Medical Facility Renovation

Safety & Health Considerations for Construction Safety Professionals

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As medical practice and equipment continues to evolve, medical facilities will continue to be modified and renovated to accommodate these advances. In 1998, approximately $15 billion was spent on healthcare facility construction. Of the 2,124 total construction projects started that year, 161 (7.5 percent) were new or replacement hospitals, while 1,070 (50.3 percent) involved expansion or renovation (Croswell 23, 33).

The construction safety professional must be aware of—and plan accordingly for—the unique occupational health hazards presented by working in active medical facilities. While the focus is usually on the safety of construction workers, the safety professional on a healthcare-facility-related project must also be concerned with the safety and health of patients, visitors and medical staff. To achieve this, the construction safety professional must ally with healthcare facility safety professionals. As with most renovations, each facility will have its own unique hazards that the safety professional must be ready to anticipate.

PRE-BID PREPARATIONS

Before bidding on a job, the contractor safety professional should ensure that his/her company's core safety and health programs are in place. Because of their high profile within the community, medical facilities are acutely aware of the need for safe jobsites. Therefore, most will conduct pre-qualification reviews to make sure only those contractors that will perform the job safely are allowed to bid.

Items covered in this review may include:

- management commitment to safety;
- proof of insurance, levels of coverage and insurance modification factors;
- OSHA 200 logs;
- competent, trained safety professionals (either on staff or contracted to provide service);
- regular toolbox talks or other safety training;
- documented safety audits of jobsites;
- training or experience in infection control;
- written safety and health plans covering areas such as lockout/tagout, confined space entry, hot-work permits, hazard communication, fall protection, personal protective equipment (e.g., respirators) and bloodborne pathogens.

It should be noted that OSHA's Bloodborne Pathogens standard (29 CFR 1910.1030) does not currently apply to construction. However, OSHA has stated that workers who are occupationally exposed to bloodborne pathogen hazards are afforded protection under several construction standards: 29 CFR 1926.21(b), Safety Training and Education; 29 CFR 1926.25, Housekeeping; 29 CFR 1926.28, Personal Protective Equipment; and the General Duty Clause (OSHA Standards Interpretation and Compliance Letters 1, 2). Therefore, it would be prudent for any contractor performing work within a medical facility to develop a basic bloodborne pathogens program.

Bid submittals will be examined closely to determine whether the contractor has allocated enough money to afford the safety-related procedures that it claims it will perform.

PRE-WORK PREPARATION

Before work begins, the contractor must ensure that the work area has been properly decommissioned and is safe to enter. The medical facility should certify that:

- Chemicals have been removed from the work area (e.g., ethylene oxide cylinders from autoclave areas, formaldehyde and glutaraldehyde from pathology labs).
- Radioactive materials have been removed.
- All sharps (e.g., needles, glass, scalpels) have been removed.
- Surveys for asbestos-, lead- and PCB-containing materials have been completed.

On a healthcare-facility-related project, the safety professional must be concerned with worker safety and health as well as that of patients, visitors and medical staff.

• Ventilation plenums have been shut down or isolated from the rest of the HVAC system.

• Power sources have been de-energized. In addition, contractors should consider electrically isolating their work from the rest of the facility. Voltage fluctuations from welding machines or other high-amperage equipment may cause unexpected, potentially dangerous disruption of the facility's power supply as well as equipment damage. Similarly, cell phones and two-way radios should be used in accordance with the medical facility's policy (Wiese).

• A survey for old or abandoned waste pipes or gas lines has been conducted. This is particularly important, since waste pipes, because of their intended use, are often made of glass. In many cases, they contain residual acids or mercury. Often, such lines are not discovered until walls are demolished and pipes already broken. Depending on the chemicals and amounts, materials released from broken pipes may contaminate and injure workers, which can create a potential HazWOPER clean-up situation and generate significant amounts of material that may need to be disposed of as Resource Conservation and Recovery Act (RCRA) hazardous waste.

