire population of CVTs has not yet been studied. Phase I of the study was a comprehensive survey of CVTs and addressed Aim #1. The objective of Aim #1 was to identify the frequency and consequences, as well as the sources of these injuries among an entire population of Veterinary Technicians, certified to practice within the state of Minnesota; in addition, potential risk factors were considered. To attain this objective, the working hypothesis that the risk of specific injuries is related to characteristics of the animals, the CVTs and other staff, and the clinical environment, was tested.

A specially designed questionnaire was mailed to all CVTs who were certified in the state of Minnesota through the month of October, 2004, in order to identify those who worked in the previous 12 months and to identify those who did and did not experience work-related injury events, meeting the definition of injury. In this study, work-related injury included any activities associated with the job or events that occurred in the work

environment, including travel. Such injuries could have occurred as a result of bites, lacerations, fractures, sprains, strains, skin punctures, dermatitis, needle sticks, scratches, and repetitive motion. Consequences of work-related injuries could have involved one or more of the following: 1) restriction of or interference with regular activities for any length of time; 2) loss of consciousness, loss of awareness, or amnesia for any length of time; 3) use of medical or health care as the result of an injury; 4) bruising and/or break in the skin from a bite injury.

The rationale for undertaking this research was that, once the types and sources of work-related injuries were identified, in the first phase of the study, the risk of specific injuries, through a case-control design, could be identified in the second phase of the study; this would, then, serve as a basis for further research and application to injury prevention and control techniques. The expectation, based on individual interviews and discussions with CVTs, instructors, and veterinarians, was that the CVTs would report injuries at a rate that is at least as high as that of injuries reported in the literature by veterinarians.

In Phase 1 of the study, comprehensive data were collected pertinent to injury events, including the source, surrounding circumstances, resulting injuries and consequences. Analyses of these data were used to 1) determine the rates and consequences of injury, and 2) identify the potential associations between injuries and the types of animals handled, and several CVT-related and environmental characteristics.

No prior research has been found that examines the risk and protective factors associated with employer support to use proper animal restraint techniques on the risk of

animal bite injury to CVTs. Also, no prior research was found that examined the association between exposure to the use of bite prevention precautions in the presence of the owner and the outcome of animal bite injuries to CVTs.

Phase II of the study, a nested case-control design, involved follow-up to the CVTs who responded to the phase I survey, and enabled Aims #2 and #3 to be addressed. The relations between various exposures and work-related animal bites were examined. Cases were defined as those who reported at least one bite injury, while controls were those who reported no bite injury during the 12-month study period. A specially designed questionnaire was sent to the relevant cases and controls to obtain data on the work environment exposures, including characteristics of the CVTs and other staff in the workplace, the employer, and animals. The cases were questioned about their exposures during the month prior to the bite injury incident and controls were questioned about their exposures during the month prior to a randomly selected month from the study period. Analyses to identify specific risk or protective factors for animal bite injury were conducted, using multivariate modeling, in accordance with development of a causal model, including relevant exposures of interest (Greenland et al., 1999).

The objective of Aim #2 was to determine the risk associated with employer support, or lack of support, for using proper animal restraint in order to prevent bite injuries to CVTs. To attain this objective, the working hypothesis that employer support for using proper animal restraint is associated with a decreased risk of bite injury to CVTs was tested.

The objective of Aim #3 was to determine risk associated with the CVTs' likelihood of using proper bite prevention precautions in the presence of the owner of the animals on the outcome of bite injuries. To achieve this objective, the working hypothesis that the risk of animal bite injuries to CVTs is associated with being less likely to use proper animal restraint while in the presence of the animal owner was tested.

These working hypotheses were tested by using a specially designed case-control questionnaire that was mailed to the CVTs to collect data pertinent to each of these exposures that would, then, enable analyses to quantify the point estimates relevant to each of these hypotheses. Resulting findings, pertinent to Aim #2, would be important because they would provide the opportunity for employers of CVTs to evaluate important influences on the use of proper animal restraint, which may decrease the risk of bite injuries. Animal restraint training programs could also be designed, based on this information, with the awareness of potential obstacles that would prevent the CVT from practicing safe restraint techniques. Findings, pertinent to Aim#3, would be important because they would allow employers of CVTs to evaluate the influences on the use of proper animal restraint and bite prevention in the presence of the animal owners, which may result in administrative policies that would also have the potential to reduce bite injuries.

Study Population

1) Study Cohort

This study involved the population of Veterinary Technicians certified to work in the state of Minnesota and who worked as a CVT within the 12 months prior to the

survey. There were 1,465 Veterinary Technicians in the database maintained by the Minnesota Veterinary Medical Association at the end of the month of October, 2004. Veterinary Technicians who were certified in the state of Minnesota, but had not worked as CVTs in any state during the 12 months prior to the survey, were excluded from the study population. All of the 1,465 Veterinary Technicians certified in the state of Minnesota at the end of October, 2004, were mailed the initial comprehensive survey.

2) Case Selection

Cases were identified through responses to the initial comprehensive survey instrument that was sent to all 1,465 Veterinary Technicians certified in the state of Minnesota at the end of October, 2004. Based on the literature, it was estimated that between 30% and 35% of the CVTs, who worked during the previous 12 months, would have incurred an animal bite injury meeting the definition stated in the survey (Gabel and Gerberich, 2002). Cases were defined as those who reported at least one bite injury during a month in which they worked as a CVT during the previous 12 months. If more than one bite injury was reported in the previous 12 month period, one bite injury was selected randomly from the eligible bite injuries as the injury of interest for the study. This method was chosen over choosing the first event, the most recent event, or the most severe event, because each of the alternate methods of case event selection could have contributed to biasing results of the study, due to misclassification and recall bias. Exposure information was provided for the month prior to the month in which the bite injury occurred.

3) Control Selection

All respondents who reported working as a CVT during the previous 12 months and who did not report a work-related bite injury during a month in which they actually worked, were selected as controls. Each control was randomly assigned a month, based on the months he or she indicated working during the study period to provide exposure information.

4) Sample Size Consideration

A 70% response rate was used as an estimate in the calculations to the exposure prevalence necessary to detect a relative risk of 1.50. The main exposures of interest were 1) lack of employer support to restrain animals properly, and 2) being less likely to use proper animal restraint in the presence of the owner. No information was found about these exposures in the literature. The exposure prevalence needed to detect an odds ratio of 1.50 would be between 0.16 and 0.78 at $\alpha = 0.05$ (one-sided), power = .80, estimated cases = 330, and 2 controls per case (UCLA Department of Statistics).

Contact Procedures

Initially, for phase I of the study, a survey instrument was sent to all 1,465 CVTs to identify who did and did not experience work-related injury events. Subsequently, for phase II of the study, a nested case-control design was used to examine the relation between potential risk and protective factors and work-related bite injuries. A questionnaire was sent to both cases and controls to obtain information on relevant exposures during the specified data collection period. Cover letters, providing information about the study and informed consent were enclosed with the mailing. For

those who did not respond, initially, up to three mailings were sent. To enhance participation, each participant returning a questionnaire and indicating the desire to be included in a random drawing, had approximately a one in 30 opportunity to attain a \$20 Target gift card.

In the initial survey for phase I of the study, data collection included the following: 1) whether or not the person worked in a CVT position in the previous 12 months, and during which months; and 2) demographic information such as types of animals cared for, type of facility in which they worked, years experience in handling animals, years experience as a Veterinary Technician (both certified and uncertified), year of graduation from a Veterinary Technician program, birthdate, marital status, annual household income, height, and average weight. The data collection instrument enabled participants to provide information about each event, including date(s) of the event(s), the source of the event(s), surrounding circumstances and activities at the time of the event(s), location(s) of the event(s), type(s) of injury(ies) and anatomical location(s), relevant length(s) of restricted activities, lost work time and health care treatment sought. This information enabled determination of eligibility of the respondent in the cohort (e.g., worked as a CVT during the study period), and collection of demographic and potential exposure information on the entire study population.

The phase II case-control survey data collection provided a method to investigate relevant risk and protective factors associated with work-related bite injuries. Exposure prevalence was identified by questioning the cases about their exposures prior to and during the incident, while controls were questioned about their exposures during the

randomly selected time period. Both cases and controls were questioned about: personal information (including demographics, animal restraint training, years of experience, prior work-related animal bite injuries); employer information (including employer restraint practices, encouragement of proper animal restraint, importance of animal restraint training, support of staff to speak up when feeling unsafe); facility environment (including numbers and types of co-workers, relevant co-worker training and experience, co-worker support of safety practices, workload and scheduling, quality of communication with co-workers, type and daily volume of animals, animal restraint equipment availability, type of clinic or practice); animal owner information (including perceived experience in animal restraint, frequency of assisting with animal restraint). These data were then used to compare exposures between cases and controls in order to identify specific risk and protective factors for the work-related bite injury events.

Conceptual Model

An overall conceptual model for the occurrence of work-related injury events, based on previous knowledge, is presented in **Figure 1**. This model is based on the epidemiological model of human damage involving dynamic interactions of agents, vehicles (or vectors) within the environment, and a host: the agents of injury are various forms of energy; the vehicle refers to any element in the environment that conveys the agents (in the case of CVTs, the vehicle may involve an animal who may transmit the energy via biting, kicking, scratching, etc.); the host is the person injured.

Study Hypotheses

The models in **Figures 2 and 3** were used to determine which questions to include in the data collection instrument to ensure that adequate information was collected on potential risk factors and potential confounders, without including unnecessary questions. These models enabled a view of the dynamics among the various risk factors and assisted in guiding the data collection, analysis, and interpretation. It is to be noted that very limited research has been conducted on risk factors for work-related injuries to veterinary personnel. Hypotheses without specific references identified are based on information provided by interviews with various veterinary experts, including CVTs. Hypotheses are based on the theoretical framework that considers the dynamic interaction of the CVT within the environment, including co-workers and various factors related to the facility and types of animals handled.

Phase I Hypotheses

The phase I analytic models were based on specific hypotheses pertinent to the risk of work-related injuries to CVTs; the following relationships among variables are shown in the causal diagram and were included in the phase I analyses (**Figure 2**):

1) Characteristics of Certified Veterinary Technicians

Individuals who have the following characteristics, compared with those who do not, will have an increased risk of work-related injury:

- Younger individuals (categorical) (Gabel and Gerberich, 2002)
- Less than 6 years of work experience (Gabel and Gerberich, 2002)
- Females (Gabel and Gerberich, 2002)

- Work more than 50 hours per week
- Body mass below normal range
- A low perception of risk of bite injury

2) Facility or clinic environment

Individuals who work in facilities or clinics with the following characteristics, compared with those who do not, will have a decreased risk of work-related injury:

- A lower number of animals handled per day
- A large, or mostly large private animal practice

Phase II Hypotheses

The phase II analytic models were based on specific hypotheses pertinent to the risk of work-related bite injuries to CVTs; the following relationships among variables are shown in the causal diagram and were included in the phase II analyses (**Figure 3**):

1) Characteristics of Certified Veterinary Technicians

Individuals who have the following characteristics, compared with those who do not, will have an increased risk of work-related bite injury:

- Younger individuals (categorical) (Gabel and Gerberich, 2002)
- Less than 6 years work experience (Gabel and Gerberich, 2002)
- Females (Gabel and Gerberich, 2002)
- History of a prior work-related injury (Gabel and Gerberich, 2002)
- Work more than 50 hours per week
- Body mass below normal range
- Less likely to apply proper animal restraint in the presence of the animal owner

- A low perception of risk of bite injury
- Perceived lack of adequate restraint training

2) Employer support

Individuals with employers who have the following characteristics, compared with those who do not, will have a decreased risk of work-related bite injury:

- Encouragement of proper animal restraint
- Identify proper animal restraint training as a priority
- Have a policy restricting animal owners from restraining their animals

3) Facility or clinic environment

Individuals who work in facilities or clinics with the following characteristics, compared with those who do not, will have a decreased risk of work-related bite injury:

- A lower number of animals handled per day
- A large, or mostly large private animal practice
- Frequently or always have adequate staff help available for animal restraint

4) Animal owner

Individuals who perceive the animal owner to have the following characteristic, compared with those who do not, will have a decreased risk of work-related bite injury:

- Nearly all of the owners would be capable of restraining their animals while the CVT performed a procedure

Data Analysis

1) Phase I Analyses

The data collected from the phase I comprehensive survey was used to conduct descriptive analyses to identify the magnitude and characteristics of injuries to CVTs, to determine the relevant injury rates and consequences, using SAS statistical software. Specifically, two-way tables and cross-tabulations were used to determine proportions for the self-reported four most severe injuries by type of injury, body part injured, age, gender, body mass index, income, marital status, type of practice, types of animals with which they worked, years working as a CVT, years working in the veterinary field, hours worked per week, the number of staff at the facility, the location where the injury occurred, the source of injury, work-related activity, how the injury was treated, length of work and non-work restrictions, and days absent from work.

Poisson models were used to determine injury rates by age, gender, body mass index, type of practice or facility, the numbers of species handled, years working as a CVT, years of experience in handling animals, hours worked per week, hours worked per day, and the number of staff at the facility. A point estimate and 95% confidence interval was produced for each rate.

An overall comprehensive causal model is presented in **Figure 2** to identify potential risk factors for animal bite injuries, and was elucidated into directed acyclic graphs for the relevant exposures of interest, following the methods described by Greenland, et al. (1999). This model is based on deduction from previous published information and information provided by individual interviews and discussions with

CVTs and veterinarians. The type of facility or practice will affect the type and volume of animals handled by the CVTs. The type and number of animals handled is suggested as a risk factor for injuries. Less experienced CVTs may not use recommended methods of injury prevention. Age may affect one's tolerance and reaction time, which plays an important role in preventing injury. Age may also reflect experience, resulting in the acquisition of knowledge about avoiding and preventing injuries. A person's size, the type of animal, and whether staff is available to assist, may all contribute to how animals and equipment are lifted and moved, and the risk of injury.

2) Phase II Analyses

The ultimate goal of the phase II case-control data analysis was to estimate the impact of the main exposure variables on work-related animal bite injuries, controlling for important confounding factors. The exposures of primary interest were: 1) employer support for employees to use proper animal restraint; and 2) the likelihood of the CVTs to properly restrain animals in the presence of the animal owners. The injuries of interest were those resulting from animal bites and meeting the definition as previously presented. Potential confounding factors included other known or suspected risk factors, such as age, experience, history of prior bite injury, perception of risk, animal restraint training, the types and volume of animals handled per day, and the type of facility or clinic practice in which the subjects were employed. Univariate analysis was employed, first, to describe the characteristics of individual exposures, followed by multivariate analyses. Based on the conceptual and causal models for this study, variables were selected to enter into the multivariate model analyses. Logistic regression, among other

analytical techniques, was used to investigate the relation between specific exposures of interest and work-related bite injury (Breslow and Day, 1980). Identification of risk and protective factors for animal bite injuries were addressed through multivariate modeling, in accordance with a causal model and specific directed acyclic graphs, that incorporated exposures of interest (Greenland, et al, 1999), a method used in a related prior study (Gabel and Gerberich, 2002).

A comprehensive causal model for phase II and Aims #2 and #3, animal bite injuries, is presented in **Figure 3**, illustrating the relevant exposures of interest. This model was based on deduction from previous published information and information provided by individual interviews and discussions with CVTs and veterinarians.

The types and numbers of animals handled can have an effect on how or whether the employer has the resources to provide the necessary equipment, staff, and other support for proper animal restraint. The types and numbers of animals handled per day may also affect the risk of bite injuries. The types and volume of animals will depend on the type of clinic or practice employing the CVT. A combination of the CVTs' age, experience, prior bite injury history, perception of risk, and animal restraint training can influence the CVTs' likelihood of using proper animal restraint in the presence of the owner which, then, can affect the risk of animal bite injury. A history of prior injury, the perception of risk, and animal restraint training may depend on the number and quality of staff support, as well as whether or not the employer is supportive of proper animal restraint. The need for animal owners to assist the CVTs with restraints may depend on the types and volume of animals, as well as the numbers and capability of the support

staff. The types and volume of animals, as well as the number and capability of the support staff, may depend on the type of facility or clinic employing the CVT.

Hypotheses were based on the theoretical framework that considers the dynamic interaction of the amount of employer support for proper animal restraint, the type of facility or practice, characteristics of the CVT, and the capability of the animal owner to properly restrain their animal relevant to the risk of animal bite injury.

The directed acyclic graphs are presented for each relevant exposure in **Figures 4 - 33**. Figures 4 through 19 pertain to all clinic types, and figures 20 through 34 pertain to small and mostly small animal clinics. In multivariate modeling of the effects of the exposures of interest, covariates were adjusted in accordance with the causal model. A point estimate and 95% confidence interval was produced for each model.

Example of a Case-Control Analytic Model

As an example, logistic regression was performed on the risk of work-related animal bite injury, with the exposure of interest being, “not as likely” (versus “just as likely”) to apply proper animal restraint in the presence of the animal owner. The following are potential confounders that were added to the model according to the overall causal model (**Figures 19 and 33**): age (categorical); experience (categorical); prior bite injury; perception of risk for bite injury; adequate restraint training; body mass index; animal owner present; animal owner restraint capability; employer support to restrain properly; adequate restraint equipment; staff support; type and volume of animals; hours worked (proxy for fatigue); co-worker assist with restraint; and type of practice or facility.

Expected Results and Potential Importance

The expectation upon completion of phase I was to have identified the types and mechanisms of work-related injuries to Veterinary Technicians certified in the state of Minnesota, as well as the most prevalent environmental and personal characteristics of the CVT's that are associated with work-related injuries. Another expectation for phase I was to have described the annual rate of work-related injuries and consequences to this population of CVT's.

The expectation upon completion of the phase II case-control analyses, after controlling for potential confounding, was to have identified the risk and protective factors for work-related animal bite injuries to Veterinary Technicians certified in the state of Minnesota associated with 1) employer support to use proper animal restraint associated with employer support of proper animal restraint and; 2) the likelihood of using proper animal restraint in the presence of the animal owner. These outcomes are critical in being able to prioritize further research and injury prevention and control initiatives, as well as clinical practice policies.

Bias Evaluation

Selection bias may have been a problem that could have affected the validity of the study findings. The CVTs who responded to the full survey instruments may have been very different from those who did not respond to the survey. For example, those who did not respond may not have been working at the time of the survey or they may have been working so much that they did not have time to complete the full survey. They may also have had a very low prevalence of work-related injury and, therefore, viewed

the surveys as having less personal importance. This would leave question about the ability to generalize the findings to the target population of all Veterinary Technicians certified in the state of Minnesota. It was not possible to assess the impact of the lack of information from non-responders.

Measurement error in the form of missing data within questionnaires may also have been a problem. Sensitivity analyses were conducted, using methods described by Rothman and Greenland (1998), to examine the impact of an unmeasured confounder related to the magnitude and direction of potential bias. Given that one of the results of this study suggested that the CVTs' perceptions of "frequently," but not "always" having adequate staff available for proper animal restraint was associated with increased risk of bite injury, analyses were conducted to consider the effect of an unmeasured confounder on this result -- the population density of the clinic location in which the CVTs worked the most time during the study. This factor could be associated with the pool of available trained veterinary staff and the risk of bite injury. With prevalence of the unmeasured confounder being defined as the proportion of CVT's who worked in a more densely populated work area, the examination of estimated ranges of this prevalence between staffing exposure levels was used to determine the effect of the unmeasured confounder on the risk associated with the exposure. Sensitivity analysis produces upper and lower bounds for risk estimates under different plausible scenarios, resulting in an outcome that is "adjusted" for measurement error. Sensitivity analyses indicates the necessary strength of association between the unmeasured confounder and the exposure of interest (perception of adequate staffing levels) and the necessary differences in prevalence of the

unmeasured confounder between the exposed and the unexposed, in order to remove the effect of the exposure of interest (perception of adequate staffing levels) and the risk of bite injury.

Self-reporting could introduce recall bias in the form of differential recall of events and exposures. However, by limiting the time period to one month within the preceding year, it is anticipated that this bias would have been minimized for the phase II case-control portion of the study. This approach has been found to be successful in a previous study (Gabel and Gerberich, 2002).

Human Subjects Protection

The study protocol was approved by the University of Minnesota's Institutional Review Board: Human Subjects Committee (IRB) (Study #0410P64312). Based on contact with the Minnesota Veterinary Medical Association, statistics on gender were not available on a state level. There were no exclusions on the basis of either gender or race in the proposed study; the inclusion of children was not relevant to this study that involved a working population with an expected age range between 20 and 75 years. For the first-phase mailing, a data file of all CVTs certified in Minnesota at the end of October, 2004 was obtained from the Minnesota Veterinary Medical Association and all 1,465 subjects, identified in this file, were selected for the study.

Potential risks to the participants were minimal. Although there may be concern about injury data being available to external parties, participants were informed that all data are strictly confidential. The mailing, which included a cover letter that explained the project and provided information, pertinent to informed consent, was sent to each

selected subject. In the cover letter, the subjects were advised, “Participation in this study is voluntary. Refusal to participate will not affect your future relations with any of the institutions involved in this effort. We assure you that your participation and all information collected in this study will remain completely confidential and will be reported only in aggregate form. In any published reports, there will be no information identifying any individual or associated institution.”

The following procedures were implemented to ensure confidentiality: 1) all written project materials with subject identifiers were maintained in locked file cabinets; 2) access to computerized data files were protected through the use of passwords that restrict access to the files; 3) personal identifiers were removed from the final data sets once the data collection procedures were completed; 4) in all written reports and manuscripts, no individual or institution was ever identified. Only aggregate data will ever be presented.

Benefits of the research to the subjects and others include the potential for increasing knowledge of ways to reduce associated work-related injuries. In addition, an incentive was included to optimize participation; a total of 50 Target gift cards (value, \$20 each), were provided, affording an opportunity for an award to one in every 30 participants. These were provided, following completion of the data collection. As identified in the methodology, this approach has met with success in previous efforts by the investigators and comparable approaches identified in the literature.

Importance of the Knowledge Gained

This effort enabled identification of the magnitude and consequences of work-related injuries to CVTs, as well as the identification of factors that may either increase or decrease their risk. The overall results of the project may be used as a basis for the development of injury prevention and control programs.

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Figure 1. Injuries among Certified Veterinary Technicians: Etiology and Consequences

