TECHNICAL MANUAL

Oregon OSHA

Section VI
(previously Section V of Oregon OSHA's Technical Manual)

HEALTH CARE FACILITIES

*All information within this section and chapter has been reproduced from the Oregon OSHA Technical Manual (circa 1996) unless otherwise stated within the "**Chapter Revision Information**", located at the beginning of each chapter.*

SECTION VI: CHAPTER 1

HOSPITAL INVESTIGATIONS: HEALTH HAZARDS

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Chapter Revision Information:

- *This chapter was previously identified as Section V, Chapter 1 in Oregon OSHA's circa 1996* ***Technical Manual****. The section number was modified from Section V to Section VI in March 2014 to provide uniformity with federal OSHA's Technical Manual (OTM).*
- *In March 2014, the chapter's multilevel listing format was modified from an alphanumeric system to a roman numeral system.*
- *In March 2014, all "OSHA 200 Log" occurrences were updated to "OSHA 300 Log."*
- *In March 2014, several figures were updated for clarity. All content remains the same.*

SECTION VI: CHAPTER 1

HOSPITAL INVESTIGATIONS: HEALTH HAZARDS

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I. Introduction

A. Incidence and Causal Factors

As of 1988, 4% of the total U.S. work force was employed by hospitals. The National Safety Council (NSC) reports that hospital employees are 41% more likely to need time off due to injury or illness than employees in other industries. In a survey of 165 clinical laboratories in Minnesota showed that the most frequent type of injuries were needle sticks (63%) followed by cuts and scrapes (21%).

Hospital workers frequently report stress, as a predisposing factor for accidents.

Sprains and strains (often representing low back injury) were the most common type of workers compensation claim in 1983 as reported by the Bureau of Labor Statistics.

B. Guidance

In 1988, NIOSH published *Guidelines for Protecting the Safety and Health of Health Care Workers,* the American Association of Critical-Care Nurses has published a handbook on the occupational hazards encountered in the critical care environment, and the NSC has a Safety Guide for hospital environments.

The hazards of exposure to waste anesthetic gases, cytotoxic drugs, and blood-borne diseases such as hepatitis and HIV/AIDS, are the subject of NIOSH criteria documents and OSHA policy statements.

II. Typical Hazards and Health Effects

This chapter covers hospital or health care facility-specific employee hazards. Biological, chemical and physical agents presenting potential exposure to health care employees are reviewed in Appendices VI:1-1 through VI:1-3. These lists are not inclusive.

III. Investigation Guidelines

A. Hospital Records

Hospital's OSHA 300 Log versus employee medical clinic care of employees-is there a possible trend in injuries and illnesses related to typical hazards?

If available, check the hospital's safety program records and facility-enabling or operation equipment licenses, e.g., NRC radioisotope and radiation-source license.

B. Hospital Safety Program

Note any previous health and safety inspections by local health departments, fire departments, regulatory or accreditating agencies, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), College of American Pathologists (CAP), and the American Osteopathic Association (AOA).

The policies and procedures should outline the training that all employees must receive. General hospital training should include fire and electrical safety, infection control procedures, and the hazard communication program.

The policies and procedures should also delineate appropriate personnel and methods for preparation, mixing, application, storage, removal, and disposal of any hazardous agents.

Emergency procedures should include provisions for fires, chemical or radioactive spills, extensive blood or body fluid spills, release of compressed, toxic, and corrosive gases, or power failure.

A safety committee and/or infection control committee should be established within the hospital. Periodic inspection and monitoring is the responsibility of the safety committee.

Immunizations, other than the mandatory vaccination for Hepatitis B, should be offered to personnel at risk.

All electrical equipment used in the hospital must be approved for safety by Underwriters Laboratory (UL) or another OSHA approved body.

Biosafety cabinets should be labeled and certified by the manufacturer and/or a safety officer. The cabinets should be placed in the room at a position where doors, windows, and traffic flow will not create turbulence at the face of the cabinet.

C. Walkaround: Information Interviews

The worker interviews should concentrate on compliance with appropriate policies and procedures.

The employee should be able to verbalize what actions to take in the event of an emergency, i.e., accidental chemical or radioactive spill.

