

Module 04 - Occupational Health and Safety in Experimental Animal Facilities

The Objectives of this Module will allow the reader to:

- Understand the ways common laboratory animal species react, or defend themselves, if a procedure causes pain, or they perceive their safety to be threatened
- Describe the pertinent aspects of safe handling and performance of manipulations
- Describe the procedure for reporting animal related injuries
- Identify the proper waste disposal procedures in animal facilities
- Define zoonoses, and give examples of animal infections that can be transmitted to humans
- Outline the levels of biohazard control, and methods used to minimize biohazard risks
- Describe the sources of animal allergy
- Describe the procedures necessary to minimize exposure to animal allergens

Introduction

Working safely with experimental animals encompasses not only the people and the animals, but also the facilities, equipment, and the procedures we use. It also encompasses the community in which we each live. We must each practice safe working habits to ensure that any health risks in our working environments never "leak" into the community because of faulty procedures or carelessness. The principal investigator must assume responsibility for ensuring that personnel working on the project are aware of any risks to health and safety. Policies and programs required under the Ontario Occupational Health and Safety laws and regulations are implemented by the University of Windsor to support a safe working environment in animal holding and research facilities.

Physical Hazards Associated With Experimental Animal Care and Use

Avoiding Physical Injuries

Many tasks in animal facilities require moderate to heavy physical labour, and performing these tasks may expose personnel to risks from moving heavy equipment (strains), slippery floors, electrical hazards when washing cages, etc. Each person must exercise due caution when performing such tasks. Although the importance of understanding basic animal behaviour in the human/experimental animal interaction to avoid injuries can be emphasized here, it cannot replace the skills that are learned by working directly with the animals. Skilled animal care technical staff will already have the right attitudes and approaches towards animal handling and manipulations. They will also have the practical skills to do so safely and humanely. For others, some of the material presented here can serve as a useful introduction to handling animals safely in an experimental animal facility.

To work safely with an experimental animal a person should:

- understand basic animal behaviour in relation to their interactions with people during handling
- appreciate the "flight zones" typical of a species
- understand how to communicate with the animal
- use appropriate restraint techniques
- use restraint equipment properly
- identify any animals that may be unpredictable
- wear appropriate protective clothing and equipment
- maintain appropriate vaccination status

Basic Animal Behaviour Related to Handling and Manipulations

The flight zone is an animal's "personal space". The size of the flight zone varies with the tameness of the animal, and other animal-related factors. Completely tame animals have little or no flight zone and a person can touch them. An animal will begin to move away when the person enters the edge of the flight zone. When the person is outside the flight zone, an animal (or group of animals in a herd) will turn and face the person while maintaining a safe distance. It is probably safe to say that when animals are in small cages or pens, all human "intrusions" are

inside the animal's flight zone. Therefore, it is very important to condition the animals to regular handling to reduce the apprehension and stress imposed by human presence. When an animal is apprehensive (e.g., about being picked up), aggressive (e.g., about to attack), or defensive (e.g., protecting itself, or its young in the case of a mother), its posture and other behavioural signs can give clues about its state and possible intentions. In many mammalian species the "warning" postures includes lowered head, ears down or back, and in the smaller animals, mouth open in a snarl. By carefully observing the animal's behaviour while approaching it, injuries such as bites and scratches can be avoided.

Communicating With the Animal

Your voice, your touch, your smell, are all part of an animal's knowledge about you. To establish a two-way familiarity before a project starts, the people who will be handling or restraining the animals should talk to, touch, and regularly handle each animal. The conditioning period after transport to the laboratory (usually one or two weeks) is an excellent time to begin. Consistency in handling each animal is important. Most laboratory animals learn very quickly who their regular handlers or caretakers are, and accept the handling without undue stress.

Using Appropriate Restraint Techniques

Different species defend themselves in different ways. For example, a mouse, rat, hamster or dog may bite, a rabbit may struggle furiously and kick or sometimes bite to try and escape, a cat may scratch (with intent!) or bite. The approach to restraining the animal, including any equipment used for restraint, is to prevent the animal from taking such action while ensuring it is safely and humanely held. Although the correct approach to handling and restraint can be understood from printed and audio-visual materials, practice is essential. Appropriate handling and restraint methods have been developed for most laboratory animal species. Skills in the appropriate handling and restraint methods should be attained BEFORE the research project starts. (The handling and restraint of non-human primates require special training, equipment and facilities.) For more information see CCAC Guide, Volume 1, 2nd Ed. 1993. Chapter VIII. Occupational Health and Safety.