CONCEPTUAL MODEL

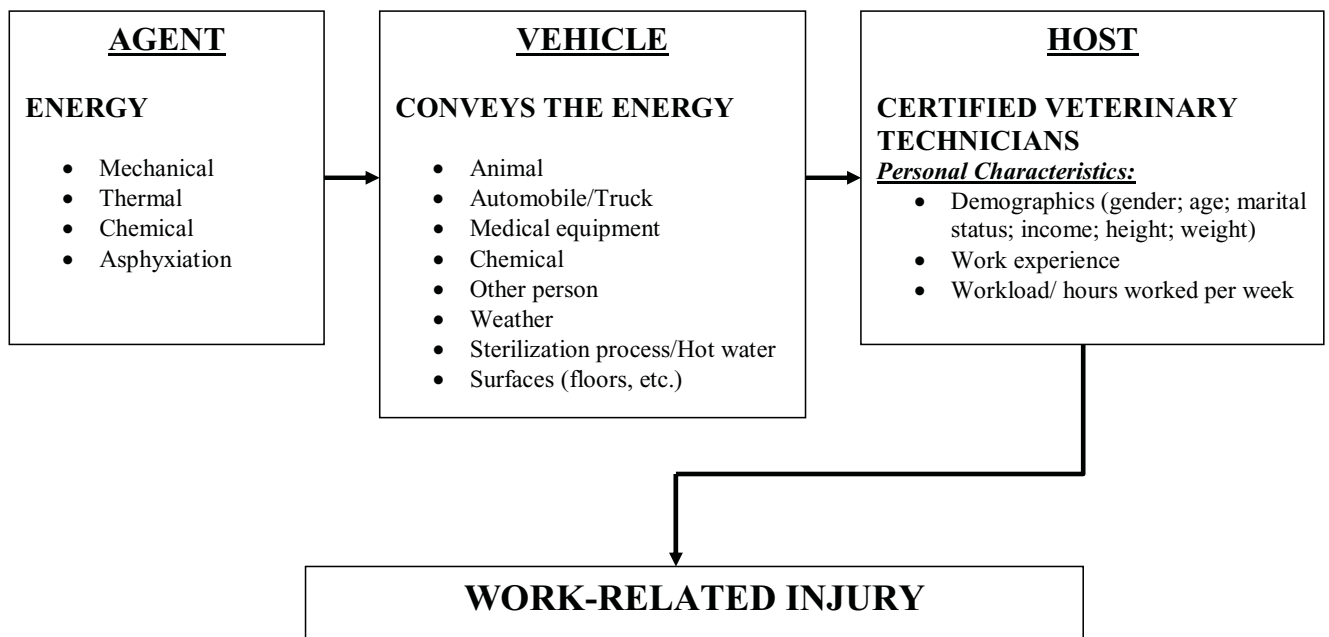


Figure 2. Phase I Causal Model: Minnesota Veterinary Technicians Study

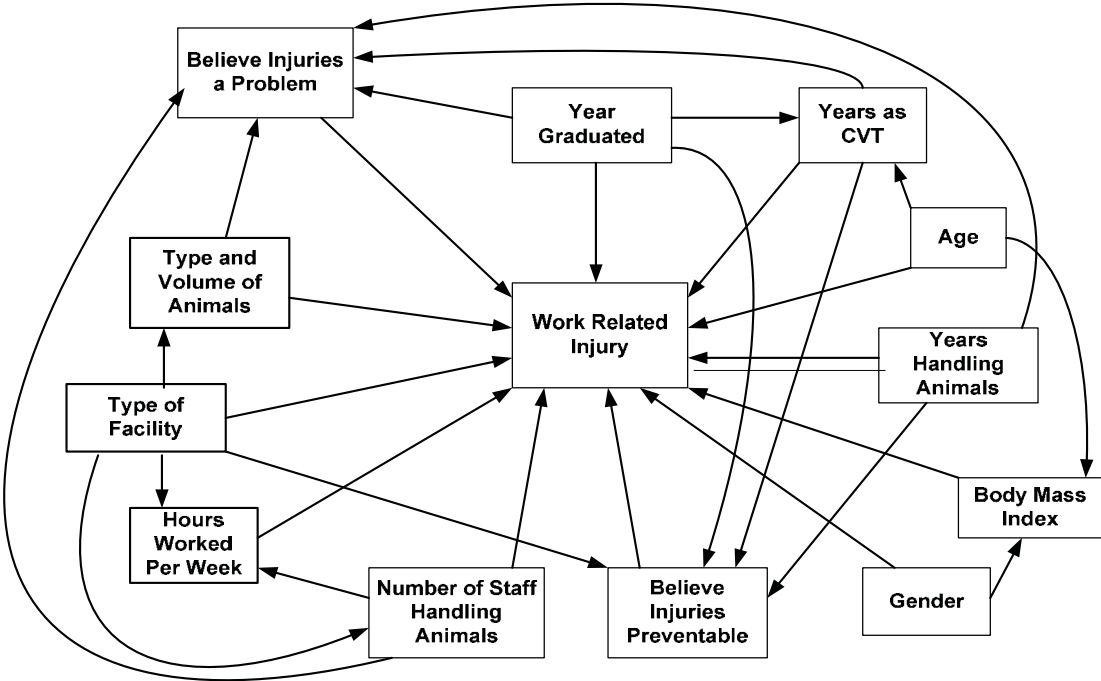


Figure 3. Bite Injuries to Certified Veterinary Technicians: Causal Model

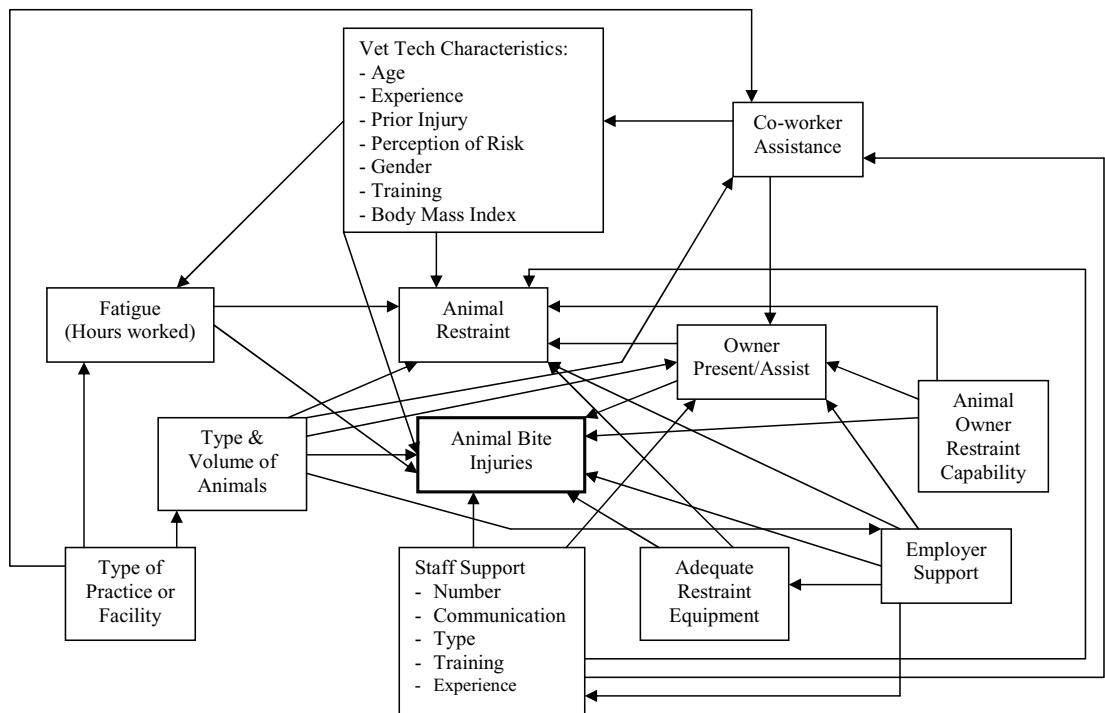


Figure 4. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Age

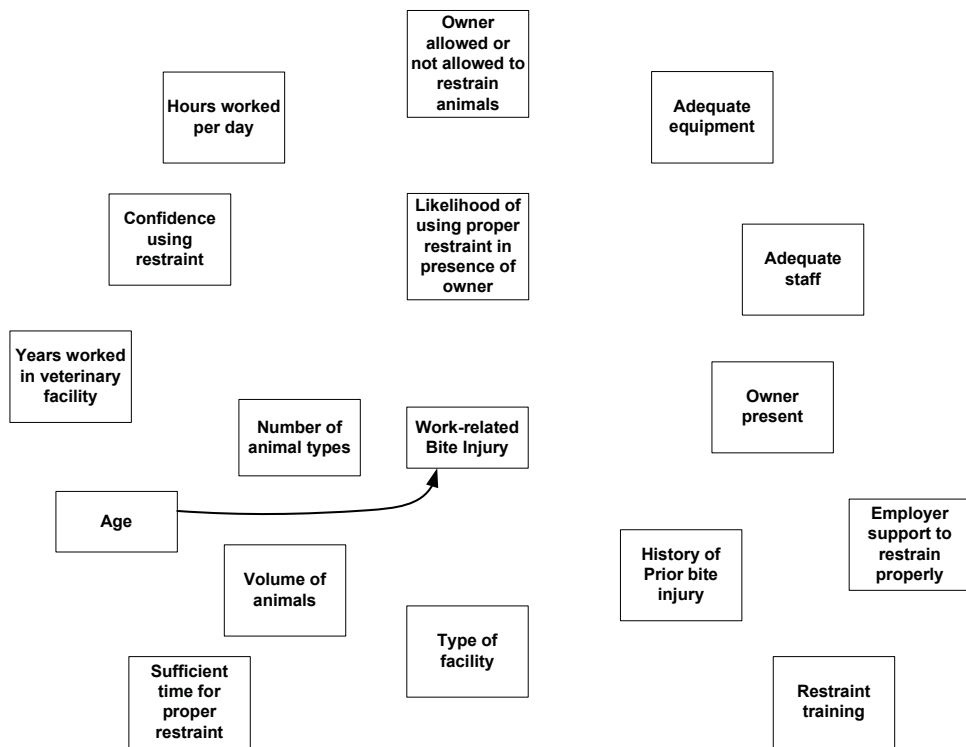


Figure 5. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Type of Facility

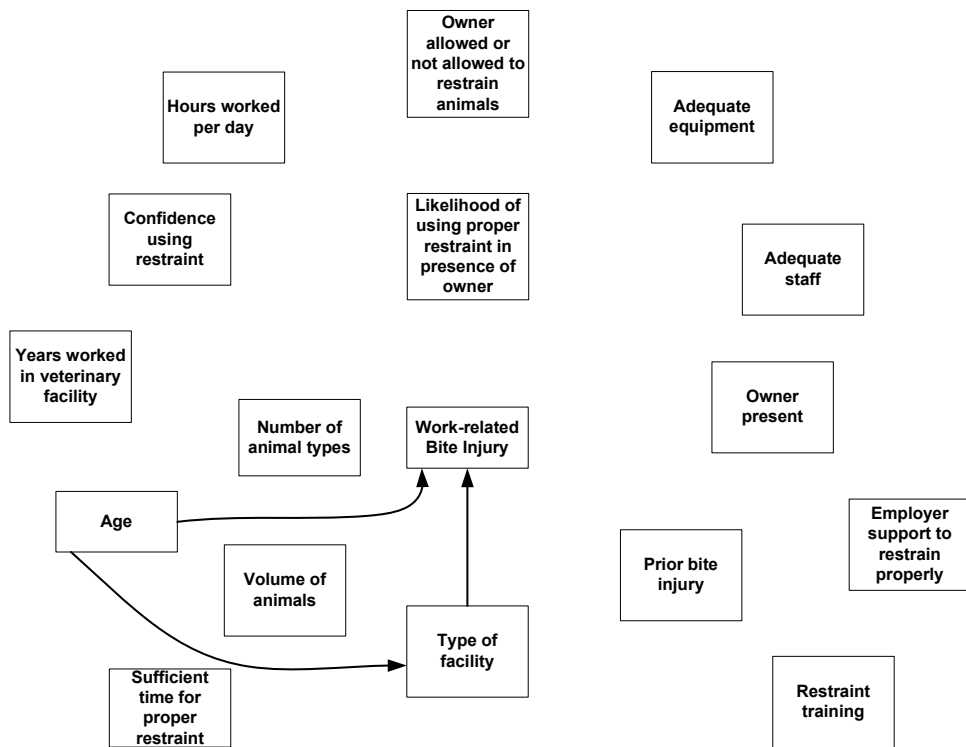


Figure 6. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Years Worked in a Veterinary Facility

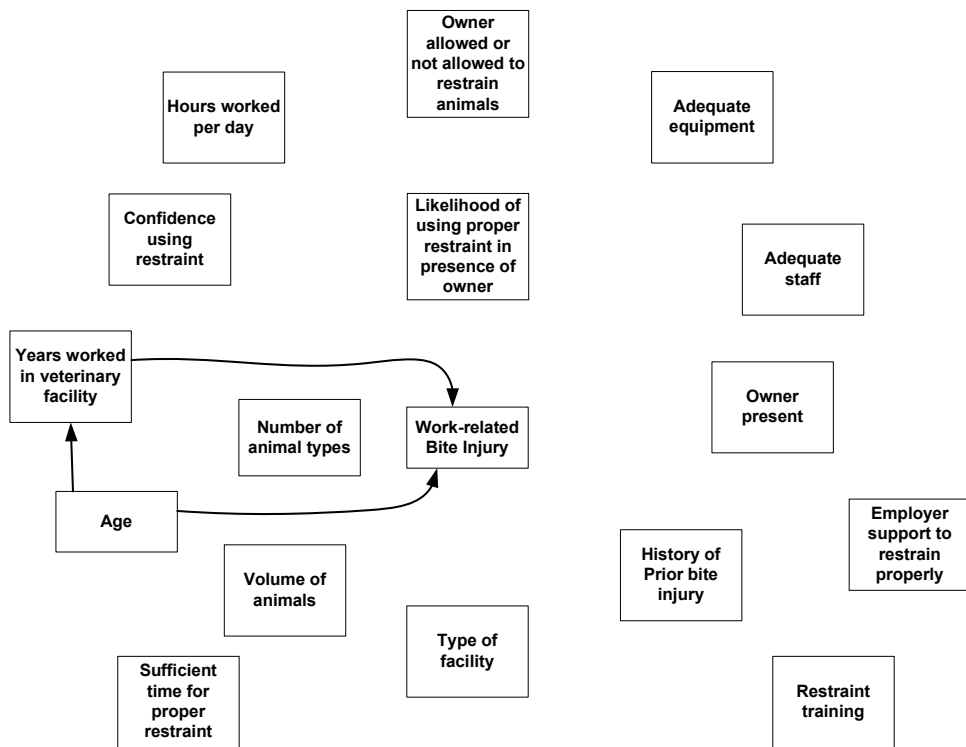


Figure 7. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Hours Worked Per Day

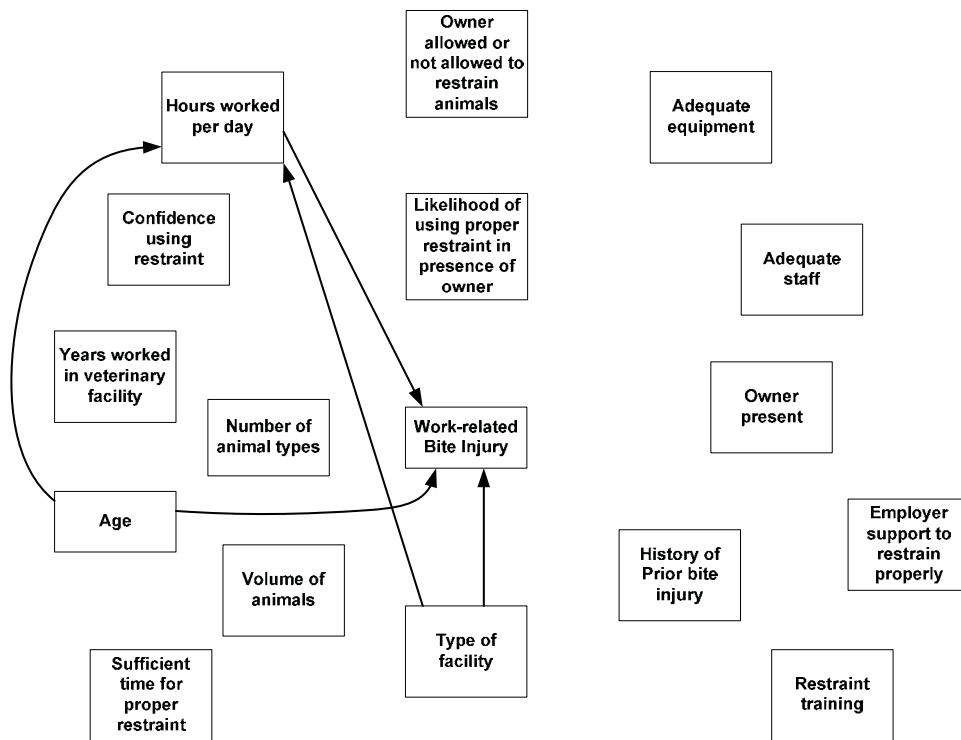


Figure 8. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – History of Prior Bite Injury

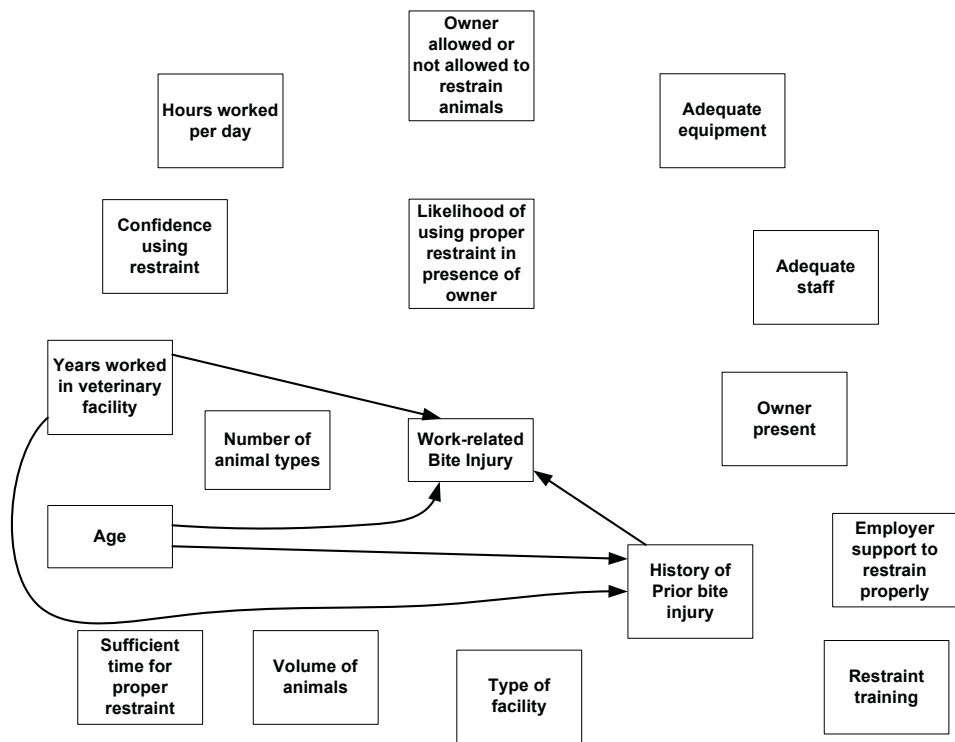


Figure 9. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Years Since Most Recent Restraint Training

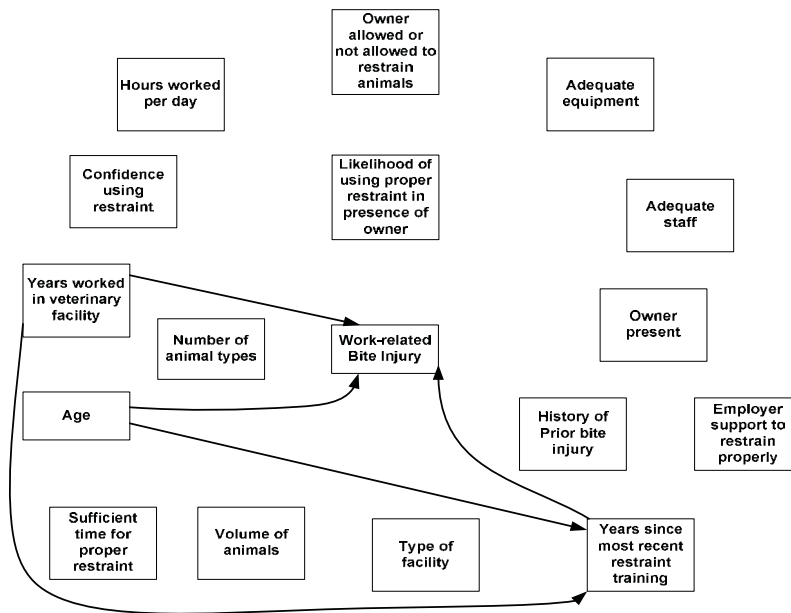


Figure 10. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Staff Help Available for Restraint

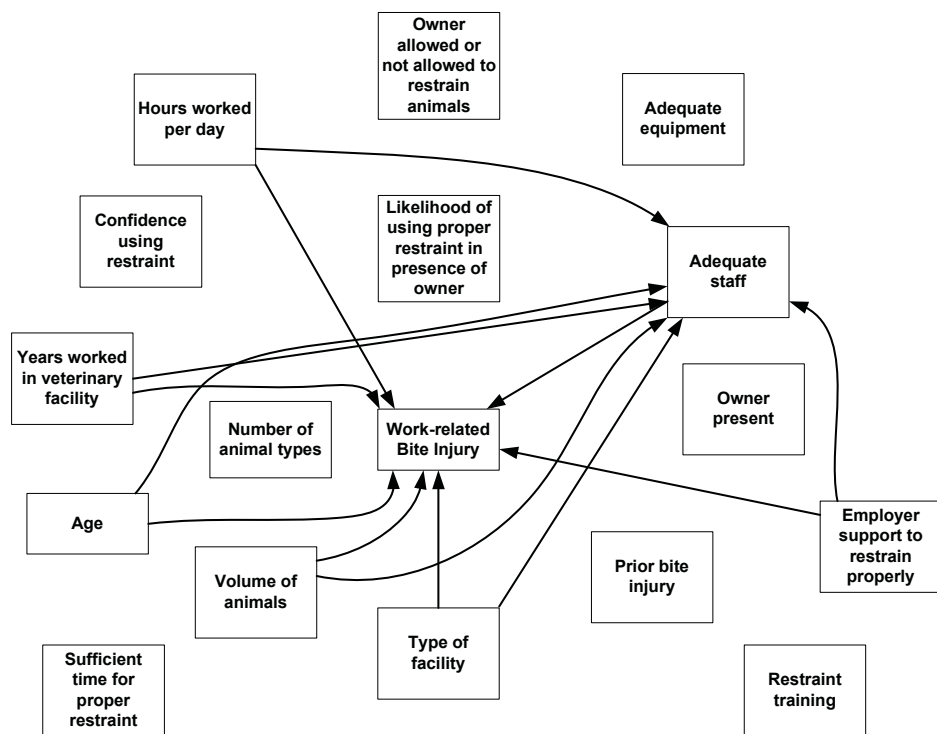


Figure 11. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Volume of Animals Handled on a Typical Day

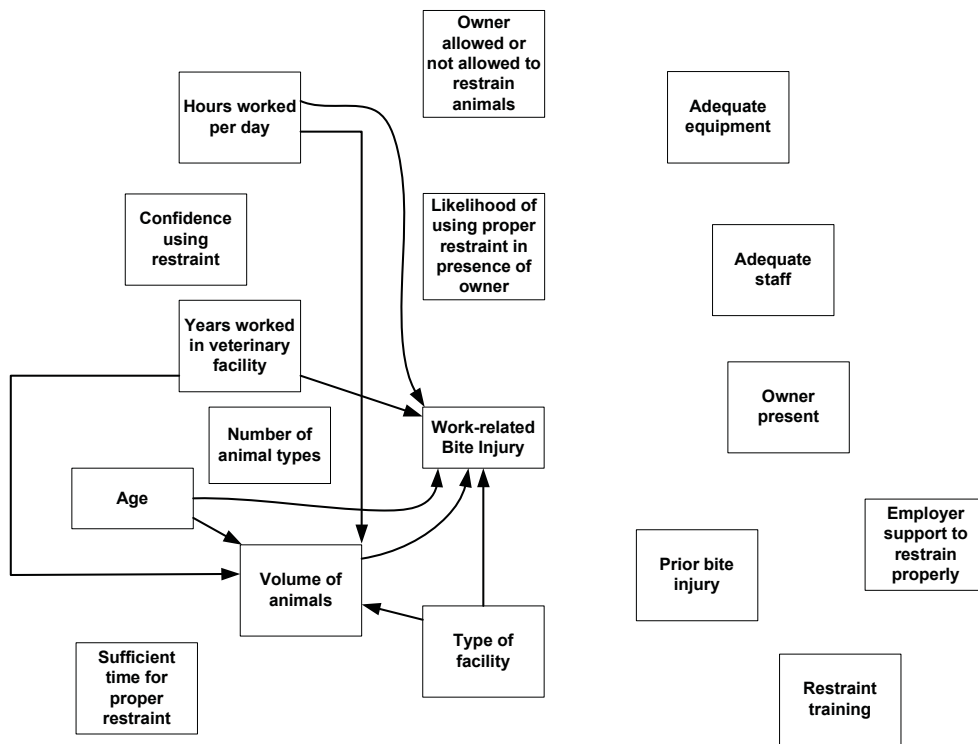


Figure 12. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Number of Animal Types Handled on a Typical Day

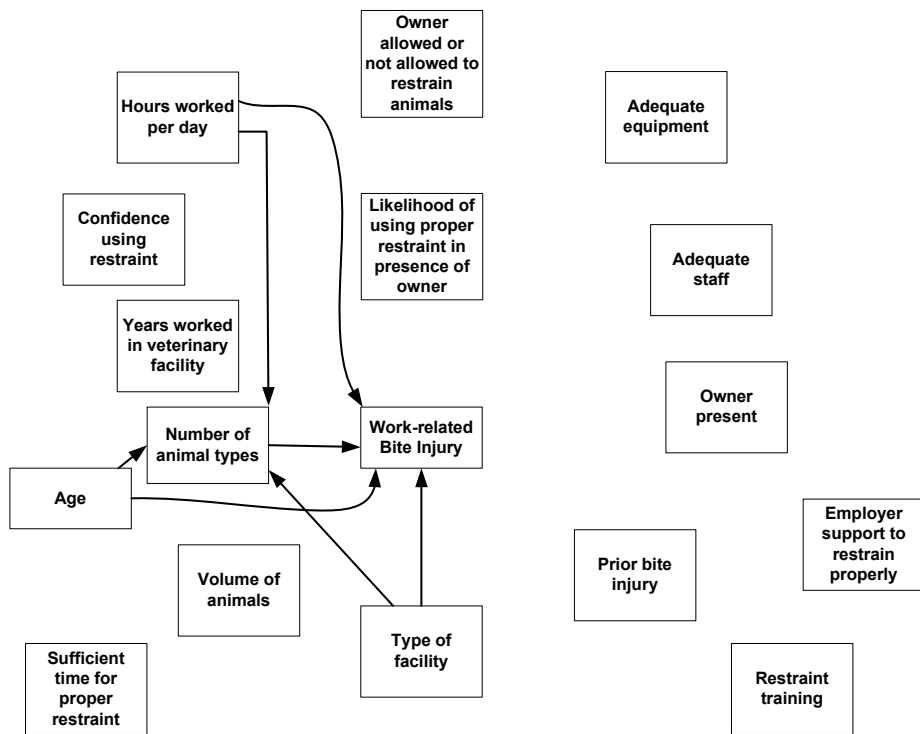


Figure 13. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Animal Owners Present During Exams and Procedures

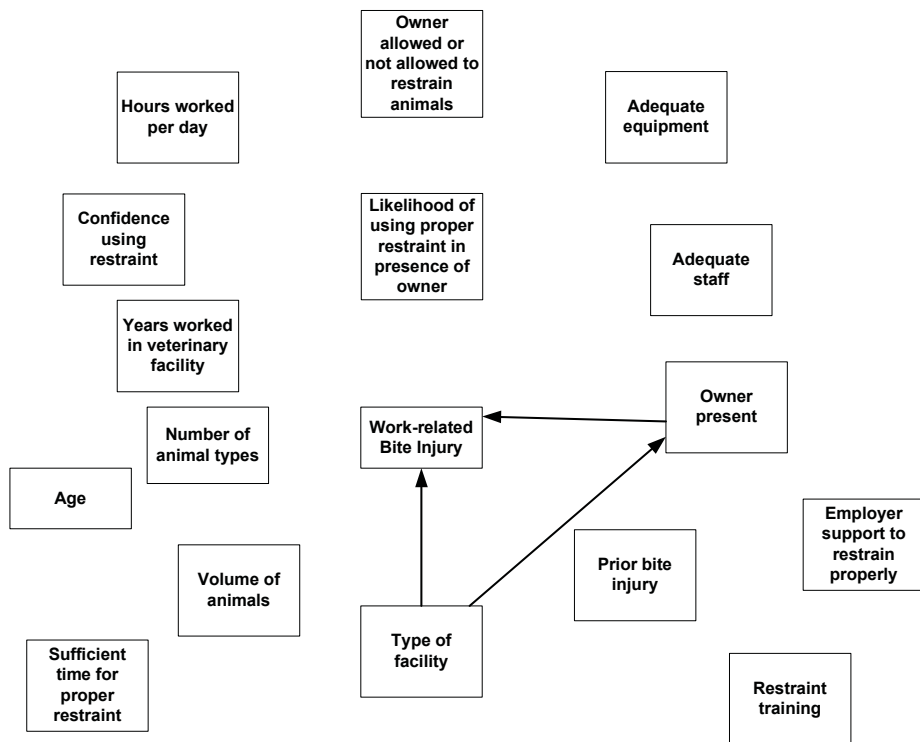


Figure 14. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Animal Owners Allowed to Restrain Pets

