ASSESSMENT OF HEALTH RISKS

Related to Construction

Minimizing the threat of infection from construction-induced air pollution in health-care facilities

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During construction and renovation projects, the primary concern of risk managers normally is fire prevention, with secondary emphasis on general safety and exposure to chemicals. Often overlooked is the threat of construction-induced air pollution.

In health-care environments, where the compromised immune status of some patients leaves them more susceptible to infection, this oversight can have dire consequences. For example, infections caused by *Aspergillus* fungi, which often are associated with water-damaged building materials, can be difficult to diagnose and treat and—especially in cases involving patients undergoing bone-marrow transplantation—even prove fatal.

Although this article provides guidance on establishing a risk-assessment tool for health-care facilities, the information can be adapted for other buildings.

A dialysis patient in close proximity to a renovation project.

INFECTION RISK

Construction procedures that can heighten infection risk in health-care environments include demolition using inadequate barriers, exterior-wall removal, and core drilling. Water leakage with mold growth, poor ventilation, and utility outages also can increase risk.

The main cause of construction-related infection are airborne fungal spores, which originate on water-damaged building materials. For example, cellulose-sheathed building material, such as gypsum board, is prone to fungal growth/contamination. When the material is wet for more than 72 hours, the fungi grow and produce spores. The spores become airborne during repair/disturbance. They are buoyant and remain in the air for long periods of time.

Table 1 lists problems that typically give rise to fungal infections in health-care facilities and offers solutions.

Another common cause of infection are aerosols released when contaminated items are disturbed. These aerosols can carry dangerous buoyant contaminants, such as fungal spores, into patient environments if controls are not in

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Problem	Consequence	Solution
Water-damaged building materials	Water leaks soak building materials, causing mold growth, which, when disrupted can cause fungal infections in compromised individuals.	Determine a barrier and airflow for the containment of airborne fungal spores. Also, determine remediation and decontamination requirements.
Ductwork disruption	Poor-fitting ducts and shutdowns can change internal pressure relationships, causing the migration of airborne particles to protected areas.	Divert compromised patients away from such activity. Provide assured pressures, air exchanges, and filtration in designated areas.
Open windows	Outdoor-excavation or demolition debris may infiltrate protected patient areas.	Close and lock windows. Seal around the frame or other leakage points.
Improper fan setting or filter installation	Airborne contaminants may enter the building.	Provide preventive maintenance to assure appropriate air-handling-system operation.

TABLE 1. Problems that typically give rise to fungal infections in health-care facilities.

place. In "Guidelines for Design and Construction of Hospital and Healthcare Facilities 2001," The American Institute of Architects (AIA) provides guidance on the assessment and control of construction aerosols.

RISK ASSESSMENT

For all projects, especially those related to health care, the risks of construction-induced infection should be assessed. The Infection Control Risk Assessment (ICRA) is part of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) inspection process (for more on the ICRA, see Andrew J. Streifel's article "Health-Care IAQ: Guidance for Infection Control" in the October 2000 issue of *HPAC Engineering*).

A risk assessment should take into consideration:

- The patient population.
- The extent of the project.
- The duration of the project.
- The impact of the project on mechanical systems.
- Whether the space will remain occupied during the project.

A risk assessment should be started during the concept-planning phase of a project, when scope, location, equipment size, etc. are determined. The internal and external impacts of the project should be considered during the design-development phase, coinciding with space planning and the determination of equipment location and traffic-flow patterns.

During the bid process, value-engineering decisions must be carefully examined regarding the potential for fungal growth and indoor-air-quality problems. Although preventive maintenance arising from a risk assessment may be costly, it often is substantially less so than problems related to building acceptance and litigation over water-damage issues.

During the implementation phase of a project, amid demolition, reconstruction, cleanup, etc., problems can be minimized in part by providing break areas and bathroom facilities for workers.

Commissioning criteria should include the prevention of the installation of water-damaged materials, as well as predetermined ventilation parameters.