Use of Restraint Equipment

For some procedures such as intravenous injection in a rabbit, restraint devices or equipment are useful adjuncts to the handling, and help ensure that the procedure can be done safely for both the animal and the person. Correct use of such restraint devices will help avoid unnecessary stress or injury to the animal during the procedure. Conditioning the animal to accept the restraint device is important to minimizing the risk of injury both to the animal and to the handler.

Use of Chemical Restraint

The safe handling of some species either in the laboratory, or in the field, may require the use of "chemical" restraint. Chemical restraint is the use of sedatives or anaesthetics to control an animal's activity and thereby allow certain procedures to be done with minimal stress to the animal. Some of the drugs discussed in the Analgesia and Anaesthesia modules of this course are useful for chemically restraining animals in circumstances where physical restraint represents a serious risk of harm to the animal or the handler, or is not feasible (e.g., many wild species).

Wearing Appropriate Protective Clothing

Protective clothing suitable for the handling to be done should be worn at all times; laboratory coats, coveralls, gloves, masks, boots (e.g., steel-toed for working with cattle), etc.

Identifying Problem Animals

Any animal known to be difficult to handle should be so identified to all who might be working with it (e.g., weekend staff, veterinarian). As an experienced veterinarian once said, "I've never been bitten by a "biting" dog, but I've been bitten by lots of dogs that didn't bite".

Immunization of Staff

Tetanus Vaccination. To minimize the risks associated with infections arising from any penetrating wounds such as animal bites or needle sticks, all persons working in laboratory animal facilities should maintain their tetanus vaccination status.

Rabies Vaccination. All persons at risk of exposure to rabies from any animals that may be infected should consider vaccination for rabies. Any animals brought into experimental animal facilities that might have been exposed to rabies should be considered risks. Generally this refers to any domestic animals housed outdoors (including farm or fur animals), random source dogs and cats, and any wild animals. Institutions may require staff to have rabies vaccination as a condition of working with such species.

Other Vaccinations. Depending on the species handled (e.g., non-human primates) other immunizations may be recommended as part of a health and safety program. Appropriate records on the vaccination status of all employees should be maintained by the institution.

Animal-Related Injuries, Management and Reporting

Any animal-related injury that may be serious should be handled by the usual emergency medical care system. Apply the appropriate first aid, and if severe take the injured person to a hospital emergency department as soon as possible. Any minor injuries or incidents (e.g., a laboratory mouse or rat bite) should be handled by the appropriate first aid, and documented. The University of Windsor has a procedure for documenting all injuries, including minor ones, in case complications develop later. The mechanism may be as simple as filing an incident report form.

Safe Waste Disposal Practices in Animal Facilities

Work in animal facilities commonly involves use of sharp instruments. All sharp items (e.g., needles, scalpels, capillary tubes, etc.) must be handled safely, and placed in designated sharps containers for disposal as per university policy. Needles should never be re-used.

Animal Waste Disposal. All animals, animal wastes and related materials should be disposed of as per university policy. Institutions commonly have a protocol defining proper disposal of all animal carcasses or organs. (see AC Handbook and appropriate SOP posted in the animal holding rooms).

Biological Hazards of Working with Experimental Animals

Zoonoses. The CCAC Guide defines zoonosis as a disease of animals that may under natural conditions be transmitted to humans. What this really means is a disease that it is communicable between animals and humans. The list of potential zoonoses related to working with animals in research, teaching or testing is quite long, and numerous books have been written on the subject. (See Appendix VII Zoonoses of Volume 1 of the CCAC Guide to the Care and Use of Experimental Animals). However, in reality the risks are very low when dealing with the common small laboratory animal species in the laboratory. There are several reasons for this low risk. Firstly, commercial suppliers of laboratory animals have done an excellent job of producing disease-free animals. As well, the university has developed a good occupational health and safety program. The risk of exposure to zoonotic diseases is greater for those who work with experimental animals from random sources (including cats, dogs and most livestock), and for field researchers studying wild animals in their habitat. Working with non-human primates in the laboratory is a special case because of the many zoonotic concerns. A few of the zoonoses common in each of these areas of animal research are given below as examples. For more information on zoonoses, and for more information about specific disease organisms, the Material Safety Data Sheets (MSDS) for individual organisms published by [Health Canada Office of Laboratory Security](#) can be consulted.