The employee should be aware of the hazards of the products with which he or she works.

Observe the employees' lifting practices.

Walk-around Inspection for health hazards.

Table VI:1-1 contains a suggested area checklist.

Table VI:1-1. **Walkaround Inspection for Health Hazards**

Area	To Check
Every Area	Floor slipperiness Adequate marking of hazards and chemical labelling Handling of infectious and chemical wastes Spill and emergency procedures Use of appropriate personal protective equipment Adequate hand-washing facilities Presence of impervious containers for needles and other sharp objects Where equipped, the aerator and local exhaust ventilation for ethylene oxide sterilizers, along with any sampling or vapor badge records Where equipped, the steam autoclave drain should be free of debris Electrical equipment and wiring must meet electrical standards
Pharmacy	Availability of a class II type A or B biological safety cabinet for mixing chemotherapeutic drugs Accurate, clear labels on all drugs, chemicals, and biological
Laboratory	Uncluttered work areas, clear ventilation slots, and properly labeled ductwork in laboratory hoods and biological safety cabinets Specimen handling Use of pipettes (no mouth pipetting) Gas cylinder placement and storage Maintenance records for laboratory hoods and other equipment Centrifuge tubes with caps Food should never be stored in refrigerators with lab specimens Readily detectable vapors, funes, or dust Laser or radiation hazards
Operating Room	Handling of waste anesthetic gases Air conditioning and humidity (should be about 50%) Static electricity control
Radiation Area	Level of radiation Maintenance and radiation logs

D. Screening Samples

All sampling is based on the CSHO's professional judgment.

1. Sampling Methods

When sampling, it is important to ensure that it is a typical day, i.e., normal exposure time.

BIOAEROSOLS

Bioaerosols can be evaluated using the ACGIH Bioaerosol Committee's Guidelines. These guidelines contain information on sampling, analysis, and recommendations for remedial actions. Hospital infection control personnel should assist in bioaerosol determinations, as this is nonroutine sampling and is specific for preidentified organisms. Specialized bioaerosol sampling equipment is available through the OSHA Health Response Team.

Some of the most commonly found chemicals, e.g., formaldehyde, xylene, halothane, and acrylamide, can be screened using detector tubes. For nitrous oxide, bag collection may be done for analysis by infrared spectroscopy. Specific sampling for chemical agents, such as ethylene oxide, methyl methacrylate, ribavirin (NIOSH recommended 8-hour TWA: 2.5 mg/m3), nitrous oxide, halothane, and other waste anesthetic gases, can be found in the *Chemical Information Manual*.

LASERS

Lasers are calibrated by the manufacturer, but the laser system must be checked prior to each procedure and during extended procedures. Classifications of lasers must coincide with actual measurement of output (See Figure V:1-1). Generally, measurements are required when the manufacturer's information is not available, when the laser system has not been classified or when alterations have been made to the laser system that may have changed its classification. Measurements should only be made by personnel trained in laser technology.

Records of alignment and power density can be checked against the manufacturer's equipment specifications. Maximum Permissible Exposure (MPE) values to the eyes and skin are given in tables 5, 6, and 7 of the ANSI standard (Z136.1-1986) as well as the ACGIH standard. Requirements for measurements and criteria for calculating the MPEs are given in section 8 and 9 of the ANSI standard.

Figure VI:1-1. **Laser Classifications**

Class 1	The least-hazardous class. Considered incapable of providing damaging levels of laser emissions.
Class 2	Applies only to visible laser emissions and may be viewed directly for time periods of less than or equal to 0.25 seconds, which is the aversion response time.
Class 3a	Dangerous under direct or reflected vision. These lasers are restricted to the visible electromagnetic spectrum.
Class 3b	May extend across the whole electromagnetic spectrum and are hazardous when viewed intrabeam.
Class 4	The highest-energy class of lasers, also extending across the electromagnetic spectrum. This class of laser presents significant fire, skin, and eye hazards.

X-RAY MACHINES

Film badges or their equivalent should be used for long-term monitoring. Ionizing radiation (x-ray)-Screening of radiation levels may be performed by using thermoluminescence detectors, pocket dosimeters, and Geiger-Mueller counters.

