ONTARIO VETERINARY MEDICAL ASSOCIATION

Your Source. Your Voice.

Health & Safety Handbook *for* Veterinary Hospitals

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Disclaimer

The following material has been prepared for the information of members of the Ontario Veterinary Medical Association as a guideline only relating to various safety issues encountered at in a veterinary hospital. In all cases, it is the responsibility of individual veterinarians to ensure that their practices and standards comply with all applicable federal, provincial, and municipal by-laws, regulations, and legislation. Nothing contained in this guideline suggests or implies complete or proper training or certification of veterinarians or their staffs as might be required by that legislation.

INTRODUCTION

This handbook is intended to provide a user-friendly source of information for persons who wish to learn more about occupational health and safety in Ontario veterinary hospitals. It is directed at veterinarians, veterinary technicians, and other hospital staff, who routinely encounter potential safety hazards in the course of their employment.

It is a general requirement of the Ontario Ministry of Labour that employers provide workers with information, instruction, and supervision adequate to do their job safely. This book summarizes important information that should be included in training programs for veterinary hospital staff, including identification of hazards, explanation of how a given hazard could affect the employee's health or safety, and information on how the worker can protect himself or herself. This handbook contains information on the following safety concerns: bite wounds and other animal-related injuries, zoonotic disease, laboratory hazards, X-rays, waste anesthetic gases, and hospital chemicals.

This handbook deals with safety issues that are particularly of concern to veterinary hospital employees. It does not include detailed information on hazards that are common to nearly every workplace, including physical hazards (vibration, electricity), or physical plant items such as stairs, exits and flooring. Basic safety precautions are listed in Appendix 1 of this manual. Persons interested in obtaining more information on these and other topics should contact the local Ministry of Labour office. Safety issues of particular concern to pregnant women are outlined in Appendix 8 of this manual.

The purpose of this handbook is to present information on safety, rather than to list regulations. A few important Ministry of Labour requirements have been included in this book (see Appendix 2 of this manual). However, readers should be aware that these are subject to change and interpretation. Final rulings and decisions are at the discretion of the Ministry of Labour. For more detailed information the reader should contact the Ontario Ministry of Labour. (1-800-268-8013, or www.labour.gov.on.ca/english/hs/intex/html)

Another good source of information on safety is the Canadian Centre for Occupational Health and Safety, **www.ccohs.ca**, or phone 1-800-668-4284.

It is sometimes frustrating and difficult to incorporate dry facts into real-life situations. The information in this book will give you the factual knowledge you need to work safely in a veterinary clinic. However, this does not mean that the clinic you work in is automatically safe. This will only happen if you and other people in the clinic use your safety knowledge to transform the workplace into a hazard-free environment, and take the necessary steps to keep it that way.

At first, the task of setting up a safety program in a veterinary practice seems overwhelming. The numerous regulations are intimidating, the practice management and staff may be unenthusiastic, and you may feel that you don't have adequate training to devise a good program. All of these obstacles can be overcome – as a start, you can learn the regulations with the help of this book, an Internet search, or a safety consultant or a compliance kit. The second and even more important step is to convince the people you work with that safety is important (or at least you should convince them to let you start working on the more obvious problems!)

As you become more knowledgeable on safety issues, it may become obvious that changes need to be made in workplace procedures or equipment, and that staff will need additional safety training. The employer has the primary responsibility for making the necessary changes in the workplace and ensuring that the staff is trained. It is therefore absolutely necessary to work with the employer on these issues. There may be some expense involved in implementing the safety plan (for example, buying personal protective equipment), and this is the responsibility of the practice management, not the employees.

There are many sources for safety equipment – local hardware stores stock basic items such as vinyl gloves and first aid kits. Specialty items such as WHMIS labels and X-ray warning signs can be ordered from companies such as Lab Safety Supply (www.LabSafety.com, or phone 1-800-356-2501 for technical information and 1-800-356-0783 to order by phone).

One good way to start is to write out a list of changes or procedures that need attention, and to concentrate on each item in turn as you work your way through the list. Start with the most hazardous situation and don't try to change everything at once. Keep records of your efforts and your plans for the future. Don't be discouraged if it takes longer than you expect.

As you set up a safety program, the practice needs to back up the program with official policies that management is willing to enforce. If an employee (or a hospital owner!) is not following a safety procedure, this needs to be brought to that person's attention, with the expectation that change is needed. If the safety plans are not enforced, they are useless. People will need to be tactfully reminded of the "new" way of doing things until the new procedures become a habit.

Staff training is a vital part of any safety program. Every employee must be trained before they are required to perform a job. For example, if a person is required to give a pesticide dip, he or she must be informed of the hazards of the chemical they will use, the personal protective equipment that is required (and how to use it), and what to do in case of a foreseeable emergency such as splashing pesticide in their eye. Training can be undertaken in many ways:

through written material, commercial DVDs, videotapes that you make in the hospital, or by conducting safety meetings and training sessions.

Once your safety program is up and running, it will require some maintenance! This is why it is so important that the employees choose a workplace safety representative (see Appendix 2, for the regulations pertaining to workplace safety representatives and joint health and safety committees). This person confers with the management about staff safety concerns, and should conduct regular inspections of the clinic. Safety inspections don't have to be difficult: the safety representative merely walks through each room, scanning for potential safety hazards. If problems are spotted, they should be discussed with the staff and the employer.

The safety representative should also attend to ongoing jobs such as:
- sorting out new MSDS and putting them in a binder
- ensuring the fire extinguishers received scheduled maintenance
- ordering personal protective equipment and emergency equipment that has been authorized by the employer,
- collecting and sending in radiation badges to a dosimetry service,
- arranging for monitoring of airborne chemicals such as anesthetic gases, formaldehyde, and ethylene oxide.
- arranging for preventative maintenance of the anesthetic machine

The rewards should make all the extra work worthwhile - fewer injuries and illness, less apprehension and uncertainty when handling hazardous materials, fewer days lost to injury, fewer injury and insurance claims, and better morale among hospital staff. A veterinary clinic can be a very safe workplace, but that doesn't happen by accident!

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CHAPTER 1 - BIOLOGICAL HAZARDS

By the very nature of their work, veterinarians, animal health technologists, kennel personnel, and receptionists are constantly exposed to animals and their blood, urine, and feces. In many cases the animals are friendly, healthy, and pose little or no danger to humans. However, veterinary staff must be aware that the potential for animal-related injury or disease is always present. The most important hazards include the following:

1. Animal kicks, bite wounds, squeeze injuries, and other physical trauma

2. Allergies to animal dander or fleas.

3. Parasites, bacteria, viruses, fungi, and protozoa that cause zoonotic disease (disease that may be transmitted from animals to humans). An animal may be suffering from an obvious zoonosis such as rabies, or it may be an inapparent carrier showing no signs of illness. An example of the latter is a cat that is shedding toxoplasmosis oocysts. Exposure to zoonotic disease may occur *directly,* when handling an animal or its excretions, blood, or tissues. *Indirect* exposure may also occur, for example when handling animal bedding or contaminated needles. Or, exposure may occur when handling bacterial or fungal cultures.

Fortunately, it is possible to protect yourself very effectively against most of these hazards. This chapter will outline the health risks associated with the most common biological hazards seen in veterinary practice and discuss practical ways to avoid injury and disease.

This chapter is divided into six parts:

Part 1: Injuries
Part 2: Bite Wounds
Part 3: Zoonotic diseases
Part 4: Allergies and vaccine reactions
Part 5: Laboratory hazards
Part 6: Ergonomics

PART 1 - INJURIES

Anyone who has worked in a veterinary practice can testify that animals occasionally injure the people that handle them. Obviously, the type of injury depends on the species of animal. Dogs primarily defend themselves with their teeth, and bite wounds are therefore a constant hazard. (In fact, each year 15 to 20 people are killed in the United States by injuries received in dog attacks). Cats scratch as well as bite. Ferrets and hamsters can bite, rabbits can bite or inflict deep scratches with the nails of their powerful hind legs, budgerigars can nip with their beaks and larger birds can bite or scratch with their claws. Persons working with cattle are at risk of being kicked, squeezed or trampled. Persons working with horses can be bitten, struck by the front hooves, squeezed, or kicked by the rear hooves. Persons working with ratites (ostriches and emus), camelids (llamas) or captive wildlife such as deer or elk are at risk of injury when handling or treating these patients. Other potentially dangerous creatures that may be presented for veterinary care include monkeys, venomous snakes and constrictors. Persons working with exotic and high risk species need to have detailed knowledge of the special risks associated with handling these animals.

There are many published surveys of animal-related trauma in veterinary practice. The most detailed study was published in 1973 (Thigpen and Dorn). In this study, 773 insurance claims made by injured American veterinarians between 1967 and 1969 were examined for the types of trauma suffered by veterinarians and the frequency of each type of injury. Cattle were most often reported to injure veterinarians, followed by horses and dogs. (This is in contrast to members of the general public - almost 90% of reported animal attacks to the public are from dogs, and the majority of the remainder are from cats). The most common injuries to veterinarians and hospital staff were lacerations and puncture wounds, followed by fractures (including facial fractures and knocked-out teeth) and sprains/torn ligaments/dislocations. More veterinarians were injured in the afternoon than in the morning, and July was the peak month for accidents.

Not surprisingly, most injuries to veterinarians in the 1973 study occurred on a farm or ranch. The authors stated:

"While in the process of treating, restraining, castrating, or examining animals, the veterinarians were bitten, kicked, gored, pawed, knocked down, trampled, run over, and even fallen upon by these animals. While treating resisting farm animals, veterinarians cut themselves, fell, stumbled, or slipped on wet ground or ice in attempts to avoid injuries. These veterinarians jumped off fences, twisting ankles or landing on nails, stepped on pitchforks, and were injured with chutes, speculums, lariats, nose tongs, halters, broken syringes, and an array of practice equipment. They were knocked over and through fences, squeezed against fences, and caught between bulls fighting. They were fallen on by horses while working cattle or else they twisted an ankle while getting off the horse."

Things did not improve much when the veterinarians returned to the hospital:

"In the clinics, they were bitten, scratched, and knocked down by the animals. They were burned when steam valves burst, and slipped while reaching in a cage for an animal. They injured their backs picking up dogs and bumped their heads and legs on clinic equipment. They cut themselves during surgery and ran pinning equipment into their fingers and wrists."

Another study (Landercasper et. al. 1988) examined the incidence of trauma in Minnesota and Wisconsin veterinarians and found that 64.6% of veterinarians had suffered a major animal-related injury sometime during their career, with 14% of the injuries being serious enough to require hospitalization. The veterinarians surveyed were found to have lost an average of 8.5 days due to injury during the course of their careers. When asked to describe the most severe animal-related injury of their career, 35.5% reported an animal kick and 34% reported an animal bite. Some of the more unusual injuries included being struck on the head with a calving jack, multiple injuries resulting from an attack by a runaway elephant, and injury from falling while running to escape from attacking cattle. Somewhat surprisingly, 48% of veterinarians did not think their occupation was dangerous! Many veterinarians reported treating their own injuries, including 20% who sutured, 67% who self-administered antibiotics, and 3.6% who reduced fractures or dislocations. [2]

One recent study (Jaggin et al, 2005) examined the incidence of kick injuries in veterinarians who examined and treated horses. This study found that the risk of injury was highest when performing hurried procedures due to time restraints. Kick injuries were also associated with horses being startled by unforseen events during the examination or treatment procedures.

The authors of these studies make many recommendations for prevention of animal - related injuries. The five items listed below were mentioned by almost all study authors:

1. Get help from veterinary technicians or animal owners when lifting or treating animals.
2. Improve restraint procedures by utilizing tranquilizers or mechanical devices such as chutes and stanchions for patient restraint.
3. Choose the treatment location with care: ensure adequate lighting and non-slippery flooring before beginning to work.
4. Obtain more education in the area of occupational safety.
5. Avoid interaction with a fractious animal when working alone.

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[2] This report also documents the high rate of motor vehicle accidents by veterinarians travelling to farms. The veterinarians surveyed averaged more than 300 miles of driving per week, and only 56% stated that they always observed the speed limit.

Other specific preventative measures will depend upon the species being examined: in general, the more familiar the veterinarian or technician is with the species being examined, the less likely that injury will result. When restraining an animal, pay attention to the animal and its reactions, not just the procedure. Use restraint equipment such as muzzles, cat bags, capture poles, squeeze cages, and leather gloves for restraint of fractious small animal patients. Don't put your face close to the hoof or mouth of an unsedated animal. If you feel unsafe working around a potentially dangerous animal, discuss the need for tranquilization or other method of restraint with the veterinarian.

Avoid working with a fractious animal when you are alone. A second person can provide a diversion for the animal and if necessary, apply first aid and call for medical attention if you are injured.

Persons working with large animals should plan in advance for a quick exit route in case of animal attack. When entering a stall occupied by a large animal, it is a good idea to stay on the side of the animal nearest the door, in case a quick exit becomes necessary.

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PART 2 - BITE WOUNDS

Bite wounds from dogs and cats are the most commonly reported animal-related injury to veterinary hospital staff. There is abundant literature on the pathogenesis and treatment of these wounds.

Dogs inflict 80 to 90% of all animal bites to the general public in the U.S. Certain breeds, including German shepherds, poodles, and terriers are reported to have higher-than-average risk of inflicting bite wounds. It has been suggested that veterinary hospital staff are generally able to predict which animals are most likely to bite: pets identified with a warning sign were four to five times more likely to bite when hospitalized. However, the same study showed that only 47% of the dogs and cats judged likely to bite were actually muzzled for procedures (muzzles were used on 12-14% of animals considered unlikely to bite). Apparently, recognition of risk does not necessarily lead to taking active steps to prevent injury ! The best way to prevent bite injuries is the consistent use of muzzles, bite resistant gloves, rabies poles and other restraint devices, and chemical sedation or anesthesia where indicated. Experienced hospital personnel are generally more reliable assistants than animal owners.

Bite wounds cause considerable tissue trauma. The jaws of a large dog can produce 150 to 450 psi of pressure, which is enough to bend steel bars and penetrate stainless steel feeding bowls. It is obviously more than enough force to severely bruise and crush tissue. The most common location for canine bite wounds to humans is the radius or ulna and the most common location for feline bite wounds is the hand.

In addition to mechanical trauma, bites often lead to infection. If the skin is broken, wounds are contaminated with the bacteria that reside in the dog or cat's mouth (and occasionally, with those that live on human skin). Over 64 species of bacteria are reported to reside in the canine and feline oral cavity. The most common bacterial invader of wounds is Pasteurella multocida in cats and Pasteurella canis in dogs. A small gram-negative coccobacillus, Pasteurella are normal resident flora in both the feline and canine oral cavity. Infection of bite wounds with other bacteria (Capnocytophaga, Streptococcus, Moraxella, Neisseira, Franciscella tularensis, and anaerobic bacteria) also occurs, but is less commonly recognized than Pasteurella. Sometimes, more than one type of bacteria can be cultured from a bite wound.

Cat bites occur less frequently than dog bites, but are associated with much higher infection rates. The risk of infection has been reported to be 3-18% for a dog bite, compared to 28-80% for a cat bite. Cat bites are associated with severe sequelae (meningitis, endocarditis, septic arthritis, septic shock) more frequently than dog bites. The higher rate of infection from cat bites may result from the shape of the teeth: in cats, whose canine teeth are finely pointed and can more easily penetrate into deep tissues. As a

result, cat bites are more difficult to irrigate and clean. It has been speculated that the type of bacteria that is found in the feline oral cavity may be more pathogenic to humans than that found in the canine oral cavity.

Typically, Pasteurella multocida infection of a dog or cat bite wound results in rapid onset of local swelling, erythema (redness) and pain, usually within a few hours of the bite. The wound will often exude a blood-tinged fluid. After 24 to 48 hours, local swelling may resolve, or the organisms may spread into other tissues, causing swelling and pain some distance away from the wound. In the case of bite wounds on the hands, the spreading infection is usually evident as an area of redness and swelling which in severe cases may advance up the arm. Systemic signs such as swollen lymph nodes and flu-like symptoms such as fever, chills, and muscle pain may also be present (see also the section on cat scratch disease). Occasionally, even more severe complications may develop following infection with Pasteurella and other bacteria, including osteomyelitis, septic arthritis, tendon and/or joint infections, meningitis, brain abscess, and septicemia, as well as scar formation and disfigurement. Persons with underlying diseases or immune system dysfunction are at particularly high risk for serious wound complications. Victims of bite wounds may also go on to develop diseases transmitted by animal bites, including tetanus, rabies and cat scratch disease.

Capnocytophaga has been recognized as the causative agent of a distinctive flu-like illness that follows a scratch or bite. The incubation time is 3 to 6 days, followed by symptoms resembling influenza. These symptoms may be present even if there is no significant lesion at the site of trauma. As with other bacteria that invade bite wounds, Capnocytophaga infections are potentially most dangerous in persons who are immunocompromised or who have had undergone a splenectomy. The case fatality rate for Capnocytophaga infections in compromised human patients is 25%.

The risk of complications from bite or scratch wounds can be substantially decreased by prompt first aid following a cat or dog bite:

1. Wash the wound thoroughly with a surgical prep solution such as chlorhexidine or povidone iodine (Betadine) solution. Surgical prep solutions are preferred to soaps, which may contain detergents and can induce pain and delay wound healing. A sterile gauze may be used to gently clean the wound, however vigorous scrubbing should be avoided. After washing, the wound should be irrigated with up to one liter of normal saline using an 18-gauge blunted needle on a 35 ml syringe. The saline should be applied with maximum pressure, in order to flush out bacteria, devitalized tissue, and other materials.

2. If the wound is severe, seek medical attention as soon as possible. The infection potential of a bite wound is reduced if it is treated promptly with deep irrigation and debridement, which should only be administered by a physician. Some physicians advocate suturing but many do not unless the wound is on the face or is deep and hemorrhagic. If signs of infection are present, the physician will likely culture the wound. Severe wounds may require immobilization and elevation of the affected area.

3. Use of prophylactic antibiotics in persons with fresh, clean wounds is controversial: some studies show that the incidence of infection in uncomplicated, minor **canine** bite does not decrease when antibiotics are given. Many physicians prescribe antibiotics for all moderate to severe bite wounds (especially **feline** bite wounds) due to the relatively high risk of infection. It is generally agreed that antibiotics should be administered to any person with a bite wound that is already infected. There is no single antibiotic that is effective against all of the aerobic and anaerobic bacteria that cause wound infections, and culture and sensitivity is therefore commonly performed. Amoxicillin with clavulanic acid is frequently administered while awaiting culture results. (Penicillin derivatives are very effective against most Pasteurella and Capnocytophaga species) Hospitalization for parenteral (usually IV) therapy with antibiotics is often recommended for patients with multiple severe bites, severe local infections, systemic involvement, bone or joint involvement, and in all immunocompromised patients.

4. Soaking the affected region in hot water (or applying a hot, damp cloth) may give temporary pain relief. Poultices are also helpful for swollen and painful wounds.[3] If purulent material accumulates, it may require drainage by a physician.

5. Tetanus is a potential (although uncommon) complication of any bite wound. There are two ways to prevent tetanus from occurring: use of tetanus toxoid (true vaccination, which causes the formation of antibody and confers long-term immunity) and the use of human tetanus immune globin (injection of pre-formed antibody, gives short-term protection only). It is advisable that persons working in veterinary hospitals be vaccinated with tetanus toxoid every 10 years in order to develop active immunity to this disease. In order to be effective, tetanus toxoid must be administered **before** a bite wound occurs, to allow time for an immune response to develop.

If a bitten person is unvaccinated, it is common for physicians to administer human tetanus immune globin to confer passive immunity against tetanus. This will prevent tetanus from developing, but unlike true vaccination, does not confer long term immunity. .

Persons who have had a tetanus toxoid booster (e.g. vaccination against tetanus) in the past 5 to 10 years and have had at least 2 previous tetanus vaccinations (usually given in childhood) should have some active immunity, and may not require tetanus immune globin following a bite wound. However this recommendation is somewhat dependent on the severity of the wound - tetanus immune globin may be recommended in all persons with severe, untreated wounds that are over 24 hours old, regardless of the vaccination history.

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[3] A poultice can be made by applying honey, syrup, or other osmotically active material to the wound surface, then wrapping it with gauze or other absorbent material. This should be left in place for at least 12 hours.

6. If the biting animal is potentially rabid, it may be necessary for the person who was bitten to undergo rabies prophylaxis (see section on Rabies)

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PART 3 - ZOONOSES

At least 150 diseases can be transmitted between humans and animals.[1] Disease can be transmitted not only from animals that are clinically ill, but also from asymptomatic carriers (for example, Salmonella bacteria are often shed by healthy reptiles and poultry). In some cases, an animal's endogenous flora can be pathogenic to humans (for example Pasteurella, the organism that infects cat bite wounds and which is normally found in the oral cavity of a cat). Zoonotic pathogens may be transmitted directly from patients or their secretions and excretions, or indirectly, from contaminated objects in the environment such as bedding material, food and water bowls, and equipment used to treat the patient. A few zoonoses are transmitted by shared vector such as fleas, or shared environmental exposures (e.g. contaminated drinking water).

Because of their frequent exposure to animals, veterinarians and veterinary hospital staff are at relatively high risk for acquiring zoonotic disease. In a recent study of California veterinarians, 40% of the respondents reported infection with a zoonotic disease at some point in their career.

The zoonotic diseases that are most commonly reported in Ontario are discussed individually below. Some exotic diseases that are rare or have not yet been reported in Ontario (cryptococcus, hantavirus, plague) are also included for completeness. These diseases cover the whole spectrum in terms of severity, from nuisance (e.g. ringworm) to almost invariably fatal (e.g. rabies). Each section will summarise the distribution of the disease agent, the clinical signs of disease in animals and in humans, the method of transmission of the disease from animals to humans, and explain how transmission may be prevented. As the emphasis of this publication is on disease prevention, the diagnosis and treatment of these diseases in animals and humans has not been outlined in detail. The information given here is an overview only, and readers with an interest in a particular disease are urged to obtain additional information from the local public health office or the references listed at the end of each section.

Transmission of Zoonoses

Before discussing individual diseases, it may be helpful to examine the ways in which zoonotic diseases are transmitted to humans. Most zoonotic diseases are transmitted by one of four routes:

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[1] It should be recalled that not only can animals transmit disease to people, but people can also transmit their diseases to animals. One example is human influenza, which can cause respiratory disease in ferrets. Another example is tuberculosis: almost all canine and feline infections are acquired from humans with tuberculosis.

1) Oral ingestion of infective material (usually feces) - The fecal-oral route is the most common route of zoonotic disease transmission, occurring in numerous disorders such as salmonellosis, toxoplasmosis, and many parasites of the gastrointestinal tract. Zoonotic organisms are common in feces: intestinal agents with zoonotic potential were detected in the feces of 13% of healthy cats tested in Colorado and more than 40% of kittens tested in New York State (Feline zoonoses guidelines, American Association of Feline Practitioners, 2004). Some agents are immediately infectious (Giardia, Cryptosporidium, Salmonella, Campylobacter), whereas other agents (Toxocara, Toxoplasma) require a period of time outside the host to become infectious.

Small children are particularly prone to develop infectious or parasitic diseases, as they are more likely to consume material that is contaminated with canine feces. Obviously, veterinarians, veterinary hospital employees, and other adults are at lower risk of acquiring diseases in this way. Nevertheless, it is common for infective agents (parasite eggs, bacteria, viruses, etc...) to be present on the hands of personnel who work with animals or their excretions (particularly feces). Once the hands are contaminated, the organism can enter the mouth when the person smokes, eats, or bites their nails.

Frequent hand washing is the best way to prevent ingestion of infectious substances. Gloves are a helpful barrier to infection, but hands should still be washed after removing the gloves. It is also a good idea to avoid touching the face, mouth, or eyes with your hands when doing laboratory work or handling animals.

2) Skin contact - Several parasitic diseases of the skin, including ringworm and scabies, are transmitted by direct skin contact with an infected animal. Transmission of the infective agent may occur when a susceptible person pets, grooms, kisses, or merely picks up the animal that carries that agent. A few infectious agents are able to penetrate intact skin, and some can cross intact mucus membranes in the mouth, nose and conjunctiva. Many agents can invade cuts or abrasions in the skin. Again, hand washing is the single best way to prevent infection by this route. In some circumstances, gloves, goggles, and/or the use of a face shield, fume hood, or biological safety cabinet may be advisable.

3)Wounds – Some diseases, including tularemia, cat scratch disease, and rabies are transmitted by bite or scratch wounds.

4) Inhalation - A few zoonoses can be transmitted when a person breathes air which is contaminated with a virus, bacteria, or fungus. One example is chlamydiosis, which is caused by an agent that is shed in bird droppings and which may be inhaled by persons when cleaning a cage or handling an infected bird. Other examples include plague, Q fever, and tularemia.

Inhalation of infectious material may also occur in the following ways:
- when examining a fungal or bacterial culture that is producing spores

- when flaming an inoculating loop or needle that has been used to culture bacteria
- when using a saw to cut bone during a necropsy procedure
- when a test tube breaks inside a centrifuge, and material is expelled from the tube.
- when performing a dental prophylaxis using ultrasonic equipment
- suctioning, lavage, or using a high pressure spray around infected tissues.

Under any of these circumstances, use of a surgery mask will decrease the potential for infection. Goggles may be necessary in some cases (particularly when performing dental work).

Preventing Transmission of Zoonotic Diseases

By following a few simple rules, it is possible to greatly reduce the risk of becoming infected with a zoonotic disease when working in a veterinary environment.

1. **All persons handling animals should wear a lab coat or uniform**. The uniform should be washed daily, and preferably left at work. Otherwise, infective organisms may be present on clothing, to be taken home to infect pets or family members. For the same reason, it is a good idea to shower and change clothes after arriving home from work.

Although it is not necessary to wear gloves when handling normal, healthy animals, particular care should be taken to use protective clothing such as gloves and a lab coat when handling patients known or suspected to be infected with zoonotic organisms. This precaution applies whether treating a live animal, working with infected tissues or body fluids, cleaning a cage that was occupied by an affected animal, or handling the carcass of an animal that has died from a zoonotic disease. For example, if an animal has a potentially zoonotic skin condition such as scabies it is a good idea to avoid skin contact by wearing gloves and a water-proof apron when touching or bathing the animal. Similarly, it is a good idea to wear gloves and a lab coat when cleaning up fecal material from a puppy or kitten with diarrhea, as many of these patients are infected with zoonotic agents (Salmonella, Campylobacter, Giardia, Cryptococcus, roundworms). Gloves should also be worn when handling soiled laundry and bedding material.

Gloves and other contaminated protective clothing should be changed between patients. When wearing these articles, care should be taken not to touch (and therefore contaminate) items such as computer keyboards, door handles, or telephone receivers.

In special cases, respiratory protection and eye and/or face protection (safety glasses, goggles, face shields) should be worn.

2. **Avoid eating, drinking, or smoking when handling patients, their feces, and body fluids**. Infective agents are readily transmitted from the hands to the mouth and

mucous membranes when eating, drinking, or smoking.

3. **Hand washing is the single most important means of preventing the spread of infection**. Hands should be washed after handling feces, urine, or wound secretions, or after cleaning cages. If possible, wash hands between every patient, and be particularly careful to wash hands after handling patients with zoonotic diseases. Hand washing is recommended even if gloves were worn when handling a patient, because of the risk of minute leaks through the glove material or around the cuff of the gloves.

Normally, it is adequate to wash hands with ordinary soap and water. (For complete instructions on hand washing, see Appendix 3) Soap and running water mechanically remove soil and organisms on the skin. However, if the patient suffers from a known zoonosis, it is recommended that a surgical soap be used. Surgical soap kills both transient and resident flora by damaging the bacterial cell walls and dissolving the envelope that surrounds many viruses. Surgical soaps also have a residual effect that suppresses microbial growth for several hours.

In some situations, soap and water may not be immediately available (for example, when working on a farm or ranch). In this case, alcohol based gels such as Purell are moderately effective in killing bacteria and enveloped viruses, especially if the hands are not soiled. Alcohol-impregnated wipes such as towelettes are not as effective as gels or hand washing.

4. **Transmission of zoonotic pathogens is reduced by appropriate cleaning of work areas and equipment.** Surfaces should be cleaned of gross contamination before disinfection, as organic material such as feces decrease the effectiveness of disinfectants. Materials that cannot be easily cleaned and re-used (for example, toys or disposable litter boxes) should be discarded between patients.

5. **All persons at risk for rabies or tetanus should be vaccinated.** Tetanus vaccination every 10 years is recommended. Recommendations on rabies vaccination vary depending upon the risk of exposure (see section on Rabies).

6. **Maintain a high level of awareness about zoonotic disease**. Patients with contagious zoonotic disease should be clearly identified so their infectious status is obvious to everyone. Ideally these patients should be kept in an isolation area with restricted access. Personal protective equipment used by persons handling patients in isolation should be laundered or discarded immediately after use or should remain in the isolation room with the patient.

7. **Document exposure to significant zoonotic pathogens.** If a veterinary employee is ill and seeing a physician, the physician should be made aware that the patient works in a veterinary hospital and may have been exposed to zoonotic microorganisms. This is particularly important for persons who have increased susceptibility to disease (see following section).

References:

1. U.S. Department of Health and Human Services: Guidelines for protecting the safety and health of health care workers. National Institute for Occupational Safety and Health (NIOSH), U.S. Government Printing Office, Washington DC, 1988.
2. National Association of State Public Health Veterinarians (NASPHV), Veterinary Infection Control Committee (VICC). Model Infection Control Plan for Veterinary Practices, 2006.
3. Feline zoonoses guidelines from the American Association of Feline Practitioners. Journal of Feline Medicine and Surgery 7, p 243-274, 2005.

Susceptibility to Disease

It is well established that some persons are at greater risk of developing a zoonotic disease than others. In general, these "high risk" groups include...

1. **Persons who are very young or very old.** The immune system is "inexperienced" in young persons, and they have not yet developed immunity against some diseases. For example, children often develop ringworm infections, whereas most adults are relatively resistant to ringworm. Elderly persons are also at a higher risk of developing infectious disease than the general population. In older persons, the immune system is not as efficient as it once was, and organ function (heart, liver, kidney) may be impaired. As a result, even a relatively minor pathogen may cause serious disease in the elderly.

2. **Persons who are receiving drugs that suppress the immune system**. Immunosuppressive drugs include prednisone/prednisolone, cancer chemotherapy agents (or radiation treatment for cancer) cyclosporin, and similar agents.

3. **Persons infected with the human immunodeficiency virus (HIV).**

4. **Persons with serious pre-existing disease**, including congenital immunodeficiencies, autoimmune diseases, diabetes mellitus, chronic renal failure, alcoholism, liver cirrhosis, malnutrition, or cancer. Persons who have undergone a splenectomy are also at higher risk of acquiring some diseases.

5. **Pregnancy**. Working in a veterinary hospital is not necessarily hazardous for pregnant personnel, but some common-sense precautions should be taken. Some zoonotic agents can cause devastating illness in the unborn fetus, leading to miscarriage or congenital disease. The diseases that are of most concern are toxoplasmosis and listeriosis. These and other hazards for pregnant individuals are discussed in more detail under individual disease headings, and in Appendix 8.

6. **Persons in which the body's first line of defence mechanisms (skin, mucus membranes) are not intact**. For example, some bacterial and viral pathogens may readily invade damaged skin (for example, a skin abrasion, or cut).

Persons who have one or more of the risk factors listed above should consult with their physician regarding safe work practices. In some cases, special precautions (such as wearing gloves when handling patients and washing hands before and after every patient) may be necessary. Diseases that are of particular concern include toxoplasmosis, brucellosis, chlamydia infection, cat scratch disease, and diarrhea due to Salmonella, Cryptosporidium, Giardia, or Campylobacter. Direct patient care is of particular concern for high risk animals such as the following:

- ruminants prior to weaning
- puppies and kittens, especially those with diarrhea
- parturient animals (those that are giving birth)
- stray or feral animals, particularly predators or rodents
- animals fed raw meat diets
- exotic pets (e.g. reptiles)
- animals housed in crowded or unsanitary conditions

Reference:

1. Angulo FJ, Glase CA, Juranek DD, Lappin MR, Regnery RL: Caring for pets of immunocompromised persons. Canadian Veterinary Journal 36 (4): 217-221, 1995.

ZOONOTIC DISEASES - DETAIL ON SPECIFIC DISEASES

In this section, diseases are discussed in alphabetical order by the common name of the disease or the name of the infectious agent. There are many sources for additional information on zoonotic diseases, including the following:

1. American Veterinary Medical Association website, (avma.org). This website features a comprehensive list of zoonosis updates, which can be accessed by non-members. The page location is www.avma.org/reference/zoonosis
2. Understanding Zoonotic Diseases (2008) by Janet Amundson Romich. This is an excellent textbook on zoonoses, written for veterinarians and animal health technicians. It is published by Thomson Delmar Learning.

Ancylostoma

Several species of hookworms affect humans and domestic animals, including Ancylostoma caninum, Ancylostoma braziliense, and Uncinaria stenocephala. These parasites normally live in the intestines of dogs and cats. The most common clinical signs in affected animals are diarrhea and anemia, which occur when the hookworms attach to the intestinal lining and cause hemorrhage into the bowel. Adult worms in the intestine release eggs, which are expelled in the feces and contaminate the environment. Larvae hatch from the eggs and reach an infective stage between 3 and 22 days after the feces are passed, depending upon the environmental temperature (more rapid maturation occurs at higher temperatures). The larvae can survive for many weeks in a warm moist environment.

Hookworm larvae may infect humans by penetrating through intact skin (most common) or by ingestion (rare). The resulting disease, called cutaneous larva migrans, is particularly common in the south-eastern and Gulf Coast areas of the United States, where infection usually occurs in persons walking barefoot in contaminated areas such as playgrounds, beaches, or crawl spaces under houses.

When the hookworm larvae enter the body, there is an immediate stinging sensation, followed within 2 weeks by a skin eruption which is very itchy. Papules and blisters appear and spread a few millimeters per day as the larvae migrate. Edema and enlarged regional lymph nodes may also be present. The larvae are usually confined to the epidermis but on occasion may migrate inside the body, causing pneumonia and ocular disease.

Cutaneous larva migrans is usually self-limiting, but symptoms can last up to several weeks. Treatment with albendazole, thiabendazole, or ivermectin is helpful in eliminating the infection.

Hospital staff in Canada are at relatively low risk for the disease, as the species of hookworm involved are not well adapted to cool climates. Staff are advised to wash hands frequently and to wear shoes when walking in potentially contaminated areas.

References:

1. Bowman DD: Hookworm parasites of dogs and cats. Compendium Small Animal 14 (5): 585-593, 1992.
2. Shantz PM: Ancylostomiasis. In Health Hazards in Veterinary Practice 3rd edition, American Veterinary Medical Association, 1995.

Anthrax

In Canada, anthrax is an uncommon disease that causes septicemia, edema, and sudden death in cattle and wild ungulates. It is considered to be a significant zoonosis and as such all suspected cases in animals must be reported to a Federal veterinarian working for Agriculture Canada. Many reported cases of anthrax in Canada involve wood bison in the Northwest Territories. A significant outbreak of anthrax in cattle and horses occurred on the Prairie provinces in 2006 and 2007.

Anthrax is caused by an aerobic gram-positive bacteria, Bacillus anthracis, which is common in the soil of some geographical regions. Animals become infected by ingesting spores in soil or vegetation. The course of the disease is rapid, and most affected animals are found dead with no signs of disease being observed prior to death. Unclotted blood may be present at body orifices.

Humans may become infected with anthrax in several ways:

- contact with bacteria while performing an examination or necropsy on an infected animal
- contact with a blood sample from an infected animal
- contact with hair, wool, or skins of affected animals

In humans, the most common sign of disease is a skin nodule (cutaneous anthrax). This appears 2 to 5 days after contact with the bacteria, and at first appears as a red pimple similar to an insect bite. This may blister, rupture, and form a depressed, black eschar (scab). If untreated, septicemia or meningitis may develop, which may be fatal in some cases.

Occasionally, persons may inhale the Bacillus anthracis spores and develop anthrax. This at first appears to be a mild flu-like disease (fever, malaise, cough) but rapidly progresses to respiratory distress, edema of the neck and thorax, and pneumonia. Once severe signs are present, treatment is rarely successful.

An Agriculture Canada veterinarian should be notified of any suspected case of anthrax, and this person will normally supervise and direct all handling of infected animals and diagnostic specimens. Human anthrax can be prevented by avoiding contact with blood or tissues of an infected animal. For this reason (and to prevent the formation of spores) the carcass of an animal suspected to have died from anthrax should not be opened. Contaminated clothing should be burned, as the spores are very difficult to kill with disinfectants. If a blood sample is cultured or examined in a laboratory, it is necessary to use universal precautions (see section under laboratory hazards). A vaccine is available for human use but is seldom administered except to persons conducting anthrax research.

References:

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2. Hunter, L et al. Anthrax. JAVMA April 15, 1989.
2. Whitford HW: Anthrax. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg, Ill., 1989, p. 3-6.

Avian Influenza

Avian influenza is caused by a type A influenza virus. Like most influenza viruses, avian influenza is capable of rapid genetic change, and many different strains have been reported. The natural hosts are many species of wild and domesticated birds, however the virus has also been reported other species, including mammals[1]. Avian influenza is common in wild bird populations, which are the suspected source of infection for commercial and hobby poultry flocks. The disease in turkeys, ducks, and chickens ranges from very mild to fatal respiratory disease, depending upon the strain involved.

Most cases of human influenza are caused by influenza A viruses of human origin but occasionally, influenza A viruses of non-human origin (including swine influenza and rarely, avian influenza) may be transmitted to humans. It appears that contact with live infected poultry is the usual source of infection, although some strains appear to be passed from human to human. Cooking or eating poultry meat does not seem to be a risk factor for acquiring avian influenza.

Until recently, human infection with the avian influenza virus was considered rare. Mild

[1] An outbreak of avian influenza occurred in harbour seals in the North-eastern United Sates in 1978-79.

cases of conjunctivitis or flu-like symptoms in humans caused by the avian influenza virus were reported in 1959, 1978-9, and 1996. More serious outbreaks occurred in 1997 and 2003, when multiple human cases of avian influenza occurred in Asia. In both of these outbreaks, human fatalities were reported. Although each of these outbreaks was suppressed by depopulation of affected poultry and strict quarantine measures, human cases caused by the avian influenza virus strain responsible for the 2003 outbreak (called the H5N1 strain) continue to be reported sporadically in Southeast Asia, Russia, and Turkey. To date, H5N1 influenza infection has caused over 160 human fatalities.

One serious concern with avian influenza virus is that a new, hybrid human-avian influenza virus could arise in the future. Such a virus would have characteristics of both human influenza and avian influenza viruses, and as a result would have the potential to be easily transmitted to humans and capable of causing severe disease. Depopulation of birds in Hong Kong and China before the onset of the human influenza season may have forestalled this outcome in 1997 and 2003, but the potential for a human pandemic is still present.

The most common signs of avian influenza in humans are fever, fatigue, cough, sore throat, muscle aches, and conjunctivitis. Fatalities are most commonly associated with the H5N1 strain, and are usually due to interstitial pneumonia. (Interestingly, the first human fatality in the 2003 outbreak was a Chinese veterinarian who had recently treated sick birds at a poultry farm).

Avian influenza has been reported in both the US and Canada. In 2004, an H7N3 strain of avian influenza caused a disease outbreak in the Fraser Valley. Two cases of human infection (both mild) were reported in association with this outbreak. In 2005, an outbreak of H5N1 influenza occurred in a duck farm in Chilliwack, BC. Apparently this was not the virulent strain of the H5N1 virus, as no cases of human illness were reported with this outbreak. Another outbreak occurred in Saskatchewan in 2007, and in this case the causative agent was confirmed to be the H7N3 strain of avian influenza.

Reference:

Swayne DE and King DJ: Avian Influenza and Newcastle disease. JAVMA, June 1, 2003.

Baylisascaris

Baylisascaris procyonis, the common roundworm of racoons, may cause visceral larva migrans, ocular larva migrans, or fatal cerebrospinal nematodiasis in humans. Infection of humans occurs through accidental ingestion of infective eggs passed in the feces of racoons.

Although racoons are the most common host of this parasite (with prevalence reported to be 68 to 82% of racoons in the mid-western and northern United States), infection has been reported in dogs that run free in racoon habitats. As with Toxocara, young animals are most likely to be infected.

The infection in racoons is usually asymptomatic, even in animals that are shedding millions of eggs daily in the feces. Eggs become infective 3 to 4 weeks after being passed in the feces and may persist in the environment for months to years. When infective eggs are ingested by humans, larvae migrate to the liver, lungs, brain, spinal cord, and eye. Asymptomatic infection with a few larvae is probably the most common form of the disease in humans. If clinical signs develop, they may include fever, blindness, muscle incoordination, nystagmus, stupor, coma, and death. There is no effective treatment for advanced cases.

Hospital employees who are in close contact with racoons (particularly racoons between 2 and 12 months of age) and environments contaminated with their feces are at some risk for this disease. Many drugs are effective in eliminating adult worms in racoons, including pyrantel pamoate, mebendazole, and fenbendazole. Routine sanitation and hand washing are also important control measures. Standard disinfectants do not kill the eggs, although a 1:1 mixture of xylene and ethanol has been reported to be effective after most organic debris has been removed. Large areas of contaminated soil or concrete are best treated by thorough flaming using a portable propane torch.

Persons working in contaminated areas should consider using gloves and a face mask to prevent inhalation or ingestion of eggs.

Recent reports have suggested that other species of Baylisascaris found in badgers, skunks, fishers, martens, and bears may also cause human disease.

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2. Kazacos KR, Boyce WM: Baylisascaris larva migrans. Journal of the American Veterinary Medical Association 195 (7): 894-903, 1989.
3. Kazacos KR: Baylisascaris. In Health Hazards in Veterinary Practice, 3rd edition. American Veterinary Medical Association, 1995: p. 13-14.
4. Ruddman DG: Baylisascaris procyonis larva migrans in the dog: A case report and update for the veterinarian. The Journal of the American Animal Hospital Association 32 (Jan/Feb): 73-76, 1996.

Brucellosis

Brucellosis is fortunately a rare disease in Canada at the present time. Almost all currently reported cases are in wildlife such as bison, caribou, elk, and moose. In the past, brucellosis was commonly reported in many species of domestic animals including cattle, sheep, dogs, swine, and goats, but has been largely eliminated by test and slaughter programs. Brucellosis in domestic animals other than dogs is a reportable disease in Canada and an Agriculture Canada veterinarian must be notified of any suspected case.

The most common signs of brucellosis in animals are abortion and infertility. The disease in animals may also be asymptomatic, or it may appear as chronic lymphadenopathy, epididymitis and orchitis. The cause is a gram-negative rod, Brucella. There are several species, the most important of which are Brucella abortus (affecting cattle), Brucella melitensis (affecting sheep and goats), Brucella suis (affecting pigs and caribou), and Brucella canis (affecting dogs).

Brucellosis in cattle, swine, and goats is very contagious to humans. Canine brucellosis appears to have a lower risk of transmission to humans.

Brucellosis is transmitted to humans by ingestion, inhalation, or direct contact with infective materials. The organism can invade through mucous membranes, skin cuts, or abrasions. Infective materials include:

- newborn animals or aborted fetuses infected with the disease;
- placenta and vaginal discharges from a female animal infected with brucellosis;
- blood and tissue from any animal (male or female) infected with the disease.
- brucellosis may also be transmitted by drinking unpasteurized milk from affected cows

In humans, brucellosis is a severe illness, commonly known as undulant fever. Affected persons suffer from recurrent fever, chills, sweating, headache, malaise, weakness and fatigue, anorexia, nausea, muscle pain, diarrhea with stomach cramps, and weight loss. Neurological effects include depression and nervousness. Antibiotics are helpful in treatment of clinical signs, but the organism may persist in the body for several years, causing recurrent backache, joint pain, and malaise. Treatment with a combination of tetracycline and streptomycin (or doxycycline and rifampin) is fairly effective in preventing recurrent infection.

Transmission of this disease to veterinary hospital staff can be prevented by avoiding direct contact with tissues or fluids from affected animals. Frequent hand washing and the use of gloves, protective clothing, and eyewear are important when working with known positive animals or tissues. Persons handling laboratory samples from animals

with brucellosis (particularly if caused by B. melitensis) should utilize universal precautions (discussed in the section on laboratory safety). As with other reportable diseases, handling of affected animals and tissues should be supervised by an Agriculture Canada veterinarian.

In the past, a form of brucellosis could be acquired by accidental self-inoculation or syringe splash into the face or eyes from Brucella abortus Strain 19 vaccine. The more virulent form of this vaccine is no longer manufactured in Canada or in the United States. The vaccine available at the present time has considerably fewer live B. abortus organisms (3 to 10 billion per dose, compared to 25 billion in the older vaccine). Reactions are still possible, however, and care should be taken to avoid self-injection when vaccinating animals.

References:

1. Young EJ: Brucellosis. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg, Ill., 1989, p. 15-18.
2. Currier, R.W. Brucellosis. JAVMA Sept 1989.

Campylobacteriosis

Campylobacter jejuni (formerly called Campylobacter fetus subspecies jejuni, also previously called Vibrio) is a gram-negative, motile bacteria which causes diarrhea in dogs, cats, horses, cattle, sheep, pigs, goats, and poultry (particularly chickens). It has also been reported in ferrets, monkeys, hamsters, and caged birds.

Infected animals may show no signs of illness, or clinical signs may include three to ten days of watery, mucoid, or bloody diarrhea. Anorexia, vomiting, and fever may also be observed in some cases, but the disease is usually mild and most animals recover without treatment. Dogs may shed the bacterium for up to 120 days following infection.

The most likely source of infection for veterinary hospital employees is probably puppies that have been recently obtained from crowded and/or unsanitary areas such as kennels or pounds. Some surveys have shown a high incidence of Campylobacter in the feces of healthy dogs and cats (an average of 27% of healthy dogs and 11% of healthy cats, according to Williams, 1988) whereas others report a relatively low incidence (4% of healthy dogs, is cited in Dillon et al, 1987). Prevalence in adult dogs with diarrhea is reported to be up to 53%, and in puppies with diarrhea up to 75%.

Birds commonly harbour C. jejuni, often with no signs of illness. Occasionally, infected caged birds show signs of anorexia, diarrhea, and emaciation, and fledgling mortality is common. From 30 to 100% of avian fecal samples contain this organism, depending

upon the species. Up to 91% of chickens and 100% of turkeys appear to harbour the organism.

Diagnosis can be made by gram stain of fecal specimens (Campylobacter can be identified by its "gull wing" appearance), selective fecal culture, or serology.

Campylobacter is probably the most common cause of bacterial gastroenteritis in humans in North America, with an estimated 2.5 million human cases in the United States per year. Fortunately for veterinarians and veterinary hospital employees, only 5% of human cases are thought to due to transmission from infected animals and their feces. More common sources of human infection include contaminated water, dairy or poultry products, pork, and garden vegetables. Farm residence and daily contact with chickens appears to be a significant risk factor for the disease in humans. As few as 500 organisms are required to cause the infection in man. Each gram of feces from an affected dog may contain 100,000,000 (one hundred million) organisms.

After 2 to 10 days of incubation, the first sign of disease in humans is usually vague abdominal discomfort, headache, and muscle pain. This is followed by 3 to 5 days of illness, including fever, severe abdominal cramps, and mucoid or bloody diarrhea. Vomiting is uncommon. The disease is usually self-limiting, but it is estimated that 100 people die of C. jejuni infections each year in the US. Most of the deaths occur in infants, the elderly, or immunosuppressed individuals.

Most cases of human campylobacteriosis respond to antibiotic treatment, although antibiotic resistance appears to be increasing. Resistance to fluoroquinolones appears to be a particular concern. Untreated individuals may shed the organism for many weeks, and human to human transmission (particularly to infants) is common. As there are many serotypes, repeated infection is possible. Guillain-Barre syndrome, an immune-mediate nervous system disorder associated with muscle paralysis, is a complication in 1 in every 1,000 patients with campylobacteriosis. An increased incidence of reactive arthritis (Reitier's syndrome) is also associated with campylobacteriosis in humans.

Campylobacter infection may be avoided by using disposable gloves when handling feces from animals that are known or suspected to be infected. As some animals infected with Campylobacter may not show any signs of disease, it is advisable to wear gloves and wash hands after handling feces from any dog or cat, particularly young animals with diarrhea. The same precautions apply when handling items such as cage bedding, which may be contaminated with feces. Feces from suspect animals should be promptly disposed and infectious materials such as soiled cage bedding should be disinfected and laundered, or discarded. Bleach and quaternary ammonium compounds are reported to be effective against this agent.

References:

swollen and tender. Although most affected individuals do not appear to be ill, up to one third of patients exhibit fever, malaise, generalized muscle pain, fatigue and headache. Symptoms usually resolve spontaneously after several weeks, but lymph nodes may remain enlarged for two to four months.

Approximately 5 to 10% of infected individuals develop more serious signs, including conjunctivitis and ocular granuloma formation, encephalitis (with signs including mental derangement, combativeness, and convulsions) tonsillitis, and peripheral neuritis. Immunocompromised persons may develop recurrent systemic illness which may be life-threatening, with clinical signs of persistent fever, weight loss and lymph node swelling.

It is fortunate that most persons who develop cat scratch disease experience only minor clinical signs, as medical treatment is not very effective. Analgesics, bed rest, and hot compresses applied to affected lymph nodes are usually recommended. Occasionally, affected lymph nodes may require aspiration of pus using a needle and syringe. Antimicrobial treatment does not appear to be effective for persons suffering from mild clinical signs, but may be helpful in severe systemic disease.

It is difficult to prevent a disease that may be transmitted by very minor scratches. Cats should be handled in a manner that reduces the likelihood of scratches or bites. As a general rule, it is a good idea to thoroughly wash any bites, scratches, or cuts, and to not allow a cat to lick an open wound. Declawing or the use of claw covers has not been demonstrated to decrease the risk of disease transmission. Flea control is the most effective way to prevent infection in cats.