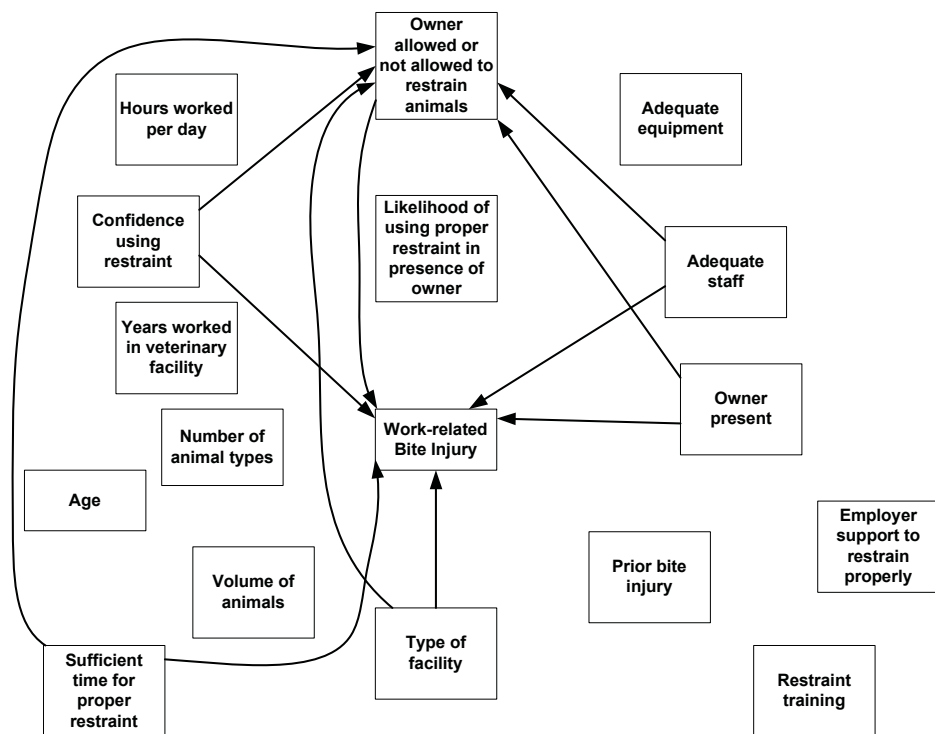


Figure 15. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Equipment Available for Proper Restraint

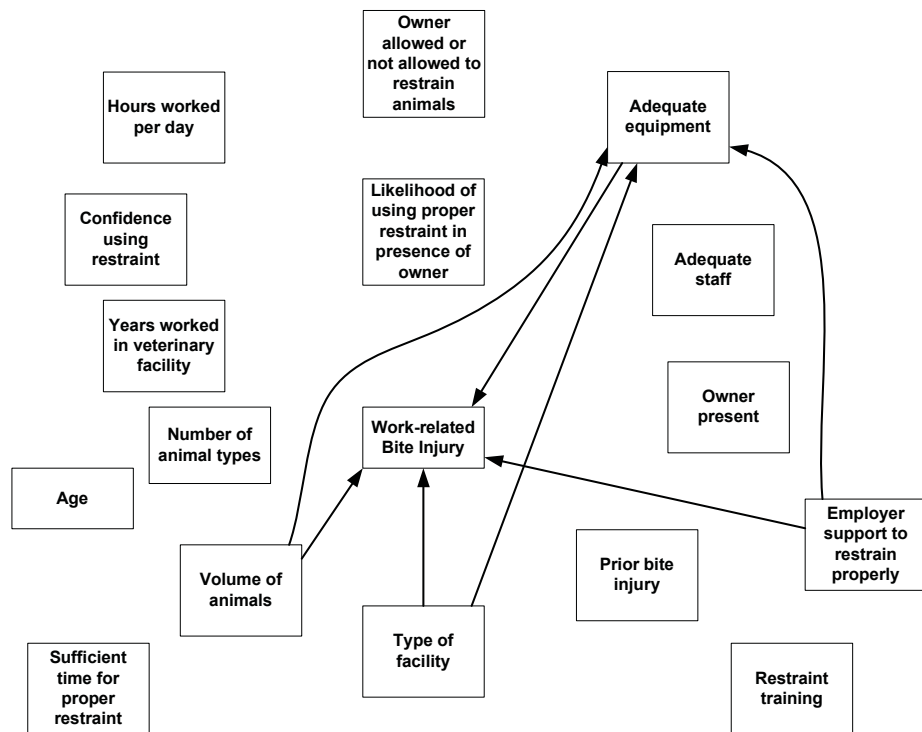


Figure 16. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Support from Employer to use Proper Restraint

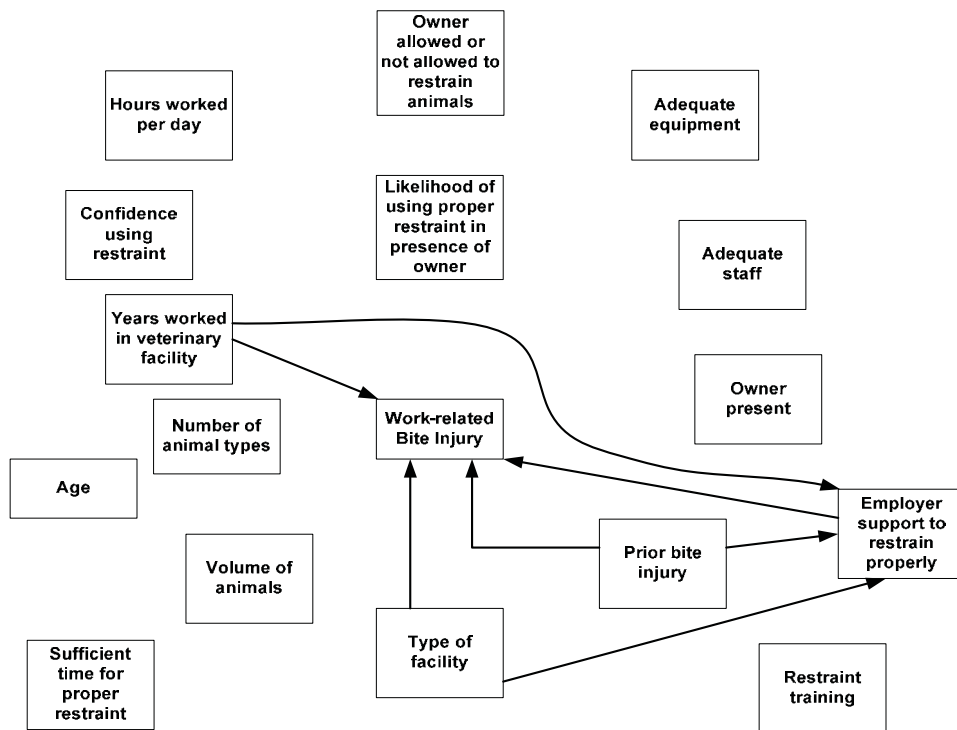


Figure 17. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Felt Confident when Applying Restraint Techniques

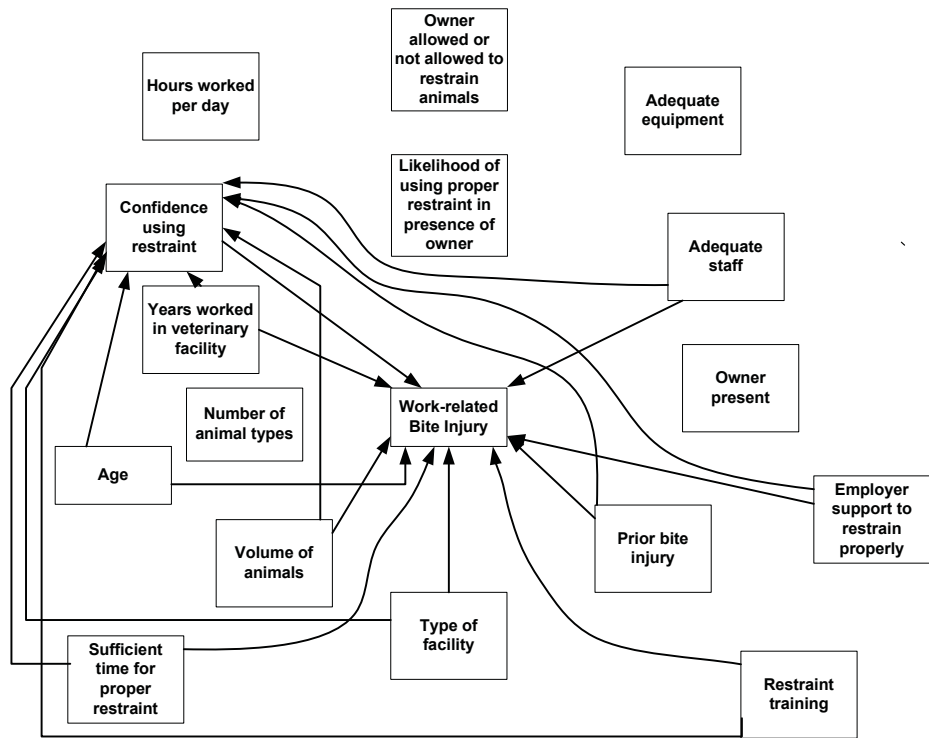


Figure 18. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Sufficient Time Allowed to Perform Adequate Animal Restraint

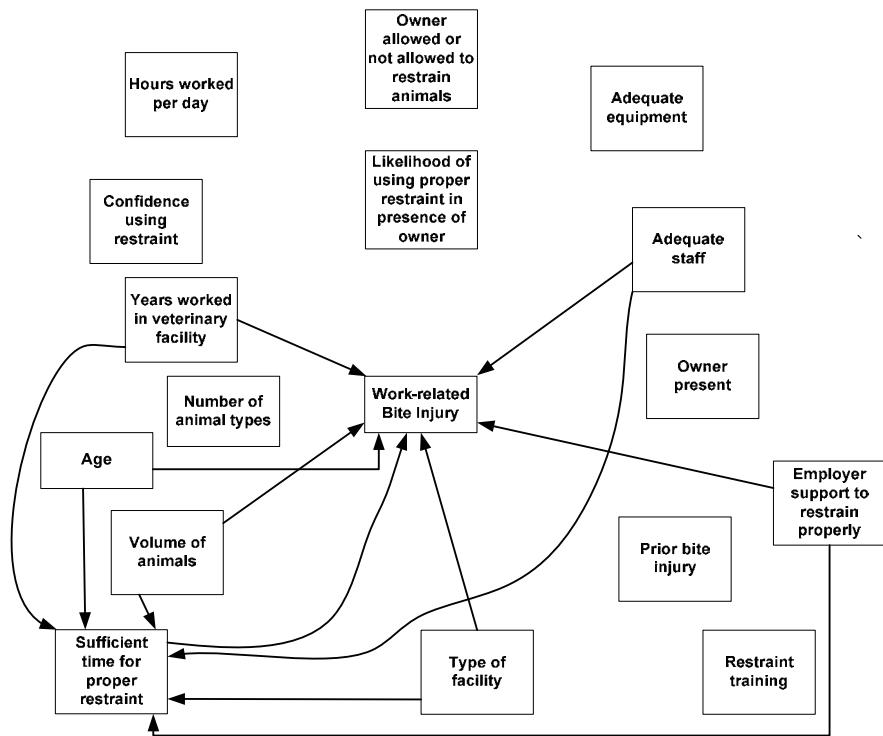


Figure 19. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Just as Likely to Use Proper Restraint in Presence of Owners as if Owners Not Present

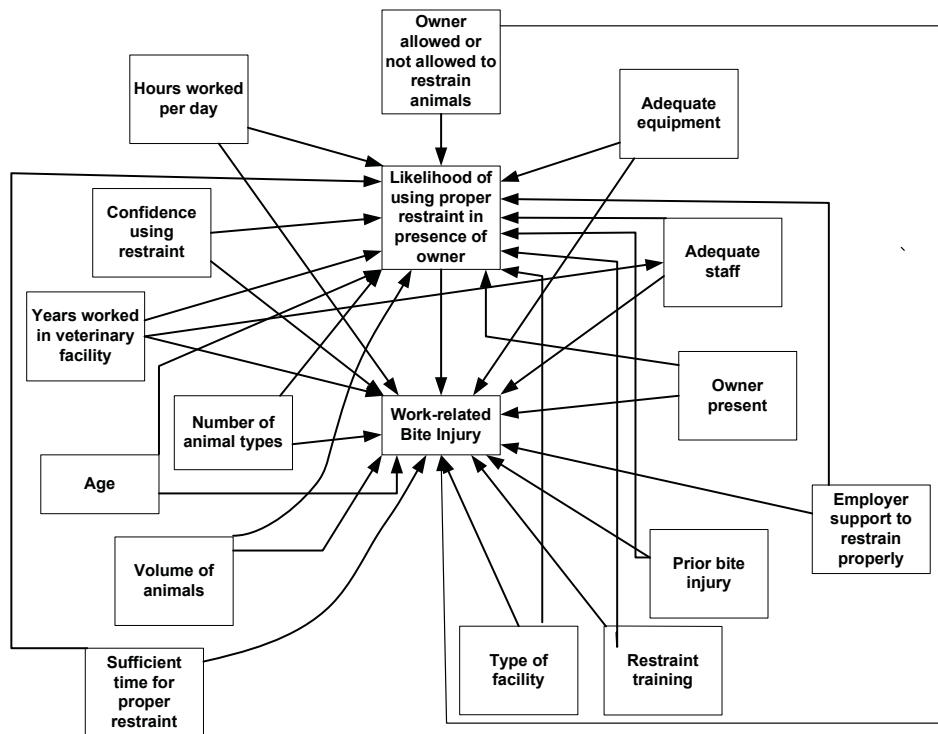


Figure 20. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Years Worked in a Veterinary Facility – CVTs Working in Small or Mostly Small Animal Clinics

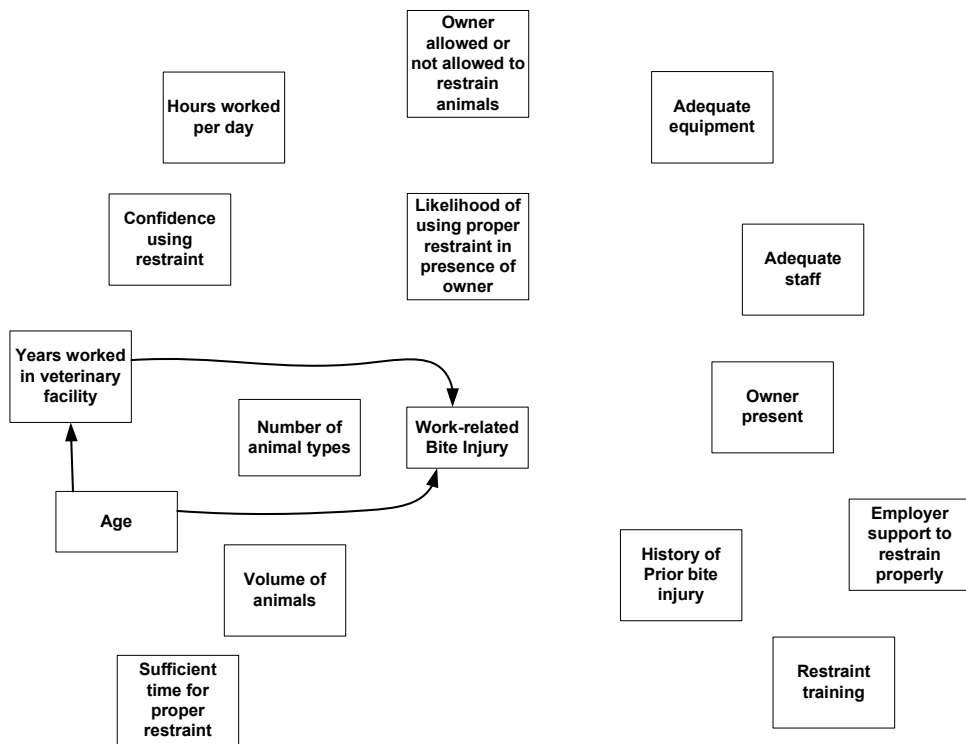


Figure 21. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Hours Worked Per Day - CVTs Working in Small or Mostly Small Animal Clinics

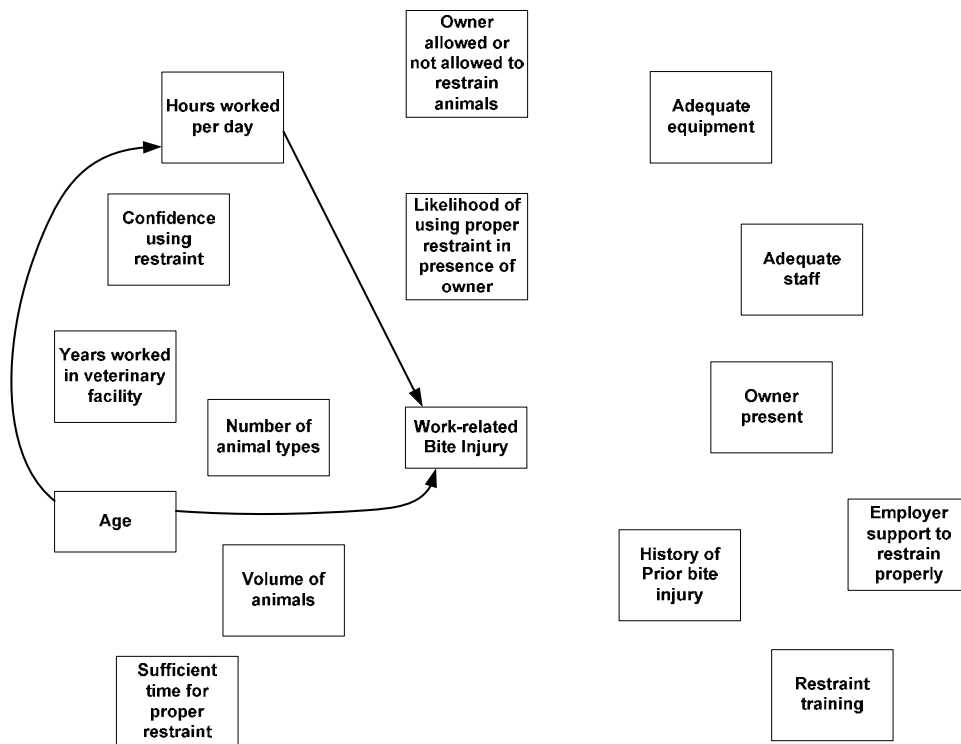


Figure 22. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – History of Prior Bite Injury – CVTs Working in Small or Mostly Small Animal Clinics

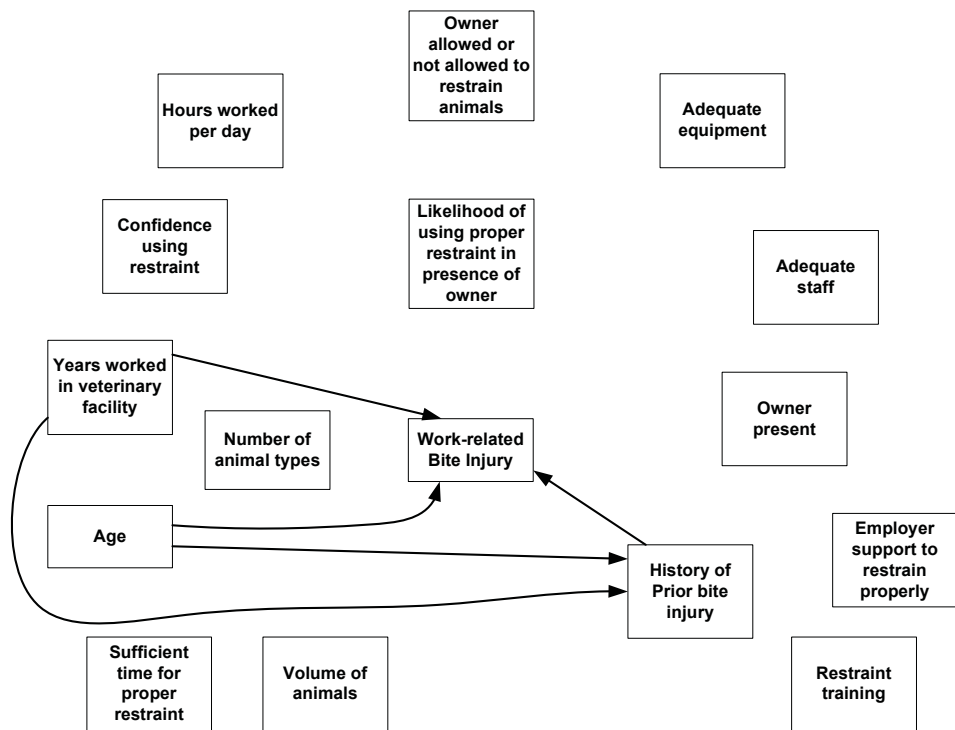


Figure 23. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Years Since Most Recent Restraint Training – CVTs Working in Small or Mostly Small Animal Clinics

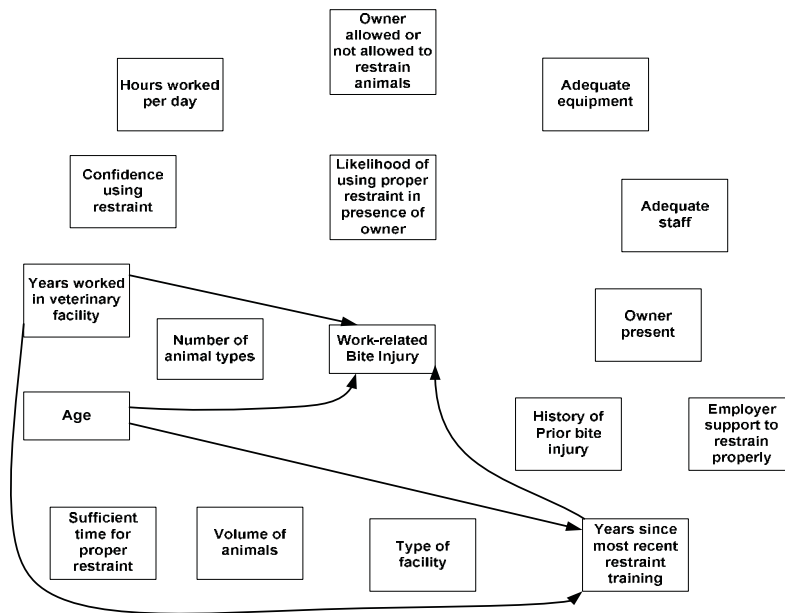


Figure 24. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Staff Help Available for Restraint – CVTs Working in Small or Mostly Small Animal Clinics

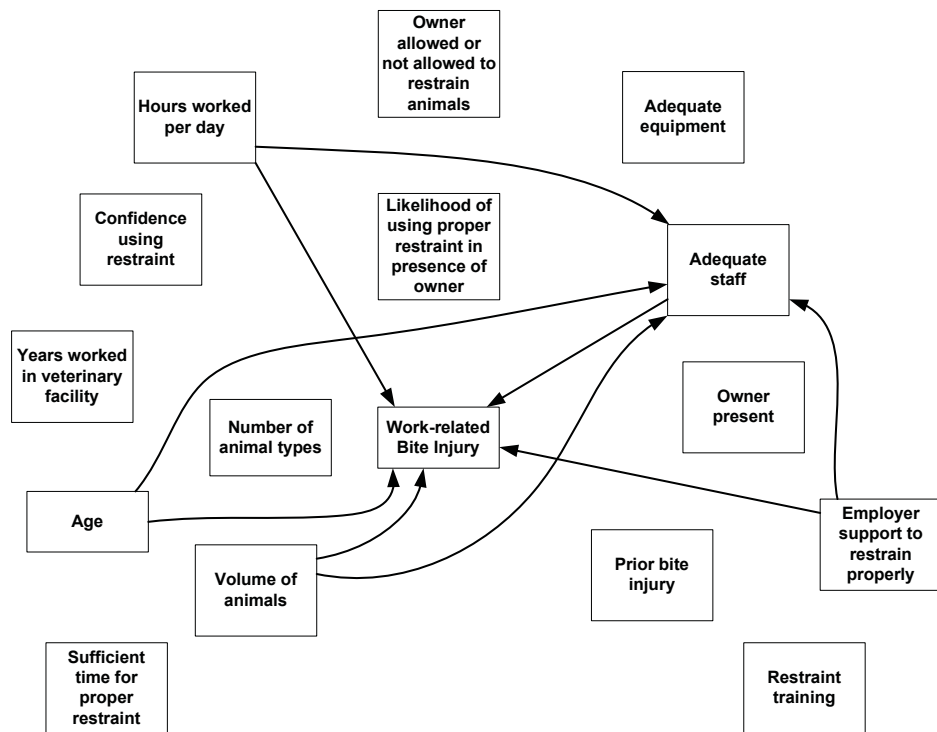


Figure 25. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Volume of Animals Handled on a Typical Day – CVTs Working in Small and Mostly Small Animal Clinics

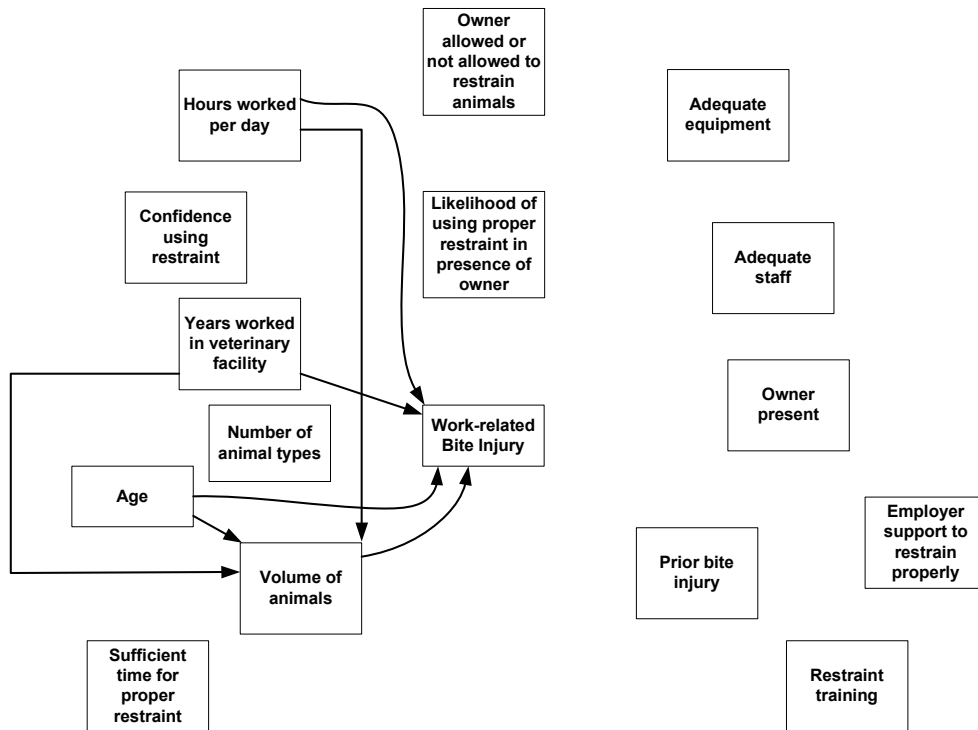


Figure 26. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Number of Animal Types Handled on a Typical Day – CVTs Working in Small or Mostly Small Animal Clinics

