An Instrument to Assess Occupational Health Hazards of Veterinary Health Workers

By

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ABSTRACT

There are many hazards faced by veterinary health care workers. In this paper, the worker population was identified and defined, the economic and legislative context impacting this workforce was explored, and a literature review was conducted to outline the current state of occupational health and safety practices in organizations employing veterinary health workers. The literature review considered the five categories of occupational hazards (biological, chemical, enviromechanical, physical, and psychosocial), and identified the many occupational environments including work practices, work tasks, and common materials.

The purpose of this research was to explore the occupational hazards in the veterinary workplace and develop a survey tool to further expand knowledge related to these hazards, as well as identify the characteristics and attitudes of this worker population regarding work-related hazards.

Key words: Veterinary worker, Occupational Hazards, Occupational Health Survey
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I would also like to thank my wife, Jennifer Malak, who maintained our home and family while I focused on the program; and my daughter-Adara Hart and my son-Jacob Malak who both helped me keep everything in perspective.

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CHAPTER I
INTRODUCTION

For several years the practice of veterinary health has consistently been one of the most hazardous occupational categories in the United States (U.S.). The U.S. Bureau of Labor Statistics (U.S. BLS) ranks the veterinary services field as the fifth most hazardous industry in the nation having an incidence rate of 11.0 injuries and illnesses per 100 worker-years (U.S. BLS, 2014). This incidence rate is only marginally less hazardous than the more widely recognized hazardous occupations of police protection (11.5 injuries and illnesses per 100 worker-years) and fire protection (11.2 injuries and illnesses per 100 worker-years) (U.S. BLS, 2014). Over the course of their careers, most veterinary health workers will be scratched, bitten, kicked, stuck with a needle, or suffer some type of musculoskeletal injury. While these injuries can be personally devastating, they can also be economically costly to the veterinary practice. It is estimated that the total annual cost of workers compensation claims for veterinary injuries and illnesses alone exceeds $24 million dollars (Zimlich, 2010).

Veterinary health workers (veterinarians, veterinary technologists, and veterinary assistants) are exposed to a wide variety of occupational health threats including biological, chemical, physical, enviromechanical, and psychosocial hazards. Biological hazards are the most common and diverse hazards that this occupational group faces. In a recent survey of Oregon veterinarians, 47.2% indicated they had become ill from a workplace biological exposure (Jackson & Villarroel, 2012). Despite the known hazards of rabies and 20.8% of the study population having a known rabies exposure at least once in their career, it is surprising to many that only 86.1% of the worker population have completed the rabies vaccination series (Jackson
While many veterinary health workers may not immediately correlate a workplace exposure to subsequent symptoms, survey respondents identified 18 other biological hazards other than rabies such as ringworm, cat scratch fever, giardiasis, cryptosporidiosis, sarcoptic mange, and salmonellosis which they experienced during their careers.

The veterinary health workforce is also exposed to a variety of chemical risks including anesthetic gases, hazardous medications, and cleaning and disinfecting agents. Halogenated anesthetic gases are associated with an increased risk of spontaneous abortion, congenital abnormalities, and increased incidence of hepatic disease (U.S. Occupational Safety and Health Administration [U.S. OSHA], 2000). Hazardous medications, particularly antineoplastic drugs such as cisplatin are known to produce carcinogenic, mutagenic, and/or teratogenic effects in humans (Pfizer Inc., 2015). Cleaning and disinfecting agents such as formaldehyde, ethylene oxide, and peracetic acid have all been shown to be human health hazards capable of producing carcinogenic effects (Merck, 2014).

There are also a number of enviromechanical risks abundant in the veterinary workplace including animal bites and scratches, sharps and needlestick exposures, and musculoskeletal hazards that frequently produce injury and illness. An analysis of workers’ compensation claims, submitted to veterinary insurance broker Hub International, of reports by veterinary health workers conducted between 2002 and 2004 documented that over 90% of all claims were attributable to animal bites (Zimlich, 2010). Another study showed that the risk of secondary infection from animal bites was 81% for cat bites and 63% for dog bites (Landercasper, Cogbill, Strutt, & Landercasper, 1988). Sharps and needlestick injuries are also common with reported rates of lifetime injury prevalence as high as 71% (van Soest & Fritschi, 2004). In addition to the physical trauma produced by a needlestick injury, there are additional risks posed by accidental
injection of a biological or chemical agent. Work-related musculoskeletal injuries are another source of enviromechanical risk for this population. Ordinary movements such as reaching, lifting, gripping, or twisting can become hazardous when performed over an extended period or performed in a forceful or awkward way. Certain job tasks for veterinary workers such as testing for lameness in horses, or performing ultrasound diagnostics are associated with an increased risk of distal upper extremity disorders (Rogers, Kaber, & Taylor, 2013).

These workers also experience a number of physical risks including ionizing radiation used in radiography, exposure to heat and cold stress, and considerable noise exposure. Ionizing radiation is frequently used for diagnostic purposes in veterinary practice and subsequently exposes workers to this hazard. Studies have documented an increased risk of leukemia as well as hazards to the fetus which are dependent on the type of radiation exposure, individual age, and dose (Moritz, Hueston, & Wilkins, 1989). Veterinary health workers working outside in extreme conditions are potentially exposed to heat and cold stress (Douphrate, Nonnenmann, & Hagevoort, 2015). These workers may also experience significant noise levels capable of producing hearing loss in various working areas including large kenneling ranges or in spaces containing loud equipment such as air compressors or dental gear (National Institute for Occupational Safety and Health [NIOSH], 2006).

Veterinary health workers face a large number of daily psychosocial risks which are capable of inducing substantial stress. In a study of Canadian veterinarians, 53% reported having moderate stress and 7% reported having severe stress (Epp & Waldner, 2012a). Some research shows that ethical decisions such as those involved in animal euthanasia are the most stressful in veterinary health (Kahler, 2015). Some of the other most commonly reported risks include
difficulties in managing workload, establishing an effective work-life balance, protection of physical safety, psychological support, recognition and reward.

**Purpose of Paper**

The purpose of this paper is to examine the incidence of occupational and non-occupational injuries and illnesses to the veterinary health worker; describe the laws, regulations, standards, and strategies currently used to prevent these injuries and illnesses; and develop a survey tool to further expand knowledge related to these hazards. In addition, the characteristics and attitudes of this worker population regarding work-related hazards will be identified and worker behavior and attitudes regarding their occupational health and safety practices will be uncovered.
CHAPTER II
LITERATURE REVIEW

Definition of Veterinary Health Workers

Veterinary health workers are in the category “Veterinary Services” North American Industry Classification System (NAICS) code 541940 and include veterinarians, veterinary technologists, veterinary technicians and veterinary assistants who are employed in veterinary offices, clinics, and hospitals (U.S. Census Bureau, n.d.). As outlined in Table 2.1, veterinarians diagnose and treat medical conditions of companion animals, livestock, and other animals. Per the most recent assessment provided by the Occupational Outlook, there were about 70,300 practicing veterinarians in the U.S. (U.S. BLS, 2015a). The majority of these veterinarians (74%) practice in the veterinary health industry (not in education, research, or governmental agencies) and a much smaller percentage (18%) are self-employed. Veterinarians are state licensed and are subject to routine licensing renewals. Veterinary technologists and technicians work under the direct supervision of a licensed veterinarian to assist in the treatment of animals. Their scope of practice typically includes observation, nursing care, anesthesia/medication administration, surgical assistance, sample collection, and performing laboratory test procedures. Additional tasks that the state-licensed veterinary technologists and technicians perform vary by state but may include activities such as radiographic contrast studies or dental procedures. In 2012 there were about 84,800 veterinary technologist and technician jobs in the U.S., with 92% of these positions in the veterinary health industry (U.S. BLS, 2015c). Veterinary assistants are unlicensed workers who care for the well-being of animals by performing routine tasks under the
<table>
<thead>
<tr>
<th>Occupation</th>
<th>Definition</th>
<th>Scope of Practice</th>
<th>Duties</th>
<th>License</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarian</td>
<td>A veterinary physician or veterinary surgeon who practices veterinary medicine by treating disease, disorder, and injury in non-human animals.</td>
<td>Diagnosis and treatment of medical conditions of companion animals, livestock, and other animals</td>
<td>Diagnose animal diseases and conditions; prescribe medications, treatments, and/or appliances; perform surgery</td>
<td>State-licensed</td>
<td>Undergraduate degree; graduate degree (Doctor of Veterinary Medicine); national board examination and clinical competency test; and state-licensing</td>
</tr>
<tr>
<td>Veterinary Technician</td>
<td>A person properly certified by a state veterinary examining board to work under the direct supervision of a licensed veterinarian.</td>
<td>Observation, nursing care, anesthesia/medication administration, surgical assistance, sample collection, and laboratory test procedures</td>
<td>Provide veterinary health services under the direct supervision of a veterinarian, provide nonsurgical veterinary treatment of animal diseases and conditions, observe related animal diseases, and administer medications, obstetrical treatment, nutritional evaluation, and counseling</td>
<td>State-licensed</td>
<td>Associate’s degree or baccalaureate degree program; credentialing exam; state-licensing</td>
</tr>
<tr>
<td>Occupation</td>
<td>Definition</td>
<td>Scope of Practice</td>
<td>Duties</td>
<td>License</td>
<td>Certification</td>
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</tr>
<tr>
<td>Veterinary Assistant</td>
<td>A person not holding a license, permit or certificate issued by a state veterinary board.</td>
<td>Restricted to functions as delegated by veterinarian not to exceed that of state statute</td>
<td>Feed, clean, and the exercise animals; clean and disinfect equipment and work areas; assist with restraining animals during procedures</td>
<td>Unlicensed</td>
<td>High school graduate with subsequent on the job training; may also become certified through a combined online training/externship program and exam</td>
</tr>
</tbody>
</table>
supervision of veterinarians and veterinary technicians. Their scope of practice includes the feeding, cleaning, and restraining of animals. In 2012 there were about 74,600 veterinary assistant (and laboratory animal caretaker) jobs in the U.S., with 82% of these positions in the veterinary health industry (U.S. BLS, 2015b). There are veterinary assistant certification programs which provide extensive education and practice components with a wide scope of practice (Animal Behavior College, 2016). There are also many additional allied veterinary professions, such as veterinary chiropractors, physiotherapists, groomers, and farriers. These allied veterinary positions provide related services and often collaborate with veterinary health workers but these groups will not be focus on in this paper. Occupational licensing and certification for veterinary health worker positions are governed by regulation and state veterinary medical boards (National Board of Veterinary Medical Examiners, 2015). Private business establishments employing veterinary health workers are tracked collectively under the NAICS code number 541940 for the purpose of gathering, studying, and circulating statistical data (U.S. Census Bureau, n.d.). The American Veterinary Medical Association (AVMA) has suggested guidelines for describing the type of veterinary facility but is superseded in areas where the state or local practice act specifically regulates the naming of a veterinary facility (AVMA, 2015b). The AVMA naming facility guidelines recommends the following descriptions:

- a veterinary hospital is “a facility in which the practice conducted typically includes in-patient as well as out-patient diagnostics and treatment” (AVMA, 2015b, para. 3)
- a veterinary clinic is “a facility in which the practice conducted may include in-patient as well as out-patient diagnosis and treatment” (AVMA, 2015b, para. 4)
a veterinary office is “a veterinary practice where a limited or consultative practice is conducted and which typically provides no facilities for housing or in-patient diagnostics or treatment” (AVMA, 2015b, para. 6)

**Current Health and Safety Practices in Facilities Employing Veterinary Health Workers**

The National Association of State Public Health Veterinarians (NASPHV) has published both the Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel (NASPHV, 2006) and the Model Infection Control Plan for Veterinary Practices, 2015 as guidance to veterinary infection control practices (NASPHV, 2015). The Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel describes the standard precautions necessary in veterinary practice to prevent transmission of zoonotic agents from animal patients to veterinary health workers. The Model Infection Control Plan for Veterinary Practices serves as a template which a veterinary practice can use to establish its site-specific infection control program. An effective infection control plan is necessary to prevent the transmission of communicable diseases in all veterinary health settings. Without a thorough plan in place, the risk of zoonotic disease transmission increases dramatically. Infection control planning requires a background in relevant biological agents, a basic understanding of disease epidemiology, sensitivity to risk factors that may increase animal or worker susceptibility to potential infection, and knowledge of the recurring practices and procedures which may result in infections.

