Doctors and nurses who work in the surgical suite have to deal with several different types of hazards, including waste gases and hazardous chemicals. This course is geared towards the employee and will provide some possible solutions to protect you against the various hazards that are present in a surgical suite.
OSHAcademy Course 631 Study Guide

Healthcare: Surgical Suite Safety

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This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 631.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Revised: August 13, 2020
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Course Introduction

Doctors and nurses who work in the surgical suite have to deal with several different types of hazards, including waste gases and hazardous chemicals.

This course is geared towards the employee and will provide some possible solutions to protect you against the various hazards that are present in a surgical suite.

Once you complete this course, you will have knowledge of the following components:

- dangerous waste gases
- sharps injuries
- static and awkward postures
- smoke plume
- hazardous chemicals
- medical laser classifications
Module 1: Surgical Suite Hazards

The anesthetic gases and vapors which leak into the surrounding room during medical procedures are considered waste anesthetic gases. It is estimated that more than 250,000 health care professionals who work in hospitals, operating rooms, dental offices and veterinary clinics, are potentially exposed to waste anesthetic gases and are at risk of occupational illness.

Dangerous Waste Gases

The waste anesthetic gases and vapors of concern include the following:

- nitrous oxide
- halogenated agents (vapors)
  - halothane
  - enflurane
  - isoflurane
  - desflurane

Some potential effects of exposure to waste anesthetic gases are:

- nausea
- headaches
- irritability
- miscarriages
- cancer
- dizziness
- fatigue
- sterility
- birth defects
- liver and kidney disease among operating room staff
Employers and employees should be aware of the potential effects and be advised to take appropriate precautions.

**Exposure Hazards**

Many health care workers are unaware of the potential health hazards associated with waste anesthetic gases in their work environment. This makes them more vulnerable to illness.

**Potential Hazards**

Workers could be exposed to waste anesthetic gases from:

- poor work practices during the anesthetization of patients
- leaking or poor gas-line connections
- improper or inadequate maintenance of the machine
- patient exhalation in the recovery room or Post Anesthesia Care Unit (PACU) during off-gassing of surgery patients

**Possible Solutions**

Employers should use an anesthetic gas finding system in operating rooms. An appropriate waste gas evacuation involves collecting and removing waste gases, detecting and correcting leaks, considering work practices, and effectively ventilating the room.

There also needs to be enough ventilation in the surgical suite to keep the room concentration of waste anesthetic gases below the applicable occupational exposure levels. To minimize waste anesthetic gas concentrations in the operating room, the recommended air exchange rate (room dilution ventilation) is a minimum total of 15 air changes per hour with a minimum of 3 air changes of outdoor air (fresh air) per hour.

When using a properly designed and operating dilution ventilation system, it will minimize waste anesthetic gas concentrations in recovery room areas. The system should provide a recommended minimum total of 6 air changes per hour with a minimum of 2 air changes of outdoor air per hour.

OSHA also recommends the following when dealing with anesthesia gases and machines:
• Vaporizers of anesthesia machines should be turned off when not in use. Proper face masks, sufficiently inflated endotracheal tubes, and the prevention of anesthetic spills will decrease the amount of waste anesthetic gases in the operating room.

• Inspection and maintenance of anesthesia machines should be conducted by factory service representatives or other qualified personnel at least every four months.

• Prior to each day's use, a complete check of all anesthesia equipment (connectors, tubing, etc.) should be conducted.

• Spills of liquid anesthetic agents should be cleaned up promptly.

**Bloodborne Pathogens**

**Potential Hazards**

Occupational exposure to blood and other potential infectious material (OPIM) puts surgical room employees at risk of infection from bloodborne pathogens while performing surgery-related tasks. These include:

- Hepatitis B Virus
- Hepatitis C Virus
- Human Immunodeficiency Virus (HIV)

**Possible Solutions**

Among other things, OSHA's [Bloodborne Pathogens Standard, 1910.1030](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=1030), requires that engineering and work practice controls be used to eliminate or minimize exposures to blood and OPIM.