ELECTRICAL EQUIPMENT

Electrical equipment used in the hospital must follow Hospital Grades under Underwriter's Laboratory (UL) Standards 498 and 544. Resistance measurement and leakage measurements can be determined using the criteria in the National Fire Protection Association's Health Care Facilities Handbook, Chapter 7.

IV. Control and Prevention

A. Engineering

All rooms should have adequate ventilation to remove contaminants. If air recirculation is required, then adequate filtering must be installed.

> **NOTE:** Intensive care units (ICU), particularly neonatal ICUs, may be designed without walls between patient spaces. This may allow aerosolized chemicals and x-ray radiation to escape to neighboring areas.

B. Local Ventilation

1. General Points

Hoods should be used for specific procedures, such as mixing antineoplastic drugs. A scavenging system that contains a proper gasdisposal system must be in place and operable.

Portable suction devices may be used for direct removal of contaminants. Portable ventilation should be used for smoke plume removal during laser surgery.

Ethylene oxide should be ventilated through a nonrecycled or dedicated ventilation system. For a discussion of ventilation of aeration units, sterilizer door areas, sterilizer relief valves, and ventilation during cylinder changes, see the appendix of 29 CFR 1910.1047 (Ethylene Oxide). Alarms for inadequate ventilation and automatic shutdown should be in place.

Air pressure in laboratories and isolation rooms should be negative so that contaminated air is drawn through the exhaust vents rather than circulating throughout the rest of the building.

Biological safety cabinets are primary containment devices used by workers when handling moderate and high risk organisms. There are three types of biological safety cabinets.

- **Class I**-Open fronted, negative pressure, ventilated cabinet.
- **Class II**-HEPA-filtered, recirculated air cabinet with an open front face.
- **Class III**-A totally enclosed HEPA-filtered cabinet of gas-tight construction.

A class-III biological safety cabinet provides the highest protection to a worker.

The effectiveness of the biological safety cabinets is dependent on air flow; therefore, the front intake grill and rear exhaust grill should not be blocked.

All windows must be covered or blacked out in laser surgical areas for protection of employees outside the surgical area.

Installation of automatic fire and explosion detection and protection equipment is recommended. The type should be specific to the hazard in the area.

In the morgue, local vacuum systems should be in place for power saws. Shields should be in place when significant splash hazards are anticipated.

There should be a separate storage area for radioactive sources. This area should be adequately shielded.

Laser systems, especially ones with high voltage capacitance, should be adequately covered. Also, bleeders and proper grounding should be attached to the system.

All operating room doors to rooms that house lasers should contain safety interlocks, which shutdown the laser system if anyone enters the room.

Mixing of Methyl Methacrylate should be done in a closed system.

Ultraviolet lamps have been used to prevent tuberculosis transmission.

2. Administrative

Workers should receive health and safety training.

Vaccination for rubella, measles, mumps, and influenza is recommended, especially for women of child-bearing age.

Work related stressors, such as adequate work space, reasonable work load, readily available resources, adequate and safely functioning equipment, should be considered.

Appropriate emergency equipment (i.e., fire extinguishers, showers, eye wash) should be readily available.

Perform periodic environmental sampling when indicated.
Replace hazardous substances with less hazardous substances whenever possible (i.e., plastic for glass, small packets of chemicals, pre-poured formalin containers).

Provide appropriate containers for disposal of sharps, hazardous waste, personal protective equipment.

Provide conveniently located and supplied hand washing facilities.

Document and retain inventories of radioactive materials. Only authorized personnel should have access to storage areas.

3. Maintenance Schedules

Hospital grade electrical equipment including anesthesia machines, portable x-ray machines and laser systems, biological safety cabinets, and exhaust ventilation systems should have a preventive maintenance schedule. Testing intervals of electric equipment shall be set by the institution.

A specific person should have the responsibility for assuring proper maintenance of the portable x-ray machines. Preventive and corrective maintenance programs for x-ray machines are detailed in 21 CFR 1000, Radiological Health.

The anesthesia machine should be inspected and maintained at least every 4 months. This should be done by factory service representatives or other qualified personnel. Leakage of gas should be less than 100 ml/min during normal operation.