The AVMA (Table 2.2) has published a set of 16 guidelines for the clinical operations of veterinary medicine. These guidelines fall into six broader program categories and include infection control (with subsections for environmental infection control, employee health,
TABLE 2.2

AMERICAN VETERINARY MEDICAL ASSOCIATION GUIDELINES FOR VETERINARY PRACTICE FACILITIES

<table>
<thead>
<tr>
<th>Procedural Category</th>
<th>AVMA Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection Control</td>
<td>1. Overall cleanliness and neatness of personnel and facilities. 2. Adequate protection against dissemination of disease. 7. Adequate restraint facilities that are humane in providing proper care to patients during all aspects of their visit. 8. Availability of proper refrigeration and sterilization equipment. 9. Facilities and equipment provided and properly maintained that are suitable for currently acceptable veterinary practice. 14. Provide laboratory services to assist with accurate diagnosis.</td>
</tr>
<tr>
<td>Infection Control / Waste Disposal Practices</td>
<td>3. Proper disposal of all waste material. 5. Adequate ventilation and freedom from noxious odors.</td>
</tr>
<tr>
<td>Radiation Protection Program</td>
<td>4. Access to adequate equipment for generation of quality diagnostic images. Provide proper procedures and equipment to protect staff members from radiation exposure.</td>
</tr>
<tr>
<td>Hearing Conservation Program</td>
<td>6. Freedom from noise pollution.</td>
</tr>
<tr>
<td>Infection Control, Employee Health</td>
<td>10. Adequate and complete patient, personnel and financial records.</td>
</tr>
<tr>
<td>Personnel and Staffing Policies</td>
<td>11. Adequate personnel to provide proper veterinary care.</td>
</tr>
<tr>
<td>Veterinary Prescription Drug Dispensing Policies</td>
<td>12. Appropriate facilities and records for the proper storage and dispensing of drugs and supplies in compliance with federal and state laws.</td>
</tr>
<tr>
<td>Procedural Category</td>
<td>AVMA Guideline</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Waste Anesthetic Gas Policies</td>
<td>13. Proper equipment for anesthesia management and monitoring of patients under anesthesia.</td>
</tr>
<tr>
<td>Infection Control, Environmental Infection Control</td>
<td>15. Provide surgery in an aseptic environment with appropriate pre- and post-operative considerations.</td>
</tr>
<tr>
<td>All Six Categories</td>
<td>16. Provide a safe and healthy environment for clients, patients and staff that are in compliance with governmental jurisdictional entities such as but not limited to FDA, USDA, OSHA and EPA.</td>
</tr>
</tbody>
</table>

Source: Adapted from AVMA (2015c)
bloodborne pathogens, pesticide use, and waste disposal), radiation protection, hearing conservation, personnel and staffing, waste anesthetic gas, and prescription medication dispensing. An effective infection control policy includes a discussion of zoonotic agent transmission, veterinary standard precautions including personal protective actions and equipment, use of humane restraint, adequate and calibrated refrigeration, and discussion of additional precautions needed during certain veterinary procedures. Within this section, the environmental infection control section includes policies for cleaning and disinfecting, disposal of medical waste, ventilation of noxious or harmful odors, and vector control.

In addition, the employee health subsection includes a discussion of recommended vaccinations, management and documentation of post-exposure events, and staff training and education. If it is determined that workers are exposed to inhalation hazards, the veterinary organization will institute a respiratory protection program. Occupational safety and health regulations require that employers implement and maintain a written management program to protect the safety of every employee who wears respiratory protection, whether the respirator use is voluntary or a condition of employment. This program generally has nine components including a purpose statement, policy and regulatory guidance, responsibility delineation, a listing of approved respirators, definitions of appropriate medical clearances and fit testing, applicability of respirator-use (routine versus emergency), maintenance procedures (and cartridge replacement schedules if applicable), training, and recordkeeping.

The veterinary organization may also want to develop an animal allergy program to mitigate the progression of allergies in their workers. This is generally a medical surveillance program which seeks to support the earliest possible detection of developing workplace allergies. An initial evaluation will be conducted and focuses on an individual’s medical history with a
special focus on preexisting allergies. Additional components of a comprehensive animal allergy program include staff training on animal allergies, prevention control methods, symptom recognition and reporting, alternative work methods which may reduce allergen exposure, and judicious use of personal protective equipment.

The radiation protection program typically includes training requirements, personnel and equipment requirements, worker and supervisory responsibilities, procedures for monitoring radiation exposures, and sets occupational dose equivalent limits in line with OSHA guidelines. The hearing conservation program typically includes provisions for employee training, noise monitoring, audiometric testing, hearing protection devices, and recordkeeping in line with OSHA regulation. Personnel and staffing policies include a mandate of hiring qualified individuals who are able to consistently provide proper veterinary care in a demanding environment. Staffing levels and appointment scheduling should be maintained in such a way as to allow for thoughtful and leisurely patient encounters while also giving workers an appropriate amount of breaks throughout the day and vacation time throughout the year.

The waste anesthetic gas policy should include thorough training (written procedures showing approved techniques and work practice), daily system checks and routine scheduled equipment maintenance, use of waste gas scavenging systems, and regular monitoring for gases. The veterinary prescription drug dispensing policies are designed to be compliant with the Food, Drug, and Cosmetic Act (Section 503 (f)) which regulates which medications the licensed veterinarian may prescribe. The policy must show that medications are only prescribed within the context of a veterinarian-client-patient relationship, properly labeled, dispensed only in quantities required for the current treatment of the animal, and that any abnormalities identified from this procedure should be reported to state or federal authorities. Procedures should also be
developed which ensure that documentation of clinical treatment and medication dispensing records are securely maintained for at least three years beyond the last date of treatment.

Related to medication dispensing policies, practice management should also specifically address documentation and security of controlled substances. Policy makers need to address “off-label” use of approved animal or human drugs in animals in compliance with the Animal Medicinal Drug Use Clarification Act of 1994 which allows veterinarians to use medications beyond the approved medication labeling and in circumstances when the health of an animal is threatened.

**Relevant Laws, Standards, and Regulations, Professional Society Positions**

Current health and safety practices in veterinary facilities are governed by a variety of sources including federal and state agencies (Table 2.3). These regulations are often shaped by non-governmental groups with significant expertise in the area such as the AVMA, National Council on Radiation Protection & Measurements (NCRP), and the NASPHV.

The majority of federal oversight for occupational health and safety programs within the veterinary practice comes from the OSHA in the form of specific guidance and applies to all U.S. enterprises regardless of type. For example, noise exposures are governed by OSHA through regulation 29 CFR 1910.95 (U.S. OSHA, n.d.c). Certain pesticide agents are regulated by the Environmental Protection Agency (U.S. Environmental Protection Agency [EPA], 2014). Veterinary practices may also have some influences from the U.S. Department of Agriculture through the Animal Welfare Act (U.S. Department of Agriculture, 2013). Veterinary medications and animal feeds are regulated by the U.S. Food and Drug Administration under Section 503 of the Food, Drug, and Cosmetic Act (U.S. Food and Drug Administration [FDA], 2015).
### TABLE 2.3

**OCCUPATIONAL HEALTH AND SAFETY OF VETERINARY HEALTH WORKERS**

**REGULATORY AND PROFESSIONAL ORGANIZATION’S IMPACT**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Relevance</th>
<th>Scope of Law/Guideline</th>
<th>Type of Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Veterinary Medical Association (AVMA)</td>
<td>Practice Guidelines</td>
<td>Establishes and publishes best practice policies related to veterinary operations</td>
<td>National professional organization</td>
</tr>
<tr>
<td></td>
<td>Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel</td>
<td>Outlines good practice guidelines for infection control practices in veterinary health including recommended PPE while performing certain procedures</td>
<td>National professional organization</td>
</tr>
<tr>
<td>Department of Agriculture (USDA)</td>
<td>Veterinary Practice</td>
<td>Establishes and manages the National Veterinary Accreditation Program (NVAP) which qualifies veterinarians to certify animals to cross state lines and perform certain animal testing</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td></td>
<td>Animal Vaccines</td>
<td>Regulates the use of vaccines for animals</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td>Environmental Protection Agency (EPA)</td>
<td>Pesticides</td>
<td>Governs use of certain pesticides (such as carbamates or organophosphates)</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td>Food and Drug Administration (FDA)</td>
<td>Veterinary Medications and Feeds</td>
<td>Controls the food, food additives, and drugs which may be given to animals</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td>Occupational Safety &amp; Health Administration (OSHA)</td>
<td>Noise Exposure</td>
<td>Mandates institution of hearing conservation programs if certain noise volume thresholds are met</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td>Agency</td>
<td>Relevance</td>
<td>Scope of Law/Guideline</td>
<td>Type of Agency</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<td>---------------------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Occupational Safety &amp; Health Administration (OSHA)</td>
<td>Respiratory Protection</td>
<td>Establishes health and safety standards to minimize occupational exposure to airborne hazards</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td></td>
<td>Formaldehyde</td>
<td>Establishes health and safety standards to minimize occupational exposure to formaldehyde</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td></td>
<td>Ionizing Radiation</td>
<td>Establishes health and safety standards to minimize occupational exposure to ionizing radiation</td>
<td>Federal governmental agency</td>
</tr>
<tr>
<td>State Veterinary Practice Boards</td>
<td>Occupational Licensing</td>
<td>Controls the licensing of veterinarians through the state Veterinary Practice Acts, state statutes, and administrative codes</td>
<td>State governmental agency</td>
</tr>
</tbody>
</table>
States regulate the industry through state-specific veterinary practice acts (AVMA, 2015a). When creating new legislation, state regulators will often receive subject matter assistance from organizations with expertise in the matter such as the American Association of Veterinary State Boards (AAVSB). There are a variety of resources for veterinary organizations to find best occupational health and safety practice guidelines. Veterinarians are licensed by state veterinary examining boards, subject to state statutes, and administrative codes. These regulations establish conditions under which veterinarians licenses can be granted, suspended, or permanently revoked. In addition the regulations establish definitions, professional boundaries, and mandate recordkeeping practices.

Veterinary technicians are also state-licensed under state-specific statutes, and administrative codes (American Association of Veterinary State Boards, 2016). These regulations describe the background necessary for licensure within the state. These laws define the state veterinary board, veterinary records laws, medication use (prescribing, dispensing, labeling, and administering) licensing, and disciplinary actions. Veterinary technicians must successfully complete both an Associate or Baccalaureate degree program and then the Veterinary Technician National Examination. The examination is administered by the American Association of Veterinary State Boards (AAVSB) and confirms that new veterinary technicians are sufficiently competent to be credentialed (American Association of Veterinary State Boards, 2016).

**Review of Significant Occupational Health Hazards**

A literature review of current research was conducted to determine the types and frequencies of occupationally-related hazards encountered by veterinary health workers. The 2013 incidence rate of occupational injury and illness for veterinary health workers (NAICS
code: 54194) is 5th highest among of any industry just behind police protection (3rd) and fire protection (4th) (U.S. BLS, 2014). There are five basic areas of hazards which were reviewed—biological hazards, chemical hazards, enviromechanical hazards, physical hazards, and psychosocial hazards (Rogers, 2003).

- Biological hazards are those infectious agents such as bacteria, viruses, and fungi capable of producing human infection.
- Chemical hazards refer to any form of chemical “including medications, solutions, gases, vapors, aerosols, and particulate matter that is potentially toxic or irritating to the body system” (Rogers, 2003, p. 148).
- Enviromechanical hazards are those workplace aspects capable of creating injury such as hazardous flooring or insufficient equipment.
- Physical hazards are those workplace agents capable of inducing tissue damage such as radiation or noise.
- Psychosocial hazards are those factors which may produce stress in the exposed worker.

Studies of biological hazards have documented that veterinary health workers have a variety of viral, bacterial, and fungal exposures (Table 2.4). In a study by Epp and Waldner (2012b), veterinarians reported having been diagnosed with infection by a variety of zoonotic agents including anthrax, bartonella, blastomycosis, canine brucellosis, campylobacteriosis, cryptosporidiosis, giardia, leptospirosis, methicillin-resistance staph aureus, Q-fever, rabies, ringworm, and west Nile virus. A 2012 survey of Oregon veterinarians documented that they were most concerned about rabies but reported infection with 18 other unique zoonotic agents (Jackson & Villarroel, 2012).
# TABLE 2.4