Thus, it is critical that the pre-work survey is performed; that supervisors and workers are trained to be alert for unexpected (and expected) piping during demolition; and that proper reporting procedures are developed if pipes are discovered, as are response procedures to address any accidental breaks that may occur.

Prior to the start of work, the contractor and medical staff must partner to develop an interim life safety management plan. During construction, life safety codes must be maintained for patients and staff, as well as for construction workers. For example, if any regular entrances or exits are blocked or removed, the facility's Life Safety Plan must be modified to reflect these changes. Here, safety professionals can refer to publications by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and National Fire Protection Assn. (NFPA).

The contractor and medical staff must also develop an infection control plan. This plan helps ensure that construction activities do not put patients at risk. It should include:

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1) Risk assessment of the most-susceptible patients, particularly immunosuppressed patients (e.g., organ transplant) and those in the oncology, burn therapy, surgical and neonatal units. These patients must be protected not only from chemical agents present on construction sites, but also from naturally occurring microbes (e.g., the fungus *aspergillus fumigatus*) that may be released during construction; microbial contamination shed from construction workers; and physical "contamination" such as vibration that may be created during renovation.

When determining what areas may be impacted, one must look in both horizontal and vertical directions. Areas below construction may be the most susceptible. Vibration can shake loose dust and debris, with ducts, shafts and conveyors acting as conduits between floors.

2) Routes for delivery of construction materials and removal of debris;

3) Access to locations away from the main construction activity (e.g., electrical junction boxes, plumbing valves that may be in active wards) (Williams).

In a recent lawsuit, a plaintiff contended that faulty installation of a ventilation system by a general contractor and sheet metal contractor helped cause fungal contamination of a surgical suite and the plaintiff's subsequent infection. The case was eventually settled, with the plaintiff awarded $717,000 (*Massachusetts Lawyers Weekly* 27).

The American Institute of Architects (AIA) first established a construction standard of care in its *Guidelines for Design and Construction of Hospital Healthcare Facilities 1996-97.* The 2001 edition features requirements for infection control in planning, design and commissioning of healthcare facilities (AIA). The Assn. for Professionals in Infection Control and Epidemiology also offers a report on infection control during construction activities. Figure 1 presents a sample checklist to help contractors develop and maintain an effective infection control plan.

Action plans are also needed for:

- fire or severe weather emergencies;
- discovery of "mystery" chemicals or fluids;
- radiation concerns;
- reporting accidents;
- obtaining emergency assistance (medical or fire);
- remediation of water damage during the project.

In addition, the contractor must coordinate the scheduling of "problem" activities such as noisy and dusty operations (e.g., drywall); vibration-producing activities; and odor-producing operations (e.g., painting, carpeting). Here, two-way communication between contractor and facility staff is crucial. Noise, dust and vibration can be critical problems for the nursing staff—especially in a surgical environment. Odors can be a major public relations problem in a medical facility.

Therefore, the contractor should forewarn facility staff when odors may occur, their cause and when it will dissipate. This information, along with MSDS or other similar materials, enables hospital staff to address any concerns or complaints quickly and efficiently. In this vein, it is also important to determine upfront who has authority to stop the project and for what reasons, as well as who has authority to restart the project.

Appendix C of OSHA's "Framework for a Comprehensive Health and Safety Program in the Hospital Environment" provides an extensive list of potential hazards by location within a medical facility. This list can help safety professionals anticipate potential hazards they may encounter in specific areas (OSHA 23).

DURING CONSTRUCTION

During construction operations, a contractor must be prepared to deal with various unique situations.

Worker Medical Qualifications

To the extent allowable, a contractor should medically evaluate site workers. All workers should be healthy with no communicable diseases. They should also be current in their vaccinations—including tetanus. The contractor may want to consult with a healthcare practitioner about the usefulness of providing the hepatitis B vaccination and baseline TB skin test to workers for the particular job site in question.

Site Security

All construction sites are vulnerable to the problem of trespassing, but medical facility sites may have the added concern of wandering patients. Due to medication or disease, some patients may be unable to read or comprehend warning signs. To address this problem, a contractor should:

1) Ensure medical and security staff are aware of all work locations in their area and the importance of keeping patients (and staff) away from the worksite.

