

M10-EN.4 OPERATING ROOM

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M10-EN.4.1 Blood borne Pathogens

Health care personnel working at the surgical department are exposed blood borne pathogens or OPIM.

Safety Precautions

- Use appropriate personal protective equipment, (e.g. gloves during hand contact with blood, mucous membranes, OPIM, or when handling contaminated items or surfaces). (Link: M10-EN.3.1)
- Minimise hazards of exposure to blood borne pathogens in the surgery by using:
 - Safer needle or other sharps devices
 - Rounded stitch needles
 - Needle-free intra venous (IV) connectors
 - Proper containerisation of sharps
 - Use hands-free technique, for passing instruments safely between surgeon and assistants. A tray or other means are used to eliminate simultaneous handling of sharp instruments during surgery

M10-EN.4.2 Hazardous Chemicals

In the operating room a variety of hazardous chemicals can be found, such as:

- ethylene oxide, glutaraldehyde and paracetic acid used for sterilization
- Methyl Methacrylate (MMA) (an acrylic cement-like substance used to secure prostheses to bone during orthopaedic surgery)

The personnel of the operating room are exposed to these chemicals, usually during their mixing, preparation, and in the surgery room in general.

Ethylene Oxide is used within health care facilities (outpatient surgery clinics, cardiac catheterization laboratories, operating rooms, autopsy laboratories, etc), as a sterilant

for items that can not be exposed to steam sterilization. Exposure occurs from improper aeration of the ethylene oxide room after the sterilizing process or during off-gassing of sterilized items or poor gas-line connections.

EtO has many effects on health. In liquid form, it can cause eye irritation and cornea injury, frostbite, and severe irritation and blistering of the skin upon prolonged or confined contact. Ingestion of EtO can cause gastric irritation and liver injury. Acute effects from the inhalation of EtO vapours include respiratory irritation and lung injury, headache, nausea, vomiting, diarrhoea, shortness of breath, and cyanosis. Exposure to EtO has also been connected with the occurrence of cancer, reproductive effects, mutagenic changes, neurotoxicity, etc.

General Safety Precautions

- Read and follow carefully the instructions and warnings on labels, (e.g. use gloves during the use of cold sterilant machines for the equipment sterilisation that cannot be autoclaved, never open these machines until they are in a safe to open mode, etc)
- Mix hazardous chemicals used in surgeries, (e.g. Methyl Methacrylate) only in a well ventilated, closed system
- Follow all Material Safety Data Sheet (MSDS) instructions regarding safe handling, storage, and disposal of hazardous chemicals. In addition, consider using less hazardous disinfectants

More specific, for the sterilants used in an operating room, the following **Safety Precautions** are given:

- Avoid close contact with newly sterilized unaerated loads. Aerate them before moving them to transfer carts.
- Use appropriate PPE (gloves, canister respirator, etc) when changing cylinders
- Use EtO detector systems, and room monitors for signalling in case of gas leakage
- Use glutaraldehyde products in well ventilated rooms, and large enough to ensure adequate dilution of vapour
- Store glutaraldehyde products in closed containers and in well ventilated areas
- Use proper PPE, minimising the exposure (i.e. gloves, splash proof goggles or full-face shields)
- Use the local exhaust ventilation, such as a properly functioning fume hood for controlling vapour
- Remember to replace lids after using the product (read the warning signs)

Employers should:

- Substitute with other cold sterilants (such as glutaraldehyde, hydrogen peroxide, sodium hypochlorite, etc). An evaluation is essential of possible health effects and exposure potentials of alternatives to EtO before its substitution
- Provide proper and adequate ventilation during work with EtO gas. Airborne concentrations of EtO can be controlled effectively at the source of contamination by enclosing the operation and using local exhaust ventilation

- Install a ventilated exhaust hood above the sterilizer door
- Install machine alarms that cause an automatic shutdown, when the ventilation is inadequate. Air pressure in laboratories and isolation rooms must be negative, making the contaminated air draw through the exhaust vents rather than circulating all over the rest of the workplace
- Conduct periodic personal monitoring, for leaks at gas-line connectors by using passive dosimeters
- Keep a record of detected leaks and services done on an EtO room. Replace sterilizer/aerator door gaskets, valves, and fittings when necessary

M10-EN.4.3 Waste Anaesthetic Gases

Healthcare workers and especially those working at the operating room can be exposed to waste anaesthetic gases in many ways. These gases include nitrous oxide and halogenated agents (vapours of halothane, enflurane, methoxyfluorane, trichloroethylene, and chloroform).

Potential Hazard

The personnel of the surgical suite can be exposed to these waste gases usually because of the poor work practices (take precautions, using proper PPE, such as masks, etc) or during surgical procedures, during the anesthetization of patients, leaking of gas-line connections, improper or inadequate maintenance of the machine, and/or patient exhalation after the surgical procedure, while in recovery. Health effects of this exposure include nausea, dizziness, headaches, fatigue, irritability, drowsiness, coordination and judgment problems, as well as sterility, miscarriages, birth defects, cancer, liver and kidney diseases.

