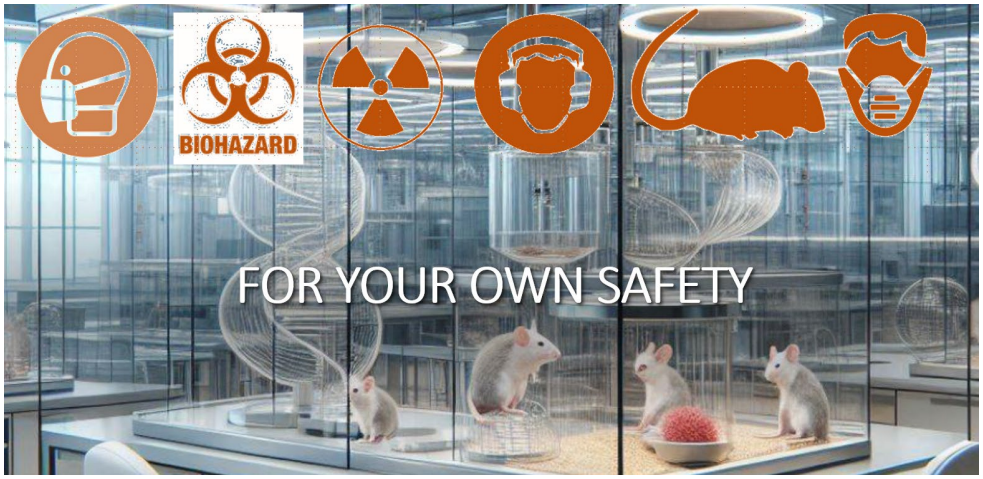
Occupational health and safety program – Animal facility UiB



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BIOLOGICAL HAZARDS

Biological health hazards - Allergy

Biological hazards represent an important occupational challenge in laboratory animal facilities, with rodent allergy being the most common health concern among exposed personnel. Understanding the sources of exposure, recognizing early symptoms, and implementing effective control measures are

essential for protecting employee health. Through comprehensive occupational health programs and proactive risk management, laboratory animal facilities can minimize biological hazards while maintaining high standards of animal care and research excellence.

Allergy to Laboratory animals

Allergy to Laboratory animals, especially rodents and rabbits, is a severe problem that needs attention and preventive action. The source of allergens is found in urine, salvia, and epithelia cells from the animals. You therefore also find large concentrations of allergens in the bedding of the animal cages, and especially old male animals excrete large concentrations of these allergens.

Allergies can also be a problem if you are working with farm animals. The most common problem is, however, not the animals themselves. Gras allergies are very common when you are exposed to grass or hay that are fed to the animals or used as bedding.

Allergy to fur bearing laboratory animals.

Allergy to fur bearing animals is a severe problem in animal research. Symptoms of allergy can be sneezing, watery eyes or rashes. In more severe cases, this can develop coughing, wheezing, short breath, and asthma.

Earlier studies have shown that 40% of all new employees at UiB developed IgE antibodies to rodents unless preventive initiatives and personal protective equipment are applied. It has also been demonstrated that people working with animals can bring allergens with them out of the animal facility. In this way there is a risk that sensitive people become allergic to laboratory animals without themselves being in direct contact with the animals.

In 2012 and 2022, the Lab Animal Facility, in cooperation with the occupational health unit at the University of Bergen, tested allergen

Question
It is said that rodent work should be done great precautions to prevent exposure to allergens. Many have had rodents at home when growing up. Are rodents for scientific use generally more allergenic than rodents for home keeping?

Answer:
Laboratory rodents are not generally more allergenic than pet rodents. The concern in research facilities is that personnel are exposed to much larger quantities of rodent allergens and much more frequent contact, especially during animal handling and cage cleaning. This higher cumulative exposure increases the risk of developing allergies over time.

concentrations at different places in the Lab Animal Facility.

We found, as expected, large concentrations in the dirty cage cleaning area. We also found large concentrations in situations when working directly with the animals, such as when changing cages and preparing for surgery.

In the following part, we will focus on these procedures and how you are expected to behave in the Laboratory Animal Facility at UiB.

Protection against allergy to fur bearing rodents

When you visit the Lab Animal Facility, you are exposed to allergens from animals.

The correct use of personal protective equipment (PPE) is of critical importance for protecting yourself, your colleagues, and the animals.

Before entering rodent areas, please change from your personal clothing into facility clothing. Blue or white trousers, blue or white T-shirts, and shoe covers are provided in the changing rooms. These measures help protect you, your colleagues, and the animals. For added comfort, we recommend bringing a pair of clean shoes to be used only within the Laboratory Animal Facility.

When working directly with animals in animal rooms or laboratories, you must wear appropriate personal protective equipment (PPE), including a protective gown, hair cover, gloves, and an FFP2 particulate respirator (dust mask).

FFP2 mask

A surgical mask protects the animals and other people from you. An FFP2 mask protects you from airborne particles generated by the animals and their environment.
Surgical masks primarily protect against droplets.

Respiratory protection, gloves, hairnets, protective glasses, and laboratory coats are all important because allergens can be carried in airborne particles, dust, fur, dander, saliva, urine proteins, and contaminated clothing or equipment. Together, these protective measures reduce both personal exposure and the spread of allergens to other people and areas.

Respiratory protection
Prevents inhalation of airborne allergen particles.
Particularly important when working with animals, bedding, feed, or during cage changing and cleaning activities that generate dust and aerosols.
Helps reduce the risk of developing respiratory allergies, asthma, and allergic reactions.

Gloves
Prevent direct skin contact with allergens.
Reduce transfer of allergens from animals, surfaces, or equipment to the face, eyes, and respiratory tract.
Help prevent contamination of door handles, keyboards, phones, and other shared items.

Hairnet
Prevents allergens from accumulating in hair.
Reduces transport of allergens from animal facilities to offices, homes, or public areas.
Helps protect colleagues who may be sensitized to allergens.

Protective glasses
Protect the eyes, which are a common route of allergen exposure.
Reduce irritation, itching, redness, and allergic conjunctivitis caused by airborne allergens or accidental splashes.
Provide an additional barrier when working in environments with high levels of dust or animal-derived particles.

Protective coat or gown
Prevents contamination of personal clothing with allergens.
Reduces the spread of allergens between rooms, facilities, and outside environments.
Makes it easier to remove contamination when leaving the work area by changing or laundering protective clothing.

