The Joint Commission on Accreditation of Healthcare Organizations also recognizes the importance of improved hospital security and has developed a Security Systems Standard, PL.19.11 (JCAHO 1987).

3.2 SPECIFIC SAFETY HAZARDS BY HOSPITAL DEPARTMENT

The safety hazards discussed in the preceding subsection are found in most or all areas of the hospital, but some hazards are typically found in one or only a few departments. This subsection outlines the most important safety problems in each major hospital department. See Section 5 and Appendices 5, 6, and 8 for the health effects of some of these hazards.

3.2.1 Central Supply

Central supply areas in some hospitals are very similar to small manufacturing plants. Their operations include receiving, packaging, processing, and distributing. The major activities involve some type of material handling.

3.2.1.1 Sterilization Equipment

Improper use of sterilization equipment can result in burns from steam and exposure to ethylene oxide. Detailed operating instructions should be posted on or near the sterilization units. Autoclaves and other steam-pressured vessels should be inspected periodically, and records of the inspections should be maintained. These steps will protect workers and ensure that sterilization is adequate.

Piping ethylene oxide through the hospital from a storage area may increase the potential for exposure to this hazard. During such piping, supply lines from gas cylinders transfer a liquid mixture of 12% ethylene oxide and 88% Freon® under pressure to the sterilizers. Ethylene oxide is usually supplied with Freon® so that the mixture is nonflammable. If supply lines are not drained before the tanks are changed, the gaseous mixture can spray the maintenance worker before the pressure is released. Long supply lines from the cylinders to the sterilizers are also a potential source of exposure for many people and may make it difficult to locate and repair ruptures or leaks. By placing the cylinders close to the sterilizer in a mechanical access room (as many hospitals do), the exposure and accident hazard can be contained and controlled. Although the mechanical access room is usually very warm and humid, these conditions can be controlled through adequate exhaust ventilation.

Hospitals with sterilizers that use 100% ethylene oxide cartridges should store only a few cartridges in the department. The rest should be kept in a

cool, dry place. Exhaust systems for ethylene oxide should be designed to prevent re-entry of the vapors into other areas of the building. The health effects of ethylene oxide are discussed in Section 5.1.5.

3.2.1.2 Sharp Objects

Cuts, bruises, and puncture wounds from blades, needles, knives, and broken glass are among the most common accidents in central supply areas. Rules for gathering and disposing of sharp or other hazardous instruments should be reviewed regularly. Workers should handle items returned to central supply as if they contained sharp or hazardous instruments.

3.2.1.3 Material Handling

Strains, sprains, and back injuries are common in central supply areas. Workers should be provided with appropriate carts, dollies, and other material-handling aids, and they should be instructed in proper techniques for handling materials. Step stools and ladders should be available and checked frequently for serviceability. Chairs, boxes, and other makeshift devices should not be used for climbing because they are a frequent cause of falls.

3.2.1.4 Soaps, Detergents, and Cleaning Solutions

Workers may also develop dermatitis from soaps, detergents, and solutions used in central supply. When possible, agents that do not cause dermatitis should be substituted for those that do, or protective clothing should be provided.

3.2.2 Food Service

Injuries occur in food service areas while workers are (1) handling materials as they are received, processed, and distributed, (2) walking on wet and greasy floor areas, and (3) using faulty equipment. These hazards can be reduced by

- servicing electrical components and equipment adequately,
- training workers in correct material-handling techniques,
- properly guarding machinery and hot surfaces,
- maintaining dry and uncluttered walking and working surfaces, and
- maintaining good work and housekeeping practices.

3.2.2.1 Walking and Working Surfaces

The floors in wet and greasy areas (around sinks, dishwashers, and stoves), should be made of nonskid material or covered with nonskid mats. Spilled foods, liquids, and broken dishes should be swept or cleaned up immediately, or the area should be clearly marked and roped off until cleanup. Where work surfaces are slippery, workers should wear shoes with slip-resistant soles. Damaged floor mats should be repaired or replaced promptly.

Workers should not stand on chairs, stools, and boxes. Step stools or ladders should be provided to help workers reach high storage areas. Carts, boxes, or trash should not obstruct aisles or block exits.

3.2.2.2 Electrical Equipment

Workers should follow the recommendations discussed in Subsection 3.1.5 (Electrical Equipment). Toasters, blenders, hand mixers, fans, refrigerators, and radios should be grounded or double insulated. If these items were designed for household use, they should be checked to ensure proper grounding for industrial application.

Workers should turn off switches and pull plugs before adjusting or cleaning power equipment such as slicers, grinders, and mixers. Equipment that is being serviced or cleaned should be tagged as "OUT OF SERVICE." Workers should never plug in electric equipment while their hands are wet or while they are standing in water.

When fixed-equipment (i.e., permanently wired equipment) must be serviced, the electrical power to the equipment should be disconnected. To prevent someone from inadvertently turning the power on while the unit is being serviced, a lock and a tag should be placed on each disconnecting means used to deenergize the equipment. Each worker should apply his own lock, and only the person who applies the lock should remove it.

3.2.2.3 Stove Hoods

Stove hoods should be cleaned and filters should be replaced on a regular schedule. The flange on a stove hood, which is a repository for condensed oil from cooking, should be cleaned regularly. The stove should not be used if hood filters are not in place. Because improperly installed and makeshift filters can be fire hazards, only the proper size and type of filters should be used as replacements.

3.2.2.4 Fire Extinguisher Systems

Kitchen workers should be taught how to use the fire extinguishers and hood extinguishing systems. They should also know when to stay in the area and

use the fire extinguisher and when to leave and call the fire department. Fire extinguishers should be properly mounted, and the immediate area around their location should be kept clear.

Where automatic fire control systems are in place, the head or nozzle should be directed toward a potential fire area.

Inspections must be made in accordance with OSHA standards (29 CFR* 1910).

3.2.2.5 General Kitchen Equipment

Meat saws, slicers, and grinders should be properly guarded. Tamps or push sticks should be used to feed food grinders and choppers.

The wheels of food carts should be kept in good repair. Workers should be instructed to obtain help when moving a heavily loaded cart over a carpet or mat or from an elevator that has not leveled properly. Workers should also be instructed to push (not pull) food carts.

Carbon dioxide tanks should be secured or stored where they cannot be knocked over. All tank gauges should be kept in good working order.

All exposed drive belts, gears, chains, and sprockets on dishwashers, conveyors, and other equipment should be guarded.

Dumbwaiters should be securely closed when not in use.

Steam, gas, and water pipes should be clearly marked (e.g., color-coded) for identification, and personnel should learn the coding system and the location and operation of shut-off valves.