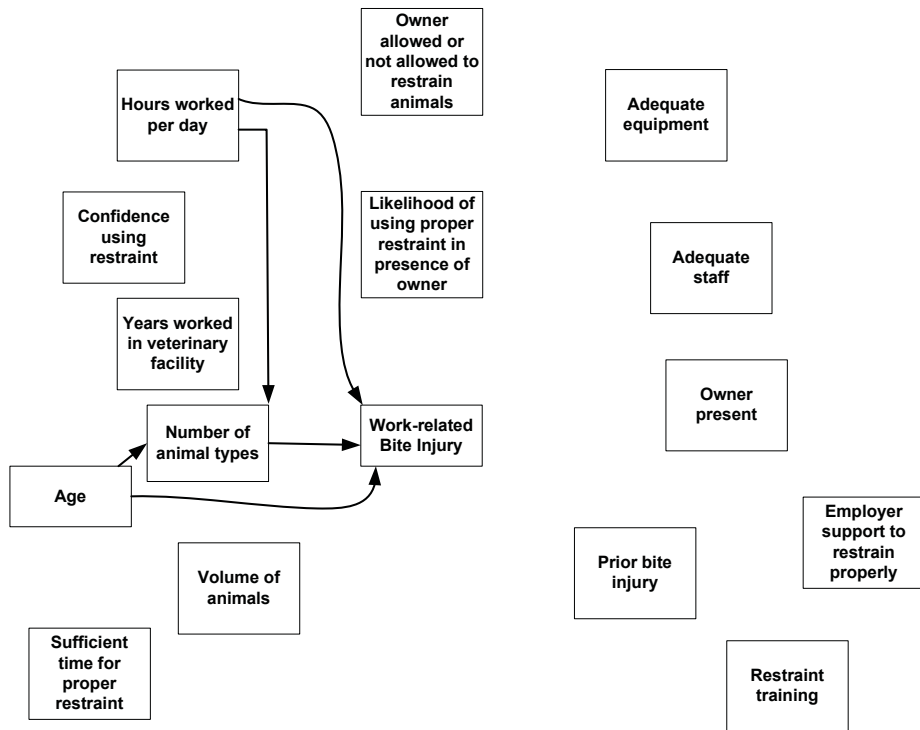


Figure 27. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Animal Owners Present During Exams and Procedures – CVTs Working in Small or Mostly Small Animal Clinics

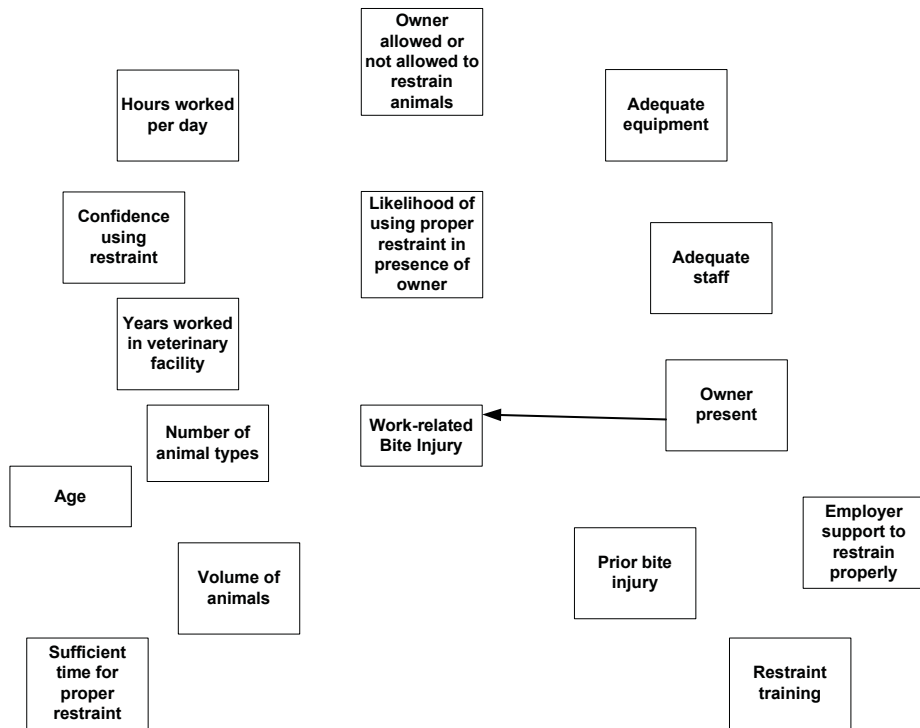


Figure 28. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Animal Owners Allowed to Restrain Pets – CVTs Working in Small or Mostly Small Animal Clinics

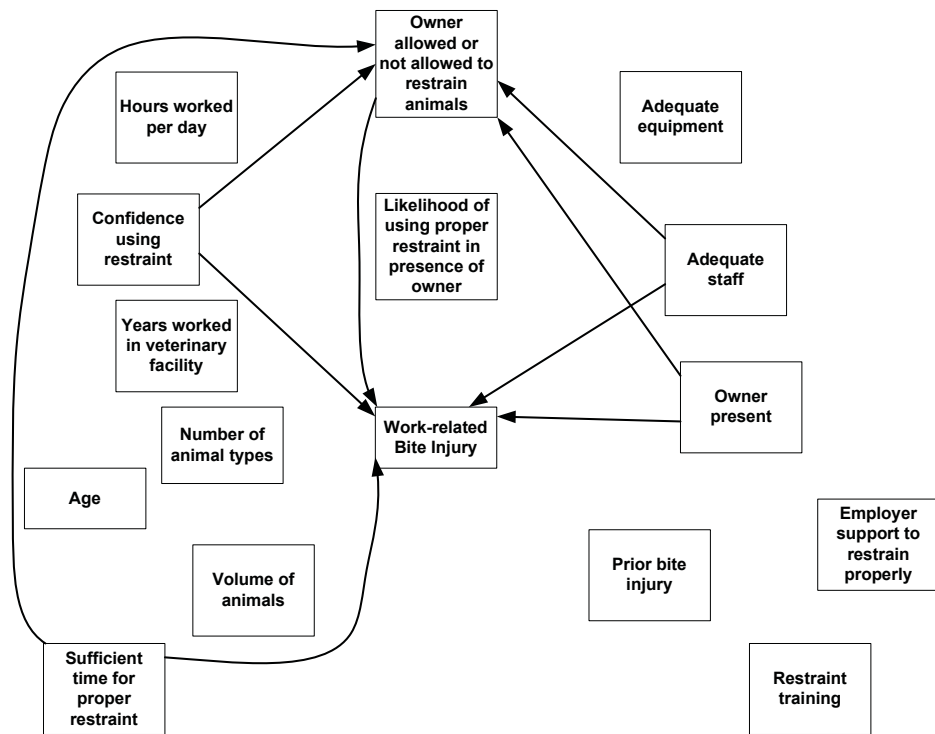


Figure 29. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Equipment Available for Proper Restraint – CVTs Working in Small or Mostly Small Animal Clinics

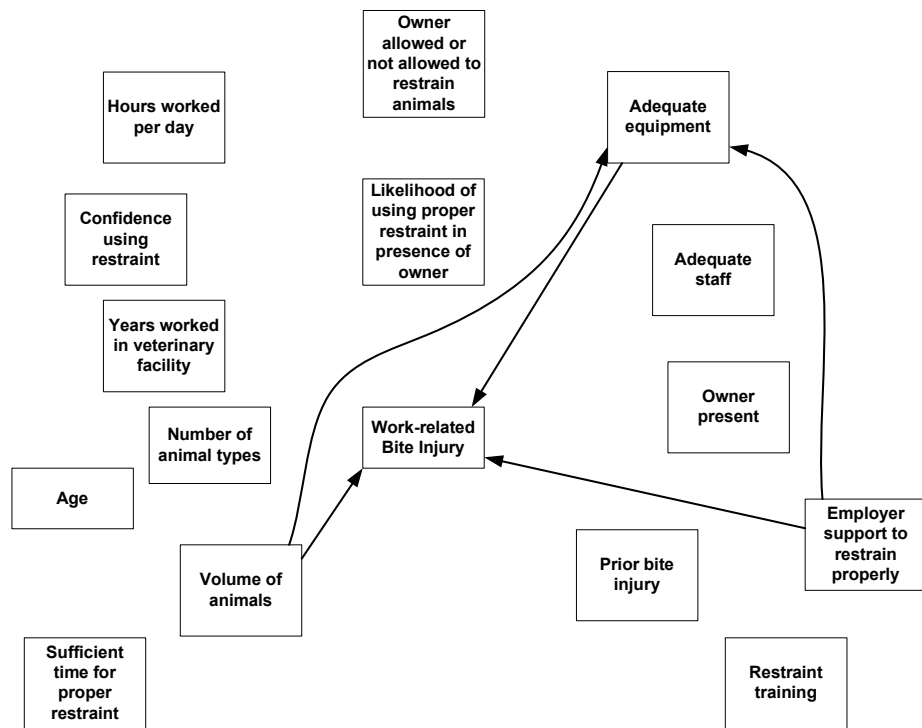


Figure 30. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Adequate Support from Employer to use Proper Restraint – CVTs Working in Small or Mostly Small Animal Clinics

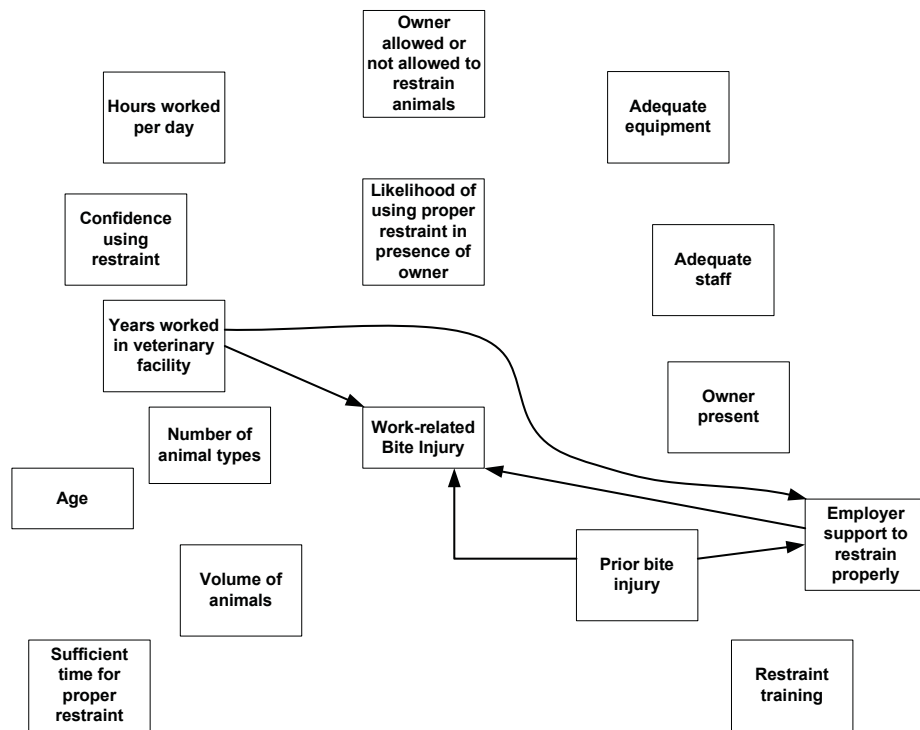


Figure 31. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Felt Confident when Applying Restraint Techniques – CVTs Working in Small or Mostly Small Animal Clinics

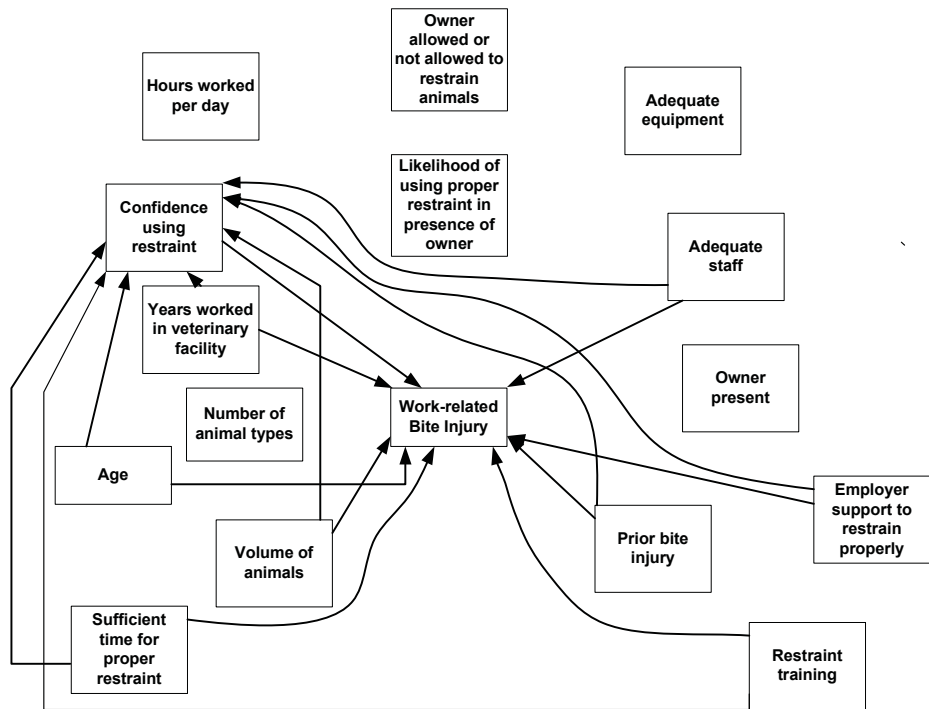


Figure 32. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Sufficient Time Allowed to Perform Adequate Animal Restraint – CVTs Working in Small or Mostly Small Animal Clinics

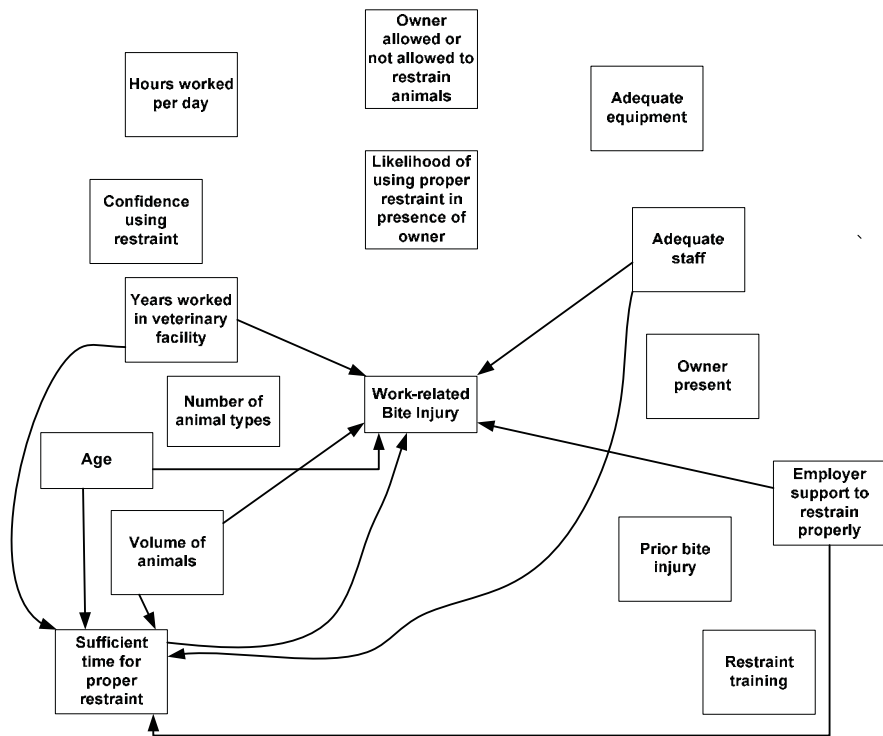
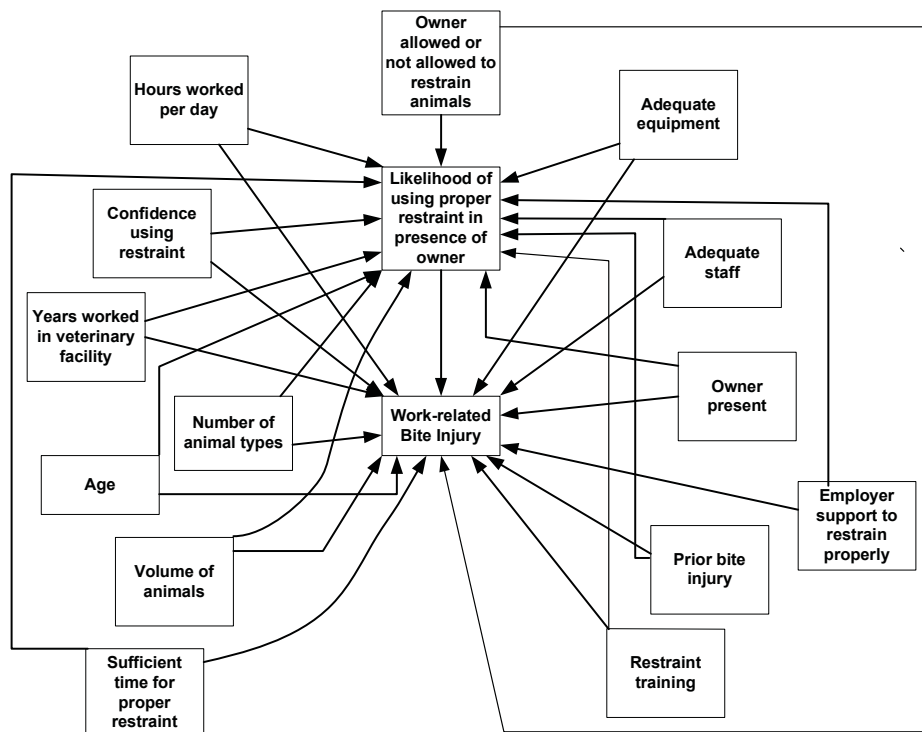


Figure 33. Directed Acyclic Graph: Minnesota Veterinary Technicians Study – Just as Likely to Use Proper Restraint in Presence of Owners as if Owners Not Present – CVTs Working in Small or Mostly Small Animal Clinics



CHAPTER 4

Please refer to Appendix A for supplemental tables

TITLE: An Epidemiological Study of the Magnitude and Consequences of and Risk Factors for Work-Related Injuries to Veterinary Technicians

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ABSTRACT

Objective — To determine the frequency and consequences of and potential risk factors for injuries among all 1,427 Certified Veterinary Technicians (CVTs), certified in Minnesota.

Design — Cross-sectional study

Procedures — A mailed survey was used to collect data on demographics, personal characteristics, injury occurrences, and consequences from the previous 12 months (74% response). We estimated annual injury rates by demographic and work-related characteristics. The risk of risk of injury associated with demographic and clinic factors was estimated using multivariate logistic regression models.

Results — For the 873 respondents, there were 1,827 injury events reported by 445 CVTs. Injury rates (95% Confidence Intervals) per 100 persons per year included all injuries, 236.8 (226.2 – 247.9) and bites, 77.7 (71.7 – 84.2). Increased injury rates (95% confidence intervals [CI]) were found for the following factors: <6 years handling animals, 411.5 (384.6 – 440.3); worked \leq 3 years as a CVT, 396.4 (370.5 – 424.1); and worked in a mixed, mostly small animal clinic, 593.8 (540.5 – 652.4). Of the most severe injuries, primary types were: bites, 52%; cuts/lacerations/scratches, 31%; bruises/contusions, 22%; abrasions, 9%; sprains/strains, 7%; and punctures/needle sticks, 5%. For all injuries, the leading sources were cats (47%) and dogs (35%). The primary activities leading to injuries were performing animal restraint (54%), or treatment (20%), and lifting animals or equipment (9%). Injury consequences included: treatment, 78%; restricted work activity, 24%; lost time from work, 12%; and persistent symptoms, 9%.

Multivariate modeling (odds ratios [OR], 95% CIs) identified a decreased risk for working <40 hours/week, 0.6 (0.4 – 0.9). Increased risks were found for the following factors: handling >6 types of animals per day, 1.7 (1.1 – 2.6); handling animals <6 years, 1.9 (1.3 – 2.7); belief that injuries are not preventable, 2.6 (1.8 – 3.7); ≤26 years of age, 2.6 (1.7 – 3.9); working in an emergency clinic, 3.1 (1.3 – 7.4); and working in a small animal clinic, 2.4 (1.5 – 3.8).

Conclusion – The CVTs’ environment places them at risk of injuries with serious consequences. In addition to documented risks, further examination of relevant exposures is integral to the development of relevant interventions.

Key Words: Certified Veterinary Technicians; work related injuries;

INTRODUCTION

Thousands of Certified Veterinary Technicians (CVTs) nationwide are at potential risk of traumatic occupational injuries with associated financial and other losses. It is difficult to estimate the number of CVTs who are injured each year, because a large number of veterinary practices employ less than 11 full-time employees, exempting them from the Occupational Safety and Health Administration (OSHA) reporting requirements. While there is no apparent literature on specific studies of injuries to CVTs, there have been studies that investigated work-related injuries to veterinarians (Thigpen and Dorn, 1973; Landercasper, et al., 1988; Smith and Stilts, 1996; Wilkins and Bowman, 1997; Hill, et al., 1998; Gabel and Gerberich, 2002; Fritschi, 2006), with some including veterinary staff, in general (Poole, et al., 1998; Poole, et al., 1999; Jeyaretnam and Philips, 2000; Drobatz and Smith, 2003; van Soest and Fritschi, 2004; Nienhaus, et al., 2005). Veterinary injuries have also been evaluated using Workers' Compensation claims (Thigpen and Dorn, 1973; Poole, et al., 1998; Nienhaus, 2005), but these injuries are limited to the most serious resulting in more than three days of lost work time. With few exceptions, prior studies were primarily limited to descriptive cross-sectional study designs.

Beyond understanding the basic epidemiology, there is a critical gap in the knowledge base on the sources, the costs, and the risk/protective factors associated with work-related injuries specific to CVTs. The lack of information on occurrence, severity and consequences of work-related injuries to CVTs limit the ability to develop and evaluate effective prevention and control strategies for occupational injuries to CVTs.

The current study was designed to provide a comprehensive evaluation of not the frequency, consequences and potential risk factors of injury to CVTs.

METHODS

This study was approved by the Institutional Review Board, University of Minnesota.

Study population

This study included veterinary technicians, certified to work in the state of Minnesota throughout the end of October 2004, and who worked as CVTs within the 12 months prior to the survey administration. The CVTs were identified from a database maintained by the Minnesota Veterinary Medical Association. All CVTs who achieved certification in the state of Minnesota were entered into this database; certification renewal was confirmed, based on the completion of continuing education requirements. Of the 1465 veterinary technicians certified in the state of Minnesota, 1,427 with valid addresses were mailed a survey. Surveys were returned by 1052 CVTs (74%), of whom, 873 confirmed they worked in the previous 12 months and were thus eligible.

Data collection

Work related injury events included any activities (including travel) associated with the job or events that occurred in the work environment. Both intentional (assaults and self-inflicted injuries) and unintentional injuries were defined as injury events. An event was defined as, but not limited to, such injuries as bites, lacerations, fractures, sprains, strains, allergic reactions, ergonomic and repetitive motion injuries, injury outcomes from exposures to radiation or anesthetic agents, and injuries incurred in a

motor vehicle crash while traveling to or from a client's location as part of the CVTs' work responsibilities. To be defined as a work-related injury, the injury must have resulted in restriction of normal activities for any length of time, loss of consciousness, the use of medical assistance, or incurring a bruise or break in the skin from a bite injury.

Contact procedures

A survey instrument was sent to all 1,427 CVTs with valid addresses. Cover letters, providing information about the study and informed consent were enclosed with the mailing. For those who did not respond, initially, up to three additional mailings were sent. To enhance participation, each participant returning a questionnaire and indicating the desire to be included in a random drawing, had an opportunity of approximately one in 30 to attain a \$20 retail gift card.

Data collection instruments

A comprehensive diagram, representing causal relations, was used to define variables to be included in the data collection instruments. To describe the population the survey recorded: 1) whether or not the person worked in a CVT position in the previous 12 months, and during which months; and 2) demographic information such as types of animals cared for, type of facility, years experience in handling animals, years experience as a Veterinary Technician (both certified and uncertified), year of graduation from a Veterinary Technician program, birthdate, marital status, annual household income, height, and average weight. The survey allowed for self-report of up to four work-related injuries over the last 12 months. Severity was determined by the CVTs' most severe injuries in terms of requiring the most medical care or restriction of work or activity. The

information included: date(s) of the event(s); source(s) of the injury(ies); surrounding circumstances and activities at the time of the event(s); location(s) of the event(s); type(s) of injury(ies) and anatomical location(s); relevant length(s) of restricted activities; lost work time; and health care treatment sought. Study data collection instruments and methods were pre-tested. Data collection began, after making minor modifications.

Data analyses

The data collected from the comprehensive survey were used to identify the frequency and characteristics of injuries to CVTs, and to determine the relevant crude estimates of injury rates and consequences, using SAS statistical software (SAS Institute, 2002-2003). Specifically, two-way tables and cross-tabulations were used to determine proportions for the self-reported four most severe injuries by type of injury, body part injured, source of injury, years working as a CVT, location of the injury event, source of injury, work activity, how the injury was treated, length of work and non-work restrictions, and days absent from work.

Poisson models were used to determine injury rates by age, gender, body mass index, type of practice or facility, the numbers of species handled, years working as a CVT, years experience in handling animals, hours worked per week, hours worked per day, and the number of staff at the facility. In calculating the injury rates per 100 full-time CVTs per year, the numerator consisted of the total injury events (1,827) multiplied by 200,000 full-time annual hours; the denominator included the total hours worked per year for 861 of the 873 respondents (1,543,203.2 hours). Of the 873 CVTs, 10 did not report hours worked, and two did not report total number of injury events; thus, the

hours-per-year data for these 12 respondents were removed from the rate calculations. A point estimate and 95% confidence interval was produced for each rate.

In addition to identifying risk factors for injury events from all sources, this study addressed risk factors for animal bite injuries through multivariate modeling; exposures were selected for analysis in accordance with a causal model and specific directed acyclic graphs (DAGs), pertinent to exposures of interest (Greenland, et al., 1999; Hernan, et al., 2002). Selection of confounders for multiple logistic regression was based on the DAG (Figure 1). In multivariate modeling of the effects of the exposures of interest, on injury outcomes, DAGs were used to identify potential confounders for each of the models. Odds Ratios and 95% confidence intervals were generated for each of the models.

