HEALTH CARE FACILITIES

INTRODUCTION

Unlike other service oriented occupancies such as office buildings, department stores, and exhibition halls, health care facilities such as hospitals, clinics, nursing homes, and medical and dental offices, are unique and present unusual problems and concerns. Patients might be immobile and have smoking habits that are difficult for them to control. Operating rooms must be free of contaminants. Drugs can be stolen and sold on the streets. Very expensive and sophisticated equipment is present. The focus of this document is on hospitals; however, some of these problems and concerns also exist in clinics, nursing homes, and medical and dental offices.

The mission of all hospitals is to save lives. In an emergency, the priority of hospital employees and firefighters is to take care of the patients first, then focus on the emergency.

Hospitals contain many areas of concern including storage rooms, laundries, kitchens, pharmacies, flammable liquids and gases, hazardous materials, boiler rooms, paint shops, repair shops, laboratories, and operating rooms. There are also areas containing high valued equipment, such as Computerized Axial Tomography (CAT) scanners, Magnetic Resonance Imaging (MRI), and hyperbaric chambers. It is not uncommon to have significant losses in these occupancies.

There are generally two types of hospitals: general practice hospitals and specialized hospitals. General practice hospitals perform most types of operations and procedures. Specialized hospitals, which perform only specific operations and procedures such as cancer research and cure, include children's hospitals, psychiatric hospitals, and heart institutes.

Between 1975 and 1991, there were 2083 reported losses at hospitals insured by IRI. Fire, the leading cause, accounted for over 30% of these losses. Water damage losses caused by failure of or damage to pipes and fittings, other than sprinkler piping, were second, accounting for 16% of these losses. Sprinkler leakage and boiler and machinery losses each accounted for approximately 9% of the overall losses. Typically, the losses occurred in boiler rooms, closets, classrooms, cooling towers, computer and control rooms, kitchens, laboratories, laundry areas, operating rooms, rest rooms, storage areas, patient rooms, and X-ray rooms.

AREAS OF CONCERN

General Patient Care Floors

Patient care floors consist of patient rooms, residence on-call rooms, soiled and clean utility rooms, pantries, medication rooms, equipment storage rooms, nurses stations, lounges, mechanical equipment rooms, trash and linen chutes and collection areas.

Combustible loading is generally light, except for trash and linen chutes and collection areas that are considered moderate. Most areas are normally constantly attended; therefore, loss exposure is not very great. The areas of concern are patient rooms where a patient is a smoker, patient rooms where oxygen therapy is used, and the trash and linen chutes and collection areas.

Special Patient Areas

Special patient areas include the Intensive Care Unit (ICU), Acute Care Unit (ACU), Cardiac Care Unit (CCU), psychiatric, and drug addicted patient areas. Patients in the ICU, ACU, and CCU areas are monitored continuously with very expensive and sophisticated monitoring equipment.

To ensure personal safety, the psychiatric, and substance addicted patient areas are sometimes locked. A locked door can increase the time required to gain access to these areas. These areas are also subject to vandalism incidents including fires.

Operating Rooms and Surgical Suites

The Operating Rooms (OR) are vital to the operating income of the general practice hospitals. Operating rooms and surgical suites, which contain specialized equipment such as lasers, monitors, and fiber optic scopes, must be free of contaminants. In an emergency, cystoscopic rooms and delivery rooms can be used as operating rooms.

Fuel loading in the OR is considered light to moderate. Loading consists of surgical sponges, foam pads, cotton sheets and blankets, paper or plastic surgical drapes, paper and plastic packaging material, and wastebaskets. The OR also contains antiseptic solutions such as 70% isopropyl alcohol or tincture of zephiran. The solutions get on the sheets covering the operating table and the drapes covering the patient. Vapors released from these solutions, when trapped under the surgical drapes, can lead to a fast developing fire. Excess solution wiped up with surgical sponges and thrown into the wastebaskets along with other materials could ignite. The high value of these rooms creates a severe loss exposure.

Pharmacies

Hospitals have pharmacies to dispense medicines. Some of the medicines stored in the pharmacies are very expensive to purchase while others are easily sold on the streets, and some medicines require refrigeration. Some medicines are flammable or combustible liquids.