3.2.2.6 Knives

Workers should be instructed about the safe handling and use of knives. Cutlery should be kept sharpened and in good condition: dull knives tend to slip. A cutting board or other firm surface should always be used. The direction of the cut should always be away from the body.

Knives, saws, and cleavers should be kept in a designated storage area when not in use. The blades should not be stored with the cutting edge exposed. Knife holders should be installed on work tables to prevent worker injury. Knives and other sharp objects should not be put into sinks between periods of use.

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*Code of Federal Regulations. See CFR in references.

Newly purchased knives should be equipped with blade guards (knuckle guards) that protect the hand from slipping onto the blade.

3.2.2.7 Hot Utensils and Equipment

All stoves, pots, and pans should be treated as hot equipment. The handles of cooking utensils should be turned away from the front of the stove. Hand protection for grasping hot utensils should be readily available near stoves.

When uncovering a container of steaming material, the worker should hold the cover to deflect steam from the face.

Workers should take special care to stand to the side of the unit when lighting gas stoves and ovens.

3.2.2.8 Chemical and Physical Agents

Workers in food service areas can be exposed to agents that pose potential occupational safety and health problems. The most common are listed below:

3.2.2.8.1 Ammonia

Ammonia solution is frequently used as a cleaning agent, and ammonia gas is used as a refrigerant. Because concentrated solutions of ammonia can cause severe burns, workers should avoid skin contact with this substance by wearing protective clothing such as appropriate gloves (see Section 2.3.5). Respirators should be used as needed (see Section 2.3.5.6). If skin or eye contact occurs, the affected area should be washed promptly with water.

Workers who handle concentrated solutions of ammonia should wear rubber gloves and goggles or a face shield. Because ammonia gas is released from solution, good ventilation should be provided. For example, stove hoods should be operating when workers use ammonia to clean grease from stoves. Because ammonia can react with some deodorizing chemicals to produce harmful byproducts, these substances should not be stored or used together.

3.2.2.8.2 Chlorine

Chlorine solutions can be used as disinfectants in dishwashing. When chloride solutions are added to other compounds, a chemical reaction may occur, and chlorine gas may be released. Exposure to chlorine, even at low concentrations, can cause eye, nose, and throat irritation; high concentrations can produce pulmonary edema. Protective clothing and equipment should be used when personnel are working with chlorine. Selection of the appropriate protective equipment and clothing should be based on the type and extent of exposure anticipated (see Section 2.3.5).

3.2.2.8.3 Drain cleaners

Drain cleaners can cause skin burns and damage to the eyes. Workers should wear rubber gloves and goggles or face shields when they use drain cleaners and when splashing is possible (see Section 2.3.5).

3.2.2.8.4 Ambient Heat

Ambient heat may be a problem in kitchen areas. High heat levels can cause heat-related illnesses, and workers should be aware of the symptoms of heat disorders and the need for frequent water consumption and rest periods.

3.2.2.8.5 Microwave Radiation

Microwave ovens are becoming standard appliances in hospitals. As these ovens wear out, hinges and catches may loosen, and microwave radiation may be released from the units. The units should be cleaned regularly because spilled food can prevent oven doors from closing properly. If the interlock system fails, the unit may not shut off when the door is opened. Trained personnel should check units periodically for leaks.

3.2.2.8.6 Oven cleaners

Oven cleaners may be sprayed or brushed onto oven walls. Workers using oven cleaners should wear protective gloves and goggles and avoid breathing the vapors. Most oven cleaners can cause skin irritation, such as rashes and dermatitis; inhaled vapors are also irritating to the respiratory tract (see Section 2.3.5).

3.2.2.8.7 Soaps and detergents

Soaps and detergents may cause dermatitis if precautions are not taken (for example, gloves should be worn and substitutes should be found for known sensitizers).

3.2.2.8.8 Strong caustic solutions

Strong caustic solutions are often used to clean reusable filters on stoves, grills, and broiler exhaust hoods. Strong caustics can burn the skin, harm the eyes, and cause skin rashes and dermatitis. Protective clothing and equipment should be used to prevent skin and eye contact.

3.2.3 Housekeeping

Housekeeping workers serve in all patient and nonpatient areas and are thus potentially exposed to all of the health and safety hazards found in the hospital environment. They should receive periodic instruction to keep them aware of the specific hazards in each department, especially in those areas where X-rays, radioisotopes, oxygen and other gases, and specific chemicals are used.

3.2.3.1 Health and Safety Guidelines for Housekeeping Workers

The following specific guidelines should be included in a health and safety program for housekeeping workers:

- Workers should be trained in proper material-handling techniques.
- Workers should be instructed to wash their hands thoroughly before eating, drinking, and smoking, before and after using toilet facilities, after removing contaminated work gloves, and before going home.
- Workers should be aware that other persons may not have followed proper procedures for disposing of needles, knives, and glassware. All refuse should be handled as if hazardous items were present.
- Workers should seek help either from other persons or with mechanical devices when lifting or moving equipment or furniture that is heavy or awkward to handle.
- Workers may be injured as a result of improper use and poor maintenance of ladders, step stools, and elevated platforms. To reduce the frequency of falls,
  - -- workers should not stand on the top two steps of a ladder, and
  - -- workers should not substitute chairs, beds, boxes, or other items for a ladder.
- All electrical appliances, such as vacuums and polishers, should have grounded connections.
- Service carts should be equipped with large, wide wheels to make them easier to push.
- The slippery areas on floors that are being scrubbed or polished, should be identified with signs or roped-off areas.

3.2.3.2 Chemical and Physical Agents

Some hazardous chemical and physical agents frequently encountered by housekeeping workers are listed below.

3.2.3.2.1 Soaps and detergents

Soaps and detergents may cause dermatitis or sensitization reactions. Workers should be trained to use these materials properly and should be provided with appropriate protective gloves (see Section 2.3.5). Effective cleaning solutions that do not cause dermatitis or sensitization should be substituted when possible. Sensitized workers should be transferred to other duties if necessary.

3.2.3.2.2 Solvents

Solvents, such as methyl ethyl ketone, acetone, and Stoddard solvent, are often used to clean grease from equipment and may have several cleaning applications throughout the hospital. Workers should be instructed in their proper use to prevent both fire hazards and exposures that could lead to illness. Many solvents remove the natural fats and oils from the skin and when absorbed through the skin, can cause respiratory effects. Appropriate personal protective equipment (see Section 2.3.5) should be worn by workers who come into contact with solvents.

3.2.3.2.3 Cleaners

Cleaners used throughout the hospital may contain acids or caustics that can cause burns. Workers who use these solutions should wear proper protective clothing such as rubber gloves, rubber or plastic aprons, and eye protection.

