THESIS

REVIEW, ASSESSMENT AND PRIORITIZATION FOR AN OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM IN A VETERINARY TEACHING HOSPITAL USING THE ANSI/AIHA Z10 STANDARD

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ABSTRACT

REVIEW, ASSESSMENT AND PRIORITIZATION FOR AN OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM IN A VETERINARY TEACHING HOSPITAL USING THE ANSI/AIHA Z10 STANDARD

There are many hazards that could cause employee injuries and illnesses in veterinary hospitals. An effective way to control hazards in any organization is the implementation of an Occupational Health and Safety Management System (OHSMS). However, there are no published reports of any veterinary hospital that has successfully implemented an OHSMS using the ANSI/AIHA Z10 Standard. In 2005, the voluntary standard, Occupational Health and Safety Management Systems (ANSI/AIHA Standard Z10-2005) was published to assist organizations in implementing an OHSMS. This research was focused on the development of the initial stage of an OHSMS at Colorado State University (CSU)'s Veterinary Teaching Hospital (VTH), following the ANSI/AIHA Standard. The VTH was audited in 2003 and 2009 revealing significant health and safety hazards, yet there was little improvement in health and safety performance between the two audits. The rationale for this study was to improve the health and safety performance at the VTH as well as provide a template that other veterinary hospitals may use to develop and implement an OHSMS. Through a health and safety assessment and employee interviews at the VTH, the researcher identified hazards; conducted a comprehensive hazard analysis and risk

assessment of the service areas; identified applicable regulations, standards, and requirements; prioritized health and safety issues based on risk; and recommended protective strategies for each service area to lower the health and safety risk. Per the risk assessment and prioritization strategy of the 20 service areas that were evaluated, Large Animal Surgery was the number one service area priority followed by Livestock and Small Animal Surgery. Identified issues in these service areas were related to confined spaces, lack of lock-out tag-out procedures, chemical storage, and zoonotic disease. The service area with the lowest priority rating was Reception/Call Center/Business Office/Medical Records. Except for the Maintenance Service Area risks, all other serious health and safety risks affected all or the majority of the hospital and included violent patients, anesthetic waste gas, zoonotic disease, formalin, and lasers.

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I am grateful to the Colorado State University Veterinary Teaching Hospital personnel who were so helpful and even enthusiastic with this research. Last, I would like to thank the College of Veterinary Medicine and Biomedical Sciences (CVMBS) for funding and the National Institute for Occupational Safety and Health (NIOSH) Mountain and Plains Education and Research Center (MAP ERC) training grant for supporting my graduate education.

DEDICATION

I would like to dedicate this work to my loving family. A special thanks to my mother who has offered me unconditional love, patience, and guidance throughout my life.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

CHAPTER 1 – INTRODUCTION

Close to 24,000 workers are injured every eight hour work day and almost 17 workers are killed on the job each day in the United States (OSHA, 2007). In 2009 there were 3,277,700 recordable nonfatal injuries and 4,340 fatalities (Bureau of Labor Statistics, 2009). Hospitals had a rate of 7.3 recordable injury and illness cases per 100 full-time workers in 2009 and specialty hospitals had 168,700 injury and illness cases (Bureau of Labor Statistics, 2009). These incidents not only cause immense pain and suffering to friends and families, but these injuries, illnesses and fatalities are estimated to cost $170 billion dollars per year (OSHA, 2008). The National Safety Council estimated $1,330,000 per death and $53,000 per disabling injury (National Safety Council, 2009).

Veterinary Hospitals have a greater than average risk for injuries and illnesses than many other occupations (Jeyaretnam & Jones, 2000; Blair & Hayes, 1982). Injury rates for veterinarians are at least 10 per 100 cases per year (Landercasper, Cogbill, Strutt, & Landercasper, 1988; Langley, Pryor, & O'Brien, 1995; Hashemi, Brown, & Buckley, 1990; Poole, 1998) and 23 per 100 shown in another case (Gabel, 2000). These numbers do not include the many medical doctors who self treat and do not report their injuries and/or illnesses (Landercasper, Cogbill, Strutt, & Landercasper, 1988). Most of the risk is due to animal-related injuries and the most costly injuries are strain and back injuries (Landercasper, Cogbill, Strutt, & Landercasper, 1988). Researchers conducted a study of all the veterinarians in North Carolina which showed injury rates for major animal-related trauma were 67.8% (474/701)

(Langley, Pryor, & O'Brien, 1995). Landecasper, et. al., reported most severe animal-related career injury from kicks 35.5% (279/785) and bites 34% (267/785). A 2007 survey of registered practicing veterinarians found that 28% of veterinarians (105/371) experienced zoonotic illnesses during their career (Lipton, Hopkins, Koehler, & DiGiacomo, 2008). Although literature has been found on the subject, the area is relatively unexplored (Gabel & Gerberich, 2002).

There is an even greater risk for injuries and illnesses in Veterinary Teaching Hospitals. This is due to high referral case load, relative inexperience, naïveté due to student populations, and constant research and use of emerging techniques and technologies. Researchers found in a study that included 28 veterinary schools in the United States (U.S.) and Canada that veterinary teaching hospitals have a higher number of injuries and illnesses. (Morrow & Langley, 1996). Furthermore, the Bureau of Labor Statistics (BLS) reported that 40% of workers injured on the job had been there for less than one year, indicating that if one is new at their job (students, volunteers, or new hires); they are more likely to be injured. The reason reported for this, however, was not naïveté per se, but lack of information or experience. In 2003, a study was conducted that included 27 U.S. veterinary schools (all that were in operation at that time) to determine improvement of nontechnical skills, knowledge, aptitudes, and attitudes of veterinary students. The article was not detailed, but the authors suggested changes to admissions, orientation, curriculum, co-curricular activities, and other programs to improve the veterinary profession. However, the authors did not address health and safety knowledge, attitudes, or culture (Lloyd & King, 2004). The Healthy People Report of 2010 focused on veterinary medicine opportunities, but it was aimed at food safety, disease prevention, and the benefits of being a pet owner. It was more focused on the pet owner rather than the veterinarian and did not address many important health and safety issues (Hendrix, McClelland, Kahn, Thompson, & Pence, 2002).

Occupational Health and Safety Management Systems (OHSMS) are an effective way to reduce injuries, illnesses, fatalities, and costs. The costs saved from a functional OHSMS are greater than the costs of implementing it, and the final result is decreased injuries, illnesses, and fatalities; billions of dollars saved, improved productivity, and increased employee morale (OSHA, 2008).

There are many tools and various OHSMS that are available for use (Bovornsuppasri, 2005). However, few studies have been done on the analysis, comparison, and use of these systems. A study conducted in Canada described methods to implement data systems in order to assist occupational health programs in hospitals (Yassi, 1998). In an unpublished study (master's thesis) written in 2010, the author compared the OSHA Consultation Form 33 (a safety and health assessment form used to assess OHSMS) with the ANSI/AIHA Z10 - 2005 Standard and concluded there were many elements in the ANSI Z10 Standard that were not covered in the OSHA Form 33. In addition, an OSHA Consultant must be trained and certified to use Form 33 which is defined as 'tool' whereas ANSI Z10 is a 'standard' designed so that non-trained and non-certified employees can implement it (Henk, 2010). In another comparative study conducted in Australia, the researchers compared 10 OHSMS including both Australian and international systems. The ANSI Z10 Standard was concluded to be by far the most comprehensive system with 48 of the 57 elements used for analysis. Only one of the systems stressed the importance of task hazard analysis, which was an attribute that the ANSI Z10 Standard did not address. The ANSI Z10 Standard was said to be direct and confronted problems with reporting injuries and illnesses and included details such as cautioning against incentive schemes for decreasing incidence rates (Makin & Winder, 2009).

There are many hazards that could cause injuries and illnesses in veterinary hospitals and the risks have been shown to be greater, yet there are no published reports of any veterinary hospital in the U.S. of successfully implementing an OHSMS. A [human] hospital in Victoria, Australia implemented an OHSMS, but it was not based on the ANSI Z10 Standard and the effectiveness has not been published (Department of Human Services-Public Hospital Sector, 2003). Another study addressed an occupational health system in a hospital in Romania, but it was not nearly as comprehensive as the Australian 2003 OHSMS or the ANSI Z10 Standard (Rapas, Predut, Mocanu, & Popescu, 2000).

Based on a current literature review, no veterinary hospital in the world has successfully implemented an OHSMS using the ANSI/AIHA Z10 Standard. The purpose of this study was to complete the initial steps toward the goal of implementing a successful OHSMS using the ANSI Z10 Standard as a guideline. The Veterinary Teaching Hospital (VTH) at Colorado State University (CSU) was chosen as the site of this research project. The framework of this study could assist veterinary hospitals across the U.S. and even the world in implementing the initial stages of an OHSMS. Veterinary hospitals world-wide that have similar hazards could benefit from the documented process to implement an OHSMS in their own hospitals.

CHAPTER 2 – LITERATURE REVIEW AND BACKGROUND

Management Systems

A management system is a proactive process with an organized set of components which enable an organization to accomplish a set of goals. Management systems usually focus on continuous improvement using the plan-do-check-act model. A goal could be anything from facilitating the flow of information to improving quality to minimizing losses from accidents and injuries (Pascal, 1997). There are many types of management systems; environmental (Saad, 2003; International Organization for Standardization), hazardous waste (Massoomi, Neff, Pick, & Danekas, 2008), infectious disease (Tomiczek, Stumpo, & Downey, 2006) and many more. When implementing a management system, it is important to note how multiple management systems will work together. In 2004, a study was conducted on two different methods to implement an integrated management system (IMS), which combined quality (ISO 9000), environment (ISO 14000), and health and safety. One method was to implement separate management systems and then create an IMS. Alternatively, the management systems could be implemented as a single system that encompasses all three from the beginning. The researchers successfully implemented an IMS in two different companies using the two different methods (Labodová, 2004). The International Organization for Standardization (ISO) creates all its standards to be compatible for just this reason. The ANSI Z10 Standard is ISO compatible as well.

Occupational Health and Safety Management Systems

A management system specific to occupational health and safety is comprised of four interrelated components. These include management leadership and employee involvement; worksite analysis; hazard prevention and control; and safety and health training (OSHA, 2008). OHSMS are performance oriented as opposed to compliance oriented. They use risk management to evaluate success as opposed to "body count" data (Doidge, 1997). For an OHSMS to be successful there must be emphasis on management leadership, management-employee communication, and human behavior factors. Management must lead the safety culture consciousness (Barnes, 1991). A safe work environment strengthens and supports individual safety behaviors, and this further affects behavior due to the influence workers have on one another. Furthermore, safety climate is correlated with employees' compliance to safe work practices as well as workplace exposure incidents (Gershon, et al., 2000). Management is the motivational force and the source of necessary resources for employees. The OHSMS should have a health and safety policy, goals and objectives to demonstrate management's involvement, and lastly, management should lead by example (Henk, 2010).

The Health Hazard Evaluation (HHE) Program is used by the National Institute for Occupational Safety and Health (NIOSH), however, NIOSH only evaluates each hazard and not a management system as a whole (National Institute of Occupational Safety and Health). The British Standards Institute (BSI), specifically the Occupational Health & Safety Advisory Services (OHSAS) in 1999 wrote an international occupational health and safety management system specification entitled OHSAS 18000 (Occupational Health & Safety Advisory Services, 2007). The BSI 18800 is the guide to the OHSMS which was written in 1996 and updated in 2004. The Canadian Centre for Occupational Health and Safety (CCOHS) published the first Canadian consensus-based workplace standard in 2006 entitled, Occupational Health and Safety

Management (CSA Z1000). As with the OHSAS 18000, this standard was created to be compatible with ISO systems such as ISO 9000 (Quality Management) and ISO 14000 (Environmental Management Standard) (Canadian Centre for Occupational Health and Safety, 2006). Similarly, the International Labour Organization (ILO) created the OSH 2001 which provides guidelines on OHSMS (International Lebour Organization). Australia and New Zealand have several OHSMS standards and guidelines: AS/NZS 4801/4804 (Australian/New Zealand Standard; Occupational Health and Safety Management Systems), Victoria SafetyMAP, Australian Federal Government Safety-Wise, Western Australia WorkSafe Plan, South Australia Safety Achiever Business Scheme, and Queensland Tri-Safe (Makin & Winder, 2009).