FFP2 masks filter ≥94% of airborne particles and allergens and provide a tight facial seal.
Rodent work can generate allergen-containing dust and aerosols. Therefore, an FFP2 mask is required when working directly with animals.
The service life of an FFP2 dust mask depends on the level of allergen exposure in the work environment, but a mask must never be used for more than one working day. In areas with high allergen concentrations, such as during the emptying of used cages, the mask should be replaced immediately after the task is completed. Always record the duration of mask use, and do not use a mask for more than 7 hours in total.

Replace the mask sooner if it becomes damaged, contaminated, damp, or difficult to breathe through.

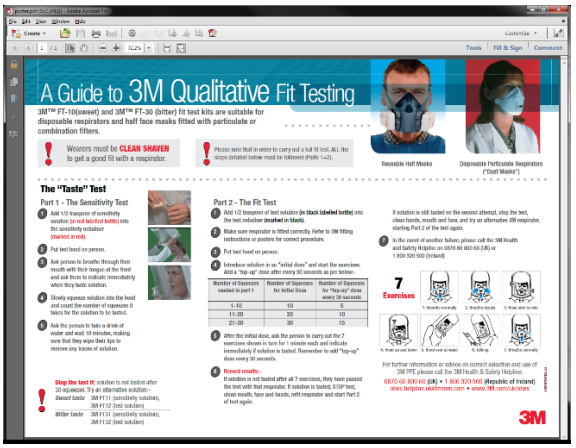
Make sure the mask covers well over the nose back (use the metal in the mask and adjust)

- Place the mask well under the chin.
- If there are adjustable straps, pull them so that the mask is comfortable.
- If the person is bearded, it may cause the mask to be bad / does not cover properly.
- Replaceable filters should be stored in a closed container in an area without exposure.

A fit-test should be performed for all employees to be sure that everyone uses a mask that fits the shape of their face.

Follow the instructions provided by the producer.

You can find personal protection equipment in the animal rooms. Change gloves frequently and never take the coat or the gloves out of the animal room as they belong to the barrier.



Why all these measures are needed together

No single control measure can completely prevent allergen exposure. Respiratory protection reduces inhalation, gloves reduce skin contact, glasses protect the eyes, and hairnets and coats prevent allergens from being carried to other locations. Together, they form a layered approach that:

- Protects workers from sensitization and allergic disease.
- Reduces symptoms in already sensitized individuals.
- Minimizes contamination of clean areas.
- Prevents allergens from spreading to coworkers, offices, homes, and public spaces.

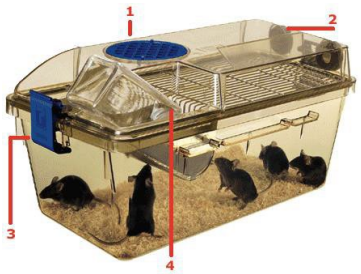
In laboratory animal facilities, this combined approach is particularly important because animal allergens can remain airborne, settle on surfaces and clothing, and be transported far beyond the animal room if appropriate protective equipment is not used.

Other technical protective measures

Besides the personal protective equipment, the

Lab Animal Facility is equipped with other technical means to prevent exposure to allergens and spread of infections.
Technical control measures such as Individually Ventilated Cages (IVCs) and change stations are among the most effective methods for reducing occupational exposure to laboratory animal allergens because they control allergens at the source before they can spread into the work environment.

IVC are closed cages that are connected to a closed ventilation circuit. All air in and out of such a cage is filtered through a HEPA- filter so that no allergens will escape into the room.



The IVC cage only protects you if the animals are inside the cage and the lid is closed. When you are handling the animals and opening the cage, you must do this in a ventilated bench such as a cage changing station or a laminar airflow cabin.

Individually Ventilated Cages (IVCs)

IVCs are cages supplied with filtered air and maintained under controlled airflow conditions.

How IVCs reduce allergen exposure:

- **Contain allergens within the cage**, preventing allergens from escaping into the room air.
- **Reduce airborne allergen concentrations** by continuously removing allergen-containing particles through ventilation and filtration.
- **Limit the spread of allergens** during routine animal housing.
- Protect workers who enter the room by lowering the overall allergen burden in the environment.

How IVCs reduce allergen spread:

- Air leaving the cage is typically passed through **HEPA filters**, which capture allergen-containing particles.
- Allergens are contained in individual cages rather than accumulating throughout the animal room.
- Reduce cross-contamination between animal groups and between rooms.

Change Stations and Biosafety Cabinets

Change stations provide a ventilated and filtered workspace for activities such as cage changing, animal handling, and husbandry procedures.

How change stations reduce allergen exposure:

- Capture allergen-containing dust, dander, bedding particles, and aerosols generated during cage opening and cleaning.
- Direct contaminated air away from the worker's breathing zone.
- Filter exhausted air through HEPA filters before it is released.

Where air-showers are installed, as a consideration to your colleagues and your own health, we encourage you to use the air shower after you have worked with animals or dirty cages, before you enter offices, lunchrooms, or any other area we want to keep free of allergens.

After working in the Lab Animal Facility, you are recommended to take a shower before you put on your private clothes. As an alternative to a water shower, there is also available an air shower. An air shower is equipped with fans that blow away most allergens within 90 seconds. This is much faster of course than taking a water shower. Studies have shown that there is a larger compliance among people to include this step when air showers are installed.

A study showed that allergens could also be found in the homes of people who work in a Lab Animal Facility! This underlines the importance of complying with the rules and use of protective equipment.

IVC cages and change stations help prevent allergens from becoming airborne and spreading throughout the facility. By containing allergens at their source and removing them through filtered airflow, these technical controls reduce workers' exposure and limit the transfer of allergens between rooms, equipment, and people. When combined with good work practices and personal protective equipment, they provide effective protection against laboratory animal allergens.

Other Technical Controls

Ventilation Systems
Provide adequate air exchanges within animal facilities.
Dilute and remove airborne allergens.
Maintain airflow from clean areas toward animal areas to prevent allergen spread.

Vacuum Bedding Disposal Systems
Minimize dust generation during bedding removal.
Reduce airborne allergen release compared with manual emptying.

Automated Cage Washing
Decrease manual handling of contaminated cages.
Reduce worker contact with allergen-rich bedding and cage surfaces.
Hierarchy of Control Perspective

Technical controls are generally preferred over personal protective equipment because they remove or reduce the hazard before it reaches the worker.