RESULTS

Among the CVTs, 51% experienced at least one injury in the 12 months prior to the survey completion and, of those, 36% reported having three or more injuries. There were 1,827 injury events reported by 445 CVTs who completed full surveys; one, two, three, four and more than four events were reported, respectively, by 171, 110, 70, 30, and 64 CVTs. Characteristics for injured and non-injured CVTs are summarized in Table 1. Injury rates for the all injuries are presented in Table 2.

The overall injury rate was 236.8 per 100 persons per year. Increasing dose rates were seen with increasing numbers of animal species handled and number of staff handling animals in the facilities. Inverse relations were noted with years of handling animals, CVT age, years since graduation, and years worked as a CVT. Great differences in rates were identified among the types of facility in which they worked.

Among the total injuries, there were 600 bite injury events reported by 353 CVTs who completed full surveys; one, two, three, four and greater than four bite events were reported, respectively, by 224, 82, 22, 13, and 12 CVTs. Table 3 shows the rates of bite injuries for CVT characteristics. An inverse relation was noted with years of handling animals and CVT age. The lowest bite rate was identified for those handling smaller numbers of animal species. Increased bite rates were identified for CVTs believing injuries could not be prevented.

The injured CVTs were asked to provide descriptive details pertaining to their four most severe injuries during the prior 12 months, starting with the most severe event first, in terms of the most medical care or time restriction. Of the 1,827 total injury events, 777 'most severe' events were identified by the CVTs. Characteristics of the most severe injuries are included in Table 4, based on their perception of the four most severe injuries in the past 12 months. Animal bites were the most frequent type of reported injury that primarily involved hands, fingers, or thumbs; cats were the most frequent injury source. Performing restraint was the most frequent work activity associated with the injuries.

Consequences of the most severe injuries are reported in Table 5. Of the 777 most severe injuries, the most frequently reported source of injury treatment was by the CVTs (self-treatment). Nearly one-fourth of the most severe injuries resulted in restriction of normal activities, with 18% of those reporting work restriction for one day or more; 10% lead to persistent problems, identified at the time of the survey.

Of the most severe injuries, oral reports were submitted to a supervisor or management for 57% of the injuries; only 11% were in writing and 10% were submitted both orally and in writing. Of those not reporting, reasons given included: considered it a minor incident (58%); considered it part of the job (12%); too busy (6%); perceived it as unnecessary to report (4%); injury resolved itself (4%); it happened over time or wasn't immediately aware of the injury (3%); was own fault (3%); was still able to work (2%); - no management present (1%).

Among the 873 total respondents, 793 (91%) resided in Minnesota. Over 66% of the CVTs worked in clinics with three or more doctors, and 72% worked in clinics with three or more CVTs. The respondents reported handling the following types of animals during the 12 months prior to the survey: dogs (96%); cats (91%); pocket pets, including rabbits, rodents, chinchillas, etc. (74%); ferrets (48%); avian pets (46%); exotics, including snakes, turtles, lizards, etc. (28%); horses (17%); pigs (16%); sheep (15%); goats (14%); cattle (14%); poultry (10%); monkeys or other primates (5%); zoo animals (4%); and other (5%). Nearly 99% of the CVTs had graduated from a CVT program, and 91% worked the most time in Minnesota during the study period. The CVTs reported the following household income levels: less than \$20,000 (9%); \$20,000 to less than \$25,000 (13%); \$25,000 to less than \$35,000 (17%); \$35,000 to less than \$50,000 (18%); \$50,000 to less than \$75,000 (25%); \$75,000 and over (15%); unsure (2%); and missing (4%). Marital status included: married (55%); never married (34%); living as married/domestic partner (5%); divorced (4%); and separated or widowed (1%).

In Table 6, results of multivariate modeling of several exposures of interest are presented. Directed acyclic graphs, based on a causal model, were used to select potentially confounding variables. Multiple logistic regression analyses identified increased dose-response risks for the numbers of animal species handled. Inverse relations were noted with years of handling animals and CVT age. Increased risks were identified for working in emergency and small animal clinics. Analyses pertinent to number of hours worked (not shown) identified reduced risks for less than 40 hours (0.65; 0.58 to 0.74) and more than 40 hours (0.47; 0.41 to 0.53), compared with working 40 hours per week.

DISCUSSION

This comprehensive population-based effort enabled identification of the frequency, consequences, and potential risk factors for work related injuries among CVTs. Due to differences in study methods, populations, and definitions of injuries, previous studies could not be directly compared with these results; prior studies focused specifically on veterinarians or data were combined for both veterinarians and staff. For example Thigpen and Dorn (1973) analyzed data from the American Veterinary Medical Association (AVMA) Group Insurance Trust (GIT) and reported an average work-related injury rate of 22.7/1,000 insured veterinarians per year. Nienhaus et al. (2005), studied insurance claims data for German veterinarians and their staff, using the equivalent of the U.S.'s Worker's Compensation insurance and reported an annual incidence rate for work-related injuries of 10 per 100 full-time veterinarians and staff. Many less severe injuries

may not have been included in the insurance claims data, thus, resulting in an underestimation of the injury rates.

Among the participants in the current study, nearly all were women. In contrast, previous studies, which included veterinarians, reported lower percentages of women as participants (Landerscaper et al, 1988; Gabel and Gerberich, 2002; Drobatz and Smith, 2003).

Most of the CVTs in this study did not work in small clinics and the injury rates were highest for those in the largest clinics or departments, based on the number of staff; clinics with greater than 13 veterinary staff members who handled animals at the facility or in the department were found to have increased rates of injury. Decreased rates were identified for total injuries and injuries from bites among CVTs who worked at a facility or in a department with less than six veterinary staff who handled animals and were likely associated with a lower animal volume. In contrast, a higher injury rate in large clinics or departments may be due to the complexity of the procedures and communication among large numbers of staff.

Of the CVTs participating in the current study, 68% worked in clinics serving small animals. A descriptive study of a convenience sample of attendees at an Australian veterinary nurses conference, found that 83% of the 147 veterinary nurses worked in small animal clinics (van Soest and Fritschi, 2004). Based on multivariate modeling, working as a CVT in an emergency clinic or a small animal clinic, compared to a college/university practice, was associated with an increased rate of injury in the current study. An increased rate of injury was also found for CVTs working in mixed, mostly

small animal clinics which may involve working with a greater number of animal species or types and, therefore, lead to an increased risk of injury; dose-responses in injury rates and risk were identified with increasing numbers of animal types handled while a decreased rate of bite injury was seen for CVTS who handled fewer than four types of animals. According to Nienhaus et al. (2005), there was a higher risk (2.1) of injuries in large animal practices compared to small-animal practices. These findings were identified from German injury insurance claims submitted in 2002 and may have been based on more severe injuries associated with caring for large animals.

Consistent with previous reports for veterinarians treating small animals, cats and dogs were reported most frequently as the sources of injury in this study. According to Nienhaus et al. (2005), animals were the most frequent cause of occupational injury insurance claims (66%) by veterinarians and their staff, with cats and dogs the source of most animal-related injuries in practices that treated small animals; horses and cows prevailed as injury sources in practices that treated large animals. These findings are also supported by other studies of injuries to veterinarians (Thigpen and Dorn, 1973; Landercasper et al, 1988; Gabel and Gerberich, 2002). It is interesting to note that, in this study, dogs were the most frequently handled type of animal, but cats were the most frequent source of more severe injuries.

Compared with those employed for a 40-hour per week schedule, personnel working less than or greater than 40 hours per week had lower rates of injury. We expected to find that those CVTs who worked more than 40 hours per week would experience a higher rate of injury, due to fatigue. However, CVTs working 40 hours per

week may have experienced higher rates of injuries because they may have been working during periods when clinics have full schedules, with resulting increased work loads and time pressures; they may have also engaged in work activities that increased the risk of injury, compared to those who worked part time or more than full-time. Further research is needed to determine whether the nature of the work or the demands of the work schedule, during certain hours, may explain the higher rate of injury for those specifically working 40 hours per week.

Despite the inability to directly compare these results with those from previous studies, some findings were similar. As in this study, younger age has been associated with an increased likelihood of incurring an occupational injury (Thigpen and Dorn, 1973; Gabel and Gerberich, 2002). Gabel and Gerberich (2002) found a higher risk of work related injuries for veterinarians under age 36, compared to older age groups. However, the youngest age group for veterinarians in those studies was higher than for CVTs, possibly due to the length of time required to complete a degree in Veterinary Medicine. In addition, as in this study of CVTs, veterinarians with less than six years of work experience have been associated with an increased risk of injury (Gabel and Gerberich, 2002).

Consistent with findings from a study of veterinarians' perception that their occupation was dangerous (Landerscaper, et al, 1988), more than half of the CVTs in this study believed that work-related injuries were problematic. An increased rate of bite injury was found for CVTs who believed that work-related injuries were a problem, and

may reflect an accurate perception of the potential for injury risk by the CVTs; they may also work in environments with greater exposures.

The most frequently reported body locations of injuries in this study were hands and arms, which is in consonance with findings from previous studies (Drobatz and Smith, 2003; Nienhaus et al, 2005). Also, consistent with previous studies, the current research found bites were the most frequently reported type of injury for CVTs. In a study by Poole et al. (1998), cat and dog bites were among the most common injuries to veterinarians and their staff. Jeyaretnam and Phillips (200) found that dog and cat bites were a major source of physical injuries for veterinarians and accounted for the largest number of workdays lost. In a study by Smith and Stilts (1996), cat bites represented 54% of the reported workers' compensation claims from veterinary practices in 1996. Nienhaus et al. (2005), using insurance claims data, reported that the most frequent injuries to German veterinarians caused by animals were bites and scratches. A study by van Soest and Fritschi, 2004, found that 98% of the reported injuries during the veterinary nurses' careers were due to bites and scratches, whereas, the current study found that more than 66% of the total injuries in the 12 months prior to the survey were bite injuries. Dog bites, as well as cat bites and scratches were major sources of injuries to veterinarians and their staff in predominantly small animal clinics, while horse and cattle kicks were major sources of injuries in clinics that predominantly cared for large animals

More than half of the respondents in the study of Australian veterinary nurses indicated they suffered from chronic back and neck pain over their careers (van Soest and

Fritschi, 2004), and reported lifting as the most frequent cause of chronic pain (44%). In the current research, 9% of the most severe injuries reported in the 12 months prior to the survey were due to lifting animals or objects; more than 9% reported they were still having persistent problems at the time of the survey as a result of an injury, consistent with findings from a survey of veterinarians and staff (Poole et al., 1998).

In contrast to findings by Landercasper et al. (1998), a small proportion of injuries in the current study resulted in hospitalization (17% versus 0.8%). However, compared to the current study, the majority of the animals handled in Landercasper's study were cattle and horses, which would be expected to result in more severe injuries requiring hospitalization. While some workers sought care from health care providers, a large proportion of CVTs reported either having no treatment or self-treatment for their injuries; similarly, Landerscaper et al. (1988), found that 77% of veterinarians reported self-treating most injuries. Also consistent with previous studies of injuries to veterinarians (Thigpen and Dorn, 1973; Landercasper et al., 1988), over 12% of CVTs experienced lost work time, and 24% had work restrictions.

Limitations

Several imitations to the present findings were present. First, it was not possible to assess the impact of the lack of information from non-responders. This may limit generalizability if the non-respondents were different with respect to type of practice, work practices, and experience. It is likely, however, that the respondents represent the spectrum of CVTs. Second, care must be taken in generalizing the results to geographic areas, other than the state of Minnesota, as this study pertained exclusively to CVT

certified in the state of Minnesota. Third, potential biases may result from the use of self-reported surveys for injuries and relevant exposures; however, numerous strategies were utilized to minimize recall bias, including limiting recall of injury events to the previous 12 months and recall of exposures to a one-month period within the preceding year -- approaches that were utilized successfully in a previous study of injuries to veterinarians (Gabel and Gerberich, 2002). Finally, as not all individuals assisting in veterinary clinics are CVTs, the results may not apply to all individuals working in veterinary clinics. It is likely that the CVTs do more complicated procedures, but also receive training to handle animals. The effect of this bias is unknown.

Conclusions

The magnitude of the injury problem and potential risk factors in an occupational population of CVTs are identified in this comprehensive study. From the study results, years of experience in handling animals, number of animal types handled on a typical day, number of hours worked per week, and believing work-related injuries are preventable may have an effect on the risk of work-related injuries.

This study serves as the foundation for future analytical studies that can identify specific risk factors, and may serve as a basis for development of appropriate prevention and control efforts. Future studies might explore whether changes in the levels of work-related exposures have an impact on the risk of work-related injuries over time.

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Table 1. Characteristics of Injured and Non-Injured Minnesota Certified Veterinary Technicians				
	Injured (n=465)		Non-Injured (n=408)	
	n	%	n	%
Age				
Less than or = 26	134	28.8	63	15.4
> 26 – 31	126	27.1	105	25.7
> 31 – 38	104	22.4	117	28.7
> 38	98	21.1	120	29.4
Missing	3	0.6	3	0.7
Gender				
Female	451	97.0	397	97.3
Male	14	3.0	10	2.4
Missing	0	0.0	1	0.2
Type of facility				
Small animal clinic	302	65.0	202	49.5
Mixed, mostly small animal	46	9.9	42	10.3
College/University	34	7.3	62	15.2
Mixed 50:50, small and large animals	19	4.1	24	5.9
Research	19	4.1	21	5.2
Emergency clinic	18	3.9	10	2.4
Commercial/Industrial	4	0.9	14	3.4
Government/Regulatory	2	0.4	6	1.5
Humane Society/Shelter	5	1.1	4	1.0
Mixed, mostly large animal	4	0.9	3	0.7
Large animal	1	0.2	3	0.7
Other	11	2.4	17	4.2
Total years handling animals				
< 6	150	32.3	73	17.9
6 – 9	124	26.7	94	23.0
> 9 – 14	97	20.9	107	26.2
> 14	89	19.1	128	31.4
Missing	5	1.1	6	1.5
Hours per worked per week				
< 40	141	30.3	171	41.9
40 and over	324	69.7	236	57.8
Missing	0	0.0	1	100.0
Number of animals species handled on a typical day				
< 4	127	27.3	150	36.8
4 - 5	157	33.8	129	31.6
6	87	18.7	58	14.2
> 6	94	20.2	71	17.4

Table 2. Exposure Frequencies and Annual Total Work-Related Injury Rates per 100 persons: Minnesota Certified Veterinary Technicians

Exposures	Number Exposed CVTs*	Rate	95% C.I.†
Total (1,827 injuries)	861	236.8	226.2 to 247.9
Age			
Less than or = 26	192	472.1	442.0 to 504.3
> 26 – 31	226	165.9	149.1 to 184.5
> 31 – 38	220	180.6	162.4 to 200.7
> 38	218	133.2	117.6 to 150.8
Gender			
Female	836	237.9	227.1 to 249.2
Male	24	197.8	144.5 to 270.7
Number of animal species handled			
< 4	275	159.0	143.7 to 176.0
4 – 5	281	210.7	193.4 to 229.4
6	143	264.1	237.8 to 293.3
> 6	162	376.0	346.4 to 408.0
Job classification			
Part-time (< 40 hrs/week)	310	200.8	182.0 to 221.5
Full-time (40 hrs/week)	330	289.3	271.2 to 308.7
Greater than full-time (> 40 hrs/week)	221	200.0	183.5 to 218.1
Total years handling animals			
< 6	220	411.5	384.6 to 440.3
6 – 9	222	205.0	186.2 to 225.8
> 9 – 14	203	170.6	152.5 to 190.9
> 14	216	143.0	126.8 to 161.2
Years since graduation from CVT program			
Less than 3	233	403.3	377.6 to 430.8
> 3 – 6	195	178.6	160.2 to 199.2
> 6 – 12	216	194.6	175.5 to 215.9
> 12	204	133.6	117.7 to 151.8
Did not graduate from CVT program (11)			
Years worked as a CVT			
Less than or = 3	236	396.4	370.5 to 424.1
> 3 – 6	200	195.1	176.4 to 215.9
> 6 – 11	201	179.2	160.3 to 200.4
> 11	221	155.5	138.8 to 174.2
Body Mass Index			
< 18.5 (underweight)	15	81.8	44.0 to 152.0
18.5 to < 25 (normal)	435	250.4	235.2 to 266.5

25 to < 30 (overweight)	233	259.6	238.7 to 282.3
30 to < 40 (obese)	127	188.0	164.3 to 215.2
40 and greater (extremely obese)	15	342.1	254.6 to 459.6
Number of staff handling animals at facility or department			
< 6	94	86.0	67.9 to 108.9
6 – 8	130	210.0	185.2 to 238.1
9 – 13	238	238.7	219.0 to 260.2
> 13	319	283.4	264.6 to 303.5
Type of facility			
Mixed – mostly small animal	87	593.8	540.5 to 652.4
Small animal	495	241.9	227.9 to 256.8
Emergency	27	174.1	130.8 to 231.7
College/university	96	145.4	122.0 to 173.3
Humane society/shelter	9	119.1	59.6 to 238.1
Research	39	116.2	86.2 to 156.7
50:50 small/large animal	43	109.7	80.1 to 150.1
Mixed – mostly large animal	7	93.7	44.7 to 196.6
Commercial/industry	18	43.6	21.8 to 87.1
Government/regulatory	8	35.5	11.4 to 109.9
Large animal	4	30.4	4.3 to 215.7
Other (equine, zoological, wildlife rehab, other – not specified)	28	149.2	107.1 to 207.7
Believe work-related injury is a problem			
Yes	437	312.2	295.3 to 330.0
No	280	166.1	151.0 to 182.7
Unsure	139	137.6	117.9 to 160.7
Missing (6)			
Number exposed may vary due to non-response.			
†CI indicates confidence interval.			

Table 3. Annual Work-Related Bite Injury Rates per 100 Full-Time Persons: Minnesota Certified Veterinary Technicians

Exposures	Number Exposed CVTs*	Rate	95% C.I.†
Total (600 bite injuries)	861	77.7	71.7 to 84.2
Age			
Less than or = 26	193	111.9	97.8 to 128.1
> 26 – 31	228	69.9	59.3 to 82.3
> 31 – 38	218	68.9	58.0 to 81.9
> 38	216	55.6	45.8 to 67.4
Gender			
Female	836	116.6	77.5 to 175.5
Male	24	76.7	70.7 to 83.2
Number of animal species handled			
< 4	276	56.1	47.3 to 66.5
4 – 5	282	82.7	72.2 to 94.8
6	145	105.6	89.6 to 124.5
> 6	158	78.3	65.3 to 93.8
Job classification			
Part-time (< 40 hrs/week)	310	81.5	69.9 to 95.0
Full-time (40 hrs/week)	330	66.8	58.4 to 76.4
Greater than full-time (> 40 hrs/week)	221	88.1	77.4 to 100.3
Believe injuries can be prevented			
Yes	426	59.9	52.6 to 68.3
No	193	108.4	94.2 to 124.7
Unsure	213	73.2	62.0 to 86.4
Yes and No/Some but not all	22	185.8	136.3 to 253.3
Missing (9)			
Total years handling animals			
< 6	222	112.0	98.4 to 127.3
6 – 9	223	69.8	59.2 to 82.3
> 9 – 14	203	74.5	62.8 to 88.3
> 14	213	50.7	41.4 to 62.2
Years since graduation from CVT program			
Less than 3	235	100.4	88.1 to 114.6
> 3 – 6	196	86.4	73.9 to 100.9
> 6 – 12	215	62.3	51.9 to 74.9
> 12	202	51.4	41.8 to 63.2
Did not graduate from CVT program (11)			
Years worked as a CVT			
Less than or = 3	238	100.3	87.8 to 114.7

> 3 – 6	201	85.8	73.7 to 99.8
> 6 – 11	200	67.9	56.6 to 81.5
> 11	219	52.7	43.3 to 64.1
Body Mass Index			
< 18.5 (underweight)	15	32.7	12.3 to 87.2
18.5 to < 25 (normal)	435	76.1	67.9 to 85.2
25 to < 30 (overweight)	233	84.1	72.6 to 97.5
30 to < 40 (obese)	128	76.8	62.2 to 94.7
40 and greater (extremely obese)	14	109.7	63.7 to 188.9
Number of staff at facility or department			
< 6	94	36.1	25.1 to 52.0
6 – 8	130	76.6	62.2 to 94.3
9 – 13	238	88.0	76.4 to 101.4
> 13	318	83.0	73.2 to 94.2
Type of facility			
Mixed – mostly small animal	86	88.3	69.1 to 112.8
Small animal	498	90.0	81.7 to 99.2
Emergency	27	111.1	77.7 to 159.0
College/university	96	51.2	38.1 to 68.8
Humane society/shelter	9	89.3	40.1 to 198.8
Research	39	37.8	22.4 to 63.9
50:50 small/large animal	43	53.4	34.1 to 83.8
Mixed – mostly large animal	7	26.8	6.7 to 107.1
Commercial/industry	18	10.9	2.7 to 43.5
Government/regulatory	8	0.0	0.0 to -
Large animal	3	0.0	0.0 to -
Other (equine, zoological, wildlife rehab, other – not specified)	27	66.9	40.3 to 111.0
Believe work-related injury is a problem			
Yes	440	82.5	74.1 to 91.9
No	277	73.6	63.7 to 85.0
Unsure	139	70.5	56.8 to 87.6
* Number exposed may vary due to non-response.			
†CI indicates confidence interval. Confidence intervals could not be calculated in some cases due to inadequate numbers.			

Table 4. Characteristics of the Most Severe Injuries: Minnesota Certified Veterinary Technicians

Injury Characteristics	N = 777	
	N	%
Injury Type		
Bite	402	51.7
Cut/laceration/scratch	238	30.6
Bruise/contusion	174	22.4
Abrasion	68	8.8
Sprain/strain	56	7.2
Puncture/needle stick	41	5.3
Allergies	23	3.0
Other	96	12.4
Injury body location		
Hand/finger/thumb	433	55.8
Arm/elbow/wrist	230	29.6
Back (muscles/skin)	61	7.9
Leg (thigh, shin, calf, knee, ankle)	37	4.8
Face (forehead, cheek, nose, lip, jaw, ear)	34	4.4
Neck (cervical area)	26	3.4
Shoulder/collar bone/shoulder blade	20	2.6
Other	100	12.9
Injury source		
Cat	365	47.0
Dog	274	35.3
Pocket Pet (rabbit, rodent, chinchilla, etc.)	27	3.5
Needle/scalpel	27	3.5
Other	100	12.9
Missing	1	0.1
Injury location		
Treatment area	368	47.4
Exam room	143	18.3
X-ray	104	13.4
Patient's cage/kennel	93	12.0
Surgery area	71	9.2
In clinic, other	54	7.0
Other	64	8.2
CVT activity		
Performing animal restraint	421	54.2
Performing treatment	157	20.2
Lifting animal or object	72	9.3
Performing examination	67	8.6

Assisting in surgery	29	3.7
Taking animal in or out of cage/kennel	22	2.8
Clinic activity not involving animals	22	2.8
Transferring/leading animal	21	2.7
Other	75	9.6

Table 5. Consequences of the Most Severe Injuries: Minnesota Certified Veterinary Technicians

Injury Consequences	N = 777	
	N	%
Hospitalized as a result of the injury		
No	770	99.2
Yes	6	0.8
Missing	1	0.1
Treatment by any of the following*		
Self treated	366	47.4
Physician	149	19.3
Urgent care	73	9.5
Chiropractor	36	4.7
Nurse	26	3.4
Colleague	19	2.5
Physical/occupational therapist	13	1.7
Other	10	1.3
None	174	22.5
Missing	5	0.6
Lost work time		
No	673	87.3
Yes	104	12.7
Number of days lost		
No lost days	673	87.6
Lost < 1 day	57	7.3
Lost 1 day or more	41	5.3
Other	6	0.8
Work restriction		
No	589	75.8
Yes	187	24.1
Missing	1	0.1
Number of days restricted work		
No restriction	589	75.8
Restricted < 1 day	48	6.2
Restricted 1 day or more	139	17.9
Missing	1	0.1
Persistent problems resulting from the injury		
No	705	90.7
Yes	72	9.3

*Question denotes “check all that apply”; therefore, responses may total > 100%.

Exposures/Perceptions/Characteristics	N	Univariate		Multivariate	
		OR	95% CI	OR	95% CI
Age					
> 38 years	218	1.0	-	-	-
≤ 26 years	197	2.60	1.74 to 3.89	-	-
27 through 31 years	231	1.47	1.01 to 2.13	-	-
32 through 38 years	221	1.09	0.75 to 1.58	-	-
Number of animal types handled†					
Handling < 4 types	277	1.0	-	1.0	-
Handling 4 to 5 types	286	1.44	1.03 to 2.00	1.29	0.92 to 1.82
Handling 6 types	145	1.77	1.18 to 2.66	1.59	1.04 to 2.43
Handling > 6 types	165	1.56	1.06 to 2.31	1.71	1.11 to 2.64
Experience handling animals‡					
> 14 years experience	217	1.0	-	1.0	-
< 6 years experience	223	2.21	1.57 to 3.11	1.89	1.31 to 2.74
6 to 9 years experience	218	1.58	0.76 to 3.27	1.34	0.63 to 2.82
9 to 14 years experience	204	0.98	0.70 to 1.37	0.95	0.96 to 1.00
Hours worked per week§					
≥ 40 hours per week	560	1.0	-	1.0	-
< 40 hours per week	312	0.60	0.45 to 0.79	0.64	0.44 to 0.92
Type of Facility¶					
College/University	96	1.0	-	1.0	-
Emergency clinic	28	3.28	1.36 to 7.90	3.07	1.27 to 7.45
Small animal clinic	504	2.73	1.73 to 4.30	2.43	1.53 to 3.85
Shelter	9	2.28	0.57 to 9.06	2.52	0.63 to 10.11
Mixed, mostly large animal	7	2.43	0.51 to 11.50	2.34	0.49 to 11.14
Mixed, mostly small animal	88	2.00	1.10 to 3.61	1.70	0.93 to 3.10
Research	40	1.65	0.78 to 3.49	1.59	0.75 to 3.38

Mixed 50:50 small/large animal	43	1.44	0.69 to 3.00	1.32	0.63 to 2.77
Government/Regulatory	8	0.61	0.12 to 3.18	0.62	0.12 to 3.26
Large animal	4	0.61	0.06 to 6.07	0.58	0.06 to 5.78
Commercial/industry	18	0.52	0.16 to 1.71	0.51	0.16 to 1.69
Other facility (equine, zoological, wildlife rehab)	28	1.18	0.50 to 2.80	1.15	0.48 to 2.78
Believe work-related injuries preventable€					
Believe injuries can be prevented	427	1.0	-	1.0	-
Believe injuries can't be prevented	199	2.44	1.72 to 3.45	2.56	1.76 to 3.73
Believe some, but not all, injuries can be prevented	215	5.87	1.96 to 17.54	7.49	2.30 to 24.37
Unsure if injuries can be prevented	23	1.53	1.10 to 2.13	1.52	1.07 to 2.16
Believe injury a problemΔ					
Believe injuries are a problem	447	1.0		1.0	-
Believe injuries not a problem	281	0.75	0.55 to 1.01	0.65	0.47 to 0.91
Unsure if injuries are a problem	140	0.58	0.40 to 0.85	0.55	0.36 to 0.84

†Model includes: type of facility.