Although OHSMS are still emerging and the ISO has not yet been agreed upon an occupational health and safety management system standard, the idea of an OHSMS is not entirely new. In 1989, OSHA created Safety and Health Program Management Guidelines that were published in 54 Federal Register 3904-3916 (Occupational Safety and Health Administration, 1989). The guidelines were never codified into the OSHA regulations due to the following reasons: (1) Not strong enough evidence that the guidelines would be useful; (2) If a different organization of the management program elements would promote the use; (3) If the guidelines should be mandated in a rule format, and (4) Which aspects of the safety and health management program should be in writing (OSHA). In 1982, before the guidelines were written, OSHA created the Voluntary Protection Program (VPP) which allowed worksites to implement systems to manage worker health and safety with the assistance of OSHA resulting in a qualifying Merit or Demonstration status (OSHA, 2007). A more recent OHSMS standard is the ANSI/AIHA Z10 – 2005 Standard published by the American National Standards Institute (ANSI) with the American Industrial Hygiene Association (AIHA). This standard is ISO and VPP compatible and can be used for any size and any type of organization. The standard was created

with over 40 members from different industry, labor, government, and special groups (Palassis, 2007), and is the first American consensus OHSMS standard.

As of 2007, only 30% of businesses have established health and safety systems (OSHA, 2007). Proctor and Gamble implemented an OHSMS that was designed to emphasize continuous improvement in health and safety. No standard was followed, but the elements used were not uncommon: organizational planning and support, standards and practices, training, and accountability and performance feedback (Fulwiler, 1993). A study done in Greece used the ISO 18001 (Information technology -- Radio frequency identification for item management -- Application requirements profiles) to construct a web file server, which served as a communication tool both within a hospital and between hospitals. The web file server was a means of supporting the OHSMS (Velonakis, Mantas, & Mavrikakis, 2006).

The OHSMS that was created in Victoria, Australia by the Department of Human Services – Public Hospital Sector was comprised of 15 individual elements which were divided into the following three categories: system structure, system activity, and system review. The components of each system are found in Figure 1. Although hard to directly compare (due to structure of the standards) all 15 components are present in the ANSI Z10 Standard. Similarly, the components not present in the system below which are in the ANSI Z10 Standard are management leadership, employee participation, planning elements, hierarchy of controls, and communication.

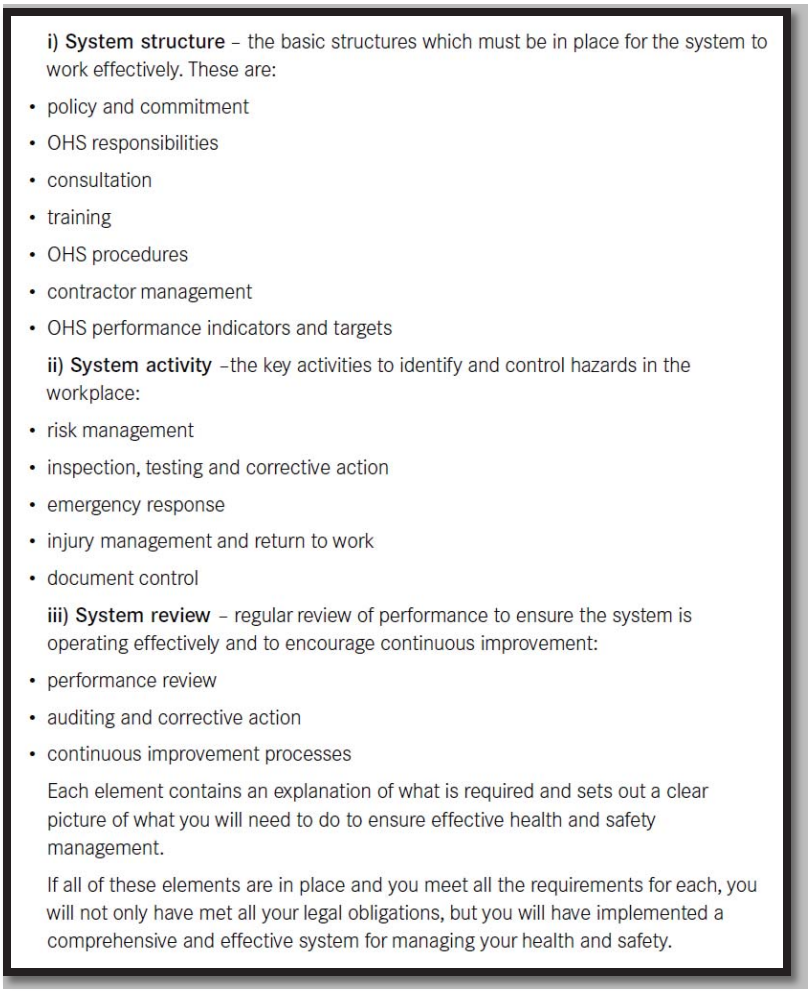

Figure 1: Structure of the Victoria, Australia Hospital OHSMS.

(Department of Human Services-Public Hospital Sector, 2003)

Benefits of OHSMSs

In addition to lowering injury/illness incidence rates, OHSMS can be financially beneficial for organizations. Studies have shown a $4 to $6 return for every dollar invested in health and safety (OSHA, 2007). A recent study of 116 companies showed that those companies that implemented OHSMS had a higher number of safety performance measures than the companies that did not implement such a system (Bottani, Monica, & Vignali, 2009). In 2007, a comprehensive review on the effectiveness of OHSMS interventions was published. The researchers found in general positive results, but did not provide a solid statement of support of

OHSMS due to the relatively small number of published studies (13) and the heterogeneity of the OHSMS interventions found. From the eight databases searched and the criteria for the study, only one hospital was included in the study (Yassi, 1998; Robson, et al., 2007). The benefits of an OHSMS are further supported by Manuele who describes that positive safety culture decreases injury and illness rates and that implementing an OHSMS can lead to the improved safety culture. It is specifically stated that the ANSI Z10 Standard can lead to these decreases injuries and illnesses (Manuele, 2008).

ANSI/AIHA Z10 – 2005 Standard

The ANSI Z10 Standard was published in 2005, and prior to this there was no consensus standard of an OHSMS in the U.S. The Standard was created based on ISO and VPP standards (Palassis, 2007). The premise of the ANSI Z10 Standard is that it can be easily integrated into current business systems. A major resource in creating this standard was the International Labour Organization's guidelines on Occupational Health and Safety Management Systems (ILO-OSH 2001). The ANSI Z10 Standard was intentionally created to be in harmony with ILO; however the Z10 Standard goes beyond the ILO guideline in certain respects. In addition, the Z10 Standard was designed to be considered by the International Organization for Standardization (ISO) (American Society of Safety Engineers). Furthermore, the Z10 Standard is compatible with other ISO Standards such as ISO 9000 (quality management systems) and ISO 14000 (environmental management systems). The ANSI Z10 Standard is comprised of six sections and 11 appendices which can be found in Appendix A (Manuele, 2008). Another aspect of the Z10 Standard is that it is not a specification standard, rather, it is a management system standard. This means that it provides broad *mandatory* elements and then *suggested* implementation strategies. This design was used because every organization may have different

implementation specifications based on the seriousness and risk of the organization's hazards and organizational structure. This approach maximizes the effectiveness of the OHSMS.

The ANSI Z10 Standard is compatible with the principles and tools developed by OSHA through the Voluntary Protection Program (VPP) (Palassis, 2007). The participants in OSHA's 2010 Injury and Illness Prevention Programs Stakeholder Meeting noted that the ANSI Z10 Standard was an effective model for improving worker health and safety (OSHA, 2010), especially the annual management review element (OSHA, 2010).

A key part of implementing a successful OHSMS is behavior change (Green, Kreuter, Deeds, & Partridge, 1980). The ANSI Z10 Standard takes this into account by emphasizing management leadership and employee participation.

To date, most literature pertaining to the ANSI Z10 Standard provides summaries of the standard, benefits of an OHSMS, and/or comparisons with other OHSMS (Manuele, 2008; Henk, 2010). Studies of implementation and system effectiveness of the ANSI Z10 Standard are not yet available. However, based on a review of the effectiveness of OHSMS implementation (Robson, et al., 2007), it is predicted that successful implementation of the ANSI Z10 Standard would have positive effects on safety and health culture, incidence rates, and financial losses (Henk, 2010).

Colorado State University Veterinary Teaching Hospital (CSU VTH)

Two health and safety audits were conducted at the VTH, but no formal plans to change the culture, control the hazards, or create an OHSMS were made. The 2003 auditor noted that the VTH had no comprehensive baseline and periodic surveys and no regular safety and health inspections. In addition, there was no facility-wide hazard prevention and control procedure. There was a system for reporting accidents, but not everyone knew how to use it or even knew that it existed; and there was no root cause analysis or incident trend analysis. There was not

much training associated with the job tasks, and the training that did exist did not typically have documentation associated with it. A few hazards were identified and abated, but these were only the results of reactive actions. The 2003 auditor did not assess radiation, hazardous waste disposal, biosecurity, or controlled substances.

In 2009, another audit was conducted without signs of much improvement from 2003. The audit conducted in 2009 was primarily based on OSHA regulations because these were generally considered minimum required standards. Over 100 inconsistencies with respect to OSHA criteria were found. The majority of the inconsistencies were related to electrical hazards. There was also a lack of safety controls, emergency and prevention plans, and hazards associated with walking and walking surfaces. Other deficiencies included issues associated with hazardous materials, personal protective equipment, environmental control, first aid, fire protection, material handling and storage, machinery and machine guarding, hand and portable powered tools, and toxic and hazardous substances.

CHAPTER 3 – PURPOSE AND SCOPE

The purpose of this project was to accomplish two specific elements of the ANSI Z10 Standard at the Colorado State University (CSU) Veterinary Teaching Hospital (VTH), including Initial Review (element 4.1.1), and Assessment and Prioritization (element 4.2). In addition, ANSI Z10 element, Management Leadership and Employee Participation (element 3) was taken into account.

The initial review included (1) Creating a walkthrough checklist, interview questionnaire, and preliminary hazard assessment (PHA) matrix; (2) identifying hazards within the VTH; and (3) identifying the culture by noting management leadership and employee participation relative to health and safety. Assessment included (4) conducting a comprehensive risk assessment of service areas within the VTH; and (5) identifying regulations, standards, and/or requirements; (6) assessment of the management leadership and employee participation. Prioritization included (7) using the risk analysis to prioritize which service areas and issues management should address first; and (8) recommending protective strategies for each service area.

The scope of this project included the initial review; and assessment and prioritization of hazards and culture of the service areas in the VTH which were categorized into 20 different areas. The service areas included: (1) Reception/Call Center/Business Office/ Medical Records, (2) Maintenance, (3) Custodial/Animal Care, (4) Custodial/Barn Animal Care, (5) Pharmacy, (6) Central Supply, (7) Anesthesia, (8) Critical/Urgent Care, (9) Ophthalmology, (10) Dermatology, (11) Neurology, (12) Livestock, (13) Equine, (14) Small Animal Medicine, (15) Small

Animal Surgery, (16) Oncology, (17) Exotics, (18) Clinical Pathology, (19) Dentistry, and (20) Large Animal Surgery.

The rationale for this study was to create a baseline assessment, improve the quality of the health and safety programming at the CSU VTH and to provide a template by which other veterinary hospitals may use the methods and results to develop and implement their own OHSMS.

CHAPTER 4 – METHODOLOGY

Site Selection and Subject Solicitation

The Colorado State University (CSU) Veterinary Teaching Hospital (VTH) was selected via request from the College of Veterinary Medicine and Biomedical Sciences (CVMBS). The VTH underwent two health and safety audits in 2003 and 2009, but did not successfully correct all identified issues.

VTH Human Resources supplied a list of service areas with corresponding supervisor names and contact information. Supervisors were solicited via email for walkthroughs and interviews, and employees were solicited in person due to population size. All research was conducted in accordance with the Colorado State University (CSU) Institutional Review Board (IRB) and the Research Integrity and Compliance Review Office. The interviews were as random as possible to ensure the best representation of the research population. Since there were typically one or two supervisors per service area, there was not much basis for randomization. An email was sent with an IRB approved script asking all supervisors if they would like to volunteer to participate in an interview. Selecting an employee to interview was more randomized. The researcher walked around the hospital and approached groups of employees and used the same approved IRB script for recruitment.

Walkthrough Checklist, Preliminary Hazard Assessment (PHA), and Interview Questionnaire Development

Walkthrough Checklist

A health and safety walkthrough checklist was created to evaluate health and safety hazards at the CSU VTH (See Appendix B). The checklist was largely based on two health and safety audits conducted by external consulting companies in 2003 and 2009. Only health and safety hazards with respect to VTH employees were evaluated in this thesis. Hazards solely related to the public, property, equipment, productivity, animals, and the environment were not assessed. The walkthrough checklist categories consisted of: 1) chemical; 2) physical; 3) explosives, flammables, and combustibles; 4) biohazards; 5) emergency preparedness; 6) general precautions; and 7) administration. Each category was comprised of subcategories and most subcategories had questions which served as a guideline to the researcher.