Most effective approach:

- Technical controls (IVCs, change stations, ventilation)
- Administrative controls (training, work practices, restricted access)
- Personal protective equipment (respirators, gloves, coats, eye protection)

Monitoring allergy development

Because allergies to laboratory animals are such a common and severe problem, the University of Bergen has a special health-monitoring program[1] for all students and employees who work with fur bearing animals more than 1 hour per week or 40 hours per year.

This service is organized by the occupational health service, and it includes consultation with the university's nurse and medical doctor. They perform lung function testing and take blood samples to test allergies.

You should have the first consultation before you start working with animals, and then have follow-up consultations after 6 months, 1 year and 2 years.

People at risk will likely develop allergies within the first 2 years. However, if you don't develop allergies within 2 years, this does not mean that you never will, so it is important that you continue to comply strictly with the rules of using protective equipment that are made to protect yourself as well as others.

The program at the occupation health service at the University of Bergen also includes vaccination against Tetanus. Other vaccination can be relevant for certain projects, like vaccination against Hepatitis or Tuberculosis. Contact your occupational health service.

For more information:

We have summarized most of this information in a document. You will receive this folder when you ask for access to the Lab Animal Facility. You can also get this folder by request to the Lab Animal Facility.

Despite preventive measures, some people develop animal allergies. If symptoms occur, consult your physician or occupational health service. If animal work must continue, strictly follow PPE requirements, especially respiratory protection. consider a fresh-air respirator and always shower after working in the facility. If allergies persist, explore alternative roles that do not involve animal exposure.

More about Biological health hazards

https://www.arbeidstilsynet.no/tema/biologiske-faktorer/

Preventing Cross-Species Contamination

Preventing the transmission of microorganisms between animal species is essential for animal health, biosecurity, and research quality.

When working with large animals on the ground floor of the Vivarium, you must wear green facility scrubs (trousers and T-shirt) and dedicated footwear that is used exclusively in this area.

If you are visiting the large animal surgery suite only briefly and will not have direct contact with the animals, you must wear a green protective coat over your personal clothing, as well as shoe covers.

Genetically Modified Organisms (GMOs)

Work involving genetically modified organisms (GMOs) is regulated by the **Norwegian Gene Technology Act** and associated regulations governing the production, use, and containment of GMOs.

For animal research, the most relevant regulations are:

- **Regulations on Genetically Modified Animals**
- **Regulations on the Contained Use of Genetically Modified Microorganisms**

A GMO is any microorganism, plant, or animal whose genetic material has been altered using gene or cell technology. This includes organisms modified through techniques such as genetic engineering, as well as microorganisms carrying

recombinant DNA, including plasmid-transformed bacteria used for DNA propagation or transfer.

A microorganism is defined as any cellular or non-cellular microbiological entity capable of replication or transferring genetic material.

Contained Use

Contained use refers to activities involving GMOs within facilities designed to prevent their release into the environment. Physical and operational containment measures are used to limit exposure to both people and the surrounding environment.

Key requirements include:

- GMO work may only be conducted in approved containment facilities.
- Activities involving contained use of GMOs must be **notified to or approved by the Norwegian Directorate of Health (Helsedirektoratet),** as required by the applicable regulations.
- Any use of GMOs outside approved containment facilities requires authorization from the **Norwegian Environment Agency (Miljødirektoratet).**
- All GMO activities must comply with regulations governing s**ystematic health, environmental, and safety (HSE) management.**

Further Information

Helsedirektoratet:
https://www.helsedirektoratet.no/tema/gentekno logi

Chemical hazards

Allergy to chemicals

Exposure to chemicals is another potential occupational health risk. A variety of cleaning and disinfecting agents are used in laboratory animal facilities, and personnel working in aquatic facilities may be exposed to additional chemicals. Some substances, such as formaldehyde (formalin), are known to cause allergic reactions or other adverse health effects.

To minimize these risks, it is essential to follow established safe work procedures, consult Safety Data Sheets (SDS), and use the required personal protective equipment (PPE).

The University of Bergen's Laboratory Animal Facility continuously works to replace hazardous chemicals with safer alternatives whenever possible. However, researchers may occasionally need to use specific chemicals for particular projects. In such cases, it is important to understand the associated risks and ensure that the chemicals are handled, stored, and disposed of safely.

Gas anesthesia

Gas anesthetics are effective for animal anesthesia but must not expose personnel to waste anesthetic gases.

Exposure can cause headaches, fatigue, and, for some agents, reproductive risks. Particular caution is needed for individuals of reproductive age and during pregnancy.

Most exposures result from:

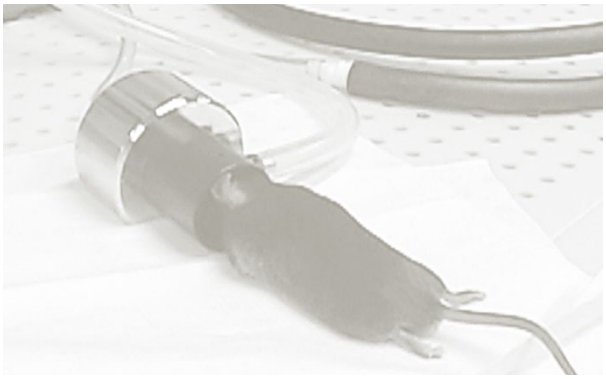
- Equipment leaks (tubes, connections, or vaporizers)

- Incorrect use of equipment
- Inadequate maintenance

To minimize risk:

- Use anesthetic equipment correctly and inspect it regularly.
- Follow established procedures and training requirements.
- Ensure effective scavenging systems are in place.
- Verify that room ventilation is functioning properly and has been regularly tested.

Safe equipment, proper training, and adequate ventilation are essential for preventing exposure.



Anesthesia mask

Leakage test

As a standard routine,

always perform a leak test before using any anesthesia system.

In addition to a visual inspection, the equipment should be tested for leaks using a gas leak detector ("sniffer"). The sniffers available in the Laboratory Animal Facility are designed to detect halogenated anesthetic agents such as isoflurane and sevoflurane.

When performing a leak test, it is important that the anesthesia system contains circulating anesthetic

gas within the circuit. Testing the equipment without anesthetic gas present may result in a false-negative result, potentially leading to the use of defective equipment and unnecessary exposure to waste anesthetic gases.