‡Model includes: age.

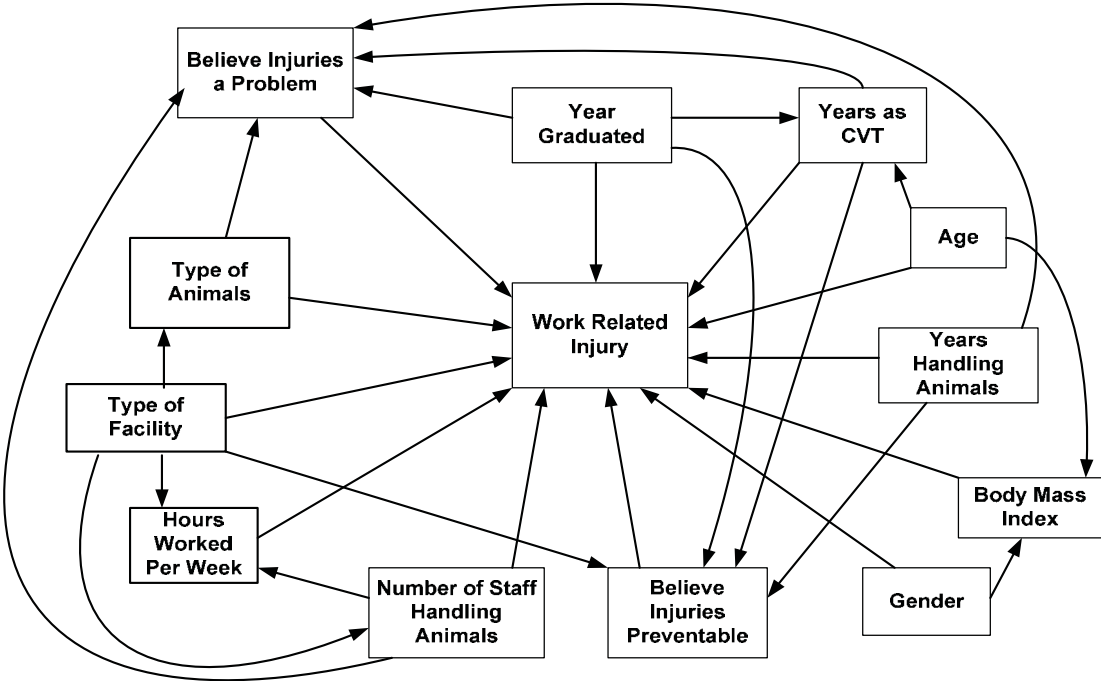
§Model includes: total staff, age, type of facility, and years as a CVT.

¶Model includes: age.

€Model includes: type of facility, years handling animals, years as a CVT, years since graduation, and age.

ΔModel includes: believe injuries preventable, type of facility, number of animals handled, years handling animals, years as a CVT, years since graduation, and age.

Figure 1. Directed Acyclic Graph: Minnesota Veterinary Technicians Study



CHAPTER 5

Please refer to Appendix B for supplemental tables and figures.

TITLE: Risk Factors for Work-Related Bite Injuries to Minnesota Certified Veterinary Technicians

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ABSTRACT

Objective — To determine the risk or protective factors for work-related bite injuries among Certified Veterinary Technicians (CVTs) in the population of Minnesota CVTs

Design — Case-control study of CVTs working in small and mostly small animal clinics

Procedures — Cases (n=176) were CVTs that reported a work-related animal bite injury in the previous 12 months; controls (n=313) reported no animal bites. Using a mailed questionnaire, exposure data pertinent to characteristics of the work environment and personal work practices, during a selected month, were collected from cases (month prior to the bite injury) and non-injured controls (randomly selected months) (61% response).

Results — Multivariate analyses, based on directed acyclic graphs for each exposure of interest, suggested that increased risk of bite injury (Odds Ratios, 95% Confidence Intervals) was associated with: age <25 years (3.82, 1.84-7.94) and 25 to <35 years (1.59, 0.97-2.60), versus age 35 and older; having <5 versus 10+ years experience (3.24, 1.63-6.45); “frequently” (2.02, 1.13-3.60) and “infrequently to never” (4.70, 0.94-23.5), versus “always” having adequate staff help available; and handling 5+ versus <3 animal types per day (1.99, 1.06-3.74). Decreased risks were identified for not having versus having a history of a prior bite injury (0.52, 0.27-1.01) and handling less than 10 versus 20+ animals per day (0.23, 0.08-0.71).

Conclusion — From the study results, age, years of experience, staffing levels, history of bite injury, and number of animals handled on a typical day, were associated with work-related bite injuries. These findings serve as a basis for development of intervention efforts and future research opportunities.

Key Words: Bite-related injury; veterinary technicians; animals; risk factors; work-related injury; occupational health and safety.

INTRODUCTION

Background

Animal bites, including dog bites, to humans have been recognized as an important public health problem (Ozanne-Smith et al., 2003; CDC, 2003). Over 300,000 patients treated for dog bites in hospital emergency departments have resulted in an estimated cost of over \$1 million, annually (CDC, 2003; Weiss, 1998). In addition, there are also costs associated with medical insurance, workers' compensation, lost wages, sick-leave-associated business costs, and physical and emotional damage to the individual. Bites may become infected in three to 18 percent of dog bites and 28 to 80 percent of cat bites that present in hospital emergency departments (Talan et al., 1999). In a study by the Centers for Disease Control and Prevention (2003), work-related dog bite injuries accounted for an estimated 8% of dog bite injuries treated in emergency departments.

Previous studies have found that cat and dog bites were among the most common injuries to veterinarians and their staff, which primarily involved the arms or hands (Fritschi et al., 2006; Nienhaus et al., 2005; van Soest and Fritschi, 2004; Jeyaretnam et al., 2000; Hill et al., 1998; Poole et al., 1998; Landercasper et al., 1988; Thigpen and Dorn, 1973). Yet, very little is known about the risk factors associated with work-related bite injuries to veterinary clinic staff, and to Certified Veterinary Technicians (CVTs).

The CVT has direct contact with animals when collecting specimens, providing specialized nursing care, preparing animals for surgery, assisting in diagnostic surgical and medical procedures, exposing radiographs, and providing dental prophylaxis. Approximately 53,000 CVTs across the United States are at potential risk of traumatic

occupational injuries (Bureau of Labor Statistics, 2004) that can be costly in terms of medical expenses, lost work time, or career loss due to disability. Developing appropriate bite injury prevention and control measures requires a better understanding of the risks specific to CVTs. Consequently, the purpose of this study was to identify factors associated with work-related bite injuries to CVTs that can serve as a basis for development of intervention efforts.

METHODS

Overview

This research is based on data collected from a study designed to identify specific risk factors for work-related bite injuries to Minnesota Certified Veterinary Technicians. Prior to implementation of this effort, approval was received from the University of Minnesota Institutional Review Board, Human Subjects Committee.

Study population

This study included the population of Veterinary Technicians, certified to work in the state of Minnesota throughout the end of October 2004, and who worked as CVTs within 12 months prior to survey administration. A total of 1,465 CVTs were maintained in this database by the Minnesota Veterinary Medical Association. Veterinary Technicians who were certified in the state of Minnesota, but had not worked as CVTs in any state during the 12 months prior to the survey, were excluded from the study population. The study involved two phases. In phase 1, surveys were mailed to 1,427 Veterinary Technicians with valid addresses who were certified in the State of Minnesota

at the end of October 2004; 74% responded (1052). Of those responding, 873 were eligible for analysis; those who reported not working as a CVT in the previous 12 months were not eligible.

Data Collection

Phase 1 was designed to identify the frequency and consequences of all CVT work-related injuries and to identify potential risk factors. Phase 2, the focus of this paper, used a nested case-control design to identify specific risk factors for the animal bite injury-related outcomes.

Initially, during phase 1, a survey instrument was sent to all 1,465 CVTs to identify those who did and did not experience work-related injury events. Phase 1 and phase 2 surveys were mailed up to four times to optimize response. All mailings included cover letters that provided information about the study and informed consent. To enhance participation, each CVT could choose to be included in a random drawing with a one in 30 opportunity to attain a \$20 retail gift card. The phase 2 case-control survey data collection investigated exposures potentially associated with work-related bite injuries in order to identify relevant risk and protective factors.

Definitions

Bite Injuries

To be defined as a work-related bite injury, the injury must have been associated with occupational activities, involved bruising or a break in the skin, and resulted in restriction of normal activities for any length of time, loss of consciousness, or the use of medical assistance.

Cases

Cases (n = 176) were identified through responses to the initial comprehensive survey instrument sent to all 1,465 Veterinary Technicians certified in the State of Minnesota at the end of October, 2004. Cases were defined as those who reported at least one bite injury during a month in which they worked as a CVT within the previous 12 months. If more than one eligible bite injury was reported in the previous 12-month period, one injury was selected randomly as the injury of interest for the study. This method was chosen over selecting the most remote event, the most recent event, or the most severe event, because each of the alternate methods of case event selection could have contributed to study bias due to misclassification and recall bias. Exposure information was collected for the month prior to the month in which the selected bite injury case occurred.

Controls

All Phase 1 respondents who did not report a work-related bite injury during the months in which they worked, were selected as controls (n = 313). To provide exposure information, each control was randomly assigned a month based on the months he or she indicated working during the study period.

Exposure prevalence was identified by questioning the cases about their exposures during the month prior to injury incident occurrence, while controls were questioned about their exposures during a randomly selected month in which they had worked. Both cases and controls were questioned about: personal information (including demographics, animal restraint training, years of experience, and prior work-related

animal bite injuries); employer information (including employer restraint practices, encouragement of proper animal restraint, importance of animal restraint training, and support of staff to speak up when feeling unsafe); facility environment (including numbers and types of co-workers, relevant co-worker training and experience, co-worker support of safety practices, workload and scheduling, quality of communication with co-workers, type and daily volume of animals, animal restraint equipment availability, and type of clinic or practice); animal owner information (including perceived experience in animal restraint, and frequency of assisting with animal restraint). These data were then used to compare exposures between cases and controls and enable identification of specific risk and protective factors for work-related bite injury events.

Data Analyses

Risk factors for animal bite injuries were addressed through multivariate modeling, in accordance with a causal model and specific directed acyclic graphs (DAGs), pertinent to exposures of interest (Hernan, et al., 2002; Greenland, et al., 1999). This method was also used in a prior study of veterinarian injuries (Gabel and Gerberich, 2002). In multivariate modeling of the effects of the exposures of interest on bite-related injuries, the DAGs facilitated identification of potential confounders to be controlled for in each model. These DAGs are available for viewing on an internet website (<http://enhs.umn.edu/riprc/riprc.html>). Odds ratios and 95% confidence intervals were identified for each model. In addition, the potential impact of an unmeasured confounder was examined, utilizing sensitivity analyses (Rothman and Greenland, 1998).

RESULTS

Among the 489 eligible CVTs for the nested case-control study, 176 were cases and 313 were controls. Characteristics of these cases and controls are presented in **Table 1**. Both cases and controls were predominantly female. Cases (31%), compared with controls (44%), were less likely to be 35 years of age or greater. They were also more likely to have worked in small animal clinics (64%, 53%) versus a college or university practice (6%, 14%), worked eight hours or more per day (87%, 80%) and to have experienced a prior bite injury (88%, 78%). Cases were also more likely to have worked less than five years in a veterinary facility (45%, 28%).

Cases, compared with controls, handled more than 10 animals on a typical day (93%, 78%). They also handled three or more different types of animals on a typical day (47%, 36%).

Cases and controls reported comparable frequencies for their last restraint training being less than five years ago (48%, 47%). The frequent presence of animal owners during exams and procedures was noted to be different for cases and controls (48%, 38%); it was also different relevant to animal owners being allowed to restrain their pets (60%, 48%). Case and control CVTs both reported having adequate equipment (94%, 94%); but, cases were less likely to indicate they “always” had adequate support from the employer to use proper animal restraint (48%, 54%) or to use proper restraint in the presence of the owner versus not having owners present (19%, 14%). However, cases were less likely to report “always” having adequate staff available to assist with restraint

(31%, 45%). They were also less likely to report that they “strongly agreed” with the statement, “I felt confident in handling animals when applying restraint techniques” (48%, 57%) or “always” having sufficient time to perform adequate animal restraint (23%, 35%).

Given the fact that the majority (69%) of CVTS worked in small or mostly small animal clinics (Cases = 75%; controls = 66%), versus other facilities/practices, the differences in types of exposures between such facilities/practices multivariate analyses were focused on this more homogeneous exposed population. Results of these adjusted analyses are shown in **Table 2**.

Inverse relations in risks of bite injuries were noted with CVT age and the number of years worked in a veterinary facility. Increased risks, associated with younger ages and the years worked, decreased as age and years worked increased. Working with five or more, versus less than three, types of animals on a typical day was associated with a suggestive increased risk of bite injury. Compared to reporting “always” having adequate staff help available for restraint, those who reported “frequently” having adequate staff help available had a risk of bite injury two times greater, while those who reported “infrequently to never” having adequate staff help available were at a risk four times greater. Decreased risks were identified for CVTs who reported: handling less than 10, versus 20 or more, animals on a typical day and having no prior (versus yes) history of bite injury.

Sensitivity analyses were conducted using methods described by Rothman and Greenland (1998) to examine the impact of an unmeasured confounder related to the

magnitude and direction of potential bias. Given that one of the results of this study suggested that the CVTs' perceptions of "frequently", but not "always" having adequate staff available for proper animal restraint was associated with increased risk of bite injury, analyses were conducted to consider the effect of an unmeasured confounder on this result -- the population density of the clinic location where the CVTs worked the most time during the study. This factor could be associated with the pool of available trained veterinary staff within the community and the risk of bite injury. Varying characteristics of animals, such as animal types and behaviors, from rural versus urban areas may present dissimilarity in risk of bite injuries to CVTs. With prevalence of the unmeasured confounder being defined as the proportion of CVT's who worked in a more densely populated work area, the examination of estimated ranges of this prevalence between staffing exposure levels was used to determine the effect of the unmeasured confounder on the risk associated with the exposure. In order to reverse the effect of "frequently" versus "always" having adequate staff available for restraint (e.g., OR changes from 2.02 to 0.93), the unmeasured confounder would have to be a relatively strong risk factor (e.g., OR = 3.0) with differences in prevalence across the exposed and unexposed of 0.8 and 0.1, respectively. The point estimate was considered, however, and not the precision of the estimate for this sensitivity analysis.

DISCUSSION

This population-based case-control study enabled identification of potential risk factors for work-related bite injuries to Minnesota CVTs. One comparable study was

identified in the literature that had previously investigated this problem using multivariate logistic regression analyses in a population of veterinarians (Gabel and Gerberich, 2002).

In the current study, average hours worked per day were reported and analyzed as a surrogate measure of fatigue, with no differences found, as a result of multivariate analyses, between levels of exposure and risk of bite injury. A prospective study design may be more effective in determining the risk of bite injury associated with the number of hours worked prior to a bite injury.

Inverse relations were found between age and number of years worked in a veterinary facility and the risk of bite injury. Similar findings were reported by Gabel and Gerberich (2002). Further research may attempt to explain the effects of the type and quality of experience on the risk of bite injury.

The results of this study suggested that having no prior bite injuries, resulting in bruising or a break in the skin, was associated with a decreased risk of bite injury during the study period. Similar findings were reported by Gabel and Gerberich (2002). It is possible that CVTs reporting a bite injury during the study period may have had enhanced recall of more distant events that may, in part, have been related to severity of the events, or that they worked in a high risk environment.

The results also suggested that an increased risk of bite injury was associated with the CVTs' perceptions of lower staffing levels. Certainly, the findings of reduced risks associated with handling lower numbers and types of animals on a typical day are integral to this finding. In particular, this suggests a need for clinics to consider, carefully, the "patient" load in order to provide adequate staffing and resources. Further research may

also elaborate on the effect of types and ratios of staff to animal clients and the respective resources available on the outcome of bite injury.

Limitations

The focus of this study was on potential risk factors for work-related bite injury, measured by the CVTs' perceptions and self-reported descriptions of the injury events and work-related exposures. These responses may possibly have lead to some biases, including those related to recall, information, misclassification, selection, and confounding. Therefore, limiting the recall period for exposures to one month during the previous 12 months was utilized to reduce recall bias – a method used in a prior study of veterinarian-related injuries (Gabel and Gerberich, 2002). For some questionnaire items, to reduce information bias, CVTs were followed-up by mail and telephone to clarify missing or unclear responses provided on the returned survey instruments. All Veterinary Technicians certified in the state of Minnesota were selected for inclusion into the study. Since no demographic information was available in the CVT certification database, it was not possible to consider response bias or eligibility. The selection of potential confounders for logistic regression analyses was guided by DAGs as an attempt to reduce the effect of confounding (Greenland et al., 1999).

Conclusions

This population-based study provided preliminary findings and analyses of case-control data pertinent to risk factors for work-related bite injuries among CVTs. These risk factors included: younger age; fewer years of experience; history of a prior bite

injury; the perception of less than adequate staffing levels; the number of animals handled on a typical day; and the number of animal types handled on a typical day.

The information from these study results is a step in adding to our understanding of the relation between various occupational exposures and work-related bite injuries. Future studies might explore whether changes in potential exposures over time have an impact on work-related bite injuries.

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Table 1 Characteristics for Cases and Controls: Minnesota Certified Veterinary Technicians				
	Cases (n=176)		Controls (n=313)	
	n	%	n	%
Total	176	36.0	313	64.0
Gender				
Female	170	96.6	304	97.1
Male	6	3.4	8	2.6
Missing	0	0.0	1	0.3
Age				
< 25	30	17.0	20	6.4
25 to <35	89	50.6	148	47.3
35 or greater	54	30.7	139	44.4
Missing	3	1.7	6	1.9
Type of facility				
Small animal clinic	112	63.6	166	53.0
Mixed, mostly small animal	20	11.4	39	12.5
College/University	10	5.7	44	14.1
Mixed 50:50, small and large animals	11	6.2	14	4.5
Research	8	4.6	13	4.2
Emergency clinic	9	5.1	5	1.6
Equine/Large animal/ Mixed, mostly large animal	1	0.6	7	2.2
Commercial/Industrial	0	0.0	8	2.6
Humane Society/Shelter	3	1.7	3	1.0
Government/Regulatory	0	0.0	5	1.6
Other	2	1.1	9	2.9
Years worked in veterinary facility				
< 5	80	45.4	87	27.8
5 to <10	54	30.7	99	31.6
10 or greater	42	23.9	125	39.9
Missing	0	0.0	2	0.6
Average Hours worked per day				
< 8	23	13.1	61	19.5
8	72	40.9	114	36.4
> 8	81	46.0	137	43.8
Missing	0	0.0	1	0.3
Prior bite injury				
Yes	155	88.1	245	78.3
No	20	11.4	68	21.7
Missing	1	0.6	0	0.0
Number of animals handled on a typical day				
< 10	10	5.7	62	19.8
10 to < 15	37	21.0	50	16.0

15 to < 20	39	22.2	59	18.8
20 or greater	87	49.3	135	43.1
Missing	3	1.7	7	2.2
Total types of animals handled on a typical day				
1	1	0.6	22	7.0
2	90	51.1	172	55.0
3	32	18.2	52	16.6
4	18	10.2	28	9.0
5	13	7.4	17	5.4
6	18	10.2	17	5.4
7	1	0.6	0	0.0
Missing	3	1.7	5	1.6
Years since most recent restraint training				
< 5	85	48.3	147	47.0
5 to <10	59	33.5	76	24.3
10 or more	22	12.5	68	21.7
Missing	10	5.7	22	7.0
Animal owners present during exams and procedures				
Always	17	9.7	29	9.3
Frequently	84	47.7	120	38.3
Sometimes	43	24.4	81	25.9
Infrequently to never	17	10.0	32	10.2
Did not apply	15	8.5	48	15.3
Missing	0	0.0	3	1.0
Animal owners allowed to restrain their pets				
Yes	106	60.2	151	48.2
No	52	29.6	114	36.4
Did not apply	18	10.2	47	15.0
Missing	0	0.0	1	0.3
Adequate equipment available for restraint				
Yes	165	93.8	294	93.9
No	10	5.7	13	4.2
Didn't apply	0	0.0	4	1.3
Missing	1	0.6	2	0.6
Adequate support from employer to use proper animal restraint				
Always	85	48.3	170	54.3
Frequently	67	38.1	103	32.9
Sometimes	15	8.5	26	8.3
Infrequently to Never	8	4.6	6	1.9
Did not apply	1	0.6	6	1.9
Missing	0	0.0	2	0.6
Adequate staff help available				

for restraint				
Always	54	30.7	141	45.0
Frequently	90	51.1	112	35.8
Sometimes	23	13.1	42	13.4
Infrequently to never	8	4.6	6	1.9
Does not apply	1	0.6	10	3.2
Missing	0	0.0	2	0.6
Felt confident when applying restraint techniques				
Strongly agree	84	47.7	180	57.5
Agree	89	50.6	126	40.3
Disagree	3	1.7	1	0.3
Did not apply	0	0.0	5	1.6
Missing	0	0.0	1	0.3
Sufficient time allowed to perform adequate animal restraint				
Always	41	23.3	109	34.8
Frequently	77	43.8	107	34.2
Sometimes	45	25.6	58	18.5
Infrequently	8	2.3	23	4.6
Never	4	2.3	7	2.2
Did not apply	0	0.0	8	2.6
Missing	1	0.6	1	0.3
Just as likely to use proper restraint in presence of owner as if owners not present				
Yes	124	70.4	209	66.8
No	34	19.3	45	14.4
Did not apply	18	10.2	57	18.2
Missing	0	0.0	2	0.6

Table 2 Multivariate Analysis of Environmental Exposures: Minnesota Certified Veterinary Technicians Working in Small or Mostly Small Animal Clinics				
Exposures/Perceptions/Characteristics	Cases n = 132	Controls n = 205	OR	95% CI
Gender (Univariate)				
Female	128	201	1.0	-
Male	4	3	2.09	0.46 to 9.51
Missing	0	1		
Age (Univariate)				
35 or older	34	81	1.0	-
25 to < 35	69	102	1.59	0.97 to 2.60
< 25	26	16	3.82	1.84 to 7.94
Missing	3	6		
Years worked in a veterinary facility †				
10 or greater	25	74	1.0	-
5 to <10	41	66	1.90	0.98 to 3.72
< 5	66	63	3.24	1.63 to 6.45
Missing	0	2		
Average Hours worked per day †				
<8	22	47	1.0	-
8	48	59	0.62	0.32 to 1.20
> 8	62	98	0.79	0.48 to 1.31
Missing	0	1		
Prior bite injury ¶				
Yes	116	168	1.0	-
No	15	37	0.52	0.27 to 1.01
Missing	1	0		
Number of animals handled on a typical day ‡				
20 and over	64	91	1.0	-
15 to < 20	34	47	0.93	0.52 to 1.64
10 to < 15	29	32	1.28	0.69 to 2.38
< 10	4	29	0.23	0.08 to 0.71
Missing	1	6		
Number of animal types handled §				
< 3 types	63	119	1.0	-
3 – 4 types	41	55	1.34	0.80 to 2.26
5 or greater	27	26	1.99	1.06 to 3.74
Missing	1	5		
Years since most recent restraint training ¶¶				
< 5	68	98	1.0	-
5 to <10	40	47	1.20	0.71 to 2.04
10 or more	14	45	0.66	0.31 to 1.39
Missing	10	15	1.33	0.52 to 3.44
Animal owners present during exams and procedures (Univariate)				

Always to Frequently	87	125	1.0	-
Sometimes	38	64	0.87	0.53 to 1.41
Infrequently to never	7	10	1.28	0.45 to 3.65
Did not apply	0	4	0.00	0.00 to >999.99
Missing	0	2		
Animal owners allowed to restrain their pets Δ				
Yes	90	121	1.0	-
No	41	80	0.76	0.46 to 1.26
Did not apply	1	3	2.10	0.12 to 35.45
Missing	0	1		
Adequate equipment available for restraint €€				
Yes	127	193	1.0	-
No	5	10	0.60	0.19 to 1.88
Missing	0	2		
Adequate support from employer to use proper animal restraint ¶¶¶				
Always	64	109	1.0	-
Frequently	52	69	1.18	0.73 to 1.92
Sometimes	11	20	0.87	0.38 to 1.95
Infrequently to Never	5	4	1.68	0.42 to 6.64
Did not apply	0	1	0.00	0.00 to >999.99
Missing	0	2		
Adequate staff help available for restraint €				
Always	39	88	1.0	-
Frequently	71	78	2.02	1.13 to 3.60
Sometimes	16	31	1.11	0.48 to 2.61
Infrequently to never	6	3	4.70	0.94 to 23.50
Does not apply	0	3	0.00	0.00 to >999.99
Missing	0	2		
Felt confident when applying restraint techniques £				
Strongly agree	61	110	1.0	-
Agree	68	94	1.20	0.71 to 2.01
Disagree	3	0	>99.9	0.00 to >999.99
Missing	0	1		
Sufficient time allowed to perform adequate animal restraint ¥				
Always	27	60	1.0	-
Frequently	58	77	1.17	0.62 to 2.20
Sometimes	37	47	1.19	0.57 to 2.48
Infrequently to Never	9	20	0.45	0.14 to 1.47
Did not apply	0	1	0.00	0.00 to >999.99
Missing	1	0		
Just as likely to use proper restraint in presence of owner as if owners not				

present ††				
Yes	100	163	1.0	-
No	31	35	1.35	0.69 to 2.61
Did not apply	1	5	0.33	0.02 to 5.11
Missing	0	2		

† Multivariate model includes: age.

‡ Multivariate model includes: average hours worked per day, years worked in veterinary facility, and age.