Major points of a risk assessment for health-care facilities can be found in Chapter 5 of the AIA's "Guidelines for Design and Construction of Hospital and Healthcare Facilities 2001."[1]

SAMPLE ICRA

The following is an example of a completed ICRA for an information-system upgrade in an intensive-care unit.

Infection Control Risk Assessment
Matrix of Precautions for Constr uction
& Renovation

Step 1. Using the following table (Table 2), identify the type of construction-project activity. *This project will occur in the intensive-care unit and be of*

Type A	**Inspection and non-invasive activities** Include, but are not limited to: • The removal of ceiling tiles for visual inspection (limited to one tile per 50 sq ft). • Painting (but not sanding). • Wall covering, electrical trim work, minor plumbing, and activities that do not generate dust or require the cutting of walls or access to ceilings other than for visual inspection.
Type B	**Small-scale, short-duration activities that create minimal dust** Include, but are not limited to: • The installation of telephone and computer cabling. • Access to chase spaces. • The cutting of walls or ceilings where dust migration can be controlled.
Type C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies** Includes, but is not limited to: • The sanding of walls for painting or wall covering. • The removal of floor coverings, ceiling tiles, and casework. • New-wall construction. • Minor duct work or electrical work above ceilings. • Major cabling activities. • Any activity that cannot be completed within a single work shift.
Type D	**Major demolition and construction projects** Include, but are not limited to: • Activities that require consecutive work shifts. • Activities that require heavy demolition or the removal of a complete cabling system. • New construction.

TABLE 2. Types of construction activity.

Low risk	Medium risk	High risk	Highest risk
• Office areas	• Cardiology • Echocardiography • Endoscopy • Nuclear medicine • Physical therapy • Radiology/MRI • Respiratory therapy	• Critical-care unit • Emergency room • Labor and delivery • Laboratories (specimen) • Newborn nursery • Outpatient surgery • Pediatrics • Pharmacy • Post-anesthesia-care unit • Surgical units	• Any area caring for immunocompromised patients • Burn unit • Cardiac-catheterization lab • Central sterile supply • Intensive-care units • Medical unit • Negative-pressure isolation rooms • Oncology • Operating rooms, including C-section rooms

TABLE 3. Patient risk groups.

the Type C variety.

Step 2. Using the following table (Table 3), identify the patient risk groups that will be affected. If more than one risk group will be affected, select the higher risk group. *This project will affect patients who have had orthopedic surgery.*

Step 3. Identify the areas surrounding the project area, assessing potential impact (Table 4).

Unit below	Unit above	Lateral	Lateral	Behind	Front
Sterile processing	*Surgery*	*Intensive-care unit*	*Intensive-care unit*	*Outside*	*Outside*
Risk group	Risk group	Risk group	Risk group	Risk group	Risk group

TABLE 4. Areas surrounding the project area.

Step 4. Identify the specific site of the activity (e.g., patient rooms, medication room, etc.). *The workers will be pulling computer wires and upgrading communication in patient rooms and corridors.*

Step 5. Identify issues related to:

• Ventilation (outages, airflow direction, clean to dirty, etc.).

• Plumbing (outages, hand-washing access, work area, flushing, etc.).

• Electricity (outages for critical equipment in special-ventilation areas, monitoring, etc.).

Airborne-infection isolation rooms and patient rooms with immune-compromised conditions will require frequent checks and utilization of portable HEPA filters.

Step 6. Identify containment measures, using prior assessment. What types of barriers (e.g., solid-wall barriers) are there? Will HEPA filtration be required? *Portable filters should be used when pulling the wires into patient-care areas because of the age of the building. Patients determined to be at risk should be diverted to another intensive-care unit until the wire pulling is finished.*

(Note: Renovation/construction areas should be isolated from occupied areas during construction and provide clean-to-dirty airflow with respect to surrounding areas.)