If you are unfamiliar with the procedure, ask Laboratory Animal Facility staff to demonstrate the correct use of the gas leak detector.

Leakage testusing a sniffer

Test of Anesthesia workstations

Because of the potential risks associated with waste anesthetic gases, the University of Bergen Laboratory Animal Facility conducted exposure assessments in collaboration with the Occupational Health Service.

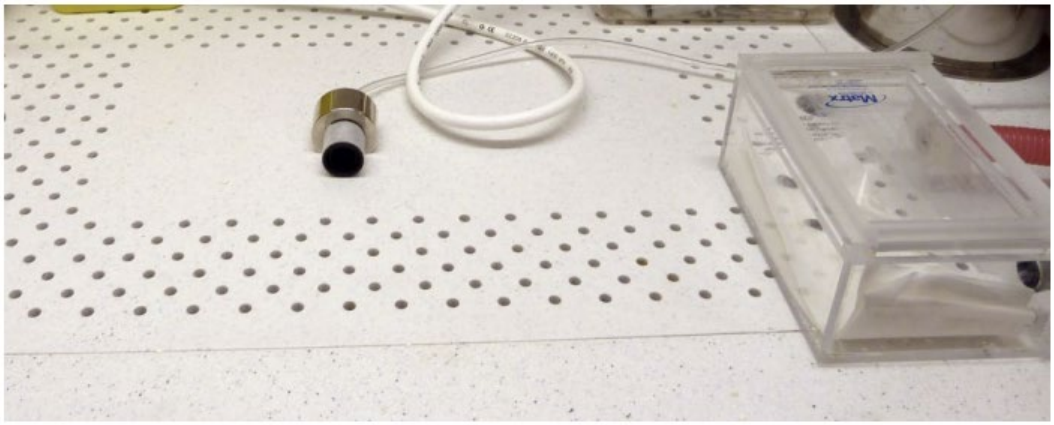
Measurements were performed using a specialized gas detector ("sniffer") to identify and quantify anesthetic gas leakage. Sampling was conducted at breathing-zone level (near the operator's nose and mouth) to provide a realistic representation of typical occupational exposure during anesthetic procedures.

These assessments help identify sources of leakage and verify that equipment, practices, and ventilation systems effectively protect personnel from exposure.

A standard rodent anesthesia workstation includes an induction chamber, an anesthesia mask, and a downdraft (under-ventilated) worktable. When used correctly, this setup helps

minimize exposure by keeping personnel at a safe distance from the anesthetic gas source and effectively removing waste gases.

In addition to preventing anesthetic gas exposure, personnel should protect themselves from animal allergens by wearing appropriate personal protective equipment (PPE), including gloves, a head cover, and a P2-filter respirator. Proper use of PPE is an important part of maintaining a safe working environment.



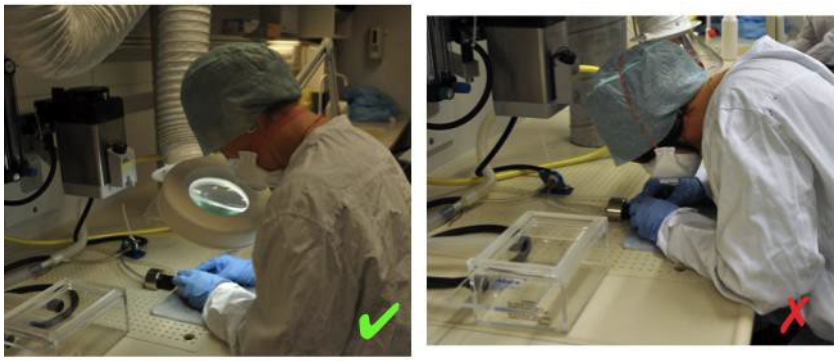
In this figure you see an anesthesia mask and anesthesia chamber placed on an under-ventilated bench.

Maintaining a Safe Working Position

When performing surgery or other procedures that require precise visualization, use a magnifying lens with integrated lighting. This improves visibility while allowing you to maintain an appropriate distance from the animal and the anesthetic gas source.

Always ensure that local exhaust ventilation is positioned close to the source of waste anesthetic gas, such as the induction chamber or anesthesia mask.
Avoid the working position where you lean over the animal places your breathing zone closer to the anesthetic gas source, increasing the risk of exposure. In addition, poor posture can lead to strain and discomfort in the back, neck, and shoulders during prolonged procedures.

Safe work position (left) and wrong work position (right)



Housekeeping and Ventilation Safety

Avoid placing equipment, supplies, or other items on or around ventilated workstations. Obstructing the airflow can significantly reduce the effectiveness of the ventilation system, resulting in higher concentrations of anesthetic gases and an increased risk of personnel exposure.

The figure below shows a ventilated bench that has been partially blocked by equipment and materials. This obstruction restricts airflow, reduces the efficiency of gas removal, and may allow anesthetic gases to accumulate in the work area.

Properly organized work bench (left) and crowded work bench covering the ventilation (right)

We tested the effect of covering the bench. When a heating mat covered the ventilated bench,

anesthesia gas concentration doubled from 0,2 ppm to 0,4 ppm. Wrapping the animal in isolating material can maintain the animal's body temperature in anesthesia without interfering with the ventilation.

Some workstations are equipped with an under-ventilated table with integrated hot water. Then the use of a heating mat is unnecessary. In addition, the ventilated table is made in material that is easy to clean so covering the table with absorbing paper should not be necessary. If a point-ventilation is also available, keep it close to the anesthesia gas source.

Some places you can still find flowmeters that are made for large animals. These flow meters can deliver up to 15 liters per minute of fresh gas. This is not a problem if you know how to operate it correctly. When fresh gas flow increases from 1 liter per minute to 12 liter per minute, the anesthesia gas concentration in the room increased from 0,2 ppm (which is below the critical threshold) to 40-50 ppm, which is far beyond the critical threshold.

For an anesthesia machine for rodents a flow meter delivering 1 liter/min is enough, and therefore we recommend this when purchasing new anesthesia machines to reduce the risk of user mistakes.
To avoid leakage caused by failure of equipment all anesthesia machines belonging to the University of Bergen are regularly checked. All machines shall have a unique ID and a maintenance log or journal. Here you can check when the machine was maintained or checked last. You can also find information about ownership and responsibility for the anesthesia machine. This includes information on who to report failures and problems too.