§ Multivariate model includes: age and average hours worked per day.

¶ Multivariate model includes: age and years worked in veterinary facility.

£ Multivariate model includes: age, years worked in veterinary facility, years since most recent restraint training, history of prior bite injury, adequate staff available for animal restraint, adequate employer support to restrain properly, sufficient time allowed for proper restraint, and number of animal types handled on a typical day

€ Multivariate model includes: number of animals handled on a typical day, age, average hours worked per day, years worked in a veterinary facility, and employer support to restrain properly.

Δ Multivariate model includes: animal owner present, adequate staff available for proper restraint, felt confident when applying restraint, and sufficient time allowed for proper restraint.

¥ Multivariate model includes: number of animals handled on a typical day, adequate staff available for animal restraint, adequate employer support to restrain properly, years worked in a veterinary facility, and age.

†† Multivariate model includes: age, number of animals handled on a typical day, years worked in a veterinary facility, years since most recent restraint training, adequate employer support to restrain properly, animal owner present, average hours worked per day, history of prior bite injury, adequate staff available for animal restraint, number of animal types handled on a typical day, adequate equipment available for restraint, felt confident when applying restraint, sufficient time allowed for proper restraint.

€€ Multivariate model includes: number of animals handled on a typical day and employer support to restrain properly.

¶¶ Multivariate model includes: years worked in veterinary facility and history of prior bite injury.

CHAPTER 6

DISCUSSION

This study explored the relations between work exposures to Certified Veterinary Technicians (CVTs) and the risk of work-related injuries. Due to differences in study methods, populations, and definitions of injuries, only one previous study could be directly compared with these study results; prior studies focused either, specifically, on veterinarians or combined both veterinarians and staff. In an effort to address several work-related research questions, the findings from this study were based on the population of Veterinary Technicians certified to practice in the State of Minnesota.

The study involved two phases. Phase I was designed to estimate the frequency and consequences of work-related injuries and to identify potential risk factors. Phase II used a nested case-control design to identify specific risk factors for the animal bite injury-related outcomes.

Phase I

The first aim of this study was to identify the frequency and consequences of and potential risk factors for injuries to CVTs. Among the 873 respondents to the Phase I survey, 51% experienced at least one injury in the 12 months prior to the survey completion; 36% of those injured reported having three or more injuries. The overall injury rate was 236.8 per 100 full-time persons per year. An increasing dose-response was identified between rates and increasing numbers of animal species handled and the number of staff handling animals in the facilities. Inverse relations were noted with years

of handling animals, CVT age, years since graduation, and years worked as a CVT. Compared with those employed for a 40-hour per week schedule, CVTs working less than or greater than 40 hours per week had lower rates of injury per 100 full-time CVTs per year. Among the total injuries, there were 600 bite injury events reported by 353 CVTs who completed surveys in Phase I.

Great differences in injury risk were identified among the types of facilities in which they worked. Based on multivariate modeling, working as a CVT in an emergency clinic or a small animal clinic, compared to a college/university practice, was associated with greatly increased risks of all types of injury in Phase I of the study.

Compared with those employed for a 40+ hour per week schedule, CVTs working less than 40 hours per week had a lower risk of injury, after adjusting for potential confounders. Consistent with findings from a study of veterinarians' perceptions that their occupation was dangerous (Landerscaper, et al, 1988), more than half of the CVTs in the current study believed that work-related injuries were problematic. Based on multivariate modeling, believing that work-related injuries could not be prevented was associated with an increased risk of bite injury.

The most frequently reported body locations of the injuries were hands and arms, findings consistent from previous studies (Drobatz and Smith, 2003; Nienhaus et al, 2005); bites were the most frequently reported type of injury for CVTs (Poole et al., 1998; Jeyaretnam and Phillips, 2000). Consistent with previous reports for veterinarians (Thigpen and Dorn, 1973; Landercasper et al, 1988; Gabel and Gerberich, 2002; Nienhaus et al., 2005), treating small animals, cats and dogs were the most common

sources of injury in this study. While dogs were the most frequently handled type of animal, cats were the most frequent source of more severe injuries. Of those CVTs reporting injuries, 18% were restricted for one or more days, and nine percent were experiencing persistent problems from the injury, at the time of the survey.

Phase II

The Phase II case-control study utilized methods to investigate exposures associated with work-related bite injuries, in order to identify relevant risk and protective factors. Aims #2 was to identify risk/protective factors associated with bite injuries to CVTs. The relation between being as likely to use proper animal restraint in the presence of the owner as when the owner is not present (aim #3) and the outcome of bite injury was not found to be statistically important.

Given the fact that the majority (69%) of CVTS worked in small or mostly small animal clinics (Cases = 75%; controls = 66%), versus other facilities/practices, and the differences in types of exposures among such facilities/practices, multivariate analyses were focused on this more homogeneous exposed population. For the CVTs who worked in small and mostly small animal clinics, inverse relations were found between CVT age, as well as the number of years worked in a veterinary facility, and the risk of bite injury, findings also reported by Gabel and Gerberich (2002). Also consistent with previous findings (Gabel and Gerberich, 2001), the results of the current study suggested that having no prior bite injuries was associated with a decreased risk of bite injury.

Working with five or more, versus less than three, types of animals on a typical day was associated with a suggestive increased risk of bite injury. Compared to reporting

“always” having adequate staff help available for restraint, those who reported “frequently” having adequate staff help available had a risk of bite injury two times greater, while those who reported “infrequently to never” having adequate staff help available had a risk four times greater. Decreased risks were identified for CVTs who reported handling less than 10, versus 20 or more, animals on a typical day and having no (versus yes) prior history of bite injury.

Limitations

For both phases of this study, the focus was on injury rates, injury consequences, and potential risk factors for work-related injury, measured by the CVTs’ perceptions and self-reported descriptions of the injury events and work-related exposures. These responses may possibly have lead to biases, including those related to recall, information, misclassification, selection, and confounding. Several potential limitations were identified. First, it was not possible to assess the impact of the lack of information from non-responders. Second, care must be taken in generalizing the results to geographic areas, other than the state of Minnesota. Third, potential biases may result from the use of self-reported surveys for injuries and relevant exposures; however, numerous strategies were utilized to minimize recall bias, including limiting recall of requested information (e.g., injury occurrences, consequences, and some exposures) to the previous 12 months. In addition, Phase II limited recall of exposures to a one month period prior to the injury, for cases, and a randomly selected month for controls -- approaches that were utilized successfully in a previous study of injuries to veterinarians (Gabel and Gerberich, 2002).

For some questionnaire items, to reduce information bias, CVTs were followed-up by mail and telephone to clarify missing or unclear responses provided on the returned survey instruments. Since no demographic information was available in the CVT certification database, it was not possible to consider response bias or eligibility. The selection of potential confounders for logistic regression analyses was guided by Directed Acyclic Graphs (Greenland et al., 1999) to limit the effect of confounding.

Bias and Sensitivity Analyses

Sensitivity analyses were conducted using methods described by Rothman and Greenland (1998) to examine the impact of an unmeasured confounder related to the magnitude and direction of potential bias. Given that one of the results of Phase II of this study suggested that the CVTs' perceptions of "frequently," but not "always" having adequate staff available for proper animal restraint was associated with increased risk of bite injury, analyses were conducted to consider the effect of an unmeasured confounder on this result -- the population density of the clinic location where the CVTs worked the most time during the study. This factor could be associated with the pool of available trained veterinary staff and the risk of bite injury. With prevalence of the unmeasured confounder being defined as the proportion of CVT's who worked in a more densely populated work area, the examination of estimated ranges of this prevalence among staffing exposure levels was used to determine the effect of the unmeasured confounder on the risk associated with the exposure. In order to reverse the effect of "frequently" versus "always" having adequate staff available for restraint (e.g., Odds Ratio changes from 2.02 to 0.93), the unmeasured confounder would have had to be a relatively strong

risk factor (e.g., OR = 3.0), with differences in prevalence across the exposed and unexposed of 0.8 and 0.1, respectively. The point estimate was considered, however, and not the precision of the estimate for this sensitivity analysis.

Future Studies

In Phase I of the study, it was expected that those CVTs who worked more than 40 hours per week would experience a higher rate of injury, due to fatigue. Further research is needed to determine whether the nature of the work or the demands of the work schedule, during certain hours, may explain the higher injury rate from all sources per 100 full-time CVTs for those specifically working 40 hours per week, compared to those working less than or greater than 40 hours per week. CVTs working 40 hours per week may have experienced higher rates of injuries because they may have been working during periods when clinics have full schedules, with resulting increased work loads and time pressures; they may have also engaged in work activities that increase the risk of injury, compared to those who worked part time or more than full-time.

In the case-control multivariate analysis, average hours worked per day were reported and analyzed as a surrogate measure of fatigue, with no differences found between levels of exposure and risk of bite injury. A prospective study design may be more effective in determining the risk of bite injury associated with the number of hours worked prior to an injury.

Further research may be designed to explain the effects of the following exposures on the risk of bite injury: the type and quality of experience in handling animals; the effect of types and ratios of staff to animal clients; and the respective

resources available to prevent bite injuries. Future studies might also explore whether changes in potential exposures over time have an impact on work-related bite injuries.

Conclusions

The magnitude of the injury problem and potential risk factors in an occupational population of CVTs are identified in this comprehensive study. From the Phase I study results that addressed all types of injuries, CVT age, years of experience in handling animals, number of animal types handled on a typical day, number of hours worked per week, number of staff, and believing work-related injuries are a problem and are preventable, may have had an effect on the risk of work-related injuries.

In Phase II, this population-based case-control study provided findings pertinent to risk factors associated with work-related bite injuries among CVTs. These risk factors included: younger age; fewer years of experience; history of a prior bite injury; the perception of less than adequate staffing levels; the number of animals handled on a typical day; and the number of animal types handled on a typical day. From the Phase I and Phase II study findings, the following exposures may have an effect on all types of injuries, as well as bite injuries, specifically: CVT age; the years of work experience in a veterinary facility; the number of animal types handled in a typical day; and having adequate staff help available for assistance.

The information from these study results is a step in adding to our understanding of the relations between various exposures and work-related injuries to CVTs. This study serves as the foundation for future analytical studies that can identify further risk factors and serve as a basis for development of appropriate prevention and control efforts.

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APPENDIX A
CHAPTER 4 SUPPLEMENTAL TABLES

Table 1 Comprehensive phase participant characteristics and exposures: the Minnesota Certified Veterinary Technicians' Study		
Characteristics/exposures	No.	%
Gender (N = 872)		
Female	848	97.2
Male	24	2.8
Missing	1	0.1
Age (years) (range 18 – 62) (median = 31)		
Under 25	143	16.5
25 – 34	413	47.6
35 – 44	222	25.6
45 – 54	79	9.1
55 and over	10	1.2
Missing	6	0.7
Primary facility worked (N = 873)		
Small animal private clinical practice	504	57.7
College/university	96	11.0
Mixed, mostly small animal	88	10.1
50:50 Mixed small/large animal	43	4.9
Research	40	4.6
Emergency Clinic	28	3.2
Commercial/industry	18	2.1
Humane society/shelter	9	1.0
Government/regulatory	8	.9
Mixed, mostly large animal	7	.8
Large animal private clinical practice	4	.5
Equine private clinical practice	3	.3
Zoological facility	3	.3
Wildlife rehabilitation	2	.2
Mobile clinic practice	0	
Other	20	2.3
Number of Doctors on staff who handled animals (N = 873) (range 0 – 100) (median = 3)		
0	20	2.3
1	87	10.0
2	157	18.0
3	176	20.2
4	166	19.0
> 4	236	27.0
Don't know	31	3.6

Number of CVTs on staff who handled animals (N = 841) (range 1 - 200) (median = 4)		
1	109	13.0
2	122	14.5
3 - 4	230	27.3
5 - 6	175	20.8
> 6	205	24.4
Don't know	32	3.7
Number of animal assistants who handled animals (range 0 - 50) (median = 2)		
0	230	26.3
1	115	13.2
2	170	19.5
3 - 4	142	16.3
> 4	178	20.4
Don't know	38	4.4
Number of other staff who handled animals (N = 805) (range 0 - 200) (median = 2)		
0	230	28.6
1	122	15.2
2	186	23.1
3	83	10.2
> 3	184	22.9
Don't know	68	7.8
Total number of staff who handled animals other than doctors (N = 843) (range 1 - 280) (median = 8)		
1 - 5	224	26.6
6 - 10	305	36.2
11 - 15	155	18.4
16 - 20	69	8.2
> 20	90	10.7
Don't know	30	3.4
Primary animal population (N = 873)		
Dogs	834	95.5
Cats	798	91.4
Pocket Pets (rabbits, rodents, chinchillas, etc.)	646	74.0
Ferrets	423	48.4
Avian	397	45.5
Exotics (snakes, turtles, lizards, etc.)	242	27.7
Horses	150	17.2
Pigs	144	16.5
Sheep	130	14.9
Goats	124	14.2

Cattle	119	13.6
Poultry	91	10.4
Monkeys/other primates	44	5.0
Zoo animals	36	4.1
Other	43	4.9
None	3	0.3
CVTs with self-reported injuries during past 12 months (N = 873)		
Yes	465	53.3
No	408	46.7
Total number of injuries per CVT (N = 445) (range 1 – 250) (median = 2)		
1	171	38.4
2	110	24.7
3	70	15.7
4	30	5.7
> 4	64	14.4
Missing	20	4.3
Total number of injuries for all CVTs in Q14	1827	
Injury rate per 100 persons 1827/872	209.5	
Bite rate per 100 persons 600/872	68.8	
Mean Full Time Equivalent (FTE) (N = 872)	0.93	
Injury rates per 100 FTE's		
Overall 1827 injuries X 200,000/total hrs./year	236.8	
Bites 600 bites X 200,000/total hrs./year	77.7	
Total number of injuries for all CVTs reported in survey	777	
Season worked		
Spring (April – June)	853	97.7
Summer (July – Sept.)	832	95.3
Fall (Oct. – Dec.)	832	95.3
Winter (Jan. – Mar.)	819	93.8
Years handling animals (N = 862) (range 0.9 – 42) (median = 9)		
<5	142	16.5
5 to < 10	322	37.4
10 to < 15	191	22.2
15 to < 20	110	12.8
20 and over	97	11.2
Missing	11	1.3
Graduate from CVT program (N = 873)		
Yes	862	98.7
No	11	1.3
Years since graduation (N = 859) (range <1 – 34)		

(median = 6)		
<1 - 4	303	35.3
5 - 9	260	30.3
10 - 14	147	17.1
15 - 19	70	8.1
20 and over	79	9.2
Missing	3	1.6
Did not graduate from a CVT program	11	1.3
Years as CVT (N = 870) (range <1 - 34) (median = 6)		
< 1 - 2	162	18.6
>2 - 5	220	25.3
>5 - 10	240	27.6
>10 - 15	133	15.3
>15 - 20	68	7.8
>20	47	5.4
Missing	3	0.3
Average annual household income (N = 838)		
Less than \$20,000	43	8.6
\$20,000 to < \$25,000	112	13.4
\$25,000 to < \$35,000	143	17.1
\$35,000 to < \$50,000	155	18.5
\$50,000 to < \$75,000	208	24.8
\$75,000 and over	128	15.3
Unsure	20	2.4
Missing	35	4.0
Marital status (N = 868)		
Married	481	55.4
Living as married/domestic partner	47	5.4
Never married	294	33.9
Separated	4	0.5
Divorced	39	4.5
Widowed	3	0.4
Missing	5	0.6
Body mass index (N = 837) (range 17.2 - 64.6) (median = 24.3)		
Less than 18.5 (underweight)	15	1.8
18.5 to < 25 (normal)	442	52.8
25 to < 30 (overweight)	236	28.2
30 to < 40 (obese)	129	15.4
40 and over (extremely obese)	15	1.8
Missing	36	4.1
Average number of hours worked per day (N = 873) (range 1 - 16) (median = 8)		

1 - 4	35	4.0
> 4 - 8	405	46.4
>8 - 12	417	47.8
>12	16	1.8
Average number of days worked per week (N = 872) (range .25 – 7) (median = 5)		
< 4	134	15.4
4 to < 5	300	34.4
5	363	41.6
> 5	75	8.6
Missing	1	0.1
Average number of hours worked per week (N = 872) (range 1 – 78) (median = 40)		
1 – 8	36	4.1
>8 – 16	24	2.8
>16 – 24	46	5.3
>24 – 32	76	8.7
> 32 – 40	465	53.3
>40 - 50	195	22.4
> 50	30	3.4
Missing	1	0.1
Believe injuries preventable (N = 864)		
Yes	427	49.4
No	199	23.0
Yes and No	215	24.6
Unsure	23	2.7
Missing	9	1.0
Believe injuries a problem (N = 868)		
Yes	447	51.5
No	281	32.4
Unsure	140	16.1
Missing	5	0.6
State worked		
Minnesota	793	90.8
Other	80	9.2
Short Survey		
Mailed	334	
Undeliverable	5	
Valid Addresses	329	
No response	286	
Refused	1	
Didn't work in past 12 months	6	
Survey completed and returned	37	

Response rate		
Surveys mailed to valid address	1427	
Responded	1052	
Response rate 1052/1427	73.7%	
Eligibility rate		
Completed surveys and worked last 12 months	873	
Eligibility rate 873/1052 returned	83.0%	

APPENDIX B

CHAPTER 5 SUPPLEMENTAL TABLES

Chapter Table 3: Multivariate analysis of environmental exposures: Minnesota Certified Veterinary Technicians – All Facilities				
Exposures/Perceptions/Characteristics	Univariate		Multivariate	
	OR	95% CI	OR	95% CI
Gender				
Female	1.0	-	-	-
Male	1.34	0.46 to 3.93	-	-
Age				
35 or older	1.0	-	-	-
25 to < 35	1.53	1.02 to 2.29	-	-
< 25	3.81	2.00 to 7.26	-	-
Type of Facility †				
Small animal clinic	1.0	-	1.0	-
Mixed, mostly small animal	0.76	0.42 to 1.37	0.72	0.40 to 1.30
College/University	0.34	0.16 to 0.70	0.36	0.18 to 0.76
Mixed 50:50, small and large animals	1.16	0.51 to 2.66	1.15	0.50 to 2.64
Research	0.91	0.37 to 2.27	0.95	0.38 to 2.37
Emergency clinic	2.67	0.87 to 8.17	2.85	0.92 to 8.80
Equine/Large animal/ Mixed, mostly large animal	0.21	0.03 to 1.74	0.21	0.02 to 1.73
Humane Society/Shelter	1.48	0.29 to 7.48	1.71	0.33 to 8.74
Other (a)	0.14	0.03 to 0.58	0.14	0.03 to 0.62
Years worked in a veterinary facility †				
10 or greater	1.0	-	1.0	-
5 to <10	1.62	1.00 to 2.63	1.59	0.92 to 2.74
< 5	2.68	1.69 to 4.25	2.67	1.52 to 4.69
Average Hours worked per day §				
8	1.0	-	1.0	-
< 8	0.60	0.34 to 1.05	0.54	0.30 to 1.01
> 8	0.94	0.63 to 1.40	0.85	0.55 to 1.31
Prior bite injury ¶				
Yes	1.0	-	1.0	-
No	0.46	0.27 to 0.80	0.40	0.23 to 0.70
Years since most recent restraint training ¶				
< 5	1.0	-	1.0	-
5 to <10	1.34	0.87 to 2.07	1.31	0.84 to 2.02
10 or more	0.56	0.32 to 0.97	0.73	0.40 to 1.32
Missing	0.79	0.36 to 1.74	0.97	0.41 to 2.28
Adequate staff help available for restraint €				
Always	1.0	-	1.0	-
Frequently	2.10	1.38 to 3.19	2.04	1.23 to 3.36
Sometimes	1.43	0.79 to 2.60	1.31	0.62 to 2.76
Infrequently to never	3.48	1.15 to 10.50	3.74	1.02 to 13.67

Does not apply	0.26	0.03 to 2.09	0.76	0.07 to 7.79
Number of animals handled on a typical day ‡				
20 and over	1.0	-	1.0	-
15 to < 20	1.03	0.63 to 1.67	0.95	0.57 to 1.59
10 to < 15	1.15	0.69 to 1.90	1.22	0.72 to 2.10
< 10	0.25	0.12 to 0.51	0.28	0.13 to 0.61
Number of animal types handled ‡‡				
< 3 types	1.0	-	1.0	-
3 types	1.31	0.79 to 2.17	1.13	0.67 to 1.92
4 types	1.42	0.74 to 2.70	1.08	0.55 to 2.16
5 types	1.63	0.76 to 3.49	1.52	0.67 to 3.45
6 or more types	2.38	1.18 to 4.78	1.63	0.79 to 3.39
Animal owners present during exams and procedures §§				
Always to Frequently	1.0	-	1.0	-
Sometimes	0.79	0.51 to 1.24	0.83	0.52 to 1.30
Infrequently to never	0.85	0.44 to 1.62	1.31	0.58 to 2.95
Did not apply	0.47	0.25 to 0.88	0.64	0.21 to 1.94
Animal owners allowed to restrain their pets Δ				
Yes	1.0	-	1.0	-
No	0.65	0.43 to 0.98	0.76	0.48 to 1.19
Did not apply	0.55	0.30 to 0.99	1.81	0.43 to 7.61
Adequate equipment available for restraint €€				
Yes	1.0	-	1.0	-
No	1.37	0.59 to 3.20	1.09	0.43 to 2.76
Didn't apply	0.00	0.00 to <999.99	0.00	0.00 to <999.99
Adequate support from employer to use proper animal restraint ¶¶				
Always	1.0	-	1.0	-
Frequently	1.30	0.87 to 1.95	1.26	0.82 to 1.92
Sometimes	1.15	0.58 to 2.29	0.99	0.49 to 2.03
Infrequently to Never	2.67	0.90 to 7.93	2.06	0.63 to 6.74
Did not apply	0.33	0.04 to 2.81	0.59	0.06 to 5.57
Felt confident when applying restraint techniques £				
Strongly agree	1.0	-	1.0	-
Agree	1.51	1.04 to 2.20	1.30	0.84 to 2.01
Disagree	6.43	0.66 to 62.72	7.22	0.50 to 105.0
Did not apply	0.00	0.00 to >999.99	0.00	0.00 to >999.99
Sufficient time allowed to perform adequate animal restraint ¥				
Always	1.0	-	1.0	-
Frequently	1.91	1.20 to 3.04	1.59	0.92 to 2.75
Sometimes	2.06	1.22 to 3.50	1.55	0.81 to 2.98
Infrequently to Never	1.06	0.50 to 2.27	0.52	0.19 to 1.38
Did not apply	0.00	0.00 to >999.99	0.00	0.00 to >999.99

Just as likely to use proper restraint in presence of owner as if owners not present ††

Yes	1.0	-	1.0	-
No	1.27	0.77 to 2.10	1.27	0.71 to 2.28
Did not apply	0.53	0.30 to 0.95	0.78	0.26 to 2.32

*95% CI excludes 1.

† Multivariate model includes: age.

‡ Multivariate model includes: type of facility, average hours worked per day, years worked in veterinary facility, and age.

‡‡ Multivariate model includes: type of facility, age, and average hours worked per day.

(a) Other includes: Government/Regulatory, Commercial/Industrial, Zoological, and Other facilities (not specified).

§ Multivariate model includes: type of facility and age.

§§ Multivariate model includes: type of facility.

¶ Multivariate model includes: age and years worked in veterinary facility.

£ Multivariate model includes: age, years worked in veterinary facility, years since most recent restraint training, history of prior bite injury, adequate staff available for proper restraint, adequate employer support to restrain properly, type of facility, number of animal types handled on a typical day, and sufficient time allowed for proper restraint.

€ Multivariate model includes: type of facility, number of animals handled on a typical day, age, average hours worked per day, years worked in a veterinary facility, and employer support to restrain properly.

€€ Multivariate model includes: type of facility, number of animals handled on a typical day, and employer support to restrain properly.

Δ Multivariate model includes: type of facility, animal owner present, felt confident when applying restraint, sufficient time allowed for proper restraint, and adequate staff available for proper restraint.

¥ Multivariate model includes: number of animals handled on a typical day, type of facility, adequate staff available for proper restraint, adequate employer support to restrain properly, years worked in a veterinary facility, and age.

†† Multivariate model includes: age, type of facility, number of animals handled on a typical day, years worked in a veterinary facility, years since most recent restraint training, adequate employer support to restrain properly, animal owner present, average hours worked per day, history of prior bite injury, adequate staff available for proper restraint, number of animal types handled on a typical day, adequate equipment available for restraint, felt confident when applying restraint, sufficient time allowed for proper restraint.

¶¶ Multivariate model includes: type of facility, years worked in veterinary facility, and history of prior bite injury.