The entire laser system should be properly maintained and serviced according to the manufacturer's instructions. Only qualified personnel from the manufacturer or in-house shall maintain the system. Maintenance may only be done according to written standard operating procedures.

A written log is recommended for any detected leak and any service done on an ethylene oxide chamber. Sterilizer/aerator door gaskets, valves, and fittings must be replaced when necessary.

4. Training

All hospital staff members should have training on electrical and fire safety, hazard communication, and infection control by qualified personnel. Some educators recommend hands on training with pre- and posttests.

In the hospital, specific training regarding hazardous substances should be given. Only qualified personnel may handle the hazardous substances or operate the specified machines.

5. Warning Signs

Specific requirements regarding the warning signs to be used on electrical equipment are outlined in UL No. 544. This should include a Hospital Grade warning. Warning signs should be placed in areas where exposure to ribavirin, antineoplastic agent spills, ethylene oxide, or lasers is likely to occur.

Contract employees should not endanger hospital employees and can be controlled sometimes through use of privileges contracts.

C. Work Practices

Hands should be washed frequently and thoroughly. Workers should wash immediately after direct contact with any chemical, drug, blood, or other body fluid.

No eating, drinking, smoking or application of cosmetics should take place in the lab.

Needles and other sharps objects should be disposed of promptly in impervious containers. Needles should not be clipped or recapped by hand. See **Program Directive A-154:***Bloodborne Pathogen.*

There should be immediate and proper disposal of biohazardous waste.

Mouth pipetting is to be prohibited.

Care should be taken not to create aerosols.

Appropriate personal dosimetry devices should be worn when working with radioactive materials.

Electrical equipment that appears to be damaged or in poor repair should not be used. Any shocks from electrical equipment should be reported promptly to the maintenance department.

Cylinders of compressed gases should be kept secured. They should never be dropped or allowed to strike each other with force.

Large pieces of broken glass should be removed with brooms and disposed of in a separate container. Small pieces can be removed with tongs. Glass should never be removed with fingers.

Vaporizers of anesthesia machines should be turned off when not in use. Also, proper face masks, sufficiently inflated endotracheal tubes, and prevention of anesthetic spills will decrease the amount of waste anesthetic gases in the operating room.

Antineoplastic drug contact requires the use of an isotonic wash to the body or eyes.

D. Personal Protective Equipment

Lab coats should be worn in the laboratory area and removed before leaving. Plastic or rubber aprons should be worn when there is a potential for splashing.

HAND PROTECTION

Gloves should be worn when performing tasks such as handling hazardous chemicals, specimens, or hot materials. The type of glove should be selected according to the task being performed.

Latex or vinyl type gloves should be changed frequently and inspected for punctures before putting them on.

- Double gloving to decrease the risk of exposure by penetration is recommended if it does not interfere with the task.
- Less permeable surgical latex gloves are recommended over polyvinyl gloves.
- Lead-lined gloves are to be worn in the direct x-ray field.

Rubber-soled shoes should be worn to prevent slips and falls. Rubber-lined shoe coverings may also be used to protect against spills or dropped objects. Fluid-proof shoes must be worn if there is a possibility of leakage to the skin.

EYE PROTECTION

Protective eyewear or shields should be used if splashes of a hazardous substance are likely to occur.

Goggles that are tight fitting may prevent irritation of the eyes if aerosolized chemicals are present.

Goggles that protect the cornea, conjunctive and other ocular tissue are required for all personnel in the operating room during laser surgery. The wavelength of the laser output is the most important factor in determining the type of eye protection to be used.

Opaque goggles are to be worn if in the direct x-ray field.

GOWNS

Impervious or low permeability gowns should be worn when in contact with antineoplastic drugs, ribavirin and blood/body fluids. These gowns should be properly stored in the area of use if contaminated. Soiled gowns should be washed or discarded.

Lead-lined aprons are to be worn if in the x-ray field.

RESPIRATORS

Respirators may be required in case of emergencies, such as accidental spills and/or exposure to specific chemicals, e.g., formaldehyde and ethylene oxide. Check for a respirator program.

