Infection Prevention's Involvement Essential in Healthcare Construction

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By: Kelly M. Pyrek
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Central to the prevention of opportunistic-pathogen transmission during any construction activity, be it new build or renovation projects, is the infection control risk assessment (ICRA). The ICRA is the tool with which the construction team can determine the levels of infection prevention needed at the site. In 2001, the American Institute of Architects (AIA) formalized this assessment tool and in 2002, the Joint Commission adopted the AIA's Guidelines for Design and Construction of Hospitals and Health Care Facilities as part if its standards for survey and accreditation.

According to the firm Environmental Health & Engineering, the ICRA must address the impact of disruption to patients and facility staff as well as potential patient relocation; must provide for the placement of barriers to protect immune-compromised patients from airborne pathogens such as Aspergillums sp.; must ensure that air handling and ventilation issues are addressed; must determine the number of isolation rooms required; and must address how waterborne pathogens such as Legionella sp. will be controlled. As Bartley, et al. (2000) explains, "An ICRA provides for strategic, proactive design to mitigate environmental sources of microbes and for prevention of infection through architectural design (e.g., handwashing facilities, separation of patients with communicable diseases), as well as specific needs of the population served by the facility."

It is the responsibility of the ICRA committee to oversee the construction process, and members should include representatives from infection prevention and control, epidemiology, risk management, construction, safety and administration. Bartley et al. (2000) notes, "The planning group's charge is to consider communicable disease prevalence in the community while recognizing the importance of disease variation and distribution across geographic regions and to weigh the availability of public support agencies, as well as to consider the needs of health systems that manage patients with communicable disease, patients who are severely immune-suppressed, or both."

While the AIA guidelines provide adequate theory, in practice, some say there are significant challenges to implementation. Richard Bennett, MSPH, CIH, president and chief science officer at Charleston, S.C.-based Risk Tech, LLC, says he is concerned about two big issues facing hospitals that are attempting to balance cost-effective construction activities with patient-safety imperatives.

"Since 2001, when the AIA and APIC guidelines came together with the Joint Commission standards, there has been a tremendous amount of progress relative to the sophistication of the infection control risk assessment that is being conducted prior to construction and renovation," Bennett says. "However, with hospital budgets tightening up, there seems to be a little less money being allocated to addressing the infection control risk assessment and monitoring the necessary controls than there was five years ago. Budgets are simply not allowing for the monitoring of construction activity to the degree that it should be monitored."

What's more, Bennett adds, there is an abject lack of infection prevention-related oversight in greenfield, or brand-new, healthcare construction. "In greenfield construction, I see a lack of monitoring by infection preventionists," he says. "People think that with new construction, there is no need for environmental rounds, for example. However, we have identified many problems that are actually built into new construction, such as in a new bed tower being added to an existing facility. And these problems can be easily rectified had there been more rigor on the part of the construction planning team members when closely monitoring the construction process. It's a significant blind spot, and there must be more education about this in the infection prevention community and in the design, architectural and engineering communities. People are not as tuned into infection control in a Greenfield project as they are in a renovation project."

As an example, Bennett points to a composite example of several greenfield hospital investigations that Risk Tech has done over the last 10 years; the cause of the outbreak was traced back to the ventilation system. The system had been activated and run during the last stages of the construction activity, and construction dust and other particulates had been introduced into the return air duct, thus contaminating the entire ventilation system. "Because of some poorly controlled relative humidity in the structure, construction material got wet and that became a fungal reservoir in the structure," Bennett says. "This resulted in dozens of patients being colonized with aspergillus, and hundreds of thousands of dollars had to be spent on cleaning the ducts of this bed tower. This unfortunate situation could have been easily prevented had environmental rounds been instituted during construction of the tower. For just a few hundred dollars, a filtration unit could have been placed over the return air vent and all of the problems would have been prevented."

Bennett says that as more greenfield projects get underway in response to the demand for more healthcare facilities, there must be renewed emphasis on equal levels of infection control in the new-build environment and in the renovation environment. He also says that the smallest details of a design project can place patients in harm's way of opportunistic pathogens.

"We are acting as consultants on a greenfield pediatric hospital and for the pediatric oncology ward the architect had designed a raised garden area with fountains," Bennett says. "We questioned how they were going to get pesticides and herbicides safely from the ground level to this third-floor atrium level, as well as how they were going to ensure the water in the water features were adequately chlorinated or sanitized -- and none of those questions had been brought up. Gardens and water features can serve as vectors and reservoirs and here was a situation where a ward full of immune-compromised patients were going to be wheeled past this potentially rich source of pathogens. It's about being in the right mindset with infection control at the forefront. You say 'infection control during construction' to an architect or an engineer and they immediately think renovation; they don't think new construction. That transition in thinking has got to be made, or we are going to be building a lot of 'sick' hospitals over the coming decades."