3.2.3.2.4 Disinfectants

Disinfectants (including quaternary ammonia compounds, phenols, and iodophors) are used in such hospital areas as nurseries and operating rooms. Because many disinfectants can produce skin rashes and dermatitis, personal protective equipment for the skin (see Section 2.3.5) and eyes is required.

3.2.3.3 Bacteria and Viruses

Housekeeping personnel are frequently exposed to viruses and bacteria. They should therefore (1) follow instructions issued by the infection control

personnel for reporting infections, and (2) take appropriate measures to limit further contagion from patients by practicing universal precautions for handling blood and body fluids.

3.2.4 Laundry

The following points should be included in a health and safety program for hospital laundry workers:

- Floors should be kept as dry as possible, and wet floors should be labeled. Nonskid mats or flooring should be provided in wet areas, and workers should wear nonskid boots or shoes.

- Laundry should be handled as if hazards were present because puncture wounds and cuts can result from needles, knives, and blades that are folded in soiled linens.

- Soiled linens should be handled as little as possible and with minimum agitation to prevent contamination of the air. This is especially true for linens used by patients who have infectious microorganisms or radioactive implants or are taking cytotoxic drugs. All soiled linens should be bagged with impervious, color-coded bags at the site where they are used, and materials contaminated with potentially infective agents, cytotoxic drugs, or radionuclides should be clearly labeled and handled with special care. To protect workers from unnecessary contact, a barrier should separate soiled linen areas from the rest of the laundry area.

- Proper precautions should be taken when handling soaps and detergents (for example, gloves should be worn and substitutes should be used for known sensitizers).

- The high temperatures and excessive humidity in some laundry areas may be impossible to control with engineering devices alone, especially during the summer months. Administrative controls may be necessary (NIOSH 1986), and persons working in excessively hot environments can be rotated to other jobs or shifts.

- Workers should be aware of the symptoms of heat stress and the need for water consumption and more frequent breaks.

- Workers who sort and wash contaminated linens should wear proper protective clothing and respirators.

- Workers should be trained in the proper techniques for lifting and material handling.

- Laundry personnel should be instructed to wash their hands thoroughly before eating, drinking, and smoking, before and after using toilet facilities, and before going home.

- Workers who handle and sort soiled linen in the laundry department should be included in the hospital immunization program.

- The wrapping on steam lines should be adequately maintained to protect workers from burns.

3.2.5 Maintenance Engineering

Maintenance shops in hospitals tend to be overlooked when safety and health are considered. Housekeeping is often very poor, with materials scattered in aisles and over floors, equipment and stock stored improperly, and machinery improperly guarded. Standards pertinent to maintenance areas may be found in 29 CFR 1910, NFPA (1983) codes, and State and local laws and regulations. Section 5 addresses in detail many of the hazards encountered in maintenance areas. The major hazards will be described briefly below.

3.2.5.1 General Rules for Maintenance Areas

The following general rules should be applied to maintenance areas:

- Drive belts must be guarded. Gears, shafting, and chains and sprockets must be properly enclosed (29 CFR 1910, Subpart O).

- Tool rests, adjustable tongue guards, and spindle guards on grinders must be installed and kept properly adjusted (29 CFR 1910, Subpart O).

- Blade guards must be installed on table saws, band saws, and radial arm saws. If saws are used for ripping, anti-kickback devices must be installed (29 CFR 1910, Subpart O).

- Electrical equipment must be properly grounded or double insulated (29 CFR 1910.3).

- Extension cords must be the three-wire type and have sufficient capacity to safely carry the current drawn by any devices operated from them. Extension cords may be used only in temporary situations and may not be substituted for fixed wiring (29 CFR 1910.3).

- Electrical switches on circuit boards should be marked with danger tags and physically locked to prevent circuit activation when machinery is being repaired. Circuits should be deenergized before repair work begins.

- Metal ladders should never be used by workers to change light bulbs or work on electrical equipment or wiring.

- Broken ladders should be destroyed or tagged, removed from service, and repaired.

- Battery-charging areas should be adequately ventilated to prevent a buildup of hydrogen gas. These areas should be designated as "NO SMOKING" areas.

- Gasoline- and diesel-powered equipment should be properly maintained and operated only in areas that are well-ventilated or vented to the outside to prevent a buildup of carbon monoxide. Data obtained recently from animal studies indicate that diesel exhaust is a potential carcinogen.

- Workers should wear protective clothing and equipment when exposed to hazards requiring such protection (see Section 2.3.5). Protective clothing and equipment include:

  -- Gloves for handling hot, wet, or sharp objects and chemicals

  -- Eye and face protection to prevent injuries from chips, sparks, glare, and splashes

  -- Hearing protection to prevent hearing loss from noise sources

  -- Respirators to prevent exposure to dusts, fumes, and vapors, as appropriate

- Paints, solvents, and other flammable materials must be stored in cabinets or rooms that meet the requirements outlined in NFPA 30 (NFPA 1983, Volume 3).

- Hand tools should be maintained and stored properly.

- Fuel and cylinders of flammable gas must be stored separately from cylinders of oxidizing gas. Cylinders must be kept away from heat sources such as radiators, steam pipes, and direct sunlight (NFPA 1983, Volume 4).

- Cylinders must be stored and used in the upright position (NFPA 1983, Volume 4). Cylinders of compressed gas must be chained or secured to prevent them from falling.

- Trash compactors should not be operated in the open position. They should have guarding devices, such as two-hand controls, electric eyes, and emergency shut-off bars.

- In laboratories that use sodium azide for the automatic counting of blood cells, the pipes should be flushed before plumbing repairs can be made because a buildup of sodium azide in the pipes can result in a violent explosion. A sodium-azide decontamination procedure is available from NIOSH (NIOSH 1976).

- The use of compressed air for cleaning surfaces should be avoided.

For additional requirements regarding electrical equipment and storing and handling compressed-gas cylinders, refer to Sections 3.1.5 and 3.1.3, respectively.

3.2.5.2 Chemical and Physical Agents

Some chemical and physical agents that pose common occupational health hazards in maintenance shops are discussed below.

3.2.5.2.1 Asbestos

Asbestos was commonly used in older buildings as an insulating material for steam pipes. When that insulation is torn off and replaced, asbestos fibers may be released into the air. Persons exposed to asbestos fibers may develop a fibrosis of the lungs (asbestosis) and possibly lung cancer or peritoneal mesothelioma. Smokers are more susceptible to asbestos-induced lung cancer than are nonsmokers.