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2. Dillon AR, Boosinger TR, Blevins WT: Campylobacter enteritis in dogs and cats. Compendium Small Animal 9 (12): 1176-1182, 1987.
3. Willard MD, Sugarman B, Walker RD: Gastrointestinal Zoonoses. Veterinary Clinics of North America: Small Animal Practice 17 (1): 152-155, 1987.
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Cat Scratch Disease (Bartonellosis)

Veterinary hospital employees are at some risk of exposure to cat scratch disease (incorrectly known as "cat scratch fever"). Serological surveys and skin tests of veterinary hospital employees in the United States show an exposure rate of 23%, compared to 4% of the general public.

The cause of cat scratch disease has until recently been under some debate. Both Afipia felis and Bartonella henselae (formerly Rochalimaea henselae) have been associated with the disease, however the latter agent is now thought to be the more common cause. Bartonella has also been linked to bacillary angiomatosis, a severe disease most commonly diagnosed in human AIDS patients. It has been suggested that the type of disease caused by this organism depends upon the immune status of the patient: cat scratch disease may be seen in persons with normal immune function, whereas bacillary angiomatosis is the form seen most commonly in immunocompromised individuals.

Although Bartonella has been reported to cause conjunctivitis, uveitis, gingivitis, and mild transient fever in cats, its pathogenicity in this species is under some debate. Investigators report that Bartonella can be isolated from blood samples of approximately 25-40% of clinically normal cats in the U.S. and the organism is probably a normal resident on cat nails. It is transmitted from cat to cat by fleas, and the incidence of Bartonella infection in cats is highest in areas with warm, moist climates which support significant flea populations.

In humans, cat scratch disease is most common in children. The disease is acquired when the organism is inoculated into the skin, usually through a cat scratch on the hand or forearm. Other means of transmission that have been documented include bites, licking, and (possibly) rubbing the eyes after handling a cat.

The first clinical sign is a small skin lesion at the site of infection which resembles an insect bite. A papule develops, which gradually changes into a blister, which breaks and forms a crust. This lesion normally resolves in a few days to weeks. However, two to three weeks after exposure, one or more lymph nodes near the scratch may become

Cheyletiella

Cheyletiella mites are occasionally transmitted to humans from affected dogs, cats and rabbits. This mite is large enough to be clearly visible as a white speck, and is particularly easy to see on a dark background (hence the common name for this disease, "walking dandruff"). Cheyletiella can sometimes be seen moving rapidly over the surface of the skin. Periodically they attach to the epidermis and become engorged with tissue fluids. The mites may be transmitted by direct contact with affected animals, or through contact with animal bedding and other fomites.

Human involvement has been reported in 20 to 80% of animal cases. The disease in humans begins as small red spots on the skin which rapidly change into papules or vesicles. Older lesions appear pustular, with central necrosis. All lesions are very pruritic, and may affect any part of the body except the face. As with scabies infections, skin scrapings are rarely diagnostic.

Treatment of Cheyletiella infestations in humans usually may involve the application of topical powders, creams, dips or shampoos. As these mites cannot complete their life cycle on human skin, infections are self-limiting. Even without treatment, human cheyletiellosis usually resolves within 3 weeks.

Prevention of infestation involves routine hygiene and hand washing after handling animals known to be infected with Cheyletiella.

Chlamydiosis (Psittacosis)

Chlamydiosis is a sporadic, often inapparent infection of birds and mammals caused by Chlamydia psittaci, (recently renamed Chlamydophila psittaci), a rickettsia-like organism. The same disease has several different names depending upon the species in which it is diagnosed, whether psittacine birds (psittacosis), other birds (ornithosis) or mammals (chlamydiosis). The disease in humans has been variously called chlamydiosis, psittacosis, or parrot fever.

Psittacine birds are the most common source of infection for humans (68% of human cases), and the organism appears to be widespread among both domestic and imported birds. Domestic budgerigars, parakeets, macaws, parrots, lovebirds, and cockatiels are the species most commonly affected with clinical disease. Other birds that may harbour Chlamydophyla include chickens, turkeys, mynah birds, doves, pigeons, seabirds, and shorebirds.

Clinically, chlamydiosis is extremely variable in psittacine birds, ranging from inapparent infection to a "sick bird syndrome", and may include acute or chronic intestinal, upper respiratory, or systemic signs. Because clinical signs are very non-

specific (weight loss, anorexia, depression, emaciation, poor feathering, listlessness, respiratory difficulty, watery diarrhea, conjunctivitis, ocular and nasal discharge), diagnosis is often difficult. Mortality in treated birds is less than 1%, but affected birds shed large numbers of Chlamydophyla in the feces for months after infection, particularly if stressed.

Transmission of avian chlamydiosis to humans is chiefly through inhalation of infective aerosols of dried droppings or dander. The disease may also be acquired by inhalation or ingestion of respiratory exudates from affected birds, bird pecks, or by direct contact with affected tissues. In some persons, "fleeting exposures" are adequate to transmit the disease.

In humans, the incubation period for chlamydiosis is one to two weeks. The disease ranges from inapparent to fatal, with most cases appearing as a mild flu-like illness. More serious disease may also occur, characterised by the abrupt onset of fever, chills, sweating, anorexia, severe weakness, headache, muscle soreness, and pneumonia. Occasionally, Chlamydophyla infections may lead to pericarditis, myocarditis or endocarditis. Psittacosis may cause severe illness in pregnant women, and fetal death has been reported. The preferred treatment for the disease in humans is chlortetracycline or intravenous tetracycline. The fatality rate varies between strains but is generally low in appropriately treated patients

If psittacosis is suspected in a bird, protective clothing such as a face mask, gloves, and cap should be worn when handling the bird or cleaning its cage. It is advisable to wet the bottom of the cage with a quaternary ammonium disinfectant prior to cleaning, to prevent formation of aerosols. Face masks and gloves should also be worn when performing a necropsy on a bird which has been diagnosed with psittacosis or any bird whose clinical signs suggest this diagnosis (particularly emaciation, diarrhea, and conjunctivitis). Carcasses should be wetted with disinfectant prior to necropsy, to reduce aerosol formation.

Chlamydophila also causes upper respiratory disease and conjunctivitis in cats. Transmission of Chlamydophila conjunctivitis from cats to humans has been documented in persons who handle cats with chlamydial conjunctivitis and subsequently rub their own eyes. For this reason it is advisable to wash hands and avoid touching your eyes after handling a cat with an upper respiratory infection, particularly if conjunctivitis is present. Chlamydophyla has also been reported to cause pneumonitis, polyarthritis, abortion, and encephalomyelitis in horses and food-producing animals, but human infection from these sources is rare.

References:

1. Ashford N: Avian chlamydiosis - A public health concern. Veterinary Technician 10 (4): 276-280, 1989.
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control. Journal of the American Veterinary Medical Association 206 (12): 1874-1879, 1995.
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4. Grimes JE: Chlamydiosis in psittacine birds. Journal of the American Veterinary Medical Association 190 (4): 394-397, 1987.
5. Richie BW, Dreesen DW: Avian zoonoses - proven and potential diseases. Compendium Small Animal 10 (4): 484-490, 1988.

Cryptococcus

Cryptococcus gattii is a pathogenic yeast-like fungus, which has recently (since 1999) emerged as a zoonosis of concern in British Columbia, particularly on Vancouver Island. In the past, this organism was considered to be restricted to tropical and sub-tropical climates but its range seems to be increasing. At the present time, approximately 25 people develop clinical illness due to Cryptococcus each year in B.C.

Cryptococcus has been reported in a variety of domestic and wildlife species including cats, dogs, horses, llamas, ferrets, and porpoises. Common symptoms of cryptococcosis in animal species include nasal discharge, facial swelling, subcutaneous lumps, pneumonia, and neurological disease. The disease is treatable with antibiotics.

Cryptococcus appears to affect otherwise healthy people with no obvious signs of immunocompromise. It most commonly affects the lungs, causing pneumonia. Meningitis has also been reported. Symptoms of cryptococcosis in humans include prolonged cough (lasting weeks to months), sharp chest pain, shortness of breath, headache, fever, night sweats, and weight loss.

This disease is apparently not transmitted directly from animals to humans. It appears to be acquired from environmental exposure. The main risk to veterinary hospital personnel is for persons handling cultures of Cryptococcus organisms, which do produce infectious spores. These spores easily become airborne and are infectious. Mycelial cultures should be tightly sealed and handled only by trained personnel in a facility equipped to work with extremely infectious agents.

Although it is extremely unlikely that hospital personnel would acquire Cryptococcosis from handling an infected animal, it is wise to use Standard Precautions (see Appendix 3). Avoid direct skin contact with infected materials during surgery or necropsy. Dressings covering a draining fungal lesion should be changed frequently to prevent spore formation on the surface of the bandage.

Reference:

British Columbia Centre for Disease Control: Cryptococcal Disease.
www.bccdc.org/topic.php?item=109

Cryptosporidiosis

Cryptosporidia parvum is a protozoan, similar to Toxoplasma and the organisms that cause coccidiosis. Cryptosporidia may infect many species, including ruminants, cats, dogs, horses, swine, primates, chickens, turkeys, caged birds, guinea pigs, and reptiles. The life cycle of Cryptosporidia is similar to coccidia, involving asexual and sexual stages within the host intestine. Numerous small (4 to 6 microns) cysts are shed in the feces, and may be identified by direct smears or flotation. Once ingested by a suitable host, the cysts release sporozoites, which invade intestinal and respiratory epithelial cells.

Disease caused by Cryptosporidia is most commonly diagnosed in ruminants. Typical signs include diarrhea, anorexia, and dehydration in young calves and lambs. The organism is reported to be shed by approximately 25% of calves with diarrhea. There is no known effective treatment, however most calves with cryptosporidiosis recover spontaneously.

Cryptosporidia has been identified in the feces of 8.1% of healthy cats. It appears that cryptosporidial infection may be common in young kittens, although infection is usually asymptomatic.

Human cryptosporidiosis was first reported in 1976, and appears to be increasing in frequency. It is now recognized to be a common cause of diarrhea in humans, particularly children in daycare centers. Surface water is commonly contaminated with Cryptosporidia oocysts, and this is a likely source of infection outbreaks. Other routes of transmission include person to person, and animal to person. Millions of infective cysts may be present in each gram of feces from an infected animal. Ingestion or inhalation of only a small number of cysts may lead to clinical infection.

After an incubation period of 4 to 12 days, clinical signs in humans include profuse watery diarrhea, abdominal cramps, fever, chills, anorexia, nausea, and malaise. The disease usually resolves in 3 to 15 days. The severity of disease in humans appears to depend upon the degree of exposure and the patient's immune status. In many cases, the disease is mild and resembles influenza. Healthy persons with normal immunity seldom develop severe symptoms, however serious disease is commonly reported in immuncompromised persons (particularly persons with AIDS, whose mortality rates for cryptococcal infections may approach 70%).

For many years, no consistently effective treatment was available for the disease in humans or animals. One author (Moore et al, 1988) cites 94 antibiotics which have been used in unsuccessful attempts to prevent or treat this disease. Recently, some success has been reported using nitazoxamide.

Transmission of Cryptosporidia appears to be primarily by the fecal-oral route as by contaminated food or water. Persons who care for affected calves appear to be at increased risk. Unlike some other protozoan diseases (for example, toxoplasmosis) cryptosporidiosis may be transmitted by fresh feces. Laboratory related infections with Cryptosporidia have occurred in almost every research laboratory working with this agent, especially in those in which calves are utilized as the source of cysts (Stefan Wagener, Michigan State University). Persons working in veterinary hospitals may protect themselves by frequent hand washing, and by always utilizing gloves when handling animals with diarrhea. As treatment options are limited, persons with compromised immune systems should avoid handling animals or feces suspected to harbour Cryptosporidia organisms.

Cryptosporidia are difficult to eliminate from the environment. Formaldehyde, bleach, and ammonia are reported to be somewhat effective, but Cryptosporidia are resistant to iodine, chlorhexidine, alcohols, dilute bleach and formalin. Routine chlorination of water systems does not eliminate this organism, but filtration can be effective.

References:

1. Moon HW and Woodmansee DB. Cryptosporidiosis. JAVMA Sept 1986.
2. Moore JA, Blagburn BL, Lindsay DS: Cryptosporidiosis in animals including humans. Compendium Small Animal 10 (3): 275-282, 1988.

Dipylidium

The common flea tapeworm of dogs and cats, Dipylidium caninum, is an occasional parasite of humans. Proglottids released from the dog or cat are ingested by fleas, and infected fleas may be in turn ingested by humans (particularly young children). The result is usually a mild or asymptomatic infection but abdominal discomfort and diarrhea occasionally occur. Motile proglottids may be seen in the stool. Affected persons may be treated with anti-cestodal drugs, although untreated infections usually resolve spontaneously.

Prevention of transmission is relatively straightforward - avoid ingesting fleas.

Reference:

1. Shantz PM: Dipylidiasis. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg,

Ill., 1989, p. 79-80.

Echinococcus

The tapeworms Echinococcus granulosus and Echinococcus multilocularis cause serious and even potentially fatal disease in humans.

Echinococcus granulosus is primarily found in sheep-rearing areas of the southwest United States, and may be transmitted by herding dogs to humans. Herding dogs develop the disease after eating infected sheep carcasses. Echinococcus granulosus has been reported in northwest Canada, where a wolf-moose cycle appears to maintain the disease in the wild.

Echinococcus multilocularis is found throughout the Canadian prairie provinces and northern territories, primarily in foxes, wolves and coyotes. Because E. multilocularis causes the more serious disease in humans and has been reported in Canada, it will be the focus of this discussion.

Adult Echinococcus multilocularis live in the intestines of wild canids, producing proglottids that are shed in the feces. The proglottids release eggs, which are immediately infective for humans and other potential hosts. The normal life cycle involves rodents, which ingest the eggs and are in turn ingested by wild canids. Pets (dogs, and to a lesser extent cats) who ingest infected rodents may also serve as hosts, although this is uncommon. Because of the mode of transmission, dogs and cats living in rural areas are at the highest risk of infection.

Echinococcus eggs and larvae in fox or coyote feces may remain infective in the environment for several months, even at sub-zero temperatures. Humans become infected by ingesting material contaminated with eggs (including fresh feces from affected canids). Ingestion of a single infective egg can potentially result in serious disease.

Although the parasite causes little or no damage in wild canids, dogs, or cats, the disease in humans may be devastating. Infective larvae migrate to the liver, forming cysts. The cysts gradually enlarge and may spread throughout the liver, destroying normal tissue. Pain and symptoms of liver failure become evident several years after infection (up to 30 years according to one report). Treatment consist of surgery and/or anthelminthic drugs, however the case fatality rate is reported to be 50 to 70%.

As feces are immediately infective and the tapeworms are small and easily overlooked, it is important that persons examining feces from wildlife, dogs and cats utilize proper sanitation and personal hygiene. Protective clothing and gloves should be worn when performing a necropsy on potentially infected animals, particularly coyotes and foxes.

Decontamination of infected areas is difficult, as the eggs are resistant to common disinfectants. Full-strength household bleach (at least 3.75% sodium hypochlorite) applied for 3 to 5 minutes has been found to be effective against E. granulosus eggs. Some authors recommend further exposure to a solution of Lysol or iodine for several minutes.

References:

1. Hildreth MB, Johnson MD, Kazacos KR: Echinococcus multilocularis - A zoonosis of increasing concern in the United States: Compendium Small Animal 13 (5): 727-740, 1991.
2. Schantz PM: Emergent or newly recognized parasitic zoonoses. Compendium Small Animal 5 (3): 163-168, 1983.

Erysipelothrix

Erysipelothrix rhusiopathiae is a gram-positive bacteria that causes erysipelas in swine and erysipeloid in humans. (Human erysipelas is caused by a streptococcal bacteria). Erysipelothrix is a well recognized pathogen of swine, causing septicemia, chronic arthritis, and "diamond skin disease". Infection in swine is uncommon in Canada due to widespread vaccination. Erysipelas is also reported in turkeys and wildfowl.

In humans, erysipeloid is characterised by localized wound infections that may spread into the joints, causing arthritis. Occasionally, more widespread disease including septicemia and endocarditis may occur, particularly in immunocompromised persons.

Human infections may be acquired by handling live animals or tissues containing E. rhusiopathiae. The usual route of infection is cutaneous, although oral transmission has been reported. Infection may be prevented by wearing gloves when handling infected animals or tissues. Frequent hand washing and prompt treatment of cuts and scratches with topical antiseptic is also helpful in preventing skin infection.

Reference:

1. Boening LF: Erysipelas. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg, Ill., 1989, p. 25-26.

E. Coli

Escherichia coli, otherwise known as E. coli, is a ubiquitous inhabitant of the mammalian (including human) intestinal tract. There are numerous strains which vary widely in pathogenicity, and the organism is associated with disease in many species of animals. The most serious clinical manifestations of E coli infection in animals include diarrhea in newborn calves and lambs, mastitis in dairy cows, septicemia also in poultry, edema disease in piglets, and colibacillosis in rabbits. E coli infections are common in cats and dogs, and may affect almost any organ including the lungs, liver, kidneys, and bladder.

E coli has long been known to cause human illness, including traveller's diarrhea and infant diarrhea in developing countries. At the present time, the strain of chief concern in North America is E. coli O157:H7, which was first identified in 1982. Each year, over 2000 people are hospitalized in the US due to E coli O157:H7 infections. The most important syndromes associated with this organism are hemorrhagic colitis and its potential sequella, hemolytic uremic syndrome (HUS). Hemorrhagic colitis is normally self-limiting, resolving within 5 to 10 days. Severe cases may require fluid and electrolyte therapy. Antibiotics and anti-diarrheal agents are generally avoided, as they apparently prolong the course of the disease and may potentiate the development of HUS. HUS is a sequella of hemorrhagic colitis in approximately 10% of cases. HUS is the leading cause of kidney failure in children and is fatal in 5% of cases.

E coli O157:H7 is found in animal feces (particularly from ruminants and horses) and in meat, milk, sawdust, and water that have come in contact with feces. The O157:H7 strain apparently does not cause disease in species other than humans, but resides as a normal inhabitant in the bovine or equine gut. It is spread between animals and to humans by fecal-oral transmission. The disease often occurs in outbreaks associated with a common source of infection: alfalfa sprouts in 1997, unpasteurized apple juice in 1996, and contaminated beef products in 2002. Other foods associated with E coli outbreaks include yogurt, cheese, milk, fruits and vegetables, and drinking water. Outbreaks have also been reported in school children having direct contact with animals during farm visits.

Of particular importance to persons working in veterinary clinics, E. coli O157:H7 is occasionally transmitted by direct contact with infected cattle (particularly calves) and horses. The organism can be shed by animals with no apparent signs of disease, and up to 25% of cattle are reported to shed the pathogen in feces during the summer months. It is thought that individual animals shed the bacteria for 1 to 2 months, but the organism is passed between animals and may persist on individual farms for years.

Although most cases of E coli in humans are associated with fecal contamination of food and the consumption of raw, unpasteurized, or undercooked foods, there is some risk of acquiring the disease from live animals and from fecal material. Persons working around cattle and horses and their bedding should be aware of the risk of contracting E coli and should use common sense precautions. These include the use of protective

clothing such as coveralls and washable boots, wearing gloves when handling feces or bedding material, and frequent hand washing.

References:

1. Romich, JA: E coli Infection. In Understanding Zoonotic Diseases, Thomson Delmar Learning, 2008. P 104-116.
2. Sanchez S, Lee MD, Maurer JJ, Doyle MP Animal issues associated with Escherichia coli infection. Journal of the American Veterinary Medical Association , Oct. 15, 2002.

Giardiasis

Giardia is a protozoan parasite commonly found in the intestinal tract of humans, some species of wildlife, and most species of domesticated animals. Giardia infection is also common in caged birds, including parakeets, cockatiels, and lovebirds. Although the organism may be difficult to detect in the feces, some investigators have documented a prevalence of 36% to 50% in healthy puppies and up to 100% in dogs housed in some puppy mills. There appears to be a much lower incidence of infection in cats (less than 5%). The most common source of infection for humans is believed to be drinking water contaminated with feces from infected wildlife (hence the common name for giardiasis, "beaver fever"). Infections may also be transmitted between humans (particularly children in daycare centers and kindergartens) by the fecal-oral route. Giardiasis is currently the most commonly diagnosed disease caused by intestinal parasites in most parts of the world, including North America.

In the past, there has been some doubt as to whether Giardia infections in domestic animals could be transmitted to humans. It is now apparent that some species of Giardia will infect many different hosts, and it has been clearly demonstrated that Giardia can be transmitted from dogs or cats to humans. (It has also been proven that Giardia can be transmitted from humans to dogs).

Giardiasis is spread by cysts, which are present in the feces of infected individuals. Like the oocysts of coccidia and toxoplasma, Giardia cysts are resistant and may survive several months in a cool, moist environment. Unlike toxoplasma, the cysts are infective immediately after they are passed and fresh feces are therefore infective. A new host ingests the cysts by drinking contaminated water or by eating food or other material contaminated with feces. Ingestion of as few as 10 cysts may cause disease in humans. After ingestion, the organism emerges from the cyst and attaches to the intestinal epithelium. Infections may be asymptomatic, mild, or severe. It is thought that clinical signs are most likely to occur if there is a poor host immune response (as for example, in a person who has AIDs or is undergoing chemotherapy). It also appears that there are variations in virulence among strains of Giardia.

Diarrhea is the most common clinical sign in both man and animals. This is seen one to three weeks after infection, and may be short-lived, intermittent, or chronic. The feces may be explosive and watery, or may be steatorrheic, pale or bloody, and malodorous. Flatulence, nausea, and abdominal pain are common in humans suffering from giardiasis. Appetite is usually normal, but weight loss may occur. One to two weeks after infection, cysts and trophozoites (the motile form) begin to appear in the feces. Diagnosis in humans is by means of an ELISA test that detects Giardia antigen in stool.

Many drugs have been used for the treatment of Giardia infections in humans and animals, including metronidazole, quinacrine, tinidazole, and furazolidone. Some of these drugs have the potential to cause birth defects and other serious complications in humans and should be used only under a physician's supervision. The disease may persist from months to years if untreated.

Transmission of giardiasis from hospitalized animals to veterinarians or veterinary employees appears to be uncommon, however routine hand washing and the use of gloves when cleaning cages of affected animals are recommended. Because of the long-lived nature of Giardia cysts, sanitation is important in removing infective cysts from hospital cages and other locations. Quaternary ammonium compounds effectively kill cysts, provided gross fecal material has been removed. Bleach has also been reported to be effective, although one author states that cysts can probably survive in unsealed concrete surfaces regardless of disinfectants. Grass areas are considered contaminated for at least one month after deposition of infected feces.

References

1. Barr SC, Bowmann DD: Giardiasis in dogs and cats. Compendium Small Animal 16 (5): 603-610, 1994.
2. Willard MC, Sugarman B, Walker RD: Gastrointestinal Zoonoses. Veterinary Clinics of North America: Small Animal Practice 17 (1): 164-166.

Hantavirus

Hantavirus (also called the Muerto Canyon virus) has been recently reported to cause a potentially fatal pulmonary syndrome in humans. In 1994, three cases were reported in British Columbia and four cases in Alberta. No human cases have been reported to date in Ontario. The disease is more commonly reported in the United States, with 102 cases reported up to January 1995.

Hantavirus is most prevalent in rural settings, where contact with wild rodents is common. The disease is most commonly transmitted to humans by inhalation of aerosolized virus contained in rodent saliva, feces, or urine, or by direct handling of a rodent. The rodent involved is usually asymptomatic, and may be a deer mouse, white footed mouse, or chipmunk. It is not known if domestic animals can be infected with the

virus.

The symptoms in humans are initially "flu-like" (fever, muscle pain, headache), but rapidly progress to shortness of breath, cough, and life-threatening pulmonary edema and hypotension. Approximately 60% of affected persons die, usually within 9 days of the onset of symptoms.

It is unlikely that a veterinary hospital employee would encounter this virus in practice. However, persons who come into contact with infected wild rodents or their excretions may be risk. Killed rodents should be handled using gloves, bagged, and disposed by burying or burning. Respiratory and eye protection may be required for fieldwork in which contact with infected rodents or their urine and feces is likely.

Reference:
1. Stephen C: Hantavirus pulmonary syndrome in BC. BCVMA Bulletin, August 1994, p. 15.

Leptospirosis

Leptospira interrogans is a bacteria which occurs in a number of serological types (canicola, icterohemorrhagica, hardjo, pomona, etc...). These serotypes infect almost all species of mammals, including pets, livestock, and wildlife. In companion animals, the incidence of leptospirosis is reported to be highest in stray dogs (37% of stray dogs in Detroit, 1982). The high incidence in stray dogs is possibly a result of contact with rats, one of the chief reservoirs for this organism. Leptospira organisms are also found in cattle, horses, and swine, with a serological prevalence in U.S. cattle reported to be approximately 16% in 1974. Commercial leptospirosis vaccines are commonly administered to dogs and cattle, however immunized animals may still become carriers of infection. Domestic animals (especially dogs and livestock) are believed to be the main source of human leptospirosis in North America at the present time. Interestingly, the largest recorded outbreak in the US occurred in Illinois in 1998, when 110 triathletes contracted the disease after swimming in a contaminated lake.

Leptospirosis is associated with a wide variety of clinical syndromes in domestic animals, ranging from inapparent infection to severe disease. Clinical signs in animals may include abortion, fever, conjunctivitis, jaundice, mucosal hemorrhages, hemoglobinuria, septicemia, and nephritis. The disease is usually mild or moderate, but a mortality rate of 10% in both humans and animals has been reported.

The organism is shed in the urine of affected animals for a year or more after infection. It is able to survive for long periods in the environment, particularly under moist conditions. Fortunately, leptospires are inactivated by freezing temperatures, and the disease is therefore less commonly reported in Canada than in semitropical and tropical regions.

Leptospirosis is transmitted to humans by contact with urine or soil or water contaminated with urine. Less commonly it is transmitted by contact with blood and tissues of infected animals. During the acute phase of infection, it is present in all body secretions, including milk and semen. Because of its ability to survive in moist environments, it may be transmitted by contact with stagnant water. The organism may be absorbed after ingestion or contact with damaged skin or the mucus membranes of the eye, nose, or mouth. After a 10 day incubation, clinical signs in humans include fever, chills, headache, malaise, muscle pain, nausea, conjunctivitis, jaundice, stiff neck, and skin rash. Although the person may appear to recover temporarily, many patients go on to develop a recurring fever, skin rash, jaundice or more serious sequella such as meningitis or uveitis. The disease often localizes in the kidneys, and live bacteria are shed in the urine for long periods of time.

Leptospirosis in humans is treated with high doses of antibiotics, however diagnosis is difficult and the disease is not always recognized. The fatality rate is humans is approximately 8 – 10 % of recognized cases.

In order to avoid infection in a veterinary hospital environment, it is important to use routine hygienic precautions when handling infected patients or their secretions. This includes frequent hand washing and wearing gloves, boots, and eye protection as needed. Care should also be taken when performing a necropsy on animals infected with leptospirosis. A physician's advice should be sought if exposure occurs, as prophylactic administration of antibiotics may prevent the disease in humans.

References:

1. Hanson LE: Leptospirosis in domestic animals - The public health perspective. Journal of the American Veterinary Medical Association 181 (12): 1505-1508, 1982.
2. Graham RR: Leptospirosis. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg, Ill., 1989, p 29-31.

Listeriosis

Listeria monocytogenes is a Gram-positive bacteria that causes disease in humans, domestic animals, and wild animals including birds and fish. The bacteria is widely distributed in nature, and is commonly found in soil, vegetation, water, sewage, silage, and food, as well as in the feces of affected animals. Listeria are resistant to environmental conditions, including heat and cold, and it is one of the few bacteria that can grow under refrigeration, making it a potential cause of food poisoning. Listeria have been shown to survive at least 12 years in frozen silage, feces, or milk.

In domestic animals, the disease is most common in cattle and sheep. The disease may occur in epidemics, with spoiled silage being the usual source of infection. Clinical

signs include encephalitis, septicemia, abortion, or mastitis, often involving numerous animals in a herd. The disease may be mild and self-limiting, or infection may lead to fatal illness. Treatment with antibiotics is helpful if started early in the course of the disease.

In the case of humans, the most common source of Listeria organisms is probably ingestion of contaminated food (often meat, milk or cheese) but direct transmission from animals to humans has been occasionally reported. Listeria organisms are present in body secretions and excretions of affected animals, and may infect humans through the conjunctiva and oral or nasal mucous membranes. Veterinarians have been infected with listeriosis after bare arm obstetrical procedures in diseased cows. It is thought that infection may also result from inhalation of dust containing Listeria organisms.

Approximately 50 cases of human listeriosis are reported annually in Canada. As the organism is difficult to culture the disease may be under-reported. Outbreaks may occur if a contaminated food source is ingested by several persons (as occurred in the summer of 2008, when meat products from a Maple Leaf meat processing plant were implicated). Most infected persons develop a mild flu-like illness characterised by fever, vomiting, cramps, diarrhea, chills, malaise, and a skin rash. If the disease is not treated with antibiotics, more serious symptoms may follow, particularly in persons with a compromised immune response. Serious complications that may arise include meningitis, encephalitis, or septicemia, with a case fatality rate of 30 to 50%.

Listeriosis is also a significant cause of abortion in pregnant women, and is estimated to cause up to 2% of deaths in newborn babies. Pregnant women are estimated to be 20 x more likely than other healthy adults to contract listeriosis and develop symptoms. Affected women may show signs of fever and malaise, followed by spontaneous abortion, still birth or live birth of a seriously ill premature or term infant. Some affected babies may also appear normal at birth but subsequently develop meningitis and hydrocephalus. The case fatality rate for infants born alive but suffering from listeriosis was 27% in one report. Listeriosis has also been linked to repeated spontaneous abortion in some women.[1]

It is interesting to note that some persons apparently harbour and shed Listeria

[1] Although toxoplasmosis and listeriosis are thought to be by far the most common zoonotic causes of fetal loss in Canada, other zoonotic agents are (rarely) reported to cause spontaneous abortion, birth defects, or prematurity. The list includes Bacillus anthracis, Brucella species, Campylobacter, E. coli and other enteric bacteria, Leptospira, Mycobacterium tuberculosis, Coxiella burnetii, Chlamydia psittaci, Yersinia pestis, Coccidioides immitus and other systemic fungi, Giardia, and the viruses which cause Western equine encephalitis, Venezuelan equine encephalitis, and lymphocytic choriomeningitis. Despite the length of this list, most authorities believe that abortion due to zoonotic infections (other than toxoplasmosis and listeriosis) is rare in Canada.

without showing any signs of disease. Listeria have been recovered from 70% of fecal specimens of healthy laboratory workers, and in 5% of fecal specimens from the general population.

Transmission from affected domestic animals (cattle, sheep) to humans may be prevented by routine hygiene, including hand washing with a germicidal soap. Gloves and obstetrical sleeves should be worn when handling infected animals or their secretions. Persons handling laboratory specimens from animals with listeriosis should wear gloves and a surgical mask. If exposure to infectious material has occurred, it is recommended that the exposed area be washed with a germicidal soap and mucous membranes be flushed with clean water. Pregnant women should be particularly cautious, and are advised to wear gloves when handling feces or performing necropsies, in addition to the hand washing precautions given above. Pregnant women are urged to seek medical attention if an influenza-like illness occurs after handling animals or tissues infected with Listeria.

References:

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2. Gold CTK, Beran GW: Occupational hazards to pregnant veterinarians. Iowa State Veterinarian 45 (1): 55-60, 1983.

Lyme Borreliosis

Several rickettsial diseases, including borreliosis (Lyme disease) and Powassan viral disease, are transmitted to humans by tick bites. Tick bites are the only known route of infection, and animals that suffer from these conditions do not transmit the diseases directly to humans. Studies have shown that ticks require between 4 and 24 hours of attachment before transmitting Lyme disease organisms to the new host.

The causative agent of Lyme disease is Borrelia burgdorferi, a spirochete. Lyme borreliosis in animals usually presents as fever and lameness. Infections have been reported in dogs, cats, horses, cattle, and humans.

Deer ticks (also known as blacklegged ticks) are known to carry Borrelia infections in Ontario. These ticks are approximately the size of a sesame seed, and tick bites may therefore go unnoticed. Ticks carrying Borrelia infections are most commonly found along the north shore of Lake Erie, including Long Point, Turkey Point, and Rondeau Provincial Park, and have also been found in St. Lawrence Islands National Park. Since 1991, approximately 15 to 40 human cases of Lyme Disease have been reported annually in Ontario. Half of these are believed to have been acquired outside of Ontario.

Even if a person is bitten by a deer tick, there is only a small chance of developing Lyme disease. Symptoms of Lyme disease usually appear one to week after exposure, and include fever, headache, muscle and joint pains, fatigue, weakness of facial muscles, and a skin rash that resembles a red bull's eye. The skin rash may occur in a different location from the tick bite. Rarely, Lyme disease can infect the fetus of a pregnant woman (by transplancental transmission). This may result in fetal death, or serious birth defects.

Veterinary clinic staff should use caution when handling animals that are infested with ticks. Ticks should not be handled with bare hands. Instead, they should be removed by applying gentle constant traction to the mouthparts as close to the skin as possible, using forceps, fine-pointed tweezers, or gloved fingers. Squeezing or crushing ticks may release infective organisms, which can then be transmitted to humans through abraded skin or intact mucus membranes. Do not allow blood from a tick or the site of removal from the animal's skin to contact human skin. After removing the tick, the site of the bite should be disinfected with alcohol or surgical soap.

If you have been bitten by a tick and wish to have it checked for Borrelia, the live tick may be saved in a container with a tight fitting top and given to your family physician, who will forward it to a public health laboratory. The container should be labelled with the date shipped, name and address of person or animal bitten and what area of the province the tick probably came from.

Persons who frequently work with tick-infested animals (or in tick-infested areas) should perform a total body search on a daily basis. Use of protective clothing and repellents may be necessary in some circumstances.

References:

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3. Madigan JE, Teitler J: Borrelia burgdorferi borreliosis. Journal of the American Veterinary Medical Association 192 (7): 892-896, 1988.
4.Ontario government web page on Lyme disease :
http://www.health.gov.on.ca/english/public/pub/disease/lyme_mn.html

Lymphocytic choriomeningitis

Lymphocytic choriomeningitis virus is an arenavirus found in the urine, feces, and saliva of infected rodents, including mice, hamsters, and guinea pigs. Human infections may occur when aerosolized infectious droplets are inhaled, or by ingestion of food contaminated with the virus. Infection may also occur if infected body fluids contact mucous membranes or cuts and other open wounds. Infection in pregnant women may

cause abortion or congenital disease such as hydrocephalus, chorioretinitis, and mental retardation.

Pregnant women and any other staff members who develop fever, malaise, anorexia, muscle aches, nausea, or vomiting within 8 to 14 days of exposure to rodents should consult their physician.

Veterinary facility employees can avoid infection by taking the following precautions:

a) avoid direct physical contact with rodents and their excreta
b) apply dilute household bleach solution to visible rodent droppings and their immediate surroundings
c) wear gloves when cleaning rodent cages and water and feed containers
d) wear a surgical mask when removing cage litter and feces. Avoid disturbing the litter in order to prevent aerosolization.

Reference:

Brocklebank, J: BCVMA Guidelines for the Pregnant Woman in a Veterinary Facility, 2005.

Mycobacterial diseases

Mycobacterium species cause several diseases in animals, including tuberculosis (Mycobacterium bovis, Mycobacterium avium, Mycobacterium tuberculosis) and Johne's disease (Mycobacterium paratuberculosis). Mycobacterium marinum affects fish.

TUBERCULOSIS

Tuberculosis is considered to be a very rare disease in domesticated animals in Canada.[2] It is most commonly reported in wildlife species such as bison, deer, and elk. A serious outbreak of M. bovis occurred in captive elk herds in Alberta between 1990 and 1993. In this outbreak, 50 out of 446 persons who had contact with affected animals developed a positive tuberculin skin test, indicating exposure to Mycobacterium. Animals living in zoos and wildlife parks are also potential sources of Mycobacterium for persons handling these animals. Cats and dogs are very occasionally infected, usually after living in close contact with a human with tuberculosis. Tuberculosis is also an important pathogen of monkeys and other primates.

[2] Mycobacterium avium infection is reported in swine, however this organism is thought to have very limited zoonotic potential.

In all species, tuberculosis is a chronic disease characterised by pneumonia, lymph node enlargement, intestinal tract granulomas, anorexia, and weight loss. Some animals show few or no symptoms until the disease is advanced. In the absence of clinical signs, diagnosis is made by a tuberculin skin test (in both humans and animals), in which purified proteins from a Mycobacterium species are injected into the suspect animal. In cattle, the injection is made into the base of the tail, whereas in primates the injection is often made adjacent to the upper eyelid or in the abdominal skin. Animals that are infected with tuberculosis will show a marked allergic response within 72 hours of the injection, consisting of a swelling that can be seen or palpated at the site of injection. These animals are called "reactors", and in the case of livestock they are condemned for slaughter. Unfortunately, tuberculin skin tests are not reliable in cats or dogs, and cannot be used for diagnosis in these species.

Occasionally, cats are diagnosed with cutaneous mycobacterial disease. Affected animals show chronic ulcers, plaques, or abscesses that may discharge thick yellow to green pus reported to have a "nauseating odour". These animals may also show signs of fever, anorexia, lethargy, weight loss, and lymph node enlargement. Most agents associated with mycobacterial skin disease in cats are not considered zoonotic.

Human tuberculosis is increasing in incidence. The usual mode of infection involves inhalation of aerosols that contain the bacteria. These are produced when infected persons breathe, talk, or cough in the vicinity of others, particularly if ventilation is poor. Infection is most common in immunosuppressed persons, including individuals suffering from AIDS. Tuberculosis can also be transmitted to humans by the ingestion of raw milk products, or by handling discharges, tissues, or carcasses of animals infected with the disease.

Human tuberculosis may be caused by M. tuberculosis, M. bovis, or (in immunocompromised persons) M. avium. Most human infections are due to M. tuberculosis. There is no way to easily differentiate between M. bovis and M. tuberculosis infections on the basis of symptoms. Infection most commonly involves the lungs, but may also affect bone, the meninges, and the lymph nodes. Treatment is difficult, and usually involves concurrent administration of several antibacterial agents, including isoniazid, rifampin, ethambutol, pyrazinamide, and streptomycin. The anti-tuberculosis drugs used to treat M. tuberculosis infections are also effective against M. bovis. Because treatment may be prolonged, drug resistance and poor patient compliance are common problems.

Although any domestic animal suffering from tuberculosis may transmit the disease to veterinary hospital staff, the greatest risk is probably associated with persons working with captive wildlife (deer, elk, bison) or monkeys. Primate colonies periodically undergo tuberculin testing in order to identify monkeys with tuberculosis before the disease is transmitted to humans and other monkeys in the colony. Quarantine and screening of new additions is also advised, with elimination of animals that react to the tuberculin test.

Tuberculosis in domestic animals is a reportable disease in Canada, and an Agriculture Canada veterinarian should supervise handling of any suspected animal.

Persons who handle animals that are known or suspected to be infected with tuberculosis should use routine precautions, including use of protective equipment (gloves, aprons, face mask, and boots). Personnel should wash their hands and change clothing after exposure to affected animals. Tuberculin testing is suggested for all persons who have been in contact with a known positive animal. A vaccine (BCG) is available for persons working in high risk environments.

Mycobacteria are relatively resistant to disinfectants and heat and survive for a long period of time in the environment. They are, however, susceptible to bleach solutions and to 2% glutaraldehyde, although 15 to 30 minutes of contact is required.

JOHNE'S DISEASE

Johne's disease, caused by Mycobacterium paratuberculosis, is occasionally diagnosed in cattle and sheep. This disease is characterised by chronic diarrhea in adult cattle, progressing to emaciation and ultimately, death. There is no effective treatment. Although Johne's disease is apparently not directly contagious to humans, recent reports have suggested that 30-75% of individuals with Crohn's disease test positive for Mycobacterium paratuberculosis antigens. However no connection has been shown between contact with animals with Johne's disease or milk consumption and Crohn's disease in humans. (A detailed discussion of this subject can be found on the University of Wisconsin's Johne's Information Center, www.johnes.org)

There have also been reports of serious reactions following accidental self-injection by persons vaccinating cattle with Mycobacterium paratuberculosis bacterin (Johne's bacterin). Reactions range from small nodules at the site of injection, to painful inflammation of an entire finger for up to one year. Occasionally, surgery is necessary to remove the granuloma and allow healing to occur.

Persons who are accidentally injected with M. paratuberculosis bacterin are advised to wash the area with soap and water. Application of a skin antiseptic may be helpful. One publication (Patterson et al, 1988) suggests that the wound should be allowed to bleed, with care taken to avoid squeezing or traumatizing the injection site. Some authorities recommend early topical application of a corticosteroid preparation, in order to decrease the severity of the reaction to the injected bacterin. A physician's advice should be sought after any incident involving self-injection of M. paratuberculosis bacterin.

References:

1 Patterson CJ, LaVenture M, Hurley SS, Davis JP: Accidental self-innoculation with Mycobacterium paratuberculosis bacterin in veterinarians in Wisconsin. Journal of the American Veterinary Medical Association 192 (9): 1197-1199, 1988.
2. Scott DW, Horn RT: Zoonotic dermatoses of dogs and cats. Veterinary Clinics of North America: Small Animal Practice 17 (1): 138-140, 1987.
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4. Truman RW, Alexander SA, Hoskins JD: Tuberculosis in the cat and dog. Perspectives July/August, 1994, p. 6-11.

Mycotic (fungal) infections

Fungal diseases affecting domestic animals can be divided into superficial skin diseases (including ringworm and sporotrichosis, each of which is discussed under its own heading in this manual) and systemic disorders. The most common fungal pathogens associated with systemic disorders are Cryptococcus, Aspergillus, Blastomyces, Coccidioides, and Histoplasma. (Note: Cryptococcus is covered in a separate section of this manual). Aspergillus is most commonly associated with airway disease (nasal passages, sinuses, lungs) in birds. Blastomycosis, coccidiomycosis, and histoplasmosis are uncommon to rare in most parts of Canada, although histoplasmosis and blastomycosis are endemic to some regions of Ontario. Mycotic infections are also occasionally diagnosed in animals arriving from the United States and other countries.

Many domestic and wild animals and birds are susceptible to systemic mycotic disease, but most cases seen in veterinary practice occur in dogs or caged birds. Infection may be asymptomatic, or the animal may display vague signs of fever, lethargy, coughing, and dyspnea. Aspergillus affects the nasal passages and sinuses, Blastomyces usually affects the eye, skin, lungs, or bone, whereas Histoplasma affects the lungs, liver, intestines, lymph nodes, and bone marrow. Coccidioides affects mainly bone, whereas Cryptococcus often affects the central nervous system or nasal cavity. (see separate write-up on Cryptococcus for more information).

Transmission of mycoses such as blastomycosis or histoplasmosis between animals and humans is extremely rare. These fungi are classified as "dimorphic fungi", which means they may be present in a yeast form (found in animal tissues, relatively non-infectious to humans) or in a spore-forming hyphae form (found in cultures and the environment, potentially infectious to humans).

The source of almost all human and animal mycotic infections is the environment. Infection may be acquired by inhalation of spores from fungal cultures or the environment (bird or bat excrement, soil, or decayed organic matter). Serological surveys show that mycotic infection in humans and animals is most common in

Orf

Contagious ecthyma, otherwise known as orf, milker's nodules, contagious pustular dermatitis (and in animals, scabby mouth) is a disease of sheep and goats, including wildlife species. It is caused by a poxvirus, which is resistant to drying and can remain viable in the environment for several months. The virus is also persistent in scabs, which can remain infective for more than 15 years.

Orf is most commonly seen in lambs and kids, who develop papules, pustules, and scabs on the lips, muzzle and oral cavity. Normally the scabs lift off in one to four weeks and healing occurs. Occasionally the disease is transmitted to the mother's udder, causing mastitis.

Humans may be infected by handling sheep with active lesions. The virus easily invades cuts and wounds on the hands, causing itchy, red, elevated, weeping nodules that form crusts and eventually heal without scar formation. Lymph node swelling and fever may occur in some cases. Usually, no treatment is necessary unless secondary bacterial infection occurs.

The disease can be prevented by wearing gloves and protective clothing on the arms when handling infected animals, their bedding, manure, and other fomites.

Reference:

Thomas MA: Poxviral Diseases. In Heidelbaugh ND, Murnane TG, Rosser WW: Health Hazards in Veterinary Practice. American Veterinary Medical Association, Schaumburg, Ill., 1989, 40-41.

Plague

Plague is a zoonotic disease caused by the bacteria Yersinia pestis (or more correctly, Yersinia pseudotuberculosis var. pestis). The organism is usually transmitted to humans or animals by contact with affected cats, rodents or rodent fleas.

Plague, also known as the "Black Death", killed one-fourth of the population of Europe during the fourteenth century. Epidemics of this type of so-called "urban plague" may occur wherever humans live in close proximity to infected rodents (for example, rats in slums). Epidemics of this type have not been reported in North America since 1924. Plague may also become established in wild rodents (so-called "sylvatic plague"). Human plague infections from this source occur sporadically, and the incidence appears to be rising. In North America, sylvatic plague is most commonly reported in the southwestern United States, as it is endemic in the rodent population there. Cases have been reported as far north as Washington State and the bacteria has been isolated from

endemic areas such as the Mississippi and Ohio river valleys in the United States.

A few human cases have resulted from inoculation of fungal organisms, including several that resulted from canine bite wounds. Some infections have resulted from laboratory accidents, including pathologists who have become exposed to tissues during post-mortem examination. Inhalation of spores when handling fungal cultures is a significant hazard for laboratory personnel, and as a rule culture of fungi (other than ringworm) should be undertaken only by trained personnel in diagnostic labs equipped with a fume hood or biological safety cabinet.

Fungi produce many clinical syndromes in humans. It is thought that 95% of infections are subclinical. Clinical cases are most common in people with immunodeficiencies, but occur sporadically in the general population. Cutaneous inoculation usually results in disease that is confined to the skin and local lymph nodes. Inhalation of spores may result in more serious systemic disease, often including pneumonia. In severe cases, fungal organisms may disseminate to the spleen, bones, and skin. Immunocompromized persons are particularly susceptible to systemic mycotic disease. Treatment of human mycotic disease with ketoconazole, itraconazole, amphotericin B, or other antifungal drugs is usually successful.

Prevention of these diseases involves a few simple precautions:

1. Wear gloves and a surgical mask when performing a necropsy on an infected animal or when handling tissues that contain these organisms.

2. Do not handle mycotic cultures (other than fungal cultures from ringworm patients) unless trained to work with high risk organisms in culture.

3. Avoid direct skin contact with infected materials, including bandages used to cover draining fungal lesions.

3. Persons working in close proximity to bird or bat droppings should be aware of their increased risk of infection for mycotic disease: airway protection by means of a mask or respirator may be advisable in some situations.

References:

1. Rotcjoe BW, Dreesem DW: Avian zoonoses - Proven and potential diseases. Compendium Small Animal 10 (6): 688-692, 1988.
2. Wolf AM: Systemic mycoses. Journal of the American Veterinary Medical Association 194 (9): 1192 - 1195, 1989.

wild rodents in British Columbia. Twenty-three cases of plague were transmitted from cats to humans in North America between 1977 and 1998. This represents approximately 10% of the total number of human plague cases.

Cats and dogs are usually infected when they catch rodents or dig in rodent burrows. The most commonly affected rodents are rock squirrels, prairie dogs, wood rats, chipmunks, and ground squirrels. Tree squirrels and rabbits may also be affected. Infection can occur when rodent fleas jump onto the cat or dog and bite their new host, transmitting the plague bacteria. Alternatively, cats that eat or are bitten by rodents that are suffering from plague may themselves be infected with the disease. Cats have also been reported to develop pneumonic plague by inhaling aerosols containing Yersinia pestis. Although rare, this form of plague is very contagious and is the form most easily transmitted to humans. It is reported to be invariably fatal if untreated.

Cats infected with plague usually develop a high fever, swollen lymph nodes, and appear very ill. Abscesses may occur in the lymph nodes of the head, neck, or inguinal region. Affected cats usually die within 3 to 4 days. Some cats do not develop lymph node swelling, and show only anorexia, fever, and lethargy. For this reason, plague should be considered as a possible cause of an acute fever of unknown origin in a cat that has contact with wild rodents in endemic areas. Dogs are considered relatively resistant to plague infection and clinical disease in dogs appears to be much less common than in cats.

In humans, plague may take several forms. The incubation period is two to six days. The most common form, bubonic plague, is characterised by enlarged, painful lymph nodes called bubos, commonly in the axillary (armpit), cervical, or inguinal (groin) region. High fever, malaise, headache, anorexia, lethargy, and muscle pain are also seen in the bubonic syndrome. Bubonic and septicemic plague (which is similar to bubonic plague, although lymph node changes do not occur) both result from inoculation of bacteria by an infected flea bite, or by invasion of Yersinia bacteria through a wound or abrasion in the skin.

Humans may also be infected by inhaling aerosolized bacteria. Exhaled droplets are reported to be hazardous within a 3 to 4 foot radius of an animal with pneumonic plague. After infected droplets are inhaled, the organism invades the lungs, causing pneumonia.

Treatment of bubonic, pneumonic, or septicemic plague may be attempted with streptomycin, tetracycline or chloramphenicol. Treatment is often successful if started early in the course of the disease. The case fatality rate ranges from 15% to nearly 100%, depending upon the type of plague and the speed with which it is diagnosed and treated.