Equipment Maintenance and Safety Checks

To minimize exposure to waste anesthetic gases and ensure safe operation, the following maintenance procedures must be followed:

- Perform a leak test before each use. The user is responsible for verifying that the system is leak-free before starting work.
- Inspect tubing and connections regularly and replace any damaged or worn components immediately.
- Keep the setup as simple as possible. Avoid unnecessary tubing and connections, as these increase the risk of leaks and make inspections more difficult.
- Maintain accurate service records. Service and maintenance logs must be kept up to date, and users should only operate equipment that has been maintained according to schedule.
- Service vaporizers regularly. Vaporizers must be checked, calibrated, and serviced by the manufacturer or an authorized service provider.
- Test ventilation systems routinely. Ventilated benches, fume hoods, and scavenging systems must be inspected and performance-tested at regular intervals.

Regular inspection, preventive maintenance, and proper documentation are essential for ensuring both user safety and reliable anesthesia delivery.

Gas Anesthesia: Benefits and Safety Considerations

Gas anesthesia is one of the anesthetic methods that comes closest to the ideal anesthetic because it allows rapid induction, easy adjustment of anesthetic depth, and quick recovery. However, its use may be limited by health, safety, and environmental considerations.

Gas anesthesia should only be used where adequate local ventilation and waste gas scavenging systems are available.

At the University of Bergen, pregnant personnel are advised not to work with gas anesthesia.

Nitrous oxide (N_2O, laughing gas) is known to pose reproductive risks, while the evidence for halogenated anesthetics such as isoflurane is less clear.

Regardless of reproductive risks, exposure to waste anesthetic gases can cause symptoms such as fatigue, dizziness, headaches, and impaired alertness. Such effects can compromise both staff safety and work performance.

For these reasons, proper equipment maintenance, effective ventilation, and correct work practices are essential to minimize exposure and ensure a safe working environment.

Recommendations for Working with Gas Anesthesia

To reduce fatigue and minimize exposure during anesthesia procedures:

- ✓ Take a short break at least once every hour.
- ✓ Stand up, stretch, and change your working position regularly.
- ✓ Leave the procedure room periodically to get fresh air and daylight.
- ✓ Stay hydrated by drinking water throughout the day.
- ✓ Take a proper lunch break away from the work area.

Avoid working alone whenever possible or arrange for regular check-ins from a colleague.

Additional Measures to Reduce Exposure

- Consider injectable anesthetics when appropriate and scientifically justified.
- Rotate tasks among team members to reduce individual exposure.
- Ensure all personnel receive training in the safe use of anesthesia equipment and maintain this competence as new staff and students join the group.
- Maintain anesthesia equipment regularly and ensure ventilation and local exhaust systems function effectively.

Responsibilities

The University of Bergen has established procedures for the safe use of anesthetic gases. Safety is a shared responsibility:

- Institute and department management are responsible for implementing procedures and ensuring a safe working environment.
- Equipment owners are responsible for maintenance, service documentation, availability of user manuals, and training of personnel.
- Users are responsible for performing pre-use equipment checks, following established procedures, never using defective equipment, and promptly reporting faults or safety concerns to the person responsible.

Safe use of gas anesthesia depends on proper training, well-maintained equipment, effective ventilation, and adherence to established procedures.

Vaporized Hydrogen Peroxide (VHP) for Disinfection in Laboratory Animal Units

Maintaining a high level of microbiological control is essential in laboratory animal units to protect animal health, ensure the validity and reproducibility of research data, and support biosecurity programs. Environmental contamination with bacteria, viruses, fungi, or spores can compromise animal colonies, interfere with experimental outcomes, and lead to costly disruptions. Consequently, effective decontamination strategies are a critical component of modern laboratory animal facility management. Vaporized hydrogen peroxide (VHP), also known as vapor-phase hydrogen peroxide, has become one of the preferred methods for whole-room and equipment decontamination in laboratory animal facilities due to its broad antimicrobial efficacy, safety profile, and compatibility with sensitive equipment.

Principles of VHP Decontamination

VHP technology uses hydrogen peroxide solution, typically around 30% to 35%, which is vaporized and distributed throughout an enclosed space. The vapor penetrates surfaces and hard-to-reach areas, including ventilation components, cage racks, biosafety cabinets, and equipment interiors. Microbial inactivation occurs through oxidative damage to cellular membranes, proteins, nucleic acids, and other essential cell structures. VHP is effective against a wide range of microorganisms, including bacteria, fungi, viruses, and highly resistant bacterial spores.

VHP is widely used in laboratory animal units for routine and emergency decontamination. Common applications include:

- Whole-room decontamination between animal cohorts.
- Eradication of infectious agents following outbreaks.
- Decontamination of individually ventilated cage (IVC) systems.
- Treatment of animal holding rooms, procedure rooms, quarantine areas, and airlocks.
- Decontamination of heat-sensitive equipment that cannot be autoclaved.

A typical VHP cycle includes four phases:

1. **Dehumidification** to reduce ambient humidity and optimize vapor distribution.
2. **Conditioning** during which hydrogen peroxide vapor is introduced into the space.
3. **Decontamination** (dwell phase) where the vapor is maintained at an effective concentration.
4. **Aeration** during which catalytic conversion removes residual hydrogen peroxide, leaving only water vapor and oxygen.

This process enables complete room decontamination

without leaving toxic chemical residues.

The technology is particularly valuable in facilities housing specific pathogen-free (SPF) animals, where strict microbial control is required to prevent introduction or spread of infectious agents. Because VHP reaches inaccessible surfaces and enclosed spaces more effectively than manual cleaning methods, it provides an additional level of assurance for facility biosecurity.

Improved occupational safety

Personnel safety is an important consideration. Animal rooms must remain unoccupied during VHP exposure, and residual vapor concentrations must be confirmed to be below occupational exposure limits before re-entry. Appropriate training, monitoring equipment, and standard operating procedures are therefore essential.

VHP presents fewer health risks than formaldehyde, which is recognized as toxic and carcinogenic. Although hydrogen peroxide vapor must still be carefully controlled, modern systems incorporate monitoring and catalytic aeration to minimize worker exposure.

Furthermore, VHP should not be viewed as a substitute for routine cleaning. Organic material can reduce disinfectant effectiveness, making thorough cleaning an essential prerequisite for successful decontamination. VHP works best as part of a comprehensive sanitation and biosecurity program.