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APPENDIX VI:1-1 Biological Agents: Blood and Body Fluids

Use or Exposure

Contact with blood and body fluids may occur as a result of medical and surgical procedures, such as labor and delivery, blood or body fluid collection and analysis, the handling of contaminated waste (e.g., gloves, linens, bandages, protective clothing, etc.) or the suctioning of airways. Exposure usually occurs because inadequate infection control procedures are in use.

Health Effects

Acute: The severity of infection depends on:

- The number of pathogens encountered;
- The worker's resistance, which is affected by such things as: state of health, predisposing diseases, age, sex, and hereditary factors;
- Portal of entry (via inhalation, ingestion, mucous membrane or skin contact, or direct inoculation); and
- Virulence of the organism.

Chronic: Reproductive consequences ranging from congenital anomalies to death of the fetus and other chronic diseases, such as cirrhosis of the liver and primary liver cancer, may result from some viruses including hepatitis B, rubella, cytomegalovirus, herpes, and human immunodeficiency virus (HIV).

Biological agents-Refer to **Program Directive A-154:** *Bloodborne Pathogens*

APPENDIX VI:1-2 Chemical Agents

The following are specifically mentioned because of the severity of their health effects. *This list is by no means all-inclusive.*

Use or Exposure

Ethylene oxide (EtO)

A disinfectant and sterilant, it is usually used in the central supply area. Exposure usually occurs from improper aeration of the ethylene oxide chamber after the sterilizing process. It can also occur in outpatient surgery clinics and in the cardiac catheterization laboratory (29 CFR 1910.1047).

Health Effects

Acute: Respiratory and eye irritation, vomiting, and diarrhea.

Chronic: Altered behavior, anemia, secondary respiratory infections, skin sensitization, miscarriages, and reproductive problems. Carcinogen.

Use or Exposure

Waste anesthetic gases such as nitrous oxide, Halothane, Enfluorane

Waste gases result from poor work practices during the anesthetization of patients, improper or inadequate maintenance of the machine, and/or patient exhalation after the surgical procedure (recovery).

Health Effects

Acute: Drowsiness, irritability, depression, headaches, nausea, and problems with coordination and judgment.

Chronic: Embryotoxicity, liver and kidney disease, and cancer.

Use or Exposure

Antineoplastic (cancer) drugs, such as Vincristine, Dacarbazine, Mitomycin, Cytosine Arabinoside, and Fluorouracil

Antineoplastic drugs, used in the treatment of cancer and other tumors, are usually given as intravenous fluids. Mixing usually occurs in the pharmacy area of the hospital in a biological safety cabinet. Exposure may occur during preparation, administration or disposal of the drug and equipment.

Health Effects

Acute: Severe soft-tissue damage, fetotoxicity, headaches, lightheadedness, dizziness, and nausea.

Chronic: Chromosomal damage, teratogenesis, and carcinogenesis.

Use or Exposure

Methyl methacrylate (MMA)

An acrylic cement-like substance used to secure prostheses to bone during orthopedic surgery. Exposure usually occurs during mixing, preparation, and in the operating room.

Health Effects

Acute: Eye, skin and mucous membrane irritant. Acute effects have varied from a decrease in blood pressure to (rarely) cardiac arrest.

Chronic: Degeneration of the liver, mutagenesis, and teratogenesis.

Use or Exposure

Ribavirin

An antiviral drug used to treat some infants and young children with lower respiratory syncytial virus (RSV) infections. This drug is aerosolized to a respirable size of approximately 1.3 microns and is usually administered to the patient in an oxygen tent or face mask. This is when exposure can occur.

Health Effects

Acute: Headaches, coughing, dry upper respiratory tract and dry-burning eyes.

Chronic: Carcinogenesis, fertility impairment and fetotoxicity.

Use or Exposure

Formaldehyde

Used as a fixative and is commonly found in most laboratories and the morgue (29 CFR 1910.1048).

Health Effects

Acute: Eye and respiratory irritation from the liquid and vapor forms. Severe abdominal pains, nausea, vomiting and possible loss of consciousness could occur, if ingested in large amounts.