Laboratories

Many hospitals have laboratories for testing and research. These laboratories may include paraffin tissue areas that increase hazards within the rooms. In addition, some laboratories contain continuously running, unattended, tissue processors. These laboratories contain flammable and combustible liquids and gases. The storage and handling of flammables is a major hazard and introduces a severe loss exposure. Fires in these areas develop rapidly.

Oxygen Storage and Handling

Oxygen is piped and used throughout the hospital. Most hospitals use bulk liquefied oxygen tanks located outside the facilities, while others use a manifolded oxygen cylinder system. A fire involving oxygen develops rapidly.

Flammable and Combustible Gas and Liquid Rooms

Most hospitals have rooms to store bulk amounts of flammable and combustible liquids and gases. Hospital laboratories performing research and diagnostic procedures require large amounts of flammable and combustible liquids and gases. These amounts can range up to 100 gal (375 L) or 100 lb (45 kg) of each type of flammable or combustible liquid and gas. Storage and handling is a major hazard, because fires involving these materials are intense and develop rapidly.

Trash and Linen Chutes

Many hospitals have chutes to transport linen and trash. Each chute consists of vertical openings and feed and collection rooms. Chutes are usually pneumatic with limited access or open gravity. The combination of combustibles and vertical floor openings presents a major loss exposure. Fires in chute areas develop rapidly and pose extinguishment difficulties due to accessibility.

Laundries

Laundry operations are important to maintain normal hospital activities. These operations may have extensive lint collection systems. Fires in these systems flash rapidly and can spread far beyond the area of origin.

Classrooms and Auditoriums

Some hospitals and medical centers are “teaching” hospitals or are associated with research universities. These hospitals can have auditoriums and classrooms for students and employees. Auditoriums can contain audiovisual rooms and equipment while classrooms contain teaching material.

Mechanical and Electrical Equipment Rooms

Hospitals have many mechanical equipment rooms containing equipment such as fans, compressors, electrical switchgear, telephone equipment, transformers, and hot water heaters. The major problem with mechanical rooms is they are often used as storage rooms, which are prime locations for the “hidden smoker.” The presence of combustible material in these usually unoccupied rooms creates a major loss exposure, especially if the rooms are unsprinklered. Fires pose large loss possibilities, because smoke can spread through the ductwork and conduits to the rest of the facility.

Emergency Generators

Most hospitals have emergency generators to power operating rooms, emergency rooms, intensive care units, cardiac care units, and important monitoring equipment. These generators are normally diesel engine driven, however, some can be natural gas engine driven. Some hospitals also have an uninterrupted power supply (UPS) system for the MRI, CAT scanners, and other computer equipment.

Boiler Rooms

Most hospitals use multiple boilers not only to heat the building but also to provide steam to operate autoclaves and sterilizers and hot water for domestic use. The boilers are usually dual, gas and oil fired for reliability.

Air Conditioning Equipment and Cooling Towers

To provide patient comfort, to maintain a clean environment, and to operate the diagnostic equipment properly, hospitals use air conditioning equipment to maintain a constant temperature and humidity in the facility.

Storage Rooms

Hospital storage areas, such as central supply, medical records, X-ray file storage, and archives storage, have heavy combustible loading. Usually these rooms are partly cut off from other areas. Medical records and X-rays are required to be stored up to 15 yr. Some older X-rays might be on cellulose nitrate film. The medical records and archive rooms contain a large amount of paper products and some plastic films. Fires in these areas spread rapidly.

Kitchens

Most hospital kitchens consist of gas fired and electric grills, stoves, deep fat fryers and a ductwork system. Some even have on-site bakeries. Kitchens will also have a dry goods storage area and

cooler or freezer boxes. The presence of grease, combustibles, and fired equipment creates a high loss potential. Fires in these areas can develop rapidly and be very hot.

Data Processing and Computer Equipment

Hospitals use computers to monitor the inventory, schedule the staff, and process and send invoices to the patients. If the computer goes down, the hospital cannot document the expenses of the patients and the medical insurance company can refuse to pay the hospital. Computers are also used in some of the specialized equipment.