Health and Safety Considerations on the use of VHP

From a health and safety perspective, vaporized hydrogen peroxide offers significant advantages over traditional fumigation methods such as formaldehyde. Following decontamination, hydrogen peroxide breaks down into water and oxygen, leaving no toxic residues on surfaces or equipment. This reduces environmental impact and minimizes risks to both personnel and laboratory animals after the aeration phase has been completed.

VHP is a powerful oxidizing agent and must be used within a controlled and validated process. **During decontamination, animal rooms must remain unoccupied**, and **personnel exposure must be**

prevented through room sealing, monitoring systems, and appropriate safety procedures. Re-entry should only occur after hydrogen peroxide concentrations have been verified to be below established occupational exposure limits. When these precautions are followed, VHP provides a highly effective decontamination method with a favorable safety profile for modern laboratory animal facilities.

Vaporized hydrogen peroxide has become a highly effective and widely accepted technology for disinfection and biodecontamination in laboratory animal units. Its broad antimicrobial spectrum, ability to penetrate complex environments, absence of toxic residues, and compatibility with sensitive equipment make it particularly valuable in modern animal research facilities. When combined with proper cleaning, validation procedures, and biosecurity practices, VHP provides a reliable method for maintaining pathogen-free environments and supporting high-quality animal-based research. As laboratory animal facilities continue to emphasize animal welfare, research integrity, and occupational safety, VHP is likely to remain a cornerstone of environmental decontamination programs.

Chemical and Drug Registration

All chemicals used in research must be registered in the University's central Chemical Inventory system.

For more information, see:

Chemical Inventory, Exposure Register and Safety Labeling | The HSE Gateway | University of BergenChemical inventory, exposure register and safety labeling | The HSE-gateway | UiB

Each research group should have a designated Chemical Safety Coordinator (or equivalent) who can assist with chemical registration and provide guidance on health, safety, storage, and handling requirements.

Registration of Drugs and Other Substances

Drugs and substances used in research animals that are not registered in the Chemical Inventory must be recorded in the Medical Register. This documentation must be submitted as an attachment to the ethical approval application.

Storage and Management of Drugs

To ensure safety and regulatory compliance:

- Store all drugs in locked storage when not in use.
- Do not use drugs beyond their expiration date.
- Record the opening date on each container when first opened.
- Follow all storage instructions provided by the manufacturer.

Expired, improperly labeled, or incorrectly stored drugs will be removed and disposed of according to facility procedures.

Chemicals That Should Not Be Used

In some cases, researchers may wish to follow older experimental protocols that include substances no longer considered acceptable because of the health and safety risks they pose to personnel and animals.

Examples include:

- Urethane (ethyl carbamate), which is a known carcinogen.
- Chloral hydrate, which has a very narrow safety margin, meaning that the difference between an effective dose and a potentially lethal dose is small.
- Diethyl ether, which is highly flammable and presents a significant fire and explosion hazard.

Modern alternatives are available that provide improved safety, better animal welfare, and more reliable research outcomes. Therefore, these substances should no longer be used unless there is a compelling scientific justification and appropriate regulatory approval.

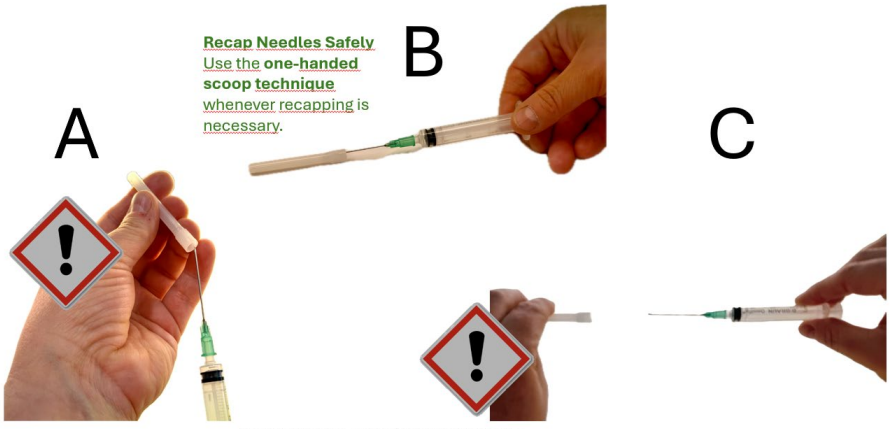
PHYSIACL HAZARDS

Needles and sharp objects

Needles and other sharp instruments must always be handled with great care to prevent injuries and accidental exposure.

The needle cap helps protect against needlestick injuries, but particular caution is required when recapping a needle. Whenever recapping is necessary, use a safe technique, such as the one-handed scoop method, to minimize the risk of self-injury.

The one-handed scoop technique is the safest method for recapping a needle and helps prevent accidental needlestick injuries.



Never hold the cap with your free hand.

In the one-handed technique, the needle cap is placed on a stable surface and picked up with the needle using one hand, avoiding the need to hold the cap with the other hand. This significantly reduces the risk of accidental puncture.

After use, all needles and other sharps must be disposed of immediately in an approved yellow

sharps container. Never leave used sharps on benches or in regular waste bins. If a sharps container is not available, ask Laboratory Animal Facility staff for one before starting the procedure.

Ergonomic Issues in Laboratory Animal Facilities

Laboratory animal facilities present a unique working environment that combines animal care, research support, sanitation, and technical procedures. Personnel, including animal technicians, veterinarians, researchers, and facility support staff, perform a wide range of physically demanding tasks daily. These tasks often involve repetitive movements, awkward postures, manual handling, prolonged standing, and interaction with specialized equipment. Consequently, ergonomic challenges are common and represent an important occupational health concern within laboratory animal facilities.

Ergonomics aims to adapt the workplace, equipment, and work methods to the capabilities and limitations of workers. Effective ergonomic programs can reduce the risk of musculoskeletal disorders (MSDs), improve employee well-being, enhance productivity, and contribute to a safer working environment.

Common Ergonomic Hazards

One of the most significant ergonomic risks in laboratory animal facilities is **manual handling of cages and equipment**. Animal care staff frequently lift, carry, push, and pull cages, feed bags, bedding containers, and waste materials. Although individual items may not be excessively heavy, the high frequency of these activities can place considerable strain on the back, shoulders, arms, and wrists.