To reduce asbestos exposure, workers should wear a NIOSH-approved, positive-pressure, air-supplied respirator (NIOSH-EPA 1986), and the insulation material should be dampened before it is cut or torn apart. Areas containing asbestos should be vacuumed rather than swept, and waste material should be discarded in sealed plastic bags. State health departments or other responsible jurisdictions should be contacted before asbestos removal operations begin; many states certify companies engaged in asbestos removal. Guidance for Controlling Asbestos-Containing Materials in Buildings (EPA 1985) contains procedures for removing asbestos. Specific federal requirements govern asbestos exposure; for more information on asbestos, see 29 CFR 1910.1001 and Section 5.1.2 of this document.

3.2.5.2.2 Ammonia

Ammonia is used as a liquid cleaning agent and as a refrigerant gas. Concentrated solutions of ammonia can cause severe burns. Workers

should avoid skin contact with ammonia by wearing protective clothing (see Section 2.3.5). If skin or eye contact occurs, the affected area should be washed promptly. Workers who handle concentrated solutions of ammonia, should wear rubber gloves and goggles or face shields. Ammonia gas is released from a concentrated solution, and thus good ventilation should be provided. Ammonia and some deodorizing chemicals should not be stored or used together because they can react to produce harmful byproducts. The NIOSH REL for ammonia is 50 ppm (35 mg/m^3) as a 5-min ceiling; the OSHA PEL for ammonia is 50 ppm as an 8-hr TWA; the ACGIH recommended TLV is 25 ppm (18 mg/m^3) as an 8-hr TWA with a STEL of 35 ppm (27 mg/m^3).

3.2.5.2.3 Carbon monoxide

Carbon monoxide exposures can occur when the gasoline-powered engines of forklifts, auxiliary power generators, etc., are run in poorly ventilated areas. Symptoms of carbon monoxide exposure begin with a slight headache followed by nausea, dizziness, and unconsciousness. Emergency care should be initiated for any worker exposed to excessive carbon monoxide. The NIOSH REL for carbon monoxide is 35 ppm as an 8-hr TWA with a ceiling of 200 ppm; the OSHA PEL is 50 ppm as an 8-hr TWA.

3.2.5.2.4 Drain-Cleaning Chemicals

Drain-cleaning chemicals can burn the skin and damage the eyes. Workers should wear rubber gloves and goggles or face shields when they use drain cleaners and splashing is possible. Product information sheets or material safety data sheets contain additional information.

3.2.5.2.5 Noise

Noise exposure at levels that exceed 90 decibels--measured on the A scale (dBA)--often occurs in boiler houses and power-supply locations. Adequate hearing protection should be provided and worn in noise areas when engineering or administrative controls cannot eliminate the exposure. When noise levels exceed 85 dBA, OSHA requires a hearing conservation plan. The OSHA standard for occupational noise exposure contains additional information (29 CFR 1910.95).

3.2.5.2.6 Paints and adhesives

Paints and adhesives contain a wide variety of solvents and should be used only in areas with adequate ventilation. If ventilation is inadequate, workers should wear respirators approved for use with organic vapors (see Section 2.3.5.6). Skin contact with epoxy paints

and adhesives can be prevented by using gloves and other personal-protective clothing (see Section 2.3.5). If skin contact does occur, the skin should be washed immediately. Section 5 contains more information about the hazards associated with solvent exposure.

3.2.5.2.7 Pesticides

Pesticides are used throughout the hospital for fumigation and pest extermination. Workers who apply these substances should wear protective gloves and respirators (see Section 2.3.5) approved for use with pesticides (organic dusts and vapors). Workers should be familiar with emergency procedures for spills and splashes and federal regulations governing the application of pesticides.

3.2.5.2.8 Solvents

Solvents such as methyl ethyl ketone, acetone, and Stoddard solvent may be used to clean parts in maintenance shops. Recommended personal protective equipment should be worn by workers who come into contact with solvents (see Section 2.3.5). Many solvents remove the natural fats and oils from the skin and may be absorbed through the skin. Neurotoxicity is a principal effect of solvent exposure (NIOSH 1987). All organic solvents should be used with adequate ventilation. Because some solvents are also flammable, they should be stored in approved safety containers. Cleaning tanks should be kept closed when not in use (See Section 5).

3.2.5.2.9 Waste anesthetic gases and ethylene oxide

Maintenance workers may be exposed to waste anesthetic gases and ethylene oxide when repairing ventilation or exhaust systems that are used to remove these gases. Workers should be aware of the health effects of anesthetic gases and ethylene oxide as well as their physical properties. For example, ethylene oxide is a carcinogen and is extremely flammable. Appropriate personal protective equipment and clothing should therefore be provided and worn by workers when exposure to either anesthetic gases or ethylene oxide is possible (see Section 2.3.5). Control measures should be followed to minimize the levels of exposure. See Section 5.1.5 for more information about ethylene oxide. See Section 5.1.12 and the NIOSH criteria document (NIOSH 1977a) for more information about waste anesthetic gases.

3.2.5.2.10 Welding fumes

Welding fumes contain particulate matter and gases from the metals being joined, the filler material used, and coatings on the welding

rods. Exposure to welding fumes frequently occurs when maintenance personnel weld in confined spaces. Local exhaust ventilation should be provided when extensive welding operations are performed. Workers who weld should be familiar with the potential adverse health effects of exposure to welding fumes. NIOSH has published a criteria document (NIOSH 1988) that contains recommendations for protecting the safety and health of welders.

3.2.6 Office Areas

Office areas are frequently overlooked during health and safety inspections in hospitals. The following guidelines should be included in health and safety programs for office workers:

- Desks and countertops should be free of sharp, square corners.
- Material should be evenly distributed in file cabinets so that the upper drawers do not unbalance the file and cause it to fall over. Only one drawer should be opened at a time, and each drawer should be closed immediately after use.
- Papers and other office materials should be properly stored and not stacked on top of filing cabinets.
- Aisles and passageways should be sufficiently wide for easy movement and should be kept clear at all times. Temporary electrical cords and telephone cables that cross aisles should be taped to the floor or covered with material designed to anchor them.
- Electrical equipment should be properly grounded, and the use of extension cords should be discouraged.
- Carpets that bulge or become bunched should be relaid or stretched to prevent tripping hazards.
- Heavy materials should not be stored on high shelves.

Video display terminals (VDTs) have been introduced on a large scale in hospital office areas during the past decade. Terminals should be selected that incorporate modern ergonomic advances in design. They should then be properly installed, and training in their use should be provided. Otherwise, they may be a source of musculoskeletal disorders (shoulder, neck, and arm) and eyestrain. The NIOSH report, Potential Health Effects of Video Display Terminals, contains recommendations for preventing these problems (NIOSH 1981a). (See also Section 5)

3.2.7 Print Shops

The following guidelines should be followed in print shops:

- Material safety data sheets (MSDS's) should be requested from the manufacturers of all chemicals used in the print shop. The MSDS's must conform to requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200). Once the composition of chemicals is known, proper safety and health precautions should be implemented.