Radioactive Isotopes

Hospitals store and use radioactive isotopes in radiology suite areas. Radioactive isotopes are a major component in many special procedure treatments. Larger hospitals may have a “cyclotron,” also known as a particle accelerator or an atom smasher, to produce radioactive compounds used for patient diagnosis. The advantage of the cyclotron is that it produces on-site compounds with short half-lives of several minutes to two hours. These isotopes or compounds are sent by pneumatic tubes in lead lined containers for immediate use. The cyclotron area normally consists of three attached rooms with 3 ft (0.9 m) thick poured concrete walls, a ceiling, and solid rock exterior exposure at the foundation. One room is called the electrical control room, another cyclotron and the third, the target room.

The cyclotron accelerates electrified particles, such as protons or helium nuclei, between the poles of a powerful electromagnet in a vacuum chamber. The electromagnetic charges are reversed several million times a second between positive and negative. A collection plate charged with a high negative potential pulls the charged particles out of the chamber so the particles bombard the desired material located in the adjacent target room.

The presence of radioactive isotopes creates a contamination exposure that poses a loss potential. It is critical that the responding fire departments know the potential hazard. Delay in firefighting can be a major factor if full procedures are not established before an incident.

The presence of high valued equipment presents a high dollar loss potential. Fire in areas containing such equipment develops somewhat slowly, usually from electrical origin. The sensitivity of this equipment makes it susceptible to damage and very expensive and time-consuming to repair or replace.

Gamma Cameras

Gamma cameras are part of Single Photon Emission Computed Tomography (SPECT) technology. Patients are injected with radioactive isotope-containing compounds, which are absorbed by various organs or bones. The compound used depends on which part of the body is to be studied. Most compounds have a short half-life ranging from several minutes to one hour. Compounds are kept in small lead lined containers.

Patients are placed on a stretcher-like frame and the gamma camera rotates around the patient on a circular frame. The camera scans the patient for radioactivity and transmits an image electronically to a viewing screen. Each camera has an individual computer to record the image. Sometimes, one or more cameras are linked to a main computer in another area where the results are recorded on laser disks.

These cameras produce images that are not possible with X-ray, MRI or MMR scanners. Scanners usually work on liquid or tissue density of the body. The cameras and computers are usually in the same area except for linked computer arrangements where the signals are sent to a main computer. Each camera and computer can operate independently, and more than one unit is most likely to be in different rooms.

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CAT Scan Suites

Computer axial tomography (CAT) scanner is an expensive and complex X-ray device to look at bone injury, lung and chest area and to look for cancer. It makes successive pictures of selected parts of the body by moving the X-ray source in an arc or through a full 360° path around the patient's body. Multiple stationary sensors record the measurements, which are combined to reconstruct an image on the control and display consoles. Images are stored on disks or magnetic tapes. Cameras make pictures of the desired display.

The CAT scan suite consists of three rooms: the scanning room, control room and a small power or computer room. The rooms are usually open to each other via an observation window or sliding glass doors.

The presence of high valued equipment presents a high dollar loss potential. Fire in these areas develops somewhat slowly, usually from electrical origin. The sensitivity of this equipment makes it susceptible to damage and very expensive and time-consuming to repair or replace.

PET Scan Suites

Positron emission tomography (PET) scanner is an expensive and complex X-ray device to see how the organs and tissues are actually functioning. The PET scanner is similar to the CAT scanner, but can give more detail information about the body.

Magnetic Resonance Imaging Facilities

Magnetic resonance imaging (MRI) is a technique used to examine the body's internal organs down to individual cells without using ionizing radiation. MRI is based on the principle of paramagnetism of atomic nuclei.

Paramagnetism is exhibited by atomic nuclei such as hydrogen (1), carbon (13), fluorine (19) and phosphorus (31). All have an odd number of nucleons. The nuclei are inclined to align themselves with a magnetic field. Each group of atomic nuclei has a distinct radio frequency resonance related to the strength of the MRI magnetic field.

Imaging is accomplished by pulsing the aligned nuclei with a specific radio frequency. This causes their axes to deviate from the aligned position. Control equipment monitors the time it takes the nuclei to return to their initial alignment and the radio frequency energy release. Computers process the monitored data electronically to produce an image.

Because of the strong magnetic field, plastic and wood are used for construction, enclosures and body positioner pillows. The presence of high valued equipment presents a high dollar loss potential. Fire in these areas develops somewhat slowly, usually from electrical origin. The sensitivity of this equipment makes it susceptible to damage and very expensive and time-consuming to repair or replace.