Routes of Exposure. Common routes of exposure to infectious organisms are:

- aerosol (inhaling the organisms)
- ingestion (swallowing the organisms)
- absorption through the skin, through mucus membranes or skin wounds
- injection (accidental, in research)

The use of appropriate equipment, including personal protective equipment appropriate to the route of exposure for a particular infectious organism, and appropriate practices, will minimize the risk of exposure.

Zoonoses associated with commercially produced laboratory animal species. As noted above, the risk of exposure to a zoonosis while working with common small laboratory animals that are commercially reared is very small. One example is presented here: Rat bite fever.

Rat Bite Fever



- Organism name, and synonyms: *Streptobacillus moniliformis*, a Gram-negative bacteria. Synonyms: Rat-bite fever, Haverhill fever.
- Reservoir: Rats. Commensal in the mouth and pharynx.
- Mode of Transmission: Animal bite, direct contact with secretions of the mouth, nose, eye of an infected animal.
- Incubation Period: 3-10 days.
- Clinical Disease: Initial bite wound usually heals. Sudden onset of fever, chills, vomiting, headache and joint pains, rash.
- Epidemiology: Uncommon in North America.
- Communicability: Not directly transmitted from person to person.

Zoonoses associated with random source laboratory animal species.

Ringworm – a fungal infection of the skin that can occur in a wide range of animals including humans.



- Organism names, and synonym: *Microsporum spp.*, *Trichophyton spp.*, fungal organisms.
Synonyms: Ringworm, dermatomycosis, tinea.
- Reservoir: Most domestic and wild animals, and humans. May be latent in hair of some species.
- Mode of Transmission: Direct or indirect contact with skin lesions or infected hair, or fomites (brushes, clippers, etc.).
- Incubation Period: 4-10 days.
- Clinical Disease: The fungi infect keratinized areas of the body - hair, skin and nails. Signs include round lesion of scaling skin, hair loss or breakage, sometimes reddened and crusting of infected skin.
- Communicability: Communicable from person to person when infective lesions are present.
- Diagnosis and Prevention: Monitoring for typical signs, confirmed by skin scrapings and culture. Many treatments are available.

Rabies



Rabies can infect any mammal, including humans. Purpose-bred laboratory animals are not a likely source of rabies. However wild animals, animals obtained from random sources, or livestock, may carry rabies. Many institutions have rabies vaccination policies for at-risk personnel.

- Organism name, and synonym: Rabies - a rhabdovirus, Rabies, Hydrophobia.
- Reservoir: Wild and domestic animals (e.g., dogs, cats, foxes, coyotes, skunks, racoons) and bats.
- Livestock and rodents may be secondary hosts if infected by a biting animal.
- Mode of Transmission: Most commonly by a bite which introduces the virus from the saliva of a rabid animal. May be airborne in caves inhabited by infected bats.
- Incubation Period: Usually a few weeks, but may be up to a year or longer. The virus propagates in nerves. Thus the site of the wound (distance from the brain), presence of nerves at the wound, etc., influence the incubation period.
- Clinical Disease: Once clinical signs appear, the clinical course is short - usually less than 10 days with death due to respiratory paralysis. Signs include apprehension, behavioural changes, spasms of swallowing muscles, delirium, weakness progressing to paralysis.
- Epidemiology: Worldwide distribution with some rabies free areas. All mammals are susceptible.
- Communicability: Infected animals shed virus for a few days before clinical signs appear. From then until the death of the animal, it is infectious.

- **Diagnosis and Prevention:** Pre-exposure immunization of all individuals at high risk (those who will handle animals, including laboratory workers, veterinarians and other animal handlers) should be carried out. The human diploid cell vaccine (HDCV) is currently used. Post-exposure treatment includes immediate first aid by generously flushing the wound and washing with soap and/or antiseptics, and providing post-exposure treatments as directed by the physician (e.g. rabies immune globulin, and vaccination).

Zoonoses Associated with Wild Animals and Field Studies

Hantavirus Infection. Deer mouse - *Peromyscus sp.* The main rodent reservoir for Hantavirus infection in humans.