Repetitive movements are another common hazard. Cage changing, animal handling, health inspections, and cleaning procedures often require workers to perform the same movements repeatedly throughout a work shift. Over time, these repetitive actions can contribute to muscle fatigue and repetitive strain injuries.

Workers may also be exposed to **awkward postures** when reaching into cage racks, handling animals at different heights, or working within biosafety cabinets and changing stations. Tasks that require bending, twisting, kneeling, or prolonged reaching increase stress on muscles and joints and may lead to discomfort or injury.

In addition, many employees spend extended periods **standing or walking** during routine husbandry activities. Prolonged standing can contribute to lower back pain, leg fatigue, and circulatory problems, particularly when flooring surfaces are hard and anti-fatigue measures are absent.

Cage Handling and Cage Washing Operations

Cage changing and cage washing operations are among the most physically demanding activities in laboratory animal facilities. Personnel may handle hundreds of cages per day, requiring repeated lifting and movement. Cage-washing areas frequently involve pushing heavy cage racks, loading washers, and transferring clean or soiled cages between workstations.

Improper workstation height can force workers to bend excessively or elevate their shoulders during loading and unloading tasks. Wet floors and confined spaces may further increase ergonomic risks by limiting mobility and creating unstable working conditions.

Automated cage-handling systems and mechanical lifting devices can significantly reduce physical demands. However, even in highly automated facilities, workers remain exposed to repetitive motions and manual handling tasks that require ongoing ergonomic assessment and intervention.

Animal Handling Procedures

Animal handling activities can also contribute to ergonomic strain. Procedures such as restraint,

weighing, dosing, blood collection, and health examinations often require precision movements while maintaining static postures. When carried out for prolonged periods, these tasks may cause neck, shoulder, and hand discomfort.

Working with larger species, such as rabbits, dogs or pigs, introduces additional challenges due to the greater force required for restraint and transfer. Poorly designed handling equipment or inadequate training can increase the risk of musculoskeletal injuries to personnel.

The use of adjustable workstations, ergonomic restraining devices, and appropriate training in animal handling techniques can help reduce these risks while improving both staff safety and animal welfare.

Environmental and Equipment Factors

Several environmental factors within laboratory animal facilities may exacerbate ergonomic problems. Limited space between racks, narrow corridors, and crowded work areas can restrict movement and force workers into awkward positions. Personal protective equipment (PPE), although essential for biosecurity and worker protection, may reduce dexterity, increase heat stress, and add to physical fatigue.

The design of equipment also has a significant impact on ergonomics. Adjustable tables, height-adjustable cage-changing stations, ergonomic chair options, and properly positioned computer workstations can reduce physical strain. Conversely, poorly designed or poorly maintained equipment may increase the risk of injury.

Prevention and Risk Reduction

Effective ergonomic programs in laboratory animal facilities should incorporate both engineering and administrative controls. Engineering controls include the use of automated cage washers, powered cart systems, adjustable workstations, mechanical lifting aids, and ergonomically designed tools. These measures aim to reduce physical demands at the source.

Administrative controls focus on work organization and staff management. Examples include job rotation, regular rest breaks, workload planning, and ergonomic training. Staff should be encouraged to report discomfort and participate in ergonomic assessments to identify high-risk tasks before injuries occur.

Training is particularly important because proper lifting techniques, posture awareness, and correct equipment use can substantially reduce injury risk. Regular ergonomic evaluations should be integrated into occupational health and safety programs to ensure continuous improvement.

Ergonomic challenges are inherent in laboratory animal facilities due to the physical nature of animal care, cage handling, cleaning operations, and research procedures. Repetitive movements, manual handling, awkward postures, and prolonged standing can contribute to musculoskeletal disorders and reduced worker well-being. By implementing ergonomic principles through facility design, appropriate equipment, staff training, and proactive risk assessment, laboratory animal facilities can significantly improve employee health and safety while maintaining high standards of animal care and research quality.

Compassion Fatigue and Psychological Well-being

In addition to physical ergonomic hazards, laboratory animal personnel may experience compassion fatigue, a form of emotional and psychological strain associated with caring for animals and exposure to animal suffering or euthanasia. Compassion fatigue is recognized as an occupational challenge in laboratory animal science and can affect animal technicians, veterinarians, researchers, and other staff who develop strong bonds with animals under their care. Employees working in laboratory animal facilities are often committed to maintaining high standards of animal welfare and may experience emotional

conflict when animals undergo invasive procedures, develop illness, or are euthanized as part of research protocols. Repeated exposure to these situations can lead to feelings of sadness, stress, guilt, emotional exhaustion, and reduced job satisfaction. Over time, compassion fatigue may contribute to burnout, decreased productivity, absenteeism, and staff turnover.

Several workplace factors can increase the risk of compassion fatigue, including high workloads, limited control over work processes, insufficient social support, ethical concerns related to animal use, and a lack of opportunities to discuss emotional challenges. New employees may be particularly vulnerable as they adapt to the realities of working with research animals.

Addressing compassion fatigue requires a proactive organizational approach. Open communication about emotional well-being, access to employee support programs, peer support networks, supervisor training, and opportunities for stress management can help reduce the impact of compassion fatigue.

Recognizing compassion fatigue as an occupational health issue is an important component of a comprehensive health and safety program in laboratory animal facilities. By supporting both the physical and psychological well-being of staff, organizations can promote a healthier work environment, improve employee retention, and maintain high standards of animal care and research quality.

While ergonomic programs traditionally focus on preventing physical injuries, a comprehensive approach in laboratory animal facilities must also consider psychological well-being. The combination of physically demanding tasks and the emotional challenges associated with animal care can place significant strain on personnel. Integrating ergonomics, occupational health measures, and compassion

fatigue awareness can help create a safer, healthier, and more sustainable working environment for laboratory animal professionals.

Radiation

Radiation safety is an important component of occupational health and safety programs in research institutions and laboratory animal facilities where radioactive materials or radiation-producing equipment are used. The primary goal of radiation safety is to protect personnel, animals, the public, and the environment from unnecessary exposure to ionizing radiation while ensuring that research activities can be conducted safely and effectively.

Sources of radiation in laboratory animal research may include radioisotopes used in tracer studies, imaging procedures such as positron emission tomography (PET) and single-photon emission computed tomography (SPECT), irradiators, and X-ray equipment. Although these technologies provide valuable scientific information, improper use can result in radiation exposure that may pose health risks.

