

WIPAG

WY Infection Prevention Orientation Manual

Section #14, Construction and Renovation

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October 2014

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Section #14: Construction and Renovation

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Objectives

At the completion of this section the Infection Preventionist (IP) will:

- Understand the different phases of construction and renovation projects
- Be introduced to facility infrastructure systems (heating, ventilation and air conditioning [HVAC], plumbing, etc.)
- Understand the role of the IP in all phases of new/renovation construction and facility operations activities
- Understand how to design infection prevention and control measures to prevent the migration of contaminants generated during construction
- Understand how to implement infection prevention control commissioning at the completion of construction

Number of hours

- Key Concepts - 4 hours
- Methods - 20 hours

Required Readings

- Grotta P, Allen V, Boston KM, et al, eds. *APIC Text of Infection Control & Epidemiology*. 4th Edition. Washington, D.C.: Association for Professionals in Infection Control and Epidemiology, Inc.; 2014.
 - Chapter 112, Maintenance and Engineering, by SD Cutter
 - Chapter 113, Waste Management, by WJ Pate
 - Chapter 114, Heating, Ventilation, and Air Conditioning, by J Bartley and RN Olmsted
 - Chapter 115, Water Systems Issues and Prevention of Waterborne Infectious Diseases in Healthcare Facilities, by L Dickey
 - Chapter 116, Construction and Renovation, by B Cotten

Overview

Construction and renovation in an occupied healthcare facility can adversely impact air and water quality. If not commissioned properly, air and water quality can continue to be a health risk to patients/residents and staff following the completion of construction. Patient/resident exposure to contaminated air or water can lead to healthcare-associated infections (HAIs). The purpose of the *Construction and Renovation* section is to help the IP understand the variables of an infection control risk assessment (ICRA); and once understood, use the ICRA process to design and implement infection controls that will reduce infectious risks to patients/residents and staff. Although the materials presented in this section describe practices that will reduce risk to patients/residents and staff, every construction project is unique, thus infection controls will likely require additional input from the infection prevention and control team/committee. Once gathered, this additional information should be used to customize infection controls to meet the individual healthcare facility needs.

Key Concepts

Dispersal of microorganisms during construction and renovation has been reported to cause significant morbidity and mortality for vulnerable patient populations. Input from IP will ensure that efforts to reduce infectious risks to the patients have been followed.

The main areas for the involvement of IP during the construction/renovation within healthcare facilities typically include:

1. Providing infection prevention and control consultation during all phases of construction/renovations
2. Monitoring of infection control precautions during and immediately following any construction/renovations
3. Reporting of any breaches of infection prevention and control precautions to the Project Leader

Major Phases of the Construction Process

Most construction and renovation projects go through a series of five phases. These phases are described in Table 1. An IP should be familiar with each phase as he/she will have a role in assuring all aspects of infection prevention are accounted for.

Table 1. Major phases of the construction process, construction documents, and associated definitions.

Term	Definition
Conceptual/Planning Phase	This phase includes the <i>big picture</i> defining the type of facility, physical location, patient population, and other aspects of master planning.
Design and Development Phase	The rough drawings prepared in the conceptual phase are detailed in the design and development phase. Items detailed include structure details; room layouts; patient flow; surface materials of the walls, floors, ceilings and window treatments; fixtures; furniture; décor and other interior, exterior and infrastructure (electrical, plumbing, HVAC, medical gas, etc.) details.
Construction Document Preparation Phase	The construction documents, prepared by the architect, list all aspects of the design in a format where the contractors can prepare cost estimates and plan construction activities. Important details in these documents include, but are not limited to installation of ventilation systems using “clean duct protocols” and disinfection steps for potable water systems.
Construction Phase	Construction is the phase where the facility is built or the area under renovation is demolished and rebuilt.
Commissioning Phase	The commissioning phase is the start-up of a building that includes testing and adjusting HVAC, electrical, plumbing, and other systems to assure proper functioning and adherence to design criteria. Commissioning also includes the instruction of building representatives in the use of the building systems. Commissioning occurs prior to the healthcare organization taking ownership of the building.