- Smoking should be prohibited because highly flammable inks and solvents are used in the print shop.

- Water-based inks should be used whenever possible.

- Safety cans should be used to store all flammable liquids. Ink-cleaning chemicals should be dispensed from plunger-type safety cans.

- All rags soaked with solvent and solvent-based ink should be disposed of in covered metal containers that are emptied at least daily.

- Ventilation should be provided as needed to control airborne concentrations of solvents and other toxic substances used in the print shop.

- The cutting edge of guillotine papercutters should be guarded. Two-hand controls are an effective method of reducing this hazard. All gears, belts, pulleys, and pinch points should be guarded.

- Because printing equipment produces a noisy environment, control measures should be implemented to reduce noise to the lowest possible level. Adequate hearing protection should be provided, and surveys of noise level should be conducted routinely.

3.2.8 Patient Care Areas (Nursing Service)

3.2.8.1 Physical Exertion

Strains and sprains account for approximately half of the compensable disorders among hospital workers (see Table 1-1 and Health Alert [1978]). Falling, lifting patients and heavy materials, moving beds and furniture, pushing heavy carts, and wearing improper footwear all contribute to the frequency of these injuries.

The following control measures can help prevent strains and sprains:

- Make aisles and passageways adequate for the movement of personnel and materials. Passageways, aisles, and halls should not be used as storage areas.
- Treat floors with non-slip material.
- Clean up spills immediately.
- Teach workers to use proper lifting techniques to help prevent injuries.
- Place temporary electric cords for lights, radios, televisions, and patient-monitoring equipment in a way that prevents tripping hazards; either tape them to the floor or cover and anchor them with other material.
- Use only properly maintained, safe ladders to reach high objects. Do not use stools, chairs, or boxes as substitutes for ladders.

3.2.8.2 Needles and Sharp Instruments

Cuts, lacerations, and punctures are also common among hospital workers (see Table 1-1 and Health Alert [1978]). Needles and other sharp instruments should be discarded in designated puncture-resistant containers and not in trash cans or plastic bags. Hospitals should establish and enforce policies to prevent the recapping of needles.

Rules for safe disposal and collection of sharp instruments or other hazardous materials should be reviewed regularly. Workers should examine and handle soiled linens and similar items as if they contained hazardous items.

3.2.8.3 Obstacles and Broken Objects

Abrasions, contusions, and lacerations are also among the more frequently reported occupational injuries in patient care areas. Control measures to prevent such injuries include

- Arranging furniture to allow free movement about the room.
- Keeping doors and drawers closed when not in use.
- Turning bed-adjustment handles in or under the bed.

- Allowing only smooth and rounded corners on desks and countertops at the nurses' stations.
- Sweeping up and disposing of broken glass immediately and properly. Workers should not pick up broken glass with their fingers.
- Grasping ampoules with protective gauze before scoring the tip with a metal file and snapping the top open.

3.2.8.4 Electrical Hazards

Workers should be instructed in the proper use of electrical equipment and should take the following precautions:

- Report defective equipment immediately, tag it, remove it from service, and repair or discard it.
- Prohibit patients, visitors, and workers from using ungrounded coffeepots, radios, cooling fans, portable heaters, or other appliances.
- Implement a program to check all electrical equipment and connections in nurses' stations and kitchenette areas regularly to find damaged cords and ungrounded electrical equipment.
- Implement a program to check regularly all electrical equipment (e.g., razors and hair dryers) brought into the hospital by patients.
- Ground beds that have electrical controls and place cords under the bed.
- Clean microwave ovens regularly and check periodically for proper door closure and seal. These ovens should be used only in designated areas.

3.2.8.5 Other Hazards

The following guidelines apply to miscellaneous hazards found in patient care areas:

- Label acids and other chemicals properly and store and handle safely.
- Label linens and wastes properly.
- Use personal protective equipment and protective measures as recommended (see Section 2.3.5).

- Enforce the isolation techniques developed according to CDC recommendations when staff members (including physicians) provide care for patients with infectious diseases.

- Enforce exposure limits for ionizing radiation according to Federal or State regulations and standards.

3.2.9 Pharmacy

Pharmacy workers are also subject to slips and falls, back injuries, cuts from broken bottles and equipment, and exposure to chemicals (such as alcohols and solvents), dusts (such as talc and zinc oxide), and antineoplastic drugs. The following control measures should be considered:

- Provide stepladders to help personnel reach items stored on high shelves.

- Clean up spills promptly.

- Dispose of broken bottles and unusable pharmaceuticals according to established procedures.

- Guard mixers, packaging and bottling equipment, and labeling machinery properly. Adequate exhaust hoods should be provided where needed. If a laminar air-flow hood is used, it should be checked frequently to determine whether it is operating properly.

- Make pharmacy personnel aware of hazards associated with handling antineoplastic agents and make them familiar with safety guidelines. See Section 5 for a more in-depth discussion of antineoplastic agents.

- Instruct workers in safe practices for lifting and carrying to prevent injuries.

- Do not repair thermometers, manometers, and other instruments that contain mercury in the pharmacy. This equipment should either be repaired in an appropriate hospital shop or sent out for repair.

- Install opening devices on the inside of walk-in vaults and refrigerators to prevent workers from being accidentally locked inside.

- Identify through medical surveillance the adverse effects of exposure to any medications that are packaged or dispensed in the pharmacy.

- Do not permit workers to smoke or eat in pharmacy preparation areas because drug aerosols may be inhaled or pharmaceuticals may be ingested.

3.2.10 Laboratories

3.2.10.1 Types of Laboratory Hazards

3.2.10.1.1 Equipment

Increased attention in the past decade has been focused on health hazards in the laboratory, such as infectious diseases and toxic chemicals, but laboratory safety is still a problem. Electric appliances that replaced the open flames of Bunsen burners have resulted in increased risk of electric shock.

Chemical Laboratory Safety Audit (Reich and Harris 1979) provides a general protocol to help identify potential safety problems.

3.2.10.1.2 Infection

Microorganisms in the laboratory can be inhaled, ingested, or inoculated through the skin. Pike (1976) reviewed published case reports of infections associated with medical laboratories and found 42% caused by bacteria and 27% associated with viruses. Many laboratory-acquired infections, especially common diseases, were not reported, and Pike concludes that laboratory-acquired tuberculosis and hepatitis are significantly under-reported. Nearly all sizable blood banks and serology laboratories had at least one case of hepatitis. Of the 3,921 cases reported, 65% involved trained workers, 59% were in research laboratories, and 17% were in diagnostic laboratories.