Step 7. Consider the potential risk of water damage. Is there a risk because of compromised structural integrity (e.g., wall, ceiling, roof)? *No.*

Step 8. Work hours: Can or will the work be done during non-patient-care hours? *No. Care must be taken to contact the nursing supervisor before workers begin to determine the most-sensitive patients and coordinate the progress of the project.*

Step 9. Plan to discuss the following containment issues with the project team: traffic flow, housekeeping, debris removal (how and when).

Comments: *This is a very sensitive job, but the patients are not particularly immune-compromised. The project will take five days to complete. Extra attention may be required for the last few wire pulls because the intensive-care unit may begin to fill up toward the end of the week, and patients may need to be moved.*

Note: The ICRA can be modified throughout a project. Revisions must be communicated to the project manager.

CONCLUSION

No building under construction or being renovated is immune to hazardous conditions, including construction-induced air pollution. That is why a risk assessment is important for all projects. The proliferation of fungi from water-damaged building materials may result in an owner not accepting a building. Often, buildings are water-damaged because the contractors did not store gypsum board in a weather-protected area, or the gypsum board was installed flush with the poured slab, enabling water absorption. Water damage and subsequent mold growth should be prohibited as part of building specifications.

Outbreaks

The following are examples of outbreaks in health-care facilities:

• In 1998, a pressure imbalance in a building housing an oncology and bone-marrow-patient-care area caused construction aerosol to migrate to patient rooms.[2] Fifty percent of the protected-patient rooms were depressurized, as was the patient-care unit housing immune-compromised patients.

• In 1991, an outbreak was associated with the installation of a supply elevator in the kitchen area of a hospital with a transplant unit. Interventions using prescribed infection-control measures reduced the infection rate in solid-organ-transplant patients from 9.4 to 1.5 percent.

• In 1988, an outbreak caused by *Aspergillus flavus* among bone-marrow-transplant patients was associated with laundry becoming contaminated because of road construction and there not being a back door on the laundry truck. The infection rate jumped from 3 to almost 7 percent that year.

This demolition project near 10 health-care buildings on the University of Minnesota campus was preceded by an extensive ICRA.

Tools are available to detect moisture in walls, ceilings, and other porous materials. The fact that mold is present in air and soil must be factored into an assessment of water damage.

Avoiding hazardous conditions requires a formal approach during the preconstruction stages of a project. The risk-assessment tool provided in this article should serve only as a model for developing site-specific assessments. The degree of development depends on the building and the scope of the project. In health care, the ICRA considers the patients and procedures affected, as well as sterile-supply storage, laundry services, the loading dock, the air intakes, and other factors that may impact the risk to patients. For other types of buildings, most concerns are associated with mineral dust (asbestos), which poses a long-term problem. In health care, the greatest concern is a mycosis such as *Aspergillosis*, which is difficult to diagnose and treat. Such a disease has a very high case fatality rate, which approaches 85 percent, depending on the patient disease and treatment. According to the Centers for Disease Control and Prevention, about 88,000 patients die each year from nosocomial (hospital-acquired) infections. From that number, it is estimated that about 2,000 to 3,000 deaths are associated with infections caused by airborne microbes.

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JCAHO Inspection Process

The following is the Joint Commission on Accreditation of Healthcare Organizations' (JCAHO's) "Intent of Environment of Care 3.2.1," which went into effect Jan. 1:

When planning for the size, configuration, and equipping (of) the space of renovated, altered, or new construction, the organization uses "Guidelines for Design and Construction of Hospitals and Healthcare Facilities," 1996 edition, published by the American Institute of Architects; or applicable state rules and regulations; or similar standards or guidelines.

When planning demolition, construction, or renovation work, the organization conducts a proactive risk assessment using risk criteria to identify hazards that could potentially compromise patient care in occupied areas of the organization's buildings. The scope and nature of the activities should determine the extent of risk assessment required. The risk criteria should address the impact demolition, renovation, or new-construction activities have on air-quality requirements, infection control, utility requirements, noise, vibration, and emergency procedures. As required, the organization selects and implements proper controls to reduce risk and minimize the impact of these activities.

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