Exercise #1: Determine what role you play as the IP in each of the phases of construction. If you need assistance, use the required readings, review your facility policies or discuss with your mentor/supervisor.

Conceptual/Planning Phase:

Design and Development Phase:

Construction Document Preparation Phase:

Construction Phase:

Commissioning Phase:

Key Ventilation Terms

Maintaining proper functioning and reducing the risk of infectious disease transmission through ventilation systems is critical in any construction or renovation project. It is essential for an IP to understand the basic concepts of a ventilation system (Figure 1) and its associated terms (Table 2).

Table 2. Key ventilation system terms and definitions.

Term	Definition
Air Exchange Rate or Air Changes per Hour	Volume of air moved in one hour. One air change per hour in a room or building means that all the air in that environment will be replaced in one hour.
Air Handling Unit (AHU)	Air handling unit; a component of an HVAC system that includes the fan(s), filters, and coils to condition the air. See Figure 1.
Differential Pressure	A measure of static pressure of one space relative to another (adjacent) space. It is used to determine if a space is positively or negatively pressurized.
Diffusers and Grilles	Components of the ventilation system that distribute and diffuse air to promote air circulation in the occupied space. Diffusers supply air and grilles return air.
Exhaust Air	Air removed from a space and not used therein.
Filtration	The removal of particulates from a moving airstream.
HVAC system	A term generally used to refer to the entire building ventilation system including heating and air-conditioning components. See Figure 1.
HEPA Filters	High efficiency particulate arrestance (filters). These are filters that are capable of removing 99.97 percent of particles at a diameter of 0.3 micrometer from the air.

Minimum Efficiency Reporting Value (MERV)	A rating value that describes the minimum efficiency of a filter to remove particles from an airstream. Ratings range from 1 to 20 where 1 is low efficiency and 20 is the highest efficiency. HEPA filters are MERV 17.
Negative Pressure	Condition that exists when less air is supplied to a space than is exhausted from the space, so that the air static pressure within that space is less than in surrounding areas. See Figure 1.
Outside Air	Air taken from the external atmosphere and, therefore, not previously circulated through the system. See Figure 1.
Positive Pressure	Condition that exists when more air is supplied to a space than is exhausted, so the air static pressure within that space is greater than that in surrounding areas. See Figure 1.
Return Air	Air removed from a space to be then recirculated or exhausted. See Figure 1.
Supply air	That air delivered to the conditioned space and used for ventilation, heating, cooling, humidification, or dehumidification. See Figure 1.