2) Carefully survey the worksite to identify all possible access routes, and work with facility security staff to provide locked doors or other barricades to physically prevent patients from entering work areas.

3) Immediately report any unauthorized entry to facility security. Some facilities have monitoring equipment to sound an alarm if patients wander. The contractor should learn whether such equipment is available and being used.

Biological Contamination

Infection is a common concern when working in a medical facility. Microbe survivability varies greatly from organism to organism, and also with environmental conditions such as relative humidity (Rechsteiner 405). In general, however, decommissioning of the work area and proper work practices should minimize the risk of infection.

Transmission of most common bacteria or viruses of concern involve transfer from contaminated surfaces. Airborne transmission either does not occur (e.g., HIV, hepatitis B) or requires that the infected, contagious person be in the airspace actively shedding organisms (e.g., staphylococcus, mycobacterium tuberculosis) (CDC). Removal of contaminated patients, decontamination of surfaces before work starts and good worker personal hygiene practices (frequent hand washing, eating in designated areas, treatment for cuts/abrasions) should control this potential hazard.

Areas such as laboratories, dialysis areas and isolation wards require greater attention. These areas should be re-inspected before workers enter them to ensure that all biological materials have been removed and surfaces decontaminated.

The primary hazard will be the unexpected discovery of any suspect biological fluids or materials. Discovery or contact with such fluids should trigger the contractor's bloodborne pathogens program. In addition, the contractor should notify the facility safety professional and work with this individual to determine how to safely and properly remove and dispose of the materials.

Chemicals

All chemicals should be removed during decommissioning. However, areas

FIGURE 1 Infection Control Checklist & Notification for Construction Projects

Project #: **Project Title/Location:**

Estimated Start Date: **Estimated Completion Date:**

1. **Pre-work infection control training completed for contractor workers.**
2. **Initial Planning**
   - Identify critical areas affected (e.g., operating rooms, ICU, pharmacy, kitchen, sterile processing, data centers, neonatal, transplant).
   - Decommission all work areas.
   - Review barrier location and construction (e.g., solid barriers, self closing doors, walk-off mats to control "tracked" dirt).
   - Plan airflow patterns—from "clean" to "dirty." May require auxiliary exhaust fans in work area. Units should have HEPA filters if air is exhausted into the building.
   - Review any planned ventilation outages.
   - Plan materials and debris transport (e.g., exterior chutes, covered carts, dedicated elevator, designated routes)
   - Review location of any exterior work, lay down or vehicle parking areas. May require relocation of building air intakes, additional filtration, sealing of windows or other potential entry points.
   - Establish communication procedures between contractor and facility infection control (both routine and emergency).
3. **During Construction**
   - Barriers in place and integrity maintained.
   - Airflow maintained from "clean" to "dirty." Air pressure gauges at barriers.
   - Compliance with traffic patterns.
   - All windows, doors, debris chutes to outside closed and secured when not in use.
   - Doors to work areas closed and properly signed.
   - HVAC servicing work area isolated or shut down, and grilles sealed off.
   - Work areas cleaned at end of day. Trash removed.
   - Any water leakage, signs of mold or vermin infestation reported to Infection Control Committee immediately.
4. **Additional Comments:** _____

Facility Construction Manager: _____
(name and phone number)

Contractor Project Manager: _____
(name and phone number)

cc: Facility Safety/Environmental, Facility Infection Control, Facility Security, Contractor Safety, Contractor Project Manager, Project File, Notebook

such as pathology, chemistry, microbiology and research labs should be re-checked before work begins to confirm that this is the case. If any chemicals are discovered, work in the area should stop and the facility safety department should be contacted to coordinate proper removal and disposal.