Certain elements (e.g., training) could not be observed during the walkthrough therefore some supervisors were asked if they would answer questions related to these elements after the walkthrough. However, if the researcher had already determined that an element did not exist (e.g., hearing conservation program), not all supervisors were asked the question related to the element. Examples of these questions included: (1) Have employees received any type of formal or informal hazard training? (2) Do you have a chemical hygiene plan? (3) Do you conduct safety equipment inspections? (4) Is there a hearing conservation program? (5) Are there emergency action plans? Please explain. (6) Is there a first aid kit available? (7) Do you have any reports and/or records related to health and safety?

The items that were evaluated during the walkthrough were either hazards or elements of controlling hazards (noteworthy practices). For data collection, it was noted that a hazard was

either present (denoted by an “x” on the checklist) or not present (denoted by an “NA” on the checklist). The denotations for hazards are as shown below in Table 1. Noteworthy practices (controls) were rated on a scale from 0 to 3, where a score of 0 meant “no control” and a score of 3 meant “good control.” This scale was chosen by the researcher because there is no neutral rating, which forced the researcher to conclude either a mostly positive association (score of 2 or 3) or mostly a negative association (score of 0 or 1). The ratings are as shown below in Table 2:

Table 1: The Code and Definition for Hazards Noted in Walkthrough.

Code	Definition
NE	Not evaluated
NA	not applicable/not present
X	Hazard is present

Table 2: The Score and Definition for Noteworthy Practices.

Score	Definition
0	No/none
1	Minimal
2	Okay
3	Good/yes

Preliminary Hazard Assessment (PHA)

A PHA was developed based on the walkthrough checklist (See Appendix C). A difference between the walkthrough checklist and the PHA was that the checklist contained details on observations whereas the PHA only contained the coding as presented in Table 1 and 2 above.

Interview Questionnaire

A questionnaire was created for supervisors and a slightly different version was created for employees. Supervisors and employees were asked about hazards, training, safeguards

(controls), and risks to obtain a general perspective to compare to the researcher's walkthrough observations. Both were asked about concerns, communication, protection, continual improvement, and involvement to obtain a sense of the safety culture. Also, both were asked about reporting accidents, injuries, and illnesses as well as Standard Operating Procedures (SOPs) to assess general knowledge of the employees.

Employees were asked how to handle an emergency situation during the interview. Supervisors (who volunteered) were asked this question during the walkthrough. During the interview, only supervisors were asked the following questions: (1) "How many employees do you supervise?" (2) "In which service areas do you work?" (3) "Are there hazardous chemicals and subsequent Material Safety Data Sheets (MSDS) in your service areas?"

Many other interview items were considered that could have influenced the respondent's answers to interview questions: the interviewer, the setting in which the interview was conducted, the length of the interview, the order of the questions, the wording of the questions, and conscious or subconscious behavior from the administrator. Since the interviewer's behavior and characteristics could have an effect on the respondent's answers (Frey & Oishi, 1995; Oppenheim, 1992) only one interviewer asked the interview questions to reduce bias and minimize inconsistencies (Schuman & Presser, 1981; Fowler & Mangione, 1990). It was a benefit of interviewing that the interviewer could clarify and probe respondents for more complete answers as well as be confident the respondent interpreted the question in the manner it was meant to be asked (Frey & Oishi, 1995; Houtkoop-Steenstra, 2000). The interview setting was typically in the same room for consistency (Lyberg & Kasprzyk, 1991; Czaja & Blaire, 1996). However, at times the same interview room was not available so a different room had to be used.

Since the sample population was in a hospital and their job duties may have included emergency care, the interviewer kept the interview as short as possible to help ensure that subjects could commit the time to complete the interview. Supervisors were asked 17 questions and employees were asked 15 questions. The interviews were between 30 and 60 minutes. Frey & Oishi (1995) recommended less than 60 minutes for an interview to minimize responder fatigue and less thoughtful or truthful responses (Oppenheim, 1992).

Many questionnaires and interviews use closed-ended questions because they are more efficient and reliable and produce more consistent results to interpret (Fink, 1995). In addition, several studies (Butler & Kitzinger; Belson, 1981; Groves, Fultz, & Martin, 1992) have demonstrated that it is nearly impossible to create a question that all respondents would interpret the same. Despite this, the researcher used open-ended questions because the advantages outweighed the limitations (Houtkoop-Steenstra, 2000), and the interviewer was capable of analyzing the answers (Fink, 1995). The advantages of the open-ended questions used in this study included: (1) interviewee freedom in responding in their own fashion while not limiting response alternatives (Peterson, 2000; Houtkoop-Steenstra, 2000; Fink, 1995); (2) allowance of unanticipated answers and descriptions per the respondent's perception as opposed to the researcher's (Fink, 1995); (3) because respondents were capable of providing their own answers, and all answers were not known (Fink, 1995). The limitations of the open-ended questions used in this study included (1) difficulty in interpretation and ability to compare; and (2) possibility of producing infrequent responses. Questions were, however, written in a clear and concise manner without slang or technical jargon that was not explained (Frey & Oishi, 1995).

Both the supervisor and employee interviews started off with simple, non-threatening, open-ended questions to maintain respondent's interest and give the interview a smooth start by making the response easy. This approach helped build the rapport of the interviewer with the respondent (Frey & Oishi, 1995; Oppenheim, 1992). Last, answers were recorded as close as possible to the exact words respondents used for quotable material and for more reliable analysis (Houtkoop-Steenstra, 2000).

Data Collection Methodology

Data collection consisted of a safety and health walkthrough of the VTH and interviews with employees. The safety and health checklist was used for the walkthrough and the data from the checklist were transferred to the PHA matrix. Interviews with supervisors and employees were then completed and the interview information was added to the PHA matrix.

Walkthrough

Supervisors of each service area were contacted and informed of the intended walkthrough. The researcher met with each service area supervisor prior to the walkthrough. The supervisor showed the researcher which rooms in the VTH were used by the specific service area and pointed out any known hazards or items not to be touched. In some service areas, the supervisor escorted and assisted the researcher, and in others the researcher worked alone.

Questions regarding psychological stress and workplace violence were not asked. Workplace violence is a possibility in every work environment. In 2009, assaults and violent acts were the second leading cause (18%) of fatality in the workplace (Bureau of Labor Statistics, 2010). Psychological stress was assumed present for every service area (U.S. Department of Health and Human Services; Public Health Service; Centers for Disease Control and Prevention;

National Institute for Occupational Safety and Health). Hospitals in general have a higher than average stress level, and even more so in a teaching hospital (BLS, 1997; OSHA).

Employee involvement ratings were based on the interview data. If employees wanted to be involved in health and safety, a score of 2 was given (*okay*), if they wanted to and they were involved, they received a 3 (*good*), if they were not and did not want to be involved, the score was either a 1 or 0 (*minimal* or *none*). The designation between *none* and *minimal* was determined by the answers and attitudes of the respondents.

Similarly, management leadership was scored on attitude and responses. Supervisors who actually showed up to an interview were seen as having a greater priority for management leadership. The scores were subjective and if a supervisor was truly busy this was also taken into account.

Interviews

After all health and safety walkthroughs of the 20 service areas were completed, the researcher conducted employee interviews. Due to time constraints, the goal was to interview one supervisor and one employee from each of the 20 service areas. The main goal of the interviews was to assess management leadership and employee participation. The interviews also provided additional information such as employee perspective of risks and hazards along with the general knowledge of employees. Last, an important reason for taking the time to interview employees was to start a change in the safety culture. Taking the time to sit down and have an open-ended question interview showed employees that someone cared about their perspectives and the health and safety of their workplace. This was proven by the email of gratitude and comments thanking the researcher for conducting the interviews. One respondent stated that with this interview they realized that they do not read the safety signs and have

decided to start. Another stated that the research was important and he/she hoped it helped to protect employees. The authors of the ANSI Z10 Standard wrote that for an Occupational Health and Safety Management System (OHSMS) to be successful there must be strong management leadership and employee participation; these two factors influence the safety culture of an organization.

Data Analysis

The interview data were primarily used to score management leadership and employee participation, which were added to the PHA. The interview data and the walkthrough data were largely analyzed separately and then both used for the assessment of risk from operations within the VTH. The risk assessment was then used to prioritize the service areas based on the identified safety and health issues within the VTH.

Walkthrough Data Analysis

There were 19 hazards that were evaluated during the health and safety walkthrough. The number of hazards present in each service area was summed. There were 30 noteworthy practices that were considered necessary and scored on a 0-3 scale. However, personal protective equipment (PPE) and respiratory protection were not evaluated due to lack of a task-based hazard assessment, which would have identified details such as specific chemical exposure, duration, and frequency. Such details would allow for proper selection of PPE as well as training, medicals exams, etc. that go along with proper PPE use. Therefore, unless a noteworthy practice was not applicable for a service area, there were 28 to be evaluated.

A series of calculations were executed to produce the average quality of noteworthy practices as well as the percentage of practices present within each service area since a mere summation would not have differentiated between a service area performing poorly on many

noteworthy practices verses an area that did very well on a few, but were completely lacking on others. For example, maintenance had 19 out of 28 possible noteworthy practices present in some manner (1-3) which was 68% of possible presence. The sum of the noteworthy practices was 27; divided by the number of practices (19) present equaled one, which was a *minimal* average quality of noteworthy practices. Similarly, equine also had 68% presence of applicable noteworthy practices, but this was 17 out of 25 possible practices present and also a summation of 27. The summation (27) divided by the number of practices present (17) equaled two, which was an *okay* average quality of noteworthy practices. However, it is important to note that even the *average* quality indicator is lacking important information and is just a tool to prioritize. Continuing with the same example, maintenance had one noteworthy practice with a score of 3 whereas equine did not have any noteworthy practices with a score of 3. Specific scores for each noteworthy practice in each service area can be found in Appendix C. By using this appendix, management can decide what is more important to them, higher frequency in presence of noteworthy practices or lower frequency of practices, but done well.

The calculation steps were as follows:

1) The number of noteworthy practices present out of 28 was determined. To conclude this, all applicable practices that had a 1, 2, or 3 score were counted and those with a 0 were not. This was done using the "COUNTIF" function in Microsoft Excel to increase time efficiency and decrease human error. In addition, this was double checked by the researcher.

2) The number of possible noteworthy practices was found (i.e., 28 minus any that were not applicable). This was also executed by using the "COUNTIF" function in Microsoft

Excel to increase time efficiency and decrease human error. Again, this was double checked by the researcher.

3) The ratio of the number of noteworthy practices present out of the total possible was calculated and presented as a percentage.

4) The total sum of the scores was then added, again using a Microsoft Excel function to minimize human error.

5) This summation (or score) was then divided by the number of noteworthy practices present.

6) The integer produced from step five was translated into the corresponding descriptive word that was used during the walkthrough (See Table 2).

Interview Data Analysis

Supervisors were asked slightly more and slightly different questions than employees. Each question was analyzed in the most appropriate and clear manner. This included paragraph form, table, statistics, and/or charts. Reporting of injuries and illnesses, communication of health and safety rules, near misses, and emergency action plans produced generally the same results and were therefore presented in paragraph form as opposed to detailed analysis per service area to reduce redundancy. Standard Operating Procedures (SOPs) and comments were analyzed and presented in paragraph form as well because a paragraph was sufficient for a clear presentation of results.

Response rates, hazards, training, controls, risk, protection and improvement, and involvement were all analyzed and presented in tables. The tables allowed for a clear assortment into useful categories. The hazards employees identified during the interview were

compared with the hazards observed by the researcher during the walkthrough. The results are displayed as a percentage; how many service area representatives identified the hazards out of the number of service areas identified by the researcher. An example of this is that 15 out of 20 service area interviewees identified that they had toxic and/or hazardous substances in their area. Training reported per the interview was categorized into types of training (none, pre hire, reactive training, EHS training, read and sign, verbal, video, and hands on). Type of controls reported during the interview were also categorized into types and displayed as a percentage (elimination, substitution, engineering, administrative, PPE, common sense, and reactive controls). Top risks reported during the interview were noted and presented as both a ratio and a percentage. Similarly, protection and continual improvement as well as employee involvement responses were both split into categories based on the answers received and presented as both a ratio and percentage.