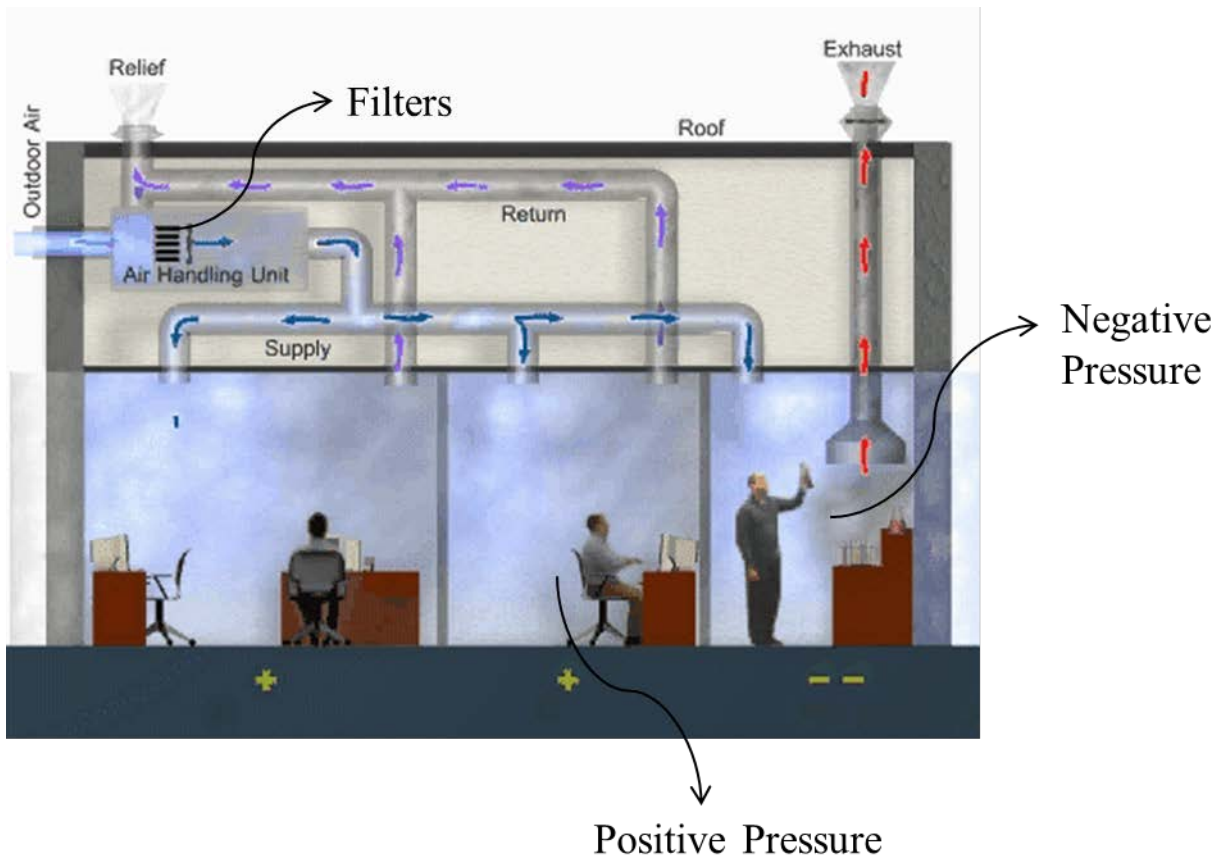


Figure 1: Visual representation of a general HVAC system. Reproduced from EPA/NIOSH IAQ Building Education and Assessment Model (I-BEAM) Visual Reference Modules; www.epa.gov/iaq/largebldgs/i-beam/visual_reference/series_1.html

Exercise #2: Using the required readings and suggested readings to complete Table 3.

Table 3. Construction and renovation terms.

Term	Definition
Authority Having Jurisdiction	
Containment Cube	
Environmental Services (housekeeping)	
ICRA	
Infection Control Risk Mitigation Recommendation (ICRMR)	
Manometer	
Non-porous Material	
Porous Material	

Airborne Contaminants Related to Construction

There are three classes of airborne contaminants generated during construction projects. These classes, and example of each, are listed below.

1. Inorganic particles (a.k.a. aerosols) which include:
 - General construction dusts (sheet rock, fiberglass, wood dust, concrete dust)
 - Metal fumes (from welding) and metal dusts (from grinding)
2. Vapors which include:
 - adhesives, paints, solvents
3. Organic particles (a.k.a. bioaerosols) which include:
 - Fungi – *Aspergillus*, *Rhizopus*, etc.
 - Bacteria – *Legionella*, *Pseudomonas*, etc.

Additionally, there are seven common sources of air contaminants within a healthcare facility:

- Upper surface of ceiling tiles
- Within wall cavities
- Within electrical boxes and medical gas panels
- Within light fixtures
- Carpet

- Water features
- Cleaning activities

Exercise #3: Using the required and helpful readings to answer the following questions:

How could a patient/resident be exposed to fungi during construction activities?

How could a patient/resident be exposed to bacteria during construction activities?

List the bacteria of concern that could potentially contaminate healthcare water systems during construction activities:

Infection Control Risk Assessment (ICRA)

An ICRA is a systematic process that determines the level of risk to patients/residents and defines controls to reduce risk. For a Microsoft Excel ICRA template, please visit the Wyoming Department of Health, Healthcare-Associated Infection Prevention website: www.health.wyo.gov/phsd/epiid/2013WyIPConference.html, look under the name Cynthia Ellwood for a document titled “Practice ICRA.” Completing an ICRA for any construction or renovation project requires four steps:

1. Identify the ***type of construction***
2. Identify the patient/resident ***risk group*** that will be most affected
3. Determine the level of infection control classification using the ***ICRA Matrix***
4. Assign appropriate controls that are needed to reduce or eliminate risk to patients

Types of Construction

There are four types of construction projects and they are described in Table 4.