**BIOLOGICAL HAZARDS FOR VETERINARY HEALTH CARE WORKERS**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Agent</th>
<th>Animal</th>
<th>Transmission</th>
<th>Clinical Signs</th>
<th>Treatment</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brucellosis</td>
<td><em>Brucella</em> bacteria</td>
<td>Aquatic mammals, ruminants, and rodents</td>
<td>Direct contact, through skin wounds or inhalation</td>
<td>Fever, night sweats, malaise, anorexia, muscle and joint pain</td>
<td>Doxycycline and either streptomycin or rifampin</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Campylobacteriosis</td>
<td><em>Campylobacter</em></td>
<td>Multiple animal species</td>
<td>Fecal-oral</td>
<td>Nausea, abdominal cramps, and severe diarrhea</td>
<td>Antibiotic, based on susceptibility study</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Capnocytophaga canimorsus</td>
<td><em>Capnocytophaga canimorsus</em></td>
<td>Cats and dogs</td>
<td>Dog bite or cat scratch</td>
<td>Fever, purpuric rash, and altered mental status</td>
<td>Antibiotic therapy based on microbial susceptibility testing</td>
<td>Infection control procedures including the use of muzzles or restraints devices for problematic animals</td>
</tr>
<tr>
<td>Cat scratch fever</td>
<td><em>Bartonella henselae</em></td>
<td>Cats</td>
<td>Feline saliva through a break in human skin and bites or scratches</td>
<td>Marked regional lymphadenopathy</td>
<td>Azithromycin</td>
<td>Avoid cat scratches or bites</td>
</tr>
<tr>
<td>Cryptococcus neoformans</td>
<td><em>Cryptococcus neoformans</em></td>
<td>Birds</td>
<td>Inhalation of bird droppings</td>
<td>Pneumonia, acute respiratory failure</td>
<td>Fluconazole</td>
<td>Use of a fitted respirator when cleaning bird manure, disinfecting contaminated surfaces and disposing of waste</td>
</tr>
<tr>
<td>Cryptosporidiosis</td>
<td><em>Cryptosporidium</em></td>
<td>Multiple animal species</td>
<td>Fecal-oral</td>
<td>Nausea, abdominal cramps, and severe diarrhea</td>
<td>Antibiotic, the protozoan medications</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Disease</td>
<td>Agent</td>
<td>Animal</td>
<td>Transmission</td>
<td>Clinical Signs</td>
<td>Treatment</td>
<td>Prevention</td>
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<tr>
<td>Giardia lamblia</td>
<td><em>Giardia lamblia</em></td>
<td>Multiple animal species</td>
<td>Fecal-oral</td>
<td>Nausea, abdominal cramps, and severe diarrhea</td>
<td>Antibiotic, the protozoan medications</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Histoplasmosis</td>
<td><em>Histoplasma capsulatum</em></td>
<td>Cats, dogs, and birds</td>
<td>Direct contact and inhalation of fungal spores</td>
<td>Fever, cough, fatigue</td>
<td>Antifungal therapy</td>
<td>Use of a fitted respirator when cleaning bird manure, disinfecting contaminated surfaces and disposing of waste</td>
</tr>
<tr>
<td>Leptospirosis</td>
<td><em>Leptospira interrogans</em></td>
<td>rats, mice, dogs,</td>
<td>direct or indirect exposure to infected urine</td>
<td>Conjunctival suffusion</td>
<td>Doxycycline or penicillin</td>
<td>Effective cleanup of any animal in continent of urine</td>
</tr>
<tr>
<td>Listeriosis</td>
<td><em>Listeria monocytogenes</em></td>
<td>Multiple animal species</td>
<td>Fecal-oral</td>
<td>Nausea, abdominal cramps, and severe diarrhea</td>
<td>Ampicillin or penicillin G</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Pasteurellosis</td>
<td><em>Pasteurella</em> bacteria</td>
<td>Many domestic mammals</td>
<td>Dog or cat scratches or bites</td>
<td>Pain and swelling at the wound site weeping drainage, and lymphadenopathy</td>
<td>Organism specific susceptibility antibiotics</td>
<td>Avoidance of scratches and bites</td>
</tr>
<tr>
<td>Psittacosis</td>
<td><em>Chlamydia psittaci</em></td>
<td>Birds</td>
<td>Bird bite or inhalation of dried bird feces</td>
<td>Rapid onset of fever, headache, and dry cough</td>
<td>Tetracycline</td>
<td>Use of a fitted respirator when cleaning bird manure, disinfecting contaminated surfaces and disposing of waste</td>
</tr>
<tr>
<td>Q fever</td>
<td><em>Coxiella burnetii</em></td>
<td>Cattle, sheep, and goats</td>
<td>Direct contact or inhalation of animal tissues and wastes</td>
<td>Acute influenza-like illness, pneumonia, or hepatitis</td>
<td>Doxycycline</td>
<td>Fastidious disinfection and cleaning when sheep or goats are at the time of birthing</td>
</tr>
<tr>
<td>Disease</td>
<td>Agent</td>
<td>Animal</td>
<td>Transmission</td>
<td>Clinical Signs</td>
<td>Treatment</td>
<td>Prevention</td>
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<tr>
<td>Rabies</td>
<td><em>Rabies Virus</em></td>
<td>Most mammals but particularly dogs, bats, raccoons, foxes, skunks, cattle, wolves, coyotes, mongooses and cats</td>
<td>Saliva- biting, or through scratches from an infected animal.</td>
<td>General weakness, discomfort, fever, or headache</td>
<td>Vaccination and rabies immunoglobulin</td>
<td>Rabies vaccination series and antibody titer</td>
</tr>
<tr>
<td>Ringworm</td>
<td><em>Epidermophyton, Trichophyton, or microsporum</em></td>
<td>Many species</td>
<td>Direct contact with fungus</td>
<td>Itchy, red, raised, scaly patches on exposed skin</td>
<td>Topical antifungals</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Roundworms</td>
<td><em>Scaris lumbricoides</em></td>
<td>Domestic cats and dogs</td>
<td>Fecal-oral</td>
<td>Nausea, diarrhea, intestinal obstruction</td>
<td>Albendazole and Mebendazole</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td><em>Salmonella</em></td>
<td>Poultry, reptiles, amphibians, rodents, and cats</td>
<td>Fecal-oral</td>
<td>Nausea, fever, abdominal cramps, and severe diarrhea</td>
<td>Antibiotic, based on susceptibility study</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Sarcoptic mange</td>
<td><em>Sarcoptes scabiei</em></td>
<td>Multiple mammals species</td>
<td>Direct contact with scabies</td>
<td>Intensely itchy skin lesion in a specific pattern</td>
<td>5% permethrin topical ointment</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td><em>Toxoplasmosis gondii</em></td>
<td>Primarily cats</td>
<td>Fecal-oral</td>
<td>Bilateral lymph node enlargements headache, fever, chills, rash</td>
<td>Pyrimethamine and either sulfadiazine or clindamycin</td>
<td>Infection control procedures including hand hygiene</td>
</tr>
<tr>
<td>Disease</td>
<td>Agent</td>
<td>Animal</td>
<td>Transmission</td>
<td>Clinical Signs</td>
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<tr>
<td>Tuberculosis</td>
<td><em>Mycobacterium tuberculosis</em></td>
<td>Primates, elephants, dogs, and Guinea pigs</td>
<td>Inhalation of bacteria</td>
<td>Cough, weight loss, fatigue, fever, chest pain, and night sweats</td>
<td>Regimen including isoniazid, rifampin, pyrazinamide, and ethambutol</td>
<td>Use of the fitted respirator whenever exposed to suspect animals</td>
</tr>
<tr>
<td>Tularemia</td>
<td><em>Francisella tularensis</em></td>
<td>Sheep, cats, dogs, and rodents (including rabbits)</td>
<td>Inoculation by an infected animal or invertebrate vector or inhalation of bacteria during veterinary procedures</td>
<td>Abrupt onset of fever, chills, and headache</td>
<td>Streptomycin, gentamicin or ciprofloxacin</td>
<td>Infection control procedures including hand hygiene and personal protective equipment</td>
</tr>
</tbody>
</table>

Source: Created by Malak (2016)
Researchers documented a variety of chemical risks including exposure to waste anesthetic gases, hazardous medications, and cleaning and disinfecting agents. While considerable research has previously documented the hazards of waste anesthetic gas exposure in pregnant women, implementation of effective prevention measures does not appear to be widespread. In a study by Epp and Waldner (2012a), accidental exposure to anesthetic gas was reported by 69% of those veterinary health workers in private practice. Studies have demonstrated a range of very hazardous medications used in veterinary medicine including antineoplastic medications and antibiotics (NIOSH, 2004b). NIOSH published a study in 2007 documenting a severe injury and death related to the particularly dangerous antibiotic Micotil 300 (NIOSH, 2007a). Hazardous cleaning and disinfectant substances such as formaldehyde and ethylene oxide are commonly found in veterinary practice (Moore, Davis, & Kaczmarek, 1993).

Studies also showed a wide range of enviromechanical hazards including animal bites, sharps and needle-sticks injuries, eye exposures, and facility design errors which can contribute to injuries and musculoskeletal disorders. Animal bites are among the most common enviromechanical risk faced by veterinary workers. One study documented that nearly two-thirds of all surveyed veterinary health workers had been bitten at least once (Epp & Waldner, 2012a). Sharps and needlestick injuries occur at rates higher in veterinary medicine than human medicine as demonstrated in a 2008 study (Weese & Douglas, 2008). Multiple studies have been published on how ergonomic improvements in veterinary facilities can help prevent musculoskeletal disorders (Rogers, Gangakhedkar, & Kaber, 2011; Rogers et al., 2013).

Current research has also documented the physical hazards faced by veterinary health workers from ionizing radiation in radiography, heat and cold stress, and noise exposure. Workers are exposed to ionizing radiation on a daily basis given the hundreds of radiographic
exams performed annually in the typical veterinary practice. However, proper radiation control measures can limit exposures (Moritz et al., 1989). Some literature also showed the hazards of heat and cold stress to the veterinary health workers working outdoors (Douphrate et al., 2013). A NIOSH Health Hazard Evaluation (HHE) Report identified noise levels in a veterinary kenneling area which exceeded standards, and recommended that the facility be modified with sound-absorbing materials and institution of a hearing conservation program (NIOSH, 2006).

Studies of psychosocial risks also documented high levels of emotional stress, high levels of responsibility, and concerns regarding litigation and liability (Harling, Strehmel, Schablon, & Nienhuis, 2009; Moore et al., 1993; Smith, Leggat, Speare, & Townley-Jones, 2009). These psychosocial risks can create high levels of stress leading to binge drinking, drug use, or even suicide (DVM360 Staff, 2009, March 3).

In total, veterinary health workers are commonly cited as having one of the most hazardous occupations in the U.S.

**Areas of Assessment**

*Biological/Infectious Risks and Practices*

Veterinary health workers are exposed to a wide range of bacterial, viral, and fungal biological hazards which are generally transmitted by dermal contact, oral, skin break, or inhalation routes. One of the most devastating viral agents is rabies. An occupational exposure to rabies occurs when staff comes into direct contact with infected wild or domestic animals in the veterinary facility for treatment. Rabies is widely considered among the worst biological exposures due to the extremely poor prognosis. Each year approximately 59,000 people worldwide die from rabies and if an individual develops symptoms, survival is exceptionally rare with only 10 documented cases of survival from clinical rabies in human history (Centers for
Disease Control and Prevention [CDC], 2012). Symptoms of acute human rabies exposure may include itching or prickling sensation at the site of exposure, general weakness, discomfort, fever, or headache (Demaria, 2015). Exposure to rabies may be completely preventable by improved personal protective equipment (PPE) usage, and additional caution when working with a suspect animal (Rupprecht et al., 2010). Current best practice guidelines for prevention suggest completion of the rabies vaccination series with subsequent antibody titer confirmations every other year following vaccination (Rupprecht et al.). Workers may be hesitant to be vaccinated given the low rates of endemic rabies in local animal populations and employers may be more resistant to paying for vaccination given the cost of over $1000 for the rabies vaccination series (Walgreens, 2015, August 4).

One of the most common zoonotic agents reported by veterinary health workers is ringworm (Jackson & Villarroel, 2012). Ringworm (or dermatophyte infection) is a type of superficial fungal infection. According to Goldstein and Goldstein (2015a), the infection is most commonly “caused by dermatophytes in the Epidermophyton, Trichophyton, and Microsporum genera” (Summary and Recommendations section, para. 1). Symptoms of ringworm include itchy, red, raised, scaly patches on exposed areas of skin. The patches typically are most intensely red on the outside with normal pigmented skin on the interior of the patch. Diagnosis of a dermatophyte infection is done by taking a skin scraping from the infected area and dissolving the collected sample in a potassium hydroxide (KOH) preparation. The KOH dissolves the healthy tissue allowing for identification of the residual fungal material. Topical antifungals are generally adequate for treatment of uncomplicated infection, although oral antifungals may be required for more extensive or complicated infections (Goldstein & Goldstein, 2015a).
Prevention of ringworm infection can be achieved by fastidious hand hygiene technique and routine use of PPE such as examination gloves.

Another zoonotic disease transmitted by direct contact with infected mammalian companion species is sarcoptic mange. Sarcoptic mange or scabies is a skin infestation by the mite *Sarcoptes scabiei* or similar species that results in an intensely itchy skin lesion having a specific pattern. These lesions will occur in several areas including wrist, axillary, groin, and feet but most commonly the areas between the fingers as “small, erythematous, nondescript papules” (Goldstein & Goldstein, 2015b, Typical infestation section, para. 1). Diagnosis of scabies is typically made from taking the patient history and observing the affected areas. The health care provider will suspect scabies immediately with the knowledge of the occupational exposures of veterinary workers, increased itching at night, the characteristic lesions and pattern, and if other members of the workplace or home are having similar symptoms. Treatment for scabies should be two-fold with care for symptoms relief and transmission prevention. For uncomplicated cases, 5% permethrin cream should be applied from the neck down and washed off after at least eight hours, then repeated after one week (Goldstein & Goldstein, 2015b). For more extensive infestations with crusted scabies lesions, concurrent treatment with oral Ivermectin may be required (Goldstein & Goldstein, 2015b). All close contacts should be considered for treatment also given the potential for spread. Fastidious cleaning of all clinical spaces will also minimize the probability of further spreading of the mites.

Veterinary health workers are also exposed to a variety of zoonotic agents via an oral route. One of the more commonly reported agents is *Giardia lamblia*. *Giardia lamblia* is a flagellated protozoan parasite which can cause nausea, abdominal cramps, and severe diarrhea in humans (Munoz, 2015). Suspected cases of giardiasis are confirmed by stool examination.
Treatment for giardiasis, according to Munoz (2015), is typically combination therapy with an antibiotic/antiprotozoal medication such as Metronidazole, Tinidazole, Nitazoxanide, Albendazole, Mebendazole, Paromomycin, Furazolidone, or Quinacrine in conjunction with supportive care to offset fluid and electrolyte losses from the severe diarrhea. Potential exposures to giardiasis can be minimized by strict adherence to infection control practices throughout all animal care areas particularly when working with a suspect animal or suspect animal samples.