For 82% of the reported infections, no source was recognized. Of the 18% for which a source was recognized, one fourth involved needle punctures, leaking syringes, or contamination while separating needles from syringes. Other commonly recognized exposure incidents included spills and breakage resulting in sprays (aerosols) of infectious material, injuries with broken glass or other sharp instruments, and aspiration during mouth pipetting. Research laboratories were the most hazardous because they lack the standard and routine handling procedures found in large commercial laboratories.

For the 75% to 80% of all laboratory infections for which there is no recognized causal accident or event, the suspected source is usually an aerosol (Collins 1980). Aerosols are airborne droplets of infectious material that may be generated by

- Opening containers

- Blowing out pipettes
- Mixing test-tube contents
- Opening lyophilized cultures
- Centrifuging suspensions
- Pouring liquids
- Using automatic pipetters
- Mixing fluid cultures by pipette
- Harvesting or dropping infected eggs
- Mixing with high-speed blenders
- Using poorly made, open, or large wire loops
- Spilling liquids

Small aerosol particles dry almost instantly and remain suspended in the air for long periods. When inhaled, they penetrate deep into the lung and may cause infections. Larger and heavier particles settle slowly on laboratory surfaces and workers' skin. They may enter the body through contaminated foods, contaminated skin, or objects that touch the eyes or mouth (Collins 1980).

Ways to reduce aerosols include

- Using smooth agar and a glass rod (or cool wire loop if necessary) for spreading
- Draining pipettes instead of blowing them out
- Mixing cultures in a tube mixer
- Using disinfectant gauze or Benchkote® on work surfaces during transfers of biogenic material
- Wrapping needles and bottle tops in alcohol-soaked pledgets when withdrawing needles from stoppered vaccine bottles
- Properly maintaining equipment such as high-speed blenders
- Using sealed centrifuge buckets
- Carefully packaging specimens during transport and storage

3.2.10.1.3 Allergic sensitization

Allergic sensitization to laboratory materials is a related but less common hazard for some workers. Severe allergic reactions may require a job change to an allergen-free environment. Ascaris, brucella, formaldehyde, penicillin, tuberculin, and the dander of laboratory animals are common allergens and sensitizers.

3.2.10.1.4 General chemical hazards

Each laboratory should identify the chemicals used there and should establish appropriate training, precautions, personal protective equipment (see Section 2.3.5) and controls. Although laboratory workers usually recognize warnings for explosive gases and liquids, they should also be aware of several hazardous mixtures, such as mixtures of bleach, chromic acid, and certain organics; oxidants and flammable liquids; and chemicals like ethers and alkenes. The American Association of Anatomists has listed and reviewed the following chemicals ordinarily used in medical laboratories (Lavelle 1979):

Fixatives	acrolein, formaldehyde, glutaraldehyde, osmium tetroxide, phenol, picric acid, potassium dichromate
Solvents	acetone, benzene, carbon tetrachloride, chloroform, dioxane, ether, ethoxyethanol, glycerol, methanol, propylene oxide, pyridine, tetrahydrofuran, toluene, trichloroethylene, xylene
Embedding media and reagents	azodiisobutyronitrile, benzoyl peroxide, benzyldimethylamine, dibutyl phthalate, dichlorobenzoyl peroxide, dimethylaminoethanol, dodecenylsuccinic anhydride, resins (acrylic, epoxy, nitrocellulose, and polyester), tridimethylaminomethyl phenol
Metals and metal compounds	chromic acid, lead acetate, mercury, osmium tetroxide, potassium permanganate, silver nitrate, uranyl acetate, vanadium, vanadyl sulfate
Dyes	acridine dyes, Auramine OH, Direct Black 38, Direct Blue 6

Explosive agents	ammonium persulfate, benzene, dioxane, azides, ether, glycerol, methanol, nitrocellulose, perchloric acid, picric acid, silver nitrate, tetrahydrofuran
Miscellaneous	acrylamide, diaminobenzidine, hydroxylamine

3.2.10.1.5 Carcinogens

Although only about two dozen chemicals have been established as human carcinogens (Olishifski 1979), several hundred have been found to cause cancer in test animals, and many more have not yet been tested. Laboratory workers may frequently be exposed to many potential carcinogens, including chromium trioxide, benzidine, carbon tetrachloride, 1,2-dichloroethane, ethylene oxide, benzene, 1,4-dioxane, and 2,2',2"-nitrilotriethanol. Because laboratory workers are potentially exposed to many suspected carcinogens, engineering controls and safe work practices should be used to reduce worker exposure as much as possible.

3.2.10.1.6 Mutagens and teratogens

Laboratory workers are potentially exposed to both mutagens (chemicals that may cause mutations or genetic changes) and teratogens (chemicals that may cause congenital malformations in the developing fetus of a pregnant worker). Although most reproductive hazards may affect both men and women, the fetus is particularly at risk from exposure to ionizing radiation, drugs, and biologic agents. An estimated 125,000 women work in laboratories in the United States (Hricko and Brunt 1976). Studies suggest a higher rate of adverse reproductive outcomes (major malformations, spontaneous abortions, and neonatal deaths) among female laboratory workers (Ericson and Kallen 1984, Axelsson and Jeansson 1980, and Meirik et al. 1979).

Known and suspected reproductive hazards include:

Ionizing radiation	alpha-, beta-, and gamma-emitting radionuclides and X-rays
Drugs	actinomycin D, antineoplastics, mitomycin, quinine, and streptomycin

Chemicals	anesthetic gases, benzene, dibutyl phthalate, diethyl phthalate, diethylhexyl phthalate, ethylene oxide, ethylene diaminetetraacetic acid (EDTA), diazo dyes (Evans blue, Niagara blue, Congo red, Janus green B), lead, lead acetate, mercury, sodium arsenate, toluene, xylene,
Biologic agents	cytomegalovirus, mumps, rubella (German measles), Toxoplasma gondii (Toxoplasmosis), varicella (herpes zoster), hepatitis viruses (hepatitis), human immunodeficiency virus (acquired immunodeficiency syndrome)

3.2.10.1.7 Physical stress

Forester and Lewy (1983) described a case of pipetter's shoulder (tendinitis resulting from the frequent repetitive movement of the shoulder joint during prolonged periods of pipetting) that developed after a worker had performed an unusually large number of assay procedures. Minuk et al. (1982) reported a case of osteoarthritis that developed in the right thumb of a pipetter. The frequency of these problems among laboratory workers has not been determined.