Table 4. Construction projects and examples of each.

Type of Construction	Description	Examples
A	Inspection, non-invasive activity	<ul style="list-style-type: none"> • Removal of ceiling tiles for visual inspection, limited to 1 tile per 50 square feet
A	Non-invasive activity	<ul style="list-style-type: none"> • Wall covering installation • Electrical trim work installation • Minor plumbing repairs (all plumbing outside of wall cavities; i.e. change faucet) • Minor patch and paint (without sanding) • Changing door hardware, or making repairs on cabinetry or millwork hardware • Activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection
B	Small scale, short duration activities which create minimal dust or where dust migration can be controlled at the source	<ul style="list-style-type: none"> • Above ceiling access to install cabling, electrical equipment and/or conduits, electrical or lighting fixtures, to perform minor plumbing repairs or clean/inspect/repair variable air volume (VAVs), fan coil boxes or humidifiers • Access to wall chase spaces via access panels for minor plumbing repairs, investigation, electrical work • Cutting of walls or ceiling where dust migration can be controlled • Minor floor repairs on vinyl or carpet flooring • Installation of wall art/framed pictures
C	Work that generates a moderate to high level of dust or requires demolition, removal and build-back of any fixed building components or assemblies	<ul style="list-style-type: none"> • Sanding of walls for painting or wall covering • Removal and reinstallation of floor coverings, ceiling tiles and casework • New wall construction • Minor HVAC duct work • Major electrical work above ceilings • Major cabling work above ceilings • Core drilling operations • Any dust generating activity which cannot be completed within a single work shift
D	Major demolition and construction projects	<ul style="list-style-type: none"> • Activities which require consecutive work shifts • Requires heavy demolition and removal of building systems (i.e. walls, floors, ceilings, and infrastructure including plumbing, electrical, HVAC) • New construction

Risk Groups

In general, patients located within specific areas of a healthcare facility can be categorized into one of four risk groups with respect to construction projects. These risk groups are identified in Table 5.

Table 5. Patient/resident risk groups.

Patient/Resident Risk Group	Example locations within a healthcare facility	
Low	<ul style="list-style-type: none"> • Administrative offices • Basement main hallways • Cafeteria 	<ul style="list-style-type: none"> • Chapel • Creative play areas • Lobby
Medium	<ul style="list-style-type: none"> • Employee health areas • Materials management • Medical day treatment areas • Outpatient pharmacy 	<ul style="list-style-type: none"> • Physical therapy rooms • Inpatient psychiatric areas • Sleep lab rooms
High	<ul style="list-style-type: none"> • Blood donation center • Central supply • Clinical laboratory • Dental clinic • Dialysis/kidney center • Endoscopy areas • Emergency rooms • Flight team areas • Inpatient floors 	<ul style="list-style-type: none"> • Milk lab areas • Inpatient pharmacy • Peri-operation Admission/Discharge areas • PACU • Procedure centers • Radiology (interventional) • Radiology (MRI, CT, Nuclear medicine)
Highest	<ul style="list-style-type: none"> • Any area caring for immunocompromised patients such as Oncology, Hematology • Cardiac Catheter Laboratories • Cardiac Intensive Care Units • Maternal Fetal Units • Negative pressure isolation rooms 	<ul style="list-style-type: none"> • Neonatal Intensive Care Units • Operating rooms • Pediatric Intensive Care Units • Pharmacy (IV room) • Positive pressure isolation rooms • Sterile Processing Department areas

ICRA Matrix

Guidelines for the specific infection control measures that can and/or should be implemented during a construction project have been developed. The guidelines are divided into four classifications, one for each of the various combinations of *construction project types* and *patient/resident risk groups*. To determine which category of infection control measures should be implemented during a construction project, an IP can use the ICRA matrix as shown in Table 6.