Many veterinarians and animal owners are justifiably hesitant to treat cats suffering from plague. If treatment is attempted, the control procedures for treatment of animals infected with plague published by the American Association of Feline Practitioners should be followed. (Journal of Feline Medicine and Surgery, Volume 7, Issue 4, August 2005, or

obtainable from the AAFP)

Humans exposed to plague should consult with their physicians concerning prophylaxis. In most cases, active surveillance of exposed persons (including recording of body temperature every 6 hours for 6 days) is undertaken.

Yersinia pestis does not survive more than three hours in the environment unless protected by organic material such as pus or sputum. It is important to thoroughly disinfect or carefully dispose of cages, bedding material, surgery instruments, and other fomites which have contacted excretions or pus from affected cats.

References:

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Q Fever

Q (for "query") fever is a zoonotic disease of sheep (and less commonly, cats, goats and cattle). The causative agent is the rickettsia Coxiella burnetii. Most investigators believe that sheep are the most common source of infection for humans. In Nova Scotia, human cases of Q fever have been associated with contact with cats, although this has seldom been reported outside the Maritime provinces. Investigators also have reported infections in pigs, horses, dogs, and many species of wildlife, however these animals rarely transmit C. burnetii infection to humans.

In animals, Coxiella burnetii infection is usually asymptomatic, although abortion and stillbirths have been occasionally reported in sheep and goats. The organism localizes in the uterus and mammary glands, and is commonly found in the placenta (a frequent source of infection for humans).

Q fever is usually transmitted to humans by inhalation of dessicated (dried) material or organisms attached to dust particles. It is believed that inhalation of as few as ten C. burnetii organisms can cause disease in man. The organism is shed in the urine, feces, milk, placenta, and reproductive tract discharges of infected animals, particularly around the time of parturition. Coxiella is very persistent in the environment, and may be present for weeks or months in the soil or in air samples taken from animal stalls where parturition occurred. Very slight contact with infected animals (for example, walking down a corridor along which infected sheep have been herded) has led to human

infection. Because Coxiella bacteria are so highly infectious, Q fever is also a potential hazard for laboratory workers who handle tissues from affected animals. Q fever is reported to be the second most common laboratory-associated infection, with outbreaks of 15 or more persons recorded in several institutions (Stefan Wagener, Michigan State University).

The disease in man varies from asymptomatic to serious illness. It is likely that there is a high incidence of subclinical disease as serological tests in Nova Scotia showed that on average, 14% of adults had antibodies to C. burnetii. The rate of positive tests was highest among veterinarians (49%), indicating that exposure to this organism may be common among veterinary hospital staff.

The most common clinical syndrome in humans is a mild self-limiting fever, headache, malaise, and fatigue, occurring two to five weeks after exposure. More serious disease may also occur, including pneumonia, hepatitis, endocarditis, neurological disease, and osteomyelitis. The fatality rate is generally low, except in the elderly and in immunocompromised persons. However, Q fever may cause abortions, premature deliveries, and stillbirths in infected pregnant women.

Most acute cases of Q fever are readily treated with antibiotics. Treatment of chronic endocarditis is more difficult, and may entail antibiotic treatment for at least 2 years (some authors recommend life-long treatment with antibiotics).

Q fever is difficult to prevent. The organism is long-lived in the environment and may be present in dust particles in a contaminated area. Even very low numbers of organisms are capable of causing disease.

Veterinary hospital employees should wear protective clothing when handling sheep or goats, especially around parturition. Pregnant women should avoid participation in obstetrical procedures in ruminants. If participation is necessary, pregnant women should wear protective clothing, gloves, and a mask, and avoid direct contact with the placenta, fetal membranes, or any aborted fetus. All persons should exercise care when handling placentas and reproductive discharges from potentially infected species, including sheep, cats and goats. Infected animals should be strictly quarantined to prevent contamination of the environment and human infection. When caring for an animal that is known to be shedding Coxiella, respiratory protection using a surgical mask or respirator is advised. Laboratory workers should use universal precautions when handling tissues from animals suspected to be infected with Coxiella. If pregnant sheep are used in research facilities, it may be advisable to test them for Q fever and to use only seronegative sheep. Routine disinfection (using 2% bleach) and hand washing may be helpful in limiting environmental contamination.

A vaccine is available for persons with significant risk of exposure. It is recommended that persons with valvular heart disease not work with C. burnetii.

Reference:

1. Marrie TJ: Q fever - A review. Canadian Veterinary Journal 31: 555-560, 1990.

Rabies

Rabies, also known as hydrophobia, is an infection of the brain caused by a rhabdovirus of the genus Lyssavirus. Because of its bizarre symptoms and almost inevitably fatal course, rabies is probably the most feared zoonotic disease. Since 1925, there have been 21 cases of human rabies in Canada. The two most recent cases both appeared to be due to unrecognized bat exposures.

On average, 373 cases of rabies in animals are reported annually in Canada. Skunks and bats account for 2/3 of the cases. Only 10% of the rabies cases reported in North America involve domestic animals.

Rabies is found almost worldwide, although in many areas it is largely confined to wildlife species. Human and domestic animal disease in North America results from disease "spillover" from wildlife species. In Canada, the principle wildlife species involved varies with the geographical area. As fox rabies has now been almost eradicated in Ontario, the skunk is presently the most important wildlife vector. Bats, particularly the big brown bat, silver-haired bat, and hoary bat, have been reported to harbour rabies in all parts of North America. Other wildlife species occasionally diagnosed with rabies in Canada include coyotes, bobcat, groundhog, beaver, and deer. Most mammals are susceptible to rabies infection.

There is evidence that some wildlife species, particularly bats, may harbour the rabies virus without showing clinical signs (asymptomatic disease). In domestic animals, rabies is apparently always symptomatic and invariably fatal, with clinical signs observed for two to ten days before death. The domestic animal species most commonly diagnosed as rabid in Canada are cats, dogs, cattle, and horses. Vaccine-induced rabies has been reported in cats, dogs, and captive wildlife given modified live rabies vaccine (no longer sold for use in these species).

The most commonly reported signs of rabies are behavioral changes and ataxia. Behavioral changes vary between animals, and may include any of the following: loss of fear (in wildlife), daylight activity in nocturnal species, excitability, unprovoked aggression, hyperactivity, nervousness, shyness, increased affection, pica (eating dirt and other non-food items), and seizures. Incoordination is commonly seen, progressing to paralysis just before death. Abnormal vocalization (bellowing in cattle, uncontrollable barking in dogs) and excessive salivation are also often noted in rabid cats, dogs and cattle. In cattle, many of these signs are also suggestive of choke (food obstruction in the oesophagus), which may lead to delayed diagnosis. Horses with rabies may show signs suggestive of colic. Pruritus in common in pigs. Rabid wildlife will invade yards

and attack pets and people. Rabid bats have been reported to fly during daylight hours, rest on the ground, and occasionally attack animals.

The disease in all species is confirmed by direct immunofluorescence on central nervous system tissue (hippocampus, cerebellum, or brain stem). Diagnostic tests for live animal are not currently available.

In humans, the incubation period may be as short as 9 days or as long as 7 years, but 3 to 8 weeks is most common. Bite wounds to the face tend to have short incubation periods compared to those to the feet and legs. The age of the victim, the amount of virus exposure, and the strain of virus also affect the incubation period. Early symptoms in humans include fever, malaise, headache, and subtle change in mental status. Later symptoms include anxiety, pain or irritation at the site of the virus entry, increased activity, increased sensitivity to stimulation, salivation, muscle spasms of the larynx and pharynx, seizures, coma, and after 2 to 8 days, death. Rabies is very rarely transmitted between humans.

Transmission of rabies is usually through a bite wound, or through contamination of a skin abrasion or mucous membrane with saliva containing the rabies virus. Ingestion, inhalation, or other mucosal contact with the virus may lead to infection, but this is rare.

Obviously, not all animal bites received by veterinary hospital employees result in exposure to rabies. Several factors should be considered in deciding whether or not an animal is a rabies suspect, including:

- the species of animal involved: in Ontario, all forms of physical contact with a bat are considered to involve potential rabies exposure. The presence of a bat in a room in which a human occupant is sleeping is also considered to be a potential rabies exposure.

- whether or not the bite was provoked

- the nature of the animal's behaviour: has it changed recently?

- other clinical signs: is ataxia present? Does the animal have trouble swallowing?

- the vaccination status of the biting animal

- whether the animal has had exposure to wildlife or other animals that may carry the rabies virus

- the frequency with which rabies is diagnosed among wildlife and domestic animals in the area

Rabies is a reportable disease in Canada. All suspected cases in animals must be reported to an Agriculture Canada veterinarian, who will supervise quarantine and collection of brain tissue.

ACTION TO TAKE IF BITTEN BY A RABIES SUSPECT

1. **If you are bitten or licked by a rabies suspect, immediately contact the local Medical Officer of Health (required by law) and your physician. Transmission of rabies virus is not always obvious: even a scratch or abrasion contaminated with infectious saliva may lead to this fatal disease.**

2. The likelihood of rabies infection appears to be decreased by immediate thorough cleansing of the bite wound with soap and water for at least 5 minutes. This should be followed by application of a quaternary ammonium compound or 70% isopropyl alcohol. It is thought that the rabies virus remains in the bite area for at least 24 hours before beginning its migration along peripheral nerves to the central nervous system.

3. If a person is bitten by an animal that is suspected to be rabid, animal control specialists should be contacted, as it is important that the animal be captured (provided human safety is not endangered in doing so). Wildlife, stray animals, and bats that have bitten humans, as well as any animal showing signs suggestive of rabies, are normally killed and the brain or whole carcass submitted to a diagnostic lab for fluorescent antibody testing. (Agriculture Canada veterinarians will usually submit the samples on behalf of the veterinarian). If the animal was capable of transmitting rabies at the time of the bite, the brain will test positive.

4. Asymptomatic dogs or cats which have bitten humans without should either be euthanized (with the head preserved for pathological examination), or confined and observed for 10 days for clinical signs suggestive of rabies. If no clinical signs appear during this period, the animal was not infectious at the time of the bite. Confinement is important because not all animals carrying the virus will show clinical signs at the time the bite occurred: virus has been recovered from the saliva of dogs and cats up to 3 days before the onset of clinical signs in the animal.

5. Following possible rabies exposure, rabies prophylaxis injections (using immune globin and/or rabies vaccine) should given as determined by a physician. The type and frequency of prophylaxis is based on the circumstances of the bite, the person's prior immunization status, and the guidelines established by the local public health department. Immune globin is not usually given if the person has been previously vaccinated against rabies with a human diploid cell vaccine. Optimally, treatment should be started within 24 hours of the bite. Prophylaxis may or may not be initiated before the diagnosis of rabies has been confirmed histologically (from examination of the animal's brain), depending on the risk assessment of the situation and how quickly the test results can be obtained.

Even persons who have been previously vaccinated against rabies should receive prophylactic treatment following possible exposure to rabies. However, the number of doses required is less than that for a person who has not been previously vaccinated (only 2 injections three days apart without rabies immunoglobin, compared to 5 or more vaccine injections plus rabies immunoglobin, administered to previously unvaccinated persons).

PREVENTION OF RABIES

Prevention of rabies transmission is twofold: constant awareness of the potential risk of rabies transmission and pre-exposure vaccination (see below). Animals hospitalized with clinical signs or history suggesting rabies (e.g. unprovoked aggressive behaviour) should be strictly isolated and must not be directly handled by hospital staff. Universal precautions, including the use of protective clothing, gloves, and eyewear should be used when handling tissues or diagnostic specimens from an animal suspected to carry the rabies virus. Normally, Agriculture Canada personnel will supervise disposal of carcasses and preparation of samples to be sent to a lab. Rabies virus can survive up to 10 days in brain tissue, even if autolysed. Fortunately, the virus is fragile in the environment and is inactivated by most disinfectants.

Vaccination against rabies is helpful for two reasons:

a) It provides some protection to persons who are unknowingly exposed to rabies (for example, after being bitten by an animal that is not suspected to be rabid but which is actually harboring the virus).

b) In the event that a previously vaccinated person is bitten by a suspected rabid animal, the number of post-exposure treatments is reduced.

Unfortunately, vaccination against rabies is relatively expensive and is also associated with vaccine reactions, although severe reactions are rare. For this reason, the decision whether hospital staff should be vaccinated against rabies is not always straightforward. Recommendations of the Canadian Immunization Guide (2006) can be summarized as follows:

- Veterinarians and staff working in enzootic areas (where rabies is present in wildlife populations and occasional cases are seen in domestic animals) should have a primary course of 3 vaccinations (at 0, 7, and 21-28 days, using a licensed human rabies vaccine). Thereafter, either serologic is recommended every 2 years. A titer of 0.5 IU/ml (1:32) is considered adequate protection.

- Veterinarians and staff working in areas with low rabies incidence should have a primary course of vaccinations. Serologic testing and booster vaccinations are not required unless exposure to rabies occurs.

- Some persons are advised to discuss with their physician the potential problems associated with rabies vaccination. These are most likely in persons with a history of vaccine reactions, persons with immune system disorders or immunosuppressive diseases, and pregnant individuals. If possible, immunosuppressive drugs should be discontinued during the vaccination period. Intramuscular vaccine is preferred to intradermal vaccine in immunocompromised persons.

If vaccination of veterinary hospital employees is undertaken, the Human Diploid Cell vaccine (IMOVAX) or a chick embryo vaccine (RabAvert) are normally used. The vaccine can be administered by a family physician. The effective dose is 1 ml given IM. Intradermal vaccination using IMOVAX is less expensive than the intramuscular vaccination, but is reported to be slightly less effective. The initial series is given on days 0, 7, and 21 (or 28) in the upper arm. The veterinary hospital should keep records of the date and nature of the vaccines given to each employee, as this information is essential in determining the optimum treatment, should rabies exposure occur in the future.

Mild local discomfort (pain, erythema, swelling, or itching around the injection site) is reported in the majority of persons receiving rabies vaccine, however this is transitory and is no more serious than for most vaccines. More serious symptoms, including headaches, nausea, and other generalized reactions may be seen in up to 25% of vaccinated persons. Severe reactions are rare with the newer vaccines, with an incidence reported to be less than 1%. All vaccine reactions should be reported to the physician who administered the vaccine.

References:

Current recommendations for human vaccination against rabies can be found in the Canadian Immunization Guide (2006), which is found on the website of the Public Health Agency of Canada (www.phac.aspc.gc.ca).

Persons seeking more information on rabies in their area are advised to contact the local public health unit.

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Ringworm

Ringworm is a form of dermatomycosis (fungal skin infection). In animals it is usually caused by Microsporum canis, Trichophyton mentagrophytes, or Trichophyton verrucosum. These fungi are widespread in the environment (particularly in soil) and cause disease in many species of domestic animals and wildlife, as well as in humans. Ringworm infection in both humans and domestic animals is usually evident as a superficial infection of the skin, hair, or nails. It does not invade living tissue.

Clinical ringworm is most frequently diagnosed in young animals, especially kittens and puppies. Yearling farm animals are also commonly infected, particularly in winter. Dermatomycosis has also been reported in birds, including budgerigars and parrots. Many animals (particularly cats) carry fungal organisms on their hair and skin without showing any signs of skin disease, and may transmit the infection to humans.

Animals with clinical ringworm infections may show a wide variety of skin lesions, including patchy hair loss and broken hairs, erythema, miliary dermatitis, and crusty dermatitis. Lesions are often roughly circular in appearance. Suspected cases are usually confirmed by Wood's lamp inspection, direct examination of hairs under a microscope, and culture of hair or scales taken from the periphery of the lesion. Treatment may involve the use of oral medications (griseofulvin, itraconazole), lufenuron, dips, or creams.

Ringworm is transmitted to humans by direct physical contact with an infected animal or its hair and dander. Transmission occurs when people handle affected animals, or from contact with infected dander or hair in the environment. Transmission is more likely if there are fresh breaks in the person's skin. Young, elderly, and immunocompromised people are at greatest risk of becoming infected. Not all human infections are the result of contact with animals: it is estimated that only 10-30% of human ringworm in urban settings is of animal origin and the remainder are acquired from the environment.

Lesions are most commonly found on the face, neck, and arm in children and on the scalp, nails and arms of adults. The first sign of infection is usually redness at the site of contact, which is an immune response to the fungal organism. If this reaction does not eliminate the organism the fungi will spread, forming roughly circular, dry, scaly lesions. Scalp lesions appear as scattered areas of alopecia, stubbled hairs, and scaling. The organisms are often present beyond the margins of the lesion (up to 6 cm away in humans). Moist lesions, called kerion, are sometimes present.

Chronic conditions such as "athlete's foot", "jock itch", and ringworm affecting the toe nails are also caused by fungal organisms. These are seldom associated with exposure to animals, and are more likely caused by fungi found in the environment.

Treatment of ringworm in humans or animals usually involves the use of skin creams containing anti-fungal agents. Occasionally, oral antifungals may be used, including ketoconazole, terbinafine, and griseofulvin.

Infection with ringworm can be largely avoided by wearing gloves when handling infected animals and by washing hands between patients. Many adults are resistant to infection, and may not develop signs of disease even after significant exposure. Because of their increased risk of infection, children are advised not to handle affected animals.

Ringworm fungi can survive for months to years in a cool dry environment, but are inactivated by sunshine. Hospital disinfection using chlorine bleach (1 part commercial bleach to 20 parts water) is effective in eliminating the organism. Enilconazole dips may prevent shedding of infective material from affected animals.

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Salmonella

Salmonella are Gram negative bacteria that are widely distributed in mammals, birds, and reptiles. There are three species: S. choleraesuis, S. typhi, and S. enterica, and these are further subdivided into approximately 1700 serotypes. S. enterica is responsible for almost all zoonotic disease, with the most common serotypes being S. enterica serovar Typhimurium or Enteritidis. Animals are thought to be the main reservoir for Salmonella species (other than Salmonella typhi, which is an exclusively human pathogen). The organism is not found in the environment except in association with animal feces and byproducts. Salmonella has been reported to be present in up to 54% of swine feces. The incidence in canine feces is reported to be between 1% and 27%, with younger dogs having a higher prevalence than older dogs. Infection rates in other species may be very high, particularly in pet turtles (50 to 85%), broiler chickens (61%), and turkeys (69%).

Salmonellosis is frequently diagnosed in humans, and some authors believe that Salmonella gastroenteritis is the most common zoonotic infection afflicting man (Loar, 1987). It is estimated that there are millions of cases of salmonellosis annually in the US, some of them fatal (Menning, 1989).

The overwhelming majority of human cases of salmonellosis are due to food-borne illness ("food poisoning") associated with consumption of raw or undercooked eggs, dairy products, poultry, beef, pork, and other food items. The most recent outbreaks in Ontario have been associated with cantaloupe, mung bean sprouts, and cheese products. Food products become infected with Salmonella when they contact animal feces during processing. Salmonellosis may also be transmitted directly from animals to humans, usually through contact with feces from infected animals (reptiles, poultry, livestock). Fortunately for veterinarians and hospital staff, direct transmission of salmonellosis from live animals to humans appears to be uncommon, and is thought to be responsible for only 1% of human Salmonella infections.

Although most animals infected with Salmonella show no signs of disease, clinical cases do occur with signs ranging from loose feces to severe sepsis. Clinical disease often occurs after an acute stressful episode, such as surgery or hospitalization. The most common clinical presentation is fever, vomiting and diarrhea. Feces may be bloody, and diarrhea may persist up to one month. Abortion and stillbirth have also been reported. Mortality is usually low, except in very young animals and in horses.

It is difficult to rule out any animal as a potential carrier of Salmonella, as asymptomatic animals may shed Salmonella in their feces, particularly under conditions of stress. Animals recovering from a Salmonella infection may shed continuously for over 3 months and periodically thereafter.

It is estimated that for most Salmonella serotypes, exposure to at least one million bacteria are required to cause disease in a healthy human host. Some serotypes are more infective, requiring only hundreds of bacteria to cause disease.

Since many cases of human salmonellosis are sub-clinical, the number of reported cases is a small fraction of the actual total. If clinical signs are seen in humans, they usually occur after an incubation period of 6 to 72 hours and may include nausea, fever, vomiting, abdominal pain, and watery diarrhea (sometimes containing mucus and blood. Serious complications including colitis, pyelonephritis, bronchopneumonia, osteomyelitis, and autoimmune disease have been linked to Salmonella infections. As with animals, humans are known to shed Salmonella bacteria in the feces for several days or weeks after clinical signs resolve.

Immunocompromised, elderly, and young persons (particularly infants) are at greatest risk of severe disease. Persons receiving antibiotic therapy are also more susceptible to Salmonella infection, as their normal gastrointestinal flora are disturbed or absent. It is thought that the normal bacterial flora in the gut may help prevent Salmonella infections from becoming established.

Treatment of Salmonella infections is controversial. The disease is usually self-limiting and does not require antibiotic treatment except in severely affected patients. In fact, the use of antibiotics appears to increase the likelihood that the person or animal will become a chronic carrier of the organism.

Because of the widespread distribution of Salmonella in domestic animals, it is difficult to completely avoid contact with these bacteria. All feces, raw poultry, raw meat (including raw food diets for dogs and cats), eggs, and rendered animal feeds should be suspect. Transmission of Salmonella from veterinary patients to humans can be avoided by strict hygiene, including hand washing, use of gloves when handling animals with diarrhea and when disposing of their feces, and routine disinfection of cages. Gloves should also be worn when handling raw food diets.

Salmonellosis outbreaks are sometimes a serious problem in veterinary referral clinics (including veterinary colleges) where relatively large numbers of debilitated animals may be housed in close proximity. Periodic surveillance by culturing cages, floors, treatment tables, ventilation systems, and feces from clinic patients may be important in determining the source of hospital infections. Prompt cleaning and disinfection of all areas contaminated with feces is vital in controlling hospital outbreaks of salmonellosis.

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Sarcoptic Mange

Mange (termed "acarisis" in humans) is caused by infection of humans or animals with one or more species of mites, including Sarcoptes, Notoedres, Otodectes (including ear mites, Otodectes cyanotis), and Cheyletiella (see separate section). The most commonly reported zoonosis is sarcoptic mange (scabies), caused by Sarcoptes scabiei. Other parasitic mites cause transient infections such as "dairyman's itch" or "cavalryman's itch". Most human infestations with mites acquired from animals are self-limiting and resolve even without treatment within 3 weeks.

There are several subspecies of Sarcoptes scabiei, each of which prefers a particular species of animal (although cross-infection does occur). Canine scabies is the most common form of scabies seen in veterinary patients, and is characterized by intensely itchy red papules, often on the ears, face, abdomen, and limbs of young dogs. The lesions become crusted and undergo considerable self-trauma from scratching. Some animals with scabies may have few or no visible skin lesions (a condition sometimes called "scabies incognito") but may nevertheless transmit the parasite to other animals.

Infection of dogs (or humans) occurs when the canine mite contacts the skin. The adult female mite penetrates into the epidermis, and burrows through the stratum corneum throughout her lifespan of about 30 days. Each female mite deposits approximately 50 eggs in the burrow. The larvae that hatch move to the skin surface, copulate, and the adult females either reinfest the same host or seek a new host.

Human scabies (acariasis) is somewhat similar to canine scabies. The disease in humans is usually caused by the human scabies mite Sarcoptes scabiei var. hominis. However, the canine scabies mite (Sarcoptes scabiei var. canis), can apparently be transmitted to humans with ease, as human involvement is reported to occur in 30 to 50% of canine cases. Signs of disease appear 2 to 3 weeks after infection. The canine mite causes vesicles (small blisters), red papules, raised wheals, crusts, and intense itchiness over areas that have contacted the pet, including the arms, legs, abdomen, and chest. Infections caused by the **human** scabies mite have a different distribution, with the hands, finger webs, and external genitalia being the areas most commonly affected. The intense skin reaction and pruritus is thought to be caused by a hypersensitivity reaction to the mites in both humans and dogs. Pruritus can continue for days or weeks after the mites are killed.

Transmission of Sarcoptes infection may occur through direct contact with diseased animals, or by indirect contact with bedding, clothing, grooming utensils, and other

fomites contaminated with mites. Sarcoptes mites are susceptible to dehydration and usually die within a few days off the host.

Diagnosis of canine scabies in humans is complicated by the fact that skin scrapings in persons (and dogs) with canine scabies are frequently negative. Diagnosis is based on a suggestive history and typical clinical findings.

Scabies in the dog may be successfully treated with several topical flea control agents. The disease in humans is normally treated with topical lotions and shampoos containing permethrin or other insecticides.

Transmission of the disease can be prevented by wearing gloves when handling animals with scabies lesions, and by conscientious hand washing. Bedding should be washed with hot water and detergent to remove mites.

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Sporotrichosis

Sporotrichosis is a chronic skin disease caused by the fungus Sporothrix schenckii. This organism is widely distributed in the environment, and is common in decaying vegetation. The fungus is also able to grow in human and animal tissues, particularly the skin and subcutaneous tissue. Sporotrichosis is most commonly diagnosed in the cat, although it has also been reported in dogs, horses and in many other domestic and wildlife species. In North America, most reported cases are from the southern United States or Mexico.

In domestic animals, infection usually occurs by invasion of a wound such as a bite or wood sliver. Clinical signs of disease in animals include the development of nodules, crusty lesions, abscesses, ulcers, or granulomas in the skin and subcutaneous tissues. Lesions are often chronic and non-responsive to antibiotic therapy.

Sporotrichosis can be transmitted directly to humans who handle infected tissues, fur from infected animals, or articles such as bandages that are contaminated with pus. As in animals, human sporotrichosis usually develops after the fungal organisms invade a wound such as a bite or scratch. It also appears that Sporothrix organisms are able to invade intact skin.

After a variable incubation period in humans (from 7 days to 6 months) a hard painless nodule forms at the site of the skin injury. The nodule, often on the finger or hand, gradually changes colour from pink to purple to black. Often, multiple nodules

appear in the subcutaneous tissue along the course of lymphatics that drain the lesion. These nodules may become firm, appearing as hard cords under the skin. Eventually, the nodules ulcerate and release grey or yellow pus. Occasionally, the disease may extend to mucous membranes, or may disseminate throughout the body. Persons with compromised immune systems appear to be at greatest risk of disseminated disease.

Sporotrichosis is treated by the administration of itraconazole or potassium iodide. This therapy is usually successful in humans, but less so in cats. The application of twice daily hot compresses has also been found to be useful in eliminating infections. Fungal organisms may remain at the site of healed lesions for as long as six months.

Because Sporothrix organisms are able to invade intact skin, care must be taken when handling cats and other animals suspected to be infected with this organism. The use of gloves and a lab coat is strongly advised. One reported case of human sporotrichosis involved a veterinary technician who wore gloves when handling an affected cat, but who subsequently developed lesions on the wrist where the cuff of the glove ended. It is therefore advised that hands and wrists be washed with a surgical soap after the gloves are removed. As the organisms are numerous in the tissue and exudates of infected animals, similar precautions should be used in the laboratory. Eye infections have been reported following from a splash of culture material into the eyes.

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Streptococcal and Staphylococcal infections

Streptococci and Staphylococci are gram-positive bacteria that commonly cause disease in both humans and animals. Transmission of bacteria between animals and humans appears to be rare under normal circumstances.

Streptococci species cause a wide range of disease conditions in domestic animals, including mastitis, respiratory disease, septicemia, genital tract infections, arthritis, abortion, meningitis, and septicemia. Most streptococcal diseases in animals are not considered contagious to humans (for example, strangles in horses). The most common streptococcal diseases of humans are "strep throat" and a related condition, scarlet fever, both caused by Streptococcus pyogenes. This species is uncommon in

animals, however it has been suggested that dogs, cats, and birds may occasionally act as reservoirs for human infection. Another serious human disease caused by streptococci is septicemia in newborn babies, caused by Streptococcus agalactiae. The same species of bacteria is a common cause of mastitis in cows, however it is believed that cow's milk does not play a role in transmission of this agent to humans. Human babies acquire this organism during birth, by contacting Streptococci that are present in their mother's birth canal.

As these examples illustrate, it is believed that human streptococcal disease is almost always acquired by contact with other humans carrying Streptococci, rather than through contact with animals. It appears that Streptococci strains that cause disease in animals are not readily transmitted to humans. One exception to this is Streptococcus suis. There are occasional reports of human infections caused by this organism, which (as the name suggests) is a common pathogen of swine. The major route of entry appears to be through skin wounds contaminated by handling pig carcasses. Aerosol transmission may also occur.

Because of the possibility of zoonotic disease, persons handling animals and tissues infected with Streptococci (particularly Streptococcus suis) are advised to protect open wounds by wearing gloves, and to utilize standard hygienic precautions, including frequent hand washing.

Staphylococcus, like Streptococcus, commonly causes disease in both humans and animals. Staphylococcus bacteria are normal inhabitants of human and animal skin. The most important staphylococcal diseases of animals are mastitis, dermatitis, and otitis externa. Genital, urinary, and respiratory tract infections are also common.

Staphylococcal diseases of humans include food poisoning and suppurative infections. There is some evidence that staphylococcal bacteria from animals can be transmitted to humans, particularly through contact with animals with skin infections, and from bites and scratches. This is of particular concern because some Staphylococcus aureus bacteria are resistant to multiple antibiotics including methicillin and are therefore very difficult to treat. Methicillin-resistant Staph aureus (MRSA) can apparently be transmitted to humans from horses, dogs, and cats. Good personal hygiene and sanitation are probably adequate to prevent transmission of staphylococcal infection from animals to veterinary staff.

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Toxocara

Toxocara canis is the most important zoonotic parasite found in dogs in Canada. This roundworm is particularly common in puppies (over 50% of puppies between two and six months of age are infected in some geographic areas) and causes visceral larva migrans and ocular larva migrans in humans. Other parasites including Toxocara cati, Baylisascaris, Strongyloides stercoralis, and Dirofilaria (heartworm) may also cause visceral larva migrans, however human infection with these parasites is relatively rare.

Transmission of Toxocara canis to humans occurs by the fecal-oral route, usually as a result of children ingesting contaminated soil. Nearly all patients with visceral larva migrans syndrome have a history of pica (ingestion of non-food material such as soil). For obvious reasons, the disease is most commonly diagnosed in children between one and four years of age. Soil in public places is commonly contaminated with parasite eggs because infected dogs may pass millions of eggs in their feces daily. Fresh feces are not an immediate danger, as the parasite eggs require approximately 2 weeks to develop into larvae that are infectious to humans. Once the soil is contaminated, larvae may survive for years, particularly in warm climates. In the populated regions of North America, 10% to 20% of soil samples collected from parks, playgrounds, and sandboxes schoolyards, and other public places are contaminated with roundworm eggs or larvae.

After ingestion by humans, the Toxocara larvae migrate through the body, ultimately reaching the liver, lungs, heart, and brain. Occasionally, larvae present in the blood may invade the eye, causing ocular larva migrans. Larvae eventually become inactive, however they may resume migration at any time within 10 years after infection. Larval migration also occurs in the dog, but in this case the larvae usually find their way back to the intestine, where they develop into adult worms and release eggs. In humans, the larvae do not return to the intestine, and no eggs are released.

Visceral larva migrans varies in severity according to the number of larvae ingested, the migratory pathway taken, and the intensity of the host's immune response. In humans, usually only a few larvae are ingested and the disease often is asymptomatic. Clinical signs seen in heavy infections include fever, leukocytosis, eosinophilia, hepatomegaly, and respiratory signs such as asthma. Serum samples from affected children test positive for Toxocara antigens. Treatment with antiparasitic drugs may be effective in killing the migrating larvae but is generally ineffective in resolving symptoms. Administration of corticosteroids, surgery, and laser therapy are used to treat inflammation and remove larvae.

Ocular larva migrans is characterised by uveitis, optic neuritis, and retinal lesions. Loss of vision is common. The disease is most commonly identified in children seven to eight years of age.

Serological studies of veterinary hospital employees show that the level of Toxocara infection is no greater than in the general public. Nevertheless, routine precautions are advised, including wearing gloves when cleaning and disinfecting cages, runs, and materials that have been contaminated with canine feces (recalling that feces must be present for at least 2 weeks in order to become infectious). Prompt disposal of feces is helpful in preventing accumulation of parasite eggs in outdoor runs. It is advisable to wash hands after handling canine feces or cleaning areas contaminated with canine feces. Lactating females and their puppies often pass massive numbers of eggs, and the whelping box and puppies' coats may be a significant source of infective eggs.

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Toxoplasmosis

Toxoplasmosis is caused by a protozoan, Toxoplasma gondii. This coccidia-like organism infects many mammalian species, however it is only able to complete its life cycle in cats. Cats and other Felidae (including mountain lions and bobcats) are the only known source of Toxoplasma oocysts, and are therefore said to be the "definitive" hosts for this organism. Other species, including humans, sheep, dogs, pigs, cattle, and almost every other domestic animal or fowl, can be infected by ingesting the oocysts. Once the oocysts reach the intestinal tract of the new host (human or animal) they hatch into tachyzoites. Tachyzoites invade the new host's tissues, including the placenta and developing embryo if the host is a pregnant female. Tachyzoites transform into the next life stage (bradyzoites) within the host tissues, and form cysts which may persist for the life of the host. The host may develop antibodies in response to these cysts, but otherwise the bradyzoites usually have little impact on the adult domestic animal host. In the natural life cycle of this organism, cats ingest the bradyzoites present in the tissues of their prey (birds and small mammals), and the organism completes its life cycle by forming oocysts in the cat's intestine.

It is apparent that many cats encounter toxoplasmosis at some point in their lives, often as recently weaned kittens catching and eating mice. The disease in cats is usually inapparent, with the only sign being a rise in antibody titer.[1] Some cats develop

[1] It would be helpful if all cats that were shedding oocysts (and therefore, were a potential threat to pregnant women) could be detected by their antibody titers to toxoplasmosis. Unfortunately, antibody titers are not useful in detecting cats that are shedding oocysts. Most cats that are shedding oocysts are seronegative, and most

anterior uveitis, fever, weight loss, seizures, or ataxia. Toxoplasma oocysts, which are similar to coccidia but smaller in size (8 to 12 microns in diameter) are shed for only a short period of time (approximately 2 weeks) in the feces of infected kittens or cats. A survey of animal pounds in Washington State showed that 41% of stray cats and 28% of surrendered cats were positive for serum antibodies to Toxoplasma. Interestingly, none of the 73 cats tested was currently excreting oocysts.

Toxoplasmosis is a significant cause of fetal death and abortion in sheep and goats. Rarely, pigs may also develop clinical toxoplasmosis.

Human toxoplasmosis is found throughout the world. Humans are infected by ingesting oocysts from cat feces or (more commonly) by eating bradyzoites in meat. A 1995 outbreak in Victoria, B.C. that affected 100 people, is thought to be due to oocysts present in drinking water. Some researchers believe that a single infective oocyst may be able to cause disease in humans.

Although clinical disease is rarely diagnosed in adults, serological studies have found Toxoplasma antibodies in 15-30% of North American adults. (Ontario Provincial Health Laboratory, 2002, and US Department of Health and Human Services, 1994). Rates of infection are even higher (up to 55%) in areas where people regularly consume raw meat.

A survey of Ontario veterinary hospital staff conducted by the OVMA and the Motherisk Program in Toronto (Shuhaiber et al, 2002) showed that the incidence of positive toxoplasmosis titers in veterinary staff in Ontario was actually less than that in the general population (13% to 14% for veterinary hospital staff, compared to approximately 17% in the general population). The authors agreed with other investigators that cat ownership, frequent contact with cats, and routine work around cats in a small animal practice are NOT associated with an increased risk of toxoplasma infection. (This study can be found online at www.biomedcentral.com/1471-2334/3/8)

Nevertheless, toxoplasmosis should be a concern for pregnant hospital employees who handle cats and cat feces. It is estimated that 3,500 children are born with congenital toxoplasmosis every year in the United States. In Canada, it has been suggested that toxoplasmosis infections occur in just under 1% of pregnant women, and that toxoplasmosis is transmitted to the fetus in approximately one third of these[2].

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seropositive cats have completed the oocyst shedding period and are unlikely to repeat shedding.

[2] Although these figures are obviously a matter for concern, it should be noted that other agents, particularly cytomegalovirus and rubella (German measles) are thought to be responsible for a much higher percentage of congenital defects. One source estimates that approximately 0.1% of newborn babies show obvious defects due to toxoplasmosis, however the corresponding figures for cytomegalovirus and rubella are thought to be at least four to five times greater. Both cytomegalovirus and rubella

Most human infections are inapparent. Some persons experience flu-like symptoms within 5 to 20 days of ingestion of oocysts or bradyzoites. Symptoms include fever, swollen lymph nodes, malaise, fatigue, sore muscles, stiff neck, sore throat, skin rash, and headache. Many persons do not seek medical attention, however those that do are often mistakenly diagnosed as suffering from infectious mononucleosis. Recovery is usually spontaneous, although serious complications such as inflammation of the retina, heart, brain, spleen, or liver occasionally develop.

Toxoplasmosis is particularly significant in two human populations:

1. *Immunocompromised persons, including AIDS patients, persons undergoing cancer chemotherapy, and organ transplant patients receiving immunosuppressive drugs.* In these persons, bradyzoites that are present in tissue cysts (acquired from infections that may have occurred many years previously) may become activated. Severe disease, including brain abscesses and encephalitis, may result and are commonly fatal.

2. *Pregnant women who are infected with toxoplasmosis for the first time during pregnancy.* These women are at risk of transmitting the disease to the fetus. Even mild or asymptomatic infections in the mother may lead to serious disease in the fetus. Toxoplasmosis can only be transmitted to the fetus if it occurs **during pregnancy** - infections acquired and resolved before the pregnancy do not affect the fetus. In fact, previously infected women who have developed antibody titers before the beginning of the pregnancy are considered to be immune to further infection and their fetuses are safe from the disease. Persons who have never had toxoplasmosis (which includes the majority of women) will have a negative titer and are susceptible to toxoplasmosis infection in a future pregnancy.

Pregnant individuals who wish to find out if they have been previously infected with toxoplasmosis usually undergo one of the following 4 serologic tests: the Sabin Feldman dye test, the ELISA test for IgM against toxoplasmosis, the complement fixation test, or the indirect fluorescent antibody test (IFA) for IgG and IgM. IgM antibody appears during the first two weeks of illness, peaks from 4 to 8 weeks, and becomes undetectable within months. IgG antibody levels increase more slowly, peak at one to two months, and may remain high and stable for years. Detection of IgM antibody or a four-fold rise in IgG levels indicates acute toxoplasmosis. Past exposure is indicated by positive IgG and negative IgM levels. It has been suggested that women who do not demonstrate antibodies at the start of the pregnancy should be retested at 20 to 22 weeks and again near term to detect Toxoplasma infections that have arisen during the pregnancy.

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infections are acquired by contact with affected humans, not animals.

Risk of transmission to the fetus is greatest in late pregnancy (that is, the disease is more easily passed on to the fetus as the pregnancy advances) but the consequences are most severe if the disease is transmitted in mid-pregnancy. Infections occurring between the second and sixth month are considered to present the greatest risk of severe fetal deformities. If infected for the first time during pregnancy, approximately 10% of infected pregnant women will abort or give birth to severely affected infants, and 20% will give birth to healthy infants that develop signs of disease at a later age. Affected infants may suffer from prematurity, intrauterine growth retardation, ocular or neurologic disease, mental retardation, or may die. Of the roughly 3000 babies infected with toxoplasmosis annually in the United States, it is estimated that 5 to 10% die, 8 to 10% suffer brain and eye disease, 10 to 13% have visual damage, and most of the remainder appear normal at birth but later develop disease symptoms (most commonly, retinal disease, or intellectual impairment).

Pregnant women diagnosed with toxoplasmosis can be successfully treated with pyrimethamine and sulfadiazine, provided the disease is apparent and is diagnosed correctly. Congenital disease may be prevented only if treatment is initiated before infection is transmitted to the fetus. Unfortunately, most women who develop toxoplasmosis during pregnancy are not diagnosed because the symptoms experienced by the mother are very mild. Most mothers of children with congenital toxoplasmosis are unable to recall an illness during pregnancy.

Because of the severe consequences of fetal toxoplasmosis, pregnant women working in veterinary hospitals must be familiar with the ways in which the disease may be transmitted to them. Adult humans may acquire toxoplasmosis in three ways:

a) **Ingestion of infected raw or partially cooked meat or unpasteurized dairy products that contain cysts of bradyzoites** (usually pork, mutton, lamb, rabbit, or venison). This is believed to be the most common route of infection.

b) **Ingestion of oocysts in cat feces or material contaminated with cat feces**. The only source of oocysts is ingestion of cat feces and material such as garden soil that has been contaminated by cat feces. Fresh cat feces are not infective, as the oocysts must sporulate before they can transmit the disease. Sporulation occurs 1 to 5 days after the feces are passed. Adults may become infected after handling feces, cat litter, or contaminated soil, and then eating, smoking, or otherwise ingesting the oocysts. Children may become infected by eating garden soil contaminated with oocysts.

c) **Ingestion of drinking water contaminated with oocysts**

Fortunately for persons working in veterinary clinics, infection due to direct contact with shedding cats is probably rare. Less than 1% of cats presented at veterinary clinics are likely to be shedding oocysts at the time of presentation. Cats that eat only commercial cat food or well-cooked meat will not be infected with the disease and will therefore not transmit it. Even if a cat is infected with toxoplasmosis, oocysts are shed

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Tularemia

Tularemia, also called rabbit fever, is caused by Francisella tularensis, a gram negative bacteria. Tularemia affects many species of vertebrates and invertebrates, with outbreaks commonly occurring in wild rodents and rabbits. Domestic animals (cats, rabbits, sheep, and pocket pets such as hamsters, gerbils, degues, and chinchillas) are occasionally infected but this form of the disease is rare in Canada. The disease is transmitted through skin contact with tissues of infected animals, tick and fly bites, inhalation of aerosols, or by ingesting insufficiently cooked meat from infected animals. Over 290 cases of tularemia were reported in Canada between 1929 and 1979, and it is likely that many more cases occurred but were not recognized.

Tularemia varies in severity, depending upon the species affected and the strain of bacteria. The disease in rodents, rabbits, and sheep is primarily septicemic, with high mortality rates in these species. Some animals may be asymptomatic or show vague signs of illness including lethargy, anorexia, rough hair coat, and inactivity.

Several forms of tularemia are recognized in humans. The most common symptom is a necrotic ulcer at the site of inoculation, accompanied by swollen regional lymph nodes and fever. If inoculation occurs by the ocular route (often by rubbing the eye with an infected finger), conjunctivitis may result. The most serious form of tularemia is septicemic and resembles plague. Pneumonia may also occur. Treatment with antibiotics is usually curative.

Veterinary hospital staff may be exposed to tularemia when handling tissues or blood from infected animals (most commonly, pocket pets or wildlife species such as cottontail rabbits, muskrats, or beaver) or through tick bites. Gloves and a face mask should be worn when working with animals or tissues known or suspected to be infected with Francisella tularensis and affected animals should be kept in isolation. Laboratory personnel should use universal precautions when working with diagnostic samples containing tularemia organisms and Level III bio-containment is advised. A vaccine is available for persons who have a high risk for exposure to this organism.

for only a short period (maximum 2 weeks) by any individual cat. Repeated infections have been reported under unusual circumstances, but the number of oocysts shed after the initial infection is believed to be small. Even if oocysts are being shed, fresh feces (less than one day old) are not infectious because sporulation has not yet occurred.

The most significant role of cats in the transmission of toxoplasmosis is not as a direct source of infection to humans, but rather their ability to pollute their environment (gardens, stored grain on farms, sandboxes) with oocysts, which remain infective for a long period of time and are very resistant to chemical disinfectants.

Toxoplasmosis may be prevented in several ways. The most important preventative measure for humans is thorough cooking of all meat to an internal temperature of 70'C or greater (indicated by a change in colour of the meat) and refraining from tasting or eating raw meat. In addition, hands, cutting boards, and cooking utensils should be washed with soap and water after contacting raw or partially cooked meat. Pregnant women should wear gloves when gardening and wash hands thoroughly with soap and water after gardening. In the case of veterinary hospital staff, it is recommended that gloves be worn when performing a necropsy and when inspecting meat.

Veterinary hospital staff can avoid contact with infective oocysts by disposing of cat feces within 24 hours, before sporulation can occur. Pregnant women are advised to avoid handling cat feces (or cat litter), especially material that is more than 24 hours old. However if this activity is necessary, pregnant women should wear gloves and wash their hands after the gloves are removed. Some authors suggest that it is prudent for pregnant hospital employees to wash their hands after handling any cat, in the unlikely event that old fecal material containing sporulated oocysts is present on the cat's coat.

As mentioned, toxoplasmosis is a common cause of abortion in sheep and goats. Both the placenta and fetal tissues from aborting animals may be infectious and should not be handled by pregnant persons.

Oocysts are highly resistant and may survive up to one year in the environment. Immersion in scalding water for 5 minutes and treatment with ammonia have been suggested as effective means of removing oocysts from soiled areas. Litter boxes of hunting cats can be disinfected once monthly by filling the box with boiling water and letting it stand for five minutes. Oocysts are very resistant to most hospital disinfectants.

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PART 4 – ALLERGIES AND VACCINE REACTIONS

Although allergies are not classified as zoonoses, they may be considered to be "pet associated illnesses". Persons working in veterinary hospitals should be aware of the potential for developing allergies to animal hair, saliva or fleas. (Note: allergies to latex, disinfectants, and laboratory chemicals are discussed in Chapter 4, Chemical Hazards)

Flea allergy dermatitis

Ctenocephalides felis, the most common type of flea affecting dogs and cats in North America, may bite humans. In a susceptible person (e.g. one who is allergic to flea bites), this may result in severe cutaneous hypersensitivity. Sensitive humans who are bitten by fleas develop raised papules at the puncture sites, sometimes with a tiny hemorrhagic punctum in the center of the lesion. The papules may enlarge and form welts, which are extremely itchy. Often the lesions occur in groups of three (sometimes referred to as "breakfast, lunch and dinner"). Lesions are most commonly found on the hands, feet, and waist, but may be in any location to which the fleas have access.

Control of flea-bite hypersensitivity in veterinary hospital employees involves flea control measures within the hospital and the home. Treatment of lesions may include topical corticosteroids and other anti-inflammatory agents. It has been reported that most individuals eventually become spontaneously desensitized.

Reference:

1. Scott DW, Horn RT: Zoonotic dermatoses of dogs and cats. Veterinary Clinics of North America: Small Animal Practice 17 (1): 117-144, 1981.

Allergies to animals

Allergies to animal dander, hair, scales, fur, saliva, and urine are common. One study showed that 57% of persons diagnosed with asthma were sensitized to animal dander (Ohman, 1978). Another study showed that approximately 33% of animal handlers have allergic symptoms including 10% with symptoms of animal-induced asthma (Chan-Yeung and Malo, 1994).

Of all mammalian species kept as pets, cats are the most common cause of human allergies to animals. Allergies to dogs, horses, cows and laboratory species (rabbits, rats, mice, hamsters, gerbils, and guinea pigs) are also commonly reported.

Laboratory workers who frequently handle or work in close proximity to mice and other small mammals are at increased risk of developing allergies to these species. From 23% to 56% of laboratory workers eventually become sensitized, according to one report (Aoyama

et all, 1992). Persons with pre-existing allergies or a family history of allergy are predisposed to develop allergies to laboratory animals. Most allergies develop within 3 years of starting exposure to these animals, although in rare cases the onset of symptoms can be delayed up to 10 years.

For persons working with large animals, the highest incidence of animal-associated allergy is in persons working in confined areas with inadequate ventilation (for example, a closed barn in which pigs are kept). Inhalation of dust from bedding (especially sawdust contaminated with livestock or horse urine) is also a significant trigger of allergic reactions.

The route of exposure to animal allergens is usually inhalation or skin contact. The most common clinical signs are runny nose and eyes. Other reported symptoms include asthma (coughing, wheezing, shortness of breath) and itchy eyes, nose, and throat. Skin contact may also cause a rash, which is often pruritic. Allergic symptoms may also occur following a lick, scratch, or bite, but this is relatively rare.

For all allergic reactions, symptoms usually peak within one hour of exposure to the allergen, although delayed asthmatic reactions may be seen up to 12 hours after contact. If the duration of exposure is short and the affected person leaves the area, the symptoms usually resolve quickly. However, the longer the exposure continues, the more likely the signs of illness will persist even when contact with the animal has stopped.

Affected persons usually have a positive skin test when tested with allergens from one or more animal species. Desensitization has been attempted, using repeated injection of extracts (similar to hyposensitization of dogs and cats), but has not been very successful in the past. Recent advances in antigen formulation (such as "AllerVax Cat") appear to offer more promise of successful desensitization, but even with the newer products there is some risk of anaphylaxis during treatment, and injections may be necessary for several years.

Severely allergic persons are advised to avoid contact with the offending animal species, and to consult with an allergist regarding desensitization or the use of antihistamines and other drugs to prevent or treat symptoms.

If contact with the animal species cannot be avoided, use of gloves, lab coats, and a surgical mask or respirator can be very effective in reducing exposure to most allergens. Some people find it helpful to use work procedures that control the spread of aerosols, such as frequently wetting down work surfaces with a water spray. In extreme cases, it may be necessary to handle animals within ventilated hoods or safety cabinets. If family members at home are allergic to animals, it is helpful to avoid wearing street clothes while working with animals, and leaving work clothes at the workplace at the end of the day.

Reference:

1. Ohman JL: Allergy in man caused by exposure to animals. Journal of the American Veterinary Medical Association 172 (12): 1403-1406, 1978.
2. NIOSH Alert: Preventing Asthma in Animal Handlers. January 1998, NIOSH Publication 97-116. www. cdc.gov/niosh/animalrt.html

Vaccine self-innoculation

Occasionally, veterinarians or their employees accidentally inject themselves with vaccines intended for use in animals. Adverse reactions including anaphylaxis and delayed hypersensitivity have been reported and are thought to be induced by the adjuvants (mineral oils, aluminum hydroxide) or the allergens contained in the vaccines.