- **Engineering controls:** These are devices that isolate or remove the bloodborne pathogens hazard from the workplace. They include sharps disposal containers, self sheathing needles, and safer medical devices, such as sharps with engineered sharps-injury protection and needleless systems.

- **Work practice controls:** These are practices that reduce the possibility of exposure by changing the way a task is performed, such as appropriate practices for handling and disposing of contaminated sharps, handling specimens, handling laundry, and cleaning contaminated surfaces and items.
Personal protective equipment (PPE): PPE includes gloves, gowns, eye protection, and masks. Employers must clean, repair, and replace this equipment as needed. Provision, maintenance, repair and replacement are at no cost to the worker.

Sharps Injuries

In addition, sharps injuries in the surgical area must be eliminated or minimized through use of measures such as:

- Using safer needle/other sharps devices.
- Using blunt-tip suture needles.
- Using needleless IV connectors.
- Providing proper containers for sharps.
- Perform a "No Pass Zone" for surgical instruments
- You should have a method for passing equipment safely between surgeon and assistants.
  - The hands-free technique is a work practice whereby a tray or other means are used to eliminate simultaneous handling of sharp instruments during surgery.
- Appropriate personal protective equipment (PPE) must be worn if blood or OPIM exposure is anticipated. The type of PPE depends on the anticipated exposure. Appropriate PPE includes, but is not limited to, gloves, gowns, face shields or masks, and shoe covers. For example:
  - Gloves must be worn when hand contact with blood, mucous membranes, OPIM, or non-intact skin is anticipated, or when handling contaminated items or surfaces.
  - Masks, in combination with eye protection devices, must be worn whenever splashes, spray, splatter or droplets of blood or OPIM may be generated.
- Contaminated needles and other contaminated sharps be discarded immediately or as soon as feasible into appropriate containers.
• Sharps containers must be located close to the area where sharps are used or could be found.

• Contaminated needles and other contaminated sharps must not be bent, recapped, or removed. Shearing or breaking contaminated needles is prohibited.

• Employers must make sure hand washing facilities be readily accessible and require employees to wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment.

  o Hands must be washed with an appropriate soap and water, whenever there has been occupational exposure to blood or OPIM. If a sink is not readily accessible (e.g., in the field) in instances where there has been occupational exposure, hands may be decontaminated with hand cleanser or towelette, but must be washed with soap and running water as soon as feasible.

  o If there has been no occupational exposure to blood or OPIM, use of an appropriate antiseptic hand cleanser is acceptable.

For more information on bloodborne pathogens in the healthcare setting, please [click here](http://www.oshatrain.org/courses/mods/655e.html).

**Latex Allergies**

Allergy to latex was first recognized in the late 1970s. Since then, it has become a major health concern as an increased number of people in the workplace are affected. Health care workers exposed to latex gloves or medical products containing latex are especially at risk. It is estimated that 8-12% of health care workers are latex sensitive.

**Potential Hazard**

• Developing latex allergy from exposure to products that contain latex such as gloves, catheters, and tubing.

**Possible Solutions**

• Provide appropriate gloves, including powder-less, hypoallergenic, glove liners, or other similar alternatives to employees who are allergic to the gloves normally provided.
Note: Do not assume hypoallergenic gloves are non-latex or latex-free.

In addition, good work practices should be used. These may include:

- providing a latex-safe work environment
- using non-latex gloves and other latex-free products
- selecting a low protein, powder-free glove

Static and Awkward Postures

Medical staff in a surgical setting often assume prolonged awkward postures. Typically, employees vary in height which may require work surfaces at differing heights to minimize awkward postures.

Potential Hazards

- Standing in static postures continuously during lengthy surgical procedures causes muscle fatigue and pooling of blood in the lower extremities.
- Standing on hard work surfaces such as concrete creates trauma and pain to the feet.
- Awkward postures resulting from prolonged standing, trunk flexion, neck flexion, and arms held higher than the optimal working height.