Table 6. The ICRA matrix. Roman numerals designate the class of infection control measures that should be implemented during the type of construction project and within the location corresponding to the column and row selected.

Patient/Resident Risk Group	Letter Designation for Construction Project Type			
	A	B	C	D
LOW	Class I	Class II	Class II	Class III or IV
MEDIUM	Class I	Class II	Class III	Class IV
HIGH	Class I	Class II	Class III or IV	Class IV
HIGHEST	Class II or III	Class III or IV	Class III or IV	Class IV

Tasks Assigned to Infection Control Classifications (from ICRA Matrix)

The following lists are the recommended infection control tasks and requirements that correspond to each of the combinations of construction project type and patient/resident risk group. It is important to note that the IP may add or omit any tasks or requirements specific to a construction project. Also note that any barriers recommended should be installed prior to the beginning of construction activities.

Preparation for all construction work

In preparation for all work that will be done in any construction project, the following tasks are typically conducted.

- All work personnel shall have clean clothing, hard hats, high visibility clothing, and shoes at all times when in the facility.
- All equipment, materials, waste carts and transfer carts shall be wiped clean prior to entry into the hospital and shall be clean at all times when moving throughout the hospital.
- Clean interior and exterior surfaces of HEPA filtered vacuum. Conduct detailed inspection of the vacuum to ensure clean, intact filters and proper seating of the HEPA filter on the filter gasket.
- Clean interior and exterior surfaces of HEPA filtered portable air scrubber. Conduct detailed inspection of the air scrubber to ensure clean, intact filters and proper seating of the HEPA filter on the filter gasket.
- Conduct detailed inspection of the HEPA filtered negative air machine to ensure clean, intact filters and proper seating of the HEPA filter on the filter gasket.
- Have available a HEPA filtered vacuum for the purposes of vacuuming dust and debris from equipment, materials, carts and personnel clothing.
- Have available clean cloths and spray disinfectant or wipes for the purposes of wiping all equipment, materials and carts.
- No tool belts, gloves, or rags shall be hanging from contractor belts or pockets. All small equipment (tool belts, tape measure, hammer, drywall saw, etc.) shall be placed inside cleanable portable containers.
- Have bunny suit ensemble (bunny suit, booties, hair bonnets) available.
- Have booties available.

Class I and Class II Infection Prevention Guidelines

- Immediately replace a ceiling tile displaced for visual inspection.
- Place HEPA filtered portable air scrubber in area with open ceiling tile.
- Immediately upon replacement of ceiling tile, vacuum personnel clothing, equipment, ladder and floor to remove dust and debris generated by removing and replacing the ceiling tile.
- Close door to work area – the room will serve as containment.
- Remove all equipment and materials from room prior to beginning work.
- Place tape and plastic over cabinets and shelving within room.
- Place HEPA filtered portable air scrubber inside work area.
- Place HEPA filtered portable air scrubber outside of work area (in adjacent occupied spaces).
- Seal unused doors with tape.
- Securely seal and block off supply air diffusers.
- Coordinate with the Control Room a shut-down of the VAV serving the work area prior to covering the supply air diffuser.
- Identify all VAVs within the work area and adjacent areas served by the same VAVs. Submit a work order to shutdown these VAVs during the same time period that infection control barriers

are being installed. Be sure to coordinate these efforts with Epidemiology and Facilities Management.