As Bartley, et al. (2000) notes, "The role of infection control is multifaceted and will be required throughout and after completion of the construction project. Infection control staff members provide important leadership and a communication link with program administrators, architects and engineers. Completion of an ICRA is only the first step; input also is needed in early stages of project design as well as during later blueprint reviews. For example, early coordination with facility management during construction phase identifies necessary support structures required to prevent and control airborne contamination, thus avoiding costly rework or redesign. Newer design challenges include retrofitting older buildings into offices and clinics to meet needs for patient examination and instrument cleaning rooms, laboratories and storage. In the absence of clear-cut rules or regulations, infection control staff members serve to bridge gaps with health agencies and facility administration regarding infection control guidelines and essential design features needed for safe practice. The ICRA sets the scene for involving infection control and supports continuing implementation of infection control principles."

Bennett advocates for the early and active involvement of the infection preventionist in all construction activities. "There must be a team effort between the general contractor, the architect and the hospital's risk assessment planning committee," he says. "Everyone has to be on the same page without any derision when it comes to the infection control plan for any healthcare construction. Patient safety is paramount and everything else is subordinate; the stakes are so high that it cannot work in any other fashion."

Those stakes include the risk of litigation over healthcare-acquired infections, Bennett says. "In many cases, the burden of proof has shifted from the patient having to prove he or she got the infection at the hospital, to the hospital having to prove that the patient didn't get the infection at the facility. The documentation becomes so much more important now, but because budgets are tightening, the documentation is getting thinner on the construction projects. As this litigation danger increases, the documentation of the adequacy and the efficacy of the controls surrounding the construction project are becoming less substantial and hospitals can be exposed to potential legal action. I see this as a perfect storm brewing for patient plaintiff litigation relative to hospital-acquired infections."

Bennett says that one of the most important things that a hospital can do is ensure that the project architect has adequate error and omission (E&O) insurance coverage. "Insurance is not looked at very closely but that's a critical issue," Bennett says. "Many architects' E&O insurance doesn't cover infectious disease-related incidents – they have to get a special rider for that. When the mold litigation got really bad in 2005, for example, many of the E&O carriers dropped mold and other infectious agents coverage. So it's critical for hospitals to scrutinize architects' E&O policies to ensure there is sufficient coverage for infectious substances and that the architect names the healthcare facility as an additional insured on their E&O policy. Also, hospital should ensure that the contractor has pollution prevention coverage that also covers infectious disease. And in the same manner, the contractor should also name the facility as an additional insured on their pollution prevention policy. These are big risk-management issues that hospitals must address if they are to mitigate risks to themselves and to their patients."

The construction planning committee must create a comprehensive construction and renovation policy (CRP) that "operationalizes the facility's ICRA, ensures management's understanding of the ICRA, and specifies essential participants," according to Bartley, et al. (2000) who adds, "A well-designed policy will ensure timely notification of the infection control professional and designated committee(s) for early program planning efforts. In addition, the CRP calls for infection control to evaluate the project from conception through completion and supports a systematic approach for project management.

Echoing this recommendation are Sehulster and Chinn (2003), who advise the establishment of a "multi-disciplinary team that includes infection control staff to coordinate demolition, construction and renovation projects and consider proactive preventive measures at the inception; produce and maintain summary statements of the team's activities."

In the CDC's guidelines for the environmental infection control in healthcare facilities, Sehulster and Chinn (2003) outline the following best practices relating to demolition, construction and renovation:

1. Educate the construction team and healthcare staff in immune-compromised patient-care areas regarding the airborne infection risks associated with construction projects, dispersal of fungal spores during such activities, and methods to control the dissemination of fungal spores

2. Incorporate mandatory adherence agreements for infection control into construction contracts, with penalties for noncompliance and mechanisms to ensure timely correction of problems

3. Establish and maintain surveillance for airborne environmental disease (e.g., aspergillosis) as appropriate during construction, renovation, repair, and demolition activities to ensure the health and safety of immune-compromised patients

Using active surveillance, monitor for airborne infections in immune-compromised patients

Periodically review the facility's microbiologic, histopathologic and post-mortem data to identify additional cases

If cases of aspergillosis or other healthcare-associated airborne fungal infections occur, aggressively pursue the diagnosis with tissue biopsies and cultures as feasible

4. Implement infection control measures relevant to construction, renovation, maintenance, demolition and repair

Before the project gets under way, perform an ICRA to define the scope of the activity and the need for barrier measures

Determine if immunocompromised patients may be at risk for exposure to fungal spores from dust generated during the project

Develop a contingency plan to prevent such exposures

5. Implement infection-control measures for external demolition and construction activities

Determine if the facility can operate temporarily on recirculated air; if feasible, seal off adjacent air intakes.