Radioactive Materials & Ionizing Radiation Sources

Again, proper decommissioning of work areas should eliminate this hazard. All facilities with radioactive materials have a designated radiation safety officer (RSO). This person should be consulted prior to any work to ensure that all sources have been eliminated as well as to outline procedures that should be followed if suspect materials are discovered. Most radioactive materials found in medical facilities (e.g., iodine 131) have short half-lives—on the order of several days—and very low activity levels. Therefore, any transient exposure should not create a significant risk.

In some cases, a facility will have a linear accelerator on site. Normally, this should not be a problem, as such devices are usually located below ground level and are not "radioactive" when powered down. The contractor should understand several key factors when working around the device, however.

1) The accelerator must be off whenever construction personnel are in the accelerator room or during exterior excavation near the beam path.

2) Minimal danger exists when working in adjacent areas, as the accelerator room shielding should control hazards.

3) The contractor must never compromise the integrity of existing shielding without first having the work plans reviewed by the facility radiology department or RSO (Mays).

Handling of lead shielding associated with x-rays or other radioactive sources may release some lead, but in most cases, this should not present a major hazard (Klein and Weilandics 1126). As a precaution, workers should minimize the handling of shielding, and wash their hands and faces after handling it. Furthermore, the shielding should be stored in a dry location to minimize oxidation of the surface, which can increase lead release. Encapsulation of the shielding prior to installation can reduce future potential lead exposure (Klein and Weilandics 1126).

Entry Into Ventilation Systems

In general, entry into shut-down and isolated plenums or ductwork should not present a significant hazard to construction workers. As noted, most microbes of concern are either transferred by contact or require the immediate presence of an infected and contagious person. In most cases, isolation of the system and good personal hygiene practices should control this hazard. However, the contractor safety professional must still review the system to determine whether it may be a permit-required confined space (PRCS) entry. In addition, if the system is used to service laboratories, the safety professional must ensure that no residual chemicals (e.g., picric or perchloric acid) are present in the ducts.

Entry into inactive ventilation systems may, however, present a significant risk to patients. Shutdown or isolation of the HVAC system may cause air pressure differentials and create new air flow patterns that may endanger critical-care patients or other immunosuppressed patients. Therefore, any work on the HVAC system must be planned well in

advance and coordinated with the infection control committee.

Entry into active plenums or ductwork should be avoided if possible. If entry is necessary, the contractor must determine whether such entry requires a permit and identify what contaminants (biological or chemical) may be present. Based on this assessment, disposable coveralls, gloves, eye protection and appropriate respirators (up to and including airline respirators) may be required.

The contractor should discuss any entry with facility staff to determine what procedures were used in the past to enter active plenums. If this is considered a PRCS, 29 CFR 1910.146(c) requires that the facility owner brief the contractor on all known or potential hazards, any past experience with entry into the space or similar spaces, and necessary precautions (OSHA).

Demolishing Walls & Floors

As noted, abandoned, undocumented pipes and drains are one of the greatest hazards during demolition. The contractor must also be aware of fungal (mold) infestation that may be exposed during demolition. Any area where water may have accumulated (e.g., kitchens, showers, roofs) has the potential for mold infestation. The City of New York has published nonregulatory "Guidelines on Assessment and Remediation of Fungi in Indoor Environments" (NY Dept. of Health). These guidelines offer recommendations for worker protection based on the amount of contaminated building materials to be removed. The contractor should also consult with the facility infection control officer to make sure adequate measures are taken to protect patients and construction workers during demolition.

Exposure to Sharps

Cuts and puncture wounds from sharps (e.g., scalpel blades, needles, broken glass) may be the most-common hazard when working in a medical facility. Again, proper decommissioning should remove this hazard before workers arrive on the scene. However, a contractor should be aware of areas where sharps can collect undetected, such as the bottom of elevator shafts, dumb waiters or other floor openings.

CONCLUSION

Construction and renovation work in medical facilities presents unique hazards to the construction safety professional. Proper decommissioning of work areas, pre-planning and close communications with facility staff can eliminate or reduce most of these hazards. Through this preplanning and cooperation, the project will run more smoothly and safely for both the contractor and the medical facility. ■

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