Table 4: Multivariate analysis of environmental exposures: Minnesota Certified Veterinary Technicians Working in Small or Mostly Small Animal Clinics

Exposures/Perceptions/Characteristics	Univariate		Multivariate	
	OR	95% CI	OR	95% CI
Gender				
Female	1.0	-	-	-
Male	2.09	0.46 to 9.51	-	-
Age				
35 or older	1.0	-	-	-
25 to < 35	1.59	0.97 to 2.60	-	-
< 25	3.82	1.84 to 7.94	-	-
Years worked in a veterinary facility †				
10 or greater	1.0	-	1.0	-
5 to <10	1.84	1.01 to 3.34	1.90	0.98 to 3.72
< 5	3.01	1.70 to 5.30	3.24	1.63 to 6.45
Average Hours worked per day †				
8	1.0	-	1.0	-
< 8	0.58	0.30 to 1.08	0.62	0.32 to 1.20
> 8	0.78	0.47 to 1.28	0.79	0.48 to 1.31
Prior bite injury ¶				
Yes	1.0	-	1.0	-
No	0.59	0.31 to 1.12	0.52	0.27 to 1.01
Years since most recent restraint training ¶				
< 5	1.0	-	1.0	-
5 to <10	1.23	0.73 to 2.07	1.20	0.71 to 2.04
10 or more	0.45	0.23 to 0.88	0.66	0.31 to 1.39
Missing	0.96	0.41 to 2.27	1.33	0.52 to 3.44
Adequate staff help available for restraint €				
Always	1.0	-	1.0	-
Frequently	2.05	1.25 to 3.37	2.02	1.13 to 3.60
Sometimes	1.16	0.57 to 2.37	1.11	0.48 to 2.61

Infrequently to never	4.51	1.07 to 18.98	4.70	0.94 to 23.50
Does not apply	0.00	0.00 to >999.99	0.00	0.00 to >999.99
Number of animals handled on a typical day ‡				
20 and over	1.0	-	1.0	-
15 to < 20	1.03	0.60 to 1.77	0.93	0.52 to 1.64
10 to < 15	1.29	0.71 to 2.34	1.28	0.69 to 2.38
< 10	0.20	0.67 to 0.58	0.23	0.08 to 0.71
Number of animal types handled §				
< 3 types	1.0	-	1.0	-
3 types	1.56	0.87 to 2.80	1.44	0.79 to 2.63
4 types	1.17	0.55 to 2.49	1.18	0.55 to 2.56
5 types	1.89	0.75 to 4.78	2.34	0.90 to 6.07
6 or more types	2.01	0.95 to 4.24	1.83	0.85 to 3.93
Animal owners present during exams and procedures				
Always to Frequently	1.0	-	-	-
Sometimes	0.87	0.53 to 1.41	-	-
Infrequently to never	1.28	0.45 to 3.65	-	-
Did not apply	0.00	0.00 to >999.99	-	-
Animal owners allowed to restrain their pets Δ				
Yes	1.0	-	1.0	-
No	0.69	0.43 to 1.10	0.76	0.46 to 1.26
Did not apply	0.45	0.05 to 4.38	2.10	0.12 to 35.45
Adequate equipment available for restraint €€				
Yes	1.0	-	1.0	-
No	0.76	0.25 to 2.28	0.60	0.19 to 1.88
Adequate support from employer to use proper animal restraint ¶¶¶				
Always	1.0	-	1.0	-
Frequently	1.28	0.80 to 2.06	1.18	0.73 to 1.92
Sometimes	0.94	0.42 to 2.08	0.87	0.38 to 1.95
Infrequently to Never	2.13	0.55 to 8.22	1.68	0.42 to 6.64

Did not apply	0.00	0.00 to >999.99	0.00	0.00 to >999.99
Felt confident when applying restraint techniques £				
Strongly agree	1.0	-	1.0	-
Agree	1.30	0.94 to 2.03	1.20	0.71 to 2.01
Disagree	>999.9	0.00 to >999.99	>999.9	0.00 to >999.99
Sufficient time allowed to perform adequate animal restraint ¥				
Always	1.0	-	1.0	-
Frequently	1.67	0.95 to 2.95	1.17	0.62 to 2.20
Sometimes	1.75	0.94 to 3.27	1.19	0.57 to 2.48
Infrequently to Never	1.00	0.40 to 2.48	0.45	0.14 to 1.47
Did not apply	0.00	0.00 to >999.99	0.00	0.00 to >999.99
Just as likely to use proper restraint in presence of owner as if owners not present ††				
Yes	1.0	-	1.0	-
No	1.44	0.84 to 2.49	1.35	0.69 to 2.61
Did not apply	0.33	0.04 to 2.83	0.33	0.02 to 5.11

† Multivariate model includes: age.

‡ Multivariate model includes: average hours worked per day, years worked in veterinary facility, and age.

§ Multivariate model includes: age and average hours worked per day.

¶ Multivariate model includes: age and years worked in veterinary facility.

£ Multivariate model includes: age, years worked in veterinary facility, years since most recent restraint training, history of prior bite injury, adequate staff available for animal restraint, adequate employer support to restrain properly, sufficient time allowed for proper restraint, and number of animal types handled on a typical day

€ Multivariate model includes: number of animals handled on a typical day, age, average hours worked per day, years worked in a veterinary facility, and employer support to restrain properly.

Δ Multivariate model includes: animal owner present, adequate staff available for proper restraint, felt confident when applying restraint, and sufficient time allowed for proper restraint.

- ‡ Multivariate model includes: number of animals handled on a typical day, adequate staff available for animal restraint, adequate employer support to restrain properly, years worked in a veterinary facility, and age.
- †† Multivariate model includes: age, number of animals handled on a typical day, years worked in a veterinary facility, years since most recent restraint training, adequate employer support to restrain properly, animal owner present, average hours worked per day, history of prior bite injury, adequate staff available for animal restraint, number of animal types handled on a typical day, adequate equipment available for restraint, felt confident when applying restraint, sufficient time allowed for proper restraint.
- €€ Multivariate model includes: number of animals handled on a typical day and employer support to restrain properly.
- ¶¶ Multivariate model includes: years worked in veterinary facility and history of prior bite injury.

Table 5: Unmeasured Confounder Sensitivity Analysis - Adequate Staff Help Frequently Available for Animal Restraint – All Facility Types

			OR_{DZ}		
			2	3	4
P_{Z1}	P_{Z0}	OR_{XZ}	OR_{DX}	OR_{DX}	OR_{DX}
0.9	0.2	36.00	1.26	1.00	0.86
0.8	0.2	16.00	1.33	1.08	0.94
0.9	0.3	21.00	1.37	1.14	1.03
0.9	0.1	81.00	1.16	0.86	0.70
0.8	0.1	36.00	1.22	0.92	0.76
0.8	0.3	9.33	1.44	1.23	1.12
0.7	0.3	5.44	1.53	1.33	1.23
0.5	0.7	0.43	2.27	2.40	2.48
P _{Z1} =P _{Z0}		1.00	2.00	2.00	2.00
The unmeasured confounder example of working in a more densely populated clinic location has an assumed prevalence of 60% among the CVT study population.					
P _{Z1} : prevalence of the unmeasured confounder among CVTs with perception of 'frequently' having adequate staff available for restraint					
P _{Z0} : prevalence of the unmeasured confounder among CVTs with perception of 'always' having adequate staff available for restraint					
OR _{XZ} : odds ratio for the association between exposure level (frequently having adequate staff) and the unmeasured confounder					
OR _{DZ} : odds ratio for the association between the unmeasured confounder and animal bite; assumed risk factor (i.e., OR _{DZ} >1)					
OR _{DX} : odds ratio for the perception of 'frequently' having adequate staff adjusted for the unmeasured confounder					

Table 6: Unmeasured Confounder Sensitivity Analysis - Adequate Staff Help Infrequently or Never Available for Animal Restraint – All Facility Types

			OR_{DZ}		
			5	6	7
P_{Z1}	P_{Z0}	OR_{XZ}	OR_{DX}	OR_{DX}	OR_{DX}
0.9	0.1	81.00	1.13	1.01	0.93
0.9	0.2	26.00	1.45	1.35	1.27
0.9	0.3	21.00	1.77	1.68	1.62
0.8	0.1	36.00	1.23	1.11	1.02
0.8	0.2	16.00	1.59	1.48	1.40
0.8	0.3	9.33	1.94	1.85	1.79
0.7	0.3	5.44	2.14	2.06	1.99
0.5	0.7	0.43	4.69	4.76	4.81
0.7	0.2	9.33	1.75	1.64	1.57
P_{Z1}=P_{Z0}		1.00	3.74	3.74	3.74
The unmeasured confounder example of working in a more densely populated clinic location has an assumed prevalence of 60% among the CVT study population.					
P _{Z1} : prevalence of the unmeasured confounder among CVTs with perception of 'infrequently to never' having adequate staff available for restraint					
P _{Z0} : prevalence of the unmeasured confounder among CVTs with perception of 'always' having adequate staff available for restraint					
OR _{XZ} : odds ratio for the association between exposure level (infrequently to never having adequate staff) and the unmeasured confounder					
OR _{DZ} : odds ratio for the association between the unmeasured confounder and animal bite; assumed risk factor (i.e., OR _{DZ} >1)					
OR _{DX} : odds ratio for the perception of 'infrequently to never' having adequate staff adjusted for the unmeasured confounder					

Table 7: Unmeasured Confounder Sensitivity Analysis - Adequate Staff Help Frequently Available for Animal Restraint – Small and Mostly Small Animal Clinics

			OR_{DZ}		
			2	3	4
P_{Z1}	P_{Z0}	OR_{XZ}	OR_{DX}	OR_{DX}	OR_{DX}
0.9	0.2	36.00	1.28	1.01	0.87
0.8	0.2	16.00	1.35	1.09	0.95
0.9	0.3	21.00	1.38	1.15	1.04
0.9	0.1	81.00	1.17	0.87	0.71
0.8	0.1	36.00	1.23	0.93	0.77
0.8	0.3	9.33	1.46	1.24	1.13
0.7	0.3	5.44	1.54	1.35	1.24
0.5	0.7	0.43	2.29	2.42	2.50
P_{Z1}=P_{Z0}		1.00	2.02	2.02	2.02
The unmeasured confounder example of working in a more densely populated clinic location has an assumed prevalence of 60% among the CVT study population.					
P _{Z1} : prevalence of the unmeasured confounder among CVTs with perception of 'frequently' having adequate staff available for restraint					
P _{Z0} : prevalence of the unmeasured confounder among CVTs with perception of 'always' having adequate staff available for restraint					
OR _{XZ} : odds ratio for the association between exposure level (frequently having adequate staff) and the unmeasured confounder					
OR _{DZ} : odds ratio for the association between the unmeasured confounder and animal bite; assumed risk factor (i.e., OR _{DZ} >1)					
OR _{DX} : odds ratio for the perception of 'frequently' having adequate staff adjusted for the unmeasured confounder					

APPENDIX C
HUMAN SUBJECTS APPROVAL

SECRET

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APPENDIX D
COMPREHENSIVE (PHASE 1) STUDY MATERIALS

2019-2020 WASH STATE UNIVERSITY STUDENT SURVEY

Thank you for your participation in this survey. Please mark all of the questions with an "X" in the appropriate response column.

For questions on frequency, please check the appropriate response for either "often" or "not often."

Warning: This survey is part of a research project. The questions are for the purpose of the study. The data you provide will be used to help improve the quality of the program. Your responses are confidential and will not be shared with anyone else.

YES NO NEVER SOMETIMES OFTEN NEVER SOMETIMES OFTEN

1. Are you the parent of a child who is currently attending school?

YES NO



2. What is today's date? _____ / _____ / _____
month / day / year

3. Did you visit within the last 12 months? (If YES, please indicate the year you visited in the space provided.)

YES NO

Thank you for taking the time to respond. Please stop here and return the questionnaire in the enclosed envelope.

4. Check off each month for the 12 months prior to today's date in which you visited the site.

7	<input type="checkbox"/> September 2018	8	<input type="checkbox"/> April 2019	9	<input type="checkbox"/> November 2019	10	<input type="checkbox"/> June 2020
8	<input type="checkbox"/> August 2018	9	<input type="checkbox"/> March 2019	11	<input type="checkbox"/> October 2019	11	<input type="checkbox"/> May 2020
9	<input type="checkbox"/> July 2018	10	<input type="checkbox"/> February 2019	12	<input type="checkbox"/> September 2019	12	<input type="checkbox"/> April 2020
10	<input type="checkbox"/> June 2018	11	<input type="checkbox"/> January 2019	13	<input type="checkbox"/> August 2019	13	<input type="checkbox"/> March 2020
11	<input type="checkbox"/> May 2018	12	<input type="checkbox"/> December 2018	14	<input type="checkbox"/> July 2019	14	<input type="checkbox"/> February 2020

5. In the 12 months prior to today's date, how often did you visit the program? (If applicable, please indicate the year you visited.)

Once Twice Three Four Five Six Seven Eight Nine Ten Eleven Twelve

6. How often did you visit the program in the 12 months prior to today's date? (If applicable, please indicate the year you visited.)

_____ times per day
and _____ times per week.

7. How does the presence of a catalyst affect the rate of a reaction? Explain your answer using the transition state theory of reaction rates. (20 marks)

.....

8. Write the rate law for the reaction: $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$

.....

9. What is the order of the reaction with respect to O_2 ?

.....

.....

10. What is the overall order of the reaction? (20 marks)

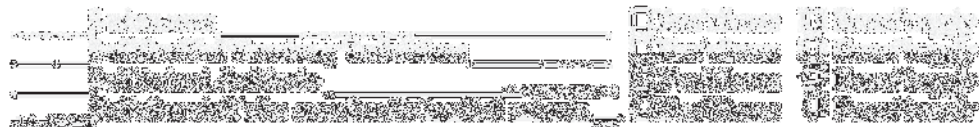
.....

11. What is the rate of reaction with respect to O_2 at the end of 10 minutes? (20 marks)

- 11.1 O_2 is consumed at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.2 NO is consumed at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.3 NO_2 is produced at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.4 O_2 is consumed at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.5 NO is consumed at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.6 NO_2 is produced at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$

- 11.7 O_2 is consumed at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.8 NO is consumed at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.9 NO_2 is produced at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.10 O_2 is consumed at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.11 NO is consumed at a rate of $1.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$
- 11.12 NO_2 is produced at a rate of $2.0 \times 10^{-2} \text{ mol l}^{-1} \text{ s}^{-1}$

12. What is the rate of reaction with respect to O_2 at the end of 10 minutes? (20 marks)



13. What is the rate of reaction with respect to O_2 at the end of 10 minutes? (20 marks)

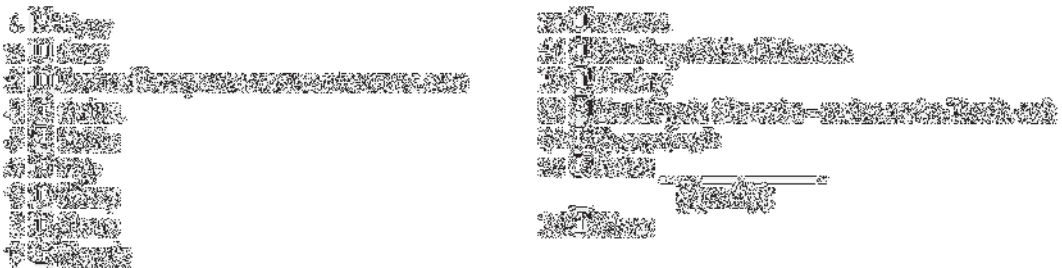


Figure 1

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Page 170

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Section 1: [Redacted]

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Section 2: [Redacted]

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Section 3: [Redacted]

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Section 4: [Redacted]

21. What are the major types of...?

	1964	1965	1966	1967
1. ...	100	100	100	100
2. ...	100	100	100	100
3. ...	100	100	100	100
4. ...	100	100	100	100
5. ...	100	100	100	100
6. ...	100	100	100	100
7. ...	100	100	100	100
8. ...	100	100	100	100
9. ...	100	100	100	100
10. ...	100	100	100	100
11. ...	100	100	100	100
12. ...	100	100	100	100
13. ...	100	100	100	100
14. ...	100	100	100	100
15. ...	100	100	100	100
16. ...	100	100	100	100
17. ...	100	100	100	100
18. ...	100	100	100	100
19. ...	100	100	100	100
20. ...	100	100	100	100

22. What are the major types of...?

	1964	1965	1966	1967
1. ...	100	100	100	100
2. ...	100	100	100	100
3. ...	100	100	100	100
4. ...	100	100	100	100
5. ...	100	100	100	100
6. ...	100	100	100	100
7. ...	100	100	100	100
8. ...	100	100	100	100
9. ...	100	100	100	100
10. ...	100	100	100	100
11. ...	100	100	100	100
12. ...	100	100	100	100
13. ...	100	100	100	100
14. ...	100	100	100	100
15. ...	100	100	100	100
16. ...	100	100	100	100
17. ...	100	100	100	100
18. ...	100	100	100	100
19. ...	100	100	100	100
20. ...	100	100	100	100

Copyright

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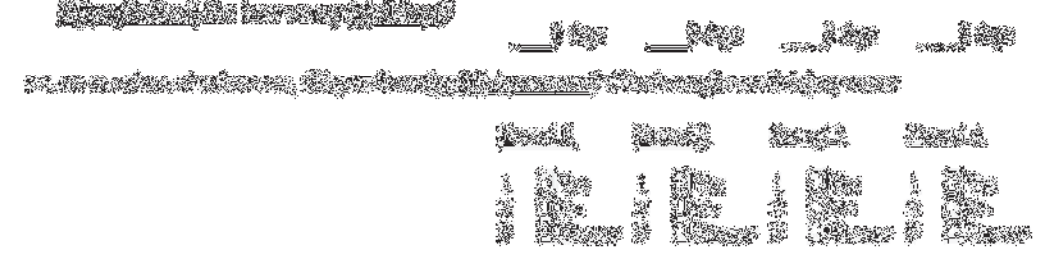
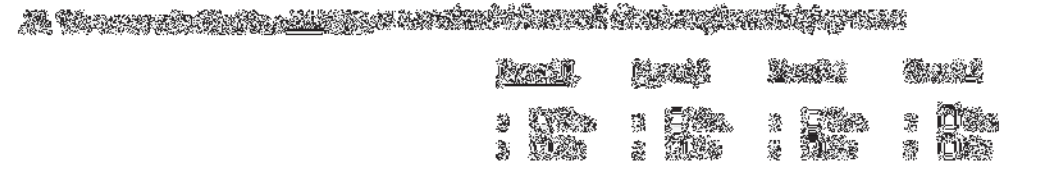
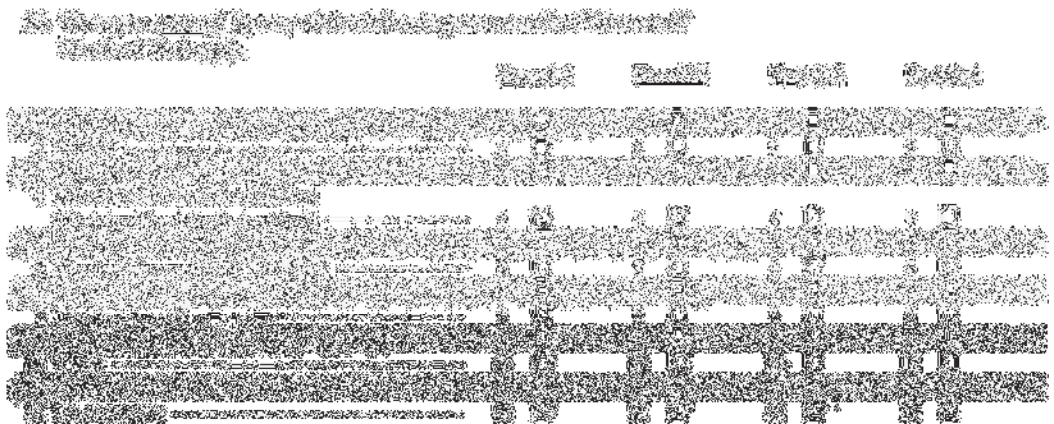
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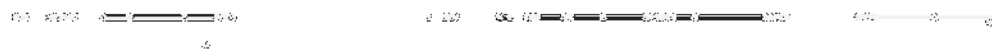
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10. Which part of the distribution is most important to you? Why?

Level 1 _____
Level 2 _____
Level 3 _____
Level 4 _____

11. Do you have any other comments regarding the distribution?

	Level 1	Level 2	Level 3	Level 4
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0

12. How do you rate the overall quality of the distribution?

Excellent _____
Good _____
Fair _____
Poor _____

13. How do you rate the overall quality of the distribution? (Please check all that apply)

	Level 1	Level 2	Level 3	Level 4
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0

14. How do you rate the overall quality of the distribution? (Please check all that apply)

Excellent _____
Good _____
Fair _____
Poor _____

15. How do you rate the overall quality of the distribution? (Please check all that apply)

Excellent _____
Good _____
Fair _____
Poor _____

16. How do you rate the overall quality of the distribution? (Please check all that apply)

Excellent _____
Good _____
Fair _____
Poor _____

17. How do you rate the overall quality of the distribution? (Please check all that apply)

Excellent _____
Good _____
Fair _____
Poor _____

PHASE I SURVEY – SHORT FORM

Introduction

The purpose of this survey is to gather information about the current state of the organization and to identify areas for improvement. Your input is valuable and will help us make informed decisions about the future of the organization.

Background

The organization has been operating for several years and has achieved significant milestones. However, there are several challenges that we are currently facing, and we need your help to address them. We are particularly interested in your views on the following issues:

- 1. **Communication:** How well do you think we are communicating our vision and goals to all employees?
- 2. **Collaboration:** How well do you think we are working together as a team to achieve our objectives?
- 3. **Performance:** How well do you think we are performing in our current market?
- 4. **Customer Satisfaction:** How well do you think we are meeting the needs and expectations of our customers?

Survey Questions

Please rate the following statements on a scale of 1 to 5, where 1 is "Strongly Disagree" and 5 is "Strongly Agree".

1. I am proud to work for this organization.

2. I have a clear understanding of the organization's vision and goals.

3. I feel that my voice is heard in the organization.

4. I am motivated to do my best work for the organization.

5. I believe that the organization is well-positioned for the future.

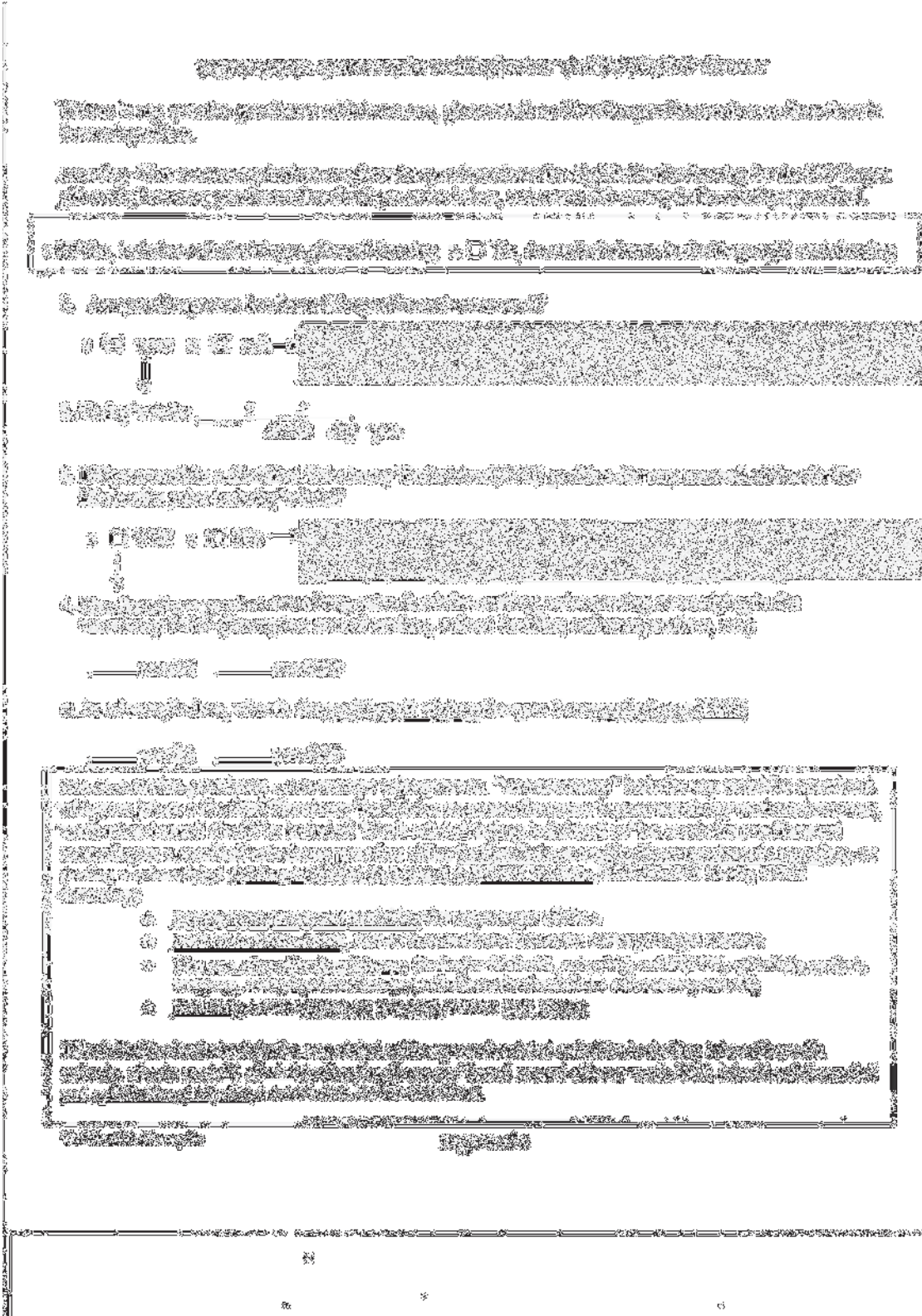
6. I am satisfied with the quality of our products/services.

7. I believe that our customers are satisfied with our products/services.

8. I believe that our employees are satisfied with their work.

9. I believe that our organization is a good place to work.

10. I believe that our organization is a good place to do business.



APPENDIX E
CASE-CONTROL (PHASE II) STUDY MATERIALS

PHASE II CASE-CONTROL - LONG FORM

PHASE II CASE-CONTROL - LONG FORM

1. Case Identification

2. Control Identification

3. Exposure Assessment

4. Outcome Assessment

5. Data Management

6. Statistical Analysis

7. Results

8. Conclusions

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1. Identify the main idea of the passage.

2. Identify the supporting details.

3. Identify the author's purpose.

4. Identify the author's tone.

5. Identify the author's bias.

6. Identify the author's main argument.

7. Identify the author's main conclusion.

8. Identify the author's main point.

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PHASE 2 CASE-CONTROL – SHORT FORM

Introduction

The purpose of this study is to determine the relationship between the exposure to the agent and the occurrence of the disease. The study is a case-control study and is designed to evaluate the risk factors for the disease.

Objectives

The objectives of this study are to determine the prevalence of the disease among the exposed and non-exposed groups, to identify the risk factors for the disease, and to estimate the relative risk of the disease among the exposed and non-exposed groups.

Methods

The study was conducted using a case-control design. Cases were identified through a review of medical records and interviews with family members. Controls were identified through a review of medical records and interviews with family members. The study was conducted in a hospital setting.

Results

The results of the study show that the prevalence of the disease is significantly higher among the exposed group compared to the non-exposed group. The relative risk of the disease among the exposed group is significantly higher than among the non-exposed group.

Conclusion

The results of this study suggest that exposure to the agent is a significant risk factor for the disease. Further research is needed to confirm these findings and to identify the specific mechanisms of action.

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1. The first part of the document is a list of names and addresses of the members of the committee.

Mr. J. H. ...
Mr. ...
Mr. ...

2. The second part of the document is a list of names and addresses of the members of the committee.

Mr. ...
Mr. ...

3. The third part of the document is a list of names and addresses of the members of the committee.

Mr. ...
Mr. ...

4. The fourth part of the document is a list of names and addresses of the members of the committee.

Mr. ... Mr. ... Mr. ...

Mr. ...

5. The fifth part of the document is a list of names and addresses of the members of the committee.

6. The sixth part of the document is a list of names and addresses of the members of the committee.

Mr. ... Mr. ... Mr. ...

Mr. ...

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