3.2.10.1.8 Laboratory animals

Animals can carry and transmit serious diseases. A university hospital reported 15 cases of lymphocytic choriomeningitis (LCM) among laboratory workers, and another hospital reported 46 cases of LCM where staff worked in close contact with a hamster colony (Hotchin et al. 1974). Q fever has been a recurrent source of infection, serious disease, and occasional fatality for laboratory and research workers, and CDC has developed a set of guidelines for managing this risk at medical research centers that use sheep (CDC 1979).

3.2.10.1.9 Emotional stress

Laboratory workers commonly report stress as a job hazard. A NIOSH study ranked clinical laboratory work seventh among stressful occupations based on frequency of admission to community mental health centers (Colligan et al. 1977). Griffin and Klun (1980) listed the primary source of stress for hospital-employed medical technologists as physician attitudes, followed by emergency-response procedures, the need for accuracy, lack of communication (between shifts, between laboratory workers and doctors, and among

laboratory staff), fear of making an error (especially if it might result in a patient's death), overwork, deadlines, lack of support from pathologists or supervisors, and lack of appreciation by other hospital staff members.

3.2.10.2 Standards and Recommendations

No uniform national safety standards exist for all laboratories. In August 1986, OSHA proposed a standard to protect laboratory workers; but until that standard is promulgated, only laboratories involved in interstate commerce are regulated by the Clinical Laboratory Improvement Act of 1967.

Accreditation by the College of American Pathologists (CAP) requires that laboratories comply with Standards for Accreditation of Medical Laboratories (CAP 1982). Some federal funding and insurance legislation also includes general requirements for safe practices and conditions in laboratories.

The CRC Handbook of Laboratory Safety (Steere 1971) contains extensive additional information on laboratory safety. Biosafety Guidelines for Microbiological and Biomedical Laboratories (CDC-NIH 1984), developed jointly by CDC and the National Institutes of Health (NIH), offer a recommended code of practice for laboratories involved with infectious microbial agents.

3.2.10.3 Methods for Controlling Exposure

Both Engineering a Safe Hospital Environment (Stoner et al. 1982) and Industrial Ventilation (ACGIH 1986) contain information on exhaust ventilation hoods, biological safety cabinets, and other forms of hazard control for laboratory safety.

3.2.10.3.1 Storage and disposal of laboratory waste

The correct storage and disposal of laboratory waste, including infectious materials and chemicals, are complex and important issues. The hazards of improper disposal include

- Mercury trapped in porous sinks that continues to vaporize
- Improper use of perchloric acid that can result in an explosion
- Azides that combine with the metals (copper, ammonium, or lead) in plumbing systems and may form explosive combinations when dry
- Organic solvents that continue to vaporize and contaminate laboratory air even after vigorous flushing

- Aerosols of infectious material that are accidentally sprayed throughout the laboratory environment

Storage of hazardous waste is discussed throughout this section; disposal is covered in Section 6. Stations should be installed to receive, handle, and dispense volatile or corrosive chemicals. Appropriate protective equipment, eye washes, and emergency showers should be provided. Laboratory workers should be trained in emergency procedures and routine safe work practices.

3.2.10.3.2 Protective equipment

Because no universally protective material exists, protective equipment such as gloves and respirators should be selected specifically for agents to which the worker may be exposed (see Section 2.3.5). The manufacturers of chemical protective clothing and equipment can provide specific information.

3.2.10.3.3 Work practices

Safe work practices are very important in protecting laboratory workers. The following precautions should be taken to avoid accidental poisonings with laboratory chemicals:

- Do not eat, drink, or smoke in a laboratory. Food and beverages should not be stored in refrigerators or elsewhere in laboratories.
- Do not wear contact lenses when working with chemicals.
- Never pipette by mouth.
- Wear a laboratory coat or apron while in the laboratory and remove it when leaving.
- Wear chemical worker's goggles or a face shield when accidental splashes to the face or eyes are possible.

Ventilation hoods can be effective for capturing and containing contaminants. Design specifications for laboratory fume hoods may be found in Industrial Ventilation: A Manual of Recommended Practice (ACGIH 1986).

Ventilation rates should be measured and recorded for all hoods, and the measurements should be kept near the hoods for future reference. The entire ventilation system should be monitored monthly to check its efficiency. In addition, chemical fume hoods must at least meet the requirements of NFPA 45, Laboratory Ventilating Systems and Hood Requirements (NFPA 1983, Volume 3).

3.2.10.3.4 Labeling

All chemicals used in a laboratory should be clearly labeled with the generic chemical name, date of arrival, probable shelf life, hazardous character, and special storage requirements. The laboratory safety officer should maintain a complete list of all chemicals in the laboratory and review it with the hospital health and safety committee and the personnel health service. The hospital health and safety committee or officer should consult the OSHA hazard communication standard (29 CFR 1910.1200).

3.2.10.3.5 Laboratory equipment

All electrical equipment should be grounded. The disconnects for all equipment should be properly marked, and the areas around the breaker boxes should be kept clear. Wiring and connections on all electrical equipment should be checked regularly; equipment that rotates, moves, and vibrates may wear through the insulation or put tension on the terminal screws.

Cylinders of compressed gas should be secured and kept upright, and the valve-protection caps should be fastened when not in use. Hoses, fittings, and gauges for compressed gas should be kept in good condition and checked periodically for leaks.

Laboratory equipment and work surfaces that have been contaminated with infectious material should be cleaned with an effective disinfectant.

3.2.10.3.6 Chemical, physical, and biologic agents

Laboratory work requires the use of many chemical, physical, and biologic agents that are not discussed in this manual. The following recommendations will help control common laboratory hazards:

- Compile a list of the common agents used in each laboratory, including
  - -- organic compounds such as acetone, formaldehyde, xylene, and other solvents,
  - -- inorganic compounds,
  - -- physical hazards such as ultraviolet radiation and ultrasonic devices,
  - -- biologic hazards such as viruses (hepatitis) and bacteria (tuberculosis), and
  - -- radioactive isotopes such as those of iodine and cesium.

- Inform workers potentially exposed to hazardous substances about the hazards, symptoms of exposure, and effects of over-exposure.
- Monitor worker exposures to ensure that airborne concentrations of specific contaminants are at least below the allowable limits. The local OSHA office, NIOSH (see the listing in Section 7), or a State or local industrial hygiene office can supply information on air sampling techniques.
- Collect biologic samples to monitor worker exposures to toxic substances (e.g., mercury in the blood, hippuric acid in the urine [toluene exposure], and enzyme activity levels [liver damage]).
- Establish a procedure for the proper storage, handling, and disposal of all chemicals.
- Establish a procedure to ensure that biologic safety cabinets are decontaminated routinely and certified annually.
- Establish a detailed procedure for dealing with chemical spills.
- Check floors and benches for accumulations of spilled mercury.
- Post names and telephone numbers of persons to be notified in emergency situations. This is particularly important for large research laboratories involved in experimental work.