If this is not possible or practical, check the low-efficiency (roughing) filter banks frequently and replace as needed to avoid buildup of particulates.

Seal windows and reduce wherever possible other sources of outside air intrusion (e.g., open doors in stairwells and corridors)

6. Avoid damaging the underground water system (i.e., buried pipes) to prevent soil and dust contamination of the water

7. Implement infection-control measures for internal construction activities

Construct barriers to prevent dust from construction areas from entering patient-care areas; ensure that barriers are impermeable to fungal spores and in compliance with local fire codes

Seal off and block return air vents if rigid barriers are used for containment

Implement dust-control measures on surfaces and divert pedestrian traffic away from work zones

Relocate patients whose rooms are adjacent to work zones, depending on their immune status, the scope of the project, the potential for generation of dust or water aerosols, and the methods used to control these aerosols

8. Perform those engineering and work-site related infection control measures as needed for internal construction, repairs, and renovations

Ensure proper operation of the air-handling system in the affected area after erection of barriers and before the room or area is set to negative pressure

Create and maintain negative air pressure in work zones adjacent to patient-care areas and ensure that required engineering controls are maintained

Monitor negative airflow inside rigid barriers

Monitor barriers and ensure integrity of the construction barriers; repair gaps or breaks in barrier joints

Seal windows in work zones if practical; use window chutes for disposal of large pieces of debris as needed, but ensure that the negative pressure differential for the area is maintained

Direct pedestrian traffic from construction zones away from patient-care areas to minimize dispersion of dust

Provide construction crews with designated entrances, corridors, and elevators wherever practical; essential services (e.g., toilet facilities) and convenience services (e.g., vending machines); protective clothing (e.g., coveralls, footgear, and headgear) for travel to patient-care areas; and a space or anteroom for changing clothing and storing equipment

Clean work zones and their entrances daily by wet-wiping tools and tool carts before their removal from the work zone; placing mats with tacky surfaces inside the entrance; and covering debris and securing this covering before removing debris from the work zone

In patient-care areas, for major repairs that include removal of ceiling tiles and disruption of the space above the false ceiling, use plastic sheets or prefabricated plastic units to contain dust; use a negative pressure system within this enclosure to remove dust; and either pass air through an industrial-grade, portable HEPA filter capable of filtration rates of 300 to 800 feet every three minutes, or exhaust air directly to the outside

Upon completion of the project, clean the work zone according to facility procedures, and install barrier curtains to contain dust and debris before removing rigid barriers

Flush the water system to clear sediment from pipes to minimize waterborne microorganism proliferation

Restore appropriate ACH, humidity, and pressure differential; clean or replace air filters; dispose of spent filters

9. Use airborne-particle sampling as a tool to evaluate barrier integrity

Commission the HVAC system for newly constructed healthcare facilities and renovated spaces before occupancy and use, with emphasis on ensuring proper ventilation for operating rooms, AII rooms, and PE areas

If a case of healthcare-acquired aspergillosis or other opportunistic environmental airborne fungal disease occurs during or immediately after construction, implement appropriate follow-up measures

Review pressure-differential monitoring documentation to verify that pressure differentials in the construction zone and in PE rooms are appropriate for their settings

Implement corrective engineering measures to restore proper pressure differentials as needed

Conduct a prospective search for additional cases and intensify retrospective epidemiologic review of the hospital's medical and laboratory records

If no epidemiologic evidence of ongoing transmission exists, continue routine maintenance in the area to prevent healthcare-acquired fungal disease

If no epidemiologic evidence exists of ongoing transmission of fungal disease, conduct an environmental assessment to find and eliminate the source

10. Collect environmental samples from potential sources of airborne

fungal spores, preferably by using a high-volume air sampler rather

than settle plates

If either an environmental source of airborne fungi or an engineering problem with filtration or pressure differentials is identified, promptly perform corrective measures to eliminate the source and route of entry

Use an EPA-registered antifungal biocide for decontaminating structural materials

If an environmental source of airborne fungi is not identified, review infection-control measures, including engineering controls, to identify potential areas for correction or improvement

If possible, perform molecular sub-typing of Aspergillus spp. isolated from patients and the environment to compare their strain identities

If air-supply systems to high-risk areas are not optimal, use portable, industrial-grade HEPA filters on a temporary basis until rooms with optimal air-handling systems become available

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