Anaphylactic reactions usually occur shortly after inoculation and are characterised by dyspnea, hives, and shaking. Immediate administration of epinephrine is an effective treatment, but if possible should be undertaken under the supervision of a physician.

Delayed hypersensitivity reactions may occur hours to days after inoculation with some vaccines. Clinical signs may include swelling, redness, and pain at the injection site. Granuloma formation may also occur.

Some vaccines, including brucellosis (Strain 19) and Mycobacterium paratuberculosis (Johne's disease) are associated with a particularly high incidence of reactions following accidental self-inoculation. Further information is given in the sections on brucellosis and mycobacterial diseases.

If self inoculation occurs with any vaccine, the site should be immediately washed with soap and water. Bleeding is encouraged to help drain injected material from the wound. Medical treatment should be sought if symptoms of hypersensitivity develop. Treatment with warm packs and immobilization of the area is helpful in reducing local pain and irritation. Tetanus prophylaxis is recommended following self inoculation if tetanus toxoid immunization is not current.

PART 5 - LABORATORY AND GENERAL HAZARDS

The most important safety issues for persons working around animals or in a laboratory setting are:

- safe practices and personal protective equipment
- general hospital biosecurity
- risk of handling blood and other diagnostic specimens and cultures
- shipping and disposal of samples
- injury from sharps

Each of these is discussed below.

SAFE PRACTICES

The following general precautions should be observed when working in a laboratory setting, including a lab in a veterinary hospital.

1. Food and beverages should not be permitted in the laboratory area, and should not be stored in refrigerators containing diagnostic samples or cultures. Employees should not eat, drink or smoke in animal care areas or in the laboratory areas.

2. Personal protective equipment should be worn when working around animals or laboratory samples. The nature of the protective equipment varies with the task, but may include protective outerwear, gloves, facial protection, and/or respiratory protection.

PROTECTIVE OUTERWEAR – A protective outer garment such as a lab coat, non-sterile surgery gown, or coveralls should be worn when attending animals or when cleaning. These should be changed whenever soiled, or after handling an animal with a known or suspected infectious disease, after working in the isolation room, and after performing a necropsy or other high-risk procedures. Closed-toe shoes or boots should be worn as appropriate. Boots should be water resistant and easily cleaned. Disposable shoe covers should be worn when large quantities of infectious materials are present or expected. Impermeable, waterpoof outer wear should be worn during obstetrical procedures, when performing necropsies, and whenever substantial splashes or large quantities of body fluids may be encountered.

GLOVES: Contaminated hands are the most common source of infectious disease transmission in the hospital environment. Although gloves are not necessary when examining or handling normal, healthy animals, gloves and a lab coat with sleeves should be worn when touching blood, body fluids, secretions, excretions, and non intact skin. Gloves should also be worn for dentistry, necropsies, and obstetrical procedures; when cleaning cages and contaminated environmental surfaces and equipment; when handling

dirty laundry, when handling diagnostic specimens (urine, feces, aspirates, swabs), and when handling an animal with a suspected infectious disease. Change gloves between individual animals or groups (for example, a litter of puppies) and between dirty and clean procedures on the same patient. Gloves should be removed and disposed promptly after use. Personnel should not touch other patients, food, door knobs, drawer or cabinet handles or contents, equipment, computer keyboards, or medical records with soiled hands or gloves. Hands and wrists should be washed immediately after glove removal.

FACIAL PROTECTION: Facial protection should be worn whenever there is potential exposure to splashes or sprays. Examples in a practice setting include dentistry, nebulization, suctioning, bronchoscopy, wound irrigation, necropsies, obstetrical procedures, or when cleaning with high-pressure sprayers. Facial protection may include a surgical mask and goggles, or a face shield.

RESPIRATORY PROTECTION: Particulate respirators should be used in any circumstance where there is concern about aerosol formation: for example when handling tissues from abortions in small ruminants, material associated with significant poultry mortality (for example, bedding from affected birds), or when handling sick psittacine birds. In some circumstances, biological containment cabinets or fume hoods may be required for safe handling of animals and samples.

In summary, the personal protective equipment that should be available for veterinary procedures is:

For **dental procedures**, wear a labcoat, gloves, surgical mask, and a face shield or goggles. For **obstetrics**, wear gloves and/or shoulder length sleeves, impermeable outerwear and boots, and a mask, face shield or goggles if splashing is likely. For **necropsy,** wear puncture-resistant gloves, mask, face shield or goggles, and impermeable outerwear and boots. Wear a respirator when using a band saw or other power equipment. If an animal is suspected of having a reportable infectious or foreign animal disease, consult with an Agriculture Canada veterinarian before proceeding with a necropsy. **An outer garment such as a smock, lab coat, or scrub suit should be worn when handling or attending to any patient.**

3. Long hair should be tied back, particularly when using a Bunsen burner or other flame. Flames and other ignition sources should not be used in an area where an oxygen tank is present. Bunsen burners should be turned off when not in use.

4. Although it may be challenging to achieve in a small facility, laboratory areas should be keptneat, orderly, and clean. Storage of other materials in the laboratory area should be discouraged.

Clean up as soon as possible after finishing work. Infectious materials should be disposed of promptly. Some laboratory materials are considered to be biomedical waste in many jurisdictions and should be incinerated or held for special pick up by a waste disposal firm

(see section on disposal of samples, below).

Equipment such as stethoscopes, pen lights, thermometers, bandage scissors, lead ropes, and clipper blades should be cleaned and disinfected after each use.

Work surfaces should be regularly cleaned with a disinfectant, especially at the end of the day, after aerosol-generating procedures, or any spill. For detailed guidelines on environmental infection control for equipment, environmental surfaces, isolation areas, and laundry, see Appendix 3.

Useful disinfectants include chlorhexidine, 70% isopropyl alcohol, and a 1:10 dilution of 5% bleach. Bleach is especially suitable for cleaning up blood spills, but is corrosive and will damage metal surfaces with prolonged use. If the surface to be cleaned is metallic, glutaraldehyde is the recommended disinfectant. Gloves should be worn when using glutaraldehyde and care should be taken to avoid inhalation of glutaraldehyde vapours. (see chapter on chemical safety for more information on glutaraldehyde).

A comprehensive table of disinfectants, showing their advantages, disadvantages and spectrum of action, is available on the Veterinary Information Network (VIN) web site image database.

5. Persons should not remove or insert contact lenses when working in a laboratory. Some guidelines suggest that contact lenses should only be worn when other forms of corrective eyewear are not suitable. (Laboratory Biosafety Guidelines, Health and Welfare Canada). Persons wearing contact lenses should remove them immediately after an eye splash.

If there is a risk of infectious material splashing into someone's eye, an eyewash fountain or bottle should be available within easy reach of the work area for use in case of an emergency. This must be cleaned and replenished regularly in order to be effective for use in an emergency.

6. When using a centrifuge, ensure that the centrifuge is balanced with equal numbers of tubes and that the lid is securely bolted on. No attempt should be made to stop the centrifuge arm or remove samples until the arm has come to a complete stop. Centrifuges should be disinfected regularly.

7. Occasional spills are almost inevitable when working with liquid samples. All veterinary hospitals should have readily available materials for clean up and spill contamination. This includes gloves (latex or heavy duty material) absorbent material such as kitty litter or paper towels, forceps for picking up broken glass, protective clothing, and equipment such as rubber boots and safety glasses, chemical disinfectant, and a heavy duty, leak-proof bag for discarded clean-up materials. A written spill clean up protocol should be posted in the clinic (see Appendix 4).

8. All specimens should be clearly labelled with the patient and owner name, and the date the specimen was taken (unless all specimens are tested on the same day as they are taken). Specimens from animals with serious zoonotic conditions should be clearly labelled as hazardous. Information on precautions to take when handling diagnostic specimens is given in the following section.

9. Mouth pipetting should NEVER be employed when working with urine, blood, serum, or other material from any veterinary patient. "Oral aspiration of infected material through pipettes" was found to be the most common cause of laboratory infections in one study. (Accidental inoculation with a needle was the second most common cause). When using a pipette, do not blow infectious material out of the pipette, as this creates aerosols that can be inhaled, conducting infectious agents directly to the lungs.

10. Hands should be thoroughly washed between every patient, and immediately after handling a diagnostic sample from any patient.

GENERAL HOSPITAL BIOSECURITY

By promptly identifying and isolating patients that pose a risk to other animals and to humans, veterinary staff can go a long way towards preventing disease transmission. Biosecurity is the application of basic principles to allow special handling of these patients, in order to prevent contamination of the hospital with infectious agents and unnecessary exposure of personnel and other patients.

If possible, front desk personnel should identify "high risk" patients. These include animals with acute diarrhea and/or vomiting, coughing or sneezing. If patient size allows, the animal should be transported in a carrier rather than being allowed to walk on the premises. The animal should be placed in an examination room or other isolated environment, rather than being conducted to a central treatment area.

Animals with suspected zoonotic diseases should be housed in a separate, isolated area of the hospital. The number of staff entering the isolation area should be kept to a minimum. Disposable shoe covers or the use of a foot-bath helps to prevent dissemination of organisms throughout the floors of the facility. A disposable gown and gloves should be worn when handling the patient or cleaning the cage. In some cases, a surgical mask should be worn. Feed bowls, litter boxes, bedding, and similar patient care items should be disposable whenever possible, and should be placed in plastic bags before being removed from the isolation area. Contaminated outer garments and shoe covers should also be removed and bagged before leaving the isolation area.

HANDLING BLOOD AND OTHER DIAGNOSTIC SPECIMENS

Most technicians and other hospital employees are well aware of the potential for catching a zoonotic disease from a living patient (for example, a dog with rabies). There are

equally serious but less obvious hazards associated with handling diagnostic samples, including blood, feces, urine, birthing fluids, aborted fetuses, and tissue specimens. These materials may contain viruses, bacteria, protozoa, or parasites that cause zoonotic diseases. Persons who work with bacterial or fungal cultures may have an even higher risk of exposure to infectious agents, as cultures obviously contain vast numbers of living organisms.

Health care workers who treat human patients are acutely aware of the risks of disease transmission when working with human blood and saliva - dentists wear gloves when examining patients, phlebotomists wear gloves when drawing blood samples, and laboratory workers routinely wear gloves when handling blood. This caution is justified because of the risk of acquiring the HIV or hepatitis B or C viruses from human specimens. These agents are relatively common in the general population and can be readily transmitted through contact with infected blood. This is not an idle fear: between 1980 and 1988 (before the initiation of universal precautions), at least 43 health care workers in the United States who had no history of high-risk behaviour or blood transfusions were documented to have acquired HIV virus, probably through exposure at work. The list of affected professionals includes physicians, dentists, nurses, nursing assistants, and clinical laboratory technicians. In the case of infectious hepatitis, the number of affected persons is even greater. Before the widespread availability of hepatitis vaccination for health care workers, an estimated 200 to 300 health care workers died each year from hepatitis infections acquired through contact with their patients.

For both HIV and hepatitis viruses, the most common route of exposure in a health care setting is a needle stick injury, although infection may also occur after direct skin or mucous membrane contact with infected blood. Unfortunately, latex gloves only offer protection against splashes of blood and other fluids, and do not prevent infection when punctured by needles and other sharps.

In response to this problem, the human health care professions have adopted "universal precautions" when handling blood, saliva, and other body fluids. (The full list includes cerebrospinal, synovial, peritoneal, pericardial, pleural, and amniotic fluids but not feces, sputum, nasal secretions, sweat, tears, urine, or vomitus unless they contain blood). Since it is impossible to reliably identify all patients infected with HIV or hepatitis viruses, precautions are used when handling blood and body fluid from ALL patients (hence the term "universal" precautions).

The question therefore arises, are universal precautions necessary for persons working with veterinary patients and their excretions? The truth of the matter is that there are no common blood-borne pathogens that can be spread between apparently healthy animals and humans in Canada. For this reason, universal precautions are not generally applied when working with veterinary patients or their body fluids and excretions. However, for the few, uncommon agents that may be transmitted from animal blood and fluids to humans (either directly, or by inhalation of aerosols) universal precautions should be applied. (Note that most of these agents have been discussed in the preceding section, and readers are

referred to the section on each individual disease for more information).

The diseases that may be transmitted from animal blood and body fluids to humans include the following: anthrax, brucellosis, tularemia, erysipelothrix/erysipeloid, rabies, equine encephalitis, salmonellosis, cryptosporidiosis, Streptococcus suis infection, Q fever, chlamydiosis, hantavirus, and mycobacteria. PERSONS WORKING WITH SPECIMENS FROM ANIMALS WITH THESE DISEASES SHOULD UTILIZE UNIVERSAL PRECAUTIONS OR (PREFERABLY) SPECIMENS SHOULD BE SENT TO A DIAGNOSTIC LAB EQUIPPED FOR SAFE HANDLING OF THESE AGENTS. Universal precautions should also be utilized by pregnant women when handling specimens suspected to contain toxoplasmosis oocytes or Listeria organisms.

Persons who are immunocompromised are at increased risk of infection when handling even routine laboratory specimens. For this reason, immunocompromised persons should avoid working with laboratory specimens, or if such work is necessary they should utilize universal precautions for all samples.

What about the risk from the routine samples of urine, feces, or blood that are handled every day by persons working in veterinary clinics? The risk of acquiring a serious disease by handling such specimens is quite minimal, provided a few simple precautions are taken. As has already been stated, routine diagnostic specimens containing less hazardous (but nevertheless infectious) organisms do not require universal precautions. Instead, "Standard Precautions for Veterinary Clinics" have been developed by the National Association of State Public Health Veterinarians and the Veterinary Infection Control Committee in the United States. These are listed in Appendix 3 and should be followed when handling routine diagnostic specimens, including blood, feces, urine, and other body fluids. A full list of precautions can be viewed on VIN (Veterinary Information Network) or on the NASPHV web site.

HANDLING BACTERIAL AND FUNGAL CULTURES

Persons who handle bacterial and fungal cultures should be aware of the risk of disease transmission that these cultures present. Obviously it is important to avoid touching the surface of media on which bacteria or fungi are present. All cultures should be covered with a lid or screw cap. Some cultures (particularly fungal cultures) have a potential to give off infectious spores, and persons handling cultures of spore-forming organisms with the lids removed should wear a respirator equipped with a HEPA filter or (preferably) use a fume hood or biological safety cabinet. If this equipment is not available or personnel are not trained in its use, culture of spore-forming organism should be referred to a diagnostic laboratory.

SENDING DIAGNOSTIC SPECIMENS AND CULTURES TO A LABORATORY

In some cases, veterinarians may elect to send certain diagnostic samples to a laboratory. If the sample contains living bacteria or viruses that have a significant zoonotic potential (classified as Risk Group III or Risk Group IV by the Health and Welfare Canada), the shipment must comply with Transport of Dangerous Goods regulations. Examples of diagnostic specimens requiring this type of shipment include those which contain live Brucella, Bacillus anthracis, Coxiella burnetii, Mycobacterium bovis, and rabies virus. The Transport of Dangerous Goods regulations specify packaging, labelling, and documentation requirements in order to protect transport workers from exposure to zoonotic agents. (Further information on these regulations can be obtained from Transport Canada). If a reportable disease is suspected, an Agriculture Canada veterinarian must be notified and will normally pick up the sample or oversee its shipment.

DISPOSAL OF SAMPLES

The question of disposal of blood and other specimens, vacutainers, and vials often arises. In most jurisdictions these wastes can be disposed into a sink or regular garbage **with the following exceptions:**

- Body fluids, blood, or tissues from an animal suffering from a serious (often reportable) zoonotic disease such as anthrax, brucellosis, or rabies. In most jurisdictions, samples from animals suffering from these diseases are considered to be biomedical waste and require special disposal. As these diseases are reportable, an Agriculture Canada veterinarian or other authorized person will normally direct the disposal of these samples or carcasses.

- Needles, scalpel blades, and broken laboratory glass. (see also following section on handling sharps) All "sharps" are considered to be biomedical waste and must discarded into a sharps container and either incinerated or picked up by a biomedical waste disposal firm. Some municipalities allow disposal into local landfill sites.

- Cultures of bacteria and fungi. Cultures are considered to be biomedical waste unless they have been "decontaminated" by disinfection, autoclaving or other procedure, prior to disposal. Decontaminated cultures may be discarded into the regular garbage.

- Other materials: Although hospital employees are very seldom required to handle samples from animals with reportable, serious zoonotic diseases, they may handle material contaminated with infectious organisms that are biohazardous (e.g. capable of causing disease in humans). Examples include ringworm cultures, milk samples from cows with mastitis, and fecal samples from puppies with diarrhea. Although not considered to be biomedical waste, these samples nevertheless have some potential to transmit disease and consideration should be given to decontaminating these materials by sterilization or disinfection before regular disposal.

SHARPS

Needle stick injuries are among the most common accidents in the veterinary workplace. Caution is advised when handling sharps (needles and scalpel blades), especially those that have been used during necropsy or for obtaining diagnostic specimens. Not only are these sharps often contaminated with infectious materials (including Staphylococcus bacteria residing on the animal's skin), but they can cause a skin wound that will inoculate hazardous material into the deeper tissues, greatly increasing the risk of infection and other adverse effects. If the needle has been used to aspirate an infected area such as an abscess, it is even more likely that infectious organisms such as Pasteurella, pathogenic fungal organisms, or Streptococcus, may be present.

Even a needle that has not touched an animal may cause significant injury. Needles from syringes containing antimicrobials such as tilmicosin, chemotherapy drugs, euthanasia solutions, anesthetics, or vaccines (particularly Johne's and brucellosis vaccines) may inject hazardous materials into the skin of the injured person.

Studies of needlestick injuries in human and veterinary medicine have reported significant adverse reactions, including skin sloughs, abscess formation, nerve damage, allergic reactions, and even miscarriage (reported after a needlestick injury involving a syringe containing a prostaglandin).

The most important precaution to avoid needle stick injuries is to avoid recapping needles. If needles must be recapped, a one-handed technique should be used (with the needle cap on the counter, the hand holding the syringe and needle guides the needle into the cap – the other hand does not hold the cap !) Other injuries occur when removing needles from syringes by hand, or scalpel blades from scalpel handles. Sharps containers generally have a needle removal device, and a pair of forceps should be used to remove scalpel blades from the handle. Where practical, the use of resheathable winged butterfly needles, bluntable needles, retractable needles, hinged syringe caps, and similar safety devices can reduce the incidence of needlestick injuries by as much as 74%.

Correct disposal of needles and other sharps is also essential. Sharps should never be placed in garment pockets, or discarded into regular hospital garbage containers. Needles, scalpel blades, broken laboratory glass and other sharp edged waste are classified as biomedical waste and should be discarded into a sharps container and either incinerated or picked up by a biomedical waste disposal firm. (Note that municipal regulations may allow disposal into landfill in some areas) Sharps containers must be labelled with an appropriate warning label and must be puncture proof and have a lid that can be tightly closed for disposal. They should not be filled more than three-quarters full and one should never put a hand or fingers into the container to retrieve an object. Once discarded, sharps should not be transferred from one container to another.

Sharps containers can be purchased or may be provided by companies that offer pick up

services for sharps and other hazardous wastes (such as cytotoxic waste). If a veterinary hospital owner elects to dispose of his or her hazardous waste, staff must receive special training in safe practices for segregation, collection, packaging, storage, movement, and record keeping involved in this task.

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PART 6 - ERGONOMICS

In Ontario workplaces, musculoskeletal disorders (MSDs) represent over 40% of all Workplace Safety and Insurance Board (WSIB) "lost time" claims. For veterinary hospital employees, most claims are for sprains and strains caused by lifting, transporting, or repositioning patients (in particular, large dogs). Most of the injuries reported were either repetitive strain injuries to the wrists and shoulder or muscle sprains and strain (primarily back injures).

Ergonomics is the application of scientific principles concerning the human body to the design of objects, systems, or work procedures. Given that the human body is designed to handle only a limited amount of strain and workload, ergonomics attempts to design a workplace that avoids the hazards associated with lifting or carrying heavy weights, awkward postures, and repetitive work.

Realms of information on ergonomics are available on the Internet, including information on how to identify and correct risk factors that can lead to musculoskeletal disorders. For worksheets that assist in this process, download the Occupational Health and Safety Council of Ontario's MSD Prevention Guideline for Ontario and its associated MSD Risk Assessment Checklist (available in Part B of the MSD Prevention Toolbox).

Research has shown that there are three factors that increase the risk of musculoskeletal injury:

- Use of excessive force in performing certain tasks, as when one person attempts to lift a heavy dog onto an x-ray table;

- Assuming awkward work postures, sometimes over a considerable period of time. Examples include bending over to lift and clean a horse's hoof, or leaning over a microscope;

- Repetitious work, which can lead to over-use injuries - for example, wrist injuries resulting from prolonged computer use.

A full discussion of ergonomics goes beyond the scope of this handbook, but there are a few key principles that are easy to understand and put in practice. In the course of everyday work, there may be warning signs that indicate that musculoskeletal injury is likely occurring: for example, a person may have an aching back after lifting a dog. Or after a hard work day you may experience reduced range of motion at a joint, such as a stiff wrist or inability to extend your shoulder over your head. Or, you may experience a swelling or tingling or numbness when using a body part. Any of these may indicate that musculoskeletal injury has resulted from performing a task in the workplace and that consideration should be given to performing tasks in a different way.

A few suggestions can be made on how ergonomics can be used to make veterinary work physically less stressful.

LIFTING OBJECTS: For most women, it is unwise to try to lift more than 40 to 50 pounds on your own (one guideline suggests a person should not attempt to lift an object weighing more than 1/3 of their own weight). Three or more people may be required to safely lift and transport a large unconscious dog. Pregnant persons should not lift *any* heavy object (see also Appendix 8 of this handbook) When you do need to lift a heavy object, whether animal, equipment, or container, keep the back straight and use the leg muscles (not the back muscles). Bend at the knees rather than at the waist.

EQUIPMENT: Install equipment that minimizes the physical demands of a job. Use portable or fixed steps for moving large dogs onto examination tables or into a bathing area. Some dogs can be readily led up the steps, avoiding lifting. Use a walk-on weigh scale, rather than lifting an animal to be weighed.

COMPUTERS: When using a computer, adjust the monitor position, brightness, and contrast to the most comfortable level. To avoid glare, locate the monitor at right angles to windows and other light sources. If you are facing windows, too much light shines in your eyes. If the windows are behind you, the light will reflect on the screen. Windows should have blinds or drapes to minimize glare. Keep overall light levels low. The top of the computer screen should be no higher than eye level. The screen should be at least 14-20 inches from your eyes.

Computer keyboards should be thin (1.5 to 2 inches high, measured at home row). The surface upon which the keyboard rests should be separate from the monitor so the user can adjust the keyboard position. The keyboard height should be comfortable, such that the upper and lower arms form a 90 degree angle at the elbow. A foam support placed under the wrist may help avoid strain with prolonged keyboard use, especially if the keyboard is more than two inches thick.

TABLES AND CHAIRS: Make sure that office equipment offers adequate ergonometric support.

Office chairs should be stable, with adjustable seat height and angle and an adjustable back rest height and angle. The seat height should be adjusted so that your feet, shins, and thighs form right angles at the knees and ankles. The front edge of the seat should be contoured. The back rest should provide firm support to the lumbar region of the back and should extend up almost to the lower end of the shoulder blade. Woven fabric covering is more comfortable than plastic or wood. Sit back in a chair, rather than perching on the front of it. Adjust the chair so feet rest flat on the floor and the seat puts even pressure on the back of your thighs. Your back should be in an upright position with some support (e.g. a lumbar cushion) to the lower back area.

Petite persons and pregnant women should use a foot rest, especially if table height is fixed and the feet dangle. The footrest should slope upward from front to rear and be as wide as the chair seat.

GENERAL RECOMMENDATIONS: The physical difficulty of a job is affected by the layout of a workstation, including how far workers are required to reach for objects, the height of the work surface, illumination, and flooring conditions. Ensure adequate lighting in all workplaces. Avoid awkward postures that stress joints and muscles, especially those causing shoulder abduction, flexion or extension of the wrist, twisting the arm, stooping, rotation or side bending of the neck. To avoid neck and shoulder strain, keep your head aligned with your spine, and avoid slouching or bending forward.

BREAKS: When restraining an animal or working with a microscope or computer, avoid a fixed, static posture. Take a stretch break when you feel fatigued. If you have been working at a microscope or a computer, relax your eyes by focussing them on objects at a distance.

REFERENCE:

OHSCO MSD Prevention Guideline for Ontario. www.preventionpratices.com/msd.html.

Chapter 1: Biological Hazards

True or False? Circle the correct answer:

1) Cat bite wounds are more likely to become infected than dog bite wounds.

true false

2) It is recommended that a person working in a veterinary facility have a Tetanus toxoid vaccination every 5 years.

true false

3) Hand washing is the most important means of preventing the spread of infection.

true false

4) Cutaneous larva migrans is a disease cause by hookworm larvae in humans.

true false

5) If a woman titer tests positive to toxoplasmosis before the beginning of her pregnancy, she is considered immune to further infection and the fetus safe from the disease.

true false

6) Most cases of ringworm in humans are transmitted from animals.

true false

7) Anthrax is caused by a bacteria commonly found in the soil of some geographical regions.

true false

8) Persons handling cultures of spore-forming organisms (other than ringworm cultures) should wear a respirator with a HEPA filter or use a fume hood or biological safety cabinet.

true false

Multiple Choice- circle the best answer.

9) It is recommended that a second person be present when a veterinarian or technician is examining a potentially dangerous animal. The reason for this is:

a) to provide first aid in case of an injury
b) to divert the animal
c) to assist with restraint
d) to call for help, if needed
e) all of the above

10) The most common route of transmission of zoonotic disease is:

a) skin contact
b) inhalation
c) oral ingestion
d) wounds

11) The best way to prevent bite injuries is:

a) consistent use of muzzles
b) bite resistant gloves
c) rabies pole/other restraint devices
d) sedation and/or anesthesia
e) all of the above

12) When performing dental procedures which of the following safety equipment should be worn?

a) gloves
b) surgical mask
c) face shield or goggles
d) lab coat
e) all of the above

13) The most common source for salmonellosis in humans is:

a) pet turtles
b) direct contact with animal feces
c) consumption of undercooked contaminated meat/dairy products
d) none of the above

14) The following zoonotic disease is most frequently transmitted by birds:

a) Giardiasis
b) Chlamydiosis
c) Baylisascaris
d) Leptospirosis
e) Erysipelothrix

15) The following waste can be disposed of by dumping down the sink or by placing in the garbage.

a) items contaminated with blood from an animal with a reportable disease
b) bacterial cultures
c) broken laboratory glass
d) fungal cultures
e) none of the above

CHAPTER 2 - WASTE ANESTHETIC GAS

Veterinarians, technicians, and veterinary staff may conduct several thousand anesthetic procedures during the course of their career, and in doing so they are potentially exposed to considerable amounts of waste anesthetic gas. This section outlines the health risks associated with exposure to waste anesthetic gases and discusses ways that this exposure can be measured and controlled. Health risks that arise when working around compressed gases (including oxygen tanks) are discussed in the section on chemical safety.

This chapter is divided into 3 parts:
Part 1: Exposure to waste anesthetic gas
Part 2: What are the effects of waste anesthetic gas?
Part 3: Measurement and control of waste gas levels in a veterinary hospital

PART 1 - EXPOSURE TO WASTE ANESTHETIC GAS

The term *"waste anesthetic gas"* refers to the vapours of isoflurane, sevoflurane, nitrous oxide, halothane, or other gas anesthetic that are present in the room air of a veterinary clinic or hospital. Exposure to these agents may occur in any of the following ways:

- Vapours may be inadvertently breathed while working around anesthetic machines that are in use, or near animals that are recovering from inhalation anesthesia.

- Persons emptying or filling anesthetic vaporizers may be exposed to high levels of waste anesthetic gas, particularly if the liquid anesthetic is spilled.

- Anesthetic machines and their components (for example, rubber rebreathing bags and hoses) absorb anesthetic gases and may release them into the air of the room in which they are stored.

Before discussing how waste gas levels are measured in veterinary clinics, it is important to understand how waste gas levels are expressed. Concentrations of waste anesthetic gas are usually given in parts per million (abbreviated ppm). If the concentration of halothane in room air is 33 ppm, this means that out of every million molecules in the air, 33 are halothane. (The rest are mainly nitrogen, oxygen, water vapours, carbon dioxide, which are the normal constituents of air). 33 ppm doesn't sound like very much, but this is the level at which the average person can smell the odour of halothane in room air. It is interesting to note that a patient breathing from an anesthetic machine that has a vaporizer setting of 1% isoflurane or halothane, is breathing 10,000 ppm of anesthetic gas!

The Ontario Ministry of Labour requires that the amount of waste anesthetic gas breathed by veterinary hospital employees in the workplace should not exceed an average of 2 ppm (25 ppm for nitrous oxide). This is an eight hour time-weighted average, which means that a person could breathe 4 ppm over 4 hours of the work day, then 0 ppm over the remaining 4 hours, and still be in compliance with the regulations because the average was 2 ppm over the 8 hours. It is the employer's responsibility to ensure this level of waste gas exposure is not exceeded.

Where does waste gas come from? Studies of veterinary hospitals have shown that the highest levels of contamination are associated with spills of anesthetic liquids. Liquid anesthetic rapidly evaporates when it is poured or spilled, and this produces a large amount of very concentrated anesthetic vapour that rapidly mixes with room air. Accidental spillage of only 1 ml of liquid halothane, for example, will evaporate to form 200 ml of halothane vapour, with a concentration of 1,000,000 ppm. Liquid anesthetic spilled on the skin can also be absorbed into the circulation.

Even without a spill, considerable amounts of waste gas are constantly generated when gas anesthetics are used in a veterinary hospital. Understandably, significant levels of waste gas are most often found in areas where anesthetic machines are in use. The highest levels are normally found in surgery suites, surgical preparation rooms, treatment rooms where dentistry or minor surgery is performed, and other areas where anesthetic gases are used. Recovery rooms may also be contaminated by moderate levels of waste gas as it is exhaled by animals awakening from anesthesia. (see the section on monitoring waste gas levels for information on how to measure the levels of waste gas in various areas of the workplace).

During the anesthetic period itself, the level of waste gas tends to be highest immediately adjacent to the anesthetic machine and the patient's mouth. The actual level depends upon several factors, including:

- **Duration of anesthesia:** The longer the machine is in use, the higher the waste gas concentration in the room air. For example, if a surgery room is used for several procedures in one morning, the waste gas levels may slowly increase, reaching a peak at the end of the final surgery.

- **The flow rate of the carrier gas:** Higher flow rates may lead to more waste gas pollution. For example, if the oxygen flow rate is 2 liters per minute, the room will contain more waste gas than if the flow rate is 500 ml/minute, unless a very effective gas scavenger is in use.

- **Whether or not an effective scavenging system is used**: When using a circle (rebreathing) system with no scavenging system, anesthetic gas mixed with oxygen is vented through an open "pop-off" valve at a rate approximately equal to the oxygen flow rate (usually 500 ml to 3 liters per minute). If a non-rebreathing system such as a Bain circuit is in use, the gas exits through the relief valve or rebreathing bag outlet. Either

way, in the absence of a scavenging system, all of the waste gas enters the room air.

- **Anesthetic machine maintenance.** Leak testing and regular maintenance of the anesthetic machine and equipment are important in reducing the escape of anesthetic gas from the equipment.

- **The anesthetic techniques that are used**: Mask inductions and anesthetic chambers may release high levels of waste gas, as a considerable quantity of air can leak around the mask or be released when an anesthetic chamber is opened.

- **Ventilation of the surgery room.** Rooms with a ceiling fan, wall fan, or other ventilating device generally have lower levels of waste gas. It is advised that all rooms in which anesthetic gases are released have at least 15 air changes per hour (20 air changes is preferred). Open windows and doors also reduce waste gas levels in surgery rooms, although this may not be consistent with principles of hospital design and sterile technique.

With all of these variables to contend with, it is impossible to accurately predict the waste gas levels in any particular hospital, and it is a good idea to measure the levels of waste gas using dosimeters (see section on measurement of waste gas levels). The concentration of halothane in the air of **unscavenged** surgery suites in **human** hospitals has been reported to be commonly as high as 85 ppm and occasionally as high as 200 ppm. More recent (but still sadly outdated, 1981) surveys of veterinary hospitals indicated that levels of waste anesthetic gas in **unscavenged** veterinary surgeries were much lower than those reported in human hospitals, ranging from 1 to 34 ppm for halothane, 1 to 62 ppm methoxyflurane, and 6 to 270 ppm for nitrous oxide. Levels for **scavenged** surgery rooms are still lower, usually ranging from 0 to 10 ppm depending upon the sampling location (see Figure 1 for typical examples).

FIGURE 1
WASTE ANESTHETIC GAS LEVELS

Technique or situation	Contamination (ppm)
Room air when filling vaporizer	> 10
Room air after rebreathing bag emptied into room	2.5 to > 10
Room air after spill of agent	> 10
Hands of personnel filling vaporizer	
- before washing	2.5 to > 10
- after washing	0
Clothing of personnel filling vaporizer	5.0 to 8.75
Residues in unwashed rubber components	I.8 to > 10
Nose and mouth of patient just removed from anesthetic chamber	> 10
Nose and mouth of anesthetized patient	
- intubated, cuff inflated	3.25
- intubated, cuff not inflated	6.10
Air outside recovery cage door	1.07
Nose of patient in recovery cage	5.43

Modified from Short CE, Harvey RC: Anesthetic waste gases in veterinary medicine, Cornell Vet 73(4) : 363-374, 19832

PART 2 - WHAT ARE THE EFFECTS OF WASTE ANESTHETIC GAS?

Since the first study of waste anesthetic gas was published in 1967, many investigators have attempted to determine the toxicity of halothane, methoxyflurane, nitrous oxide, and other anesthetic agents used for medical and veterinary anesthesia. Although much of the evidence is contradictory, it is generally accepted that exposure to waste anesthetic gas is associated with a higher-than-normal incidence of both short-term and long-term health problems. These problems appear to be dose-dependent (in other words, the greater the exposure, the greater the risk).

Short-term problems (those that occur during or immediately after exposure to waste anesthetic gas) include drowsiness, headache, fatigue, nausea, pruritus (itchiness), depression, and irritability. These appear to be a direct effect of anesthetic molecules on brain neurons. Symptoms usually resolve spontaneously when the affected person leaves the area. However, frequent occurrence of these symptoms may indicate that excessive levels of waste gas are present with an increased potential for long-term toxicity.

Long-term effects of inhaling waste anesthetic gas may include the following : reproductive disorders, liver or kidney damage, and chronic nervous system dysfunction (each of these is discussed separately below). Although current evidence suggests that the risk of these disorders is not high in normal veterinary practice settings, any person working in an environment in which waste gas is present should be informed of the potential for adverse health effects. It is thought that long-term toxicity is due to the action of metabolites that are produced by the breakdown of anesthetic agents within the body. These toxic metabolites include inorganic fluoride or bromide ions, oxalic acid, free radicals, and other substances that are known to have harmful effects on animal tissues.

If this theory is correct, anesthetics that are retained by the body and metabolized (e.g. methoxyflurane and halothane) have greater potential for long-term toxicity than those that are rapidly eliminated through the lungs (e.g. isoflurane or sevoflurane). It has been demonstrated that significant amounts of methoxyflurane and halothane may linger in the liver, kidney, and body fat stores of patients and anesthetists long after the exposure has ceased. For example, anesthetists have been shown to have traces of halothane in their breath as long as 64 hours after administering this gas to a patient.

Negative effects of waste anesthetic gas on reproduction (spontaneous abortion, infertility, congenital defects) have been investigated by numerous studies. A comprehensive survey of nurse and physician anesthetists found that the risk of spontaneous abortion in this group was 1.3 times that of the normal population (Ad Hoc Committee of the American Society of Anesthesiologists, 1974). This is equivalent to a 33% increased risk. (For the purposes of comparison, it is interesting to note that smoking one pack of cigarettes a day increases the spontaneous abortion rate by 80% and

maternal consumption of alcohol may increase the rate by 200 to 350%).

Another study (Knill-Jones et al, 1972) showed that the frequency of spontaneous abortion among working hospital anesthetists (18.2%) was higher than that observed among non-working anesthetists (13.7%) and a control group (14.7%). The same study showed that 12% of the working anesthetists interviewed were infertile, compared to 6% of the control group.

Exposure to waste anesthetic gases also has been tentatively linked to an increase in congenital abnormalities in the children born to pregnant operating room personnel. One study reported a 16% incidence of congenital abnormalities in children of practising nurse-anesthetists, compared to a 6% incidence in a control group. Reported problems included microcephaly, mental retardation, low birth weight, and heart defects. However, more recent studies have failed to show a statistically significant link between waste gas exposure and an increased incidence of congenital abnormalities. The evidence linking waste gas exposure and congenital abnormalities is generally much weaker than that linking waste gas exposure to spontaneous abortion.

It is only fair to note that the most recent studies have failed to link any adverse reproductive effects with waste gas exposure, particularly in hospitals in which scavengers are used. Most of the studies that drew attention to the effects of waste anesthetic gas on pregnant employees were done over 30 years ago, when health safeguards such as scavenging systems were not as widely used as they are today. A recent study that showed an increased risk of adverse reproductive outcomes and women working around waste anesthetic gas, was conducted in hospitals without waste gas scavenging (Shirangi et al, 2008) Other recent surveys of female veterinarians and "veterinary assistants" have shown no convincing association between waste gas exposure and increased risk of spontaneous abortion or congenital defects (Johnson et al, 1987; Shenkar et al, 1990). The absence of an connection between waste gas exposure and either miscarriage or significant congenital defects in children born to veterinary hospital staff was also confirmed by a 1999 study commissioned by the OVMA and conducted by the Motherisk Program at the Hospital for Sick Children in Toronto. Finally, a very large British study of 11,000 operating room personnel also showed no obvious relationship between hours worked in the operating room and miscarriage (Spence, 1987).

Unfortunately, contradictory studies such as these make it impossible to determine a "safe" limit for pregnant women exposed to waste gas. It is generally accepted that exposure to low levels of isoflurane or sevoflurane (less than 2 ppm averaged over an 8 hour workday) is associated with minimal risk to pregnant employees

Effect on male employees: It has been suggested that males, as well as females, may suffer from adverse reproductive effects as a result of waste gas exposure. One study found an increased incidence of birth defects in the children of one group of male dentists who used nitrous oxide on their patients. These findings have not been confirmed by

other studies.

Carcinogenic (cancer-causing) **effects** of anesthetic vapours have been investigated in the past but never proven. Some studies undertaken in the 1970s suggested that operating room personnel were at increased risk for developing certain types of cancer, particularly leukemia and cervical cancer. These studies have been criticised for inappropriate data collection and analysis, and it is now generally believed that none of the commonly used anesthetic agents are carcinogenic at the levels found in veterinary hospitals.

Liver and kidney disease. Several studies have investigated the incidence of **liver disorders** in personnel exposed to waste anesthetic gas. Halothane has been recognised for many years to be hepatotoxic in persons with individual (likely genetic) susceptibility. Fatal "halothane hepatitis" is occasionally reported in humans anesthetized with this drug and in anesthetists administering halothane. A similar syndrome has been reported following administration of methoxyflurane. However it is difficult to determine whether or not breathing waste halothane gas may cause liver problems in hospital personnel who are not genetically susceptible. One study showed that the risk of liver disease in hospital operating room personnel is 1.5 times that of the general population, however there are many factors other than waste anesthetic gas that may contribute to this finding, including exposure to viruses causing hepatitis and hepatotoxic chemicals in the operating room.

Similarly, it has been suspected that exposure to waste methoxyflurane gas may be associated with a higher risk of **renal disease**. It is well established that methoxyflurane may cause renal toxicity in humans anesthetized with this agent, but the risk to operating room personnel has been difficult to assess. Studies have shown a 1.2 to 1.4 -fold incidence in renal disease in nurses who had worked in operating rooms in which methoxyflurane was used, but again it cannot be concluded that exposure to methoxyflurane was the only factor involved.

Neurologic disease Chronic exposure to nitrous oxide gas has been associated with increased risk of neurologic disease, including muscle weakness, tingling sensations, and numbness. It also appears that exposure to a high level of anesthetic waste gas may cause a decline in short-term memory and motor skill performance. The threshold at which gases begin to affect performance has not been established.

In conclusion, despite this alarming list of potential health hazards it cannot be concluded that the average veterinary clinic employee is at significant risk for developing health problems due to waste gas exposure. There are two reasons why the studies must be interpreted cautiously:

1. There were significant inconsistencies in the way in which waste anesthetic gas studies were conducted. Studies varied widely in the types of anesthetics the personnel were

exposed to, the duration and level of waste gas exposure, and the control measures available (such as scavenging systems). Most anesthetists surveyed had been exposed to several different anesthetic gases and as a result, investigators were usually unable to determine which agent(s) is responsible for the adverse health effects observed. Early studies surveyed hospital personnel who were exposed agents such as ether and nitrous oxide, which are generally conceded to be more toxic than the more modern agents such as isoflurane or sevoflurane. Some of the surveys gathered information on anesthetists who had worked for many years in operating rooms lacking scavenging systems and other waste gas controls, whereas other surveys gathered information on anesthetists who had worked only in well-scavenged modern operating rooms. It is not surprising that the findings were sometimes contradictory.

2. Although many studies indicate an increased incidence of health problems in people working in an environment where exposure to waste gas occurs, it does not necessarily follow that the anesthetic gases themselves are the sole cause. Chemicals such as ethylene oxide, x-ray radiation, and other factors present in the operating room or the dentist's office may have contributed to increased incidence of health disorders.

The American Society of Anesthesiologists Task Force on Trace Anesthetic Gases (1999) suggests that although adverse health effects are associated with chronic exposure to high levels of waste anesthetic gas, studies have failed to demonstrate an association between the low levels of waste anesthetic gas normally found in scavenged hospitals and adverse effects to hospital employees. The Task Force concluded that even at the maximum allowable dose of isoflurane, halothane, or nitrous oxide, there was no evidence of significant damage to the gonads, liver, kidney, or other organs even in long-term studies. There are no data to suggest that waste anesthetic gases are a danger to hospital employees (including pregnant women) working in an effectively scavenged environment in which waste gas levels are monitored and known to be below the regulatory limit of 2 ppm.

Despite the difficulty in determining the absolute risk to personnel exposed to waste anesthetic gas, most occupational health authorities (including the American College of Veterinary Anesthesiologists) agree that exposure to high levels of all waste anesthetic gases should be avoided and that controls should be introduced to reduce exposure as much as possible.

PART THREE – MEASUREMENT AND CONTROL OF WASTE GAS LEVELS IN A VETERINARY HOSPITAL

Monitoring waste anesthetic gas levels is inexpensive, easy, and will give everyone in the clinic an idea of their exposure levels. This is particularly important if a hospital employee becomes pregnant and is still working around the waste gas. It is also advisable if hospital employees smell anesthetic gas, or if there are special concerns about waste gas release (for example, if the clinic is using induction chambers).

There are several ways to monitor waste gas levels. The veterinarian may hire an occupational hygienist, anesthesiologist, or other specialist, who will visit the practice and conduct air sampling tests. The hygienist can also evaluate ventilation and scavenging techniques and discuss procedures that can be used to minimise waste gas release.

Alternatively, the veterinarian can choose to periodically monitor the waste gas levels by purchasing personal self-monitoring badges. These are similar to dosimeters used to record exposure to X-rays. Badges are available to record not only waste gas exposure, but also exposure to chemicals (including ethylene oxide, glutaraldehyde, formaldehyde, and ether). Each chemical generally requires a different badge, although some badges will simultaneously monitor isoflurane and halothane. These badges enable any person working the practice to monitor the air in their breathing zone so that the amount of anesthetic present in the sample can be determined. The frequency of monitoring will vary, but once every 6 to 12 months is ideal.

The badges (called *passive dosimeters*) come with step by step instructions and are easy to use. When you are ready to use the badge, it is taken out of its sealed pouch and snapped into a sampler holder. The badge in its holder can then be placed in an area where anesthetic gases are likely to be present such as the recovery room, surgery suite, or prep room. Alternatively, the badge and holder can be attached to the clothing of a person who is most likely to be exposed to waste anesthetic gas (usually the surgeon or anesthetist) and worn for the time period in which anesthetic exposure occurs. You can choose the time period of exposure, from a minimum of 15 minutes to a maximum of 8 hours. At the end of the monitoring period, the badge is capped, sealed in a plastic bag and should be promptly mailed to the supplier or a qualified laboratory recommended by the badge supplier. It is important to indicate how long the badge was used for monitoring, as this will allow the laboratory to report the results as an average concentration in ppm over particular time hour period. (e.g. 2 ppm over a 4 hour period). Badges can detect as little as 0.1 ppm waste anesthetic gas in the air.

Badges can be obtained from industrial health and safety supply houses or companies specialising in health and safety compliance. Current suppliers include Assay Technology (1-800-833-1258) and Lab Safety Supply (1-800-356-2501). The minimum order is 5 badges, and cost, including analysis, is approximately $70.00 Cdn per badge.

Once the waste anesthetic gas levels are known, the next step is to reduce them to the lowest level possible. There are 5 important ways in which exposure can be reduced:

1. Install an effective scavenging system
2. Regularly test the anesthetic machine for gas leaks
3. Utilise anesthetic techniques that reduce waste gas release
4. Regular maintenance of anesthetic equipment
5. Utilise protective equipment when exposure is unavoidable (for example, when

cleaning up liquid anesthetic spills)

Each of these will be discussed in detail below.

Scavenging Systems

A scavenger (more correctly termed a **gas scavenging system**) is an apparatus that collects waste gas from the pop-off valve of an anesthetic machine and conducts it to a disposal point outside the building. The installation and use of an effective scavenger is the single most important step in reducing the exposure of hospital employees to waste anesthetic gas. One survey of veterinary hospitals showed that scavenging reduced waste halothane concentrations by up to 94%, compared to non-scavenged hospitals. Surveys of human operating rooms have found up to a 10-fold reduction in waste gas levels where scavengers are in use.

Every anesthetic machine or anesthetic chamber in the hospital must be connected to a scavenging system when in use. If it is not practical to install scavenging equipment in a specialised room (such as the radiography room), it is advisable that either anesthesia be maintained with an injectable agent or an anesthetic machine with an activated charcoal cartridge be used (f/air canister, A.M.Bickford, Inc.). These cartridges, available from safety supply firms, can effectively absorb isoflurane, halothane, and methoxyflurane vapour (NOT nitrous oxide) but must be replaced after 12 hours of use. It is important to note that air conditioners and air filtration systems designed for dust and other particles do not remove waste gas from room air and are not an effective substitute for a scavenging system.

Many types of scavengers are available, but all of them have the same basic design. A tube or hose connects to the pop-off valve of the anesthetic machine, and conveys the anesthetic gas to a disposal point. In a **passive** scavenging system, the tube simply carries the waste gas to an open window or exhaust vent in the wall. The gas flows to the exit because it is pushed by the pressure of gas in the anesthetic machine. The alternative type of system, called an **active** scavenging system, uses a vacuum pump or fan to draw the gas away from the anesthetic machine and discharges it through a vent to the outdoors. Both active and passive scavenging systems are effective, provided they are correctly installed[1] Ideally, scavenging systems should be professionally installed when the veterinary clinic is built.

Modern anesthetic machines are equipped with scavenging pop-off valves that are

[1] Some studies have found that active scavenging systems were more effective than passive systems (Gardner, 1989), whereas other studies (for example, Sass-Kortsak et al, 1992) have found the opposite to be true. Intelligent design and correct installation are more important than the type of system chosen.

designed to allow easy connection to scavenging systems. Adapters for use with older equipment are also readily available from anesthetic equipment suppliers. It is important to choose the type of pop-off connection that matches the type of scavenging system used, whether high vacuum, low vacuum, or passive. For further information, consult the CSA standard (see references at the end of this module) or technical personnel with expertise in servicing anesthetic equipment.

Anesthetic chambers and non-rebreathing systems such as a Bain circuit or Ayre's T-piece also should be connected to a scavenger or other exhaust system when in use. This can be achieved by connecting the scavenger to the anesthetic chamber exhaust, or the outlet of the rebreathing bag, or other outlet from the circuit. "Bag tail valves" and other adapters can be obtained from suppliers of anesthetic equipment.

No matter which type of scavenging system is chosen, the following guidelines must be followed:

- The hose conveying the waste gas should have a minimum diameter of 3/8".

- The exhaust capacity must be at least 15 Liters/minute.

- Waste gas must be totally confined within the scavenger hose from the anesthetic machine or chamber to a point of discharge and must not be recirculated into the building air. Scavengers that discharge gas within the building (for example, onto the floor of the surgery room, into the attic or basement of the clinic, or into a recirculating central vacuum system) will contaminate all building rooms with waste gas. The exhaust should be discharged to the outside of the building, away from doors, windows, and air intakes. Alternatively, the waste gas can be discharged into the exhaust of a non-recirculating room ventilation system which provides 12 to 15 air changes per hour.

- The outside vent of a scavenging system should be pointed downward, for protection against rain and snow. It should also be screened to keep out insects and foreign material.

- If a passive system is used, the hose should be as short as possible (maximum 20 feet in length if it discharges outside the building and 10 feet if it discharges into a room ventilation exhaust). The hose should travel a downward course toward the exhaust. If possible, the hose should not travel on the floor, where it may be stepped on or trapped under equipment and occluded.

- If the scavenging system is blocked, gas will accumulate in the anesthetic machine and breathing circuit. One obvious indication that this is occurring would be an overdistended rebreathing bag. Such a blockage must be immediately resolved (if necessary, by disconnecting the scavenger from the pop-off valve) or it may lead to circulatory problems or lung damage in the patient. Anesthetic machines may be equipped with a valve that automatically opens to release waste gas if the pressure within the circuit is excessive.