- Securely seal and block off exhaust air grills by placing filters with a minimum MERV rating of 8 over exhaust air grills.
- Place tacky mat at corridor entrance into the work area. Change tacky mat as needed so it remains effective at capturing dust and debris.
- Place tacky mat within work area at the exit to the adjacent corridor. Change tacky mat as needed so it remains effective at capturing dust and debris.
- Capture dust during drilling by placing the nozzle of a HEPA filtered vacuum at the drill point.
- Capture dust during cutting by placing the nozzle of a HEPA filtered vacuum at the cut point.
- Maintain a clean work area by vacuuming all affected surfaces with HEPA-filtered vacuums.
- Contain construction waste in tightly covered containers before transport. All trash carts shall be wiped clean (on all surfaces and wheels) prior to exiting the work area and again prior to re-entry into the hospital after dumping at the loading dock. This may necessitate placement of cleaning materials at the loading dock entrance.
- Cover transport receptacles or carts; tape covering down unless solid lid. All covers shall be clean and stored when not in use; the covers shall be stored in a clean container or bag, not on the floor.
- Use “Containment Cube Controls” which include the following specific steps.
 1. Access above ceiling using a containment cube that has been cleaned on all interior and exterior surfaces.
 2. Depressurize the containment cube using a HEPA filtered negative air machine.
 3. Place HEPA filtered portable air scrubber in the work area and near the exhaust discharge of the containment cube.
 4. Prior to exiting the cube, thoroughly clean (vacuum and wipe with disinfectant) the cube interior and all materials and equipment within the cube.
 5. All work personnel shall thoroughly vacuum clothing and shoes prior to exiting the containment cube. Hard hats and high visibility clothing shall also be clean.
 6. Workers are to wear bunny suits, booties and hat covers when exiting the containment cube
 7. Contain construction waste in tightly covered cleanable containers.
- Use “Cut-Out Box Controls” which include the following specific steps. Please see Figures 1a and 1b.
 1. Use cutout box (bird box) when cutting drywall and/or installing electrical box and/or pulling cable into the box.
 2. Depressurize cutout box using a HEPA filtered vacuum.
 3. Prior to removing the cutout box from the wall, thoroughly vacuum all dust and debris from within the box, and then wipe the box interior with disinfectant.
 4. Contain construction waste in tightly covered cleanable containers.
 5. Water mist work surfaces to control dust while cutting.

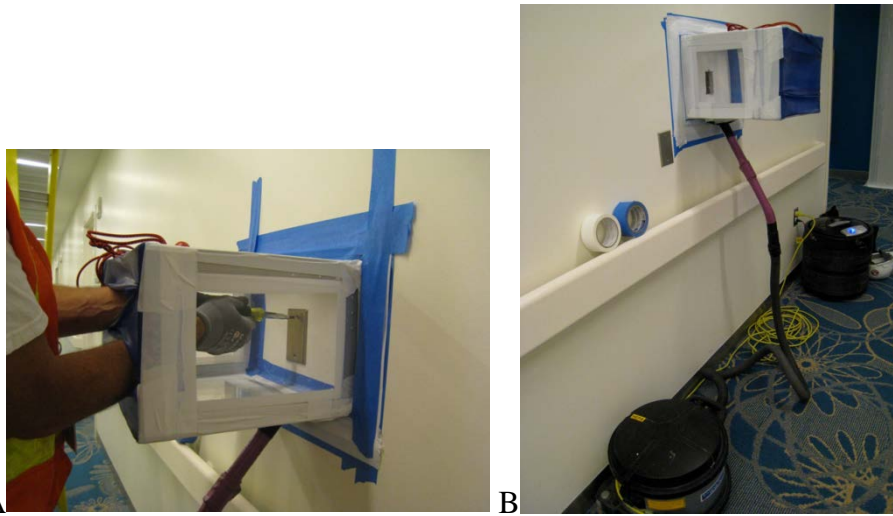


Figure 1. Cut-out box infection prevention control. A is a close up and B is a look at long range perspective.