Cryptosporidiosis is another problematic protozoan (Cryptosporidium) capable of producing severe diarrhea in exposed veterinary health workers (Leder & Weller, 2015b). Other symptoms typically include nausea, vomiting, and abdominal pain. Leder and Weller (2015b) indicate diagnosis is made by patient history, symptom assessment, and stool examination. Leder and Weller also indicate that individuals with a healthy immune system basic supportive care for fluid and electrolyte replacement is sufficient to produce a complete recovery within a few weeks. However, in some people or in individuals with a diminished immune system further treatment is necessary. Persistent symptoms in immunocompetent individuals should be treated with Nitazoxanide (Leder & Weller, 2015b). The authors caution that treatment of immunocompromised individuals is further complicated with additional antiretroviral medications, intravenous fluid and electrolyte replacement therapy, and antimotility drugs, needed to elicit a broad recovery. Prognosis for individuals co-infected with HIV and cryptosporidiosis is extremely poor with the mean survival of 25 weeks (Blanshard, Jackson, Shanson, Francis, & Gazzard, 1992). Workers may be exposed to animals carrying cryptosporidium and unknowingly ingest the protozoan and/or the oocysts when not following careful infection control practices.
Campylobacteriosis is an infection by bacteria from the genus *Campylobacter* and is most commonly acquired by workers via the fecal-oral route (Allos, 2015). Suspected cases of campylobacteriosis are confirmed by culture of stool samples and/or blood samples. The diversity of the *Campylobacter* bacteria may be responsible for the wide range of symptomology which ranges from systemic infections, isolated intestinal issues, fetal/placental complications, to oral lesions (Allos, 2015). Systemic infections generally present as a sudden onset abdominal pain and diarrhea frequently accompanied by fever (Allos, 2015). While not widely diagnosed, placental complications from campylobacteriosis can result in abortion, stillbirth, or congenital issues. One study analyzed and documented 30 cases of detected campylobacteriosis which resulted in harmful outcomes including neurological damage to the fetus (Wong, 1990). There are a number of *Campylobacter* bacteria which are part of the normal human flora but there are also several of the bacteria (primarily *C. rectus*) which are capable of producing oral lesions such as periodontitis (Allos, 2015). The majority of enteric campylobacteriosis infections are mild enough that supportive care is sufficient for recovery. If infections become systemic or severe enough, additional treatment with antibiotics is required. This is another example where the diversity of the *Campylobacter* bacteria comes into play. Effective antimicrobial treatments for complicated campylobacteriosis should be dictated by antibiotic susceptibility testing as the susceptibility profile varies widely by *Campylobacter* species (Allos, 2015).

Listeriosis is an infection by *Listeria monocytogenes* bacteria and is most commonly acquired by workers via the fecal-oral route. Suspected cases of listeriosis are confirmed by stool, blood, and/or cerebrospinal fluid samples (Gelfand, 2015). According to Gelfand, in healthy individuals, listeriosis symptoms include gastroenteritis with fever resolving without intervention within a few days. Gelfand also outlines that in certain at-risk populations the
symptoms and prognosis is dire. The very young, the elderly, and pregnant are affected to a much greater degree. Neonates and the elderly infected by listeriosis will have the characteristic febrile gastroenteritis but may also have additional symptoms including central nervous system issues such as meningoencephalitis, cerebritis, or less frequently rhombencephalitis (Gelfand, 2015). Listeria-infected otherwise healthy pregnant women will also have the characteristic febrile gastroenteritis but the fetus may bear the additional symptoms including in utero abscesses and granuloma in various organs, skin lesions, and granulomatosis infantiseptica, via placental transmission. These pathologies can result in premature birth, infected newborns, or fetal death. Gelfand recommends antibiotic treatment for a diagnosed uncomplicated listeriosis infection will include either Ampicillin or Penicillin G as the first line regimen. Secondary antibiotic regimens include Gentamicin, Bactrim Imipenem, or Meropenem (Gelfand, 2015). Complicated infections (with secondary symptoms including CNS infection) may include multiple IV antibiotic treatments. Previously healthy individuals have an excellent prognosis with a rapid recovery and few lingering effects. Individuals with pre-existing health conditions (e.g., renal transplants, diabetes mellitus, cancer, and immunological issues) have higher rates of mortality and are more likely to have recurring neurological issues (Gelfand).

Salmonellosis is an infection by one of the species of bacteria from the Salmonella genus, most commonly Salmonella typhimurium (typhi), Salmonella choleraesuis, or Salmonella enteritidis and is most commonly acquired by workers via the fecal-oral route (Swanson et al., 2007). While poultry, reptiles, and amphibians are commonly associated with transmitting Salmonella, mammals including rodents and cats have been identified as animal reservoirs (Cherry et al., 2004; Swanson et al., 2007). Suspected cases of salmonellosis are diagnosed by patient history, symptom review, and confirmed by stool culture. Cherry et al. (2004) state that
symptoms of salmonellosis vary widely by *Salmonella* species, dose, and the health of the exposed patient. The hallmark symptoms of salmonellosis include nausea, vomiting, fever, diarrhea, and abdominal cramping which make it difficult to distinguish from gastroenteritis caused by other agents particularly when symptoms are mild (Cherry et al., 2004). Most cases of salmonellosis are restricted to gastrointestinal symptoms and resolve within a few days. There are also more aggressive cases which result in other health effects including endocarditis, aneurysm, and osteomyelitis (Cherry). Current best practice guidelines advise against use of antibiotics unless the patient is severely ill or immunocompromised. If antibiotics are indicated, a short course of Ciprofloxacin, Levofloxacin, Amoxicillin, or Ceftriaxone based on susceptibility is recommended (Hohmann, 2015).

Toxoplasmosis is an infection caused by the intracellular protozoan parasite *Toxoplasma gondii*, and is most commonly acquired by workers via the fecal-oral route. *Toxoplasma gondii* reproduces in the gastrointestinal system of cats following ingestion of either the protozoan or the oocysts (Heller, 2015). Cats then excrete the infectious oocysts in feces and expose susceptible human workers. Infection is diagnosed by patient history, symptom screening, and confirmed by lab serology testing. Heller (2015) states the vast majority of otherwise healthy individuals with toxoplasmosis infections do not have symptoms. Heller (2015) shows in symptomatic patients the most specific indicator is bilateral lymph node enlargements which are typically smaller than three centimeters. Secondary generalized symptoms may include headache, fever, chills, rash, pharyngitis, uveitis, and/or hepatosplenomegaly (Heller, 2015). Gandhi (2015) states higher risk populations including HIV-infected and pregnant women are more prone to more dire prognoses. HIV-infected individuals will need supplemental antiretroviral therapy in addition to the antimicrobial therapy for the toxoplasmosis infection to
avoid development of extracerebral toxoplasmosis and toxoplasmic encephalitis (Gandhi, 2015). Pregnant women exposed to *Toxoplasma gondii* are at risk of fetal infection which can result in congenital disorders including severe brain and cranial abnormalities in the fetus (Gilbert & Petersen, 2015). Although treatment is unusual in otherwise healthy individuals, Heller (2015) endorses first line regimens of Pyrimethamine and either Sulfadiazine or Clindmycin.

Roundworms are among the most common type of parasites of domestic cats and dogs. Leder and Weller (2015a) state there is a wide range of roundworm species but the *Scaris lumbricoides* is one of the most common helminthic human infections in the world, and is most commonly acquired by humans via the fecal-oral route. Once ingested, the ova hatch in the small intestine then release larvae. These larvae can migrate throughout the human body to infect other sites including the lungs, kidney, and brain. Symptoms of infected individuals commonly include nausea, diarrhea, intestinal obstruction, biliary colic, or pancreatitis (Leder & Weller, 2015a). Suspected cases of roundworm are diagnosed by patient history, symptom review, and confirmed by stool culture. Leder and Weller recommend first line treatment for roundworm infestation is Albendazole and Mebendazole and will resolve the infestation within a few days.

Brucellosis is an infection caused by the bacteria from the genus *Brucella*, and is carried by a wide range of animals from aquatic mammals to ruminants and rodents (CDC, 2015a). The CDC’s Brucellosis website states pathogenic strains of the Brucella bacteria include *Brucella melitensis, Brucella suis, Brucella abortus, and Brucella canis*. The bacteria are transmitted from animals to human through direct contact with an infected animal and enter the body through skin wounds or inhalation of the bacteria. Symptoms of brucellosis include fever, night sweats, malaise, anorexia, muscle and joint pain, lethargy, weight loss, and mental depression (CDC, 2015a). Diagnosis of brucellosis is often difficult to achieve quickly due to these vague
symptoms. Health care providers will need to perform the assessment by thoughtful patient history (including occupational history), symptom screening, and confirmed by culture and lab serology testing (Bosilkovski, 2015).

Once the disease has been identified in a human patient, treatment with antibiotics (Doxycycline and either Streptomycin or Rifampin for 6 weeks) can begin (Bosilkovski). While these antibiotics have been shown to be very effective in resolving the primary infection, there are a number of secondary complications which will require continued monitoring. These issues commonly include osteoarticular, genitourinary, hepatic, or neurologic diseases. One study showed that 66% of brucellosis-infected patients developed bone and joint complications (Colmenero et al., 1997). Effective infection control practices are crucial in preventing exposure to Brucellosis. Most critically, veterinary health workers (particularly those with non-intact skin) must always wear proper personal protective equipment. This includes examination gloves, goggles, and gown when working with known or suspected animals or suspected animal samples.

Cat scratch fever is an infection by the *Bartonella henselae* bacteria typically through feline saliva being introduced through a break in the human’s skin through bites or scratches (Spach & Kaplan, 2015). Spach and Kaplan indicate that within two weeks of the bacteria being introduced through a broken skin surface there may be a red, round, and swollen lesion (with or without pus) that may be warm or painful. The exposed individual may also present with a fever, headache, anorexia, or lethargy. Several days after these symptoms develop, there may be development of marked regional lymphadenopathy, which Spach and Kaplan maintain is the cardinal sign of cat scratch fever. The authors also indicate there may be further life threatening complications which can affect the eyes, brain, spleen, liver, or kidney. Antibiotic treatment for
cat scratch fever can be achieved through Azithromycin (or numerous alternative antibiotics) but the majority of infections resolve spontaneously (Spach & Kaplan). Higher risk patients including those with impaired kidney function or immunocompromised individuals will require additional medical attention.

Leptospirosis is infection caused by spirochetes of the genus *Leptospira*, and veterinary health workers may come into contact with these spirochetes through contaminated animal urine or infected animal tissue (Day, 2015). Non-intact skin provides the portal of entry which allows for the pathogen to become a systemic infection. Day shows that anywhere from a few days to a month following exposure to the *Leptospira* spirochetes, an individual will develop an abrupt fever, chills, and headache. The intensity of other symptoms of leptospirosis are extremely variable with some people showing very few signs of infection while others become severely ill or even die (Day). Diagnosis of leptospirosis is difficult but one unique symptom which may assist the health care provider to identify this infection is conjunctival suffusion (or reddening of the eye surface without inflammatory fluid). This symptom is uncommon in many other infectious diseases (Day). Confirmation of the diagnosis is made by lab serology testing. Effective treatment for leptospirosis is achieved with doxycycline or penicillin given as quickly as possible following identification of the disease. Veterinary health workers must maintain immaculate infection control practices to prevent exposure to leptospirosis. If an animal is incontinent of urine in the clinic, workers should take additional caution and presume the animal is ill. Individuals with known breaks in their skin must always wear examination gloves for any procedures involving known or suspected animals or suspected animal samples.

Pasturellosis is an infection caused by any species of the *Pasteurella* bacteria. While there a diversity of *Pasteurella* species found in animal species, the most common species
experienced in veterinary care is *Pasteurella multocida* which is a normal part of the respiratory tract of many domestic mammals (Weber, Rutala, & Kaplan, 2015). Infections in humans are typically caused by dog or cat scratches or bites. Weber et al. show that within 24 hours of transdermal exposure an intense inflammatory response will create pain and swelling at the wound site with secondary signs of infection include weeping drainage and lymphadenopathy. Health care providers can diagnose the *Pasteurella multocida* infection by patient history, physical examination, and confirm the identity of organism through culturing (Weber et al.). Treatment for the infection should be based on organism-specific susceptibility testing while factoring in the potential for secondary pathogen infection. Oral penicillin (or alternative for those with allergy) is generally sufficient to resolve most common infections (Weber et al.). Intravenous antibiotic therapy may occasionally be needed to augment the immune response should the individual be immunocompromised or develop secondary complications such as septic arthritis or osteomyelitis. In addition to standard infection control procedures and personal protective equipment, additional animal control measures such as muzzles or restraints should be implemented for problematic animals to prevent injuries which might lead to pasturellosis (Weber et al.).

Tularemia is an infection caused by the *Francisella tularensis* bacteria following inoculation by an infected animal or invertebrate vector (particularly ticks) or potentially inhalation of airborne bacteria during certain veterinary or laboratory procedures (Feldman, 2003). The majority of reported cases of tularemia is in the South-Central U.S. and primarily affects sheep, cats, dogs, and rodents (including rabbits) (CDC, 2015b). Feldman (2003) states symptoms of infection abruptly develop within five days of exposure and include fever, chills, and headache. Secondary symptoms include lymphadenopathy, pharyngitis, skin ulcer or papule,
nausea, vomiting, and hepatosplenomegaly. Feldman shows suspected cases of tularemia are diagnosed by patient history, symptomology including assessment of skin lesions, and confirmed by lab cultures including blood, pleural fluid, skin lesions, lymph nodes, or sputum. Treatment of tularemia is antibiotic therapy with streptomycin, gentamicin, or ciprofloxacin (Penn, 2015). Veterinary health workers (particularly those with known breaks in their skin) must always wear proper personal protective equipment (including examination gloves, goggles, and gown) when working with known or tularemia-suspected animals or suspected animal samples.

Histoplasmosis is a fungal infection caused by *Histoplasma capsulatum* and is endemic in the North and Central U.S. (Wheat & Kaufman, 2015). The most common veterinary health worker exposures come from cats, dogs, and birds (particularly bird droppings). The two major routes of exposure include direct contact and inhalation of fungal spores (NIOSH, 2004a). Wheat and Kaufman (2015) indicate symptoms of histoplasmosis include fever, cough, and fatigue. Most infections resolve spontaneously but individuals with a compromised immune system are at higher risk for more severe complications (Wheat & Kaufman). Diagnosis of histoplasmosis can be challenging given its mild initial presentation but can be detected if occupational exposures are effectively assessed; radiography and lab (culture and serology) testing are performed (Wheat & Kaufman). If treatment for histoplasmosis is necessary it will be based upon the individual’s primary disorder. Individuals who experience severe pulmonary disease usually require antifungal therapy for several to many weeks (Wheat & Kaufman). Exposure to histoplasmosis can be prevented by effective use of personal protective equipment including respiratory protection. It is important to control dust when cleaning bird manure, disinfecting contaminated surfaces or materials, and disposing of waste to avoid aerosolizing the fungus (Wheat & Kaufman).
Psittacosis is a bacterial infection caused by *Chlamydia psittaci* which is spread to humans primarily from birds through a bird bite or the inhalation of dried feces (CDC, 2014). Richards (2015) shows that within one to two weeks of an exposure to the bacteria, otherwise healthy individuals will have a rapid onset of fever, headache, and dry cough, and that secondary complications can include further respiratory disorders, endocarditis, and encephalitis. First line treatment with tetracycline is generally recommended for all individuals, with seriously ill patients receiving intravenous tetracycline for more than two weeks (Richards). Exposure to psittacosis can be minimized by use of personal protective equipment, particularly respiratory protection. Additional precautions should be taken when cleaning potentially contaminated areas following a visit by a known or suspected animal.