Waste anaesthetic gases can be considered as anaesthetic gasses and their vapours that leak out and into the surrounding room during medical procedures. Exposure can occur due to:

- Escape of these gases during the initial assembling and checking of the anesthesia system or the scavenging system
- Escaping from around the patient's anaesthesia mask
- Exhalation of the patient (in some cases days after the surgery)
- Leaking of the anaesthesia system
- During the clearing of the system at the end of a medical procedure

Specifically, surgery of the face, throat, and neck can lead to even greater leakage of waste anaesthetic gases, because in these areas it is harder to control containment of the gases.

Safety Precautions

- Try to prevent any anaesthetic spills, in order to decrease the amount of waste anaesthetic gases in the surgery, and turn off vaporizers of anaesthesia machines when not using them
- Use appropriate anaesthetic gas scavenging systems

- Evacuate properly any waste gas, by collecting and removing them, by detecting and correcting leaks, and effectively ventilating the room

Exposure to waste anaesthetic gases can be controlled through effective waste anaesthetic gas management programs which include:

Engineering Controls

- Use of a well-designed waste anaesthetic gases scavenging system for collecting, removing, and properly disposing of the gases. The personnel must be careful not to discharge gases near the air intake of the room
- Use of proper masks (e.g. scavenging nasal mask). These masks must consist of a cover large enough to capture gases exhaled from the patient's mouth. An inner mask is contained within a larger outer mask. Between the masks, a slight vacuum exists
- Care must be taken, in order to have a proper heating, ventilation, and air conditioning system in the operating room, which contributes to the dilution and removal of waste anaesthetic gases that are not collected by the scavenging system or have escaped from leaks in the anaesthesia equipment
- Use of anaesthetic respirators where appropriate
- The scavenging system of waste anaesthetic gases, the anaesthesia machines, and the ventilation system, must be appropriately inspected and maintained. A daily check must take place, for preventing any leaks
- A regular preventive maintenance should include inspection, cleaning, testing, lubrication, and adjusting of the components of the waste anaesthetic gases scavenging system and the anaesthesia systems. In case of damaged or worn out parts, these should be replaced immediately. Documentation of the maintenance and preventive maintenance programs should be kept. This must include the type of work performed and the date, as well as the name(s) of the trained workers who serviced the equipment.

Work Practices

Employees must use proper anesthetizing techniques, such as:

- Select, fit or position adequately the face masks
- Inflate sufficiently the tracheal tube cuff
- Connect in properly the tubes and fittings for the anaesthesia machine
- Turn the gas off when the mask is removed from the patient's face

Exposure to waste anaesthetic gases can be measured by air monitoring, which can be:

- continuous or periodic but sufficiently measure exposure in the exposed work areas and surrounding areas
- aid in identifying the existence and location of leaked gases and the efficiency of corrective measures

Employers should provide their personnel at the operating room with:

- Appropriate PPE, such as face masks, and sufficiently inflated endotracheal tubes
- Room dilution ventilation in order to minimise the concentration of waste anaesthetic gas in the operating room, by changing the indoor air with outdoor air (fresh air) hourly. The air from the operating room must go outside and not in the operating room or other hospital departments. Usually a regular monitoring of these gases must take place, emphasising on peak gas levels in the breathing zone of nursing personnel working very close to the patient's head

Employers must also develop and implement a written hazard communication program regarding waste anaesthetic gases. This program should include:

- description of the physical and health hazards of anaesthetic gases in use
- the creation and availability of up to date material safety data sheets on all anaesthetic gases
- use of proper labelling of canisters, tanks, and containers
- a comprehensive employee training and information program

More specific, the training program should list measures the personnel can take for their protection from the hazards of waste anaesthetic gases. The program should include information such as:

- engineering controls
- clearly outline emergency procedures that contain spills
- description of safe work practices and the use of personal protective equipment
- use of continuous monitoring devices

Only properly trained and equipped personnel can clean up or control any spills of anaesthetic gases.

The anaesthesia machine must be regularly inspected and maintained by factory service representatives or other qualified personnel. Prior every day's use, all anaesthesia equipment (connectors, tubing, etc.) must be inspected, and any spills of liquid anaesthetic agents should be cleaned up immediately

M10-EN.4. 4 Compressed Gases

Compressed gas cylinders contain a huge amount of energy, which, if released inappropriately, can result in serious injuries. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards. Compressed gases within a healthcare facility exist either in fixed piped gas systems or in individual cylinders of gases. Gases may be:

- Flammable or combustible
- Explosive
- Corrosive
- Poisonous
- Inert

Safety Precautions

Health care workers must be very careful when they handle compressed gases, the cylinders containing them, regulators or valves used to control gas flow, and the piping used to confine gases during flow. Some general precautions are:

- Secure cylinders containing compressed gases, in order to avoid possible falls
- Clearly identify cylinders with the name of the content
- Use hand trucks, carts, etc, when moving cylinders. Never roll or drag them
- Never attempt to repair any damaged cylinder or to force frozen or stuck cylinder valves
- Close off the cylinders when not in use
- Open slowly the cylinder valves. Oxygen cylinders must have the valve opened up all the way because of the high pressure in the cylinder. A back-seating valve exists on the oxygen cylinder, preventing the high-pressure gas from leaking out through the threaded stem
- Do not store cylinders with flammable gases (hydrogen or acetylene) close to open flames, areas where electrical sparks are generated, or where other sources of ignition may be present

Also, “No smoking” signs must be placed in any area where flammable, compressed gases are stored or are in use, in addition to the general “No smoking” policy of the health care facility

M10-EN.4. 5 Laser hazards

Surgeons and their assistants are exposed to lasers used in the operating rooms during removal and cauterization of tissue. Exposure usually occurs from accidental operation and/or when proper controls are not in effect. The high electrical energy used for the generation of the beam is a potential shock hazard. Exposure to direct beam can cause burns to skin and eyes possibly resulting in blindness. Some other potential hazards are electric shock and fire, during the laser use.

Safety Precautions

- Use goggles during laser surgeries for the protection of cornea conjunctive and other ocular tissue. The type of eye protection is determined by the wavelength of the laser output
- Use tightly woven fabrics and opaque gloves for the protection against laser radiation
- Use laboratory jacket or coat for the protection of arms. It is important to use protective clothing during exposure to high radiation levels
- Check lasers, prior every procedure, and during extended procedures (although they are calibrated by the manufacturer)
- Cover laser systems adequately, and especially those with high voltage capacitance. Also, ground them properly
- Cover the windows of the surgery for the protection of the personnel outside

- All operating room doors must have safety interlocks which shutdown the laser system if anyone enters the room
- The laser system must be maintained and checked accordingly with manufacturer's instructions, only by qualified personnel
- Warning signs in areas where exposure to lasers is possible, must be placed

M10-EN.4. 6 Laser Plume

Lasers are used in surgeries for vaporising, coagulating, and cutting tissue. The vapours, smoke, and particulate debris produced during these surgical procedures are called laser plumes. These plumes may contain:

- Carcinogens, mutagens, irritants, and fine dusts
- Bio-aerosols, viruses, cancer cells, blood fragments, and bacteria spores (depending on the type of the procedure)
- Carbon monoxide, polyaromatic hydrocarbons, and a variety of toxic gases
- Chemicals such as formaldehyde, hydrogen cyanide, acrolein, and benzene

Health care personnel such as surgeons, nurses, anaesthesiologists, and surgical technologists, as well and patients in hospitals and clinics are exposed to the **hazards** caused by laser plumes.

Laser plume exposure can result in health symptoms such as: eye, nose, and throat irritation, nausea, vomiting, nasal congestion, chest tightness, abdominal cramping, general flu-like symptoms, and fatigue. At high concentrations the plume causes visual and upper respiratory tract irritation of the medical personnel, and creates visual problems for the surgeons. It has also, unpleasant odour. It may have mutagenic potential. Mutagens affect offspring through changes in the DNA of paternal spermatogonia or maternal oocytes prior to conception.

Safety Precautions

Control laser plumes hazards with:

- Proper ventilation (use portable smoke evacuators and room suction systems)
- The use of proper personal protective equipment (masks, goggles, etc)
- **Safe work practices** such as:
 - Keeping the smoke evacuator or room suction hose nozzle inlet very close to the surgical site to effectively capture airborne contaminants
 - Activating the smoke evacuator every time airborne particles are produced during all surgical or other procedures
 - Considering every tube, filter, and absorber as infectious waste and be dispose appropriately
 - Installing new filters and tubing before each procedure
 - Inspecting smoke evacuator systems regularly for the prevention of possible leaks

M10-EN.4.7 Latex Allergy

Latex allergy can be developed, from the exposure to latex from using products containing latex (gloves, catheters, etc). More information was given in chapter 3.

M10-EN.4.8 Equipment Hazards

The personnel working at the operating room are often exposed to burns or shocks from equipment that is not well maintained, or because they did not have been trained properly (e.g. on proper use of autoclaves, warming cabinets, defibrillators, etc). (Link: M10-EN.3.6)

M10-EN.4.9 Static or Awkward Postures

Because operations might be lengthy, surgeons and their assistants can be exposed to:

- Static postures from the continuous standing in one position during the surgeries, causing them muscle fatigue and concentration of blood in the lower extremities
- Awkward postures because they have to tilt their head downwards for long periods of time

Safety Precautions

Employers must ensure that in the operating room:

- Stools are provided (where their use is possible)
- The personnel use shoes with well cushioned insteps and soles
- A foot rest bar or a low stool are provided, so the personnel can continually alter their posture by raising one foot
- The height of work surfaces is adjustable

M10-EN.4.10 Slips/Trips/Falls

In an operating room, the personnel are usually exposed to trips, and falls, e.g. falling over portable equipment that easily blends into the floor or slipping on debris, (bandages, tubing, blood, intravenous fluids, etc) spilled on the floor. Electrical cords crossing floors can also create a trip hazard. (Link: M10-EN.3.7)