Time worked in service area, health and safety concerns, how many employees supervisors oversee, and specific tasks or procedures that pose risk were excluded due to the way the questions were clarified by the researcher and the answers received, which were neither consistent, and in the final analysis, not needed

The reason for asking how long a worker had worked in a service area was to ascertain if the longevity that a worker was employed in one service area was related to the worker's familiarity with the hazards and risks in that service area. The question was excluded because some subjects answered how long they worked in the area and some specified how long they worked in the service area as well as how long they had been in the supervisory position.

The question about health and safety concerns was meant to assess the worker's stress level with respect to their concern of getting injured. This was probably the most inconsistent question in terms of asking and receiving answers. Some answered the question as it was

intended (i.e., do you feel safe?); others answered it as if health and safety were an everyday priority for them or not, which is also useful to know. It was not until after numerous interviews that the researcher specifically clarified that the question was intended to gauge subject concern of getting injured. The reason further explanation was provided was because almost all interviewees responded with a confused expression. Due to the inconsistently of asking and clarifying the question, it was excluded from the analysis.

Supervisors interpreted the question, "How many employees do you supervise?" differently. Some responded for direct supervision, some for indirect and direct, some only for full time state classified employees, and some included a combination of full time, hourly, part time, and students as well. Because the question was not a necessity to the research, and was inconsistently asked and clarified, it was excluded from the analysis.

The question related to specific tasks or operations that posed risk was also excluded in final analysis due to inconsistencies in clarification and interpretation. The question was asked for future training purposes. A task or procedure could be just as risky as a hazard itself and therefore, if these were identified in a reliable manner the data could be used to identify and create a training program for not only specific hazards and risks within a service area, but for specific tasks or procedures. Additional to the training, it would be suggested that an SOP be created for the identified risky tasks or procedures. This question, however, was interpreted differently by many and some became frustrated because for their service area the answer was obvious and they were annoyed by 'redundancy'.

Finally, the question pertaining to which areas employees worked was not analyzed, it was merely noted. This question was asked to help with future training and orientation programs. Most service areas had employees that only worked within that service area while others had employees that worked in numerous service areas within the VTH. This is important

because the employees that worked in multiple service areas had the potential to be exposed to hazards in all service areas in which he or she spends time.

Risk Assessment

The data analysis from the PHA and the interview were both used to determine the health and safety risk in each service area. Since many of the service areas had ubiquitous results for certain hazards and/or noteworthy practices, those parameters were analyzed for the entirety of the VTH (i.e., they were not analyzed for each service area). Subsequent to this, a risk assessment was conducted on individual service areas. The possible severity or consequence of an injury or illness for each service area was first assessed using the definitions listed below in Table 3. The probability of an injury or illness was then assessed for each service area using the definitions listed below in Table 4.

Table 3: Severity Terms and Associated Definitions

Descriptive Word	**Severity Description**
Catastrophic	Death or permanent total disability.
Critical	Permanent, partial, or temporary disability (excess of 3 months)
Marginal	Minor injury, lost workday accident.
Negligible	First aid or minor medical treatment.

Table 4: Probability Terms and Associated Definitions.

Descriptive word	**Probability Description**
Frequent	Likely to occur repeatedly
Probable	Likely to occur several times
Occasional	Likely to occur sometime
Seldom	Not likely to occur
Improbable	Can assume incident will not occur

Combining the severity and probability, a risk assessment matrix was used (see Appendix D) to determine the risk category. The definitions for the risk categories are presented below in Table 5.

Table 5: Management Decision Levels and their Associated Meaning.

Risk category	**Remedial action or acceptance**
Serious	Immediate action should be taken
High	Remedial action to have high priority
Medium	Remedial action to be taken within appropriate time
Low	Risk is acceptable; remedial action discretionary

Prioritization

The prioritization allows the VTH management to determine objectives which will offer OHSMS improvement and risk reduction. Health and safety issues that were ubiquitous throughout the VTH were pulled out of the area specific risk assessment and discussed as a separate entity. The prioritization per service area was directly based on the service area risk assessment. Risk was determined for each hazard that was specific to a service area resulting in a risk range per service area. To prioritize, frequency of risk rating was used. Therefore, the prioritization was based on the following:

Table 6: Definitions for Priority Ratings.

Priority Rating	**Meaning**
1	Three Serious Risks
2	Two Serious Risks
3	One Serious Risk
4	A Range With a Serious Risk
5	Two High Risks
6	One High Risk
7	Medium Risks

CHAPTER 5 – RESULTS AND DISCUSSION

Interview Data Analysis

Not every service area had both supervisor and employee volunteers that participated in the interviews and two of the service areas (Barn Care and Small Animal Surgery) did not provide representatives, therefore, the statistics discussed below were in relation to 18 of the 20 service areas. Some of the questions that were asked during the interview produced generally the same answers throughout the VTH. These were (1) reporting of injuries and illnesses, (2) communication of health and safety rules, (3) near misses, and (4) emergency action plans. Many of the questions needed clarification due to multiple interpretations by respondents. If clarification was needed, a definition was supplied. If further clarification was necessary, examples were given. Terms that were often clarified were: near miss, SOP, hazard, controls, and risk.

Injuries and illnesses

There was no incident/injury/illness or near miss database for the VTH. The injury/illness reports were never reviewed for trend analysis or used to define significant problems as well as make improvements. When an incident, injury, or illness occurred, employees were required to report the incident via the CSU Environmental Health Services (EHS) online webpage within four days. The report then went to Human Resources (HR) for additional questions to be answered. After HR, the report was sent to EHS. If the employee saw a doctor, the report was then be provided to HR. The reporting policy did not require the

employee to inform the supervisor of an incident or show a doctor's note. However, per the interviews (12 areas), employees usually reported to their supervisors first and then completed the incident form online. HR maintained a copy of all reports for about 5-7 years and filed them by incident date.

Communication of Health and Safety Rules

Communication of health and safety rules was not consistent throughout the VTH. In some instances only supervisors received updates and it was up to them to relay the information to all employees for whom they were responsible. Other employees thought there was only minimal or no communication at all. Most communication on health and safety policies and updates were via email, however, sometimes only supervisors received emails. Most supervisors communicated the updates to their employees either verbally or by printing and hanging the email up in an area where employees could see it. A few said the only communication was verbally at orientation. Some mentioned meetings, SOPs, and reference material as a form of communication. One person mentioned an in-person talk that the Hospital Director had given on the health and safety pertaining to Meningitis.

Near Misses

For the most part, employees were not aware of this term or concept. Once clarified, the majority of respondents identified that near misses happened on a daily basis; on the other hand, some did not. Some even stated their corresponding corrective actions; two people stated that if an animal was seen as aggressive, the cage was labeled to communicate this. Two people noted that if a sharp was found, the supervisor would be notified and a sharps report completed as well as sent to the administrators. Heavy intravenous (IV) pumps that were not secured would fall (sometimes on people); therefore Critical/Urgent Care (CCU) employees made a

policy that any pump higher than the user's waist level was to be secured to a pole. An employee stated that if she almost fell because of a wet floor, she either cleaned it up and/or put up a caution sign. Five interviewees stated that there were many near misses with violent patients, so restraints and/or muzzles would then be used. Other responses to the question "Have you encountered near misses and how do you manage them?" were "Not really;" "I guess I have;' and 'yes, but not much you can do."

Emergency Action Plans.

The VTH had a written building safety plan that included fire, weather, and chemical emergencies among others, but it did not have all required elements per OSHA (29 CFR 1910.38). Although the VTH was not regulated under OSHA, it was considered best practice to follow the standards. The requirements per OSHA were as follows: (1) emergency escape procedures and emergency escape route assignments; (2) procedures to account for all employees after emergency evacuation has been completed; (3) rescue and medical duties for those employees who are to perform them; (5) the preferred means of reporting fires and other emergencies; (6) names or regular job titles of persons or service area employees who can be contacted for further information or explanation of duties under the plan; and (7) training when the plan is developed, if employee's responsibilities have changed, and when the plan is changed. In addition, specific elements which should be addressed for the VTH included: (1) stand-and-hold procedures (where certain employees stay with a patient rather than immediately evacuating); (2) alarm and/or notification differences for different emergencies; and (3) communication procedures for those that cannot hear via the paging system.

A few supervisors had printed out the current plan(s) and hung them up. The most common response for what to do in a fire situation was "get out." There was not a definitive

plan that identified designated muster areas to assemble outside or designated employees (sweepers) to assure that all employees evacuated. Another problem that arose was that of bringing or leaving patients. Per the interview, it was standard practice to grab a patient to bring outside during an emergency evacuation. This could lead to spread of disease or possibly further injury. In a fire emergency, the alarm sounds and lights flash. In a weather emergency, the alerts would come in on the National Oceanic and Atmospheric Administration (NOAA) weather alert system which would then be paged throughout the hospital.

Standard Operating Procedures

The VTH did not have many formal SOPs. Furthermore, the only hospital-wide SOP that was continually mentioned was the sharps SOP due to its recent update and required read-and-sign training. Only two respondents identified the biosecurity manual as an SOP. Assessment of employee behavior (if SOPs were followed in practice) was not in the scope of this research. SOPs that were identified through the interviews were as follows: mixing Virkon®, fogging, biosecurity, sharps, chemotherapy manual and safe delivery, laundry procedures, fire emergency plan, diluting chemicals, dog bite report, operating the chutes in livestock, milking procedures in livestock, isolation procedures, and down horse protocol. Other answers to the question “Do you have a documented standard operating procedure for any tasks that pose a risk?” consisted of: “none”, “we don’t have risks”, “not sure”, and “not really, it’s mostly verbal”.

Response Rate

The goal was to interview 40 participants from the VTH; ideally one supervisor and one employee from each service area. There were 29 of 40 (73%) personnel who volunteered to be interviewed. Of the 29 interviewees, 15 (52%) were supervisors and 14 (48%) were employees. The results are summarized per service area in Table 7 below. ‘NA’ was denoted for service

areas that had two interviewees but did not provide one supervisor and one employee each. The zeros denote where an interview was desired, but no personnel volunteered.

Table 7: Number of Interviewees by Type per Service Area.

Service Areas	Supervisor	Employee
Reception/ Call Center/Business Office/ Medical Records	2	NA
Maintenance	1	1
Custodial/Animal Care	1	0
Custodial/Barn Animal Care	0	0
Pharmacy	1	1
Central Supply	1	1
Anesthesia	1	1
Critical/Urgent Care	1	1
Ophthalmology	1	1
Dermatology	1	1
Neurology	1	0
Livestock	1	1
Equine	1	0
Small animal medicine	0	1
Small animal surgery	0	0
Oncology	1	0
Exotics (Zoo Med.)	0	1
Clinical Pathology	NA	2
Dentistry	0	1
Large Animal Surgery	1	1

Hazards

The question was asked, “A hazard is any act, exposure, or condition arising in and from the work performed in the work place that could result in injury or illness to the worker. What hazards are associated with your job tasks and/or those employees you supervise?” Responses

to this question varied greatly; some respondents did not think there were any hazards at all and other respondents reacted as if it would be difficult to list all the hazards because there were so many.

A comparison of the hazards identified by the researcher during the walkthrough to the hazards identified by VTH personnel via the interview process can be found below in Table 8. Therefore, the percentage depicts the awareness of the hazard. The complete table can be found in Appendix E. Seventy-five percent (75%) of the service areas were identified by interviewees as having toxic and/or hazardous substances present. Sixty-nine percent (69%) identified that violent patients were a hazard followed by 60% of the service areas identified by the interviewees as having ergonomic hazards. Conversely, not one service area interviewee identified heat stress, workplace violence, compressed gas, or the spread of human to human disease as hazards to which they were potentially exposed. Moreover, the possibility of workplace violence and the spread of human to human disease is a possibility in every service area. Assault and violent acts were the second leading cause of death in the workplace in 2009 (Bureau of Labor Statistics, 2010). If workers are not aware of the hazards to which they are potentially exposed, they may unknowingly place themselves in a hazardous situation.

Although there was a lack of awareness of many hazards, there were also hazards identified by the interviewees that the researcher had not specifically identified or anticipated during the walkthrough. For example, the possibility of incurring a burn was taken into account by the researcher when looking at first aid kit contents, but specific sources of burns were not identified. However, maintenance employees indicated that burns and catching clothes on fire from welding were hazards, and central supply employees indicated that burns from the steam produced by the autoclave was a hazard. Additional hazards identified by interviewees included:

allergic reactions to the allergens used to test the allergies of the patients (Dermatology); and crushed toes from the use of hydraulic examination tables (Large Animal Surgery). The researcher identified the hydraulic examination tables as a confined space and a possible unexpected release of hazardous energy (need for lockout/tagout), but did not have a specific hazard category for crushed limbs/digits. Livestock interviewees, however, did not identify what was hazardous about the hydraulics, just that they were a hazard. Again, the researcher identified the need for machine guards and lockout/tagout. The researcher and interviewee both identified violent patients as a hazard in Livestock, but the interviewee specifically noted the students as an indirect cause of the violent patients when stating that many students were learning and did not know proper restraint of animals. Lastly, zoonotic disease was identified by both the researcher and interviewee as a hazard for dentistry, but the interviewee pointed out that there was respirable bacteria as well (aerosolized bacteria).