*Cryptococcus neoformans* is a fungus capable of causing pulmonary infection following exposure to birds (particularly bird droppings) (Cox & Perfect, 2015). While the majority of immunocompetent individuals will show no signs of infection, infected immunocompromised individuals can develop disorders including cryptococcal pneumonia and acute respiratory failure (Cox & Perfect). Diagnosis of *Cryptococcus neoformans* infection can be confirmed by serology testing. Current treatment guidelines suggest oral fluconazole for 6 to 12 months. Exposure to the fungus can be minimized by use of personal protective equipment particularly respiratory protection. Additional precautions should be taken when disinfecting clinical areas following any visit by any fowl.

*Q fever* is a bacterial infection caused by *Coxiella burnetii* which is spread to humans primarily from cattle, sheep, and goats through a direct contact or the inhalation of animal tissues and wastes (Raoult, 2015c). Large amounts of *Coxiella burnetii* bacteria are often released in the amniotic fluid and placenta when sheep and goats are birthing their young. The released bacteria
are particularly robust, able to survive autonomously in the environment through heat and desiccation, and are resistant to many disinfectants (Raoult, 2015c). Bacteria are also highly infectious being able to cause disease with only minimal exposure. Symptoms of Q fever are wide-ranging with some people presenting with very mild symptoms while others with a similar contact presenting with an acute influenza-like illness, pneumonia, or hepatitis within three weeks of exposure, and secondary complications are more likely to occur in individuals with immunological disorders, are pregnant, or have congenital heart valve or vascular diseases (Raoult, 2015a). The predominant secondary complications for pregnant women include a higher risk for include spontaneous abortion, fetal death, and premature delivery (Raoult, 2015a). Individuals with pre-existing congenital heart valve or vascular disease disorders have an increased risk of further cardiac disorders including endocarditis (Raoult, 2015b). Health care providers should have a high index of suspicion for Q fever in individuals presenting with relevant symptoms and having exposure factors for the disease which includes anyone who has had contact with relevant species. Confirming diagnosis of Q fever is performed by serial antibody testing and or polymerase chain reaction testing (Raoult, 2015a). The recommended treatment for symptomatic Q fever is a two week course of doxycycline (Raoult, 2015c).

Prevention is crucial to avoid unnecessary exposures to Q fever particularly to high risk individuals. In any veterinary facility which services sheep or goats, appropriate policies and procedures should be developed for bagging and disposing of birth products (e.g., placenta, fetal membranes), disinfection, as well as cleaning of work equipment and clothing. Individuals with existing cardiac valvular disease or vascular grafts should receive counseling from an occupational medicine physician to discuss risk of developing chronic Q fever. Individuals with
very high occupational exposure to Q fever risk may consider vaccination when it is available in the U.S.

Tuberculosis, a bacterial infection caused by *Mycobacterium tuberculosis*, can be spread to humans from other primates, elephants, dogs, and guinea pigs through inhalation of the bacteria (LoBue, Enarson, & Thoen, 2010; Murphee, Warkentin, Schaffner, & Jones, 2011). Although the *Mycobacterium tuberculosis* can infect the skin, kidney, or nervous system tissues, the most common and most problematic organ that is affected is the lungs. Murphee and colleagues show the most common symptoms of tuberculosis are cough, weight loss, fatigue, fever, chest pain, night sweats, shortness of breath, and hemoptysis, and also show secondary complications that may develop if the disease is not quickly identified. These include formation of lung tubercles, pneumothorax, and venous thromboembolism. Diagnosis of tuberculosis should also include the patient history and symptom assessment. The diagnosis can be confirmed with a tuberculin skin test, chest radiography, and/or lab serology testing (IGRA-Interferon Gamma Release Assay). Guidance for treatment for an active tuberculosis infection takes two phases to avoid development of drug resistance. The first phase is a two month regimen of four medications – isoniazid, rifampin, pyrazinamide, and ethambutol (LoBue et al, 2010). The second phase continues on for an additional four more months of isoniazid and rifampin (LoBue et al.). Individuals will need to be monitored throughout therapy for development of side effects including liver disorders. Tuberculosis is best prevented by effective implementation of infection control practices and respiratory protection (NIOSH, 2012b).

*Capnocytophaga canimorsus* is a bacterium capable of causing severe infection within a week of being bitten by a dog or scratched by a cat. Signs of infection include fever, purpuric rash, and altered mental status (Goldberg, 2015). Immunocompromised individuals and pregnant
women are at a much higher risk of secondary complications. Health care providers can confirm diagnosis by culture of the wound site. Individuals with the active infection can be treated with a variety of antibiotic therapies based on microbial susceptibility testing (Goldberg). In addition to standard infection control procedures and personal protective equipment, additional animal control measures such as muzzles or restraints should be implemented for problematic animals to prevent injuries which might lead to bites or scratches.

**Chemical Risks and Practices**

Veterinary health workers are exposed to a wide variety of chemical hazards including anesthetic gases, hazardous medications, and cleaning and disinfecting agents. Workers can be exposed to these hazards via a variety of means including inhalation, skin (or eye) contact, ingestion, or injection. One of the most significant chemical hazards, particularly to pregnant women, is waste anesthetic gases (Epp & Waldner, 2012a). There are a number of halogenated gases that are commonly used in veterinary practice including isoflurane, sevoflurane, and halothane each having unique anesthetic properties and potential health hazards (Epp & Waldner, 2012a). Accidental release of these gases can occur through the leakage of anesthetic gas from the faulty equipment or poorly fitted patient face masks. Individuals exposed to unsafe levels of the anesthetic gas may experience adverse health effects including an increased rate of hepatic disease, spontaneous abortion, and congenital abnormalities. Routine maintenance of anesthesia equipment including daily leak testing, effective waste gas scavenging systems, and good work practices are all important to prevent unintended release of gases (NIOSH, 2007b).

Hazardous medications are another source of chemical exposure to veterinary health workers and include toxic antibiotics, artificial hormones, and antineoplastic agents. Micotil 300 is an antibiotic which is used in animals such as cattle but can be fatal to humans. If accidentally
injected into a human, the medication can produce cardiotoxicity, tachycardia, and hypotension (Emergency Medicine News, 2005). Guidance from NIOSH recommends several levels of control mechanisms when utilizing this antibiotic. This includes substituting Micotil 300 for a safer alternative when possible, use of the engineering controls such as animal restraining devices, administrative controls such as development of site-specific work instructions, and utilization of only properly trained personnel, and adequate PPE including needle-puncture-resistant gloves (NIOSH, 2007a).

Chloramphenicol is another antibiotic which is used in certain animals that is toxic to humans. While capable of curing a variety of appalling infections including typhoid and meningitis, it also has a number of adverse events including the aplastic anemia, bone marrow suppression, leukemia, gray baby syndrome, hypersensitivity, and neurotoxic reactions. Best practice guidance for this type of substance promotes prohibition of smoking, drinking, eating or storage of food in areas where the material will be handled, use of proper gloves, and thorough hand hygiene (Toxnet Toxicology Data Network, 2012).

The use of artificial hormones in veterinary care introduces a reproductive hazard to pregnant female veterinary staff (Epp & Waldner, 2012a). Corticosteroids (such as dexamethasone and prednisone) and prostaglandins can potentially induce preterm labor or abortion if accidentally injected or absorbed through the skin. Pregnant women are advised to avoid handling, and working in an area, or touching equipment where these medications are administered. Individuals with known respiratory disorders may be advised to avoid prostaglandins due to risk of inducing potentially fatal bronchial spasms (Wohlers, Smith, & Griffin, 2005).
Animals being treated for cancer and other diseases will need to be administered antineoplastic and other cytotoxic drugs such as cisplatin or doxorubicin by veterinary health workers. They may be exposed to these agents in the air, in the work environment on surfaces or equipment, or in animal wastes. While inhalation and skin contact are the most likely routes of exposure, it is conceivable to have exposures through unintentional ingestion or injections through needlestick or sharp injury (NIOSH, 2004b). Certain antineoplastic medications are capable of inducing severe skin rashes, infertility, spontaneous abortion, birth defects, or even certain types of cancers.

Cisplatin is an antineoplastic agent used in both animals and humans. The safety data sheet notes that the product is a “Possible carcinogen and mutagen” (Pfizer Inc., 2015, p. 1). Cisplatin commonly comes as a powder requiring reconstitution and it is recommended that workers avoid aerosol generation, and manage this reconstitution in a biological safety cabinet to protect workers from accidental inhalation (NIOSH, 2004b). Doxorubicin is a common veterinary cytotoxic agent used as a treatment of various types of animal cancers. The agent is not well metabolized by the animal and is excreted in animal wastes in a largely unchanged form (Toxnet Toxicology Data Network, 2010, April 30). This makes it crucial that workers wear effective PPE (gloves, goggles, and lab coat) even when handling bedding and wastes.

There are also a number of potentially problematic veterinary cleaning and disinfecting agents including glutaraldehyde, ethylene oxide, formaldehyde, and peracetic acid (Epp & Waldner, 2012a). Common routes of exposure to these chemicals may be skin contact or inhalation. Additional contact with the skin, eyes, or mucus membranes may occur if these chemicals are splashed in the working environment. Glutaraldehyde is a cleaning agent commonly used in veterinary clinics to disinfect surgical suites and endoscopy equipment.
Glutaraldehyde vapors are recognized irritants to the skin, eyes, nose, and lungs. Its use in a clinical environment requires proper ventilation to avoid development exposure-related asthma (Cohen & Patton, 2006).

Ethylene oxide is a toxic chemical used as the sanitizing agent in small volume (tabletop or multi-load) sterilizing units common in veterinary medicine practices (L. Mahr, personal communication, October 17, 2015). Although flammable and explosive, its unique chemical properties allow for sterilization of sensitive surgical instruments that cannot be exposed to heat, moisture, or pressure. The Agency for Toxic Substances and Disease Registry (ATSDR) warns human exposure to ethylene oxide may produce acute skin, eye, and mucus membrane irritation, while large doses can cause central nervous system depression and pulmonary edema (ATSDR, 2014). It is also known to be carcinogenic and have further reproductive health effects. Treatment for acute overexposure is respiratory and cardiovascular supportive care (treatment given to relieve symptoms and make patient more comfortable). The use of effective engineering controls including local area ventilation, flow sensors and alarms, and proper signage will help minimize the potential for accidental exposure. Mahr states workers assigned to sterilization duties should be assigned chemically resistant gloves to avoid direct skin contact with liquid ethylene oxide, and use goggles and a full face respirator if concentration levels are high (L. Mahr, personal communication, October 17, 2015).

Formaldehyde is used in numerous formulations within the typical veterinary practice as a disinfectant, biocide, and tissue fixative (ATSDR, 2015). A mild solution of formaldehyde is effective in killing most bacteria and fungi, while stronger solutions are effective at fixing tissues for microscopy and histology analysis. The chemical is a known carcinogen and irritant affecting
both the nose and eyes, and chronic exposure to the chemical is associated with an increased risk of asthma and or allergies (ATSDR, 2015).

Peracetic acid is a common component of disinfectants and sterilizing agents used in veterinary practice due to its broad antimicrobial properties (Epp & Waldner, 2012a). Even in low dose exposures, peracetic acid may have an irritating effect on the skin, eyes, and respiratory tract (Toxnet Toxicology Data Network, 2015, December 21). In higher doses the lungs can be damaged inducing pulmonary edema even causing death. There are some data indicating that the chronic exposure to this agent can cause lung cancer and secondary complications to the liver and kidneys (Epp & Waldner, 2012a). Treatment for acute inhalation exposure is largely supportive focused on respiratory and cardiovascular functioning. Flushing the eyes with copious amounts of water for 15 minutes is the recommended treatment for eye exposures, and decontamination with soap and water for 15 minutes is the recommendation for skin exposures (Toxnet Toxicology Data Network, 2015, December 21).

Enviromechanical Risks and Practices

There are a large number of enviromechanical risks that veterinary health workers face each day at work including animal bites, sharps and needlestick injuries, and musculoskeletal disorders. Animal bites are among the most frequently reported occupationally-related injury in veterinary medicine. A worker’s compensation study (as cited by Zimlich, 2010) documented that 90% of all claims between 2002 and 2004 were directly attributable to animal bites. Of those bite injuries, 53% were cat bites and 43% were dog bites with hands and arms the most commonly injured body parts (77%). The study further showed that additional precautions (muzzling) with animals displaying precursor animal bite warning behaviors (aggressive or
fearful displays) were taken only 47% of the time. The average claim amount for these injuries was slightly higher for dogs ($1,500) than cats ($1,200) (Zimlich, 2010).