Possible Solutions

- Provide stools, where possible.
- Use shoes with well-cushioned insteps and soles.
- Provide a footrest bar or a low stool, allowing employees to continually alter their posture by raising one foot.
- Use height-adjustable work tables and surfaces.
- Use anti-fatigue mats.
Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. Which of the following is/are potential effects of exposure to waste anesthetic gases?
   a. nausea
   b. fainting
   c. irritability
   d. both (a) and (c)

2. Why are health care workers more vulnerable to illness when it comes to waste anesthetic gases?
   a. they are not trained
   b. they are unaware of the health hazards
   c. they are careless
   d. they do not wear the proper personal protective equipment

3. It is estimated that _____ of health care workers are latex sensitive.
   a. 5-10%
   b. 8-12%
   c. 15-20%
   d. 1-3%

4. John is a surgical assistant and works for a local community hospital. He is required to put on latex gloves before performing surgery. What is this an example of?
   a. engineering control
   b. work practice control
   c. common sense
   d. administrative control
5. Which of the following is a possible solution to static and awkward positions in a surgical suite?

a. use shoes with well-cushioned insteps
b. do not work for extended periods of time
c. take numerous breaks
d. work somewhere else in the hospital
Module 2: Other Hazards

Compressed Gases

Within a healthcare facility, compressed gases are usually either fixed piped gas systems or individual cylinders of gases.

Potential Hazards

- Hazards with compressed gas varies based on the chemicals.
  - May include fire, explosion, and toxicity.

Possible Solutions


- All cylinders, whether empty or full, must be stored upright.

- Secure cylinders of compressed gases. Cylinders should never be dropped or allowed to strike each other with force.

- Transport compressed gas cylinders with protective caps in place and do not roll or drag the cylinders.

Smoke Plume

Laser or electrosurgical units may be required during surgical procedures. Smoke byproduct or "plume" is created when tissue is thermally destroyed. Smoke plume may contain toxic gases and vapors such as:

- benzene

- hydrogen cyanide and formaldehyde

- bio aerosols
• dead and live cellular material (including blood fragments)
• viruses

The research is limited on transmission of disease through surgical smoke, but the potential for generating infectious viral fragments, particularly during treatment of venereal warts, may exist. Researchers have suggested the smoke may act as a vector for cancerous cells which may be inhaled by the surgical team and other exposed individuals.

Potential Hazards

• Exposure to high concentrations of smoke may cause ocular and upper respiratory tract irritation and create visual problems for the perioperative team.

• Smoke may contain toxic gases that could have the potential for adverse health impacts, such as mutagenic and carcinogenic impacts.

Possible Solutions

• Use portable smoke evacuators and room suction systems with inline filters.

• Keep the smoke evacuator or room suction hose nozzle inlet within 2 inches of the surgical site to effectively capture airborne contaminants.

• Have a smoke evacuator available for every operating room where plume is generated.

• Evacuate all smoke, no matter how much is generated.

• Keep smoke evacuator "ON" (activated) at all times when airborne particles are produced during all surgical or other procedures.

• Consider all tubing, filters, and absorbers as infectious waste and dispose of them appropriately. Use Universal Precautions as required by the OSHA Bloodborne Pathogens Standard when contaminated with blood or OPIM.

• Use new tubing before each procedure and replace the smoke evacuator filter as recommended by the manufacturer.
• Inspect smoke evacuator systems regularly to ensure proper functioning.

Hazardous Chemicals

Potential Hazards

Employees can be exposed to possible hazardous chemicals found and used in the surgical area typically during mixing, preparation, and in the operating room. These may include:

• peracetic acid used in cold sterilant machines
• Methyl Methacrylate (MMA)
• an acrylic cement-like substance used to secure prostheses to bone during orthopedic surgery waste anesthetic gases

Possible Solutions

• Mix methyl methacrylate only in a closed system.
• Carefully read and follow instructions and warnings on labels, (e.g., when using cold sterilant machines for sterilizing equipment that cannot be autoclaved, use goggles provided and do not open machine until it is in a safe to open mode).
• Consider using disinfectants or other products that are not hazardous.
• Inform employees of chemical hazards and have on hand Safety Data Sheets, (SDS) for all hazardous chemicals used in their facilities.
• Follow all MSDS instructions regarding safe handling, storage, and disposal of hazardous chemicals.

