INFECTION CONTROL RISK ASSESSMENT

Executive Summary

Careful care has to be made during construction and renovation at hospital facilities with respect to infection control. Bacteria and microorganisms introduced during construction pose a serious risk to those with lowered immune systems. There are several infection control guidelines published; two of which are the CDC and the Healthcare Infection Control Practices Advisory Committee's *Guidelines for Environmental Infection Control in Health-Care Facilities*, and the *Guidelines for Design and Construction of Hospitals and Health Care Facilities* issued by the American Institute of Architects. Both guidelines strongly suggest the implementation of an infection control risk assessment, which is a process of looking at various project factors and determining what needs to be done to control infection during the life of the project. In this analysis an infection control risk assessment will be performed for Frederick Memorial Hospital. From the ICRA and other literature, suggestions for infection control on FMH will be recommended. Implications of these recommendations will be discussed, as well as a comparison between what is currently being done and what is being suggested. When comparing the results of the assessment to what is actually being done at Frederick Memorial Hospital it is apparent that all necessary precautions are being made at the hospital during the construction process.

Background Information & Literature Review

The risk of infection during renovation and construction is a serious concern in the healthcare industry. The Centers for Disease Control and Prevention estimates healthcare associated infections account for an estimated 2 million infections, 90,000 deaths, and $4.5 billion in excess health care costs annually. Not all of these deaths can be attributed to poor construction practices, but many bacteria and microorganism can be introduced during construction resulting in infection or death among future patients. The following table is taken from the Association for Professionals in Infection Control and Epidemiology's 2000 report on "the role of infection control during construction in health care facilities". Table 1 shows different examples where "environmental dispersal of microorganisms during construction, resulting in nosocomial infections, has been described previously". This is proof that the risk of infection from construction and renovation procedures is real.

Year, author	Organism	Population	Epidemiologic factors
Airborne			
1976 Aisner et al[1]	*Aspergillus* spp	Acute leukemia	Fireproofing insulation
1982 Lentino et al[2]	*Aspergillus* spp	BMT; renal	Road construction; window air conditioners
1985 Krasinski et al[3]	*Rhizopus*; *Aspergillus*	Neonatal	False ceiling
1987 Streifel et al[4]	*Penicillium* spp	BMT	Rotted wood cabinet
1987 Weems et al[5]	*Rhizopus; Mucor* sp;	Hematologic BMT	Construction activity
1990 Fox et al[6]	*Penicillium* sp; *Cladosporium* sp	OR	Ventilation duct fiberglass insulation
1991 Arnow et al[7]	*Aspergillus* sp	Cancer-melanoma	Tiles; humidified cell incubators; air filters
1993 Flynn et al[8]	*Aspergillus terreus*	ICU	ICU renovation; elevators
1994 Gerson et al[9]	*Aspergillus* sp	General	Carpeting
1995 Alvarez et al[10]	*Scedosporium prolificans* (*inflatum*)	Neutropenic hematology	Construction, presumed environmental
1996 Pittet et al[11]	*Aspergillus* sp	COPD	Air filter replacement
Waterborne			
1976 Haley et al[12]	*Legionella* spp	Immunosuppressed	Soil; water
1980 Dondero et al[13]	*Legionella* spp	Adults, employees	Cooling towers
1980 Crane et al[14]	*Pseudomonas paucimobilis*	ICU	Potable water used to fill flush water bottles
1985 Claesson et al[15]	Group A *Streptococcus*	Maternity	Shower head
1993 Sniadeck et al[16]	*Mycobacterium xenopi*	Endoscopy-pseudo	Potable water; scopes
1997 Dearborn et al[17]	*Stachybotrys atra*	Infants	Water-damaged homes
1997 Fridkin et al[18]	*Acremonium kiliense*	Ambulatory surgery	Vent system humidifier

BMT, Bone marrow transplant; *OR*, operating room; *ICU*, intensive care unit; *COPD*, chronic obstructive pulmonary disease.

Table 1: Selected events of nosocomial infection associated with the dispersal of microorganisms during construction

One current guideline for infection control is the *Guidelines for Design and Construction of Hospitals and Health Care Facilities* issued by the American Institute of Architects. The CDC and the Healthcare Infection Control Practices Advisory Committee

have also published the *Guidelines for Environmental Infection Control in Health-Care Facilities* which include a section on "Construction, Renovation, Remediation, Repair, and Demolition". Both of these organizations strongly support the implementation of an Infection Control Risk Assessment (ICRA). Premiere Inc., a hospital consulting company, defines ICRA as "a multidisciplinary, organizational, documented process that focuses on reduction of risk from infection; acts through phases of facility planning, design, construction, renovation, facility maintenance, and coordinates and weighs knowledge about infection, infectious agents, and care environment, permitting the organization to anticipate potential impact." In the case of Frederick Memorial Hospital an ICRA will be implemented to determine the different infection risks on the project and how to properly manage them.