An older survey of veterinarians from Wisconsin and Minnesota found the career prevalence of cat bites to be 81% and dog bites to be 63% (Landercasper et al., 1988). While the physical trauma induced by a dog bite is generally much worse than a cat bite, the risk of secondary infection appears to be much higher with cat bites (30% to 40%) than dog bites (2% to 4%) (Patronek & Slavinski, 2009). It is suspected that the risk of infection is greater in cats than dogs because the common mucosal flora of cats includes Pasteurella multocida bacteria (Lewis & Stiles, 1995). One recent retrospective study documented that approximately two-thirds of the patients (from a general population) assessed for either a dog or cat bite in a hospital emergency department required hospital admission and one-third required a surgical procedure. Eleven percent of the individuals from this study required administration of intravenous antibiotics and multiple surgeries at an estimated cost of over $77,000 (Benson, Edwards, Schiff, Williams, & Visotsky, 2006).

Sharps and needlestick injuries were another common area of occupational risk for veterinary health workers. Following passage of the Needlestick Safety and Prevention Act in 2000, there have been huge strides taken in preventing needlestick injuries in human medicine. Similar advances have not been evident in veterinary medicine. Needlestick injuries are common in veterinary medicine although secondary adverse effects are less common (Weese & Douglas, 2008). Animal movement during injection or blood collection procedures, particularly when using a large-bore needle, can result in severe physical trauma including laceration. Secondary adverse effects from inadvertent injection from substances used every day in clinical practice such as vaccines, chemotherapeutics, antimicrobials, anesthetics, and euthanasia products are
material-dependent but may induce profound health issues including systemic reactions or death. One study in female veterinarians documented that roughly 16% of needlestick injuries produced some type of secondary adverse event (Wilkins & Bowman, 1997).

The model for prevention of needlestick injuries in veterinary health workers has been established by human health care workers in several ways including the use of safer devices, enhanced prevention training programs, and greater adherence to existing safety guidance including the organization’s infection control plan. It has been estimated that up to 88% of sharps injuries in human health care workers could be avoided through the use of safer devices (CDC, 2008).

Another study of human health care workers documented that proper handling techniques could have prevented 74% of all analyzed needlestick injuries and 24% of the remaining injuries could have been prevented by safety devices (Castella, Vallino, Argentero, & Zotti, 2003). In the majority of sharps or needlestick injuries, human error is generally a contributing factor, if not the major reason, for the accident. An effective, fully-implemented, and compulsory infection control program will provide the educational backbone for sharps and needlestick prevention (CDC, 2008).

Occupational musculoskeletal injuries (or WMSDs - work related musculoskeletal disorders) are a result from enviromechanical hazards for veterinary health workers. WMSDs can be induced from such ordinary movements as reaching, lifting, gripping, or twisting. Performing these movements repetitively, or in a forceful or awkward way for an extended period of time, can make the motion itself hazardous. There is a wide variety of veterinary procedures which require transporting, positioning, and restraining animals capable of producing
human strains, sprains, or more permanent injury particularly to the back and shoulders (Rogers et al., 2011).

There are a number of tasks in veterinary medicine which require an individual to remain in an awkward position or posture for an extended period of time to complete the procedure. Large animal veterinarians performing dental procedures on horses, colic surgeries, or assisting large animals with birthing may be working with their hand or elbows of above the shoulder for extended periods of time which may induce muscle fatigue and injury. A study measuring the strain index of equine veterinarians in certain job tasks showed that examinations for lameness, lifting, and performing ultrasounds to be the most harmful for progression of distal upper extremity disorders (Rogers et al., 2013). Rogers et al. demonstrated that readings taken during lameness exams “expose the veterinarians to the most extreme wrist postures in terms of flexion \((M = 27.39^\circ)\), extension \((M = 42.84^\circ)\), and ulnar deviation \((M = 31.81^\circ)\)” (Distal Upper-Extremity Risk Analysis section, para. 1). These results indicate that many of “the tasks were considered ‘probably hazardous’ and thus posed a high risk for developing distal upper-extremity disorders” (Rogers et al., 2013, 3.2.1 Distal Upper-Extremity Risk Analysis section, para. 1).

There are also certain procedures, such as large animal abdominal surgeries, that may require the veterinarian to be kneeling or remain in a static posture for an extended period of time and therefore would be capable of inducing certain musculoskeletal disorders (Rogers et al., 2011). The use of high hand force is another risk factor commonly experienced by veterinary health workers. Applying excessive hand pressure (as in a gripping in squeezing motion) during animal restraint tasks, ear tagging, and large animal abdominal surgeries has the potential of producing muscular injury (Rogers et al., 2011).
Veterinary health workers using poor technique to lift a tranquilized animal (a large dog, for example) from the floor to the surgical table may injure their back through an ill-advised bending and twisting motion or from a sustained forceful exertion. Workers may also overexert their muscles when lifting heavy animal products or veterinary equipment (Rogers et al., 2011).

Workers repeating the same motion with their arms and hands for extended periods of time while performing injections, grooming techniques, or surgical procedures are exposed to increased muscle fatigue and potentially injury. The use of motorized equipment in animal dentistry or grinding of hooves can produce a vibration hazard for the worker. The use of these motorized tools for extended periods of time can create muscle fatigue including white finger or trigger finger injuries (AVMA, 2015a).

WMSDs can be chronically physically and emotionally debilitating for the injured individual and exceptionally expensive for the veterinary practice. A 2006 study by the AVMA-Group Health and Life Insurance Trust reports that more than $4 million dollars was paid for back WMSDs alone (AVMA, 2007). Another analysis of workers’ compensation claims for participants in the AVMA-Professional Liability Insurance Trust found that the typical workers’ compensation claim was $22,000 and was generally associated with improper lifting (AVMA, 2007). The key to reduce the rates of WMSDs in the veterinary workplace is to develop a comprehensive prevention and control program directed at recurring ergonomic injuries. A significant program will address both pre-exposure (for example-fitness for duty physical exams) and post-exposure (for example-medical treatment for musculoskeletal injuries) events. To be properly implemented an operative program will include management commitment which demonstrates a commitment to worker health promotion and protection through a written program, employee involvement, and routine program review and evaluation (Rogers, 2003).
The major building blocks of the musculoskeletal injury prevention program must include a thorough worksite analysis, consideration of hazard prevention and control measures, provision for medical management, and training and education which reflects workforce characteristics. The worksite analysis should include individual job task analyses for the recurring job processes for each worker. An ergonomic assessment specialist will observe workers performing their job tasks to assess the potential for muscular strain and offer suggestions if safer means of accomplishing the task may be available. If it is determined that the work task is unsafe, alternative methods of completing the job should be explored (Rogers et al., 2013).

Transporting large anesthetized dogs before and after surgery is a common task in veterinary medicine. Rogers et al. (2011) have shown that workers may lift an animal with their arm extended which generates high forces in the joints of the lower back. Removing or returning the animal to a cage close to the ground will likely cause the worker to lean forward significantly which involves extreme flexion of the spine and neck. To control these hazards a number of interventions could be introduced. Rogers et al. (2011) suggest a pull-out floor for the cages could be the created to allow workers to slide the animal out and avoid the hazard of workers leaning into the cage. Use of an open box or soft-sided stretcher with appropriate lifting handles would be helpful for workers team lifting and transferring an animal a short distance (Rogers et al., 2011). The authors propose load lifting tables could be used for heavier animals so that workers would not muscularly strain themselves. The lifting process or carts could be used to transport animals over a long distance within the facility. To minimize the amount of bending by workers during animal lifts, administrative controls such as the use of cages of an appropriate height are advised. Behavioral controls such as team lifting allow workers to share the load
making a lighter load for everyone and job rotation reduces the chance for back strain.

Veterinary facilities should institute effective ergonomic training programs in which workers learn to identify personal risk factors to reduce their potential for developing a WMSD (Rogers et al., 2011).

While an industrial hygiene consultant may recommend additional personal protective equipment in certain cases, they will likely advise against the use of back support devices as they have not been scientifically documented to be effective in minimizing back injuries (NIOSH, 1994). Injuries can occur even in the most successful ergonomics programs. Early reporting, assessment, and active intervention can reduce the severity of an injury, enhance the likelihood of successful treatment, and minimize the likelihood of permanent disability, and reduce workers’ compensation costs (U.S. OSHA, n.d.b).

There are numerous eye safety concerns which are common in the veterinary workplace. Workers’ eyes may be contaminated with chemicals, airborne contaminants or infectious materials, and dust or injured with lasers or penetration type wounds from animals, compressed gases, or equipment (NIOSH, 2012a). Whenever workers are transferring chemicals of any type, eye protection should be worn to avoid splash related injuries (Merck, 2014). Impact resistant protective goggles should be worn whenever connecting or disconnecting tanks of compressed gases as any rapidly escaping gases have the potential of serious injury to the eyes (Seibert, n.d.).

Grinding or buffing of animal teeth in veterinary dental procedures can create projectiles of airborne contaminants which have the potential of entering the eye if adequate protection is not being worn (Epp & Waldner, 2012a). Certain invasive veterinary surgeries routinely produce airborne infectious material. Eye protection devices, such as goggles or glasses with solid side shields, or chin-length face shields, should be worn whenever splashes, spray, or droplets of
blood or other potentially infectious materials may be generated (NIOSH, 2012a). Additionally, proper respirators in combination with eye protection devices can minimize contamination to the nose and mouth. Veterinary health workers performing duties outside in windy conditions may be exposed to large volumes of dust with the potential of entering the eye. The use of goggles or glasses with side-shields is recommended to minimize this dust exposure whenever staff is working outside of the facility. In addition to the availability of the comfortable and effective eye protection, management should also provide routine training on use and maintenance of the eye protection and the location of eyewash stations.

The use of (class IV) therapeutic lasers in veterinary practices is becoming increasingly common and carries with it a unique set of occupational hazards. These types of lasers use invisible infrared wavelengths which do not trigger the human blink reflex (Harrington, 2012). Direct or reflected laser light entering the eye can potentially cause immediate damage to the retina. Eye protective equipment is laser-specific and should be supplied by the laser manufacturer or supplier. The eye goggles should be stamped with the OD (optical density) rating which measures the ability to screen out specific wavelengths of laser light to achieve a level below the maximum permissible exposure (MPE) (Harrington).

There also are a number of general working condition enviromechanical hazards common in the veterinary workplace including slips, trips, and falls (Washington State Department of Labor & Industry, n.d.). In the veterinary environment these accidents are likely to occur due to poor housekeeping (spills or wet floors), loose cords, or distracted walking and can lead to serious injury or death. Prevention of slips, trips, and falls should start with management commitment to effective training and supervision to ensure proper housekeeping (NIOSH, 2010). All veterinary staff should be tasked with and trained to immediately clean up any spills as soon
as possible with the proper cleaning equipment and to report any areas of hazard concern. Efforts should be taken to use absorbent materials to dry a wet, slippery hazard rather than posting a wet floor sign. Removal of any potential floor obstacles including removal of damage floor tiles and rerouting cables away from walking areas quickly will minimize the potential for trips (NIOSH, 2010).

**Physical Risks and Practices**

There are a number of physical risks in veterinary practice including ionizing radiation in radiography, heat or cold stress, and noise. Veterinary workers are exposed to ionizing radiation when taking radiographic images of the animals for diagnostic study (Banfield, 2011). Exposure occurs when unshielded employees are proximate to the machine while in operation generally when holding an alert animal in position. The amount of exposure is dependent upon the amount of the radiation, the duration of the exposure, the distance from the source of the radiation, and the type of shielding material being used (U.S. OSHA, n.d.a). U.S. OSHA (n.d.e) mandates an annual occupational exposure limit to 5 rems. The effects of this radiation exposure can be either acute or chronic and affect both the individual exposed and to children of the exposed individual. Direct acute exposure can be focal and result in erythema and dermatitis; whereas whole body exposures can result in nausea, vomiting, diarrhea, weakness, and death. Chronic radiation exposure is believed to lead to premature aging, and increased incidences of neoplasia, squamous cell carcinoma, and leukemia. Chronic exposure may also lead to congenital defects in the employees offspring (U.S. OSHA, n.d.d).

Veterinary practices should design their radiation safety program with the guiding principle of getting radiation exposure levels as low as reasonably achievable. While certain financial, design, and workflow constraints may not practically allow zero exposure to radiation,
attempts should be made to reduce radiation exposure to as low as reasonably achievable. Veterinary health workers must understand that a condition of their employment may be some risk of radiation exposure but that all reasonable control measures and training will be instituted for their safety (Health Canada, 2008). A comprehensive radiation protection program for veterinary medicine will include personnel-related procedures, dose monitoring policy, as well as written safety procedures including descriptions of radiation detecting equipment, and personal protective equipment. Management will need to be conversant with notification procedures, facility annual occupational dose limits, the impact of prior employment exposures on new employee dose limits, pregnancy policy, dose limits to a fetus, and exposure record retention (U.S. OSHA, n.d.d).

There are a number of prevention tactics which can be applied in the veterinary workplace to assist employees in reducing radiation exposure. Engineering controls such as wedges, sandbags, and restraining devices should be used for animals to keep them in place while the x-ray is being taken which minimizes the amount of time the worker must hold the animal. Problematic animals should be sedated to minimize the amount of movement during radiography to decrease the number of repeated tests. Workers should be reminded to always wear their full uniform of PPE including lead aprons, thyroid shields, and lead gloves, and to stay as far away from the radiation source as possible (U.S. OSHA, n.d.d).

Heat or cold stress is another physical risk faced by veterinary staff particularly those large animal veterinarians working outside. There are various types of heat-related illnesses which can affect staff employed in outside activities during extremely warm weather including heat stroke, heat exhaustion, heat syncope, heat cramps, and heat rash. Common symptoms of these illnesses include high body temperature and dry skin, confusion, profuse sweating, extreme
weakness or fatigue, dizziness, nausea, vomiting, and headache. Without immediate remediation,
further complications can develop such as elevated blood pressure, tachycardia, breathing changes, and seizures. There are various types of cold-related illnesses which can affect staff employed in outside activities during extremely cold weather including hypothermia, frostbite, trench foot, and chilblains. Common symptoms of these illnesses include shivering, fatigue, loss of coordination, numbness or itching of the exposed skin, confusion, and disorientation (NIOSH, 2016).