3.2.11 Surgical Services

Hazardous materials found in operating rooms include anesthetic gases, their vapors, and the vapors of various solvents.

3.2.11.1 Anesthetic Gases

Because anesthetic gases can pose both safety and health hazards, testing for leaks should be performed on a continuing basis. The volume of anesthetic gases used should be recorded, and the records should be analyzed routinely as a check for leakage.

Nitrous oxide is the most commonly used anesthetic gas. The vapors of diethyl ether, cyclopropane, enflurane, halothane, and isoflurane are also used frequently and will be considered as gases in this document. The principal source of waste anesthetic gases in operating rooms is leakage from equipment, particularly when anesthetic is administered by face mask.

The NIOSH criteria document on waste anesthetic gases (NIOSH 1977a) provides a description of work practices for areas where anesthetic gases are used. More recent sources are Eger (1985), Saidman and Smith (1984), and Whitcher (1987).

3.2.11.2 Flammable Anesthetics

Although many hospitals have discontinued the use of flammable anesthetics, they may still be used in some cases. The following measures should be implemented in operating rooms where flammable anesthetics are used:

- Only electrical equipment approved by the hospital engineering department should be used in operating rooms. The equipment should be checked regularly to ensure that it is operating properly.
- Flammable anesthetics should have a separate, fire-resistant storage space that is vented to the outside.
- The floors of operating-rooms should be covered with an approved conductive material; it should be tested regularly for conductivity, and records of the testing should be kept.
- Conductive clothing should be worn where required. Conductive footwear should be required and tested daily for conductivity.

The NFPA standard for inhalation anesthetics (NFPA 1983, Volume 4) and the National Electrical Code (NFPA 1983, Volume 6) contain further information.

3.2.11.3 Compressed Gases

Compressed gases used for anesthesia or other purposes in surgical suites include oxygen, nitrous oxide, ethylene oxide, and air. These gases may be piped in from a central storage area or used directly from cylinders in the surgical suite. Hospital administrative personnel must ensure that cylinders of compressed gas are stored and used safely. The NFPA has made recommendations for the storage and labeling of compressed-gas cylinders and the use of regulators, valves, and connections (NFPA 1983, Volume 4, 56A). The principal recommendations are to conduct proper inspections to ensure that the gas delivered is the same as that shown on the outlet label and to provide appropriate storage rooms for oxidizing gases such as oxygen and nitrous oxide. The National Fire Codes (NFPA 1983, Volume 4, 56A) give a more detailed explanation of the NFPA recommendations.

3.2.11.4 Scavenging

Scavenging is the process of collecting and disposing of waste anesthetic gases and vapors from breathing systems at the site of overflow. It is carried out to protect operating-room personnel by preventing the dispersal of anesthetic gases into the room air. A scavenging system has two major parts: a collecting device or scavenging adapter to collect waste gases, and a disposal route to carry gases from the room.

The NIOSH publication, Development and Evaluation of Methods for the Elimination of Waste Anesthetic Gases and Vapors in Hospitals (NIOSH 1977), contains information about control methods to establish and maintain low concentrations of waste anesthetic gas in operating rooms. The document includes techniques for scavenging, maintaining equipment, monitoring air, and minimizing leakage while administering anesthesia. It also illustrates various scavenging systems, details procedures for initiating a scavenging program, and presents the results of gas distribution and air monitoring studies. See also Eger (1985), Saidman and Smith (1984), and Whitcher (1987).

3.2.11.5 General Guidelines

Persons responsible for health and safety in the hospital surgical department should be aware of the availability of new products and new information on familiar products. For example, methyl methacrylate, which is used in bone surgery, has been recently investigated as a potentially hazardous substance.

The following guidelines will help protect workers in the surgical service:

- Use separate collection containers for glass, empty ether cans, aerosol cans, disposables, etc., that are not to be incinerated.
- Dispose of sharp instruments, blades, and needles in designated, puncture-resistant containers. All supplies and instruments used should be accounted for to prevent their disposal in linens and other materials that will be handled by hospital workers.
- Keep towel clips and scissors closed when not in use.
- Install suction lines and electrical cords to minimize tripping hazards. Lines and cords should be suspended from the ceiling or placed under the floor whenever possible.
- Instruct personnel to report defective equipment.
- Post warning signs where necessary and enforce proper work practices.

- Instruct workers in proper lifting practices.
- Discuss safe work practices and health hazards with each new worker as part of orientation. Review this training periodically.

3.2.12 Temporary Personnel (Floaters)

Nursing students, medical students, and medical house staff who rotate through many different training situations have potential exposure to a wider variety of hazards than do most workers who are stationary. Temporary workers are usually unfamiliar with the hazards of each new department and the proper work practices and other means of preventing injury or illness to themselves and others.

Sleep deprivation is a problem for medical students and house staff (who often work 80 hr/week or more) and for some nursing students (who may support themselves with a second job while completing training). A study of sleep deprivation in a group of medical interns (Friedman et al. 1973) showed difficulty in thinking, depression, irritability, depersonalized treatment of patients, inappropriate attitudes or behavior, and short-term memory loss. Medical students have also exhibited high rates of psychotic depression, withdrawal from medical school, and suicidal thoughts and actions. When students and house staff are deprived of sleep, both patient care and inter-staff relations suffer.

Chemical hazards for laboratory and other technicians may be greater during training periods when they have not received health and safety instructions or learned to carry out procedures smoothly and quickly.

For example, nursing students who do not know how to protect themselves may change dressings, apply topical medications, and perform other duties in close contact with patients who have infectious diseases. Medical students spend many hours their first year dissecting cadavers preserved in formaldehyde (a suspected carcinogen) without knowing the danger or how to avoid the risks. The student or trainee usually feels pressured to carry out the assigned task and hesitates to question the wisdom or manner of carrying it out. Volunteers (e.g., premedical or other pre-health-care career students), who are even less well-trained to recognize or prevent health hazards in the transmission of infectious diseases, often go from patient to patient distributing reading materials and doing other errands.

To solve these problems, transient workers should have (1) prompt and adequate training in hospital health and safety, (2) training specific to the departments in which they will spend time, (3) adequate time to perform tasks in a careful and safe manner, (4) adequate supervision to monitor their performance and answer their questions, and (5) sufficient rest to perform their duties safely.