- **Organism name, and synonym:** Hantavirus, an RNA virus in the Bunyavirus family. Synonyms: hantavirus, hantavirus pulmonary syndrome (HPS), Sin Nombre Virus (SNV) in North America.
- **Reservoir:** Wild rodents such as *Peromyscus* (deer mouse) and *Microtus* species in the Americas.
- **Mode of Transmission:** Inhalation of the virus in the dust from areas where infected rodent excreta (urine and feces) are present is the most common route. Rodent bites may transmit the disease.
- **Incubation Period:** Average two to four weeks but may be shorter or longer.
- **Clinical Disease:** Hantavirus Pulmonary Syndrome (HPS) is characterized by a sudden onset fever, pain, vomiting, and onset of respiratory distress and prostration. Mortality rates are high despite symptomatic treatment.
- **Epidemiology:** Occurs throughout much of North America including the western provinces.
- **Diagnosis and Prevention:** Use of personal protective equipment to avoid inhaling the dust particles with virus, and other direct contact in high risk areas should be used. Field Biologists and persons working in previously "contaminated" buildings are at risk.
- **Communicability:** Not thought to be communicable between persons.

Exposure Control Plans

Any circumstances that present particular risks of zoonotic infections should be identified before the risks are encountered. This includes immune compromised states (e.g., HIV infection, anti-rejections drugs or steroids, pregnancy, etc.). Provincial Occupational Health and Safety regulations commonly define a requirement to develop a written "exposure control plan" for workers required to handle, use or produce an infectious material or organism or likely to be exposed. Responsibility for this rests with the employer. Such a written plan includes: identifying workers at risk, routes of infection, signs and symptoms of disease, vaccination, engineering controls, personal protective equipment, personnel training, safe work practices and procedures, dealing with accidents, and investigating accidents.

Biohazards as Part of Research Programs

When experiments are planned that will involve biohazardous agents, both the institutional occupational health and safety office, and [Health Canada, Office of Laboratory Security Laboratory Biosafety Guidelines](#) must be consulted. [Material Safety Data Sheets](#) (MSDS) are available for the individual organisms in the risk groups.

Biosafety Guidelines and Levels of Containment

Biohazards are rated at four levels with a risk group associated with each level. Containment levels refer to the physical requirements and risk groups refer to the pathogenicity of the organisms.

Biosafety Level 1 is required to manage the lowest risk and **Biosafety Level 4** is required to manage the highest risk to human or animal health. The attitudes and actions of those who work in the laboratory determine their own safety, and that of their colleagues and of the community. Laboratory equipment and design can contribute to safety only if they are used properly by people who are genuinely concerned and knowledgeable about safety issues. Since the University of Windsor is not physically equipped to conduct research requiring Level 3 or Level 4 containment, we will address only requirements for Levels 1 and 2.

Biosafety Level 1

Risk Group 1 infectious agents are biological agents that are unlikely to cause disease in healthy workers or animals (low individual and community risk). Facilities required to contain risk group 1 organisms - Containment Level 1: No special facilities, equipment or procedures are required. Standard well-designed experimental animal and laboratory facilities and basic safe laboratory practices suffice. Hand-washing facilities must be provided. Disinfectants must be properly used.

Biosafety Level 2

Risk Group 2 infectious agents are pathogens that can cause human or animal disease but, under normal circumstances, are unlikely to be a serious hazard to laboratory workers, the community, livestock, or the environment (moderate individual risk, limited community risk). Laboratory exposures rarely cause infection leading to serious disease; effective treatment and preventive measures are available and the risk of spread is limited. Facilities, equipment, and procedures required to contain risk group 2 organisms at Level 2 include a laboratory separated from other activities, biohazard sign, and room surfaces impervious and readily cleanable. Equipment should include an autoclave, certified HEPA filtered class I or II biological safety cabinet for organism manipulations, and personal protective equipment to include laboratory coats worn only in the laboratory, gloves worn when handling infected animals. All contaminated material to be properly decontaminated.