If an active scavenger is used, there are several additional considerations:

- The vacuum system can be part of the hospital's central vacuum system, or (preferably) it can be an independent system. The ideal vacuum strength is 13.5 - 27 kPa (138 -275 cm H_2O). If the active scavenger is connected to a central vacuum system, care should be taken to reduce and control the vacuum strength. Otherwise, so much air may be drawn out of the breathing circuit that the patient has little left to breathe! Anesthetic circuits that incorporate a negative pressure release valve are able to compensate to some extent, but the anesthetist must frequently check the rebreathing bag to ensure that it remains partially filled except at peak inhalation, indicating that the patient is receiving sufficient oxygen.

- Active scavenging systems with exhaust fans should be explosion-proof and designed to handle waste gases that contain oxygen.

Leak Testing

Leakage of gas from anesthetic machines is a significant source of operating room pollution, and it is NOT reduced by a scavenging system, as the gas escapes before it can reach the scavenger. A 1988 study of veterinary hospitals showed that 55% of the anesthetic machines tested had significant leaks. In one third of the cases, the leakage rate was greater than one liter per minute (under 30 cm H_2O pressure). Leaks may occur from any part of the machine in which nitrous oxide or gas anesthetic is present. The most common causes of gas leaks are the following:

- connections for nitrous oxide or oxygen gas lines may not be sufficiently tight

- O rings, washers, and other seals that join gas tanks to the machine may be missing, worn, or out of position

- the covering over a unidirectional valve may not be tightly closed

- carbon dioxide absorber canisters may not be securely sealed. Leaks commonly occur because absorber granules have fallen onto the seals under the canister, Other causes of leakage are failure to tighten the screws on the lid, and worn gaskets.

- holes may be present in the rebreathing bag or hoses (A single pin hole leak can release enough gas to raise the concentration of waste gas to 10 ppm in the surrounding room)

- the pop-off valve/scavenger connection may not be tight

- the breathing hoses, rebreathing bag, or endotracheal tube may not be not securely connected to the machine

- the vaporizer cap may not have been replaced after the vaporizer was last filled.

- ventilators may also be a significant source of pollution, as many have internal leaks.

There are two types of leaks that can develop from an anesthetic machine. *High pressure leaks* arise between the gas tanks and the flowmeter, where the pressure of oxygen or nitrous oxide is relatively high. High pressure leaks release only pure oxygen or nitrous oxide, without volatile anesthetic. The other type of leak is a *low pressure leak*, which arises within the breathing circuit, hoses, rebreathing bag, endotracheal tube, ventilator, or scavenger. Low pressure leaks release anesthetic waste gas as well as oxygen (and nitrous oxide, if used).

In some cases, the presence of a leak is obvious - there may be an audible hiss, the odour of anesthetic, or a jet of air coming out of the rebreathing bag or hose. However, small leaks are often inaudible and the odour is undetectable. These small leaks can be detected by testing the machine as outlined below.

The type of leak test used on an anesthetic machine depends upon the type of carrier gas used: if both nitrous oxide and oxygen are used, both a high pressure AND a low pressure test should be done. If oxygen alone (without nitrous oxide) is used, it is only necessary to do a low pressure test. Release of oxygen into the room through a high pressure leak does not affect the air quality, although it wastes oxygen and may empty the tank prematurely.

Low pressure tests should be performed prior to using the machine each day. High pressure tests on nitrous oxide tanks should be performed once weekly, and whenever the nitrous oxide tank is changed.

One easy way to do a **low pressure test** is to close the pop-off and place one hand (or preferably, a stopper) over the Y piece. This closes off all avenues of gas escape from the machine. The oxygen tank is turned on and the flowmeter adjusted to supply a flow rate of 2 L/minute. The rebreathing bag will gradually fill with oxygen. When the bag is full and tight, the flow rate is reduced to 200 ml/minute or less. The anesthetist should be able to squeeze the bag with significant pressure without causing escape of air from the bag. (In other words, when you squeeze on the bag with significant pressure, the bag remains tight and full). If you are able to push air out of the bag, a leak is present or the pop-off or Y piece are not completely occluded. The circuit should be able to maintain a pressure of 30 cm (as read by the pressure manometer) for 30 seconds during the test, at a flow meter setting of 200 ml/minute.

It a non-rebreathing system such as a Bain apparatus is used, the external hose can be checked by attaching it to the inspiratory outlet of the anesthetic machine, then occluding the patient port and closing the pop-off. Oxygen is then introduced into the system until the rebreathing bag fills. When the pressure manometer reads 20 cm H2O, the flow

meter should be turned off, and the pressure observed for 20 seconds. A significant decrease in pressure indicates that a leak is present.

In order to do a **high pressure test** on a system using nitrous oxide, the nitrous oxide cylinder should be connected to the machine. The cylinder is then turned on and the reading on the tank pressure gauge noted. Then, the cylinder is turned off. The flow meter is set to zero throughout this procedure, so that the pressure in the system is maintained. The tank pressure gauge should be checked again in one hour. If the pressure gauge reading is unchanged, the high pressure system is leak-free. If the pressure is significantly reduced (by more than 50 lb psi) there is a leak somewhere between the cylinder and the flowmeter, and nitrous oxide is escaping into the room air. The most likely location of the leak is at the connection of the cylinder to the machine, often due to a worn or absent washer. High pressure leaks can sometimes be resolved by turning off the cylinder, releasing the line pressure by turning on the flow meter, and then repositioning the tank on the anesthetic machine.

High pressure tests can also be conducted using the oxygen cylinder. The procedure is identical to that described above for nitrous oxide. Escape of oxygen into room air is not generally considered to be a health hazard, and the main purpose of the test is to ensure that oxygen in the tank and connections is not bleeding off through leaks.

It is important to NEVER try to stop the flow of gas from a high pressure leak by putting a hand over the leaking part.

If it has been determined that a leak is present, its location can sometimes be determined by listening carefully for the hiss of escaping gas from the source, or it may be found using a solution of liquid soap (such as dishwashing detergent) mixed with water. This solution is gently squirted on all potential leakage points, and each location is observed for bubble formation, indicating the escape of gas.

Once the source of the leak is identified, it can often be fixed by tightening a connection or replacing a part. If the leak cannot be fixed, the machine should not be used until it is serviced by qualified personnel.

Anesthetic techniques

The anesthetist, by his or her choice of anesthetic techniques, can considerably reduce the amount of waste gas released into the room air. The following procedures help to minimise waste gas release:

- Anesthetic chambers are a significant source of anesthetic waste gas pollution in veterinary facilities. Unless a scavenging system is connect to the chamber, large amounts of waste gas are released when the chamber is opened. In addition, the fur of the patient is saturated with anesthetic during the induction, and gives off significant waste gas when the animal is removed from the chamber. Chambers should only be

used in a well-ventilated room with a non-recirculating ventilation system, or under a fume hood. They must be tightly sealed to avoid leaks. The chamber should have 2 inlet holes to which the breathing hoses from the anesthetic machine can be attached, once the Y piece is removed. With this set up, the anesthetic machine scavenger will be able to remove the exhaust vapours. Alternatively, the hose from a Bain system can be attached to one inlet and the scavenging system can be directly attached to the other outlet. The chamber should be closed immediately after the anesthetized patient is removed, with the oxygen flow continued for several minutes to purge waste gas into the scavenger. This avoids the release of waste gas into the room air. Chambers should be washed with soap and water after each use to remove residual anesthetic.

- Avoid the use of masks to maintain anesthesia. It has been suggested that waste gas concentrations around the patient's head can be reduced by 50% by using an endotracheal tube instead of a mask. The high contamination level associated with masks is probably due to the escape of anesthetic gas around the mask, particularly if it is not fitted tightly over the animal's face. If mask inductions are required, the animal should be intubated as soon as it reaches an appropriate depth.

- Cuffed endotracheal tubes significantly reduce the escape of waste gas into room air, compared to uncuffed tubes or masks. To be effective, however, the tube must be of adequate size and the cuff must be inflated and in good repair. Prior to use, the cuff should be inflated with air to check for leaks. After intubation of the patient and cuff inflation, check the fit of the endotracheal tube within the trachea by closing the pop-off valve and gently squeezing the rebreathing bag, taking care not to overinflate the patient's lungs. The cuff should not leak up to an airway pressure of 20 cm water. At pressures over 20 cm water, a quiet hiss indicating air leakage is acceptable. In fact, if there is no leakage from the endotracheal tube when a pressure of 20 mm is applied, the cuff is likely too tight.

- Low oxygen flow rates produce less waste gas than high flow rates. Selection of the flow rate will depend upon the type of system, the size of the animal, and the stage of anesthesia, and should be determined in consultation with the veterinarian. In a semi-closed circuit, a 25 kg animal may be maintained on a flow rate as low as 500 ml to 1 L of gas per minute. In this case, a flow rate of 3 L per minute not only wastes oxygen and anesthetic, but also produces considerably more waste gas.

-When working with an anesthetic machine designed for use in dogs and cats, do not turn on the vaporizer or nitrous oxide flowmeter until the anesthetic machine is connected to the intubated patient and the endotracheal tube cuff is inflated. It is not necessary to fill the machine and rebreathing bag with anesthetic gas before connecting the machine to the patient. Similarly, once the procedure is under way, avoid disconnecting the patient from the breathing circuit unless the vaporizer has been turned to zero.

-When working with a large animal anesthetic machine, it is acceptable to fill the machine and rebreathing bag before connecting the hoses to the patient. The Y piece should be

occluded with a rubber plug until you are ready to attach the circuit to the intubated patient. As with small animal anesthesia, the vaporizer setting and flowmeters should be turned to zero before the patient is disconnected from the machine.

- The contents of the rebreathing bag should not be released into the room air. Rather, the bag should be squeezed gently while still attached to the machine, to allow the air to exit through the open pop-off so the scavenger can retrieve the waste gas.

- If possible, maintain the connection between the animal and the machine, with the animal breathing pure oxygen, for several minutes after the vaporizer is turned off. This allows expired anesthetic from the animal's lungs to enter the scavenging system rather than the room air. Obviously this is not always possible (for example if the animal is awakening from anesthesia and is chewing on the endotracheal tube).

- One study found that the concentration of halothane and nitrous oxide were higher in recovery areas than in scavenged operating rooms. For reduction of waste gas levels, it is usually necessary to have an exhaust fan or nonrecirculating ventilation system in the room where patients are recovering from anesthesia. Whenever possible, avoid being closer than 3 feet to the nose of a recovering or anesthetized animal. There are anecdotal reports of human health care workers who have "passed out" from the effects of waste gas while working in anesthesia recovery rooms!

Equipment concerns

Anesthetic machines should be serviced by qualified personnel at least once every 24 months, and all servicing and maintenance procedures should be recorded in a log book. Service should include inspection of the flow meter, carbon dioxide absorber, vaporizer, pop-off valve, and all tubing and connections.

Accessory equipment such as hoses, rebreathing bags, and endotracheal tubes should be regularly inspected by hospital employees, and cracked or worn items should be discarded. Endotracheal tubes with non-functional or leaking cuffs should not be used.

Hoses, rebreathing bags, masks, endotracheal tubes, and other rubber components of the anesthetic circuit should be washed with soap and water and air-dried after each procedure. Washing not only removes absorbed waste gas, but also reduces the transfer of microorganisms between patients.

Anesthetic vaporizers should be filled or drained only in a well-ventilated area. When pouring liquid anesthetic into the machine it is a good idea to use a filling device (supplied by most anesthetic manufacturers), rather than pouring directly from a bottle. If no filling device is available, use a bottle adapter with a spout. Hands should be washed after filling vaporizer as liquid anesthetics are readily absorbed through intact skin. Protective equipment, including vinyl or plastic gloves and a lab coat or plastic apron, provides additional protection to the person filling or draining a vaporizer.

Because of the risk of exposure to significant levels of waste gas when emptying or filling anesthetic vaporizers, pregnant personnel should not be assigned to this task.

Empty anesthetic bottles should be capped before being discarded, as residual anesthetic may evaporate into the room air. Likewise, filling devices should be stored between uses in a sealed plastic bag.

Spill clean-up

If liquid anesthetic is spilled, a high concentration of anesthetic vapour will be present in the immediate area of the spill. Increase ventilation as much as possible during the cleanup by opening windows or using fans. Close doors to the rest of the building to avoid contamination of other rooms. For anything other than a small spill, all personnel not involved in the cleanup should leave the area. The clean-up staff should wear protective clothing, including plastic or vinyl gloves to protect the hands. It may also be advisable to wear a respirator with an organic vapour cartridge. This is a breathing device which filters organic materials such as anesthetic vapours out of the air as you breathe. These masks can be purchased from safety supply firms and are also available from some hardware stores. The mask should fit very closely to the face, such that no air can be breathed except that which passes through the filter cartridges. If the person wearing such a device is able to smell the fumes from a spill, it is ineffective. These masks are only functional for a limited period of time, and need to be replaced after the period specified on the product.

An example of a protocol for spill cleanup is given in Appendix 4 of this manual.

References:

An Internet search on "waste anesthetic gases" reveals hundreds of web sites and articles. Most of these pertain to US regulations (which are similar to those in Canada), including the Occupational Health and Safety Administration (OSHA), at www.osha.gov, or the National Institute of Occupational Safety and Health (NIOSH) at www.cdc.gov/niosh/docs/2007-151. For recommendations specific to veterinary hospitals, the best source is the American College of Veterinary Anesthesiologists, at ACVA.org.

There are hundreds of papers on waste anesthetic gas, most of them published before 2000. The following is a list of useful articles:

1. Ad Hoc Committee of the American Society of Anesthesiologists: Occupational disease among O.R. personnel: a study. Anesthesiology 41:321-340, 1974.
2. Boivin J. Risk of spontaneous abortion in women occupationally exposed to anesthetic

gases. J Environ Med 54: 541-8, 1997.
3. Canadian Standards Association, Anaesthetic Gas Scavenging Systems (Publication CAN3-Z168.8-M82), Rexdale, Ontario, 1982.
4. Gross ME, Branson KR: Reducing exposure to waste anesthetic gas, Veterinary Technician 14(3): 175-177, 1993.
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7 Johnson JA, Buchan RM, Reif JS: Effect of waste anesthetic gas and vapor exposure on reproductive outcome in veterinary personnel. Am.Ind.Hyg.Assoc.J. 48(1): 62-66, 1987.
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11. Meyer RE: Anesthesia hazards to animal workers. In Lanley RL, editor: Occupational medicine state of the art reviews. Philadelphia, 1999. Hanley and Belfus.
12. Paddleford RR: Manual of small animal anesthesia. New York, 1988, Churchill Livingstone.
13. Potts DL, Craft BF: Occupational exposure of veterinarians to waste anesthetic gases. Appl. Ind. Hyg. 3: 132-138, 1988.
14. Purdham JT: Anaesthetic gases and vapours. Hamilton, Ontario, 1986. Canadian Center for Occupational Health and Safety.
15. Rettig, T: An inexpensive anesthetic gas-scavenging device that any technician can make. Veterinary Technician 8(3):27-31, 1987.
16. Sass-Kortsak AM, Purdham JT, Bozek PR, Murphy JH: Exposure of hospital operating room personnel to potentially harmful environmental agents. American Industrial Hygiene Association Journal 53: 203-207, 1992.
17. Shenkar MB, Samuels SJ, Green RS, Wiggins P: Adverse reproductive outcomes among female veterinarians. American Journal of Epidemiology 132: 96-106, 1990.
18. Shirangi A, Fritschi L, Holman CD. Maternal Occupational Exposures and Risk of Spontaneous Abortion in Veterinary Practice. Occup Environ Med. 2008, (April).
19. Short CE, Harvey RC: Anesthetic waste gases in veterinary medicine. Cornell Vet 73(4):363-374, 1983.
20. Spence AA, Knill-Jones RP: Is there a health hazard in anesthetic practice? Br. J. Anaesth 50: 713-719, 1978.
21. Spence AA: Environmental pollution by inhalation anaesthetics. British Journal of Anaesthesiology 59: 96-103, 1987.

Chapter 2: Waste Anesthetic Gas

True or False? Circle the correct answer:

1) Concentration of waste anesthetic are usually given in parts per million (ppm).

true false

2) Studies of veterinary hospitals have shown that the highest levels of contamination of anesthetic waste gas is due to the cuff of the endotracheal tube not being inflated.

true false

3) In general, the longer the anesthetic machine is in use, the higher the waste gas concentration in the room air.

true false

4) Chronic exposure to nitrous oxide gas has been associated with increase risk of neurological disease.

true false

5) Personal monitoring devices similar to X-ray dosimeters may be purchased to monitor waste anesthetic gas levels in a veterinary clinic.

true false

6) Every anesthetic machine and anesthetic chamber should be connected to a scavenger system when in use.

true false

7) Anesthetic bags and hoses can absorb anesthetic gases and release them into the air in the room that they are stored in.

true false

8) The Ontario Ministry of Labour recommends that waste gas levels breathed by veterinary personnel not exceed 5 ppm in an 8 hour period.

true false

9) Anesthetic machines should be periodically serviced by qualified personnel.

true false

Circle the option that makes the statement correct:

10) Chamber induction generally **increases/decreases** the amount of waste anesthetic gas present in the room.

11) An oxygen flow rate of 3 liters/min will cause **more/less** gas pollution than an oxygen flow rate of 2 liters/min.

12) Air conditioners and air filtration systems **do/do not** remove waste gases from room air.

13) A scavenger system **will/will not** remove waste anesthetic gas if there is low pressure leak in the system.

14) The average person can smell halothane in the room air at **10 ppm/30 ppm.**

15) Anesthetics that are retained by the body and metabolized such as halothane, have a **lesser/greater** potential for long term toxicity than anesthetics that are rapidly eliminated through the lungs such as Isoflurane.

CHAPTER 3 - RADIATION SAFETY

This chapter is divided into 4 parts:

Part 1 – The Nature of Radiation
Part 2 – The Harm X-Rays can do
Part 3 – How to Protect Yourself from X-Ray Radiation
Part 4 – Developing X-Ray Films

PART 1 - THE NATURE OF RADIATION

Persons working in veterinary hospitals may be exposed to energy emissions produced by a multitude of sources, including X-ray machines, lasers, ultrasound machines, microwave ovens, and video display terminals (computer screens). Much has been written about the dangers (real or imagined) of exposure to radiation from each of these sources, with particular concern being expressed for women exposed during pregnancy. In this chapter, the hazards associated with energy emissions from each of these sources will be reviewed, with particular emphasis on potential hazards associated with X-ray radiation. This module does not address regulatory issues such as inspection of X-ray machines, maintenance of X-ray logs, and X-ray room signs and furnishings, as information on these issues can be obtained from the Ontario Ministry of Labour. This module also does not address safety considerations for persons working in specialized environments (for example, handling radioactive iodine or working around CT scanners) and employees are urged to contact the Canadian Nuclear Safety Commission or the Radiation Protection Service of the Ontario Ministry of Labour for information on these issues.

X-ray machines, light bulbs, and microwave ovens have at least one thing in common: they all produce electromagnetic radiation (X-rays, light, microwaves). Electromagnetic radiation consists of photons of energy travelling at the speed of light. Photons of x-rays, visible light, and other forms of radiation differ in their wavelengths and energy levels.

Obviously, some forms of electromagnetic radiation such as natural light and radio waves cause few problems in humans or animals at normal exposures. Other forms of electromagnetic radiation, including X-rays, have a real potential to damage cells even in relatively small doses. One important factor that determines the risk associated with a given type of radiation is whether it is an **ionizing** or a **non-ionizing** form of radiation. Ionizing radiation (such as X-rays) causes the formation of ions and free radicals as it passes through tissues. These ions may in turn cause chromosomal damage and other deleterious effects. Non-ionizing radiation, on the other hand, either does not penetrate very well through tissues (as is the case with visible light) or it may penetrate tissues and pass through them with minimal harmful effects (as is the case with radio waves). High doses of non-ionizing radiation can damage tissue (for example, too much infrared

or ultraviolet radiation can cause a burn) but the potential for chromosomal damage is much less than for ionizing radiation.

Within a veterinary environment, the potential sources of non-ionizing radiation are lasers, microwave ovens, ultraviolet lamps (including Wood's lamps) and video display terminals. The potential sources of ionizing radiation are X-ray machines such as general radiographic, dental, fluoroscopic, and angiography equipment, and computerized tomography (CT) scanners.

Ultraviolet (UV) Radiation

Ultraviolet radiation is emitted by Wood's lamps and some nursery incubators and germicidal lamps. It is also a component of solar radiation. Over-exposure to ultraviolet radiation may result in burning of exposed skin, similar to a sunburn. Excessive eye exposure causes an extremely painful conjunctivitis which becomes apparent six to eight hours after exposure. Permanent eye damage, including the development of cataracts, may result from long-term unprotected exposure. Persons working in veterinary clinics who have significant exposure to ultraviolet radiation (whether from sunlight or from ultraviolet lamps) should wear protective eyewear and cover exposed skin surfaces.

Lasers

The following is a brief introduction to safety concerns when working with lasers. Employees working in veterinary practices in which laser are used are advised to consult the publication "Lasers in Veterinary Practice: Safe Use Guidelines" (available from the following website: www.bccdc.org/search.php?terms=laser&x=47&y=16) for more detailed information on laser safety.

Lasers produce electromagnetic radiation in the form of an intense beam of light of a single wavelength, whether a particular colour of visible light, or invisible infrared, or ultraviolet radiation. Although light is a non-ionizing form of radiation, a laser beam may cause considerable tissue damage because of its intensity.

Lasers are characterised as low power lasers (such as laser pointers, supermarket checkout lasers) and high power lasers (including surgical lasers). Lasers are further classified and labelled for the degree of hazard they present, which depends on the output power and emitted wavelength. Thus a laser may be labelled as Class 1, 1M, 2, 2M, 3R, 3B, or 4 and this information should be clearly indicated on the laser itself.

Lower power lasers (Class 1, 2, and 3R) may require the use of protective eyewear, as specified by the manufacturer. Protective eyewear is even more critical when using higher power lasers (Class 3B and 4, and including surgical lasers). Higher power lasers must be used in a controlled area, such as a separate treatment room or designated work space. This area must have an appropriate warning sign, and access to this area must be restricted to essential personnel during treatments.

If the laser used in a veterinary practice is Class 3B or 4 (as surgical lasers generally are), the practice owner should designate a laser safety officer. In addition, *all* laser operators must be trained in laser safety. The employer must conduct periodic safety audits of the facility, personnel, and safety procedures.

The most significant hazard associated with laser use is the risk of eye injury. This can occur as quick as it takes to blink and may not be apparent at the time. However, laser-induced eye injury is usually permanent. Potential injuries include burns to the cornea and retina, optic nerve damage, and cataract formation. It is therefore essential that all persons working with high power lasers wear appropriate protective eyewear. Goggles (preferably) or glasses must be specific to the type of laser used and must be labelled with the same wavelength of radiation as is emitted by the laser. Protective eyewear must be labelled with an Optical Density (OD) number, and should be rated at least 5 or greater (check for the recommendation of the laser equipment manufacturer). Eyewear must have adequate side and top protection and fit snugly around the nose. It should be inspected regularly for cracks and discoloration. Staff who periodically work with lasers should have an eye examination prior to their first occupational exposure to the laser.

Laser beams should never be pointed directly at a person's eye, even if protective eyewear is worn.

Unauthorized personnel must be excluded from a controlled area in which a high power laser is in use, and all personnel who regularly enter into the controlled area must have adequate training to do so safely. Windows, doorways and openings into the controlled area must either be covered or otherwise designed to reduce outside exposure to laser radiation. Because light radiation from a laser is not appreciably diminished by increased distance from the source or by reflection, all personnel within the visual range of the laser beam must be protected, no matter how far they are standing from the beam itself.

Class 4 medical lasers often produce noxious airborne contaminants during use, including bacterial and viral particles, benzene, formaldehyde, and phenol. The fumes can be irritating to the eyes and may also cause nausea, abdominal cramps, and vomiting. These contaminants should be captured as near as possible to the point of origin and removed by localized exhaust ventilation. If this cannot be achieved, a portable smoke extractor with a charcoal or HEPA filter can be used. Filters and absorbers used in portable smoke evacuators require replacement on a regular basis.

Class 4 lasers may also damage the skin, with symptoms including reddening, blistering and charring. The extent of the damage depends on the wavelength, power, and duration of exposure. Hands and other exposed skin surfaces should be covered when working near the target area of Class 4 lasers (gloves and gowns are adequate).

Some lasers produce electrical potentials as high as 15,000 volts, and may present a potential electrocution hazard. Lasers also present a potential fire hazard and should not be used in the presence of ether, prep solutions containing alcohol, and other flammable chemicals. Surgical drapes should be made from flame retardant material and be protected with moistened towels or sponges near the primary laser beam. Water and a fire extinguisher should be readily available.

Intravenous anesthetic protocols may pose less of a fire hazard potential than gas anesthesia, if oxygen is not in use. If the patient is connected to an anesthetic machine or other oxygen source, laser-safe endotracheal tubes should be used.

References:

1. Laser Institute of America: Information Bulletin 03 - Laser Safety. Toledo Ohio, 419-882-8706, or Orlando, Florida, 407-380-1553.
2. BC Center for Disease Control General Laser Guidelines (www.bccdc.org)
3. American National Standard for Safe Use of Lasers in Health Care Facilities – ANSI Z136.3, 2005. Laser Institute of America, (phone 1-800-345-2737 or order off their web site).
4. Sam's Laser FAQ – a website considered to be the most comprehensive source of information on lasers.

Microwave Ovens

Microwave ovens produce radiation that has the ability to penetrate tissue but does not cause ionization. Persons bombarded with high levels of microwaves may experience a sensation of heat in the same way that food in a microwave oven gets hot. It has been well established that lens cataracts may result from exposure to microwaves above a threshold power level. Fortunately, the amount of radiation emitted from a properly functioning microwave oven is so small that there is little risk of injury to personnel nearby.

Video Display Terminals (VDTs)

It was once suspected that prolonged exposure to video display terminals (e.g., computer screens) during pregnancy could lead to a higher risk of congenital defects. This belief has now been demonstrated to be incorrect. Under normal conditions, video display terminals emit no ionizing radiation and are not a danger to pregnant women. Although very weak X-rays are produced inside the CRT tube, they are absorbed by the surrounding glass envelope and do not escape from the terminal.

Although safe from the standpoint of radiation safety, prolonged use of VDTs is associated with cumulative trauma disorders such as carpal tunnel syndrome. The best way to prevent these injuries is to take periodic breaks and do another task away from the computer screen (for example, 10 minutes break for every hour spent at the

computer). The section on Ergonometric Hazards in Chapter 1 of this manual should be consulted for more detailed information on the ergonometric problems associated with computer use.

Reference:

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3. Electric and Magnetic Fields at Extremely Low Frequencies. www.hc-sc.gc.ca/iyh-vsv/environ/magnet_e.html.

Ultrasound

Ultrasound machines emit sound waves, although at wavelengths too high to be audible to humans. Ultrasound waves are able to pass through tissues (hence they can be used to diagnose internal disease) but are not ionizing. No adverse biological effects have been demonstrated at the levels used for diagnostic ultrasound, and it is generally accepted that exposure to diagnostic ultrasound presents a low risk or none at all.[1]

X- RAYS

After reading the reassuring news about microwave ovens, ultrasound, and video display terminals, it would be natural to assume that X-ray machines also pose little hazard to personnel working around them. Nothing could be further from the truth. X-rays are potentially dangerous and every effort should be made to avoid unnecessary exposure to them.

There are several reasons why X-rays may be hazardous. Firstly, they cannot be detected by the human senses and a person may be exposed to excessive amounts of x-radiation yet feel no immediate unusual sensation. Secondly, X-rays are able to penetrate human tissue in the same way they penetrate through the chest or leg of an animal being radiographed and can therefore cause damage not only to the skin but also to underlying organs. This means that if the abdomen of a pregnant woman is irradiated with X-rays, the fetus is also being exposed (although a portion of the X-rays are absorbed by maternal tissues). The third dangerous characteristic of X-rays is their

[1] **Therapeutic** ultrasound, produced by special units, is capable of causing injury and should only be used according to the manufacturer's specifications.

ability to form ions and free radicals in tissue (i.e., X-rays are an ionizing form of radiation), which in turn causes chromosomal damage and sometimes cell death. In summary, **X-rays are undetectable by human senses, easily penetrate tissues and have the potential to cause cellular and chromosomal damage.**

An individual's exposure to X-rays and other forms of ionizing radiation can come from a variety of sources, but these can divided into 2 categories: **non-occupational** (environmental and your personal medical or dental procedures) and **occupational** (associated with exposure to X-rays in the veterinary workplace).

Non-Occupational Exposure to X-ray Radiation

Environmental radiation: There are several natural sources of ionizing radiation, the most important of which is cosmic rays produced by the sun. Everyone who goes outdoors is exposed to this radiation, and additional amounts are also absorbed during air travel. Building materials such as concrete, soil, and brick are another source of radiation, as they may contain minute amounts of radioactive materials such as uranium and radon. Ionizing radiation is also emitted by radium dial glow-in-the-dark watches (no longer manufactured) and by some porcelain crowns or false teeth.

In Canada, the amount of ionizing radiation the average person receives from environmental sources is estimated to be 2 to 4 mSv (millisieverts), which is equivalent to 200-400 mrem (millirems) per year.[2] Values at the lower end of this range are associated with exposure at sea-level and higher values with exposure at higher elevations and certain geographic localities.

Medical radiation (diagnostic X-rays): Radiographic procedures undertaken for medical reasons (for example dental X-rays, barium series, etc...) result in predictable levels of exposure to the human patient. The average exposure is approximately 0.1 mSv for a chest X-ray, 1.6 mSv for a dental X-ray, and 85 mSv for a barium contrast GI fluoroscopy scan. A spiral full body CT scan causes an exposure of approximately 65 mSv. Persons receiving radiotherapy for cancer or other medical conditions may experience much higher levels of exposure.

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[2] A "Sievert" (Sv) is a metric unit that measures exposure to X-rays, and is therefore a measure of biologic damage that can occur from radiation. One Sievert is equal to 100 rems, which is equal to the biological effect of 100 rad of X-rays being absorbed by the body. The higher the Sv, the higher the exposure to X-rays and the more potential for tissue damage. It is most common for low doses to be expressed in milliSieverts, which is one thousandth of a Sievert. 1 Sv = 1000 mSv and 1 Sv = 100 rem, therefore 1 mSv = 100 mrem. For the purposes of this module, radiation exposure will be given in mSv, as this is the unit used for dosimeter reports. Anyone with a dosimeter badge can should be aware of their exposure to occupational X-ray radiation, expressed in mSv on the dosimeter report.

Overall, the average dose of non-occupational radiation (environmental plus diagnostic medical / dental X-rays) has been calculated as 3.6 mSv (360 mrem) per year for a person living in the US. If you are interested in calculating your personal annual radiation dose, you can do so using the worksheet provided by the American Nuclear Society (www.ans.org/pi/resources/dosechart/).

Occupational Exposure to X-ray Radiation

"Occupational exposure" refers to the X-ray radiation that is received when a person takes X-rays as part of their job. Veterinary hospital personnel are exposed to X-rays whenever they are in a room where a radiograph is being taken, unless they are standing behind a lead screen. The extent of occupational exposure depends on many factors, including the number of X-rays taken, the use of shielding devices such as lead aprons and gloves, and the person's proximity to the X-ray beam. **The maximum whole body exposure allowed by Ontario provincial regulations is 50 mSv per year** (Ontario Ministry of Labour Regulation respecting X-ray Safety – R.R.O. 1990, Reg. 861). The 50 mSv limit applies only to **non-pregnant** adults who are required to take X-rays as part of their job. For members of the general public, the allowable whole body exposure is only 5 mSv per year. For a pregnant woman, the limit of occupational radiation to the surface of the abdomen is 5 mSv during the full term of the pregnancy.

X-ray exposure has not always been so closely regulated. Prior to 1960, X-rays were commonly taken without the use of protective gloves or other equipment, and hand-held fluroscopy was common. This led to very high levels of exposure, and older references contain pictures of veterinarians who lost fingers due to extensive tissue necrosis caused by exposure to X-rays.

With the advent of better knowledge of radiation safety, veterinary personnel using appropriate precautions (described later in this chapter) are rarely exposed to more than a small fraction of the 50 mSv limit. It is not unusual for a veterinarian or animal health technician to be exposed to less than 1 mSv of occupational X-rays in one year. One survey of veterinarians reported a **maximum** exposure of 1.20 mSv in one month, equivalent to 14.4 mSv per year. A survey of veterinary staff in Ontario, conducted by the Motherisk Program in Toronto (Shuhaiber et all, 1999) showed that the annual radiation doses of veterinary staff working in 100 randomly selected veterinary practices in Ontario between 1988 and 1998 were substantially below the minimum safety levels. The highest annual mean radiation dose was 4.45 mSv, less than 10% of the occupational limit. Equine and large animal practices had similar cumulative mean radiation exposure compared to small animal practices.

You can determine your own occupational exposure to X-rays by reading the dosimeter reports that your clinic receives (see section below).

Ontario regulations state that where radiation doses in excess of 5 mSv whole body are received within a three month period, the nature and cause of the irradiation must be investigated and appropriate remedial steps must be taken to improve techniques

and protective measures. As the Motherisk study showed, this level of radiation exposure would be extremely unusual in a veterinary practice.

PART 2 - WHAT HARM CAN X-RAYS DO?

Many studies have been undertaken to determine the effect of X-rays on the fetus and on adult humans. It has been clearly demonstrated that tissue is damaged when X-rays pass through it, and that the amount of damage is proportional to the dose of radiation received. **Any amount of radiation is assumed to involve some risk.** If the exposure is small, the body has some capacity to repair the damage and no permanent harm is likely to result. However, higher levels of radiation exposure can permanently damage chromosomes in body cells. For **non-pregnant personnel,** the chief concern is an increased risk of cancer arising from chromosomal damage. There is also some potential for development of lens cataracts, following long-term exposure of the eyes to low levels of radiation. In the case of **a pregnant woman** receiving high doses of radiation, there is also an increased risk of adverse pregnancy outcomes, including spontaneous abortion and an increased risk of congenital defects in the fetus.

Cancer

X-ray radiation is associated with an increased risk of many types of cancer in humans, including leukemia and bone, skin, and thyroid tumours. X-ray radiation is particularly harmful to dividing cells, and for this reason children and unborn fetuses are at greatest risk of developing cancer and other adverse effects. The risk of bone cancer secondary to radiation exposure to open growth plates is the reason why persons under the age of 18 are prohibited from assisting in radiographic procedures.

There is some evidence that professionals who take diagnostic X-rays may have higher rates of cancer than the general population, particularly if radiation safety precautions are not observed. One report showed that leukemia rates for veterinarians and physicians were higher than those of the general public between 1947 and 1977, a time period in which radiography safeguards such as gloves and aprons were not always consistently used (Blair and Hayes 1989). However, no increased risk of cancer or other medical disorders has been documented in persons whose exposure is under 20 mSv per year (Wiggins et al, 1989, Schenker et al, 1990).

Effects on the fetus

Many adverse effects have been reported in fetuses exposed to X-ray radiation in utero (see particularly Oppenheim et al, 1975 and Dekaban, 1968). The type of effect depends upon the amount of radiation received, and the time period when it is experienced. Most of the studies have been done on women who received high doses (500 to 3000 mSv) of radiation just prior to, or during pregnancy. These huge doses of radiation were given to women during the 1920s and 1930s with the aim of causing therapeutic abortion. Although the radiation did indeed induce abortion in some women,

some fetuses survived and were subsequently born with very small brains (microcephaly), mental retardation, and abnormally small eyes. In current medical practice, the only indication for high doses of X-ray radiation during pregnancy is treatment of certain types of malignant cancer.

In the case of women who were exposed to large amounts of radiation in the period **immediately before** pregnancy began, there appears to be an increased incidence of leukemia and Down's syndrome in the children conceived after exposure. (Presumably these children are affected because the egg cell from which they arose was damaged by the radiation). For this reason, persons who have received a high dose of radiation to the gonads (more than 250 mSv) are advised to wait several months before conceiving a child.

In cases in which radiation was experienced in the **first 2 weeks after conception**, there appeared to be no higher incidence of fetal malformations, but a very high incidence of embryo death was observed. An embryo that receives significant exposure to X-rays (500 mSv or greater) during the first 2 weeks of its existence is unlikely to survive. Since most women are unaware that they have conceived at this early point in their pregnancy, they would normally be unaware of the embryonic death. The effect of smaller doses of X-rays (less than 500 mSv) on the fetus during the first two weeks after conception is not known.

In cases in which the radiation exposure was received **between three and eleven weeks after conception**, severe abnormalities were common in the fetus, including brain abnormalities (epilepsy, retardation, microcephaly), eye problems, and genital and skeletal defects. Embryonic death was relatively uncommon.

If the radiation exposure was received **between eleven and sixteen weeks after conception**, abnormalities such as stunted growth, mental retardation, and microcephaly were seen but were generally less severe than for fetuses irradiated in the 3 to 11 week period. Fetuses who received high doses of radiation **after 16 weeks** had an even lower incidence of defects, and the defects reported were less severe (primarily hair loss and skin lesions).

It is evident that the most dangerous time for the fetus is from 0 to 11 weeks after conception and that embryonic death resulted if exposure occurred from conception to 2 weeks and gross abnormalities resulted if exposure occurred from 3 to 11 weeks. It can be concluded that the first few weeks of pregnancy are the time period in which the most stringent precautions should be exercised.

From these and other studies, it has been concluded by many investigators that there appears to be no increased risk of obvious birth defects, miscarriage, or embryonic death for the children of mothers who are exposed to less than 50 mSv of X-ray radiation during pregnancy. However, some investigators believe that although gross abnormalities are not observed following exposure to less than 50 mSv during pregnancy, there is still the possibility that low doses of X-rays may have subtle effects

on the fetus. It has been suggested that exposure to doses as low as 10 - 20 mSv in utero may increase the risk of leukemia in the offspring by a factor of 1.5 to 2. (Since the normal incidence of childhood leukemia is 1 in 3000, this means that the risk in children who received 10-20 mSv of X-ray radiation before birth is increased to 1 in 1500). Some authorities believe that the developing nervous system may be damaged if the fetus is exposed to as little as 10 mSv during the critical period between the 8th and 25th weeks of pregnancy (Gold and Beran, 1983). Fetal exposure to 100 mSv causes a measurable decrease in average IQ scores, and it is speculated that small shifts in IQ may result from lower exposures. This is most evident following exposures during period from 8 to 15 weeks after conception. (BC Centre for Disease Control).

After weighing the evidence, the United States National Council on Radiation Protection and Measurements recommended a total maximum radiation dose (for the fetus) of 5 mSv during pregnancy. Since the fetus receives approximately 1/3 of the radiation dose that bombards the mother's abdomen, this translates into a total maximum of 15 mSv for the mother's abdomen during her pregnancy. This is considerably greater than the allowed occupational exposure maximum of 2 mSv, however the pregnant woman may also experience radiation from medical or natural sources and these must also be considered when determining the entire dose of radiation that she receives. Fortunately, the evidence indicates that only the radiation that is absorbed by the abdomen has the potential to affect the fetus, and although exposure to the mother's face, hands, and other body parts must be avoided as much as possible, X-rays that penetrate these areas do not cause fetal damage.

Based on the evidence given here, it appears that a veterinary hospital employee has relatively little increased risk of congenital malformations in her children or of spontaneous abortion provided she uses protective equipment and good radiographic technique during pregnancy, and her total occupational exposure during the pregnancy (as measured by a dosimeter worn on the inside of her apron) is below the maximum permissible exposure of 5 mSv. However, there is a potential that inadvertent exposure to X-rays may occur if, for example, a damaged apron is worn or the X-ray machine is leaking radiation from the beam housing. Also, it is impossible to know for sure that subtle damage to the fetus does not occur following exposure to low doses of radiation. For this reason, most physicians advise their patients that they should avoid being present in the same room where X-rays are being taken during pregnancy (particularly during the first 12 weeks of pregnancy) This caution is reinforced by studies that demonstrate that there is a slightly increased risk of spontaneous abortion among veterinarians and veterinary assistants who take more than 4 radiographs per week during pregnancy, even though a 2 mSv exposure is not exceeded. (Johnson et al, 1987 and Schenker et al, 1990).

There is, of course, no guarantee that every pregnancy will result in a normal, healthy baby, as even persons with no occupational exposure to X-rays may miscarry or give birth to children with congenital malformations. Major congenital malformations are observed in 2.75% of all newborn babies in North America. By the age of 5, when minor congenital malformations have become manifest, the percentage of children affected is

6% to 10%. The normal rate of spontaneous abortion is estimated to be at least 25% of all pregnancies. Most of these occur in the first two weeks after conception, and are not recognized by the affected woman.

Obviously, the pregnant employee should discuss this issue of occupational exposure to X-rays with her physician to determine the course of action with which she is most comfortable. **It is preferable that pregnant employees not be assigned to radiography duties. However if an employee continues take X-rays while pregnant, she must wear a dosimeter (which is regularly sent in for reading) and good quality protective equipment (apron, thyroid collar, gloves), and use care in avoiding unnecessary exposure to X-rays.**

Summary of Radiation-Related Health Hazards

It is evident that X-ray radiation can cause serious injury to the unborn fetus and may lead to increased risk of cancer in adults. Fortunately, these effects are unlikely to occur **if common-sense precautions are used and the maximum allowable limits are not exceeded.** One authority (DePaolis and Cottrell, 1981) concluded:

> Permissible levels are set so low that clinical evidence over the past 50 years has indicated no observable injuries to medical personnel when the radiation limits are not exceeded. If awareness, caution, and common sense are utilized the hazards associated with radiation exposure are only potential and, practically, non-existent.

PART 3 – HOW TO PROTECT YOURSELF FROM X-RAY RADIATION

Given that it is possible to protect yourself from the harmful effects of X-rays by using simple precautions that minimize your exposure, it would seem logical that all persons working in veterinary hospitals would take all possible measures to avoid exposure. However, it is apparent that many veterinarians and technicians do not take even basic precautions when working with X-rays. This was first documented in a study of Michigan veterinarians undertaken in 1964 (Jacobson and Van Farowe, 1964), which revealed numerous dangerous practices. One commonly-observed problem was inadequate collimation of the X-ray beam (in other words, a large area was irradiated by the primary beam, with no attempt to restrict the beam to the area of interest). This can result in the person restraining the animal receiving ten times more radiation exposure than a person working with a collimated machine. Even worse, many veterinarians routinely took X-rays without using protective gloves and aprons, and those that used protective equipment commonly used gloves with cracks or holes from cat bites (both of which reduce the effectiveness of the glove). Most astounding, some veterinarians allowed their hands to be exposed to the direct X-ray beam, (It's easy to determine if one's gloves or hands are in the primary beam – they show up on the X-ray). In some cases

the dose received was **three thousand times** the maximum permissible dose. The authors concluded that although most veterinarians were aware of the dangers of radiation and were familiar with proper techniques, there was often a failure to apply this knowledge to routine practice.

A later study (Wiggins et al, 1989) found that 41% of female veterinarians who took X-rays did not wear film badges (dosimeters). Only 70% of the persons who wore badges knew the dosages that were reported back.

Such carelessness is not confined to veterinarians. One veterinary technician educator (Loncke, 1993) concluded:

> Few technicians would stand in the path of a speeding car, because the event and the consequences are obvious and almost simultaneous. But many technicians will routinely conduct X-ray procedures with inadequate personal protection. Years later... the consequences of failing to follow safety guidelines may harm these people.

So, how can hospital employees protect themselves from X-ray radiation ? The basic principle is simply to avoid unnecessary exposure to X-rays. The level of exposure should be "ALARA" (as low as reasonably achievable). This can be done in three ways:

1. Decreasing the amount of time you are exposed
2. Increasing your distance from the source
3. Shielding yourself from exposure using protective clothing and barriers containing lead

Exposure may occur in two ways. The first (and by far the most serious) is **contact with the primary beam**, which is the stream of X-rays that flows from the machine and passes through the animal, the photographic film, and the hands – and other body parts - of any personnel that are "in the way" of the beam. It is a basic principle of veterinary radiography safety that no human hands or other body parts should be placed in the primary beam, **even if gloves are worn.**

The other form of exposure, more common but less intense, is the **X-rays that are bounced off (scattered) after contacting the X-ray table and the animal**. This scattered radiation strikes persons who are standing nearby. The closer you are standing to the primary beam, the greater the amount of scattered radiation that will reach you. The best protection against scattered X-rays is distance, as the intensity of radiation falls off as the square of the distance from the source. For direct beam exposure, an object that is in the path of the primary beam, one meter away from the source of the beam, will receive four times the amount of radiation compared to an object that is in the path of the primary beam but is two meters away from the source of the beam. For scatter radiation, the intensity of exposure drops off even more dramatically with increasing distance. By moving one meter further away from the beam, you may decrease your exposure to scatter radiation by a factor of 1000.

With these facts in mind, the following precautions become self-evident:

1. Don't take any more X-rays than you have to. Some practices rotate X-ray duties between staff members, so that no one employee receives the entire exposure to X-rays. It is advisable that pregnant employees and persons under 18 should not be in the room when X-rays are taken.

It also makes sense to use the best technique possible to limit the number of re-takes. Careful measurement of the animal, adequate sedation, use of a technique chart, and optimal film processing all help to reduce the frequency of re-takes.

2. **When exposing a film, use the least amount of radiation possible**. Fast screens and film should be used, as they reduce the amount of radiation required to produce an image. Use of higher kilovoltage techniques allows the milliampere-seconds setting to be reduced, which in turn decreases the dose of X-rays received by the animal and hospital employees. Obviously, only persons who are thoroughly familiar with the operation of X-ray machines should set machine controls.

3. Put as much distance and shielding between you and the X-ray beam as possible. The ideal solution is to stay out of the room entirely. Only those persons whose presence is essential should be in the X-ray room when the machine is in use. The door should be closed when the room is being used.

The owner of the clinic is responsible for ensuring that staff outside the room are protected against accidental exposure to X-rays. The floors, walls, ceilings, and doors to the room must be constructed of materials that provide adequate radiation protection to employees. Normal walls (composed of concrete block or double thick dry wall) provide some protection, and by leaving the room one increases the distance from the primary beam such that very little radiation exposure occurs anyway. The protection afforded by 8 inches of concrete is equivalent to that given by 2.5 mm of lead, or by six feet of air.

Warning signs must be posted on all entrance doors of the room in which X-rays are taken, and must incorporate the X-radiation warning symbol. Warning signs can be ordered from safety supply firms, by phone or on the Internet. Signs must be at least 2 cm high and 2 cm wide and visible and identifiable from a distance of one meter.

Of course, it is usually necessary that at least one employee be present in the room when the X-ray is taken, in order to restrain the patient and take the radiograph. If possible, patient restraint should be achieved through sedation and the use of passive restraint devices such as sandbags and foam wedges. Unfortunately, not everyone can leave the room as someone has to stay behind to press the button or the foot pedal to make the X-ray exposure. If the animal is adequately restrained by passive restraint devices, the person taking the X-ray can be effectively protected by a lead lined screen

situated between them and the X-ray table. If no lead screen is available, protective equipment must be worn.

The question sometimes arises, should clients be permitted to assist in radiographic procedures. From a health and safety viewpoint it is better if they do not, given that the average member of the public has no training or expertise in radiographic procedures or safety issues. In some cases (for example, after hours procedures, or farm work) the client may be required to assist in the procedure. If this is the case, they must follow the veterinarian's instructions regarding safety and wear the appropriate protective equipment. It is not necessary for a client to wear a dosimeter, unless the client or their agent (e.g. a worker in a stable) frequently assists in X-ray procedures.

4. **If you have to restrain the animal, keep your hands out of the primary beam**. Extensive exposure to x-radiation occurs if your hands are in the path of the primary beam, **whether or not you wear lead-lined gloves**. Gloves are not designed to protect your hands from these levels of radiation. If your fingers or your gloves show up on the X-ray, you were exposed to the primary beam.

It is sometimes difficult to avoid the primary beam, but you can help yourself a great deal by collimating the beam size down to include only the area of interest. Ideally, there should be a clear (non-exposed) border of at least 1/2 inch around the outside of the exposed film: this indicates that the beam size was reduced to cover less than the area of the photographic film.

It is particularly difficult to avoid the primary beam when restraining very small patients (such as a small bird, pocket pet, or kitten) or when photographing extremities. Consider taping small patients to the cassette and use rope or gauze (rather than your fingers) to hold a leg that is being radiographed. When using a table top technique, the film cassette must never be held by hand.

If it is necessary to manually restrain animals for radiographic procedures, it is a good idea to stand as upright as possible. Persons who sit on or lean over the X-ray table are exposed to much greater amounts of scattered radiation.

5. If you are in the room when the X-ray is taken and are unable to stand behind a protective barrier, you must wear protective clothing. In Ontario, every person that is in the room when a veterinary X-ray is taken is required to wear a thyroid collar and an apron. Gloves are required to be worn when holding an animal in close proximity to the x-ray beam. These must be permanently and legibly marked with the lead equivalent thickness of the material used.

a. Gloves. There should be an adequate supply of gloves for every person in the room (usually, a minimum of 2 pairs per practice). X-ray gloves range from $100 to $250 (Cdn). per pair, depending upon the type of glove. Bulky, full hand gloves offer significant protection from X-ray exposure. Seamless lead-vinyl gloves are lighter and more flexible than conventional gloves, yet offer comparable protection. One-sided

gloves, called "X-ray Hand Shields" have the advantage of allowing greater dexterity. However, hand shields may not adequately protect the hands from scatter radiation and are not legal for use in some jurisdictions.

b. Aprons. In Canada, aprons, gloves, and thyroid shields used for X-ray voltages up to 150 kVp must contain 0.5 mm of lead equivalent. At 70 kVp, this amount of shielding reduces exposure by a factor of 800. The thickness of lead contained in an apron must be permanently marked on the outside of the apron. Aprons cost approximately $150 to $250 each.

c. Thyroid collars. Thyroid collars protect the thyroid gland, which is a potential site for X-ray induced cancer. Thyroid collars cost approximately $50.