Equipment Hazards

Potential Hazard

• Surgical employees can be exposed to burns or shocks from poorly maintained equipment (e.g., autoclaves, warming cabinets, defibrillators).

Possible Solutions
Employers should create a safety and health program to monitor the condition of equipment and address work practices of employees. This program should include practices such as:

- Train employees to correctly and safely use and clean equipment.
- Maintain adequate working space and access to equipment.
- Visually inspect equipment before using.
  - Visually inspect cords and do not use if frayed or damaged.
  - If something does not look right, do NOT use the machine and call for assistance.
- Ensure that all electrical service equipment near sources of water are properly grounded \[29\text{ CFR 1910.304}\].
- Use appropriate personal protective equipment and safe work practices for assessed hazards (e.g., when handling hot items use gloves, and do not open autoclaves or sterilizers until items are sufficiently cooled).
- Adhere to all manufacturer and operator instructions to ensure safe use of equipment.

**Slips, Trips, and Falls**

**Potential Hazards**

- falling over portable equipment of a color that visually blends into the floor
- slipping on debris (bandages, tubing, blood, IV fluids) that had fallen or spilled on the floor
- tripping on electrical cords that may cross floors

**Possible Solutions**

- Keep all places of employment clean, orderly, and in a sanitary condition \[29\text{ CFR 1910.22(a)(1)}\].
- Keep aisles and passageways clear and in good repair, with no obstructions across or in aisles that may create a hazard \[29\text{ CFR 1910.22(b)(1)}\].
• Provide ceiling or floor outlets for equipment to ensure that power cords do not run across pathways.

• Mark mobile equipment (e.g., stools) with a bright color, or a taped "X", making them more visible and distinguishable from the floor. Tape should be washable and durable.
Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. The potential hazard associated with compressed gas includes _____.
   a. gas leak
   b. explosions
   c. death
   d. nausea

2. When is a smoke plume created?
   a. when there is an excess of anesthetic gases
   b. when there is too much smoke in the surgical area
   c. when tissue is thermally destroyed
   d. when equipment fails

3. Keep smoke evacuator OFF at all times when airborne particles are produced during all surgical or other procedures.
   a. true
   b. false

4. When can employees be exposed to possible hazardous chemicals found and used in the surgical area?
   a. during mixing
   b. during preparation
   c. always
   d. both (a) and (b)

5. Surgical employees can be exposed to burns or shocks from _____.
   a. lack of training
   b. poorly maintained equipment
   c. carelessness
   d. hazardous chemicals
Module 3: Laser Usage in a Surgical Suite

Introduction

Although there are hundreds of different types of lasers, only about a dozen laser systems are found in everyday clinical use. Employees are exposed to lasers used in healthcare facilities during diagnostic, cosmetic, preventive, and therapeutic applications. Nearly all laser products used in surgery are Class 4. They are designed to deliver laser radiation for the purpose of altering biological tissue.

Laser Classifications

Federal regulations require manufacturers to classify medical laser systems based primarily on their ability to cause damage to the eye and skin. This classification must be indicated on the laser system’s label.

Let’s now take a look at the various types of laser classifications.

Class 1

A Class 1 laser system is considered to be incapable of producing damaging radiation levels during normal operations. This system is also exempt from any control measures or other forms of surveillance. Although some Class 1 laser systems emit very weak, non-hazardous beams, most incorporate “embedded” higher-power lasers. These lasers can only be accessed if important safety features, such as interlocks, are defeated or deliberately bypassed.

Class 1M

A Class 1M laser system is also considered incapable of producing damaging radiation levels during normal operations unless the beam is viewed with an optical instrument, such as a telescope.

Class 2

A Class 2 laser system emits in the visible portion of the spectrum. Eye protection normally occurs with an aversion response, such as the closure of the eyelid, eye movement, or movement of the head to avoid an exposure to a bright light. The aversion response to a bright visible laser source limits the exposure of the retina to .25 seconds or less.
Class 2M

A Class 2M laser system emits in the visible portion of the spectrum. Eye protection normally occurs with an aversion response for unaided viewing. However, viewing the beam with optical aids is potentially hazardous.