Class III and IV Infection Prevention Guidelines

- Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system.
- Coordinate with the Control Room a shut-down of the VAV serving the work area prior to covering the supply air diffuser(s).
- Identify all VAVs within the work area and adjacent areas served by the same VAVs. Submit an SIR to shutdown these VAVs during the same time period that infection control barriers are being installed. Coordinate these efforts with Epidemiology and Facilities Management.
- Install all critical barriers(i.e., sheetrock, plywood, plastic), to seal area from non-work area.
- Install hard-wall barriers with or without an anteroom as applicable.
- Install plastic wall barriers with or without an anteroom as applicable.
- Install plastic sheeting above the ceiling up to the ceiling deck.
- Seal holes, pipes, conduits, and all other penetrations through containment barrier.
- Maintain negative air pressure within work site utilizing HEPA-equipped air filtration units.
- Discharge negative air to the outside of the building if at all possible.
- Place manometers with data logging or printing capabilities in each anteroom. Measure pressure differential between work areas referencing the corridor. Program alarm set point at -0.01/-0.02/-0.03 inches water gage.
- Place HEPA filtered portable air scrubber inside work area.
- Place HEPA filtered portable air scrubber inside anteroom.
- Place HEPA filtered portable air scrubber outside of barriers at work area entrance.
- Do not begin construction work until barriers and other infection controls are inspected by the Epidemiology Department or other similarly authorized individual and an infection control permit is issued.
- When personal protective equipment (PPE) is required, it should be stored off the floor inside the anteroom.
- Bunny suits shall be worn by all subcontractors within work area while dusty tasks are being performed. These tasks include demolition and installation/sanding drywall.
- Contain construction waste in tightly covered containers before transport. All trash carts shall be wiped clean (all surfaces and wheels) prior to exiting the work area and again prior to re-

entry into the hospital after dumping at the loading dock. This may necessitate placement of cleaning materials at the loading dock entrance.

- Cover transport receptacles or carts; tape covering down unless solid lid. All covers shall be clean and not stored on the floor when not in use; the covers shall be stored in a clean container or bag.
- Workers are to wear bunny suits, booties and hair bonnets/hat covers when exiting the work area.
- Anteroom shall be clean at all times.
- Maintain a clean work area by vacuuming with HEPA-filtered vacuums.
- Maintain a clean work area. Use dust suppressant when broom sweeping.
- Workers are required to vacuum their clothes with a HEPA vacuum while in the anteroom and before exiting the work site
- All personnel entering work site are required to wear shoe covers (booties). Shoe covers must be changed each time the worker exits the work area.
- Install new HVAC ductwork using clean duct protocols - cover all open ducts at the end of each shift.

At the Completion of Work

At the completion of all construction work, the following tasks are typically conducted.

- At the completion of work, but prior to removal of the barriers, thoroughly wipe walls and floor with disinfectant.
- Perform a construction area clean by wiping all work surfaces with disinfectant.
- Perform a construction area clean by wet mopping.
- Perform a construction area clean by vacuuming the floor, walls and other affected surfaces at the completion of work using a HEPA filtered vacuum.
- Coordinate an environmental services (EVS) terminal clean at the completion of the work.
- Coordinate an EVS triple-terminal clean at the completion of the work.
- Remove isolation of HVAC system in areas where work was performed.
- Perform test, balance and adjustment of the HVAC system as required by Facilities Management.
- Do not remove barriers from work area until completed project is inspected by the Epidemiology Department or other authorized individual.
- Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.

Methods

Through the completion of the following exercises, the IP will explore their own healthcare facility and introduce themselves to the facility's Construction Coordinators/Property Planning personnel, Facilities Operations personnel and finally, Superintendents, Project Managers and Project Foreman for any construction projects occurring at the facility. Once introductions have been made it would be prudent for the IP to discuss the following topics/items with each group.

Exercise #4: Arrange a meeting with the following managers/directors/leaders and complete each table.

1. *Construction Coordinators / Property Planning Group – Table 7*
2. *Facilities Operations Group – Table 8*
3. *“Construction Team” often made up of contractors, such as the Project Superintendent, Manager and Foreman – Table 9*

Table 7. Topics to discuss with Construction Coordinators/ Property Planners.