Further complications can develop if action is not taken by the worker including bluish skin, dilated pupils, bradycardia, slowed breathing, loss of consciousness, and death. Several administrative measures can be taken to avoid the exposures of individuals to heat or cold stress including scheduling of events to times when the temperature will be more temperate, reduce the physical demand to workers when the temperature is a contributing factor, where practical use relief workers, provide temperature controlled areas for recovery, encourage substantial fluid intake and appropriate clothing and gear for the climate. Extremes of temperature training should be designed to discuss worker risk, symptoms, prevention, self and team monitoring, treatment, and personal protective equipment (NIOSH, 2016).

Veterinary workers may be exposed to excessive noise levels in certain areas of the facility such as large kenneling ranges or from certain pieces of equipment. Large open kennels without sound deadening devices tend to create substantial noise. An analysis at an animal hospital by NIOSH found that “Noise levels exceeded the NIOSH recommended exposure limit on 10 occasions and exceeded the OSHA criteria on 6. Eleven of the workers have normal hearing patterns. Three employees showed hearing loss” (NIOSH, 2006, p. iii).
NIOSH recommended noise exposure prevention for kennel noise is installation of sound-absorbing materials, and use of hearing protection when working the kennel area. Equipment used during certain veterinary procedures is capable of producing significant noise such as dental procedures with drills, cleaning burs and discs, and air compressors.

Exposure occurs when employees are proximate to the noise while equipment is in operation. The use of acoustic enclosures or sound barriers around air compressor units or moving the unit a safe distance away will help reduce the noise near to the workers (Veterinary Practice News, 2010). The use of sound blankets in areas where dental procedures using drills and ultrasonic cleaners are being performed may reduce noise to safe levels.

If it is determined that the recommended noise level is exceeded, the veterinary facility will need to create a hearing conservation program which will include provisions for noise monitoring, annual employee training, implementation of noise exposure reduction measures, and routine audiometric evaluations of all affected employees (U.S. OSHA, n.d.c)

**Psychosocial Risks and Practices**

Veterinary health workers face a wide range of work-related stress and psychosocial risks capable of inducing physical or emotional harm. Veterinary organizations need to consider these components of the workplace environment as an important part of the overall health and safety program. Studies have shown that veterinary health workers report having one of the highest rates of work-related stress. A recent study of Canadian veterinarians stated that “median stress levels were similar across work environments; overall, 7% indicated either no stress or severe stress, while 53% indicated moderate stress” (Epp & Waldner, 2012a, p. 151). There are five major categories of psychosocial risks common in veterinary health workers. These risks include
workload management, balance, protection of physical safety, psychological support, recognition, and reward.

Some of the psychosocial risks experienced by veterinary health workers in the workload management category include long working hours and insufficient restorative vacation time. Frequently workers are asked to provide coverage on nights and weekends and respond to emergencies outside of normally scheduled hours. In 2012, about 1 in 3 veterinarians reported working more than 50 hours per week (U.S. BLS, 2015a). Workers may also feel rushed when they are not allotted enough time per patient or given enough breaks during the work day.

Veterinary staff frequently works long hours including nights and weekends. Emergency veterinary health staff is required to provide coverage nights, weekends, and holidays. They may need to cover additional hours or shifts for sick co-workers with little notice (L. Mahr, personal communication, October 17, 2015). The veterinary medical practice can be challenging itself with a diverse range of species and a multitude of potential animal disorders to differentiate. All of these workload management psychosocial risks can be mitigated by thoughtful consideration and personnel planning.

Work-life balance is another psychosocial risk factor common in veterinary practice (Roark, 2010). An organization should recognize the need for balance between the demands of work, family, and personal life. Everyone within an organization has multiple roles which require time and attention but conflicting responsibilities can lead to role clash or overwork. Improved workplace flexibility enables workers to minimize this conflict by allowing them to complete the tasks necessary for fulfillment of their daily lives and maintain an effective work-life balance.
Veterinary workers at many positions are seeing increased levels of workplace responsibility such that it becomes challenging to complete all of their duties (Roark). Veterinarians may find it exceptionally difficult to juggle all of the tasks that are asked of them including clinical, administrative, and managerial duties in addition to maintaining family and personal life. To minimize the psychosocial risks related to these hazards, one must have a commitment to improve work-life balance. This commitment can be demonstrated by letting employees attend to personal tasks or attend family events during work time if it is convenient for the clinic operations and on a very limited basis. Workers should be encouraged to communicate the need for family time, and to be protective of their private time without guilt.

Protection of physical safety is another important psychosocial risk factor common in veterinary practice (Epp & Waldner, 2012a). Staff may be faced with challenging co-workers and customers. Animal owners may become verbally or physically abusive at times due to unrealistic expectations of veterinary care (Epp & Waldner, 2012a). There is also the potential for workplace violence in veterinary practice (SafetyVet, 2015). Workers may also be wary of physical safety hazards throughout the veterinary workplace. It is important that management protect the physical safety of employees by developing policies, training, and appropriate responses to incidents and situations to demonstrate a concern for employees’ physical safety. The work environment which is perceived as physically safe will have a more engaged workforce and lower rates of psychological distress and mental health issues.

Psychological support is an important psychosocial risk factor in veterinary practice. The Occupational Outlook Handbook lists “Compassion” as one of the most important qualities in all of the veterinary health worker professions (U.S. BLS, 2015a). These workers are commonly sensitive personality types who may care more deeply than the average person about those
unable to speak for themselves. Veterinary work may be very emotionally demanding in situations where they care for abused animals, or need to euthanize ill or unwanted animals (Nolen, 2011). Workers in the field often have exceptionally high levels of dedication to their clients. Staff may suffer compassion fatigue through unceasingly serving animals in distress to the point it becomes an obsession with the suffering of those being helped (L. Mahr, personal communication, October 17, 2015).

Many veterinarians operate independent practice which may lead to greater isolation and fatigue (Larkin, 2013). This may also reduce the potential for healthy dialogue and problem-solving with peers. The veterinary staff may also feel a lack of recognition from the general public compared to their peers in the human medical field. It is important that an organization design psychological support mechanisms which can protect against traumatic stressors in the workplace. Policy should be developed where coworkers and supervisors are encouraged to be sympathetic of one another and responsive when needed.

Recognition and reward are the other psychosocial risk factors recurring within veterinary practice (Harling et al., 2009). Veterinary practice is generally not as financially lucrative as human medical practice and some workers may be struggling financially. At the time of graduation, veterinarians will have near the same amount of student loan debt as medical doctors but at best will have about half the earning potential of their human medical peers. While veterinary assistants and veterinary technicians often cite their love of animals as the reason for their vocation, they also have personal financial obligations to meet. Veterinary practice managers have their financial concerns as well as with issues of time and personnel management, billing, finance, and marketing (Veterinary Economics, 2008). While it is important for an organization to be competitive in compensating its employees financially, it should also find
nonfinancial compensations to acknowledge staff contributions in an appropriate and equitable manner. Workers being recognized and rewarded appropriately will have a greater sense of pride and participation in work and are likely to treat colleagues and customers in kind.
CHAPTER III
DEVELOPMENT OF AN INSTRUMENT TO ASSESS OCCUPATIONAL HEALTH HAZARDS IN VETERINARY HEALTH WORKERS

Development and Organization of Survey

The purpose of this survey is to gain the perspective of veterinary health workers to better understand their awareness and recognition of workplace hazards, and their individual perceptions of risk.

The survey instrument was developed by considering the five categories of workplace hazards (biological/infectious hazards, chemical hazards, enviromechanical hazards, physical hazards, and psychosocial hazards) and putting them into a questionnaire format to assess the work-related hazards of the worker population. The survey tool is designed to also identify worker concerns, individual perceptions, and attitudes of the veterinary health population regarding occupational health and safety practices. In addition, the survey tool may help identify the reasons workers choose to follow or not follow occupational health and safety policies and procedures.

Part I of the survey, Demographic Information, asks 9 questions. Part II provides definitions of each of the five hazards and lists hazards for each category to be rated using a 5-point Likert scale ranging from minimal to great risk. Part III, Related Factors, is a listing of statements where workers are asked for their opinions regarding occupational health and safety using a 5-point Likert scale ranging from strongly agree to strongly disagree to express their perception of risk throughout the veterinary health field. A rank order of 10 hazard risk concerns regarding health and safety practices is also included. Part IV, Related Concerns, is a listing of
statements where workers are asked for their opinions regarding their personal apprehension of risk using a 5-point Likert scale ranging from very little concern to a great deal of concern.

This survey is meant to be administered to all members of the veterinary health facility so that a wide range of opinions will be reflected in the findings. Analysis of results derived from the survey may provide the foundation for a better understanding of risks and hazards in the veterinary health field, and development of prevention strategies for risk mitigation.
Occupational Health Hazard Assessment Survey for Veterinary Health Workers

Part I Demographic Information

The questions in Part I are exclusively about you and your education, background, and clinical practice. Please fill in the blank or check the boxes in the column or circle response(s) which corresponds with your answer(s).

1. Your Age _____
2. Your Gender _____
3. Education: please indicate all that apply and in what field (e.g., zoology, veterinary medicine, veterinary pathology)
   a. Certificate in___________________________________________________
   b. Associate in_____________________________________________________
   c. Diploma in_______________________________________________________
   d. Baccalaureate in__________________________________________________
   e. Master's in________________________________________________________
   f. Doctorate in_______________________________________________________
   g. Post Doctorate in__________________________________________________
   h. Specialty Certification/Diplomate in________________________________
   i. Other ____________________________________________________________
4. Years of Experience in Veterinary Health/Medicine ______
5. Employment Status (please check):
   a. Full time in Veterinary Health/Medicine (at least 32 hours/ week) ______
   b. Part time in Veterinary Health/Medicine (less than 32 hours per week) ______
   c. Not currently employed in Veterinary Health/Medicine ______
   d. Student ______

If employed in Veterinary Health/Medicine, please use your current position as a reference to complete the remainder of the survey and continue to the next section.

If you are not employed in Veterinary Health/Medicine, please complete the remainder of the survey using your most recent Veterinary Health/Medicine experience as a reference.
6. Which one of the following best describes your workplace setting? (please check one)
   a. ____Hospital (including Veterinary Teaching Hospitals) — a facility in which the practice conducted typically includes in-patient as well as out-patient diagnostics and treatment.
   b. ____Clinic— a facility in which the practice conducted may include in-patient as well as out-patient diagnosis and treatment.
   c. ____Office — a veterinary practice where a limited or consultative practice is conducted and which typically provides no facilities for housing or in-patient diagnostics or treatment.
   d. ____Mobile Practice — a veterinary practice conducted from a vehicle with special medical or surgical facilities, or from a vehicle suitable for making house or farm calls.
   e. ____Emergency facility — a facility with the primary function of receiving, treating, and monitoring of emergency patients during its specified hours of operation. A veterinarian is in attendance at all hours of operation and sufficient staff is available to provide timely and appropriate care.
   f. ____On-call emergency service — a veterinary medical service where veterinarians and staff are not necessarily on the premises during all hours of operation.
   g. ____Specialty facilities — a veterinary/animal facility that provides services by board-certified veterinarian(s) specialists.
   h. ____Referral facilities — a facility which provides services by those veterinarians with a special interest in certain species or a particular area of veterinary medicine.
   i. ____Other (Please specify) __________________________________________________

7. Which one of the following best describes your present position? (please circle one letter)
   a. Veterinary Receptionist
   b. Veterinary Assistant
   c. Veterinary Technician
   d. Veterinary Technologist
   e. Veterinarian
   f. Administrator/Veterinary Practice Manager
   g. Veterinary Office Manager
   h. Veterinary Hospital Administrator
   i. Faculty/Researcher/Consultant
   j. Supervisor (or Assistant)
   k. Infection control manager
   l. Other (please specify) __________________________________________________
8. Which one of the following best describes your primary area of practice?
(please circle one letter)
   a. Avian Practice
   b. Equine Practice
   c. Beef Cattle Practice
   d. Feline Practice
   e. Canine/Feline Practice
   f. Exotic Companion Mammal Practice
   g. Food Animal Practice
   h. Dairy Practice
   i. Reptile and Amphibian Practice
   j. Mixed Practice (please specify)_________________________
   k. Specialty Practice (please specify)________________________
   l. Other (please specify)______________________________

9. In your present veterinary position, are you aware of any occupational hazards that could endanger your health? (please circle one letter)
   a. Yes
   b. No
   c. Do Not Know

PART II: Occupational Hazards

This section lists the five categories of possible or actual occupational hazards to which you may be exposed in the course of your work within your workplace setting including:

1. Biological/Infectious Risks—Infectious biological agents, such as bacteria, viruses, fungi, or parasites, that you may come into contact with infected animals or contaminated secretions/fluids.

2. Chemical Risks—Chemicals which are used in the workplace which may have potentially toxic or irritating effects on you, including pharmaceuticals, cleaning products, and anesthetic gases.

3. Enviromechanical Risks—Environmental or mechanical hazards faced in the workplace with the potential to cause or potentiate accidents, injuries, strain, or discomfort.

4. Physical Risks—Various physical hazards within the work environment that can cause trauma or discomfort such as nonionizing radiation, heat stress, and noise.
5. **Psychosocial Risks**—Hazards encountered in the workplace which may play a role in increased stress, emotional strain, and/or interpersonal problems.