Infection Control Risk Assessment Analysis

There are many different forms and checklists used as Infection Control Risk Assessments. For this analysis the "Infection Control Risk Assessment Matrix of Precautions for Construction & Renovation" distributed by the Association for Professionals in Infection Control and Epidemiology will be used as the assessment tool. The following 4 pages show the ICRA matrix filled out for the G wing renovation.

Infection Control Risk Assessment
Matrix of Precautions for Construction & Renovation

Step One:
Using the following table, *identify* the Type of Construction Project Activity (Type A-D)

TYPE A	**Inspection and Non-Invasive Activities**. Includes, but is not limited to: ▪ removal of ceiling tiles for visual inspection limited to 1 tile per 50 square feet ▪ painting (but not sanding) ▪ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	**Small scale, short duration activities which create minimal dust** Includes, but is not limited to: ▪ installation of telephone and computer cabling ▪ access to chase spaces ▪ cutting of walls or ceiling 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: ▪ sanding of walls for painting or wall covering ▪ removal of floorcoverings, ceiling tiles and casework ▪ new wall construction ▪ minor duct work or electrical work above ceilings ▪ major cabling activities ▪ any activity which cannot be completed within a single workshift.
TYPE D	**Major demolition and construction projects** Includes, but is not limited to: ▪ activities which require consecutive work shifts ▪ requires heavy demolition or removal of a complete cabling system ▪ new construction.

Step 1: D

Step Two:

Using the following table, ***identify*** **the Patient Risk Groups** that will be affected.
If more than one risk group will be affected, select the higher risk group:

Low Risk	Medium Risk	High Risk	Highest Risk
▪ Office areas	▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy	▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units	▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Medical Unit ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

Step 2 Low Risk

Step Three: *Match* the

Patient Risk Group (***Low, Medium, High, Highest***) with the planned **…**
Construction Project Type (***A, B, C, D***) on the following matrix, to find the **…**
Class of Precautions (***I, II, III or IV***) or level of infection control activities required.

Class I-IV or Color-Coded Precautions are delineated on the following page.

IC Matrix - Class of Precautions: Construction Project by Patient Risk

Patient Risk Group	Construction Project Type			
	TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary.

Step 3 Class III/IV

Description of Required Infection Control Precautions by Class

	During Construction Project	Upon Completion of Project
CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection	1. Clean work area upon completion of task.
CLASS II	1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed.	1. Wipe work surfaces with disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Remove isolation of HVAC system in areas where work is being performed.
CLASS III	1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with disinfectant. 5. Remove isolation of HVAC system in areas where work is being performed.
CLASS IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Dept	1. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop area with disinfectant. 6. Remove isolation of HVAC system in areas where work is being performed.

Step 4. **Identify the areas surrounding the project area, assessing potential impact**

Unit Below	Unit Above	Lateral	Lateral	Behind	Front
		High	High		
Risk Group	Risk Group	Risk Group	Risk Group	Risk Group	Risk Group

Step 5. **Identify specific site of activity eg, patient rooms, medication room, etc.**
Patient rooms, Nursery, Labor & Delivery, Radiology, Cardiology

Step 6. **Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.**
Outages must be planned in advance, construction utility interrupt requests

Step 7. **Identify containment measures, using prior assessment. What types of barriers? (Eg, solids wall barriers); Will HEPA filtration be required?**
Solid wall barriers, yes HEPA filtration

(Note: Renovation/construction area shall be isolated from the occupied areas during construction and shall be negative with respect to surrounding areas)

Step 8. **Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (eg, wall, ceiling, roof)** No

Step 9. **Work hours: Can or will the work be done during non-patient care hours?** No

Step 10. **Do plans allow for adequate number of isolation/negative airflow rooms?** Yes

Step 11. **Do the plans allow for the required number & type of handwashing sinks?** N/A

Step 12. **Does the infection control staff agree with the minimum number of sinks for this project?** (Verify against AIA Guidelines for types and area) N/A

Step 13. **Does the infection control staff agree with the plans relative to clean and soiled utility rooms?** Yes

Step 14. **Plan to discuss the following containment issues with the project team. Eg, traffic flow, housekeeping, debris removal (how and when),**
Finishes work from top floor down
temporary trash chute constructed for debris removal

Appendix: Identify and communicate the responsibility for project monitoring that includes infection control concerns and risks. The ICRA may be modified throughout the project. Revisions must be communicated to the Project Manager.