All lead protective equipment must be in good repair and tested yearly for leaks (more often, if damage is suspected). This testing can be done by placing the glove on a cassette and taking a radiograph using sufficient kVp and MAS to slightly penetrate the lead (a grey, rather than white image should result). The approximate settings used to check protective clothing are 90 kVp and 5-10 mAs for aprons and thyroid shields, and 90 kVp and 10-20 mAs for gloves. Aprons can be done in a similar manner, using masking tape to divide the apron into sections and radiographing each section separately. The test radiographs should be examined for signs of exposure (black), which is most likely to occur due to tears and cracks in the lead. Gloves and aprons can also be tested using fluoroscopic equipment, if available.

X-ray lead aprons, collars, and gloves should be stored unfolded. It is acceptable to leave them on the X-ray table between use, or they may be hung over a round bar. Folding the equipment results in permanent weak lines and cracks and therefore should be avoided.

Gloves should be stored in a vertical position in order to allow air circulation inside the glove. Equipment containing lead should never be machine-washed, but can be safely wiped with hospital disinfectants.

Lead protective equipment is expensive and easily damaged and should never be used to handle fractious animals. A single bite can damage the lead and make the glove virtually useless.

6. If a portable X-ray unit is used, special precautions must be taken to prevent personal exposure. Portable X-ray units must be used only if patient requirements make it impossible for the procedure to be performed with conventional equipment. Personal protective equipment (lead apron and gloves, thyroid shield) must be provided for the operator and any person who assists (whether employee or member of the public).

During the procedure, the X-ray beam must be collimated and must be directed away from occupied areas if possible. Particular efforts should be made to ensure the beam

does not irradiate other persons in the vicinity. Persons in the vicinity should be warned that X-rays are about to be taken, and cautioned to put adequate distance between themselves and the X-ray beam. No one should be standing in the path of the primary beam.

The film cassette must be held in a cassette holder, not by hand. Any person who holds or stands behind a cassette when a radiograph is taken receives direct exposure to the primary beam. The operator must stay at least 3 meters from the X-ray tube and the patient. There must be an electronic timer that allows the operator to take the exposure while standing 3 meters from the source.

7. **Monitor your X-ray exposure using a dosimeter (also called a "monitor" or "badge"**). A dosimeter is a small piece of thermoluminescent material contained in a badge that is worn by each person taking radiographs. The dosimeter records the amount of radiation received by that person.

In Canada, dosimeters can be obtained from the National Dosimetry Services of the Radiation Protection Bureau, Health Canada (800-261-6689, email NDS-SND@hc-sc.gc.ca, website www.healthcanada.gc.ca/nds). Other approved dosimetry service providers include Landauer Inc, (www.landauerinc.com) and Global Dosimetry Solutions (www.dosimetry.com). After a period of use (from two weeks to three months), the thermoluminescent plaque from the dosimeter is returned to the supplier in order that the exposure to X-rays can be measured. Exposure results are returned to the employer and must be made available for all employees to see. The dosimetry service of the Radiation Protection Bureau offers a special service for pregnant radiation workers who wish to monitor their exposure on a biweekly basis.

In Ontario, it is currently recommended that dosimeters should be worn on the outside of the thyroid collar. When reporting the dosimeter type/location to Health Canada, this is referred to as a “Head and Neck” dosimeter. If desired, an additional monitor can be worn under the apron of a pregnant x-ray worker to monitor the exposure to the abdomen.

Every person who is "occupationally exposed to ionizing radiation" (in other words, routinely participates in radiological procedures or may receive a radiation exposure in excess 5 mSv in one year) is required to wear a dosimeter. Each staff member who assists in radiography must have their own dosimeter clearly marked with their name: Ministry of Labour regulations state that shared dosimeters are not acceptable. Some veterinarians use one dosimeter as an area monitor for the radiography room, but this is not required by federal or provincial regulations. Alternatively, an extra dosimeter can be used as a "control badge" to measure background radiation from natural sources. The control badge and personal badges should be kept in a central location outside of the X-ray room[3].

Dosimeters supply several types of useful information. They verify that the maximum permissible dose limit has not been exceeded, and give each employee an exact

measure of their occupational exposure. Comparison of dosimeter readings also allows the veterinarian or employee to detect changes in exposure levels, whether due to poor technique, increased workload, or equipment problems. Dosimeters are sensitive to dosages as small as 0.1mSv (10 mrem): exposures smaller than this are indicated on the report as a dash (-). As previously mentioned, the regulated maximum occupational exposure to X-rays in Ontario is 50 mSv per year for non-pregnant personnel and 5 mSv during a pregnancy.

The Ontario Regulation Respecting X-ray Safety specifies that each radiation worker must have access to their dosimeter readings, and must be specifically informed of unusually high results. The National Dose Registry utilizes the social security number of each individual to compile a lifetime exposure record. Dosimeter reports must be kept by the employer for 3 years.

8. **Periodically monitor the performance of the X-ray machine**. Installation and use of veterinary X-ray equipment is regulated by the Ontario Ministry of Labour's Radiation Protection Service, who enforce Regulation 861/90, respecting X-ray safety under the Occupational Health and Safety Act. The employer, supervisor, and employee of a veterinary facility are each responsible for compliance with these regulations.

Within the veterinary practice, AHTs may be able to do some machine checks on their own, such as ensuring that the collimator corresponds exactly to the radiation field produced by the machine. (This can be done by using lead markers to indicate the edges of the visible light beam that falls on the cassette - the position of the markers should correspond exactly to the edges of the black, exposed part of the X-ray after the picture is taken).

9. **The employer and employees must work together to ensure radiation safety.** Ultimately, the veterinary hospital owner is responsible for radiation safety in their facility. However the employer can delegate some duties to staff. Every practice should have a designated person responsible for radiation safety, the "competent person". This person is designated by the employer, and may be a veterinarian, AHT, or registered radiology technician. This person has responsibility for the following items:

- Equipment: ensuring that the equipment is maintained properly and functions correctly and that maintenance is performed by competent personnel; ensuring that the equipment is used correctly and only by competent personnel ;establishing safe operating procedures for the equipment and ensuring that operating staff are adequately instructed in them; carrying out routine checks of equipment
- Prescribing rules of radiation safety and ensuring that staff are made aware of them
- Ensuring that radiation levels outside controlled areas are below the permissible limits
- Ensuring that the facility complies with regulatory requirements and establishing safe working conditions

- Keeping records of radiation surveys, including summaries of corrective measures recommended or instituted; keeping records of occupational exposures received by personnel
- Declaring which persons are occupationally exposed persons (e.g. likely to receive a radiation dose in excess of 1 mSv per year)
- Organizing participation in a personnel radiation monitoring service (e.g. use of dosimeters)
- Ensuring that all occupationally exposed persons wear personal dosimeters during radiological procedures or when occupational exposures are likely
- Investigating known or suspected cases of excessive or abnormal occupational exposure to determine the cause and take remedial steps to prevent its recurrence
- Ensuring that all safety devices are in good condition and that warning signs are properly located

All medical staff who participate in X-ray procedures must receive training on basic principles of radiation protection. The employer and radiation safety person must ensure that all personnel who assist in radiography are adequately trained in radiation safety, and must ensure that all regulations are followed. Students and inexperienced persons must work under direct supervision of a qualified operator.

10. Special precautions for fluoroscopy. Fluoroscopic equipment emits a continuous stream of X-rays, resulting in "X-ray motion pictures". These are useful in demonstrating dynamic events such as swallowing or cardiac contractions, but there is an increased risk of X-ray exposure compared to conventional radiography. Protective equipment should be worn, and the fluoroscopic beam should be collimated. Hands should never be placed under the primary beam, and manual palpation or manipulation of the area being examined is prohibited. This does not, however, rule out the use of a paddle or similar device.

PART 4 - DEVELOPING X-RAY FILMS

Strangely enough, poor darkroom procedures can lead to excessive exposure to X-rays. If you fail to change chemicals regularly or use the incorrect temperatures and times for developing films, you will be forced to re-take numerous films, increasing your exposure to radiation. Because of this fact, the Canadian federal government has established guidelines for darkrooms in veterinary hospitals (included in Safety Code 28, Health Canada). These can be obtained at www.hc-sc.gc.ca/ewh-semt/pubs/radiation/91ehd-dhm151/index_e.html. These guidelines specify the following:

- The darkroom must be impervious to light, must have an outside warning light or sign when in use and have a lockable door. The dark room must have a means of storing film to shield it from stray radiation.

- The dark room must be of adequate size, with good ventilation (preferably by an exhaust fan that is wired to operate when the safe light is on). It must be equipped with a safelight that is compatible with the type of film used, a sink, and catch pan or film dryer to catch drippings from wet films.

- Veterinarians are required to follow manufacturer's specifications with regard to the use of darkroom chemicals. A common problem is the use of developer that is too old, or which has not been mixed to the manufacturer's recommendations. Or, the developer may not be replenished as recommended. Sometimes, the temperature of the developer may be too low (this can be easily checked with a darkroom thermometer). These problems may occur not only with hand developing, but also with automatic processors. Any of these problems may lead to underdevelopment of the films, which causes the technician to increase exposure settings in order to obtain a readable film. As a result, personnel are exposed to unnecessary radiation. When the developing problem is finally corrected, the technician is sometimes surprised to find that the radiographs now appear very dark, indicating that the settings on the X-ray machine have been raised to excessive levels in order to overcome the poor developing performance. Once the developing problems are addressed, it is often possible to reduce the kVp setting considerably.

- Although strictly speaking not a safety issue, environmental regulations in most areas specify that fixer solutions may not be disposed through a sewer or septic system, unless the silver has been extracted by a silver recovery module. The only other option for disposal of fixer solution is pick-up by a disposal firm for transport to an approved extraction or disposal site.

- Protective equipment must be provided for persons who hand-develop X-rays. This includes gloves, apron, and goggles. As both the fixer and developer used for developing X-rays are classified as WHMIS substances, WHMIS labels must be present and staff must be trained in the safe handling of these chemicals (see the section on WHMIS in Chapter 4 of this manual). Tanks must be covered when not in use.

- A regular maintenance schedule should be established for cleaning and servicing equipment, whether automatic processor or manual processor. Maintenance can be done by an outside agent or by hospital employees. Adequate ventilation and equipment (including goggles and water-proof clothing) must be provided for persons who change chemicals.

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Chapter 3: Radiation Safety

True or False? Circle the correct answer:

1) Ionizing radiation is more harmful than non-ionizing radiation.

true false

2) High power lasers (such as ones used for surgical procedures in a veterinary clinic) must be used in a controlled area where access is restricted to essential personnel while the laser is in use.

true false

3) The most significant hazard associated with laser use is skin burns.

true false

4) Lasers present a potential fire hazard and should not be used in the presence of ether, prep solutions containing alcohol, or other flammable chemicals.

true false

5) Prolonged exposure to video display terminal has been proven to increase the risk of congenital birth defects in pregnant women.

true false

6) Ultrasound machines emit non-ionizing sound waves that pass through tissue but cause no adverse biological effects.

true false

7) The maximum whole body exposure for any person who operates an X-ray machine in Ontario is 20 mSv per year.

true false

8) The most dangerous time for the fetus to be exposed to X-ray radiation is between 0 to 11 weeks after conception.

true false

9) It is OK to hold the cassette by hand when using a portable X-ray machine as long as you are wearing protective clothing and a dosimeter.

true false

10) In Canada, regulations state that any person in the room when veterinary patients are radiographed MUST wear lead lined gloves and an apron unless they stand behind a lead shield?

true false

11) Collimation of the x-ray beam can significantly reduce staff exposure to x-ray radiation.

true false

12) Microwave ovens, X-ray machines, and sunlight are all sources of electromagnetic radiation.

true false

13). X-rays cannot be detected by human senses (sight, hearing, or touch).

true false

14) Exposure to X-ray radiation is potentially more hazardous for adolescents than for adults.

true false

15). Ontario Ministry of Labour regulations prohibit pregnant employees from taking X-rays.

true false

CHAPTER 4 - CHEMICAL HAZARDS

Veterinarians and technicians frequently treat animals that have been poisoned or burned by chemicals such as pesticides, pharmaceuticals and cleaning agents. These same chemicals are handled by veterinarians and hospital employees on a daily basis and may be as harmful to humans as they are to animals. Fortunately, chemical hazards are similar to radiological, biological, and anesthetic hazards, in that anyone can reduce the hazards significantly by taking common sense safety precautions.

Chemical safety is a huge topic, encompassing such diverse subjects as toxicology, WHMIS, first aid, spill clean up, and personal protective equipment. This chapter is intended to be a brief introduction to the field of chemical safety, with emphasis on the hazardous chemicals that veterinary hospital staff are most likely to encounter in the workplace, including pesticides, ethylene oxide, disinfectants, formalin, cytotoxic drugs, and compressed gases (oxygen and nitrous oxide). For more detailed information on specific hazards and protective measures, please consult the references listed at the end of each section or the Ontario Ministry of Labour.

This chapter is divided into 5 parts:

Part 1: Introduction to Chemical Hazards
Part 2: WHMIS
Part 3: Hazard Classes
Part 4: First Aid and Emergency Response
Part 5: Hazardous Chemicals Commonly Used in Veterinary Hospitals

PART 1 – INTRODUCTION TO CHEMICAL HAZARDS

Acute and Chronic Effects of Chemicals

No matter how a chemical enters the body, it can cause two types of problems: acute and chronic. Both the acute and chronic effects of any given chemical are listed on its Material Safety Data Sheet (MSDS). Acute effects are those experienced after a single large dose or exposure (for example, formalin splashing into the eyes) and often result in a trip to a hospital emergency room. Chronic effects are more insidious, as they usually result from repeated small doses absorbed over a long period of time. Chronic effects may not be apparent for years after the chemical exposure, and may be difficult to trace back to any particular chemical or other cause.

Once a hazardous chemical is identified in the workplace, all necessary steps must be taken to reduce employee exposure. If possible, a less harmful chemical should be substituted. If it is impossible to eliminate the use of a hazardous chemical, installation of engineering controls (for example, use of an approved ventilating device for ethylene oxide) is the preferred option. If engineering controls cannot be established, personal protective equipment such as gloves or a respirator must be supplied for each employee who handles a hazardous chemical, and employees must be trained to use the chemical safely.

Chemicals normally enter the body by one of three routes: **inhalation**, **absorption following eye or skin exposure**, and **ingestion**.

Inhalation

Inhalation of chemical vapours or dusts may cause immediate or long-term damage to the respiratory tract and lungs. Some of the more obvious sources of hazardous vapours in a veterinary hospital include ethylene oxide (a gas used to sterilize surgical instruments and other equipment), anesthetic gases, ether, x-ray developing chemicals, and formalin. Potentially toxic vapours may also be given off by items that seem innocuous, including correction fluid such as Liquid Paper, marker pens, and photocopy machine toner.

Hazardous vapours and dusts affect the body in several ways.

-Many chemicals give off vapours that may directly irritate the eyes and respiratory tract. One example is formaldehyde vapours, which may cause watery eyes, coughing, and shortness of breath.

-Some vapours may be absorbed from the lungs, enter the bloodstream, and affect internal organs. An example is ethylene oxide gas.

- A few gases (for example, pure nitrous oxide) can cause asphyxiation if oxygen is unable to reach and bind to hemoglobin in the red blood cells.

There are two important ways to protect yourself from inhalation of injurious gases, vapours and dusts: (1) increasing ventilation and (2) wearing protective equipment.

Ventilation

There is less likelihood of injury from chemical vapours if the vapour is diluted with fresh air. Open windows, doors, or fans that direct exhaust outside of the room may be used to increase ventilation in critical areas such as the following:

- a surgical preparation room where patients are masked with anesthetic gases

- a darkroom where chemicals in tanks are used to develop x-rays

- any location where formalin or solvents such as ether or acetone are used

- a barn that is being sprayed with a pesticide or disinfectant

Sophisticated ventilation devices such as biological containment cabinets, fume hoods, and dedicated ventilation systems are available for special purposes such as preparation of cytotoxic drugs and ethylene oxide sterilization.

Protective Respiratory Equipment

If dangerous fumes or dusts are present and ventilation is not adequate, it is necessary to use protective equipment such as respirators. Use of protective equipment is only permitted where prevention or elimination of a hazardous condition is not reasonably practicable, or where the exposure results from temporary or emergency conditions only. The need for respiratory protective equipment is most likely to arise in a veterinary clinic when cleaning up spills of toxic liquids such as x-ray fluids, liquid anesthetics, or ethylene oxide.

Three types of equipment are commonly used to prevent inhalation of toxic vapours or particles: surgical masks, disposable respirators, and cartridge respirators. One of these may be preferred over the others for a given hazard. For example, a **surgical mask** is an effective barrier against some dusts and bacterial spores. **Disposable air-purifying respirators** (obtainable from safety supply companies and hardware stores) are designed to screen out a specific substance such as dust, nuisance odours, hot air, or chlorine mist.

Surgical masks and disposable air-purifying respirators do not offer effective protection against gases such as ethylene oxide or waste anesthetic gas: and in this case a reusable **cartridge respirator** may be required. Like a mask, a cartridge respirator is worn over the face, and the wearer breathes only air that has passed through the respirator filters. Most filters use activated charcoal as an absorbing agent. For some highly toxic chemicals and infectious agents (very pathogenic bacteria or viruses) a high-efficiency particulate absolute (HEPA) filter cartridge must be used. A HEPA filter removes 99.97% or more of particles with a diameter of 0.3 microns or more from the inspired air.

Cartridges designed for use with chemicals are assigned a colour designating the type of contaminant they will filter: white for acid gas, black or yellow for organic vapours, green for ammonia gas, orange for dust, fumes and mists. An organic vapour cartridge respirator (yellow or black) is adequate protection against anesthetic gases and most chemicals used in the clinic.

Cartridge respirators can be obtained at a reasonable cost through safety supply catalogues, safety supply outlets, and some hardware stores. Reusable respirators come with breathing cartridges and/or filters that must be changed after extensive use. As a general rule, cartridges should be changed if odours are detected when the respirator is worn, or after cleaning up an extensive spill.

Any person who uses a respirator must be given instruction on its proper use and its limitations. Cartridge respirators should be fitted and tested for each employee. The instructions that come with the respirator should be consulted for detailed information on these topics.

Oral ingestion

It is unlikely that a veterinary clinic employee would knowingly eat or drink a hazardous chemical, however there is a potential to ingest these materials if you smoke, eat, or drink while handling chemicals.[1] Ingestion of harmful materials not only irritates the gastrointestinal tract but may also lead to absorption of the material and resultant spread throughout the body. Nursing mothers who are exposed to toxic chemicals such as pesticides should be aware that these once chemicals enter the body, they may be excreted in breast milk.

To prevent accidental ingestion of chemicals, food and drinks should not be stored in close proximity to chemicals, or in a refrigerator that is used for chemical storage. Food or other items that are suspected to have been contaminated by a chemical spill or splash should be discarded. Hands should be washed immediately after handling

[1] Smoking not only creates the risk of chemical ingestion, but may also lead to fire or explosion. Smoking should not be permitted in areas where oxygen, nitrous oxide, flammable liquids, pesticides, ethylene oxide, and other chemicals are stored or used.

chemicals, and both the hands and face should be washed again before eating. As with biological materials, many chemicals can be removed by washing with soap and water. If an employee routinely handles chemicals in the workplace, it is a good idea to shower and change clothes when arriving home from work.

Absorption

Absorption of chemicals such as pesticides through the eyes, mucus membranes, or skin is very common. Some chemicals may be absorbed through intact skin, or (more commonly) they enter through a rash, skin puncture, or wound.

One obvious effect of chemical absorption is local irritation and tissue damage. The eyes are particularly sensitive to chemicals, as is evident to anyone who has splashed formalin or x-ray fixer into their eyes. The skin, although less sensitive than the eyes, may also be irritated by chemicals, and the use of concentrated disinfectant solutions and other chemicals may lead to skin rashes and even allergic dermatitis.

Some chemicals can be are absorbed through the skin or mucus membranes, enter the bloodstream and be distributed throughout the body. This phenomenon is familiar to anyone who has applied DMSO without wearing gloves, and has shortly after perceived a garlic taste in their mouth. Once present in the tissues, chemicals may affect almost any organ, including the brain, heart, liver, kidney, reproductive tract, immune system, and bone marrow. Some chemicals are teratogenic (cause birth defects), carcinogenic (cause cancer) and/or mutagenic (cause chromosomal mutations, leading to increased risk of birth defects in future offspring).[2] Some of the chemicals used in veterinary hospitals (in particular, ethylene oxide and cytotoxic drugs) have the potential to cause multiple adverse effects including local inflammation, internal organ damage, chromosomal changes, and increased risk of miscarriage and/or cancer.

Protective Equipment used to prevent absorption or ingestion of toxic materials

Many types of personal protective equipment (PPE) can be used to prevent absorption of toxins. Simply wearing a lab coat may be sufficient when working with chemicals that have low toxicity (for example, diluted hospital disinfectants). Long sleeved shirts and pants offer more protection than short-sleeved shirts and shorts. Similarly, conventional shoes offer more protection than open-toed shoes and sandals. If significant exposure is expected (for example, when cleaning up a chemical spill)

[2] Obviously, birth defects and cancer may arise from many causes other than exposure to chemicals. Birth defects most commonly occur if a teratogen is ingested between 25 and 35 days after conception, although some risk is present from 21 days to 90 days of pregnancy. The most common teratogenic effects include low birth weight, mental retardation, and functional deficits.

rubber boots and a rubber or plastic apron should be worn.

It is sometimes advisable to wear hand protection when using chemicals. This is particularly true when working with concentrated solutions, as they have more potential for harm than diluted solutions. Gloves should be worn if there is any risk of hand contact with formalin, carbon dioxide absorber (soda lime or bara lime), pesticides, concentrated disinfectants, liquid anesthetics, chemicals used to fix and develop x-ray films, and cytotoxic drugs.

Many types of glove materials are available, including latex, nitrile, neoprene, butyl, PVC, and PVA. Disposable latex gloves are available in every veterinary hospital and provide adequate protection against most infectious organisms and mild chemicals. One disadvantage of latex gloves is the fact that they are easily torn or punctured, and double gloving is helpful in preventing exposure in the event that a tear develops in the outer glove. Surgical gloves should be used only for a limited time period and are not intended for complete immersion in chemicals.

Although more expensive than latex, nitrile gloves are a good choice for general duty work with most chemicals and can also be used in place of latex gloves by persons with latex allergy. Nitrile is a synthetic rubber material that offers better protection against chemicals than latex, as they are generally thicker than latex gloves and offer more resistance to puncture and immersion. Thin, disposable nitrile gloves are also available for fine detail work. Nitrile gloves have an odour that is offensive to some people.

Vinyl gloves (either polyvinyl chloride - PVC, or polyvinyl alcohol - PVA) have special applications. PVC gloves can be used with most acids and petroleum hydrocarbons, whereas PVA is an excellent glove for handling organic solvents. Other than these special indications, vinyl gloves are not useful for work with most hospital chemicals or biological agents and it is often difficult to obtain a good fit.

No one glove is suited for all hospital uses. For information on whether or not a particular glove offers adequate protection against a hospital chemical, check the Material Safety Data Sheet provided with the chemical.

Unfortunately, gloves do not always provide full protection, as some chemicals (particularly acids and solvents) can penetrate gloves or may be splashed onto skin and clothing beyond the glove margins. Protective creams can be worn under gloves or on their own, and are helpful in preventing skin contact with irritating substances. Hands should always be washed immediately after removing gloves.

Gloves are a limited use item and should be replaced after prolonged use or chemical exposure. Gloves should be inspected before use and discarded if the glove material is cracked or discoloured.

Almost all chemicals are harmful if splashed or sprayed into the eyes, and in situations where an eye splash may occur it is advisable to wear safety goggles or a

face shield. Goggles should always be worn when pouring or handling concentrated pesticides and disinfectants, chemicals used to develop x-rays, and cytotoxic drugs.

Exposure to vapours, dusts, and liquid chemicals may be irritating to persons who wear contact lenses. Contact lenses may increase the damage caused by any chemical that is splashed into the eye by trapping the material next to the cornea. Persons who wear contact lenses should notify their co-workers of this fact, so a co-worker giving first aid will know to remove the contact lens if the eye is splashed or injured. Once removed under these circumstances, contact lenses should not be worn again until a physician is consulted.

Labels

The key to safety when working with chemicals is **familiarity with the chemical you are using and the type of hazards it presents**. It is no coincidence that the basic principle behind the Workplace Hazardous Materials Information System (WHMIS) is education of employees. Every person needs to know what they are handling, how dangerous the material is, and how they can protect themselves from injury.

Since information is the key to protection, it is obvious that labels are a fundamental key to chemical safety. All containers of potentially hazardous chemicals should bear labels giving the name of chemical and a brief description of the dangers associated with handling it. (Often this information is indicated by a hazard symbol - see Part 3 of this chapter) Labels should be replaced when they start to peel off or become illegible. Persons handling a chemical should always take the time to double check the label before opening the container, in the same way that persons handling pharmaceuticals should double check the label before dispensing a drug. If the chemical is unfamiliar, the label should be consulted for information on safety hazards and protective equipment that should be worn. If the label doesn't give the particular information that you need, the MSDS for that chemical should be consulted.

When a chemical is diluted or transferred to another container, this container must be identified by a new label. This is particularly important if the new container is to be used by several people or over several days. If the chemical falls under federal WHMIS regulations, the label must contain specific information about the hazards associated with it (see Part 2 of this chapter, on WHMIS).

Storing Chemicals

Care should be used when choosing a place to store chemicals. The following guidelines may be useful in selecting storage areas in the clinic:

1. Separate storage areas should be used for each group of hazardous chemicals, including strong oxidizers (peroxides), flammable liquids, acids, alkalis, and

compressed gases.

2. Storage areas should be tidy, with good access to all materials without climbing over boxes or reaching over bottles.

3. Hazardous chemicals should not be stored in passageways, aisles, hallways, or next to emergency exits.

4. For any hazardous chemical, it is wise to purchase the smallest quantity that is needed, as there will be less material to spill or catch fire.

5. Some type of absorbing agent, such as kitty litter, should be readily available for use in cleaning up spills. If a spill occurs, it should be cleaned up immediately. Appendix 4 outlines a spill clean-up protocol for spills of both chemical and biological materials.

6. Corrosive chemicals should not be stored above shoulder height, as accidental dislodgement of the container could result in chemical splashing onto a person below. Storage in a closed cupboard at floor level is preferred.

7. Flammable materials (ether, acetone) and compressed gases (oxygen, nitrous oxide or nitrogen tanks) should not be stored where there is a possibility of exposure to heat, sunlight, or a source of combustion, including cigarettes.

8. All containers should have a purchase and expiry date written on the label or box, and stocks should be reviewed at least annually. Expired or deteriorated chemicals should be discarded or returned to the supplier.

9. Caps should be immediately replaced on chemical bottles after use.

Diluting and mixing chemicals

Many accidental exposures occur when chemicals are diluted with water or mixed with other chemicals. As a general rule, chemicals should not be mixed together unless the label or material safety data sheet states that the chemicals are compatible. One example of incompatible chemicals is bleach and ammonia-containing disinfectants. Mixtures of these two compounds can release chlorine gas, which is extremely hazardous.

If a material is to be diluted with water, it is always a good idea to start with the water, and to gradually add the chemical to it. That way, if the solution is spilled or reacts, the employee is more likely to be splashed with water or diluted chemical, rather than the chemical in concentrated form.

Disposal of Chemicals

Disposal of chemicals is often a problem, as many cannot be safely (or legally) mixed with regular garbage or poured down the drain. Landfills usually will not accept materials that are:

- ignitable (can easily start on fire)
- corrosive (dissolve metals or skin)
- reactive (unstable)
- environmental contaminants (for example, x-ray fixer, pesticides, cytotoxic wastes).

For each of these types of waste, there are four options for disposal: recycling, return to the manufacturer, transport to an approved disposal site, or treatment in the hospital to make the waste safe for disposal with regular garbage.

The MSDS (material safety data sheet) should be consulted to determine correct disposal options for any particular chemical. Municipalities often have regulations that govern disposal of chemicals and should be consulted for further information.

Packaging of waste materials is important. Waste materials such as solvents, oils, grease, paints, and other flammable substances should be placed in covered metal containers prior to disposal. Broken glass must be clearly identified and placed in a puncture-proof container. Broken medical glass (for example, vacutainers containing blood) should be discarded in a sharps container.

Although small amounts of some liquid chemicals may be discarded into the sewer system and flushed with copious amounts of water, this is not a good option for chemicals that can damage sewer pipes, or chemicals that are an environmental hazard. For example, x-ray fixer contains silver and should not be discarded down a sink or drain.

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PART 2 – WHMIS

In 1987, the Canadian federal government introduced the Workplace Hazardous Materials Information System (WHMIS). The federal regulations are supplemented by provincial legislation in Ontario. This legislation requires that every person who handles potentially dangerous materials ("controlled products") must be informed of the nature of the chemicals they work with, the hazards that are present, and how to protect themselves by safe handling, storage, and use of the chemical. They must also be familiar with spill cleanup procedures appropriate to the chemical and provided with the protective equipment necessary for the safe use and cleanup of chemicals used in the workplace. Appendix 6 gives details on how WHMIS applies to a veterinary workplace.

The information that the employee needs is accomplished through the use of WHMIS labels, material safety data sheets (MSDS) and employee training. Training should be required for all staff who are potentially in contact with controlled products and should be developed in consultation with the worker safety representative or hospital safety committee. The training program should have 2 parts: education of staff about the general principles of WHMIS, and specific training in safe work procedures for handling, storing, and disposing of controlled products used in the veterinary workplace.

The fundamental purpose of WHMIS is to give employees adequate knowledge and equipment to perform their jobs safely. This requirement is not unique to WHMIS materials: the employer must ensure that staff understand how to safely handle and store **all** of the chemicals and other materials that they handle, not just the WHMIS items. Similarly, the employer must supply all necessary protective equipment, not just for WHMIS chemicals but for any chemical in the hospital that may pose a hazard to staff.

Because these controlled products are deemed to be potentially hazardous, WHMIS legislation requires that supplier labels, workplace labels, and material safety data sheets (MSDS) be provided by the manufacturer and/or the employer. There is also a requirement that employees understand what WHMIS is and how to read the labels and MSDS.

Given that proper training and adequate protective equipment are mandatory not just for WHMIS materials, but for all materials in the hospital, what is different about a WHMIS controlled product?

A chemical is designated as a controlled product subject to WHMIS regulations if it falls into one or more of the following hazard classes:

Class A Compressed gases (gas cylinders, including oxygen, nitrous oxide, nitrogen)

Class B Flammable and Combustible Material

Class C Oxidizing Material

Class D Poisonous and Infectious Materials (examples include glutaraldehyde, formalin, ethylene oxide, methanol and solutions containing methanol such as cold sterile fluid and common lab stains, isopropyl alcohol, bleach, ether, acetone, photocopy toner, x-ray fixer and developer)

Class E Corrosive Materials (carbon dioxide absorber in anesthetic machines, sodium hydroxide)

Class F Dangerously Reactive Materials

Certain materials are currently exempt from federal WHMIS legislation. These include pesticides, pharmaceuticals (both over-the-counter and prescription drugs) vaccines, most disinfectants and soaps, household items purchased in "consumer quantities" (e.g. in a container available at a store, such as drain cleaner, toilet bowl cleaner, window cleaner, hydrogen peroxide, and aerosol cans), office supplies such as correction fluid and marker pens, cosmetics, and medical devices. The employee must be trained in safe use of these and any other materials used in the veterinary clinic, however there is no requirement for a WHMIS label or MSDS.

WHMIS regulations have considerable impact on veterinary hospitals because they apply to many commonly used items, including isopropyl alcohol, oxygen, and formalin. For this reason, each of the three mandatory requirements for WHMIS chemicals (supplier labels, workplace labels, and MSDS) will be presented in some detail in this section.

WHMIS REQUIREMENT # 1: WHEN A WHMIS MATERIAL IS SENT TO THE HOSPITAL BY A SUPPLIER, IT MUST HAVE A SUPPLIER LABEL.

The purpose of a supplier label is to alert employees to potential hazards associated with handling a controlled product. The manufacturer must either put the label on the container or send it loose in the shipping box, to be applied when the container reaches its destination. Supplier labels can be recognized by their distinctive outside borders, which have diagonal stripes (see Figure 1 on the next page). This "supplier label" must contain specific information about the substance, including the name of the chemical, the symbol for the hazard class that it belongs to (compressed gas, corrosive chemical, etc...), phrases that describe the risks associated with handling the material, precautions for safe use, first aid instructions, and the statement that a "Material Safety Data Sheet" or "MSDS" is available. If the chemical is purchased in a container of 100 ml or less or is a laboratory chemical, some requirements are waived.

Since it is the responsibility of the supplier, not the hospital, to prepare the supplier label for any given chemical, hospital staff normally don't have to worry about making these labels unless the hospital manufactures or imports a chemical for sale (in which case the hospital has become a "supplier").

Figure 1

Example of a Supplier Label

If a WHMIS substance arrives without a supplier label, the supplier should be contacted with the request that they send one immediately. If the supplier label is lost or becomes unreadable, it can be replaced with a workplace label (described below) until a new supplier label can be obtained.

WHMIS chemicals do not need to have a supplier label if they are purchased in small consumer quantities from a department store, hardware store, grocery store, or any other outlet that is used by the general public. However, the same chemical when supplied in bulk by a veterinary supply company is subject to all the regulations. This means, for example, that a 200 ml bottle of isopropyl alcohol that is purchased at a drug store does not need to have a WHMIS label or an MSDS, whereas a four liter container of isopropyl alcohol that is ordered from a veterinary supplier **DOES** need to have a supplier WHMIS label and an MSDS. The chemical is the same, but in one case it is exempt from the federal regulations and in the other case it is regulated.

WHMIS chemicals obtained from a laboratory supply house and intended to be used in a hospital laboratory may not need a full supplier label. In this case, the supplier may apply a simpler label which identifies the product, gives appropriate risk phrases and handling precautions and indicates that an MSDS is available.

WHMIS REQUIREMENT # 2: WHEN A CONTROLLED PRODUCT IS REMOVED FROM ITS ORIGINAL CONTAINER AND PUT INTO A NEW CONTAINER, A WORKPLACE LABEL MUST BE PLACED ON THE NEW CONTAINER.

Obviously, if a WHMIS material is taken out of its original container, the supplier label on that container is no longer helpful. It is therefore necessary that an employee make up a "workplace" label for the new container. For example, methanol used for cold sterile solutions is a WHMIS substance and arrives from the supplier with a WHMIS supplier label. If methanol is poured out of its original container into a cold sterile tray, a workplace label should be affixed to the tray. Workplace labels must give the name of the product, the statement that an MSDS is available, and brief precautions on safe handling.[3] These precautions are usually similar to those on the supplier label, but may be more succinct, for example "AVOID EYE CONTACT", "DO NOT INHALE", or "WEAR GLOVES". There is no firm guideline as to what information should be on the workplace label, but suggestions for precautions can be obtained by reading the Material Safety Data Sheet and supplier label.

The workplace label can be replaced by information written directly on the container using a permanent marker. Placards may also be used.

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[3] Alternatively, a hazard symbol may be used in place of handling precautions, providing the employees have been trained to recognize the hazard symbols and know the appropriate precautions to take with each hazard class. This information is given in Part 3 of this chapter.

Workplace labels are not necessary if the chemical is to be used by the same person who took it out of the original container, within the same shift. For example, if an employee makes up a solution of bleach (a WHMIS material) and water to clean out a kennel contaminated with parvovirus, it isn't necessary to make a workplace label for the cleaning bucket, provided the cleaning is done by that person alone, and all remaining solution is discarded by the end of the day.

In the case of chemicals used for laboratory analysis (for example, a bottle of crystal violet used for a Gram stain, or stain used for blood slides), the regulations are slightly different. If the material is transferred to another container, a workplace label is not necessary, provided the new container is identified through a combination of any means of identification and worker education, such that the employees understand where to obtain more information about the product if needed.

Pipes containing controlled substances (for example, oxygen) do not require a workplace label but should be identified by a placard or coding system using colours, numbers, or letters, providing all the employees understand the coding system.

Sometimes it is difficult to know which materials require a workplace label. As a rule of thumb, if the material came in a container with a supplier WHMIS label, a workplace label should be applied if the material is put into a new container. Ordinary paper can be used for the labels (provided it sticks to the container) or special WHMIS labels can be purchased from safety supply companies and outlets (see under "Safety" in the Yellow Pages or contact a safety outlet such as Lab Safety Supply. (www.labsafety.com).

WHMIS REQUIREMENT # 3: THE SUPPLIER MUST PROVIDE MATERIAL SAFETY DATA SHEETS (MSDS) FOR ALL CONTROLLED PRODUCTS.

Material safety data sheets (MSDS) give details on the hazards associated with each chemical. An MSDS is valid for three years, after which time the supplier should send a new MSDS with the next shipment.

An example of an MSDS is given in Figure 2 on the next page.

Each MSDS has at least 9 sections:

1) General information. This section lists the product, manufacturer or supplier, contact information in case of an emergency, and the product's intended use.

2) A list of all hazardous ingredients. For example, the list of hazardous ingredients in the X-ray developer given in Figure 2 includes hydroquinone, potassium hydroxide, sodium metabisulfite, and sodium metaborates, each of which is described separately on the MSDS for "x-ray developer".

Figure 2

MATERIAL SAFETY DATA SHEET

SECTION 1 - General Information

PRODUCT NAME **T2 Automatic X-Ray Developers Concentrate, Part 1**

PRODUCT USE Photographic solution — HMIS SCALE HEALTH 1 FLAMMABILITY 0 REACTIVITY 0 PPE C

SUPPLIER White Mountain Imaging

ADDRESS P.O. Box 216 Salisbury NH 03268

CATALOG # 4010D, 4010D-ADM, 4010D-AG, 4010D-DP, 4010D-EX, 4010D-LA, 4010D-MR, 4010D-MV, 4010D-UM, 4200D, 4200D-LA

PHONE NO **603-648-2124** EMERGENCY TEL # **CHEMTREC 800-424-9300**

SECTION 2 - Product and Hazardous Ingredients Information

HAZARDOUS INGREDIENTS	CAS NUMBER	W/W %	Permissible Exposure Limit	LD50	LC50
Water	7732-18-5	60-70	not listed	42.6 gm/kg	not available
Sodium metabisulfite	7681-57-4	5-10	NIOSH TWA 5 mg/m3	2000 mg/kg	not available
Hydroquinone	123-31-9	5-10	OSHA TWA 2 mg/m3	320 mg/kg	not available
Potassium hydroxide	1310-58-3	2-6	NIOSH (C) 2 mg/m3	365 mg/kg	not available
Sodium metaborates	12179-04-3	2-6	NIOSH TWA 1 mg/m3	not available	not available

SECTION 3 - Hazards Identification

EFFECTS OF ACUTE EXPOSURE TO PRODUCT

Harmful if swallowed. May cause burning or irritation of eyes and mucous membranes. May cause mild skin irritation and or allergic reaction. Prolonged inhalation of vapors may be irritating and cause headaches

EFFECTS OF CHRONIC EXPOSURE TO PRODUCT

None known

SECTION 4 - First Aid Measures

SKIN CONTACT

Wash exposed skin thoroughly with soap and water. If irritation persists seek medical advice.

EYE CONTACT

Flush eyes with water for 15 minutes. Seek medical advice if symptoms persist.

INGESTION

DO NOT induce vomiting. Seek medical attention immediately.

INHALATION

If inhaled, remove to fresh air.

SECTION 5 - Fire Fighting Measures

FLAMMABILITY YES [ ] NO [X] IF YES, UNDER WHAT CONDITIONS

MEANS OF EXTINCTION

As needed to extinguish adjacent fire source.

FLASHPOINT (°C) AND METHOD	UPPER FLAMMABLE LIMIT (% BY VOLUME)	LOWER FLAMMABLE LIMIT (% BY VOLUME)	AUTOIGNITION TEMPERATURE (°C)
Not appropriate	Not appropriate	Not appropriate	Not appropriate

HAZARDOUS COMBUSTION PRODUCTS	EXPLOSION DATA SENSITIVITY TO IMPACT	SENSITIVITY TO STATIC DISCHARGE
See "Hazardous Decomposition Products".	Not susceptible	Not susceptible

SECTION 6 - Accidental Release

Flush to sewer with plenty of water, if permitted. If not, soak up with dry absorbent material. Consult with **governmental regulatory** agencies for appropriate disposal of this material. Wear appropriate protective equipment.

SECTION 7 - Handling and Storage

Read and follow the label, material safety data sheet, and instructions before using. Avoid any contact with skin and **eyes. Keep** container tightly closed. Avoid incompatible substances. Wash thoroughly after handling this product

SECTION 8 - Exposure Controls

VENTILATION Good general ventilation.

SKIN Latex or nitrile EYE Splash goggles RESPIRATORY Not normally required

OTHER Eye wash station

SECTION 9 - Physical and Chemical Properties

PHYSICAL STATE	ODOR AND APPEARANCE			ODOR THRESHOLD
Liquid	Clear, off-white to pale yellow liquid			Not available
VAPOUR PRESSURE (mmHg)	VAPOUR DENSITY (Air = 1)	EVAPORATION RATE(Water = 1)	BOILING POINT (°C)	FREEZING POINT(°C)
< 17 mm Hg	0.6 mm Hg	Not available	≥ 212°F	≤ 32°F
pH	SPECIFIC GRAVITY	SOLUBILITY IN WATER (20°C)	COEFF WATER OIL	PERCENT VOLATILE (BY VOLUME)
10.60	1.270	Complete	Not available	Not available

SECTION 10 - Stability and Reactivity Data

CHEMICAL STABILITY YES [X] NO [ ] IF NO, UNDER WHAT CONDITIONS

INCOMPATIBILITY WITH OTHER SUBSTANCES IF YES, WHICH ONES? YES [X] NO [ ] Strong oxidizing agents and strong acids

REACTIVITY, AND UNDER WHAT CONDITIONS Stable under ambient pressure and temperature.

HAZARDOUS DECOMPOSITION PRODUCTS None

SECTION 11 - Toxicological Information

EXPOSURE LIMITS	IRRITANCY OF PRODUCT	SENSITIZATION TO PRODUCT	CARCINOGENICITY
None known	Skin: Irritant	None known	Not listed by IARC, OSHA or ACGIH.
TERATOGENICITY	**REPRODUCTIVE TOXICITY**	**MUTAGENICITY**	**SYNERGISTIC PRODUCTS**
Not known	Not known	Not known	Not known

SECTION 12 - Ecological Information

No data available

SECTION 13 - Disposal Considerations

Dispose of this product in accordance with federal, state and/or local laws.

SECTION 14 - Transportation Information

Not regulated for transportation

SECTION 15 - Regulatory Information

SARA: Reportable quantity (RQ) for Hydroquinone 5000 lb, Potassium hydroxide 1000 lb
SARA Section 304, CERCLA Hazardous components - (None)
SARA Section 302,304,313 Hazardous components (None)
Not a controlled product under Canadian WHMIS regulations.

SECTION 16 - Other Information

The information contained in this MSDS is furnished without warranty of any kind. The user should consider this data a supplement to other data gathered and must make an independent determination of suitability from this and other sources to assure proper use and disposal of this material and the health and safety of employees and customers.

PREPARED BY Envision Compliance Ltd. PHONE NUMBER 905-760-1638 January 15, 2005

3) Information on how the MSDS was prepared, and who did it. A telephone number is given in case additional information about the product is needed. (This is listed at the bottom of the second page of the MSDS).

4) Physical data, including information on vapour pressure, boiling and freezing points

5) Fire and explosion hazard, and how to extinguish fires

6) List of incompatible materials and hazardous decomposition products, if any.

7) Hazardous identification, including effects of short-term exposure, long-term exposure, carcinogenicity, teratogenicity, etc..

8) First aid measures in case of exposure

9) Exposure Controls and preventative measures to be used when handling the product. Suggestions are made regarding safe storage and use, spill clean up, protective equipment that should be used, and how waste material should be discarded.

Sometimes the information given in an MSDS is intended for persons handling large amounts of concentrated product and is not very realistic in a veterinary hospital. For example, the MSDS prepared by Canadian Liquid Air for oxygen states that one should wear gloves, safety goggles or glasses, and safety shoes when handling oxygen. Few anesthetists follow this advice when administering oxygen to an animal, as this protective equipment is not necessary when the oxygen tank is safely attached to an anesthetic machine or is chained to a wall inside the clinic. If questions arise on interpretation of information given in an MSDS, it is a good idea to talk to the manufacturer, an occupational hygienist, or Ministry of Labour inspector.

Some of the terminology used in an MSDS may be difficult for a non-chemist to understand - see Appendix 5 for explanations of some commonly-used terms.

The MSDS for some chemicals may be 6 or 7 pages long, and it is obviously not possible (or necessary) for the veterinary hospital employee to have detailed knowledge of every characteristic of each WHMIS chemical used by the hospital. Much of the information is technical and is probably of more interest to fire fighters and occupational hygienists than it is to veterinarians or their staff. However, the information given in the MSDS is very useful if you need to answer a particular question, for example: Can exposure to this material cause birth defects? How do I clean up a spill? What kind of fire extinguisher can be used if this material catches on fire? Do I need to wear gloves when I handle this, and are latex gloves sufficient?

The MSDS is only useful as a reference if every person in the hospital has easy access to it, and WHMIS legislation therefore requires that the MSDS for all of the WHMIS chemicals used by the hospital should be gathered together in a binder and

kept in a place that is readily accessible to all staff. Alternatively, the MSDS may be available through a computer data base, provided this is accessible to all workers at all times. If a spill occurs and an employee wants to know how to clean it up, it is frustrating to have to search through all the papers in the bottom drawer of someone's desk in order to find the MSDS that gives the required information.

If an MSDS cannot be obtained from the supplier, alternative sources such as MSDS data bases on the Internet can be utilized, provided the information is accurate, complete and current. In the case of products sold for laboratory use, a supplier does not have to provide an MSDS if all the following conditions are met: the product has a label that contains all the information that would be required on the MSDS for that product; the product comes from a laboratory supply house; the product is intended for use in a lab; and the individual containers of the product hold less than 10 kilograms.

In the unlikely event that the veterinary hospital is manufacturing a WHMIS substance, the hospital must prepare an MSDS, which must given to each person who buys the product.

Veterinary hospitals frequently receive MSDS for materials that are not covered by federal WHMIS regulations (for example, a pharmaceutical or pesticide). The manufacturers of these materials have chosen to prepare and circulate an MSDS, even though they are not currently required to do so by legislation. If the hospital has received an MSDS and it is not clear whether or not the material falls under the WHMIS regulations, the label on the original container should be checked. If it is a WHMIS substance, there should be a supplier label with a striped border and the label will refer to an MSDS. If there is no striped border and no reference to an MSDS, it is probably exempt from WHMIS requirements but the manufacturer has decided to send an MSDS just in case the hospital needs the detailed information that it provides.

Safety requirements that apply to all hospital chemicals

The three requirements discussed above (supplier label, workplace label, MSDS) apply only to WHMIS controlled products. Other regulations exist that apply to any chemical used in the hospital:

1. PROTECTIVE EQUIPMENT MUST BE PROVIDED: It is the employer's responsibility to provide the protective equipment that is needed for safe handling of any hazardous material, including WHMIS chemicals. For example, the employee must supply gloves for persons who administer pesticide dips, because pesticides are potentially toxic. Other protective equipment and materials that may be necessary for safe handling of chemicals include respirators, face masks or shields, goggles, rubber aprons, boots, eyewash fountains, and spill clean-up kits. In this guide, the protective equipment needed for each of the hazardous chemicals commonly used in veterinary hospitals is outlined in the section on each chemical. The MSDS is also a good source of

information.

2. EDUCATION: WHMIS legislation very clearly makes the employer responsible for employee training. The employer doesn't have to train the employees personally, but must ensure that they somehow acquire sufficient training to handle the materials safely. If an employee handles a WHMIS chemical (for example, formalin), that person must know first of all what it is and that it is hazardous (the supplier label tells you that!). He or she must also know how to handle it safely, how to store it and dispose of it, how to clean up a spill, and what kind of first aid is needed if accidental exposure occurs (for example, splashing in the eyes). This manual attempts to give basic information for chemicals commonly used in veterinary hospitals, but the MSDS for each chemical is a more complete source of information and should be consulted for details.

3. EMPLOYEE RESPONSIBILITIES: The employee has several responsibilities under the WHMIS legislation:

- To use the protective equipment or clothing supplied by the employer
- To report hazards to their supervisor (including damaged or missing labels)
- To work in a way which does not endanger themselves or other workers, by following recommended procedures
- To accept and review information on hazardous materials that they work with.

PART 3 – HAZARD CLASSES

At first, it may seem overwhelming to learn the safety hazards of every chemical used in a veterinary hospital. There is, however, one way to make the job easier - to learn the hazard classes. All WHMIS controlled products fall into at least one of six hazard classes. These classes are:

Class A: Compressed Gases

Class B: Flammable and Combustible Material

Class C: Oxidizing Material

Class D: Poisonous and Infectious Materials

Class E: Corrosive Materials

Class F: Dangerously Reactive Materials

Once an employee becomes familiar with the characteristics of each of the hazard classes, the information can be applied to any chemical in that class. For example, the supplier label on a bottle of sulfuric acid shows a picture of a test tube dripping liquid on

a hand. This is the symbol for Class E, Corrosive materials. All chemicals in this class are corrosive, meaning that skin or eye contact with the material can cause severe tissue damage. It would obviously be a good idea to wear protective equipment (gloves, protective clothing, a face shield) when working with a chemical from this class.