LOSS PREVENTION AND CONTROL

These loss prevention and control guidelines are not all-inclusive and are written for an average hazard level. Increased hazard levels require increased protection and additional loss prevention and control features.

General

Construct hospitals with fire resistive or heavy noncombustible materials. Use furnishings and interior finishes, wall coverings, ceiling tiles, etc. of noncombustible or limited combustible material as defined by NFPA 220. Install electrical equipment in accordance with Article 517 of the *National Electrical Code*® (NFPA 70).

Provide an automatic sprinkler system throughout the hospital in accordance with NFPA 13 and PRC.12.1.1.0 as follows:

- Patient rooms and adjacent areas based on a Light Hazard occupancy. General patient rooms can be protected using residential sprinklers.
- Linen and trash areas on patient floors based on an Ordinary Hazard Group 1 occupancy.
- Classrooms, projection rooms, and auditoriums based on a Light Hazard occupancy.
- Operating rooms and adjacent areas based on an Ordinary Hazard Group 1 occupancy.
- Boiler rooms based on an Ordinary Hazard Group 1 occupancy.
- Kitchen areas based on an Ordinary Hazard Group 1 occupancy.
- CAT scan suites based on an Ordinary Hazard Group 1 occupancy.
- Gamma camera rooms based on an Ordinary Hazard Group 1 occupancy.

  NOTE: Use copper piping and glass bulb sprinklers for the sprinkler protection due to the effects steel has on the procedure.
- MRI facilities based on an Ordinary Hazard Group 1 occupancy.

  NOTE: Use copper piping and glass bulb sprinklers for the sprinkler protection due to the frictional heat generated by the magnetic flux on steel piping and sprinklers. Install a dielectric union where the copper pipe connects with the steel piping.
- Laboratories not containing any flammable or combustible liquids, based on an Ordinary Hazard Group 1 occupancy.
- Laboratories containing up to 300 gal (1125 L) of flammable and combustible liquids, including liquids stored in flammable liquids cabinets, based on an Ordinary Hazard Group 2 occupancy.

Design and install the HVAC system in accordance with NFPA 90A or NFPA 90B whichever is applicable. For smoke control, subdivide major floor areas with smoke barrier walls into compartments not to exceed 22,500 ft^2 (2100 m^2). Arrange the HVAC system to provide full exhaust when smoke is detected in the area or ductwork. Arrange the exhaust outlets so the exhausting smoke can not reenter the HVAC system through a fresh air intake. Protect all openings in these walls with listed, ½ hour fire doors or smoke dampers. Arrange the fire doors and smoke dampers to be self-closing, held open by an electrically-actuated device and released when any fire alarm or sprinkler system operates in the area. In addition, follow the recommendations in NFPA 92A.

Special and General Patient Care Floors

Keep combustible loading to a minimum. Use flame retardant draperies and other furnishings. Use mattresses and bedding assemblies tested in accordance with ASTM E 590, and upholstered furniture tested in accordance with ASTM E1474. Use furnishings with a peak rate of heat release of 500 kW or less and the total energy release during the first five minutes of 75 mJ or less.

Cut off the patient rooms from each other by at least a 1 hour, fire rated, fire barrier wall. Protect all openings with a 1 hour, fire rated, automatic closing, fire door. For smoke control, arrange the HVAC system to go into full exhaust when smoke is detected in the room or ductwork.

Operating Rooms

Provide operating rooms, where flammable anesthetics are used, with conductive floors, grounded and bonded equipment, and Class I, Group D, Division 1, electrical equipment below the 5 ft (1.5 m) level. Personnel in the operating room area should wear special clothing to eliminate static electricity buildup.

Cut off the operating rooms from each other and from the rest of the facility by at least a 1 hour, fire rated, fire barrier wall. Protect all openings with 1 hour, fire rated, automatic closing, fire doors. For smoke control, arrange the HVAC system to go into full exhaust when smoke is detected in that room or ductwork. Provide smoke detectors in the entire area to actuate the HVAC exhaust system and to notify the hospital personnel. Additional features can be found in NFPA 99.