Class 3R

A Class 3R laser system is potentially hazardous under some direct and shiny or mirror-like viewing conditions if the eye is focused and stable. The probability of an actual injury is small. This laser will not pose either a fire hazard or diffuse reflection hazard.

Class 3B

A Class 3B laser system may be hazardous under direct and specular viewing conditions, but is normally not a diffuse reflection or fire hazard.

Class 4

A Class 4 laser system is a hazard to the eye and skin from the direct beam, and may pose a diffuse reflection or fire hazard. This type of laser system may also produce laser-generated airborne contaminants and hazardous plasma radiation.

Safety Issues

When lasers are introduced into a healthcare environment, professionals must be prepared to address safety issues for both the staff and patient. Safe use of these systems requires an understanding of the engineering, training, and administrative requirements for all elements of a healthcare system as well as the risks associated with use of laser light.

All medical lasers are regulated and federal regulations require manufacturers to classify the medical laser system based primarily on its ability to cause damage to the eye and skin. This classification must be indicated on the laser system’s label ranging from Class 1 (no hazard) to Class 4 (serious hazard).

Potential Hazards

- severe eye injuries from direct or reflected laser beams
- skin burns from the direct beam of surgical lasers when misdirected
- respiratory hazards when breathing laser-generated airborne contaminants (LGAC)
Possible Solutions

The American National Standard Institute (ANSI) Z136 series of laser safety standards covers lasers in medical settings and provides guidance for the safe use of lasers in healthcare facilities. These guidelines are considered to be the standard for safe practice in the industry and include solutions such as:

- Use laser protective eyewear that provides adequate protection against the specific laser wavelengths being used. All laser eyewear must be marked with Optical Density (OD) and laser wavelength.

- Display warning signs conspicuously on all doors entering the Laser Treatment Controlled Area (LTCA) to warn those entering the area of laser use. Warning signs should be covered or removed when the laser is not in use.

- Facility-authorized technicians who are trained in laser service must perform maintenance on lasers and laser systems.

- Provide local exhaust ventilation with a smoke evacuator or a suction system with an in-line filter to reduce laser-generated airborne contaminants (LGAC) levels in laser applications.

- Use an appropriate filter or barrier which reduces any transmitted laser radiation to levels below the applicable Maximum Permissible Exposure (MPE) level, for all facility windows (exterior or interior) or entryways located within the Nominal Hazard Zone (NHZ) of a Class 3B and Class 4 laser system.

- Use skin protection if repeated exposures are anticipated at exposure levels at or near the applicable MPE limits for the skin.

Training

Detailed training in laser safety should be provided for those healthcare personnel using, or working in the presence of Class 3B and Class 4 health care laser systems. All training activities should be documented and retained on file. Laser safety training should be presented to the following healthcare personnel:
1. Laser Safety Officer (LSO)

2. users

3. laser technical support staff

4. nurses and allied health personnel

**Credentialing**

Each medical specialty has evolved its own procedures for bringing in new techniques and new surgical procedures. In all cases, the laser user should use the laser for its intended purpose within the user's scope of practice, training and experience. All credentialing processes must require training in the safe clinical use of the laser, as well as the maintenance of a safe environment in compliance with defined standards, and local, state and federal requirements.
Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. Nearly all laser products used in surgery are _____.
   a. Class 3R
   b. Class 1M
   c. Class 4
   d. Class 2

2. Eye protection normally occurs with an aversion response, such as the closure of the eyelid, in which type of laser?
   a. Class 2
   b. Class 3M
   c. Class 1
   d. Class 4

3. A _____ laser system is potentially hazardous under some direct and shiny viewing conditions.
   a. Class 1
   b. Class 4
   c. Class 1M
   d. Class 3R

4. All laser training activities should be documented and retained on file.
   a. true
   b. false

5. Class 2 and higher lasers must have a _____.
   a. laser radiation warning label
   b. usage requirements
   c. protective cover
   d. training aspect
Endnotes