Allergies to Laboratory Animals

Laboratory animal allergy (LAA) may be the most prevalent occupational hazard facing people working in experimental animal facilities. Surveys have revealed that up to 44% of people working with laboratory animals develop allergies to one or more species, and they usually become allergic within 3 years of first exposure (range; 1 month to 9 years). Allergic reactions can be classified according to the site of the reaction: upper respiratory; lower respiratory; skin; generalized, anaphylactic. In any individual, several symptoms may occur. The upper respiratory symptoms are the most common - up to 80% of affected people experience symptoms such as itchy, runny nose and eyes, and sneezing. About 20-30% of affected people experience lower respiratory symptoms, some progressing to occupational asthma. There is shortness of breath due to bronchoconstriction and airway mucus production. Asthma may

become life-threatening if not treated. About 40% of laboratory animal allergic people experience skin reactions upon contact with the animal or the allergens. Much rarer, fortunately, is the acute generalized reaction (anaphylaxis) requiring emergency treatment. There are only a few documented cases of anaphylactic reactions to laboratory animal bites (e.g., rat bites). Almost all species of common laboratory animals can trigger an allergic reaction. Allergies to the rat, rabbit, mouse, guinea pig, cat and dog are the most common. The animal allergens are mostly small molecular weight proteins in the albumen family. These proteins occur in the serum and tissues, but also in the saliva, urine and skin dander. When animals groom themselves, the salivary proteins also end up on the skin, and on the dander particles that flake off and become aerosolised.

Risk Factors for Becoming Allergic to Laboratory Animals. The risk factors for becoming allergic to laboratory animal allergens include atopy, smoking, gender and intensity of exposure. There is a correlation between atopy (an inherited, familial tendency to develop some form of allergy such as hay fever, asthma, eczema) and the potential for developing LAA, and a stronger positive correlation between atopy and development of lower respiratory symptoms (asthma). Pre-employment health screening may be useful to identify atopic individuals. Smoking reportedly does not increase the risk of developing LAA, but if a smoker does develop LAA, they are 1.5-3 times as likely to get the lower respiratory symptoms (asthma). Males are more likely to be atopic than females (47% vrs 37%) and so more likely to develop LAA. There is a strong correlation between the intensity of exposure to the allergen, and the severity of symptoms. However, any allergen exposure, even very low levels, will trigger symptoms in allergic individuals.

Ventilation and Relative Humidity – animal holding rooms. Directional room ventilation, negative flow laminar ventilated cage racks, or ventilated racks assist in reducing particles in room air. Low relative humidity results in higher dust and allergen levels. A relative humidity of 50-65% significantly reduces the quantity of allergen being aerosolized.

Type of Bedding. Studies have shown that sawdust/wood chip bedding results in higher levels of aerosolised allergen in rodent rooms than corncob bedding. Use of processed paper products and absorbent pads result in lower levels of aerosolised allergens.

Cleaning and Sanitation Practices. A high level of cleanliness results in reduced levels of allergens circulating in laboratory animal rooms.

Animal Room Tasks Associated with Exposure to Allergens. All commonly performed animal room tasks result in significant exposure to airborne allergens and dust. Cage cleaning (and waste dumping), animal care procedures (feeding, watering, etc.), animal manipulations (e.g., handling, injections), and general room cleaning all result in significant levels of airborne allergens.

Reducing Exposure to Allergens. There are several approaches to reducing exposure to laboratory animal allergens. Housing rodents in filtered cages and ventilated cage racks, use of ventilated waste dumping stations and laminar flow hoods for animal manipulations, will all help minimize exposure to laboratory animal allergens. Maintaining a high level of cleanliness, and using a bedding type that minimizes aerosol dust particles will also help minimize exposure to laboratory animal allergens. The appropriate use of personal protective equipment such as good quality particulate masks and gloves can significantly reduce exposure to animal allergens. Such equipment should be provided for all staff required to work in high exposure areas. As well, good personal hygiene (regular hand washing, showering, etc.) should be practised.

Chemical Safety

Experimental animal facilities routinely contain various chemicals such as detergents, disinfectants, anaesthetics, tissue preservatives (e.g., formalin). Most staff will be familiar with safe work practices for use of these chemicals. A laboratory animal facility should be following the [Canadian Workplace Hazardous Materials Information System \(WHMIS\)](#), which consists of labelling chemicals, provision of material safety data sheets (MSDSs) and employee education programs. A detailed discussion of all the chemicals used in experimental animal facilities, their hazards and safe use is beyond the scope of this module.

Radiation Safety

Most institutions have a program in place to ensure work with ionizing radiation, including isotopes injected into animals as part of their research use, is done safely. [Training and licensing of users and facilities are mandated.](#) A detailed discussion of the use of radiation in experimental animal facilities, their hazards and safe use is beyond the scope of this module. Remember: YOU are the primary person responsible for working safely in your laboratory animal facility!