Chronic: High concentration of vapor inhaled for long periods can cause laryngitis, bronchitis or bronchial pneumonia. Prolonged exposure may cause conjunctivitis. Nasal tumors have been reported in animals. Suspected carcinogen.

Use or Exposure

Toluene or Xylene

Solvents used to fix tissue specimens and rinse stains. They are primarily found in the histology, hematology, microbiology, and cytology laboratories (29 CFR 1910.1000 Subpart Z).

Health Effects

Acute: Eye and mucous membrane irritation from vapor and liquid forms. Dizziness, headache, and mental confusion from inhalation of vapor. Ingestion or absorption through the skin can cause poisoning. There is a potential for thermal burns as it is extremely flammable.

Chronic: If the xylene or toluene contains benzene as an impurity, repeated breathing of the vapor over long periods may cause leukemia. Prolonged skin contact may cause dermatitis. Toluene has been implicated in reproductive disorders.

Use or Exposure

Acrylamide

The resin, usually found in research labs, is used to make gels for biochemical separations (29 CFR 1910.1000 Subpart Z).

Health Effects

Acute: Eye and skin irritation.

Chronic: Central nervous system disorders, i.e., polyneuropathy. Suspected carcinogen. Mutagen.

APPENDIX VI:1-3 Physical Agents

Use or Exposure

Laser

Used in the operating rooms for excision and cauterization of tissue. Class 3b and 4 lasers are most often used. Exposure usually occurs from unintentional operation and/or when proper controls are not in effect. The high electrical energy used to generate the beam is a potential shock hazard. The smoke plume during a surgical procedure and the laser's reaction to certain explosive or flammable agents also present
hazards in the operating room.

Health Effects

Acute: From direct beam exposure, burns to skin and eyes possibly resulting in blindness. Chemical by-products in the smoke plume may cause irritation to the eyes, nose and throat, and nausea (see OSHA Hazard Information Bulletins). Biological and inert particulates can also be found in the smoke plume but these have not been well studied for their effects.

Chronic: Unknown.

Use or Exposure

Ionizing radiation

Portable and fixed X-ray machines are used for diagnostic procedures. Exposure occurs when unprotected employees are near a machine in operation. The degree of exposure depends on the amount of radiation, the duration of exposure, the distance from the source and the type of shielding in place.

Kits containing radioactive isotopes or specimens and excreta of humans and animals who have received radionucleotides may pose a hazard. Exposure may also result from handling of radioactive spills (29 CFR 1910.96).

Effects of radiation exposure are somatic (body) and/or genetic (offspring) in nature.

Health Effects

Acute: Erythema and dermatitis. Large whole-body exposures cause nausea, vomiting, diarrhea, weakness, and death.

Chronic: Skin cancer and bone marrow suppression. Genetic effects may lead to congenital defects in the employee's offspring.

Use or Exposure

Magnetic radiation

Magnetic resonance instrumentation.

Health Effects

No conclusive effects are documented.

Use or Exposure

Electrical hazards

Exposure may occur when there is lack of maintenance to any electrical equipment, abuse, and lack of understanding of the equipment and/or its controls. Oxygen- enriched atmospheres and water may contribute to hazardous conditions.

Health Effects

Acute: Painful shocks, respiratory inhibition, deep burns (electric and thermal) heart rate irregularities, death.

Chronic: No documented effects.

Use or Exposure

Ultraviolet radiation

Ultraviolet lamps are sometimes used in biological safety cabinets.

Health Effects

Acute: Skin burns, damage to the eye.

Chronic: No documented effects other than cataracts.

Use or Exposure

Compressed gases

Compressed gases are used in many clinical laboratories. They are found in varying sizes and in pure or mixed states. Examples: ammonia, carbon dioxide, and nitrogen.

Health Effects

Compressed gases can be toxic, radioactive, flammable, and explosive. These effects arise from the compression of the gas and the health effects of the chemical itself.

Use or Exposure

Glass

Glassware is used as bottles, beakers, flasks, test tubes, pipettes, and tubing. Chipped, cracked, badly etched glassware and sharp edges present hazards, as does broken glass.

Health Effects

Cuts, scratches, abrasions, are potential locations for infection.