Pharmacies

Store the very expensive and easily sold medicines in a secure area of the pharmacy. Pharmacies using ordinary refrigeration units must label these units, “No Flammables.” Keep flammable liquids that must be refrigerated in listed flammable liquid refrigerators. Store flammable and combustible liquids in listed flammable liquids cabinets and containers

Laboratories

Store flammable and combustible liquids in listed flammable liquids cabinets and containers. Store flammable and combustible liquids in excess of 300 gal (1125 L) in a flammable liquids room built in accordance with NFPA 30.

Cut off laboratories containing up to 300 gal (1125 L) of flammable and combustible liquids, including liquids stored in flammable liquids cabinets, from other laboratories and other occupancies by a minimum 1 hour, fire rated, fire barrier wall. Protect all openings in the fire barrier wall with 1 hour fire rated fire doors and fire dampers. Laboratories not containing any flammable or combustible liquids do not need to be cut off from other laboratories and other occupancies.

Laboratories using ordinary refrigeration units must label these units, “No Flammables.” Keep flammable liquids that must be refrigerated in listed flammable liquid refrigerators.

Oxygen Storage and Handling

Provide manually operated isolation valves in the piping distribution system for oxygen supply throughout the facility. Locate these valves on each floor and in each patient wing. In addition, provide a remote shutoff valve near the oxygen supply tank. Full protection details can be found in NFPA 55.

Trash and Linen Chutes

Construct the laundry and trash chutes of noncombustible material, enclosing the openings with a 1½ hour, fire rated, self-closing fire door. Equip the collection room chute opening with a fusible link operated door. In addition, follow the requirements of NFPA 82.

Laundries

Follow the recommendations in PRC.17.14.4.

Mechanical and Electrical Rooms and Equipment

Keep these rooms free of combustibles. Install, arrange, test, and maintain electrical equipment used in areas such as operating rooms, the emergency room, the intensive care unit, and the cardiac care unit, and monitoring equipment in other areas, in accordance with PRC.5.

Emergency Generators

Install, arrange, test and maintain all emergency generators and drivers in accordance with NFPA 110 and NFPA 37 and PRC.6.2.1.1. Install and maintain UPS equipment in accordance with PRC.5.7.4.

Boiler Rooms

Install boilers in accordance with NFPA 85 and PRC.4.0.1.

Air Conditioning Equipment and Cooling Towers

Use noncombustible cooling towers. If using combustible towers, provide automatic sprinkler protection in accordance with NFPA 214, and locate these towers where they will not expose the rest of the facility.

Storage Rooms

Store combustible materials in a separate building, if possible. If these materials must be stored in the hospital building, use a 3 hour, fire rated, fire barrier wall to cut off the area from other occupancies. Protect all openings with 3 hour, fire rated, automatic closing, fire doors. Protect the area with an automatic sprinkler system arranged in accordance with NFPA 13, and PRC.12.1.1.0 according to the storage arrangement.

Protect X-ray film with cellulose nitrate backing in accordance with NFPA 40.

Flammable and Combustible Gas or Liquid Rooms

Construct and protect flammable and combustible liquids storage rooms in accordance with NFPA 30. Arrange and protect the flammable and combustible gas storage and piping in accordance with NFPA 99.

Kitchens

Provide an automatic shutoff valve on all gas fired equipment interlocked with the actuation of the fixed fire extinguishing system. Install and maintain the ductwork over the cooking equipment in accordance with NFPA 96 and PRC.9.2.7.

Data Processing/Computer Equipment

Back up all accounts receivable and patient record tapes daily. Protect the equipment and room in accordance with PRC.17.10.

Radioactive Isotopes

Plan with the fire department, the procedures for handling the isotopes on hand. Store all isotopes in a cut off, protected, isolated room. Additional information can be found in NFPA 801.

CAT Scan Suites

Provide smoke detection in accordance with NFPA 72.

PET Scan Suites

Provide smoke detection in accordance with NFPA 72.

Gamma Cameras

Provide smoke detection in accordance with NFPA 72.

Magnetic Resonance Imaging Facilities

Keep the combustible body positioner pillows outside the examining room. Provide smoke detection in accordance with NFPA 72.

Surveillance

Provide either full central station supervision or a combination of security guard service and a proprietary alarm system to the switchboard operator. See NFPA 601 and PRC.11.0.1 for more information on security guard service and NFPA 72 for the central station and proprietary alarm systems.