*Please use the following Likert scale to indicate the degree to which you feel at risk for adverse health effects (harm/disease) from the specific agent, exposure, or concern for each item in each of these categories.*

*To the left of each item, write in the appropriate scale number that best represents your estimation of your degree of risk.*

1. **No Risk** – no concern about this hazard
2. **Some Risk** – some concern about this hazard
3. **Undecided** – uncertain if this is relevant hazard
4. **Moderate Risk** – generally concerned about this hazard
5. **Great Risk** – often or always concerned about this hazard

**Category 1—Biological/Infectious Risks**

1. Rabies
2. Cytomegalovirus
3. Other Enteric pathogens
4. Ringworm
5. Sarcoptic Mange
6. Cryptosporidiosis
7. Giardia
8. Salmonella
9. Campylobacter
10. Listeriosis
11. Toxoplasmosis
12. Roundworms
13. Brucellosis
14. Cat Scratch Fever
15. Leptospirosis
16. Pasturellosis
17. Tularemia
18. Histoplasmosis
19. Psittacosis
20. Cryptococcus Neoformans
21. Q-Fever
22. Tuberculosis
23. Capnocytophaga Canimorsus
24. Other(s): Specify
Category 2—Chemical Risks
__1. Anesthetic agents/anesthetic gases
__2. Antimicrobials/antibiotic drugs
__3. Micotil 300
__4. Disinfecting agents
__5. Ethylene oxide
__6. Formaldehyde/formalin
__7. Mercury
__8. Latex
__9. Chlorine Bleach
__10. Solvents
__11. Cisplatin
__12. Doxorubicin
__13. Other Antineoplastics (chemotherapeutic) agents/drugs
__14. Chloramphenicol
__15. Corticosteroids
__16. Prostaglandins
__17. Glutaraldehyde
__18. Peracetic acid
__19. Other(s): Specify___________________________________________

Category 3—Enviromechanical Risks
__1. Animal bites
__2. Sharps and needlestick injuries
__3. Awkward body positions
__4. Awkward hand posture with high hand force
__5. Bent back with twist
__6. Animal restraint procedures
__7. Air quality issues
__8. Inadequate ventilation
__9. Lifting/pushing/pulling of sedated animals
__10. Slippery flooring
__11. Inadequate work area
__12. Eye splashes
__13. Workplace violence/hostility
__14. Awkward reaching and lifting
__15. Working with hand or elbow above the shoulder
__16. Maintaining a crouched position for an extended period of time
__17. High hand force (squeezing/clenching fist)
__18. Poor lighting
__19. Other(s): Specify___________________________________________
Category 4—Physical Risks
___1. Non-ionizing radiation (radiography)
___2. Heat or cold stress
___3. Laser exposure
___4. Radiotherapeutic agents/waste
___5. Noise
___6. Electrical hazards
___7. Airborne particles/eye hazards
___8. Other(s): Specify____________________

Category 5—Psychosocial Risks
___1. Long hours
___2. Insufficient breaks or time away from work
___3. Concerns regarding financial solvency
___4. Concerns about aggression towards you by animals’ owners/others
___5. Emotional demands/strain of coping with ill animals/animal death
___6. Pressure to keep up with schedule/increase productivity
___7. Inadequate staffing
___8. Deficiency of co-worker support
___9. Physical demands/workload
___10. Long hours/weekend shifts/on-call coverage
___11. Sexual harassment
___12. Demanding animal owners
___13. Poor implementation of technology
___14. Balancing work & personal life
___15. Physical hazards in the workplace
___16. Animal euthanasia
___17. Lack of peer interaction
___18. Lack of recognition from general public
___19. Financial remuneration
___20. Non-financial remuneration
___21. Other(s): Specify_____________________

PART III: Related Factors

This section asks your own opinion regarding occupational health and safety in the field of Veterinary Health/Medicine.

For each of the statements that follow please respond using the Likert scale below to indicate the degree of agreement with the statements. Please record your opinion using the corresponding scale number to the left of each statement.
1 – Strongly Agree
2—Agree
3—Undecided
4—Disagree
5—Strongly Disagree

___1. One of the major reasons for workers leaving the veterinary health field is the fear of the occupational hazards to which workers are exposed.

___2. The employer gives workers sufficient training and background in occupational health and safety that should make them feel safe in the work environment.

___3. It is up to the employer to ensure the safety of the workplace.

___4. There are certain hazards which are unavoidable in the veterinary health workplace.

___5. It is the role of the veterinary health worker to help identify hazards to the employer.

___6. The veterinary health worker should understand all of the hazards which are present in the workplace.

___7. Veterinary health workers are generally very knowledgeable about workplace health hazards.

___8. Veterinary health workers are unable to control the health-endangering conditions of their work.

___9. Most veterinary health environments have implemented an effective workplace safety program.

___10. The workplace safety culture encourages workers to suggest a change in workplace practices which they consider hazardous.

___11. Veterinary health staff generally recognize when an animal may need to be restrained prior to performing a procedure.

___12. Veterinary health staff are typically not too apprehensive to ask an animal’s owner if they are able to restrain an animal prior to a procedure.

___13. Veterinary health workers wear personal protective equipment based on the perceived risks posed by an animal.
___14. Veterinary health workers have received adequate training in safe and humane restraint of an animal.

___15. Veterinary health staff often feel restraining an animal is unnecessary.

___16. Most veterinary health workers typically have the same views on workplace hazards.

___17. Most veterinary health organizations will make changes promptly if new hazards are detected in the workplace.

___18. Most veterinary health workers recognize the importance of maintaining a physically safe work environment.

___19. Veterinary health workers may choose to step away from environments which they feel are unsafe.

___20. Most veterinary health workers are aware of laws and guidelines published by national organizations for the health and safety of veterinary health workers (for example, OSHA and AVMA).

___21. Most veterinary health workers recognize the importance of following their organization’s infection control policies and procedures.

___22. Most veterinary health staff know how to protect themselves from hazards and therefore oversight from outside agencies is unnecessary.

___23. There are not many biological agents to which workers are regularly exposed.

___24. Most veterinary health staff are concerned about upsetting the animal’s owner if the staff puts on personal protective equipment in their presence.

___25. Overall most veterinary organizations do a great job with occupational health and safety in the workplace.

The following is a list of 10 possible reasons that animal care staff, do not follow health and safety protective measures. Using the numbers 1 through 10, please rank order these reasons from the most influential reason not to follow protective measures (=1) to the least influential reason (=10).

Put a "1" next to the reason that you feel is the most influential reason, a "2" by the second most influential reason, a "3" by the third most influential reason, and so on through to number "10". The one you think has the least influence to follow protective measures should have a rank of "10."
Each item should have only one rank number.

___ Belief that veterinary health practice has inherent dangers which are unavoidable and cannot be minimized through available control measures

___ Belief that animals carry diseases that can impact human health

___ Coworkers do not always follow the rules

___ Belief that workers are too young or healthy to be injured in the workplace

___ Concern that the animal’s owner may be offended or will be made uncomfortable by the protective measures taken

___ Indifferent attitude

___ Inability to break bad habits or work practices

___ Lack of management oversight

___ Lack of readily available personal protective equipment

___ Lack of forethought in preparing for a surgery or procedure

PART IV: Related Concerns

Please respond to the following statements or questions by circling the number that best corresponds to your opinion or answer.

1. I am concerned about my workplace exposures to hazardous agents.

   None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
   1                2                 3                   4                   5

2. My co-workers and I have talked about workplace hazards.

   None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
   1                2                 3                   4                   5
3. I have advocated for additional safety measures in my workplace.

<table>
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<tr>
<th>None/Very little</th>
<th>To some degree</th>
<th>Undecided</th>
<th>To a moderate degree</th>
<th>To a great degree</th>
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4. I have advocated for additional personal protective equipment in my workplace.

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<th>None/Very little</th>
<th>To some degree</th>
<th>Undecided</th>
<th>To a moderate degree</th>
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5. I have requested additional training related to occupational health and safety in the workplace.

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<th>None/Very little</th>
<th>To some degree</th>
<th>Undecided</th>
<th>To a moderate degree</th>
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6. I have requested additional clarification of policies and procedures related to occupational health and safety in the workplace.

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<th>None/Very little</th>
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<th>Undecided</th>
<th>To a moderate degree</th>
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7. I routinely encourage others to follow proper safety policies and procedures and/or don additional personal protective equipment when needed.

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<th>None/Very little</th>
<th>To some degree</th>
<th>Undecided</th>
<th>To a moderate degree</th>
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8. I share my concerns about occupational health and safety in my workplace with my friends and family.

<table>
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<tr>
<th>None/Very little</th>
<th>To some degree</th>
<th>Undecided</th>
<th>To a moderate degree</th>
<th>To a great degree</th>
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9. I am concerned that I may unknowingly bring a contagious disease into my home.

<table>
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<th>None/Very little</th>
<th>To some</th>
<th>Undecided</th>
<th>To a moderate</th>
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10. I am comfortable in asking my peers for their emotional support.

None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
1  2  3  4  5

11. I am at greater risk of being exposed to certain workplace hazards than my co-workers.

None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
1  2  3  4  5

12. I recognize the importance of following occupational health and safety policies and procedures to minimize potential hazards in my workplace to a greater degree than my peers.

None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
1  2  3  4  5

13. Have you ever been employed in an animal care position during a pregnancy? (please check)

☐ Yes  ☐ No

14. If you answered "yes" to question 13 please answer the following: During my pregnancy I was concerned about my job endangering my pregnancy.

None/Very little  To some degree  Undecided  To a moderate degree  To a great degree
1  2  3  4  5

15. Have you ever considered leaving or changing your present position because of the occupational hazards related with the job?

☐ Yes  ☐ No
CHAPTER IV
RECOMMENDATIONS / NEED FOR FURTHER RESEARCH

Veterinary health workers are at a high risk for a variety of injuries and illnesses related to their employment. They are exposed to a variety of biological, chemical, enviromechnical, physical, and psychosocial risks on a daily basis. There are three areas of focus which could help guide the future of occupational health and safety for this group of workers: recognition of hazards, improved practice/policies, and further research.

One of the most important considerations for veterinary health workers would be enhanced hazard recognition mechanisms. Additional worker training in hazard recognition could increase awareness of potential hazards to prompt workers to take the necessary precautions or don the prescribed PPE.

There are some occupational health recommendations related to several areas of veterinary health but there does not appear to be one singularly recognized source for a comprehensive program. In similarly hazardous occupations there are comprehensive occupational health guidelines developed by a national professional organization (National Fire Protection Association, 2013). If there was a similarly recognized and equally comprehensive program document, it would be useful for veterinary facilities when refining their occupational health and safety programs. There are also numerous human health care worker standards which could be adapted to the veterinary health worker.

There are also several areas of veterinary health practice which could be improved to enhance worker safety. Veterinary health workers are known to treat their injuries themselves rather than seek external health care services and report the injury (Weese & Douglas, 2008).
This treatment can lead to exacerbated medical conditions and underreporting of illness and injury rates. Veterinary practices should encourage reporting so that medical professionals can assess the injury and treat if needed. Timely reporting will also allow tracking of illnesses and injuries to put in place strategies to mitigate hazards and risks.

Veterinary health workers should also receive comprehensive training in management of workplace hazards throughout their academic career, at the beginning of new employment, and augmented by recurrent training throughout their careers. Occupation-specific health and safety training can be developed and then integrated into all levels of precursor veterinary education so that workers are habituated to safe work practices by the time they begin in the workforce. This training should emphasize the safe handling, lifting, and restraint of animals; the proper use of equipment, anesthetics, and medications; and discussion about psychosocial stressors. Management best practices should include training of newly hired personnel in general occupational health and safety tailored to the type of veterinary practice as well as the need for periodic updating of all workers in reviewing the health and safety issues within the organization.

There is a noticeable lack of current research on injury and illness rates of veterinary health workers and specific to work-related hazards, the impact of occupational health and safety (including training) programs on reducing these rates, the presence of risk factors which may predispose a specific sub-population of workers to higher rates, and veterinary health worker knowledge about work hazards. Little data are available publicly to tabulate specific illness and injury rates or to estimate the cost of specific types of common injury events. Using the instrument developed here could provide substantial data about specific hazards in an effort to mitigate risk and improve work conditions. Studies located which have documented how
implementation of occupational health and safety programming has affected injury and illness rates among veterinary health staff could not be found. Future research should be conducted to determine which safety interventions are most broadly accepted by this workforce. Many workers tend to work without personal protective equipment due to a long history with these work habits (Jackson & Villarroel, 2012). Studies could be done to understand what would encourage behavior change in veterinary health workers to begin wearing recommended personal protective equipment at all times. Researchers could undertake studies to discover any potential link between pre-existing risk factors (such as previous injuries) and occupational injuries (particularly musculoskeletal disorders (MSDs) of the upper and lower extremities) in order to design future programming to prevent these types of injuries.

Limited research documents that veterinary health workers have a large, diverse, and often underappreciated set of workplace hazards. Research over the past decade has not resulted in improved occupational health and safety for these workers based the published BLS incidence rates (U.S. BLS, 2015d). Additional occupation-specific resources such as a comprehensive occupational health standard could be created through joint efforts from the government (through OSHA and NIOSH) and industry groups (such as AVMA and AAHA) in promoting healthier workplaces to combat these hazard challenges.

Conclusion

The available data suggest that illness and injury rates have not improved despite some research into their current occupational health and safety working conditions. Veterinary health workers need the focused attention of experts in occupational health and safety such as occupational medicine physicians, occupational health nurses, industrial hygienists, safety professionals, and ergonomists to develop more effective programming tailored for the unique
needs of the veterinary health worker. These programs should be developed to fit the specific needs of the targeted organization based on the type of veterinary practice, current occupational health programs, worker involvement, and illness and injury experience.

The tool developed here is for research purposes. Through research better occupational health and safety programs can be developed and veterinary health workers can continue providing care to animal companions while remaining healthy and safe in their workplace.
REFERENCES