Table 8: A Comparison of Hazards Identified by VTH Personnel to Researcher Observations.

Hazard	No. of Times Hazard was Indentified by VTH Interviewees	No. of Times Hazard was Identified by Researcher	Percent
Toxic & Hazardous Substances	15	20	75%
Violent Patient	11	16	69%
Ergonomics	12	20	60%
Zoonotic Disease	10	20	50%
Bloods, Fluids, Sharps	8	20	40%
Radiation	3	11	27%
Lasers	1	5	20%
Noise	3	17	18%
Confined space	1	6	17%
Powered trucks/tractor	1	6	17%
Cranes & hoists	1	6	17%
Slips, Trips, and Falls	3	20	15%
Bloodborne Pathogens	2	20	10%
Hand/Portable Power Tools	1	13	8%
Electrical	1	20	5%
Heat stress	0	8	0%
Workplace Violence	0	20	0%
Compressed Gas	0	13	0%
Human to human	0	20	0%

Training

Interviewees were asked what training they and their employees (if applicable) had received, the type of training, and if the training was documented. The complete training results can be found in Appendix F. The type of training and the number of service areas (out of the 18 areas that interviewed) which reported that type of training are presented in Table 9. Most employees received verbal on-the-job training. The second and third most reported training were pre-hire at the VTH and no training, respectively. The "not specified" category referred to the report of training on chemical hazards, Virkon®, stall cleaning, and the zoonotic diseases Methicillin-resistant Staphylococcus aureus (MRSA) and Leptospirosis. The platform in which they received this training was not specified. The training that was reported as documented

were biohazard training on the CSU campus, radiation training on the CSU campus, reading and signing the sharps policy online, verbal training and signature for working with chemotherapeutic drugs, and the forklift training taught at the VTH.

Supervisors were asked if both they and their employees had received training or education, and employees were asked if they had received training or education. It would have been a useful comparison to evaluate if there were discrepancies between the supervisors' and employees' answers, but 1) not every service area had one supervisor and one employee who volunteered to be interviewed and 2) many supervisors were unaware of what type of training, if any their employees received.

Table 9: Training Type Reported and Corresponding Number of Service Areas that Reported it.

Training Type	No. of Service Areas
Verbal	11
Pre VTH	7
None	6
EHS/Campus Training	5
Reading	5
Not Specified	4
Hands on	4
Pre Hire Reqs.	2
Reactive Training	2
Video	2

Controls (Safeguards)

Respondents were asked if controls were present in their service area and if they had suggestions for additional safeguards. Some respondents identified training as a safeguard, and, many respondents identified the muzzles as a safeguard post clarification.

The safeguards reported by the interviewees were categorized by the researcher into the hierarchy of controls (CDC, 2010). Two additional categories of safeguards were added based on interviewee answers; these included: 1) common sense, awareness, and communication, and 2) reactive controls such as spill kits and eyewash/shower stations. The complete results can be found in Appendix G, and the summarized results are shown below in Table 10.

A total number of 43 controls was used because this was the sum of the total number of controls (depicted as x's in Appendix G) reported from the interview. However, if three different controls were reported from the same service area but all three could be categorized under the same control definition (e.g., personal protective equipment), then they all were counted as one 'x' under that control category for that service area. PPE and administrative controls were the highest reported controls which are not preferable per the hierarchy of controls. Furthermore, common sense, awareness, and communication (i.e., verbal exchange of current susceptibility and aggressive patients), although good to have, are not forms of control.

Table 10: Controls Reported by the Interviewees.

Type of Control	**No. of Service Areas That Listed Control Type**	**Percentage**
PPE	13 of 43	30%
Administrative	11 of 43	26%
Engineering	8 of 43	19%
Common Sense', 'Awareness', 'Communication'	5 of 43	12%
Substitution and/or Dilution	4 of 43	9%
Elimination	1 of 43	2%
Reactive controls (spill kits, eyewash/showers)	1 of 43	2%

Top Risk

Respondents were asked what they felt the riskiest part of their job was (as well as the employees they supervise if applicable). The summarized results of each of the 29 interviewees' opinions of their most significant safety and/or health risk are in Table 11 (full results found in Appendix H). Forty-one percent of the respondents identified patients as the greatest risk, followed by zoonotic disease (14%) and sharps (14%). These results differed from the study done in 2008 (Weaver, Newman, Lezotte, & Morley, 2010) at the VTH on the personnel perceptions of risks, where respondents identified and ranked hazards and injuries and illnesses, and named job-related incidents as well as the most severe incident. In the 2008 study, personnel were most concerned about chemicals (36.7%), followed by biological (26.7%), and lastly physical hazards (23.3%). Compared to the expert panel, VTH personnel perceived greater risk of sharps, ionizing radiation, loud noises, emissions from the digester, pesticides and insecticides. VTH personnel perceived less risk than the expert panel for patients, moving and lifting, anesthetic gases, disinfectants, antimicrobial-resistant bacteria, and sensitizing allergens (Weaver, Newman, Lezotte, & Morley, 2010). It is possible the answers differed due to the difference in interview population, questions, and administration of interview. It is also possible that personnel either understand the term risk differently or have learned since the past study.

Table 11: Top Risk Respondents Identified.

Top Risk	No. of Employees Who Identified this Top Risk	Percentage
Violent Patients	12 of 29	41%
Zoonotic Disease	4 of 29	14%
Sharps	4 of 29	14%
Ergonomics	3 of 29	10%
Chemotherapeutic Drugs	2 of 29	7%
Chemicals (Virkon® powder)	1 of 29	3%
Students (improper restraint)	1 of 29	3%
Welding	1 of 29	3%
Papercuts	1 of 29	3%

Protection and Improvement

Interviewees were asked if they felt there was protection and continual improvement of their health and safety (as well as their employees, if applicable). Twenty one of 29 (72%) respondents thought there was some sort of protection and improvement, while the remaining 8 of 29 (27%) did not think so. The answers to this interview question were categorized into six different categories based on the answers received. The responses can be seen in Table 12 (full results in Appendix I). Most of the interviewees (10 of 29, 34%) reported that they felt there was improvement in one or a few issues, but no improvement for the majority of issues. Seven of nine (24%) respondents reported that they did feel there was protection and continual improvement in the VTH. Fourteen percent (4 of 29,) reported that they did feel there was protection and continual improvement, but only recently (less than one year). The remaining eight respondents (27%) were either not sure, did not think so, or did not feel there was protection and improvement.

Table 12: Respondents Perceptions of Protection and Continual Improvement at the VTH.

Respondent Answers	No. of Respondents Answers to Total Respondents	Percentage
Yes, but only with one or a few things	10 of 29	34%
Yes	7 of 29	24%
Yes, but only recently	4 of 29	14%
Not sure	3 of 29	10%
Not really	3 of 29	10%
No	2 of 29	7%

Involvement

Respondents were asked if they were involved in the health and safety aspect of the VTH, and if so, how. The answers are shown below in Table 13. Twenty-eight percent (8 of 29) of the interviewees responded that they would feel comfortable expressing concern to at least one person in the Director's Office. However, this question was not consistently clarified to every interviewee since the definition of "involvement" was interpreted differently and many interviewees did not think of the different levels of involvement. The researcher sorted the answers into the categories as shown in Table 13 (full results in Appendix J), but it was not specifically asked to what degree the interviewee was involved.

Table 13: Respondent Answers to their Involvement in Health and Safety at the VTH.

Involvement Level	No. with Response of Total Interviewees	Percentage
Only with going to director's office with issues	8 of 29	28%
Department Level	7 of 29	24%
Both Levels	6 of 29	21%
No, and *would* like to be	3 of 29	10%
VTH Level	2 of 29	7%
Would like to, but don't feel people listen	2 of 29	7%
No, and *would not* like to be	1 of 29	3%

Walkthrough Data Analysis

Each service area was evaluated for the presence or absence of 19 hazards identified in the safety and health walkthrough checklist. The number of hazards that were found in each service area is presented in Table 14 in order of the least to the most hazards present. The hazards themselves did not necessarily mean there was more risk; it just meant that there were relatively more or less hazards present in the service area. The number of hazards present ranged from 10 in the Reception/Call Center/Business Office/Medical Records Service Area (RCBM) to 19 in the Large Animal Surgery (LAS) Service Area. The complete results of the health and safety walkthroughs presented in the PHA can be found in Appendix C.

Table 14: The Number of Hazards Found per Service Area out of a Possible 19.

	Service Area	No. of Hazards (of 19)
1	Reception/ Call Center/Business Office/ Medical Records	10
2	Clinical Pathology	11
3	Critical/Urgent Care	12
4	Pharmacy	13
5	Dermatology	13
6	Neurology	13
7	Small animal medicine	13
8	Small animal surgery	13
9	Exotics (Zoo Med.)	13
10	Dentistry	13
11	Custodial/Animal Care	14
12	Oncology	14
13	Central Supply	15
14	Equine	15
15	Custodial/Barn Animal Care	16
16	Anesthesia	16
17	Ophthalmology	16
18	Livestock	16
19	Maintenance	18
20	Large Animal Surgery	19

The percentages of noteworthy practices (i.e., spill response, hazard communication, equipment inspection, emergency preparedness, etc.) present in each service area are presented in Table 15 in descending order. The percentages are relative to their own service area, and there were 28 possible noteworthy practices that could be present in each service area. However, some areas had less noteworthy practices due to the fact that some were not applicable. For example, machine guarding and fall protection were not applicable practices for many areas and therefore were not taken into account. It is important to note that the percentages are displayed as the presence or non-presence of noteworthy practices and do not indicate how well each practice was carried out. Dermatology had the least amount of noteworthy practices present (52%), and Critical/Urgent Care and Clinical Pathology both had the most present (72%).

Table 15: The Percentage of Noteworthy Practices Present per Service Area.

	Service Area	Noteworthy Practices
1	Critical/Urgent Care	72%
2	Clinical Pathology	72%
3	Livestock	70%
4	Large Animal Surgery	70%
5	Oncology	69%
6	Anesthesia	68%
7	Ophthalmology	68%
8	Equine	68%
9	Dentistry	68%
10	Maintenance	68%
11	Central Supply	67%
12	Neurology	67%
13	Small animal surgery	67%
14	Custodial/Animal Care	65%
15	Reception/ Call Center/ Business Office/ Medical Records	63%
16	Custodial/Barn Animal Care	62%
17	Small animal medicine	60%
18	Exotics (Zoo Med.)	58%
19	Pharmacy	56%
20	Dermatology	52%

Through a series of calculations (details found in methodology and the grey area of Appendix C), the average quality of noteworthy practices was determined (i.e., how well a noteworthy practice was being followed or performed). They are presented in descending order in Table 16 below. All of the service areas had some noteworthy practices present to address the identified hazards, but no service area was rated as 'good' for the implementation of

noteworthy practices. Twelve of 20 (60%) service areas were rated as *okay* for implementation of noteworthy practices and eight of 20 (40%) service areas were rated *minimal* for implementation of noteworthy practices.

Table 16: Average Quality of Noteworthy Practices per Service Area.

Service Areas	Average Quality of Noteworthy Practices
Reception/ Call Center/ Business Office/ Medical Records	Okay
Small animal surgery	Okay
Small animal medicine	Okay
Oncology	Okay
Neurology	Okay
Livestock	Okay
Equine	Okay
Dermatology	Okay
Dentistry	Okay
Custodial/Animal Care	Okay
Critical/Urgent Care	Okay
Clinical Pathology	Okay
Pharmacy	Minimal
Ophthalmology	Minimal
Maintenance	Minimal
Large Animal Surgery	Minimal
Exotics (Zoo Med.)	Minimal
Custodial/Barn Animal Care	Minimal
Central Supply	Minimal
Anesthesia	Minimal

Health and Safety Hazards Present in all Service Areas:

Many hazards on the walkthrough checklist were found to be present in all or nearly all service areas. The VTH should address these hazards on a hospital-wide level as opposed to within each service area. For example, a hospital wide policy should be written as opposed to a service area specific policy. Similarly, training on a certain hazard should be hospital-wide as opposed to specific service areas. In addition, the risk assessment was meant to aid in the prioritization of hazards in service areas. If these elements were not taken out of the risk assessment, it may not have led to significant differences in risk. Therefore, the following hazards were not included in the service area risk assessments: (1) toxic and hazardous substances; (2) ergonomics (specifically lifting and restraining); (3) slip, trips, and falls; (4) electrical; (5) bloodborne pathogens; (6) bloods, fluids, and sharps; (7) zoonotic disease; (8) human to human spread of disease; (9) workplace violence; (10)Violent patients; and (11) workplace stress.