For each WHMIS chemical, the hazard class(es) that the chemical belongs to is identified in 2 ways: it is written on the MSDS, and the hazard symbol is displayed on the supplier label. Some chemicals belong to more than one hazard class and both must be illustrated. For example, the supplier label for an X-ray fixer would likely show two symbols: a test tube pouring material on a hand (this means the substance is Class E - corrosive) and a "T" (this means the substance is Class D Division 2 - toxic).

In order to interpret the hazard symbols correctly, it is necessary to have a good working knowledge of the hazard classes. This section briefly outlines the characteristics of each of the hazard classes. WHMIS regulations require that veterinarians develop written safe work procedures for handling, using, storing, and disposing controlled products. To assist veterinarians in doing this, work practices are included in the sections on each of the hazard classes below.

Class A: Compressed Gases

Class A includes all gases that have been liquefied or compressed under pressure. One familiar example of this class is an oxygen tank. Another example is liquid nitrogen or carbon dioxide, used to hold frozen semen at very low temperatures. Compressed gases are commonly used in anesthesia, welding, in analytical laboratories, and for fast refrigeration of food. Propane and butane fuel tanks are also classified as Class A materials. The symbol for Class A is a gas cylinder enclosed in a circle.

Oxygen, nitrous oxide, nitrogen, and other compressed gases are classified as controlled substances and all cylinders and pipelines should be identified with a supplier or workplace WHMIS label.

Not only are both oxygen and nitrous oxide classified as compressed gases (Class A) but they are also considered to be toxic materials (Class D2). Prolonged exposure to a high concentration of oxygen is unlikely to occur in a veterinary environment, but has been reported to cause cramps, nausea, dizziness, hypothermia, blindness, respiratory difficulties, bradycardia, fainting spells, and convulsions. Prolonged exposure to nitrous oxide is reported to cause dizziness, nausea, and unconsciousness.

Safe work procedures for handling compressed gases: Only trained users should handle or connect gas cylinders. The following precautions should be taken:

1. One significant hazard associated with handling compressed gases is the potential of the gas cylinder to explode. Because the cylinder contents are held under pressure, the cylinder may explode if exposed to heat. For this reason, compressed gas cylinders that are not in use should be stored in a well-ventilated area away from flammable chemicals and hot objects (including radiators, steam pipes, and heating ducts). Compressed gas cylinders should never be subjected to a temperature above 124'F (51'C) as the gas will expand and the cylinder may explode.

2. Cylinders containing compressed gases should be moved and handled with caution, and should never be allowed to drop or fall over. A cylinder carrier should be used to move large cylinders, and the cap should be in place over the regulator when the cylinder is moved.

3. Gas may be suddenly released from the cylinder if it is damaged or knocked over and the regulator (the metal attachments at the top of the tank) or cylinder neck is broken off the tank. If this happens, the force of the gas suddenly escaping from the tank may cause the tank to move like a rocket through a wall or roof. To prevent this occurrence, large cylinders should be chained or belted to a wall and should always be stored in an upright position. Cylinders should never be chained to a portable object such as a chair or surgery table. Small cylinders are best stored upright in bins or racks constructed from a material that will not burn.

4. The flow of a compressed gas should not be directed towards any person, regardless of the nature of the gas. Persons connecting compressed gas cylinders to an anesthetic machine or gas piping system should wear goggles to protect their eyes from jets of gas.

5. Full, partially empty, and empty cylinders should be clearly labelled as such and stored separately. Cylinders should be used in the order in which they are received: first in, first used, first out. Never store a gas cylinder near an emergency exit or in an area with heavy traffic.

6. Oxygen and nitrous oxide are not flammable, however both support combustion. This means that materials that burn in air will burn more vigorously in the presence of pure oxygen or nitrous oxide. For this reason, oxygen and nitrous oxide should never be used in the same room as an open flame. To be safe, no sources of ignition (matches, lighters, lighted cigarettes, Bunsen burners) should be present in any room in which oxygen or nitrous oxide cylinders are stored or used. Easily visible signs with a warning notice (such as GAS CYLINDERS - NO SMOKING) should be posted outside the storage area and inside the storage room itself.

7. Oil, grease, WD 40, and other lubricants should not be used anywhere on an oxygen or nitrous oxide gas cylinder, as these materials will burn and present a real danger of fire or explosion when used in proximity to oxygen or nitrous oxide.

8. Cryogenic (supercooled) gases such as liquid oxygen, nitrogen or carbon dioxide may cause frostbite and therefore direct skin or eye contact should be avoided. Face protection and impervious clothing and gloves should be worn when working around cryogenic liquids. Care should be taken not to overfill the unit, or to tilt the unit such that spillage occurs. Units should be stored and used only in well ventilated areas to avoid suffocation from released gas. It is important to use only the type of liquid gas that the unit is designed to carry. If a cryogenic gas unit requires regular monitoring and re-filling with cryogenic liquid, this should be done only by trained personnel.

Class B: Combustible and Flammable Material

A combustible or flammable material is one that can catch fire in the presence of a spark or open flame under normal working conditions, and is therefore a potential fire hazard. This group includes ether, acetone, alcohols, formaldehyde, gasoline, butane, and other organic chemicals. The symbol for this class is a flame inside a circle.

It is important to differentiate between combustible and flammable materials. Both kinds of materials will burn, but they differ in the temperature required for ignition. A **flammable material** is one that has a "flash point" (the temperature at which vapour from the substance will ignite) less than 37.8'C. This means that fumes or vapours from flammable substances may catch fire even at room temperature, if they are exposed to a spark or static electricity. Some flammable materials may spontaneously burst into flame when exposed to air, or release a flammable gas on contact with water. One example of a flammable material is ether, which was notorious for causing operating room fires in the days when it was used as an anesthetic. Other examples of flammable materials are acetone, isopropyl alcohol, and gasoline. A **combustible material**, in contrast, has a flash point greater than 37.8'C, and the chemical and its fumes will catch fire only if heated above this temperature or exposed to an open flame. Kerosene is one example of a combustible material. Because combustible materials burn only when exposed to relatively high temperatures, they are less easily ignited than flammable materials.

Class B also includes flammable aerosols, which are products packaged in aerosol containers. The product is considered flammable if either the aerosolized product or the propellant may catch fire.

Many combustible and flammable materials, including ether and acetone, are organic solvents and it is tempting to use them as cleaning agents. This is very unwise, as it not only results in skin contact but may also lead to inhalation of vapours. Many of these solvents are central nervous system depressants, and skin absorption or inhalation of vapours may lead to headaches, dizziness, and nausea. Some are toxic to the liver and kidneys, and may cause cardiovascular problems, aplastic anemia, or cancer.

Safe work procedures for handling combustible or flammable materials:

1. Since the major hazard associated with Class B materials is fire, it is recommended that flammable and combustible materials be purchased in small quantities (four liters or less) and stored in a cool, fire-proof cabinet or other secure area. The storage area should be labelled "FLAMMABLE MATERIALS - NO OPEN FLAMES, NO SMOKING"

2. When working with any Class B chemical, use care to keep them away from all sources of heat or ignition, including lighted cigarettes. Store them separately from oxidizers. Never smoke when working with these materials!

3. When handling ether, acetone, xylene, toluene, or formaldehyde, protective equipment including gloves, a lab coat, and safety goggles should be worn. Good ventilation is essential to prevent inhalation of vapours. The MSDS gives more information on hazards associated with specific agents and the type of gloves and other protective equipment that should be worn.

Class C: Oxidizing Materials

An oxidizing material is one that can provide or give off oxygen. Compressed oxygen in a cylinder is an obvious example of an oxidizing material. Another familiar example is hydrogen peroxide, which gives off bubbles of oxygen when it is applied to a wound. Medical grade hydrogen peroxide is a 3% to 5% solution in water and is considered to be a weak oxidizer. Sodium hypochlorite (bleach) and perchloric acid are stronger oxidizing materials. The symbol for this class is an "O" with a flame.

Safe work procedures for handling oxidizing materials:

1. The main hazard posed by oxidizing materials is the increased risk of fire if they come in contact with flammable or combustible materials. Because Class C chemicals release oxygen and heat, they can sometimes cause even inert materials such as wood to catch fire at room temperature. Strong oxidizers may react violently or cause an explosion when in contact with fuels and flammable materials. To prevent this, oxidizing materials should be stored separately from Class B (combustible and

flammable) materials. Store away from heat and avoid smoking and other sources of ignition when working near these materials.

2. Many oxidizing chemicals are caustic and can burn skin and eyes upon contact. It is a good idea to use eye, face and hand protection when handling potent oxidizers.

Class D: Poisonous and Infectious Material

Class D is a large class, and one that is ubiquitous in veterinary clinics isopropyl alcohol, x-ray solutions, glutaraldehyde, and many other chemicals belong to this class. Class D is subdivided into three Divisions according to the type of hazard present. All Class D materials have the potential to cause tissue damage or illness in exposed persons.

CLASS D, Division 1

Materials in Class D Division 1 are potentially fatal poisonous substances. Chemicals in this class may cause immediate and serious toxic effects and possibly death if they are inhaled, swallowed, or contact the skin or eyes. This group includes such poisons as sodium cyanide and hydrogen sulphide. The symbol for this group is the skull and crossbones. Fortunately, Class D Division 1 substances are not normally found in veterinary workplaces.

CLASS D, Division 2

Class D Division 2 includes chemicals that may be harmful, but are not immediately dangerous to health after a single exposure. Examples of Class D Division 2 materials include acetone and asbestos. Many hospital chemicals belong to this division, and are described more detail in Part 5 of this chapter.

Although exposure to Class D Division 2 chemicals is not immediately life-threatening, they may cause death or permanent damage if a person is exposed to them repeatedly. There are many different kinds of toxic effects, including the following:

- Most Division 2 chemicals cause local irritation if splashed onto the skin or eyes
- Many Division 2 chemicals are poisonous and may cause organ damage if inhaled

or swallowed
- Some Division 2 chemicals can induce allergies and are known as "sensitizers"
- Exposure to some Division 2 chemicals leads to an increased risk of cancer, birth defects, or infertility

For each Class D Division 2 chemical, specific information on toxic effects can be found in the MSDS. If, for example, an employee is pregnant and worried about the risk of birth defects when working with a Division 2 chemical, she can find this information in the "Toxicity" section of the MSDS.

CLASS D, Division 3

Class D Division 3 includes materials that are infectious or "biohazardous". Tissue and blood samples containing live viruses or bacteria that may cause serious disease in humans or animals are classified as Class D, Division 3 materials (for example, a fecal sample containing live Salmonella organisms). Fungal and bacterial cultures containing viable organisms are also classified as Class D, Division 3 materials. The symbol for Class D Division 3 is the biohazard symbol, consisting of three interlocking rings. (See Chapter 1 for more information on hazards associated with infectious materials).

Safe work procedures for handling poisonous or infectious materials:

1. Whether they are from Division 1 (the most dangerous), 2, or 3, chemicals and materials in Class D may be harmful when swallowed, inhaled, or when they contact the skin, mucus membranes, or eyes. Use appropriate facilities such as a biological safety cabinet or a fume hood if the toxicity of the chemical requires this type of handling. For less toxic controlled substances, personal protective equipment (such as gloves, a face shield, goggles, and a lab coat or apron) may be necessary. Usually, the supplier label and MSDS will suggest the appropriate equipment and clothing to wear when handling any particular substance. Ventilation is also important, particularly if the material gives off aerosols or fumes that could be breathed by persons working nearby.

2. Wash your face and hands after using a Class D material, even after wearing gloves when handling the material. Class D materials should be stored only in areas designated for this purpose, and never in a cupboard or refrigerator used to store food or drink. They should never be stored in food or beverage containers.

Class E: Corrosive Materials

This class includes acidic, alkali, and other caustic materials that can damage skin and mucus membranes (including eyes) or eat through metals. Hydrochloric acid and sodium hydroxide (used to identify ringworm on hair samples) are examples of Class E materials.

Some corrosive materials produce a toxic mist that can cause irritation or severe damage to the respiratory tract when inhaled. Sulphuric acid mists can even dissolve tooth enamel in persons working nearby. Some corrosive materials can cause serious burns or other illness after a single exposure, whereas others are hazardous only after repeated exposure.

Safe work procedures for handling corrosive materials:

1. When working with corrosive materials, it is wise to keep containers tightly closed and to ensure that these chemicals are stored in a cool, dry, well-ventilated area. The containers should never be stored above eye-level, to avoid a container falling off the shelf and onto a person below. Acids should be segregated from alkalis (bases), as the two may react violently if they are accidentally spilled.

2. When diluting any corrosive substance with water, is it very important to always pour the substance into the water, rather than the water into the substance. This way, you are more likely to be splashed with water than with the chemical, if an accident occurs.

3. Personal protective equipment including eye, face, and hand protection plus a lab coat or coveralls should be worn when handling these materials. Use these chemicals only in a well-ventilated area or when wearing proper respiratory equipment.

4. An eyewash station and (if possible) shower facilities should be available for persons working with corrosive substances, in the event of skin or eye contact.

5. Corrosive materials must be stored in corrosion-resistant containers.

6. If skin or eye contact occurs, flush with cool water for 15 minutes and seek medical attention.

Class F: Dangerously Reactive Materials

Class F materials are very unstable, and undergo dangerous reactions if subjected to heat, pressure, shock, or contact with water. Even a mild increase in temperature may cause these materials to explode. Examples of this class include plastic monomers such as butadiene and some cyanides. Fortunately, members of this class are seldom encountered in veterinary clinics. Only persons with special training should handle these materials.

PART 4 – FIRST AID AND EMERGENCY RESPONSE

Despite the best of precautions (or possibly, because adequate precautions are not taken), accidental exposure to chemicals may occur. The actions you take in responding to an emergency may make the difference between a minor mishap and a tragic accident.

- Plan ahead! During an emergency there is no time to hunt around for a spill kit or eyewash fountain or to learn how to use a fire extinguisher. The hospital employees and staff should identify ahead of time the kinds of emergency that could occur in the hospital and develop appropriate written response procedures. These procedures should be reviewed by qualified persons (for example, the local fire department). Practice use of the equipment ahead of time and conduct emergency drills: these will quickly reveal how well everyone understands the plan!

- At least one person on staff should have a current first-aid certificate, and should be available to direct care of the exposed person. A first aid kid containing bandage material, gauze, scissors, and other supplies should be readily available at all times. The kit should be regularly inspected and restocked as needed.

- Would-be rescuers should not endanger themselves while attempting to help another person. Wear adequate protective equipment (gloves, goggles, respirator) to avoid becoming another victim. If you cannot safely help the person, call for emergency personnel (911, or the local fire department and ambulance).

Eye Exposure

Every veterinary clinic in which corrosive or toxic materials are used should have emergency eye wash equipment or an emergency shower for use by persons whose eyes are splashed with x-ray fluids, formalin, concentrated cleaning solutions, and other toxic liquids . An eyewash fountain that can be fixed to a tap is preferred to a hand-held eyewash bottle, as it supplies copious amounts of fresh water. The fountain must be

located in an easily accessible place adjacent to where the chemicals are used, as the person may be temporarily blinded by the chemical and need to find the eyewash quickly. Note that spray attachments used to bathe animals in tubs are not suitable as eyewashes, as the water pressure is often excessive and the water stream may damage the cornea.

If a corrosive chemical is splashed into the eyes, the affected person should first call for help. Contact lenses, if present, should be removed. If the chemical is a powder, it should be brushed off the area around the eyes. Then, for either powders or liquids, BOTH eyes must be continuously washed for 15 minutes with lukewarm or cold water, using the eyewash fountain or bottle. It is usually necessary to hold the eyelids open during the washing period, otherwise the natural inclination is to close the eyes and keep water away from the cornea. The affected person should not rub or touch the eyes, as this is likely to introduce more chemical. After 15 minutes of continuous washing, the person should seek medical attention. Bring the labelled bottle or the MSDS sheet for that chemical to the hospital with the injured person.

Ingestion

If a corrosive or toxic chemical is inadvertently swallowed, the affected person should seek medical attention immediately. Again, the chemical MSDS sheet or the container label should be sent with the person seeking medical help. If medical help is not immediately available, a poison control center should be contacted for advice. The package and MSDS may be consulted for information regarding inducing vomiting and other first aid recommendations. Vomiting is generally not advised if the person is unconscious, showing signs of seizure activity, or has ingested a corrosive (acid, alkali) or petroleum-based chemical. If vomiting is recommended, hydrogen peroxide (3%) at a dose of 15 ml every 15 minutes can also be used to induce vomiting.

Inhalation

Persons who inhale toxic or corrosive vapours should be immediately brought into a well ventilated place - outdoors is best. Medical attention should be sought at once. If breathing has stopped, artificial respiration must be initiated.

Skin Contact

In case of splashing or other skin contact with a corrosive or toxic substance, all contaminated clothing should be removed and placed in a plastic bag. If the chemical is a powder or other dry material, brush away as much of the chemical as possible (the person doing this should wear gloves). The affected area should then be rinsed with water. For liquid chemicals, immediate water rinse is advisable. If the chemical is not corrosive (for example, isopropyl alcohol) it is usually adequate to wash the exposed area with soap and water. If the chemical is toxic or corrosive (for example, concentrated bleach or formaldehyde) the exposed skin should be flushed with cold

water and soap for 15 minutes. If the exposure is extensive or the material is very toxic (for example, ethylene oxide liquid) the person should be transported to medical attention immediately after the 15 minute flushing period. During transport, the affected area should be covered with a loose clean cloth. Cold packs or ice can be used as necessary to relieve pain.

Fires

Fires are the most common cause of emergencies in small businesses. Many fires could have been prevented by sensible storage of hazardous materials. Do not allow flammable materials such as rags, paper, or empty boxes to collect in storage, as they may catch fire or add fuel to a fire. Do not store combustible materials near oxygen or sources of sparks or flames. Smoking must be prohibited wherever oxygen, nitrous oxide, or combustible materials are stored or used.

All laboratories and veterinary clinics should be equipped with one or more fire extinguishers of a size easily manipulated by the employees. Every employee should know the location of each extinguisher, and how the extinguisher should be used. Different classes of fire extinguisher are designed to extinguish different types of fires (A= paper or wood, B= flammable solvents such as ether or gasoline, C=electrical). A veterinary hospital should have an extinguisher that is effective against a wide range of materials: a dry chemical (ABC) type is often recommended. They should be inspected monthly by a hospital employee or other designated person to ensure that they are properly charged, mounted in their assigned place free of obstructions, and the pin and seals are in place. A qualified person should disassemble and inspect the fire extinguisher annually.

Hospitals, like homes, should be equipped with smoke detectors on each floor (including the basement).

When a fire occurs, the person who detects the fire first should call for help by phoning the appropriate emergency number (for most areas in Ontario, this is "911"). Someone must ensure that all persons in the building are immediately informed of the situation and evacuated as soon as possible. If time allows, oxygen tanks and natural gas lines should be turned off. Evacuation of animals may be possible, depending on the location and size of the fire, but workers should not attempt animal rescues if their own safety would be endangered. Rescued animals can be temporarily confined in cars parked outside the clinic.

If the fire is small and an employee knows how to handle the fire extinguishing equipment, that person may attempt to extinguish the fire immediately. There are two circumstances in which you should NOT attempt to fight a fire: if the fire is spreading beyond the immediate area where it started, or if it could block your escape route.

Obviously, it is difficult for anyone to respond to an emergency such as a fire in an effective manner if they have never had any training or practice. It is a good idea to prepare written emergency procedures and post them in the clinic (for examples of such procedures, see Appendix 4 and Appendix 7). All persons working in a veterinary hospital should undergo fire safety training, including assignment of responsibilities (for example, receptionist calls the fire department, veterinarian attempts to extinguish the fire, technician locates all persons in the building and supervises evacuation of persons and animals). Some provision should be made for an evacuation plan (where are the exits, and what alternative exit should be used if one is blocked?) and a location should be designated where all personnel are to report after leaving the hospital. Every employee must know the location of the fire extinguisher, chemical spill kits and kitty litter, and protective equipment such as goggles, gloves, and a respirator. Every person should have some experience in operating the fire extinguisher, and know the types of fires that it can effectively extinguish.

A local fire marshal or fire station personnel may agree to conduct a complimentary fire safety inspection of a veterinary hospital and recommend improvements in fire safety. They may also be willing to train staff on fire safety (including operation of a fire extinguisher).

CHEMICAL SPILLS

If a chemical spill occurs and there is no danger of fire, the procedure to be taken depends upon the size of the spill and how dangerous the material is. A written clean-up procedure for chemical spills should be posted in the clinic, giving details of the recommended procedures and protective equipment required (see Appendix 4). As with fire response, it is a good idea to conduct training drills for spill cleanup. If an employee is unfamiliar with the procedure for cleaning up a particular chemical, the MSDS should be consulted. The following is a general approach that can be safely used for most spills:

- Commercial spill kits are available for certain materials (flammable solvents, acids, mercury). These kits make clean up both safer and easier to accomplish.

- If the spill involves a small amount of a relatively non-toxic liquid (for example, overturning a bottle of Gram stain), the employee should immediately place a towel, newspaper, kitty litter or other absorbent material on top of the spill. When the liquid is completely absorbed, the absorbent material should be swept up (or picked up using gloved hands) and placed in an airtight, sealed plastic bag for disposal.

- If the spilled material gives off potentially hazardous vapours (for example, a spill of formalin, liquid anesthetic, or bleach), all adjacent doors and windows should be opened to increase ventilation. If a large amount of material is present and toxic fumes are being produced (for example, a whole bottle of halothane is dropped and broken, or

a vial of ethylene oxide is opened and exposed to the room air) all personnel should leave the area at once. A person wearing a respirator may re-enter the room and clean up the mess by first increasing ventilation and then using kitty-litter or other absorbent as described above. If a respirator is not available, or if staff is not trained in its use, the fire department should be contacted.

PART 5 – HAZARDOUS CHEMICALS COMMONLY USED IN VETERINARY HOSPITALS

This section focuses on the potential hazards of chemicals commonly used in veterinary hospitals, including pesticides, darkroom chemicals, disinfectants, formaldehyde and formalin, ethylene oxide, diethyl ether, and cytotoxic drugs. Readers are advised to consult references listed at the end of each section for further information.

PESTICIDES

Pesticides are exempt from WHMIS requirements but are regulated under the federal Pest Management Regulatory Agency of Health Canada (Phone 1-800-267-6325 or see www.hc-sc.gc.ca/pmra-arla).

Any chemical that is used to control pests can be described as a "pesticide". Most pesticides fall into one of 5 classes: rodenticides, fungicides, herbicides, fumigants, and insecticides. Although the introduction of newer and minimally toxic spot-on insecticides such as Revolution and Advantage have greatly diminished the use of hazardous insecticides in small animals, products containing potentially hazardous chemicals such as organophosphates, carbamates, and permethrin are still on the market. Insecticide products also are extensively used in livestock pour-ons, dusts, sprays, aerosols, and backrubbers. These products can be used directly on the animals, or they may be applied to barns and other environments where animals are housed.

Although it is unlikely that a person will show signs of illness after giving a single flea bath, the risk of toxicity increases with exposure. Persons who use pesticides in their own home and garden must also be aware of their non-occupational exposure: rose dust containing 5% carbaryl is similar in composition to some brands of cat and dog flea powder. Because the toxicity of pesticides is additive, it is the TOTAL exposure from all sources that determines the likelihood of toxicity. One recent report estimates that the average U.S. household uses 57 applications of pesticides per year (Grossman, 1995). Not surprisingly, there were over 140,000 accidental human pesticide exposures reported to U.S. poison control centers annually.

Many of the signs of pesticide exposure are subtle and non-specific (nausea, dizziness, headache, fatigue), and it is often difficult to know if a staff member is being

exposed to toxic levels of these drugs. Signs of illness may be mistakenly attributed to heat, stress, fatigue, or the "flu". As with most chemicals, the signs and symptoms of insecticide exposure depend on the absorbed dose, with low doses causing mild signs and higher exposures causing more serious effects. Any person who experiences symptoms suggestive of pesticide toxicity or observes these symptoms in others should contact medical personnel or a poison control center for advice.

Significant exposure may occur when handling or diluting insecticides or when applying them to animals or barns. The following section is a brief summary of the hazards posed by each class of insecticide.

ORGANOPHOSPHATES (malathion, coumaphos, fenthion, dichlorvos) and CARBAMATES (carbaryl) The site of action of organophosphate agents is the nervous system, as they inhibit acetyl cholinesterase, the enzyme that degrades the neurotransmitter acetyl choline. Carbamates are similar to organophosphates, however carbamates reversibly inhibit acetyl cholinesterase, whereas the inhibition of this enzyme by organophosphates is not reversible. There are hundreds of chemicals that may be classified as organophosphates or carbamates, with a wide range of toxicity and duration of effect.

As a group, organophosphates are considered to have a narrow margin of safety, and "even the least toxic of this group is easily capable of poisoning humans when used improperly" (Adams, 1990). Organophosphate and carbamate insecticides can be absorbed through intact skin.

Persons suffering from acute organophosphate or carbamate poisoning may show a multitude of clinical signs, all due to inhibition of acetyl cholinesterase and subsequent overstimulation of the central nervous system, skeletal muscles, and/or the parasympathetic nervous system. Signs of illness may include vomiting, salivation, lacrimation, nausea, cramps, diarrhea, sweating, muscle weakness, twitching, blurred vision, restlessness, headache, dizziness, fatigue, chest tightness, vision disturbance, loss of appetite, wheezing, nasal discharge, confusion, and slurred speech. If exposure is sufficient, death may occur from suffocation (resulting from bronchoconstriction, paralysis of the diaphragm, and failure of the respiratory center in the medulla). Treatment of affected persons includes washing the skin with mild soap and water in cases of skin exposure, removal of contaminated clothing, and administration of atropine and/or palidoxime (2-PAM).

Exposure to toxic levels of organophosphates is probably not as rare in veterinary practice as one would like to believe. One survey of large animal veterinarians who used pour-on organophosphates to treat cattle grubs reported that many practitioners experienced headache, nausea, dizziness, and irritation of the nose and throat, particularly when these products were used in a poorly ventilated location (Beat and Morgan, 1977). None of the veterinarians reported accidental or unusual exposure to the pour-on preparation, and the authors concluded that these symptoms occurred after normal, routine use of the insecticides.

Recently, attention has also been focused on health problems associated with chronic exposure to organophosphates and carbamates. There is a growing body of evidence that suggests that adverse health effects may occur after frequent use preparations that contain only moderate concentrations of organophosphates. An "intermediate" syndrome of neurologic symptoms may develop one to four days after acute exposure to organophosphates, and may include muscle palsies of the facial, neck, limb, and respiratory muscles. Duration of the muscle weakness is variable but many exposed persons recover within 3 weeks. Long-term exposure to organophosphates may cause subtle behavioral effects for weeks to months after exposure, including decreased mental alertness and intellectual functioning, poor neuromuscular control, sleep disorders, memory loss, and psychotic, schizoid, and paranoid reactions (Bukowski, 1990). One 1995 study of sheep farmers who used sheep dip containing organophosphates found them to have slow reaction times, poor short-term memory, difficulty on reasoning tests and problem solving, and an increased incidence of psychiatric disorders compared to farmers who were not exposed to organophosphates.

Unfortunately, there is little evidence to show what level of exposure is "safe" for individual organophosphate agents. As with waste anesthetic gases, it is wise to minimize exposure as much as possible.

Other insecticide classes are generally less toxic than organophosphates, but may nevertheless cause significant health problems. ORGANOCHLORINES such as DDT have been almost entirely removed from the market in North America for environmental or health reasons. A few agents are still in use, including lindane and methoxychlor. Signs of acute toxicity include irritability, headache, dizziness, nausea, tingling lips, and (if exposure is sufficient), convulsions. Organochlorines may be stored for long periods of time in body fat, and long after exposure may be excreted in breast milk. Some organochlorines are known to be carcinogenic.

PYRETHROIDS and other botanicals such as d-limonene, pennyroyal, oil of citronella, melaleuca oil ("tea tree") and rotenone are derived from natural sources such as plant oils and flowers. Despite the "natural" origin of botanicals, many have significant toxicity.

Pyrethrins are extracted from plants that are closely related to ragweed, and contact dermatitis and allergic reactions (wheezing, shortness of breath) have been reported in persons who handle raw pyrethrum. Fortunately, these symptoms appear to be much less common in persons who handle refined pyrethrum (the form that is found in insecticides). Contact allergies to d-limonene and melaleuca oil have also been reported.

Pyrethroids such as permethrin are synthetic pyrethrins that are generally more effective than natural pyrethrins. Permethrin is widely used for tick, flea and lice control in dogs (Defend and other products) and as a general insecticide in livestock. It is toxic to cats and may be lethal to some fish and aquatic insects at a concentration of less

than one part per billion. Like other pyrethroids it is a neurotoxin, and toxic ingestion in humans is associated with tremors, incoordination, elevated body temperature, increased aggressive behaviour, and disruption of learning. It has been classified as a carcinogen by the US Environmental Protection Agency as it causes lung and liver tumours in mice and is known to cause chromosome aberrations in human and hamster cells. It is also irritating to the eyes and skin.

Exposure to melaleuca oil may cause contact allergies, mental depression, weakness, and incoordination. Rotenone is reported to cause reproductive problems in pregnant lab animals, including increased incidence of babies born dead, and reduced maternal and fetal weight gains.

DEET (found in most mosquito and other insect repellents) has been reported to cause toxic effects in children. Up to 48% of the chemical that is applied to the skin may be absorbed into the bloodstream. DEET has been associated with acute reactions including skin blisters and ulceration. Nervous system signs such as irritability, delusions, paranoia, aggressive behaviour, tremors, and ataxia have also been reported. Although the use of DEET on clothing appears to be safe, it should not be applied to intact human skin.

AMITRAZ (Mitaban) is a pesticide used in the treatment of demodectic mange in dogs. This drug can be absorbed through intact skin, and may cause dizziness and fatigue in persons who bathe dogs without wearing gloves and other protective equipment. It is essential to use gloves and some form of waterproof covering over the arms, protective eyewear, and an apron when mixing Mitaban with water or when treating dogs. Contact with wet animals should be avoided and hands and arms should be washed with soap and water after treatment. There is also some danger of toxicity if Mitaban vapours are inhaled, and the drug should only be applied in areas where ventilation is excellent. Because of the toxicity associated with inhalation of vapours or skin absorption of amitraz residues, close contact should be avoided with dogs bathed with Mitaban within the past 24 hours. Unused Mitaban solution should be immediately discarded by flushing down a sink.

Amitraz is a monoamine oxidase inhibitor (MAOI) and may have increased toxicity to people who are taking certain prescription medications, including tricyclic antidepressants, serotonin re-uptake inhibitors, decongestants, vasoconstrictors, Ritalin, and Demerol. Persons being medicated with these drugs should avoid any contact with amitraz.

Safe work procedures for handling pesticides in veterinary hospitals:

Regardless of the type of pesticide that is used, there are a few common-sense guidelines that will greatly reduce an employee's risk of exposure.

1. In all cases, the employee should know the chemicals that are found in the preparations that they are using, and the class of insecticide to which each

chemical belongs (organophosphate, pyrethroid, etc..). Obviously, when treating an animal it is wise to use the least toxic chemical that is effective, for both human and animal safety.

2. Follow the label directions, and avoid "extra label" use unless it is backed by an expert opinion. Agricultural insecticides and preparations intended for use in cattle should not be utilized on pets, as excessive exposure to both humans and animals may result. Several cases of human and animal toxicity have reported in persons administering "Pro-Spot" (a cattle insecticide) to dogs.

3. Some authorities suggest that human fetuses and infants are particularly sensitive to pesticides, and recommend that pregnant women avoid exposure to any pesticides (Dr. Sheila Zahm, U.S. National Cancer Institute). There is little research that can be used to either confirm or refute this opinion.

4. Many pesticides (pyrethrins, carbamates, any pour on product) can be readily absorbed through intact skin. Skin exposure to pesticides can be avoided by wearing protective clothing. It is advisable to wear neoprene rubber or butyl rubber gloves and a lab coat or coveralls when applying foams or liquid insecticides, and an apron or other waterproof covering should be worn when applying insecticidal shampoos and dips. Protective gloves should be discarded after limited use, as pesticides are absorbed into the rubber and will eventually penetrate through them. Lab coats, coveralls, and other protective clothing should be laundered between uses. Contaminated clothing should be placed in plastic bags until it can be discarded or washed.

5. If gloves are not worn when handling an insecticide (for example, when applying Defend to a dog), hands should be washed as soon as possible after applying the pesticide. Persons whose hands have contacted a pesticide solution or dust should avoid putting their fingers near their mouth or eyes.

6. Goggles or a face shield should be worn when pouring or mixing concentrated pesticide solutions or when working around pesticide mists such as barn sprayers. Eye washes should be available in case of accidental exposure.

7. It is advisable to use all pesticides (even shampoos) only in areas with good ventilation. If the odour of insecticidal chemicals is strong in the area in which they are used, ventilation is inadequate. If this is the case, doors and windows should be opened, or portable fans used to increase air flow. Use of a pesticide filter mask or respirator may be necessary in some situations (for example, when spraying a barn).

8. Although it is unlikely that veterinary staff will deliberately drink insecticidal solutions, ingestion may occur if the chemical is present on the hands, eating utensils, or food. Open containers of food, beverages, cigarettes, and similar

articles should not be left on the counter of a room in which insecticides are being used. Obviously, it is inadvisable to eat, drink, or smoke when using insecticides. Pesticides should not be stored near food for humans or animals.

9. Many serious pesticide exposures result from improper labelling of pesticide containers - it is surprising how many persons accidentally drink pesticides that have been stored in Coke bottles and other beverage containers. Pesticides should be handled and stored in the original labelled container only, or in an administration device designed for that use (for example, a tank for mixing pesticides).

10. If possible, insecticide administration should not be assigned to only one person on staff. As with radiography duties, administration of baths and dips should be assigned to several staff members on a rotating basis.

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4. Canadian Cooperative Wildlife Health Center: Health Risks to Wildlife Personnel, Western College of Veterinary Medicine, 1995: p 49-56.
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9. Wiggins P, Schenker MB, Green R, Samuels S: Prevalence of hazardous exposures in veterinary practice: American Journal of Industrial Medicine 16: 55-66 (1989).
10. Permethrin Fact Sheet, www.safe2use.com/poisons-pesticides/pesticides/permethrin/cox-report/cox.htm
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CHEMICALS USED IN DEVELOPING X-RAY FILMS

All of the chemicals used in developing X-ray films are classified as WHMIS controlled products. The chemicals most likely to be present in developer, developer-replenisher, fixer, and fixer-replenisher include acetic acid, glycol, hydroquinone, pyrazolidone, and sulfites. All of these are classified as Class D (poisonous) and some are also Class E (corrosive) substances. The most common problems seen in persons exposed to these chemicals are:

- Severe eye irritation, including the potential for permanent corneal damage if the liquid is splashed into the eye

- Respiratory tract irritation if concentrated vapours are inhaled

- Skin irritation if there is direct contact with unprotected skin. Allergic dermatitis has also been reported after chronic exposure to these chemicals (see section on disinfectants for a detailed description of allergic contact dermatitis).

Safe work procedures for handling X-ray fluids in veterinary hospitals:

Persons who process exposed X-ray films by hand should be particularly aware of the risks associated with use of these chemicals and the safety precautions that are necessary. These include the following:

1. Workplace WHMIS labels should be posted in a prominent place near the developing tanks (alternatively, the supplier label can be cut off an empty container and posted).

2. Persons who are processing films should wear gloves. Goggles should also be worn if there is a risk of splashing fluids into the eyes (for example, when pouring fluids into or out of a tank).

3. The hospital should be equipped with an eyewash fountain in case of eye exposure. Ideally, the eyewash should be of the type that can be directly affixed to a tap, as first aid treatment of eye splash injuries requires at least 15 minutes of continuous water flow.

4. Tanks should be covered when not in use, and the X-ray room should have sufficient ventilation to prevent fumes from accumulating in the room air. Installation of a small exhaust fan may be helpful in venting small rooms.

5. The use of automatic processors greatly reduces the potential exposure to developing chemicals. There is some risk of chemical exposure when cleaning or replenishing the automatic processor, however, and employees should use appropriate protective clothing and equipment (gloves, goggles, apron).

Reference:

1. Material Safety Data Sheets for X-ray Fixer, Developer, and Replenishers.

DISINFECTANTS

Most disinfectants used in veterinary hospitals are relatively non-toxic, with the exception of glutaraldehyde (see next section). Some agents, including isopropyl alcohol and sodium hypochlorite (bleach) are classified as controlled products and therefore subject to WHMIS regulations unless purchased as "consumer commodities". Other agents, including most popular disinfectants (Hibitane, Betadine, etc..) are not subject to WHMIS labelling and MSDS requirements, as they are regulated separately under the Food and Drug Act. Recognizing that there are some health hazards associated with the use of these agents, some manufacturers have chosen to publish and distribute material safety data sheets, although these are not required under the regulations. Hospital staff seeking more information on the toxicity associated with a particular agent are urged to review the appropriate MSDS.

The most common health problem arising from the prolonged use of disinfectants is skin irritation. Skin irritation has been reported after prolonged use of almost every type of disinfectant, with lesions appearing on the areas that are routinely exposed to the disinfectant solution (usually the hands and arms). Disinfectants remove protective lipids and protein from the skin, resulting in dehydration and death of superficial cells. Affected skin has a red, peeling, dry, and cracked appearance, and may be itchy. Irritation is more pronounced if the skin has been damaged by sunburn, scratching, or prolonged soaking.

For most persons, dermatitis quickly resolves even without treatment. However, if persons with skin irritation continue to have contact with the offending disinfectant, they may eventually develop an allergy to that disinfectant. Symptoms of a contact allergy to disinfectants are more severe than for simple irritation, and include blistering of the skin and extreme itchiness following contact with the offending substance. Lesions may resemble poison ivy dermatitis. Fortunately, allergic dermatitis can usually be successfully treated by applying corticosteroid ointments and avoiding future skin contact with the offending agent.

Disinfectants are not the only hospital chemicals that may cause contact irritation and allergies. Dermatitis may develop after prolonged contact with other cleaning agents (detergents, soaps) and drugs for topical use (antibiotics, local anesthetics).

Diagnosis of allergic dermatitis caused by a cleaning agent or other chemical is usually self evident, as there is always a history of contact with the offending substance (often long term, repeated contact) and lesions can be induced by patch testing. In this

procedure, a small amount of the suspect material is applied to unaffected skin, which is then observed for the development of typical lesions, usually within 48 hours.

The less exposure that you have to chemical agents, the lower the risk of becoming sensitized. Unfortunately, it is difficult to totally avoid contact with disinfectants in veterinary hospitals, because tables and other working surfaces are regularly sprayed with disinfectants. The easiest way to avoid developing skin irritation and possible allergic dermatitis to a cleaning solution or disinfectant is to wear gloves when using cleaning agents. For each agent, refer to the MSDS for selection of an effective glove type (latex, neoprene rubber, nitrile, polyvinyl alcohol, etc...)

Although dermatitis is the most common health problem associated with the use of disinfectants, some agents also have a potential for systemic toxicity. Many disinfectants are toxic when ingested or when vapours are inhaled. Fortunately, the diluted solutions typically used in veterinary hospitals generally have low toxicity, and gloves and good ventilation are probably adequate protection.

Toxic effects of specific disinfectants include the following:

ISOPROPYL ALCOHOL is irritating to the eyes and mucus membranes, and may cause dry skin after repeated or prolonged contact. Oral ingestion of isopropyl alcohol may be fatal.

Concentrated solutions of SODIUM HYPOCHLORITE (bleach) may be irritating to the hands, eyes, and respiratory tract. Gloves should be worn when handling bleach solutions, and safety goggles should be used if there is a possibility of splashing. Repeated exposure to vapours from concentrated bleach solutions may cause coughing, runny nose, wheezing, and other respiratory problems, and persons should ensure that ventilation is adequate when using this agent. Bleach should NEVER be mixed with any disinfectant containing ammonia (for example, quaternary ammonium compounds such as Quatsyl and many other deodorizers and disinfectants), as the combination of bleach and ammonia produces chlorine gas, which is extremely toxic.

IODINE-CONTAINING SOLUTIONS such as concentrated Betadine solution may cause irritation to the eyes and mucus membranes if splashed, and may cause headaches and breathing difficulty in susceptible persons. Dilute iodine solutions such as those used on animal skin are relatively non-toxic and it is not necessary to wear personal protective equipment when applying these agents.

QUATERNARY AMMONIUM COMPOUNDS such as benzalkonium chloride and zephiran chloride are relatively non-toxic at low concentrations, although nasal irritation has been reported. Concentrations greater than 10% may produce chemical burns when spilled on unprotected skin. Oral ingestion is poisonous.

PHENOLS are toxic when inhaled, absorbed through the skin, or ingested by mouth. Exposure to large quantities of these agents (for example, drinking a phenol solution)

may lead to seizures, coma, cardiac arrhythmias, respiratory paralysis, and death. Skin exposure may cause dermatitis.

HEXACHLOROPHENE has significant toxicity, particularly to pregnant women, as it may penetrate intact skin and cross the placenta. It is known to induce birth defects and neurotoxicity in animals.

GLUTARALDEHYDE is associated with a variety of health problems including dermatitis, and nasal, throat, lung and eye irritation. It is a *sensitizer*, which is a chemical that may cause unusually strong symptoms in susceptible people. These may take the form of asthma-like reactions (wheezing, tightness in the chest, difficulty breathing) Solutions containing over 50% glutaraldehyde quickly generate 20 ppm glutaraldehyde in room air, which may cause significant respiratory problems. Many people exposed to even 0.4 ppm glutaraldehyde in room air show adverse effects including eye, throat, and lung irritation, cough, chest tightness, and headaches. Glutaraldehyde is also known to be mutagenic and toxic to fetuses.

Glutaraldehyde should only be used in areas with excellent ventilation. It is wise to avoid breathing vapours from concentrated solutions, to wear goggles if there is any possibility of eye splash, to wear protective clothing including gloves when handling this agent, and to wash skin that has been exposed to this agent. The Ontario Ministry of Labour has established a ceiling exposure value (the highest concentration to which workers can be exposed for any period of time) of 0.05 ppm. Glutaraldehyde levels can be measured using glutaraldehyde dosimeter badges from safety supply companies. Use of these badges is described in detail in this handbook's section on monitoring waste anesthetic gas levels.

References:

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LATEX ALLERGIES

Individuals who routinely wear latex surgical gloves may eventually develop a contact allergy to latex. It is thought that proteins found in natural latex are responsible for the allergic reaction.

The most common reaction to latex gloves is contact dermatitis. Affected persons develop a red, intensely itchy rash after wearing latex gloves. Other reactions to latex include nasal congestion and sneezing, conjunctivitis, and swelling of the lips, eyelids, and throat. Severe reactions may involve the respiratory tract and include asthma, coughing, and dyspnea. These reactions have been reported in sensitized persons who are exposed to latex not only in gloves but also in rubber catheters, barium enema tips, and condoms.

Persons with an allergy to latex have several options. Some persons prefer to use cotton glove liners inside latex gloves. Others find that barrier creams effectively reduce contact with latex, if latex gloves must be worn. Hypoallergenic latex gloves are available, but may still cause allergic reactions in some individuals. The best solution for many people is to wear non-latex gloves, which are readily available through veterinary surgical supply outlets.

FORMALIN AND FORMALDEHYDE

Formaldehyde and its derivatives (including formalin, which is a 37% solution of formaldehyde in water and 10% methanol) have many uses in veterinary clinics. Formaldehyde is found in some hospital disinfectants and diagnostic test kits (for example, the Knott's test). It is used as a fumigant, particularly in poultry housing. 10% formalin is commonly used as a preservative for biopsies and other tissue samples being sent to a lab for histopathology. Students of anatomy are familiar with the use of formaldehyde as a preservative in animal specimens used for dissection. Formaldehyde is also found in cigarette smoke (up to 40 ppm formaldehyde) and in polluted air (up to 0.06 ppm in areas of heavy smog).

Although formalin and formaldehyde can be safely handled with appropriate protective equipment, caution should be used, particularly when handling concentrated solutions. Both liquid formaldehyde and formaldehyde vapours are toxic.

Liquid formaldehyde is intensely irritating when splashed into the eyes or on skin, causing burning and tearing, and in severe cases, corneal damage and permanent eye damage and blindness. Ingestion of 10% formaldehyde causes severe abdominal pain, hematemesis (vomiting blood), and may be fatal. Ingestion of formalin may cause gastrointestinal ulceration and perforation, blindness, seizures, and permanent brain damage.

Formaldehyde vapours are irritating to the nose, throat, and respiratory tract. The eyes are particularly sensitive to formaldehyde vapours, and lacrimation (watery eyes) may occur even at low concentrations (0.1 ppm in susceptible persons, 1 ppm for most workers). Other signs include a burning sensation of the nose, coughing, wheezing, chest pain, and choking. Given that the odour of formaldehyde is detectable at about 1 ppm, it is evident that if you can smell formaldehyde in a room, eye irritation may result.

Higher exposures (10 to 20 ppm) may cause shortness of breath, coughing, a sense of pressure in the head, heart palpitations, nausea, and excess phlegm production. At a concentration of 50 to 100 ppm, inhalation of formaldehyde vapours may cause respiratory distress and death.

Long-term exposure to formaldehyde vapours may cause asthma-like reactions (wheezing, chest tightness, coughing). Chronic exposure to liquid formaldehyde may cause allergic dermatitis (itchy, red, sore, cracked and blistered skin, soft brown fingernails). Once a person is sensitized to formaldehyde, exposure to even trace amounts (including inhalation of vapour) can cause an outbreak of dermatitis.

Formaldehyde is known to cause cancer in laboratory animals. After 24 months of exposure to 15 ppm of formaldehyde, 93 of 240 rats developed squamous cell carcinomas of the nasal turbinates (NIOSH, 1981). Squamous cell carcinoma has been report in rats exposed to as little as 6 ppm formaldehyde for long periods of time. In the United States, human pathologists are reported to have a higher than expected incidence of liver cancer and lung cancer, although it is not known if this is due to exposure to formaldehyde. One review paper concluded that "the existing epidemiologic studies are inadequate to provide any evidence for the possible carcinogenicity of formaldehyde in humans" (Vainio, 1982). Nevertheless, NIOSH in the United States has classified formaldehyde as a potential carcinogen.

Both formaldehyde and formalin are classified as controlled substances and are therefore regulated by WHMIS. Persons who handle formalin should be familiar with the material on the formaldehyde MSDS. Formaldehyde is also sold as a pesticide, in which case it is exempt from WHMIS label and MSDS requirements but must conform to the requirements of the federal Pest Control Products Act.

The Ontario Ministry of Labour has established a short term (15 minute) formaldehyde exposure limit of 1 ppm, and a ceiling exposure value (maximum concentration to which a worker can be exposed for any time period) of 1.5 ppm.

Safe work procedures for handling formalin and formaldehyde in veterinary hospitals:

1. In order to minimize the concentration of formaldehyde vapours in room air, formaldehyde and formalin should only be used in areas with excellent ventilation, and persons should avoid breathing vapours as much as possible. Butyl or nitrile rubber should be worn and all skin contact should be avoided. Goggles and an emergency eyewash station are also required if there is a danger of splashing formaldehyde into the eyes.

2. Disinfectants that contain formaldehyde appear to be relatively safe for use over short periods of time. Formacide contains 2% formaldehyde but appears to have a relatively low toxicity when used with appropriate precautions (good ventilation, butyl or nitrile rubber gloves, goggles used when diluting concentrated solutions). One study

conducted by the manufacturer showed that the level of formaldehyde in room air during the application of Formacide disinfectant was less than 0.5 ppm.

3. The formalin that is found in biopsy jars is a relatively dilute solution of formaldehyde. For safety and convenience, it is usually ordered in small, pre-diluted, and labelled containers rather than in bulk containers. Gloves should be worn when handling this material, and care should be taken to avoid splashing the skin or eyes. Containers of formalin should be capped with tightly fitting lids to prevent evaporation and contamination of the surrounding room air.

4 Formaldehyde levels in room air can be monitored using dosimeter badges, available from Assay Technology (1-800-833-1258) and other safety supply companies.

Reference:

1. National Institute for Occupational Safety and Health (NIOSH): Current Intelligence Bulletin 43: Formaldehyde - Evidence of Carcinogenicity. United States Department of health and Human Services, Cincinnati, 1981.

ETHYLENE OXIDE

Ethylene oxide (Anprolene) is a gas sterilization agent, most commonly utilized in veterinary clinics such as the "blue box" sterilization system manufactured by Andersen Products. Ethylene oxide is used to sterilize materials that cannot undergo conventional autoclaving, including bone drills and other electrical equipment, plastic and rubber items such as catheters and endotracheal tubes, and delicate ophthalmic and surgical instruments. Ethylene oxide is classified as a "designated substance" in Ontario, which means that its use is subject to special regulations, including the following:

1. The employer must take all necessary measures to reduce the airborne ethylene oxide such that the time weighted average exposure of a worker does not exceed 1 ppm ethylene oxide in air. The maximum short-term exposure concentration is limited to 10 ppm ethylene oxide in air.

2. If a worker is exposed to airborne ethylene oxide, the worker may request a respirator regardless of the level of exposure and the respirator shall be provided by the employer. The respirator must meet the requirements set out in the Code for Respiratory Equipment for Ethylene Oxide (Feb 28, Ministry of Labour) and the employee must be provided with training and instruction on the care and use of this equipment.

3. The employer must cause an assessment to be made in writing of the exposure or likelihood of exposure to ethylene oxide in the workplace. Details of such an

assessment are listed in Reg. 900841, published by the Ministry of Labour. A copy of the assessment must be given to each member of the Health and Safety Committee.

4. The employer must establish a control program which provides for appropriate employee training, engineering controls, work practices, monitoring procedures, and personal exposure records.