Steps 1-3 Adapted with permission V Kennedy, B Barnard, St Luke Episcopal Hospital, Houston TX; C Fine, CA
Steps 4-14 Adapted with permission Fairview University Medical Center, Minneapolis MN
Forms modified and provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills MI 2002 Reviewed 2005

Suggested Infection Control Actions

The results of the ICRA show that the project is in between the class III and class IV precaution level. This is a result of the patient groups in the construction area being low risk, like offices and reception areas, but the surrounding wings are all high risk patient groups, like labor & delivery and the nursery. Taking into account the results of the ICRA, other published guidelines, and the project specifics of Frederick Memorial Hospital the following precautions should be taken:

- All HVAC returns in the construction spaces should be completely sealed off with plastic.
- Temporary wall partitions that are completely sealed around the edges should be constructed separating the construction area from the hospital.
- Negative pressure utilizing HEPA filtration should be maintained in the zones adjacent to the hospital to prevent air and particulate in the construction area from flowing into the hospital.
- Testing should be performed daily to ensure that the area around the temporary barriers is indeed in negative pressure when compared to the hospital on the other side of the barrier.
- All above ceiling penetrations from the construction area into the hospital should be completely sealed.
- Place sticky mats at all construction entrances into the building. This will prevent excess dust and dirt from being tracked inside.
- Construction debris should be wrapped in plastic, sealed, and HEPA-filter vacuumed before removal from the construction area.
- Debris and construction tools should be cleaned daily to prevent build up of dust and microorganisms.
- Seal the window openings with plastic until the windows can be put in to minimize infiltration.
- Workers should be HEPA-filter vacuumed before they enter the construction zone.

Implications of ICRA

There are several different implications that arise from an ICRA. The party with by far the largest impact on the success of infection control is the contractor. It is imperative that all contractors involved in the demolition and construction of the hospital understand the importance of infection control to the project. This is the job of the construction manager to lead by example and stress how essential infection control is. Before a subcontractor begins any work, the infection control procedures must be explained to him/her, and they must understand the role they play in minimizing potential infection risks. The construction manager must also hold the subcontractors accountable to the infection control plan and punish any misdeeds. An effective way of stressing the importance of infection control would be to have it be a topic regularly discussed in the weekly superintendents meeting. The contractors on the project are not hospital specific contractors, they do projects in all industry sectors, therefore the mistake must not be made of assuming that the contractors know what infection control precautions to take.

Another implication that arises from the ICRA is cost. It can begin to get expensive to build multiple temporary barriers, have continuous negative pressure in the construction space, and to use HEPA-filtered vacuums numerous times daily. The owner must understand that money needs to be budgeted for infection control. Additionally, the owner must understand that the there can be no value engineering when it comes to infection control, if the budget needs to be cut it has to come from other areas of the project.

Comparison to FMH Methods

Although there was no official infection control risk assessment performed, Frederick Memorial Hospital does have some mandated infection control precautions that are being followed during construction. These prescribed precautions are mostly all from the various published guidelines. There is no area of infection control that is not being covered at the hospital, and in some cases more stringent provisions are being made. For example: interim air-tight reinforced plastic dust abatement curtains are being installed before the prescribed temporary barriers are built, that way no dust or debris enters the building during the construction of the temporary barrier. Also site construction activities are not permitted within 25 feet of existing fresh air intakes, and materials or supplies may

not be placed near intake louvers. Compressed air may not be used to clean away dust and dirt.

Conclusion

Infection control is very important on hospital construction projects. There are several resources available to determine what level of precaution needs to be taken with the facility in question. After performing in infection control risk assessment for Frederick Memorial Hospital several specific methods for minimizing infection risk were identified. Two implications of the infection control procedures were discussed: the need for getting contractors to understand the importance of minimizing infection risks, and the need for maintaining the infection control budget if money starts to becomes tight on the project. Finally, when comparing the results of the assessment to what is actually being done at Frederick Memorial Hospital it is apparent that all necessary precautions are being made at the hospital during the construction process.