Toxic and Hazardous Substances:

Every service area had the potential exposure to toxic and hazardous substances. All service areas had cleaning chemicals. Some areas used the chemicals more frequently and with different durations. Some area employees were exposed to Formalin and Chemotherapeutic drugs as well as other potentially hazardous drugs (medicines) that others were not.

Ergonomics:

Every service area had the potential for ergonomic hazards. Employees from many different service areas stood on hard ground (inside or concrete) for long shifts. RCBM employees spent a lot of time sitting, but it was discovered in the interview that EHS had

completed ergonomic assessments in these areas and loaned items to minimize ergonomic hazards. Maintenance, surgeons, and every worker who handled or lifted heavy objects or patients were at risk of injury (OSHA). Surgeons are often in static or awkward positions for a long duration. This can lead to muscle fatigue and pooling of blood in lower extremities. In addition, standing on hard surfaces can lead to pain in the feet (OSHA).

Slips/Trips/Falls:

Every service area had the potential for injury from slips, trips, or falls. Some specific issues that were observed or raised during the interview were as follows:

- Many electrical cords were observed on the floors of Large Animal Surgery.
- Animal Care employees reported that the "non-slip" floors were more slippery when wet.
- Pharmacy had a lot of boxes in walkways.

Electrical Hazards and Associated Noteworthy Practices:

Many areas throughout the VTH were lacking sufficient electrical safety which could lead to electrical hazards. Per the 2009 audit (Hellman & Associates, 2009); there was a great quantity of electrical hazards, but not great severity. Electrical safety was a measure of how well the electrical hazards were controlled. Per the health and safety walkthrough checklist electrical items that were evaluated consisted of: electrical equipment free of water, oil, chips, and excessive dust; all box covers in place; labeled disconnects; ground fault circuit interrupters (GFCI)s where needed; grounding plugs for in use extension cords; power strips prohibited of being daisy chained; electrical cords off the floor; no wiring or cords with frayed or deteriorated

insulation; and sufficient access to working space to provide ready and safe operations and maintenance. Some hazards observed at the VTH:

- Electrical devices not approved for wet locations
- Extension cords through holes in walls, ceilings, or floors
- Use of temporary devices for permanent situations
- Damaged or frayed electrical cords
- Blocked or unlabeled disconnects

Bloodborne Pathogens, Blood, Fluids, & Sharps, Zoonotic, and Human to Human Disease:

Every service area was at risk for bloodborne pathogens; bloods, fluids, and sharps; zoonotic disease; and the spread of disease from human to human. There was a 300 page biosecurity protocol that was accessible via the VTH employee website, but there was no required training pertaining to it (interview).

Violent Patient and Workplace (coworker) Violence:

With the exception of Central Supply, Clinical Pathology, and Dentistry every service area was at risk for violent patients. Reception often delegated the task of placing a collar on the patient to the owner. However, this was not a formal policy and as some employees were not comfortable with doing this, the decision was left to Reception personnel. Although the VTH as a whole was at risk of violent patients, there was a greater risk of adverse affect from large animals.

Workplace violence could not be observed in this study, but it was assumed as a possible hazard for every service area since it is a possible hazard for nearly every occupation (Bureau of Labor Statistics, 2010).

Workplace Stress:

This was not addressed during the walkthrough, but workplace stress is commonly found in hospital settings (OSHA). Hospital personnel deal with life-threatening injuries and illnesses while working long shifts and tight schedules. They have a significant amount of paperwork, work with intricate or malfunctioning equipment, stressed patients and owners, as well as teaching students and working with new technology.

Health and Safety Hazards Present Some Service Areas:

Hand & Portable Power Tools, Confined Space, Powered Trucks & Tractors, Cranes & Hoists, Lasers, Radiation, and Heat Stress:

These categories all varied in terms of their presence or non presence throughout the VTH service areas. The hazards of greatest concern were the confined spaces in LAS and the lasers used throughout the hospital. The only training an employee had on laser safety was either prior to their hiring at the VTH or verbally from their supervisor. Radiation safety seemed to be the most strictly regulated at the hospital. There were required radiation courses that employees had to attend which were held on CSU's main campus. The details of these courses were not evaluated as they were outside the scope of this project.

Compressed Gas:

With the exception of RCBM, Pharmacy, Ophthalmology, Dermatology, Neurology, and Clinical Pathology, the other 15 service areas had compressed gas. Most cylinders seemed in

good condition; however, many were not stored and transported with caps on. In addition, CCU personnel stored one cylinder on its side on a bottom shelf where employees could knock it. The Anesthesia storage room in LAS had cylinders that were upright, but not secured with chains.

Noise:

Employees from nearly every service area, with the exception of Small Animal Surgery and Exotics, had complaints regarding noise. Much of these complaints were attributed to current and ongoing construction that was occurring in the VTH.

General Trends of Noteworthy Practices for all Service Areas:

Noteworthy Practices for Chemical Hazards:

Handling and Storage:

VTH employees in all of the service areas handled and stored toxic and/or hazardous chemicals in an *okay* to *good* (rating of 2-3) manner with the exception of the Pharmacy Service Area whose employees handled and stored chemicals in a *minimally* (rating of 1) healthy and safe manner. Every service area had at least one toxic or hazardous chemical present to which VTH employees could be exposed. Most of the chemical substances were cleaning/disinfecting agents. However, this assessment did not include drugs administered to patients (aside from chemotherapeutic drugs). The Pharmacy service area had many cabinets with items on top of each other in a disorderly fashion, which included, in part, glass containers and chemicals. In addition, there were many boxes, of various items including chemicals, stored in the aisles that impeded the means of egress.

Spill Kits:

Per the VTH policy, large spills ("a spill that may contaminate the water supply, sewer, or any other area and is too large to be easily handled by VTH personnel") or highly hazardous chemical spills were not to be cleaned up by employees. However, it was VTH policy that benchtop spills be cleaned up with absorbent pillows, and if the employee felt comfortable and familiar with the chemical, he/she can use the "proper spill kit and follow directions that are with the spill kit." However, not all service areas that housed toxic/hazardous chemicals had a chemical spill kit to clean up chemical spills. The spill kits should at least contain goggles, proper gloves, a gown, and some absorbent material (Seibert, 2011). It was noted that only the Oncology, Pharmacy, and Clinical Pathology Service Areas had spill kits for chemotherapeutic chemicals. Per OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) standard 29 CFR 1910.120, all employees working with hazardous substances that are instructed to clean up spills shall be trained and provided with the appropriate resources.

Hazard Communication and Chemical hygiene plan:

Hazard communication was inadequate throughout the VTH. None of the service areas had a chemical hygiene plan, nor had any hazard assessments been conducted to determine what personal protective equipment (PPE) was needed. It was observed that some service areas did have Material Safety Data Sheets (MSDS) binders, although not all hazardous chemicals were included in the binders. Some employees had received informal hazard communication training, but most had not received any formal, documented hazard communication training. Some employees requested better training on chemical safety. Most chemical containers were labeled, but the few that were not were mostly those chemicals that were transferred to countertop dispensers. A chemical hygiene plan, per OSHA, is a written program developed and

implemented by a qualified (by training or experience) individual who sets forth procedures, equipment, PPE and work practices to protect employees from health hazards as well as meets the requirements of 29 CFR 1910.1450(e); Chemical Hygiene Plan.

Sanitation:

For the most part, sanitation was ranked as *okay* to *good*. However, a few important issues were observed. Sanitation was ranked by the following elements: leak proof waste receptacles, clearly marked non-potable water outlets, separate facilities for street clothes and PPE if change rooms are required, sanitary toilets, showers, and change rooms, eating/drinking/food storage allowed only in designated areas, and no potential for exposure to hazardous substances in designated food areas (Ellwood, 2003).

- Neither Maintenance nor Animal Care had a designated eating/drinking/food storage area that was free from potential exposure to hazardous substances.
- Pharmacy had beverages stored in a refrigerator with medicine and chemicals, as well as food stored in a refrigerator with equine plasma.
- A bag of open chips was observed in Anesthesia.
- Many sinks throughout the VTH were lacking a non-potable water sign.

Noteworthy Practices for Physical Hazards:

Equipment Inspection and Lockout/Tagout:

These two areas were generally deficient throughout the hospital. Equipment inspection was generally inadequate throughout the VTH, and lockout/tagout was not implemented anywhere in the VTH. A lockout/tagout safety program is designed to protect employees from

unexpected startup of machinery and equipment or release of hazardous energy during service or maintenance activities. Equipment specific procedures are generally required when there is a potential for stored or residual energy or the reaccumulation of energy after the equipment is shutdown, there is more than one single energy source associated with the equipment, or the service work creates a hazard for other employees (OSHA 29 CFR 1910.147). Examples of equipment that should have a lockout/tagout procedure are the LAS exam tables and the green and red chutes in Livestock.

Hearing Conservation Program:

Based on employee complaints and unknown noise levels, noise monitoring should be conducted. The results of the noise monitoring would identify if a hearing conservation program (29 CFR 1910.95) should be implemented. In the interim, if employees have noise complaints, it would be best practice to provide hearing protection along with a training program. Maintenance, Animal Care, and Barn Care are the only service areas that had hearing protection.

Noteworthy Practices for Explosives, Flammable, and Combustibles:

Fire Protection and Fire Extinguishers:

Fire protection was generally deficient throughout the hospital, although not all service areas needed the same level of protection. Fire protection was evaluated by the following criteria: only approved, vented containers and portable tanks used; are flammables and combustibles stored with incompatibles; are proper metal storage cabinets used where applicable; do they exceed the proper amount of flammables and combustibles; and are the cabinets labeled.

Not all service areas had ready access to a portable fire extinguisher nor had VTH employees been trained to use a portable fire extinguisher. Fire extinguishers have to be within a 50 foot reach for class B fires (29 CFR 1910.157(d)(4)). Per the VTH Building Safety Plan, all personnel shall "know how to properly use fire safety equipment." Furthermore, there was only annual testing, whereas OSHA requires monthly inspections as well (29 CFR 1910.157(e)(2)). Conversely, most of the fire extinguishers were mounted in a well-seen location and not moved from that location.

- Critical Urgent Care (CCU) and Small Animal Surgery had CO_2 fire extinguishers. CO_2 extinguishers are not intended for ordinary combustible material (Type A fires) such as paper, wood, cardboard, and most plastics. They are used only for class B and C fires (OSHA, 2007).

- All other service areas had ABC Dry Chem which can be used on Type A, B, and C fires, but will ruin electrical equipment.

- Some service areas did not have a fire extinguisher in the area and depend on the extinguishers in the hallways (the distances were not measured by the researcher).

- Maintenance had an old, unused fire extinguisher that had not yet been properly disposed.

- The green lines that hung down from the ceiling throughout the hospital were O_2 lines, but were not labeled.

- CCU had a cylinder stored on its side on a bottom shelf where it is sticking out and could be knocked.

- Storage room (H116) in Large Animal Surgery had many compressed gas cylinders. Many cylinders were secured with chains, one was lying on its side, and five small cylinders in a corner were not secured.

Emergency Preparedness:

Means of Egress and Emergency Action and Fire Prevention Plans:

Emergency preparedness as a whole for the VTH was *nonexistent* to *okay*. There was a building safety plan that included many different types of emergencies, but the plan was general and lacked important information such as distinguishing alarms, evacuation meeting points (in a fire emergency), a means of accounting for employees, proper training, etc. The plan was not evaluated in detail for that was outside the scope of this project. Furthermore, the policy and procedure were not well known throughout the hospital. The majority of the deficiencies in the means of egress were a lack of signage. Conversely, most service areas had a clear and unobstructed pathway to evacuate the building safely. The Dermatology Service Area did not have exit signs in any of the exam rooms and there was no sign on one of the rounds room doors. In addition to the fire, chemical, and weather emergency plans, there should be emergency preparedness plans written for workplace and client violence.