Further regulations can be found at the following site:
www.elaws.gov.on.ca/html/regs/english/elaws_regs_900841_e.htm

Ethylene oxide may be purchased either as a liquid in ampules or as a compressed gas stored in cylinders similar to those used for oxygen and nitrous oxide. Sterilizers that utilize compressed gas cylinders are found in a few large veterinary institutions, and users are referred to the 1989 NIOSH publication on ethylene oxide for further information on the safe use of these systems[2].

Most veterinary practices that use ethylene oxide find it more convenient to use the liquid form, which is purchased in single-use glass ampules. In order to sterilize materials with ethylene oxide, an ampule is placed inside a plastic bag that contains the items to be sterilized. The ampule is broken, and the bag containing the broken ampule is placed in a sturdy plastic box. The box is immediately closed and left in a ventilated enclosure for 12 hours to allow ethylene oxide gas to escape from the ampule and sterilize the contents of the bag.

Many concerns have been raised regarding the safety of ethylene oxide. Several hazards are associated with ethylene oxide use, including the following:

a) **Liquid ethylene oxide is flammable and potentially explosive**. Ethylene oxide ampules should be stored away from heat and sources of ignition. Smoking should be prohibited near the sterilizer when loading or unloading it.

b) **Liquid ethylene oxide can cause severe burns if it is accidentally splashed onto the skin or eyes**. Liquid ethylene oxide may cause severe eye irritation, corneal injury, and in some cases permanent impairment of vision. When spilled on the skin, liquid ethylene oxide causes frostbite-type burns, although injury may not be visible for several hours.

Ethylene oxide is so caustic that trace amounts that remain on plastic or rubber items following sterilization may cause irritation and even chemical burns when in contact with

[2]This publication can be ordered free of charge from Publications Dissemination, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, Ohio, 45226.

living tissue. Plastic and rubber items should be aired for at least 24 hours after sterilization to allow the ethylene oxide to completely disperse. The National Institute for Occupational Safety and Health (U.S.) recommends that hospital personnel stay at least one arm length distance from sterilized materials until they have undergone the 24 hour aeration period. A special drying/aeration chamber which more rapidly disperses the residual gas can be purchased from Andersen products.

c) **Exposure to ethylene oxide vapours at a concentration of 100 ppm may cause acute irritation of the eyes and respiratory system.** Exposure to this concentration of vapour is almost inevitable if a hospital employee opens the sterilizing box before the sterilization process is complete, as ethylene oxide concentrations approach 100,000 ppm inside the box during sterilization. Inhalation or skin exposure to high concentrations of gas or liquid may cause headache, nausea, vomiting, and red blood cell hemolysis. Very high exposures may cause drowsiness, incoordination, cyanosis, and pulmonary oedema.

d) **Chronic exposure to moderate levels of ethylene oxide (10 ppm) has been shown to cause chromosomal abnormalities in male and female laboratory animals and may cause similar problems in humans. It is therefore considered to be a "mutagenic" agent.** The significance of the chromosomal abnormalities is not known, but it is possible that they may lead to increased risk of adverse reproductive effects. Long-term exposure to ethylene oxide has been associated with an increased incidence of spontaneous abortion in laboratory animals, possibly due to chromosomal changes in the fetus. There is some evidence, however, that birth defects in humans only occur at exposures that are immediately toxic for the mother.

e) **Ethylene oxide has been classified as a potential human carcinogen** by the National Institute of Occupational Safety and Health (NIOSH) in the United States. This classification was the result of studies that showed an increased rate of leukemia in humans exposed to low levels (under 10 ppm) of ethylene oxide over 8 hours per day for several months. Studies in rodents have shown that chronic exposure to ethylene oxide (30 ppm) is associated with an increased incidence of leukemia and mesothelioma. More recent studies have been unable to confirm some of the findings (Stennland et al, 1991) and the connection between low level exposure to ethylene oxide and increased risk of cancer remains inconclusive. A 1991 study of workers exposed to an average of 4.3 ppm ethylene oxide eight hours per day for several years reported that there was no significant increase in mortality from any cause (including cancer) in the exposed population.

f) **Ethylene oxide may cause transient neurological problems**. This has been reported in workers exposed to high levels (over 100 ppm) for a short period of time.

Safe work procedures for handling ethylene oxide in veterinary hospitals:

All employees who handle ethylene oxide must be trained in safe handling techniques for this substance, and routine work and emergency procedures should be reviewed by the employer and employees at least annually.

There are many ways in which hospital staff may be exposed to excessive levels of ethylene oxide: through accidental breakage or spills from an ampule, by breathing gas released by broken ampules before they are placed in a box, by breathing vapours emitted from a box during sterilization and by breathing vapours given off by newly sterilized loads. In each case, exposure can be prevented by taking common sense precautions.

1. **Preventing exposure from broken glass ampules**

Care should be taken to avoid accidental breakage of glass ampules, as the spilled liquid quickly evaporates, contaminating the room with ethylene oxide vapour. Each ampule contains 4 grams of ethylene oxide, which is sufficient to produce a concentration of 100 ppm of ethylene oxide throughout a normal sized room once the liquid evaporates. To avoid accidental breakage, store the ampules in the box they were received in, and if possible store the box in a drawer rather than on an open shelf or counter.

Ampules are provided encased in a plastic tube or a white paper cloth, which is in turn enclosed in a plastic bag. When preparing to sterilize a load, the ampule should be broken while still encased in these protective wrappings. The plastic tube and bag should NEVER be opened, as they help to prevent splashing of the hands, face, and eyes with liquid ethylene oxide. A lab coat and neoprene rubber or butyl rubber gloves should be worn when breaking the ampule. If contact with liquid ethylene oxide occurs, all contaminated clothing should be removed, and the skin or eyes should be flushed with water for at least fifteen minutes. The affected area should be covered with a dressing and the person transported immediately to medical care. Clothes and shoes that have been contaminated with ethylene oxide should be discarded.

In case of accidental spill or gas release, staff should be notified and the immediate area of the accident should be evacuated. Windows in the area should be opened and the room should be left empty for at least 12 hours. Only persons wearing an ethylene oxide approved respirator and trained in its use should be allowed to enter the room during the aeration period.

2. **Preventing inhalation of vapours during sterilization**

When an ampule is opened just prior to sterilization, the liquid ethylene oxide starts to evaporate, producing ethylene oxide gas which may penetrate through the tube and bag and contaminate the room air. The broken ampule should be immediately placed in

the blue sterilizing box, which is then locked and placed inside a ventilating unit or fume hood. As previously mentioned, the concentration of ethylene oxide in the sterilizing box may exceed 100,000 ppm during the sterilization process, and for this reason the box or ventilating unit should NEVER be opened until the sterilization period is over.

Even though the gas is now contained in the blue box, ethylene oxide levels in the room rapidly exceed the recommended maximum level unless the room has forced air ventilation with at least 10 air changes per hour. Since many veterinary hospitals do not have this level of ventilation, the sterilizer box should be placed inside a dedicated local exhaust system (this means the box must be inside a ventilator or fume hood).[3] A ventilator is a device that suctions away escaping gas from the blue box and discharges it outside the building. The exhaust gases are conducted through a hose that passes through a wall vent or a window, much like an anesthetic scavenger. The discharge point should be located at least 25 feet from any fresh air intakes, including open windows, air conditioners, and heating or ventilation intakes.

Use of a ventilator throughout the 12 hour sterilization period dramatically reduces the contamination of room air with ethylene oxide. Ventilated sterilizers must be tested for efficacy at least once yearly. The manufacturer should be contacted regarding availability of this service in your area.

In the past, some persons have attempted to avoid the risk of ethylene oxide exposure by sterilizing outdoors in containers such as plastic garbage pails. This practice is inadvisable, as effective sterilization is very difficult to ensure under these conditions.

3. **Preventing exposure to ethylene oxide given off by sterilized materials**. There is a potential for ethylene oxide exposure when the sterilization is complete and the items are removed from the plastic box and bag. Studies have shown that levels of 10 to 100 ppm are commonly present in the air surrounding newly sterilized loads. To address this concern, some ventilating systems provide a two hour "purge" cycle, which is initiated when the sterilization is complete. The purge cycle removes residual gas from the sterilized items, further decreasing risk of exposure. Even after purging, it is necessary to aerate the sterilized materials for 24 hours before use in surgery.

Used liner bags and ampules should be discarded in an isolated trash receptacle **outside** the building.

4. **Monitoring ethylene oxide gas levels**. If ethylene oxide is used in a veterinary clinic, gas levels must be regularly monitored, even if a ventilator is in use. Hospital staff can monitor ethylene oxide levels using dosimeter badges (Air Scan monitors,

[3] Ventilators are manufactured by Andersen Products, 1-800-423-1276. Andersen also gives practical advice on installation and operation of their sterilizers and offers a "certified key operator" training course.

obtainable from Andersen Products 1-800-523-1276 or Assay Technology, 1- 800-833-1258). Badges are worn by personnel when sterilizing and unloading equipment, and will record exposure levels within a range of 0.24 to 600 ppm. Two types of badges are available: one that is worn for 15 minutes (usually during the loading or unloading period) and one that is worn for 8 hours when the sterilizer is in use. The cost is approximately $70 per monitor.

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DIETHYL ETHER

Diethyl ether (commonly known as "ether") is classified as an oxidizer and flammable liquid. Use of diethyl ether has been associated with numerous accidents, including explosions that have occurred as the cap of the container was removed. The explosions are caused by unstable peroxides, which form spontaneously when ether is stored for long periods of time. Formation of peroxides is accelerated by exposure to air or light. Peroxides may sometimes cause the ether to assume a cloudy appearance, but this is not a reliable indication of their presence. The best test for the presence of peroxides is the use of starch iodide indicator paper.

In addition to the explosion hazard associated with diethyl ether, it is also very flammable. Because the flash point of ether is very low, vapours readily ignite when exposed to a spark or static electricity at room temperature. Disastrous operating room fires occurred in the past when ether was used in combination with oxygen to induce and maintain anesthesia in human patients.

Like many organic solvents, ether produces toxic vapours that may be inhaled, causing headache, drowsiness, nausea, vomiting, upper respiratory irritation, and ultimately unconsciousness. It can also be absorbed through the skin, with similar effects.

Given the hazards associated with ether and the fact that safer alternatives are available for anesthesia, it is advisable that it not be used in a veterinary clinic. If it is purchased, it should be stored in an airtight amber glass bottle in a dark area. The date

that the bottle was received and the date it was opened should be written on the bottle, with a notice to discard or test for peroxides within 6 months of opening. Bottles containing ether that is more than one year old should be discarded. When in use, bottles should be kept as full as possible, to avoid exposure to air. Refrigeration does not inhibit peroxide formation or explosion (the flash point is -47'C) but if the ether is kept in an explosion-proof refrigerator there is some protection for people working in the clinic should the bottle explode during storage.

Reference:

1. University of Vermont Safety Notes, January/February 1990, (reprinted in CUSSCO Newsletter)

PHARMACEUTICALS

Most persons who administer drugs to animals are well aware that pharmaceuticals, when inappropriately used, may cause harm to veterinary patients. It is less obvious (but equally important) that drugs can cause health problems in the hospital staff themselves. These problems may be divided into two areas: toxicity arising from inadvertent exposure to drugs, and deliberate substance abuse.

Drugs are so routinely handled by veterinary staff that it is easy to forget that many of them can act as dangerous poisons. For example, tilmicosin (Micotil), an antibiotic used in large animal practice, can cause severe cardiovascular problems if the drug is accidentally injected into a human. Xylazine (Rompun) can be absorbed through intact skin and has the potential to cause bradycardia, heart block, and sedation. Prostaglandins (Synchrocept, Lutalyse, Estrumate) can be absorbed through breaks in the skin and may disrupt menstrual cycles and cause miscarriage at any point of a human pregnancy. Prostaglandins may also cause bronchospasm, and are therefore potentially hazardous to persons with respiratory problems (particularly asthmatics). Chloramphenicol, clenbuterol (Ventipulmin), flunixin (Banamine), methimazole (Tapazole), and phenylbutazone are also reported to be potentially hazardous to humans. Dermatitis has been reported after skin exposure to many veterinary pharmaceuticals, including bacitracin, chlortetracycline, levamisole, neomycin, nitrofurazone, oxytetracycline, phenothiazines such as acepromazine, piperazine, sulfa drugs, and tylosin.

Probably the most hazardous pharmaceuticals that the veterinary technician is likely to handle are the cytotoxic drugs used in cancer chemotherapy. These drugs are also called antineoplastic, chemotherapeutic, or anti-cancer agents. The agents most commonly used in veterinary medicine include cyclophosphamide (Cytoxan), vincristine (Oncovin), vinblastine (Velban), cisplatin (Platinol), chlorambucil, and doxorubicin (Adriamycin),

Because of the relative danger of these drugs and the regulations associated with their use, many veterinarians elect to prepare and administer cytotoxic drugs themselves, rather than assign this task to employees. All hospital employees who are assigned to handle or administer cancer chemotherapeutic agents (or even to dispose of materials contaminated with these drugs) must receive special training in the toxicity of these agents and the techniques required for safe handling, including spill cleanup and first aid after acute exposures.

It is ironic that cytotoxic drugs, which are used to kill cancer cells as part of cancer chemotherapy, are themselves carcinogenic. There is ample evidence that many of these agents can induce cancers in laboratory animals. It has been shown that human patients given cancer chemotherapy with the agent cyclophosphamide have an increased incidence of developing malignant tumours at a later date, possibly because of the toxic effect of the cyclophosphamide itself. Many anticancer drugs (including prednisone) are also teratogenic, causing an increased incidence of birth defects in children born to pregnant women who are given these drugs. In addition, these drugs often depress the activity of the immune system. Other side-effects of cytotoxic drug administration include hair loss, bone marrow suppression, gastrointestinal toxicity, nausea, decreased sperm production, and cessation of menstrual cycles.

From the standpoint of hospital personnel working with these drugs, it is significant that very fleeting exposures may cause serious health effects. Many cytotoxic drugs are extremely irritating to the eyes, skin, and tissues. A single needle prick to a finger with a syringe containing the cytotoxic drug mitomycin-C was reported to cause the eventual loss of function of that hand (Duvall and Baumann, 1980) Doxorubicin, when spilled onto abraded skin, may cause severe soft tissue injury and sloughing of exposed areas.

Why are these drugs so toxic? Many anticancer drugs exert their beneficial effects in cancer patients by reacting with DNA in rapidly growing cancer cells, causing death of the cell. Unfortunately, these agents may also interact with DNA in healthy cells, causing cell death or chromosomal mutations that can lead to cancer or birth defects.

Although the toxicity of these drugs to patients receiving chemotherapy has been known since their earliest use in 1943, it is only more recently that they have been recognized as a potential hazard to medical personnel who administer them. The first reports regarding toxicity of these drugs to medical personnel arose from studies of nurses working in human cancer wards (Falck et al, 1979, Nikula et al, 1984). Nurses who frequently handled and administered cytotoxic drugs were found to have an unusually high incidence of chromosomal damage in their white blood cells. In addition, the urine of nurses and pharmacists who handled these drugs was found to cause mutations in bacteria, presumably due to trace amounts of active drug in the urine. After pharmacists stopped handling cytotoxic drugs, the mutagenic activity of their urine fell within two days. Studies of nurses working in cancer wards (reported in Crudi, 1980) showed a higher-than-expected incidence of liver damage with elevation of liver enzymes, nausea, dizziness and light-headedness, chronic headaches, dermatitis (particularly after exposure to cisplatin, methotrexate, and vincristine), and hair loss.

Many of the side effects observed in nurses were the same as those noted by patients receiving antineoplastic drugs. A 1983 report also suggested a correlation between occupational exposure to cytotoxic agents during the first trimester of pregnancy and fetal loss in nurses (Seleva and Lidbohm, 1983). Nurses who handled anti-neoplastic drugs when pregnant were shown to have increased risk of fetal malformations, with the risk being highest for nurses who had the greatest exposure to these drugs (Hemminki, 1985).

None of the nurses and pharmacists interviewed in these surveys appeared to be deliberately exposing themselves to the drugs. Exposure was thought to arise from accidental contact through routine handling of the drug preparations. It is suspected that **inhalation** of drug aerosols and **skin absorption** of powders and liquids are the chief routes of entry into the body. This is consistent with the observation that oncology nurses who took appropriate precautions (use of gloves, masks, a safety cabinet) showed no increased incidence of chromosomal changes, whereas those who inconsistently took precautions showed a significant increase in chromosome gaps.

Safe work procedures for handling cytotoxic drugs

All persons handling cytotoxic drugs must be aware of the acute and chronic toxicity of each drug, the treatment for acute exposure, safe handling procedures, and spill and waste disposal procedures.

It would seem at first that there is minimal danger of contact with a cytotoxic drug that is administered to an animal. In fact, there is ample opportunity for **skin exposure** when crushing or dividing a tablet or when handling urine or stool from an animal that has been treated with antineoplastic drugs. Exposure through **inhalation of aerosols** is also a very real danger. Aerosols can be generated in numerous ways: when withdrawing a syringe from a vial, when breaking an ampule, when expelling air from a partly-filled syringe, or when liquid containing the drug drips from tubing or a syringe.

The following suggestions are taken from the Canadian Society of Hospital Pharmacists guidelines. These precautions apply to all personnel who handle cytotoxic drugs.[4] Comprehensive outlines of safe practices, written for veterinary technicians are readily available (Fox, 1996; Swanson, 1988; Dickinson, 1995)

1. Eating, drinking, smoking, chewing gum, and storage of food or beverages should be prohibited in the room in which cytotoxic drugs are prepared and used.

2. Injectable drugs should be stored at eye level in a bin or on a shelf with barriers at the front. Cytotoxic drugs that require refrigeration should be kept in bins separated

[4] Prednisone, although frequently used in cancer chemotherapy, appears to have little potential for causing chromosomal damage in persons administering this drug, and is therefore not included in the recommendations.

from other drugs. All bins should be clearly labelled with a warning sticker and the drug name. All areas where cytotoxic drugs are stored or mixed should have clear warning signs incorporating the cytotoxic danger symbol. (these signs are available through supply companies such as LabSafety Supply).

3. When counting or administering tablets, the minimum necessary protective equipment is a long-sleeved lab coat and disposable latex gloves. The greatest risk of exposure occurs when capsules are opened, tablets are crushed, or topical preparations are removed from their original containers. Whether intact or broken, cytotoxic drug capsules and tablets should never be manipulated with bare hands. Capsules and tablets should be broken inside plastic food storage bags, so that powdered drug does not contaminate the work area.

4. For procedures involving liquid cytotoxic drugs, it is recommended that personnel handling the drugs wear a disposable surgical gown (or other "long sleeved, back closure, disposable protective garment with tight fitting cuffs and neck") and disposable latex gloves. If the material is not prepared in a biological containment cabinet, the person preparing cytotoxic drugs should wear a face shield or goggles[5] and some type of exhaust ventilation should be provided. Goggles should be cleaned with alcohol wipes after use. Contact lenses should not be worn even with eye protection, as they may absorb aerosolized material. Respiratory protection can be provided by a respirator with a high-efficiency (HEPA) filter or a biological containment cabinet. A surgical mask offers very minimal protection against aerosols.

Gloves should be changed at least hourly, and immediately after being contaminated or punctured. Powder should be swabbed off gloves before use. Hands should be washed thoroughly after removing gloves. Used gowns and gloves must not be worn outside the preparation or administration area.

5. Aseptic techniques should be followed when preparing cytotoxic drugs for injection. Preparation should be performed on a disposable, plastic-backed absorbent cloth or liner that may be removed and disposed as cytotoxic contaminated waste immediately after the preparation is completed. Tablets should be counted and administered only by persons wearing powder-free latex gloves (this recommendation extends to animal owners also).

6. Gloves should be worn when opening ampules. Before opening an ampule, gently

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[5] One set of recommendations (Yodaiken and Bennett, 1986) acknowledges that the use of goggles may not be essential if health professionals are routinely careful when handling cytotoxic drugs. However they remind the reader that there have been incidents of nurses inadvertently spraying their eyes with a drug aerosol when ridding syringes of air. They also acknowledge that health professionals must walk a narrow line between alarming their patients unnecessarily (by wearing goggles, respirators, and other safety equipment) and protecting their own health.

tap all fluids or powders down from the top and neck of the ampule and wrap the ampule neck in a gauze pad prior to breaking. Ampule breakers, if available, avoid the hazard of accidental skin breaks that can occur when glass ampules are broken. Ampules should not be held close to the face when opening. When removing liquid from an ampule, the ampule should be held vertically with the needle upward. After removing the syringe from the ampule, the syringe should be tapped to remove air bubbles, which should be expelled into sterile gauze, not into the air.

7. When reconstituting powders in glass vials, the diluent should be added slowly down the wall of the container to thoroughly wet the powder before agitating. All the diluent should not be injected at once - rather, one should inject small amounts of diluent and then allow displaced air to escape back into the syringe. Avoid adding any air to the vial - a slight negative pressure (vacuum) inside the vial is ideal, as this helps to prevent spraying of the drug when the needle is withdrawn from the vial. Use of an air-venting hydrophobic filter device or disposable chemodispensing pin helps to prevent release of aerosol droplets from the vial. A gauze pad should be wrapped around the needle and vial top when solution is withdrawn, taking care to avoid needle sticks during this procedure. Syringes should not be filled more than 3/4 full when drawing up a liquid cytotoxic agent. The volume of the cytotoxic solution should be adjusted while the needle is still in the vial (do not pull the needle out and squirt the excess liquid into the room air). Only luer-lock syringes should be used to draw up cytotoxic agents, to prevent accidental separation of the syringe from the needle.

8. An injectable cytotoxic drug can be administered to a patient either by injection into an IV catheter or administration port, or by adding the drug to a bag of IV fluids.

The pharmacy providing the cytotoxic drug may provide the drug already contained in an IV bag. If the cytotoxic drug is provided separately and must be added to an IV bag, the administration set should be attached and primed prior to adding the drug to the IV fluid. The IV bag should be labelled with a distinctive warning label such as "Chemotherapy - handle with gloves, dispose of properly", and the name and quantity of drug should be written on the bag. The IV tubing should not be removed from the IV bag at any time (dispose still attached).

If the cytotoxic drug is contained in a syringe and is to be administered into an IV catheter or an injection port, an alcohol-moistened cotton ball should be placed under the needle before withdrawing the needle from the catheter cap or injection port, in order to catch drops that escape from the needle hole.

Regardless of how the injectable cytotoxic drug is administered, the person administering the liquid should wear two pairs of powder-free latex gloves, a gown, and protective eyewear.

9. Cytotoxic wastes (syringes, IV sets, gauzes, gloves) should be placed in a sealable plastic bag and disposed by incineration or held for biomedical waste pick-up. Cytotoxic sharps (needles, broken ampules) must be placed in a leak-proof, shatter-proof,

closable, and puncture-proof sharps container. Needles should not be clipped or recapped. Excess cytotoxic fluids must be placed in sealed containers (the original vial is acceptable) and disposed by incineration or held for biomedical waste pick-up.

10. Patient care: Two pairs of unpowdered latex gloves should be worn when handling urine, feces, vomitus, and other body fluids from an animal that has received cytotoxic drugs within the previous 48 hours. In most areas, patient waste may be disposed of through the sewage system or municipal garbage. Only disposable bedding should be used in the cage.

11. An eyewash should be present in the area where the cytotoxic drugs are prepared and administered. If a cytotoxic drug accidentally contacts the eyes or unprotected skin, immediately wash the drug away with copious amounts of water (this procedure also applies to other toxic medications such as prostaglandins). If a skin puncture or needle stick injury occurs, the affected location must be washed with running water and squeezed to encourage bleeding to flush out any drug that may have been accidentally injected. In any case of eye splash or needle puncture involving a cytotoxic drug, medical attention should be sought as soon as possible.

12. Spills must be cleaned up immediately by personnel using protective equipment and clothing and following a written emergency procedure (see Appendix 4). Double gloving is recommended. Commercial skill kits are available, or materials can be assembled using hospital supplies (Holt, 1995). In the case of liquids, an absorbent material such as dry gauze pads or paper towels can be used. For powders and tablets, a wet absorbent gauze is more effective. Following the clean-up, the area should be washed three times with a detergent and water, then dried. A spill kit and a sign giving detailed spill clean-up procedures should be kept in or near the area where cytotoxic drugs are prepared, administered, or stored.

13. Persons who are pregnant, breast feeding, or attempting to conceive are advised not to handle cytotoxic drugs.

14. If a veterinary hospital regularly prepares and administers injectable cytotoxic drugs, consideration should be given to the purchase of a glove box, biological safety cabinet or a vertical laminar flow hood. This equipment has been shown to significantly reduce exposure to aerosols of cytotoxic drugs, however the cost may be significant (approximately $8000 in the case of a biological safety cabinet). Improperly functioning cabinets may be more hazardous than not using any cabinet at all, and correct work practices are essential for safe use of this equipment (for details, see Swanson, 1988B). Alternatively, preparation of cytotoxic agents may be contracted to a local pharmacy or hospital.

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Chapter 4 - Chemical Hazards

True or False? Circle the correct answer:

1) Mixing bleach and ammonia-containing disinfectants such as Quatsyl causes the release of chlorine gas, which is very toxic.

true false

2) When diluting chemicals with water, it is always safer to pour the water into the chemical being diluted.

true false

3) The MSDS (material safety data sheet) should be consulted to determine the correct disposal method for hazardous chemicals.

true false

4) When a controlled product is removed from its original container and put into a new container, a workplace label MUST be placed on the new container unless it is to be used up that day.

true false

5) Wearing contact lenses may decrease damage to the eyes if splashed with a harmful chemical because they stop the chemical from reaching the cornea.

true false

6) A single storage area may be used for all groups of hazardous chemicals.

true false

7) WHMIS stands for Workplace Hazardous Materials Information Standards.

true false

8) The employer has no requirement to train staff in the use of certain materials that are WHMIS exempt such as pesticides, vaccines and pharmaceuticals.

true false

9) Out of all of the classes of insecticides use in a veterinary clinic, organocklorines are most frequently associated with human and animal toxicity.

true false

10) The most common health problem arising from prolonged use of disinfectants is skin irritation, therefore gloves should always be worn when using cleaning agents.

true false

11) All hospital employees who are assigned to handle or administer cancer chemotherapeutic agents (or even to dispose of materials contaminated with these drugs) must receive special training in the toxicity of these agents and the techniques required for safe handling, including spill cleanup and first aid after acute exposures.

true false

12). Allergic contact dermatitis is commonly caused by exposure to latex products.

true false

13) Formalin and formaldehyde are equally toxic.

true false

14) Compressed gas cylinders should be chained or otherwise secured to a wall, cart, or similar structure.

true false

15) The main hazard associated with handling prostaglandins is risk of skin necrosis if the drug is spilled on bare hands.

true false

APPENDIX 1

BASIC SAFETY PRECAUTIONS FOR VETERINARY EMPLOYEES

MACHINERY AND EQUIPMENT

1. Do not attempt to operate hospital equipment unless you are familiar with its use.
2. Make sure all proper guards are in place before starting to work.
3. Tie long hair back to prevent it from getting caught up in equipment. For the same reason, avoid loose-fitting clothing.
4. Vent all autoclaves before opening, and keep hands and face away from steam. Avoid handling autoclaved materials until they have cooled.
5. Use the insulated handle when picking up cautery or branding devices.
6. When using a centrifuge, ensure that the centrifuge is balanced with equal numbers of tubes and that the lid is securely bolted on. No attempt should be made to stop the centrifuge arm or remove samples until the arm has come to a complete stop.

FLOORS

1. Wear slip-proof shoes and avoid running.
2. Install non-slip mats or strips in areas that are frequently wet.

HOUSEKEEPING

1. Clean up spills as soon as possible.
2. Return equipment and chemicals to the proper storage area immediately after use.
3. Avoid clutter in drawers or counters.
4. Hallways, exits, and stairs should be free of obstructions. Equipment or chemicals should not be stored in these locations.
5. Store chemicals and heavy equipment on lower shelves to avoid injury or exposure to chemicals in case the container falls off the shelf.
6. Tightly replace lids on all containers.
7. Use a ladder or step stool to reach high places.
8. Follow a checklist for regular facility maintenance, including daily, weekly, monthly, semi-annual, and annual procedures.

ELECTRICITY

1. Do not remove light switch or electrical outlet covers.
2. Keep circuit breaker boxes closed.
3. When using electrical equipment in wet areas (for example, a portable dryer), it must be properly grounded and only plugged into a ground-fault circuit interruption outlet.
4. Extension cords must never be run across aisles or floors or through window or doors.
5. Appliance with defective plugs should not be used until repaired. Never alter or remove the ground terminals on plugs.

APPENDIX 2

Ontario Occupational Health and Safety Regulations

1. Occupational Health and Safety Committees and Representatives

Workplace safety in Ontario is regulated by the Occupational Health and Safety Act (1978). This Act specifies that a joint health and safety committee (JHSC) must be established and maintained in every workplace that has a workforce of 20 or more employees, and in any workplace where a designated substance (for example, ethylene oxide) is utilized. A full committee is not required in workplaces with fewer than 20 employees, However a health and safety representative must be selected by the workers in any workplace with fewer than 20 but more than five employees.

Joint health and safety committees have the right to make recommendations to employers about health and safety improvements. The Act requires employers to reply in writing to such recommendations within 21 days. Committee members also have the right to participate in Ministry inspections and investigations, and to investigate accidents.

If the practice is large enough to require a JHSC, the employer must ensure that at least one worker member and one employee member become certified. The employer must pay for time spent by joint committee members while exercising their rights and duties under the Act.

Employers must also prepare a written occupational health and safety policy, and a program to implement that policy. This is the employer's statement of principles that will guide health and safety in the workplace. This policy must be posted in the workplace and reviewed every year.

The duties of the JHSC should include the following:

- regular inspection of premises, equipment, work methods, and work practices
- holding periodic meetings with management for the purpose of reviewing health and safety activities
- ensuring that staff are adequately trained in safety issues
- prompt investigation of incidents to determine the action necessary to prevent their recurrence
-maintaining records and reports of training, inspections, and incident investigations
- ensuring that the hospital complies with WHMIS requirements (see Appendix 6)

2. Duties

Under the Occupational Health and Safety Act, specific duties are assigned to owners, supervisors, workers, and directors/officers of companies.

WORKERS have a duty to work in compliance with the Act and regulations. They must wear or use protective equipment or clothing provided by the employer, and must not interfere with protective devices. Workers have a duty to report any violations of the Act, defective equipment or workplace hazard. They must not operate equipment in a way that may endanger themselves or any other worker, and are prohibited from engaging in contests, pranks, or "boisterous conduct" that could endanger themselves or other employees.

OWNERS have a duty to ensure that the workplace and its facilities comply with the regulations.

SUPERVISORS have a duty to take every precaution reasonable in the circumstances for the protection of workers. This includes ensuring that workers comply with the Act and regulations and that they use protective devices and clothing as required by the employer. Supervisors have a duty to advise workers of actual or potential health and safety hazards.

3. Work refusal

Workers can refuse work they feel is unsafe, without discriminatory action taken against them for such a refusal. This includes refusal to carry out any work process or operate any tool or equipment if there is reasonable cause to believe that to do so would create an undue hazard to the safety of any person. However, once a supervisor has investigated the refusal, the worker must have reasonable grounds to believe that the work is still dangerous in order to continue refusing.

4. Harmful or unsafe conditions

Whenever a person observes what appears to be an unsafe or harmful condition or act, the person must report it as soon as possible to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition and must ensure that any necessary corrective action is taken without delay.

5. Orientation

Any young or new worker must be given health and safety orientation and training specific to the workplace, before beginning work in a workplace. The employer must keep records of all orientation and training provided.

6. Designated Substances

There are currently 11 designated substances in Ontario:

acrylonitrile
arsenic
asbestos
benzene
coke oven emissions
ethylene oxide
isocyanates
silica
mercury
vinyl chloride
lead (not considered a designated substance if contained in X-ray safety clothing or equipment)

The Ministry of Labour closely regulates the use of these substances. Fortunately, veterinary practice employees are unlikely to handle any of these, with the exception of ethylene oxide (see special regulations given in the section on ethylene oxide in Chapter 4 of this handbook and contact the Ministry of Labour for more information).

7. Posting Requirements

Employers are required to post a copy of the Occupational Health and Safety Act in their workplace. The act is available online for free, or can be purchased from Publications Ontario for a cost of $8 plus GST. The online ordering search code is 111759.

Employers must also post a health and safety policy (see next item).

Employers must also prominently displace the poster entitled "In Case of Injury –1234" in the workplace. This is provided free of charge and can be obained online or by calling 1-800-663-6639.

8. Health and Safety Policy

The Ontario Health and Safety Act requires that employers prepare and review at least once yearly, a written occupational health and safety policy, and to develop and maintain a program to implement that policy. Detailed information about preparation of a health and safety policy can be found in Appendix A of the *Guide to Occupational Health and Safety Act,* which can be found on the Ministry

of Labour website at www.labour.gov.on.ca/english/hs/ohsaguide. The following is an example of such a policy. (template provided by the Ontario Ministry of Labour)

Health and Safety Policy

Management of NAME OF VETERINARY CLINIC is vitally interested in the health and safety of its employees. Protection of employees from injury or occupational disease is a major continuing objective. THE CLINIC will make every effort to provide a safe, healthy work environment. All supervisors and workers must be dedicated to the continuing objective of reducing risk of injury.

CLINIC OWNER'S NAME as employer, is ultimately responsible for worker health and safety. As owner, I will take every reasonable precaution for the protection of workers.

Supervisors will be held accountable for the health and safety of workers under their supervision. Supervisors are responsible to ensure that machinery and equipment are safe and that workers work in compliance with established safe work practices and procedures. Workers must receive adequate training in their specific work tasks to protect their health and safety.

Every worker must protect his or her own health and safety by working in compliance with the law and with safe work practices and procedures established by the company.

It is in the best interest of all parties to consider health and safety in every activity. Commitment to health and safety must form an integral part of this organization, from the president to the workers.

Signed:
Clinic owner

APPENDIX 3

STANDARD PRECAUTIONS FOR VETERINARY CLINICS

(From the Centre for Food Security and Public Health, Iowa State University)

Standard Precautions approach infection control with the concept that all blood and body fluids should be treated as if they are infectious. These precautions help prevent disease transmission from staff to patient, patient to patient, and patient to staff. Standard Precautions include hand washing, barrier protection, limiting contact, disposing of waste appropriately, and cleaning and disinfection protocols.

Hand washing is the single most important measure for reducing the risks of transmitting organisms. Hands should be washed:

-Before and after handling each patient
-After touching blood, body fluids, secretions, excretions and contaminated items, whether or not gloves are worn
-Immediately after gloves are removed
-Between tasks and procedures on the same patient to prevent cross-contamination of different body sites
-After handling laboratory specimens or cultures
-After cleaning cages or animal care areas
-Before meals, breaks, smoking and leaving work for the day
- Before and after using the rest room
- When hands are visibly soiled

The recommended technique for hand washing:

-Wet hands and forearms with warm water
-Add at least 2 full pumps of soap to palm of hand
-Lather up and vigorously scrub each side of the hands beyond the wrist for 10-30 seconds, cleaning between fingers, under rings and fingernails
-Rinse under warm water until all soap residue is removed and dry hands with paper towel or warm air dryer
-If it is not possible to wash your hands immediately (when working in the field), wet wipes with alcohol or hand sanitizers can be used until you have access to warm water and soap.

Barrier protection should be appropriate for the type of procedures being performed and the type of exposure anticipated. Wear gloves, protective clothing such as lab coat, uniform, apron or coveralls when handling patients known or

suspected to be infected with infectious or zoonotic diseases. Washable boots, shoes or shoe covers may protect against infectious material being tracked around a hospital. This applies whether working with infected tissues or body fluids, treating a live animal in cages or stalls, cleaning cages occupied by animals with infectious diseases, or handling the carcass of an animal that has died of a potential infectious/zoonotic disease. Additional protection in the form of a mask, eye protection, or respirators, may be necessary depending on the circumstances and disease.

Limit the staff that comes into contact with infectious animals to only those essential for its care. The fewer the number of individuals exposed, the less the risk of disease spread.

Dispose of infectious waste appropriately. Waste should be bagged in the area where it was generated and re-bagged once outside of the infected area.

Isolation of Infectious Animals: Animals with a contagious or zoonotic disease should be housed in isolation as soon as possible. Clearly mark the room or cage to indicate the patient's status and describe additional precautions. Only equipment needed for the care and treatment of the patient should be kept in the isolation room, and there should also be dedicated cleaning supplies. Disassemble and thoroughly clean and disinfect any equipment that must be taken out of the room. Discard gloves after use. Discard other personal protective equipment (e.g., gown, mask) in the isolation room or leave in the room for reuse. Clean and disinfect protective equipment between patients and whenever contaminated by body fluids or excretions. Bag potentially contaminated materials before removal from the isolation room. Use disinfectant foot bath before entering and leaving the room. Access to the area should be limited. In case with a potentially serious zoonotic disease, keep a sign-in log of all people (including owners or other non-employees) having contact with the patient in isolation. Monitor air pressure daily while the room is in use.

Cleaning and Disinfection of Equipment and Environmental Surfaces: Clean surfaces and equipment first to remove organic matter, and then use an hospital disinfectant, applied according to manufacturer's instructions. Minimize dust and aerosols when cleaning. Clean and disinfect animal cages, toys, and food and water bowls between animals and whenever visibly soiled. Clean litter boxes once a day. Wear gloves when cleaning, and wash hands afterwards. There should be a written checklist for each area of the facility (e.g., waiting room, exam rooms, treatment area, kennels) specifying the frequency of cleaning, disinfection procedures, products to be used, and staff responsible.

Handling Laundry: Wear gloves when handling soiled laundry. Wash animal bedding and other laundry with standard laundry detergent and machine dry. Use separate storage and transport bins for clean and dirty laundry.

APPENDIX 4

SPILL CLEAN UP PROTOCOL

If a spill of a potentially toxic substance occurs (including a biological sample from an animal with a zoonotic disease, liquid anesthetic, X-ray developing fluid, formalin, concentrated cleaners, or solvents) the cleanup procedure should be as follows:

1. All personnel not directly involved in the cleanup should leave the vicinity immediately. In particular, pregnant personnel should not participate in clean-up efforts.
2. If anyone's skin or clothing has been contaminated, remove the contaminated articles and thoroughly wash any contaminated skin. Seek medical attention, if necessary.
3. If the spilled substance is likely to release vapours or aerosols, close doors to the rest of the building and turn off the central vacuum system. Persons remaining in the room should wear respiratory protection.
4. Increase ventilation as much as possible by opening outside doors and windows.
5. Staff involved in the cleanup should wear protective equipment: a lab coat or coveralls and vinyl or plastic gloves in the case of a chemical; and a lab coat or coveralls and latex or rubber gloves in case of an infectious substance.
6. Remove all contaminated articles and place them in an airtight container outside the building.
7. Pour absorbent material such as kitty litter on the spill, such that the liquid is completely absorbed.
8. If the spill involves a biohazardous substance (for example, a urine sample from an animal with leptospirosis), the absorbent material should be sprayed with disinfectant after use, moving from the outside towards the center.
10. Once absorption is complete, use a broom to sweep up the litter, and dispose of it in an airtight container, outside the clinic.
11. If the spill is large or if protective equipment is not available, all personnel should leave the building and the local fire department should be notified.

APPENDIX 5

TERMS USED ON MATERIAL SAFETY DATA SHEETS

Acute exposure: A single exposure to a substance, or multiple exposures occurring within a short time (24 hours or less)

Auto-ignition temperature: Temperature at which the vapour from a liquid will ignite without a source of ignition such as a spark or flame.

Ceiling Exposure Limit (C or CEL): The maximum concentration of a chemical to which one may be legally exposed at any time. This value is never to be exceeded without special precautions.

Chronic Exposure: Repeated exposure to a substance over a relatively long period of time, typically more than 7 years.

Combustible Liquid: Liquids with flash points 37.8'C (100'F) or more, but less than 200'C.

Flammable Liquid: A liquid with a flash point below 38.7'C (100'F).

Flash point: The minimum temperature at which a liquid gives off enough vapour to ignite in the presence of a source of ignition.

I.D.L.H: Immediately Dangerous to Life and Health. Usually refers to an atmosphere that would cause a person without respiratory protection to be fatally injured, or would cause irreversible and incapacitating effects on that person's health.

LC50 or LD50: Concentrations taken orally (LD50) or inhaled (LC50) that kill 50% of a test population (usually a laboratory animal). A low LC50 or LD50 indicates that a material is very toxic, whereas a high LC50 or LD50 indicates less toxicity.

Odour Threshold: The lowest airborne concentration of a chemical that can be perceived by the average person's sense of smell.

Parts per million (PPM) - Part of air by volume. A vapour or contaminant may for example, occupy 10,000 parts per million parts of air. The concentration of this vapour is 10,000 / 1,000,000, or 1% of the air.

Permissible exposure limit (PEL). The concentration that must not be exceeded during any 8 hour shift of a 40 hour week.

Short term exposure limit (STEL): The maximum exposure limit to which one may be exposed for a brief (generally 15 minute) period for a maximum of 4 such periods per day, without suffering serious health effects.

Threshold Limit Value (TLV): The airborne concentration of a material to which nearly all persons can be exposed to day after day without adverse effects.

APPENDIX 6

WHMIS REGULATIONS – A HOSPITAL CHECK LIST

1. Make a list of the WHMIS controlled products used in the clinic. This should include any chemical used in the hospital that has a supplier WHMIS label. The most common controlled products to be found in a veterinary clinic include oxygen and other compressed gases, formalin, ethylene oxide, carbon dioxide absorber in anesthetic machines, methanol and solutions containing methanol such as cold sterile fluid and common lab stains, X-ray fixer and developer, isopropyl alcohol, concentrated bleach, ether, acetone, and glutaraldehyde. You can also contact your suppliers and ask for a list of the WHMIS chemicals that they ship. Be aware, however, that some companies issue an MSDS for materials that are NOT covered by WHMIS legislation (for example, prescription drugs and disinfectants) and these are not controlled products and therefore don't need WHMIS labels.

2. Consider whether you can substitute a less hazardous product or eliminate the chemical from the workplace altogether (for example: ether, mercury)

3. Make sure you have an MSDS for each WHMIS chemical. Gather them together in a binder and put them in a place that is accessible to all staff.

4. Make sure that all controlled products that you receive have a supplier label. If the shipment comes without such a label, contact the supplier to find out if the product is exempt.

5. Ensure that all decanted controlled products have workplace labels (for example, cold sterile solutions containing methanol, or isopropyl alcohol containers in the exam rooms)

6. Identify and evaluate the hazards of WHMIS controlled products and other products (e.g. cytotoxic drugs, prostaglandins) in the clinic. Consider the quantities that are used and stored and the extent of exposure. Then ensure that all staff who handle these chemicals are familiar with their hazards. One way to do this is to train each employee to recognize a hazard label, and the general characteristics of each hazard class and work procedures needed to safely handle the chemicals in this class.

7. Make sure that every hospital employee who uses a WHMIS controlled product knows how to safely dispose of the chemical and is familiar with procedures for treating accidental inhalation, eye splash, or skin contact.

8. Develop procedures for spill cleanup (see also Appendix 4) and what to do in case of fire (see Appendix 7) and post in a prominent place.
9. Ensure that the following protective equipment is available:

    - organic vapour respirator for clean up of spills that release vapours (liquid anesthetics)
    - eyewash fountain if there is a risk of eye splash
    - rubber gloves for handling X-ray fluids, disinfectants, other irritating or corrosive materials
    - chains or belts for securing large compressed gas cylinders
    - absorbent material (e.g. kitty litter) and other materials for spill clean up (see also Appendix 4)
    - fire extinguishers appropriate for the types of chemicals used in the hospital
    -chemical splash goggles to be worn if corrosive materials are to be poured from one container into another

10. Ensure that proper ventilation or scavenging is provided for any procedure in which hazardous vapours may be present (developing X-rays, sterilization, using ethylene oxide, application of pesticide dips or sprays, administration of anesthetic gases).

11. Keep a record of dates of staff training and equipment maintenance (for example, anesthetic machine service and X-ray inspection)

12. Periodically evaluate the hospital with regard to WHMIS compliance – MSDS should be replaced every 3 years, workplace labels must be used as required, and education and training must be undertaken for all new staff.

APPENDIX 7

IN CASE OF FIRE

1. SOUND THE ALARM, CALL FOR HELP

2. The receptionist to call FIRE DEPARTMENT - Phone 911

3. Veterinary technicians alert staff and clients and ensure all clients and staff not involved in fighting the fire or evacuating animals leave the hospital. Check all rooms including the washroom. Meeting place for staff members is to be in front parking lot. DO NOT RE-ENTER THE BUILDING ONCE YOU HAVE LEFT !

4. If possible to do SAFELY...

a) evacuate animals and either place in vehicles or tie with leads to stationary objects (fences, etc..) outside the clinic.

b) close windows and doors

c) turn off the oxygen tanks

d) turn off fans

e) use fire extinguishers, but only attempt to extinguish the fire if it is small and it does not block your exit - otherwise shut the door to contain it to the area, and LEAVE!

APPENDIX 8

GUIDELINES FOR THE PREGNANT EMPLOYEE

Sometime during their career, many veterinary hospital employees will be faced with the difficult question of whether it is wise to continue working while pregnant. Most decide to remain at work for at least a portion of their pregnancy. The veterinary hospital employee who continues to work while pregnant must educate herself about the potential dangers to the fetus which may be present in the workplace. Armed with this information, she can hopefully continue to work without unnecessarily jeopardizing the safety of herself or the fetus.

No one can guarantee the outcome of a pregnancy, and it is impossible to totally eliminate every risk. The information available for many chemical and physical agents (including noise, X-rays and electromagnetic radiation) is incomplete. Some agents have the potential to harm the embryo from the moment of conception on, and the embryo may be adversely affected even before the woman realizes she is pregnant.

However, many women work in veterinary hospitals throughout their pregnancy and deliver healthy, normal babies. The chances of doing so are increased if the employee uses caution in several areas of the hospital, including those described below. The employee should use her best judgement in consultation with that of her physician to interpret and act on the information currently available.

CONTINUATION OF TASKS – The American Veterinary Medical Association suggests that the following tasks not be performed past 20 weeks gestation: lifting more than 50 lb; stooping and bending below knee level more than 10 x per hour. Past 24 weeks of gestation a pregnant woman should not stand for more than 4 hours or lift more than 25 lb. Past 32 weeks of gestation the pregnant woman should not stand for more than 30 minutes per hour. Past 40 weeks of gestation, many tasks should be avoided, including prolonged sitting, repetitive stairs, and repetitive lifting even of light objects.

ANESTHETIC GASES – Avoid exposure to high levels of waste anesthetic gases, especially halothane, nitrous oxide, and methoxyflurane. Although the evidence is somewhat contradictory, some studies have shown an increase in the incidence of congenital abnormalities and miscarriage after the mother is exposed to waste anesthetic gases in the surgical environment. A pregnant employee should not clean up spills of liquid anesthetics or be assigned to filling or emptying vaporizers. Anesthetic techniques which release large amounts of waste anesthetic gas into the room should be avoided, including the use of masks for

induction, anesthetic chamber induction. The use of endotracheal tubes with well inflated cuffs is preferable to the use of face masks. An effective scavenger system must be connected to the anesthetic machine whenever it is in use. If no scavenger is available, the pregnant employee should not be in the same room as the anesthetic machine when it is in use. It is advisable that monitoring badges or other method of measuring waste gas levels be used early in the pregnancy, in order to ensure that excessive levels of waste gas are not present. Present information indicates that risk to the pregnant employee is minimal if the 2 ppm level of waste anesthetic gas is achieved in every location where anesthesia is performed (particularly if the anesthetic used is isoflurane or sevoflurane). See Chapter 2 for more information.

PHARMACEUTICALS AND CHEMICALS – Pregnant employees should avoid handling materials that have an adverse effect on the fetus, including ethylene oxide (Anprolene), hexachlorphene soaps, pesticides, solvents, formaldehyde, prostaglandins, and drugs used in cancer chemotherapy. This list of chemicals is incomplete and the pregnant employee should consult drug labels and product MSDS for information on the teratogenicity of chemical agents in use in her workplace. Employees should routinely utilize protective equipment such as gloves when handling any chemical deemed to be hazardous (e.g. has a hazard class symbol on the label or is a WHMIS product). See Chapter 4 for more information on chemical hazards and WHMIS.

ZOONOSES – The zoonoses of primary concern to pregnant women are toxoplasmosis, Q fever, listeriosis, lymphocytic choriomeningitis, cat scratch disease and chlamydiosis. For information on these diseases, see specific disease headings (e.g. toxoplasmosis) in Chapter 1.

X-RAYS – Authorities differ on the danger of X-ray radiation to the fetus. Ideally, the employee should not participate in X-ray procedures (whether occupational, or for medical or dental diagnostic purposes). However, some studies suggest that there is little risk to the pregnant employee provided proper protective equipment is used, including dosimeters and lead-lined gloves and aprons), the X-ray machines have been recently tested and shown to be operating in a safe manner, and provided maximum permitted radiation exposure is not exceeded (see Chapter 3 for more information).

QUIZ ANSWERS

Chapter 1: Biological Hazards

1. T
2. F
3. T
4. T
5. T
6. F
7. T
8. T
9. E
10. C
11. E
12. E
13. C
14. B
15. E

Chapter 2: Waste Anesthetic Gas

1. T
2. F
3. T
4. T
5. T
6. T
7. T
8. F
9. T
10. increased
11. more
12. do not
13. will not
14. 30 ppm
15. greater

Chapter 3: Radiation Safety

1. T
2. T
3. F
4. T
5. F
6. T
7. F
8. T
9. F
10. T
11. T
12. T
13. T
14. T
15. F

Chapter 4: Chemical Hazards

1. T
2. F
3. T
4. T
5. F
6. F
7. F
8. F
9. F
10. T
11. T
12. T
13. F
14. T
15. F