Radiation safety programs are based on the principles of **justification, optimization, and dose limitation.** A key concept is the ALARA principle ("As Low As Reasonably Achievable"), which aims to minimize radiation exposure through appropriate planning, engineering controls, safe work practices, and the use of personal protective equipment. Measures such as personnel training, radiation monitoring, controlled access areas, proper waste management, and regular equipment maintenance are essential components of an effective radiation safety program.

By following established radiation safety procedures and regulatory requirements, laboratory animal facilities can ensure the safe use of radioactive materials and radiation-producing devices while

protecting both personnel and research animals.
https://www.uib.no/en/hms-portalen/74149/radiation-and-radiation-protection

ADMINISTRATIVE MEASURES

Risk assessment

Before an experiment can be approved, a risk assessment must be completed. This is a requirement under Norwegian occupational health and safety regulations.

A risk assessment evaluates both:

- The potential consequences of an unwanted event.
- The likelihood (probability) that the event will occur.

The overall risk is determined by combining the severity of the consequences with the likelihood of occurrence. This is often illustrated using a risk matrix, where colors indicate the level of risk:

- 🟢 **Green**: Low risk
- 🟡 **Yellow**: Moderate risk
- 🟠 **Orange**: Significant risk
- 🔴 **Red**: High or unacceptable risk

The specific categories and acceptance criteria may vary depending on the nature of the work. Therefore, individual projects may need to develop or adapt their own risk matrix to ensure that all relevant hazards are assessed appropriately.

Examples of how it works

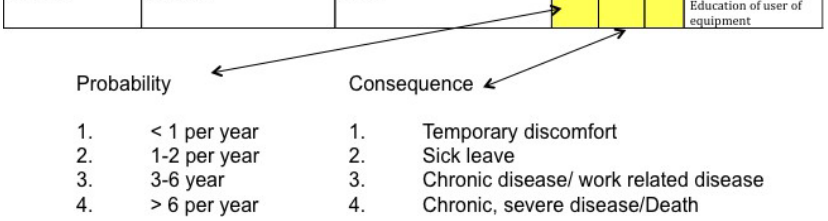
Allergy to laboratory animals can cause allergic reactions and in severe cases severe asthma. In the worst cases, this can cause chronic work-related disease and sick leave. This corresponds

to a degree 3 in our scale.

The occupational health service reports 3-6 new allergic persons every year, which give a three also for probability. The overall risk is three multiplied by 3, which give nine. This is not the most severe outcome; however, it is still so severe that preventive actions must be used actively.

Example of risk evaluation

Unwanted event	Causes	Possible consequences	Cons.	Prob.	Risk	Risk reducing means
Allergy to fur bearing animals	Work related exposure Ignorance in use of Personal protective equipment Spread of allergens by clothes, persons or equipment's	Allergy Asthma	3	3	9	Information education Use and availability of PPE
Exposure to gas anesthesia	Leakage User failure	Dizziness, tired Fainting	2	3	6	Regular maintenance of equipment Education of user of equipment



Exposure to gas anesthesia can cause tiredness and headaches and this can lead to sick leave, which gives a grade 2. Despite all actions to maintain, equipment and train people we believe that people are exposed maybe 3-6 times per year, which give a grade 3. The total risk is six.

By systematically evaluating different risks, we can identify severe outcomes and activities that need extra preventive means or maybe that activity should be avoided or replaced by an alternative method.

You will find more information on Risk assessment on

https://www.uib.no/en/hms-portalen/137423/risk-assessment-related-hse-and-emergency-preparedness

Project start-up meetings

Once a project has received regulatory approval, the Laboratory Animal Facility requires a project start-up meeting with the research group. This meeting is intended to establish effective collaboration from the outset and ensure that all practical, scientific, and welfare-related aspects of the project are addressed before work begins.

The goal is to ensure:

- High standards of animal welfare are implemented from the very beginning.
- The health and safety of all personnel involved are protected.
- Roles, responsibilities, and procedures are clearly understood.
- The project is conducted efficiently and in compliance with all relevant requirements.
- The research is performed to the highest possible scientific and ethical standards, supporting robust and reliable results.

Reporting accidents, incidents, and other divergent events (“Avviksskjema”)

UiB has an electronic reporting system for accidents and incidents using
Melde avvik - UiBhjelp

HSE non-conformities are all adverse events and/or matters that have resulted or may result in harm to people, the environment and property, such as:

- fires and explosions
- break-in, theft, robbery and unauthorized access to buildings and areas

- damage to property and structural conditions in buildings
- personal injuries
- harmful emissions to the environment
- incorrect handling of chemicals, gas, biological agents and sources of radiation
- Third party violence and threats (students reports in the Speak-up system (Si fra))
- Breaches of the health and safety legislation, guidelines and routines.

Nonconformity/Deviations and undesirable incidents for people and equipment must be reported.

UiB has adopted an electronic deviation system UiBhjelp to be used for accidents and incidents

Here you shall report

1. Violence of HES-regulations and procedures
2. Issues that may violate security
3. Thefts or vandalism
4. Personal injuries on campus
5. Unwanted incidents in the laboratory

Notification of accidents, incidents and other divergent events is a tool for systematic improvement in the Lab Animal Facility.

Notification concerning

- Animal welfare
- Equipment
- Noncompliance with the Animal facility's routines and procedures

Must be reported on this link
Reporting unwanted incidents | The Laboratory Animal Facility | UiB

Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, written instructions designed to achieve uniformity in the performance of specific functions. They outline the steps necessary to carry out routine operations, ensuring that tasks are performed **consistently** and **correctly**. SOPs are commonly used to maintain quality, safety, and efficiency.

The advantages of using SOPs are numerous. First, they promote **consistency** by ensuring that tasks are performed correctly and the same way every time, regardless of who is doing them. This reduces errors and improves quality. Second, SOPs enhance **training and onboarding**, providing new researchers with clear guidance on how to perform their duties. Third, they support **compliance** with industry regulations and standards, which is especially important in highly regulated sectors as animal research is. Additionally, SOPs improve **efficiency** by streamlining processes and reducing the need for constant supervision. They also serve as a reference in case of disputes or audits, offering documentation of proper procedures. Lastly, SOPs contribute to **workplace safety** by outlining correct procedures and precautions, helping to prevent accidents and injuries.

Other links

More shortcuts at the UiB HSE-gateway

https://www.uib.no/en/hms-portalen/74307/shortcuts