General Precautions:

Safety Color Codes & Signs and Tags, and First Aid:

Safety color codes, signs, and tags, as well as first aid were on the low end (*nonexistent* to *okay*) throughout the different service areas. There were many signs throughout the hospital in various colors; however, the colors had no meaning and no trend. There were black, red, navy blue, light blue, green, yellow, etc. signs. This can be problematic if employees start to associate colors instead of reading the words. Most service areas did not have first aid kits. Most either

had all the items necessary in their service area or would attend to Pharmacy for necessary items. Pharmacy employees stated that they did not have a lot of band aids, ibuprofen, etc. that other areas might need. In addition, there was no burn cream in any service area, including Pharmacy. The service areas that did have first aid kits and were relatively far away from Pharmacy did not have a designated employee to be responsible for the update of the contents and there had not been an assessment to ascertain what the kits should contain. Most service areas had eyewash stations and deluge showers, but not all. Some service areas depended on saline bottles which are only sufficient for a foreign object in the eye and not a chemical splash. In addition, most eyewash/deluge showers had been installed fairly recently (a few months before the walkthrough) and not one employee knew where it came from, who installed it, or most importantly, how to use them. In addition, most of the eyewashes were supplied with non-potable water. Per ANSI, all eyewash stations must be connected to a potable water source (ANSI/ISEA Z358.1-2009).

Machine Guarding and Walking/Working Surfaces:

Machine guarding was not an applicable precaution to most service areas, but for those that it was necessary, the guards were in general, lacking. On the other hand, walking and working surfaces were generally adequate for the hospital.

Personal Protective Equipment and Respiratory Protection:

Personal protective equipment and respiratory protection were not evaluated (noted as "NE" in the PHA) during this preliminary hazard assessment due to insufficient information. A hazard assessment must first be done to determine if the proper PPE is being used as well as maintained. Along with this should be training on use and limitations of the PPE, which also cannot be completed until a hazard assessment has been conducted specifically for PPE.

Controls and Training:

Controls in general throughout the hospital were *minimal* and *okay* at best. The controls evaluated consisted mainly of good housekeeping, safety and health rules and work practices effectively in place, and feasible engineering controls in position. Preventative maintenance programs were also evaluated. Training is a control that was assessed in a separate category. Training was identified as *minimal* throughout the VTH. A major lack of minimum requirements and orientation training was noted. The training that was in place consisted of either independently reading lengthy pages; or informal, verbal, non-documented training. There was some training such as the radiation training and the forklift training that were not assessed in this assessment due to the scope of the project.

Industrial Hygiene Monitoring:

Industrial hygiene monitoring was inadequate since many service area employees had the potential to be exposed to numerous chemical, physical, and biological hazards. With the exception of CCU and Reception, none of the service areas had any industrial hygiene assessments or monitoring. CCU interviewees reported that noise monitoring was conducted, and in response, many of the metal cages were replaced with plastic cages. No post monitoring assessments were done to verify acceptable noise levels. Reception interviewees conveyed that EHS conducted ergonomic assessments for their service area. No other service area employees stated that their area had industrial hygiene monitoring done. It is important to note that the researcher did not ask every supervisor or service area interviewee if this had been done because some areas did not have workers that were willing to speak with the researcher.

Administration:

Administration & Supervision, Planning & Evaluation, Project Review, Standard Operating Procedures, and Reporting & Recording:

These were the most deficient areas of the PHA matrix that were almost ubiquitous throughout the VTH. There was no formal health and safety administration and supervision, planning and evaluation, or project review. The SOP ratings were based on observations made during the walkthrough combined with answers from supervisor's post-walkthrough and interview data. Therefore, even though there were hospital-wide SOPs such as the Sharp's Policy, if there was no mention and no observance of an SOP, it was possible for a service area to score a 0 (none). The service areas scored *none* to *okay* for presence and knowledge of SOPs as well as reporting and recording.

Management Leadership and Employee Participation:

Management leadership and employee participation with respect to health and safety was for the most part nonexistent. Many employees (including supervisors) interviewed had a great attitude, but health and safety was not most employee's priority. Of the service areas, CCU, Maintenance, Animal Care, and Clinical Pathology seemed to exert the most leadership and involvement via attitude, involvement on committees, certifications, and daily addressing of health and safety issues. Management leadership and employee participation were assessed primarily through the interviews. These were fairly biased scores since they were decided based on zero to two representatives. If no supervisors responded to the opportunity to be interviewed, it was automatically recorded as a zero for management leadership.

Service Area Risk Assessments

These risk assessments were based on the severity of an incident and the probability of that incident occurring. Using these two parameters, the risk was determined by using the risk assessment matrix (Figure 2). Some service areas were designated as a range of risk due to the multiple events and hazards that were taken into consideration. Please note that the risk assessments specific to service areas were not based on all hazards present in the service area because many were addressed as a whole for the VTH. The items listed below were identified hazards specific to a service area. However, if a VTH-wide hazard posed a greater risk for a specific service area, then it was addressed in accordance to a specific service area for the risk assessment. A summary of the risk assessment is presented in Table 17.

Probability of OCCURRENCE or EXPOSURE for selected unit of time or activity	**CATASTROPHIC** Death or permanent total disability	**CRITICAL** Disability in excess of 3 months	**MARGINAL** Minor injury, lost workday incident	**NEGLIGIBLE** First Aid or Minor Medical Treatment
Frequent Likely to occur repeatedly	**SERIOUS** Immediate action should be taken	**SERIOUS** Immediate action should be taken	**HIGH** High priority remedial action	**MEDIUM** Take remedial action at appropriate time
Probable Likely to occur several times	**SERIOUS** Immediate action should be taken	**SERIOUS** Immediate action should be taken	**HIGH** High priority remedial action	**MEDIUM** Take remedial action at appropriate time
Occasional Likely to occur sometime	**SERIOUS** Immediate action should be taken	**HIGH** High priority remedial action	**MEDIUM** Take remedial action at appropriate time	**LOW** Risk acceptable: remedial action discretionary
Seldom Not likely to occur	**HIGH** High priority remedial action	**MEDIUM** Take remedial action at appropriate time	**MEDIUM** Take remedial action at appropriate time	**LOW** Risk acceptable: remedial action discretionary
Improbable Very unlikely- may assume exposure will not happen	**MEDIUM** Take remedial action at appropriate time	**LOW** Risk acceptable: remedial action discretionary	**LOW** Risk acceptable: remedial action discretionary	**LOW** Risk acceptable: remedial action discretionary

Figure 2: Risk Assessment Matrix

Table 17: Summary of Risk for Each Service Area*.

Service Areas	Hazard	Severity	Probability	Risk
Administrative:				
Reception/ Call Center/Business Office/ Medical Records	Angry Client	Cr	Se	M
	Fire	Cr	Se	M
	Filing Cabinets	Cr	Im	L
	Papercuts	Ne	Pr	M
Maintenance	Welding	Ma-Ca	Oc	M-S
	Moving Hay	Ma-Ca	Oc	M-S
Custodial/Animal Care	Cleaning Chem.	Ma, Ca	Oc, Se	M-H
	LAS Pits	Ca	Oc	S
	Sharps(puncture)	Ne	Fr	M
	Sharps(zoonotic)	Ca	Se	H
	Wet Floors	Ma	Oc	M
Custodial/Barn Animal Care	Fogging	Cr	Se	M
	Tools	Cr	Oc	H
	Large Animals	Cr	Oc	H
General Hospital Services				
Pharmacy	Chemo. Drugs	Ca	Se	H
	Acids	Cr	Se	M
Central Supply	Sharps(puncture)	Ne	Fr	M
	Sharps(zoonotic)	Ca	Se	H
	Autoclave	Cr	Oc	H
Clinical Services				
Anesthesia	Radiation	Cr	Se	M

	Anesth. Gas	Ca	Oc	S
Critical/Urgent Care	Patients	Ca	Oc	S
	Chemo. Drugs	Ca	Se	H
	Compressed Gas	Cr	Oc	H
Ophthalmology	Formalin	Ca	Se	H
	Laser	Ca	Se	H
	Zoonotic	Cr	Se	M
Dermatology	Laser	Ca	Im	M
	Allergen	Cr	Oc	H
Neurology	Chemo. Drugs	Ca	Se	H
	Rabies	Ca	Im	M
Livestock	Chutes	Ca	Oc	S
	Acid/Base Drums	Ca	Oc	S
Equine	Chemo. Drugs	Ca	Se	H
Small Animal Medicine	Zoonotic	Ca	Oc	S
Small Animal Surgery	Anesth. Gas	Ca	Oc	S
	Radiation	Cr	Se	M
	Formalin	Ca	Oc	S
	Tools	Cr	Se	M
Oncology	Chemo. Drugs	Ca	Se	H
Exotics (Zoo Med.)	Violent Patient	Ca	Se	H
	Laser	Ca	Se-Pr	H-S
Clinical Pathology	Zoonotic	Ca	Se	H
Dentistry	Zoonotic	Ca	Oc	S
Large Animal Surgery	Lasers	Ca	Oc	S
	LAS Pits	Ca	Oc	S
	Radiation	Cr	Se	M
	Anesth. Gas	Ca	Oc	S

*Ne=Negligible; Ma=Marginal; Cr=Critical; Ca=Catastrophic; Fr=Frequent; Pr=Probable; Oc=Occasional; Se=Seldom; Im=Improbable; L=Low; M=Medium; H=High; and S=Serious.

Reception/ Call Center/Business Office/ Medical Records (RCBM):

The RCBM Service Areas were all addressed as one service area in the PHA. There were a total of 10 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for these service areas were *low* to *medium*, which was based on the following possible incidents and their analysis:

- Angry clients were a threat in this service area, but the probability of encountering an angry client was *seldom*. However, if an angry client was realized, the severity of the encounter could be *catastrophic* in the worst case scenario of gunfire. The severity of encountering an angry client was reduced to *critical* since the VTH staff could alert the police via a silent alarm button at Small Animal Reception and the Business Office.

- Medical Records employees stored all of their files as hardcopies and there was no fire extinguisher in the room. The probability of a fire was *seldom*, but if incurred could be *critical*.

- The moving filing cabinets in Medical Records could potentially crush a worker which could be *critical*. However, there was a protocol in place, emergency stop pedal, and a mechanical stop response to pressure (human or object in aisle) if the emergency stop pedal should fail to work which reduces the probability to *improbable*.

- The most common hazard noted in this service area per the interviews was paper cuts. The probability of suffering a paper cut in these service areas is *probable* with a severity rating of *negligible*.

Maintenance:

There were a total of 18 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal*. The risk rating for this service area was *medium* to *serious*, which was based on the following possible incidents and their analysis:

- Welding was mentioned as a hazard in the interview, but only for potential skin burns and catching clothes on fire. They had two smoke eaters and an exhaust fan in the ceiling above the welding area (Jim Flowers). OSHA typically requires local exhaust ventilation (LEV) and an approved respirator along with appropriate PPE and face shield (29 CFR 1926.353). The VTH did not require the use of respirators (interview). The consequences of welding depend on many factors such as type of metal fumes emitted from the welding, length of time welding is performed, concentration of the metals, and controls used. Even from acute exposures, health effects range from lung irritation and pulmonary edema to cancer and death (*marginal* to *catastrophic)*. Welding tasks depended on what needed to be fixed and on current projects. It was reported to the researcher that maintenance employees may weld once a month or every day for a week. For this risk assessment, the probability was noted as *occasional.*

- Hay was moved every day, as the animal feed was replenished daily. The probability of an incident was *occasional* based on the activity of leaning tall ladders against unstable hay to climb up and lift and move 80-100lb hay bales. If an incident were to occur the severity would range from *marginal* to *catastrophic* because of the potential consequence of death or permanent disability although it was more probable the consequence would be a permanent, partial, or temporary disability.

Custodial/Animal Care:

There were a total of 14 hazards present out of a possible 19, and the quality of noteworthy practices was *okay*. The risk rating for this service area was *medium* to *serious*, which was based on the following possible incidents and their analysis:

- Although cleaning chemicals were addressed as a whole for the VTH, the concern in this area was greater than others because the primary task was cleaning everything in the VTH apart from the barn area (which was taken care of by the Barn Care Service Area). Therefore, the chemicals were used for a much longer duration and at a higher concentration. The chemicals used in this service area may cause acute effects from dermatitis to death (OSHA). The likelihood of a *marginal* consequence was *occasional,* and the likelihood of a *catastrophic* consequence was *seldom*.

- Large Animal Surgery (LAS) pits in the VTH were confined spaces because they were large enough for a person to enter and carry out work, they had limited egress, and they were not designed for long periods of occupancy (OSHA). The LAS pits under the exam tables could be permit required confined spaces because the hydraulic tables could fall and trap an employee (OSHA). All the tables were different and some had been altered by the VTH, therefore a separate assessment of each table should be done to identify fail mechanisms and controls. The consequences could be *catastrophic* and the probability of this incident is *occasional*.

- Sharps were named the top risk in the interviews for this service area. Although there had been a newly updated sharps policy and some improvements were seen, occurrences still happen on a *frequent* basis. Usually, employees experience a *negligible* consequence.

- If a disease is contracted from a sharp, it could be catastrophic (Canadian Centre For Occupational Health and Safety, 2005). It was difficult to estimate what the risk would be in the VTH for transmission of zoonotic disease and the severity of that disease. Employees seemed to be unaware of the significance of zoonotic diseases, which increased the probability of contracting a zoonotic disease. One study indicated that two thirds of sharps were contaminated (Leggat, Smith, & Speare, 2009). In addition zoonotic diseases can be transferred through a series of other mediums aside from sharps, such as blood and other fluids (Weese & Faires, 2009). Weese and Faires conducted a study of 226 veterinary technicians and found that only 3.5% needed medical attention. Therefore, the risk assessment is concluded to be *seldom* chance of a *catastrophic* event.

- An employee mentioned that the "non-slip" floors were more slippery than normal floors when wet. This would most likely lead to a slip or fall which could result in a *marginal* consequence with a probability of *occasional* occurrence.

Custodial/Barn:

There were a total of 16 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal*. The risk rating for this service area was *medium* to *high,* which was based on the following possible incidents and their analysis:

- Fogging of the barn stalls occurred *seldom*, there was a protocol, and PPE. Furthermore the protocol was currently being assessed and updated. However, there was a complaint of a sore throat post-fogging even with the current PPE. Therefore, the severity could be *critical*.

- The tools that were used could potentially be *critical.* A worker was observed cutting a piece of metal with a hack saw on his knee. The catastrophic consequence has an *occasional* probability of occurrence.

- Although violent patients were addressed as a whole for the VTH, the employees in this service area were exposed to large animals with less training than those currently in or have graduated from a veterinary program. Therefore, the consequence of a *critical* event occurring was *occasional*.

Pharmacy:

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal*. The risk rating for this service area was *medium* to *high*, which was based on the following possible incidents and their analysis:

- Chemotherapeutic and other hazardous medicines had many controls associated with them. There was formal and documented training on the chemotherapeutic drugs, but this was not evaluated by the researcher. The area also had PPE and engineering controls for chemo in addition to SOPs and MSDSs. However, there was still a lot of transporting and could easily drop and break, leading to exposure. Chemotherapeutic drug exposure can be life threatening (MacDondald, 2009), therefore it was *catastrophic*. Work with chemo drugs was frequent, but likelihood of a catastrophic incident considering the current controls was *seldom.*

- Acids could be *critical* in consequence depending on the acid and the concentration as well as the controls associated with it. Work with acids was frequent, but the likelihood of a critical incident was *seldom.*

Central Supply:

There were a total of 15 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal*. The risk rating for this service area was *medium* to *high*, which was based on the following possible incidents and their analysis:

- As with the Animal Care Service Area, the probability of a puncture from a sharp is *frequent* while the severity was *negligible*. Similarly, the probability of contracting a *catastrophic* zoonotic disease from a sharp was *seldom* likely to occur.

- Although personnel did not enter the autoclave, it is a confined space because it is large enough for a person to enter and carry out work, has limited egress, and is not designed for long periods of occupancy (OSHA). The autoclave could be a permit required confined space because it could entrap or asphyxiate an employee who enters (OSHA). The bigger issue with the autoclave was the steam which was released several times per day. The steam could burn an employee which could be *critical*. The supervisor was very strict on training employees to back away as they open the autoclave to avoid a burn. With the training, the probability of a *critical* occurrence was *occasional.*

Anesthesia:

There were a total of 16 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal*. The risk rating for this service area was *medium* to *serious*, which was based on the following possible incidents and their analysis:

- Radiation was pretty well controlled with training and badges, although training was not cross checked by researcher, the 2009 audit by Hellman & Associates stated that the VTH was in compliance with the Colorado Department of Public and the Environment

(CDPHE). Therefore, a *catastrophic* incident was *improbable.* Similarly, a *critical* incident was *seldom* likely to occur.

- Waste anesthetic gases (especially doses for horses) (CDC; NIOSH, 2007) could lead to unconsciousness, nausea, dizziness, headaches, fatigue, irritability, drowsiness, coordination and judgment problems, sterility, miscarriages, birth defects, cancer, and liver and kidney disease, and was therefore *catastrophic*. (OSHA). Since no controls were observed or mentioned during the interview, it was assumed the likelihood of a *catastrophic* incident was *occasional*.

Critical/Urgent Care (CCU):

There were a total of 12 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *high* to *serious*, which was based on the following possible incidents and their analysis:

- The CCU Service Area employees were the first to see a patient and attempt diagnosis. In addition, since they were the first to assess a patient, they were the first to encounter the aggressiveness of the patient. This could result in higher probability of a violent patient hazard and zoonotic disease transmission. CCU employees did not wear precautionary PPE to prevent airborne transmission of a disease. In addition, there was no requirement for vaccinations; these were only used in a reactive situation. Therefore, the severity could be *catastrophic* and the probability was *occasional.*

- As with the Pharmacy Service Area, CCU employees also worked with chemotherapeutic drugs. Similarly, it could be *catastrophic*. Work with chemotherapeutic drugs was frequent, but likelihood of a *catastrophic* incident considering the current controls was *seldom.*

- It was observed during the walkthrough that CCU had a compressed gas cylinder stored laying down, on a bottom shelf and sticking out so workers could trip on it. Compressed gas cylinders should be stored upright and chained up at all times (29 CFR 1910.101) (OSHA). If this were to be knocked, it could lead to an explosion, fire, or toxic release which could be *critical*. The likelihood of this occurring is *occasional.*

Ophthalmology:

There were a total of 16 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal.* The risk rating for this service area was *medium* to *high*, which was based on the following possible incidents and their analysis:

- Formalin was occasionally used in this service area. Acute affects of formalin in the liquid or vapor form include eye and respiratory irritation. Ingesting formalin in large amounts could lead to severe abdominal pains, nausea, vomiting and possible loss of consciousness. Furthermore, formalin (formaldehyde) is a suspected carcinogen. These consequences could be *catastrophic*; however the probability of occurrence was *seldom*. (29 CFR 1910.1048(c)(1) and 29 CFR 1910.1048 App A).

- There was a Diode laser under lock and key, only used by supervisors, with safety glasses, however this could still lead to *catastrophic* consequences, but the likelihood was *seldom.* Please note that an assessment of the current PPE that was used in conjunction with the laser was not assessed as it should be with the rest of the VTH PPE hazard assessment.

- Although all service areas are at risk of zoonotic diseases, ophthalmology employees spent a lot of time with their faces very close to patients. This could lead to higher risk

of biting and possible transfer of disease. The consequences could be *critical* and the likelihood would be *seldom.*

Dermatology:

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *medium* to *high*, which was based on the following possible incidents and their analysis:

- Dermatology employees used the small laser from Exotics rarely and with safety glasses. The 2009 audit classified the Exotics laser as a 3b or 4 leading to a high priority where immediate action should be taken to address the hazard. Therefore, the severity could be *catastrophic*, but with the infrequency of use, an *improbable* catastrophe.

- Dermatology employees were frequently exposed to allergens which could lead to "sensitization and exacerbation of allergic diseases" (Samadi, Heederik, Krop, Jamshidifard, Willemse, & Wouters, 2010).This could *occasionally* lead to *critical* consequences.

Neurology:

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *medium* to *high*, which was based on the following possible incidents and their analysis:

- As with the Pharmacy and CCU, Neurology employees also worked with chemotherapeutic drugs. Similarly, it could be *catastrophic*. Work with chemotherapeutic drugs was frequent, but likelihood of a *catastrophic* incident considering the current controls was *seldom.*

- Rabies could lead to death which would be *catastrophic*, but the likelihood is *improbable* because one can be treated rather quickly (Centers for Disease Control and Prevention, 2010).

Livestock:

There were a total of 16 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was s*erious*, which was based on the following possible incidents and their analysis:

- The hydraulic chutes in this area were insufficient in both machine guards and lockout/tagout procedures. These deficiencies could lead to *catastrophic* consequences. The chutes were used frequently, but there was oral training as well as procedural and warning signs on the chutes as well which would lead to an *occasional* likelihood of occurrence.

- There were large drums of acid and alkaline chemicals to clean the milk machine. They were both stored on the same plastic tray in the milk room. The liquid acid cleaner and liquid caustic chlorinated cleaner were corrosive. Furthermore, the MSDS stated that the liquids were incompatible with each other. The consequences could be *catastrophic*. The likelihood of the catastrophe was *occasional*.

Equine:

There were a total of 15 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *high*, which was based on the following possible incidents and their analysis:

- As with the Pharmacy, CCU, and Neurology, Equine employees also worked with chemotherapeutic drugs. Similarly, it could be *catastrophic*. Work with chemotherapeutic drugs was frequent, but likelihood of a *catastrophic* incident considering the current controls was *seldom.*

Small Animal Medicine:

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *serious*, which was based on the following possible incidents and their analysis:

- There was a higher risk of zoonotic disease in this area because the employees' primary task was to take fluid samples. It was observed that samples had been taken without the use of gloves. Zoonotic diseases can lead to death so the consequences are therefore catastrophic. Although there was frequent exposure to blood and other fluids, the researcher considered the possibility of a transfer of zoonotic disease that would lead to *catastrophic* consequences, and therefore the likelihood is *occasional*.

Small Animal Surgery (SAS):

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *medium* to *serious*, which was based on the following possible incidents and their analysis:

- As with Anesthesia, SAS employees could have been exposed to waste anesthetic gases frequently which can lead to unconsciousness, nausea, dizziness, headaches, fatigue, irritability, drowsiness, coordination and judgment problems, sterility, miscarriages, birth defects, cancer, and liver and kidney disease, and is therefore *catastrophic* (OSHA). The likelihood of a *catastrophic* incident was *occasional*.

- As with Anesthesia, radiation was pretty well controlled with training and badges, although training was not cross checked by researcher, the 2009 audit by Hellman & Associates stated that the VTH was in compliance with the Colorado Department of Public and the Environment (CDPHE). Therefore, a *catastrophic* incident was *improbable.* Similarly, a *critical* incident is *seldom* likely to occur.

- Formalin was frequently used in this service area. Acute affects of formalin in the liquid or vapor form include eye and respiratory irritation. Ingesting formalin in large amounts could lead to severe abdominal pains, nausea, vomiting and possible loss of consciousness. Furthermore, formaldehyde was a suspected carcinogen. These consequences were *catastrophic*, while the likelihood of an incident was *occasional* due to the frequency of use (29 CFR 1910.1048(c)(1) and 29 CFR 1910.1048 App A).

- Hand/portable power tools can lead to *critical* consequences from vibration or direct contact leading to lacerations, etc. The likelihood of this effect was *seldom.*

Oncology:

There were a total of 14 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *high*, which was based on the following possible incidents and their analysis:

- As with the Pharmacy, CCU, Neurology, and Equine chemotherapeutic drug exposure could be *catastrophic*, but there was oral training and the use of the Phaseal® engineering control which makes the probability *seldom*. Please note the researcher did not ask each service area employee if the Phaseal® control was used as this was not a known control per the beginning of the study, however, this was the only service area to mention such a control aside from the training.

Exotics (Zoo Med):

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *minimal.* The risk rating for this service area was *high* to *serious,* which was based on the following possible incidents and their analysis:

- Animal violence in this area was much different because the employees treated a variety of exotic animals that the workers may not have been as familiar with as far as handling and/or transfer of diseases. This could lead to a *seldom* occurrence of a *catastrophic* incident.

- The laser used in Exotics was assessed in the 2009 audit which classified the laser as a 3b or 4 leading to a high priority where immediate action should be taken to address the hazard. Therefore, the severity could be *catastrophic*. The frequency of laser use was not determined. Therefore, the likelihood of occurrence is most likely *seldom* to *probable*. Please note an employee reported the use of PPE in conjunction with the laser; the PPE should be assessed during a hazard/task specific evaluation for more accurate risk determination.

Clinical Pathology:

There were a total of 13 hazards present out of a possible 19, and the quality of noteworthy practices was *okay.* The risk rating for this service area was *high*, which was based on the following possible incidents and their analysis:

- Clinical Pathology employees were exposed to a greater amount of zoonotic diseases since they primarily analyze fluid samples. They recently started wearing gloves, but there was still a *seldom* chance of a *catastrophic* effect.