Discuss with Construction Coordinators/Property Planning Group
1. Review the <i>Major Phases of the Construction Process</i> as presented in Key Concepts (above) and revise the terminology and description of the <i>phases</i> to reflect the policies and procedures at your facility.
2. Does the Construction Coordinators/Property Planning group have written policies or procedures that describe at what stage in the construction/renovation planning process that infection control is invited to the table? <ol style="list-style-type: none"> a. If yes, discuss these policies to determine the adequacy to insert infection control concerns into the construction process in a timely and effective manner. Pay particular attention to the development and implementation of ICRMR for actual construction/renovation projects. b. If no, begin the process whereby policies and procedures are reviewed and revised to include infection control concerns into the construction process in a timely and effective manner. c. Revise or create IP policies to reflect activities and responsibilities as determined in steps 2a and 2b above.
3. Request an electronic copy of your facility’s architectural drawings for: floor plans, mechanical, and plumbing. If electronic versions are not available, learn where hard copies are stored and ask how access is obtained.
4. Spend some time with the Construction Coordinator/Property Planning personnel for the purposes of learning how to read and visualize two-dimensional floor plans into three dimensional spaces (rooms within the facility). <ol style="list-style-type: none"> a. Learn to identify the following design elements on drawings, and then use this knowledge to incorporate infection control criteria into new construction/renovation projects. <ol style="list-style-type: none"> i. Hand hygiene stations ii. Patient rooms – number, locations and types of rooms (airborne infection isolation [AII] and protective environment [PE]) iii. Flooring, ceiling and wall surfaces iv. Location of: <ol style="list-style-type: none"> 1. Clean/dirty utility rooms 2. Washrooms for patients, staff, visitors 3. Elevators and flow of patients from floor to floor 4. Scrub sinks 5. Nourishment rooms 6. Visitor laundry
5. Determine Infection Control Commissioning and Facility Acceptance criteria for new construction or renovation projects. Verification and validation of the following parameters might be considered: <ol style="list-style-type: none"> a. Adequate pressure relationships (differentials) and air changes per hour for rooms

<p>such as: AII, PE, operating rooms, sterile processing, laboratories, pharmacy, clean supply, soiled utility, and other select rooms.</p> <p>b. Adequate environmental quality demonstrated through:</p> <ul style="list-style-type: none"> i. Verification that installation of the HVAC system followed clean duct protocols. Verification can include documented visual inspections conducted during construction and photographs. ii. Air quality monitoring (particle counts, fungal spores, etc.) iii. Water quality (<i>Legionella</i>, heterotrophic plate counts, fecal coliform, <i>E. coli</i>, etc.)
<p>6. Determine the Construction Coordinator/Property Planning group’s level of infection control knowledge. Identify deficiencies and prepare and deliver routine education sessions. Education content for the Construction Coordinator/Property Planning personnel might include:</p> <ul style="list-style-type: none"> a. Purpose of infection control b. Importance of incorporating infection control in the design phase c. Infection control considerations for: <ul style="list-style-type: none"> i. Air and water quality ii. Sinks – numbers, types, placement, operational controls (infrared, foot pedals, hand controls) iii. Sharps and waste disposal placement iv. Floor, ceiling, wall and counter-top surfaces v. Flow of patients, staff, visitors and patient-care items through the facility vi. Adequacy and locations of patient-care supply storage areas vii. Locations of utility rooms (clean, dirty, instrument processing, workrooms, etc.) d. Importance of including Infection Control in the bidding process to ensure inclusion of costs related to a) ICRMR for construction/renovation projects within occupied facilities, and b) infection control commissioning.

Table 8. Topics to discuss with Facilities Operations Group related to construction projects.

Discuss with Facilities Operations (FO) Group
<p>1. Review the routine preventative maintenance (PM) activities performed by the FO. Break the PM activities into building system components and introduce yourself to the FO manager and Lead for each team. Teams may include:</p> <ul style="list-style-type: none"> a. Plumbing and Medical Gas b. Electrical c. Mechanical d. Paint and Patch (may also include carpentry, flooring and ceilings) e. Grounds (may include lawn care, snow removal, concrete/asphalt repairs) f. Hazardous materials and waste
<p>2. Does the FO group have written policies, procedures or permits that incorporate infection control criteria?</p> <ul style="list-style-type: none"> a. If yes, discuss these policies, procedures or permits to determine the adequacy of infection control concerns in a timely and effective manner. Pay particular attention to the development and implementation of ICRMR for actual PM activities. Some important activities that may require lengthy discussion include AHU filter changes and other activities that require a shutdown of units, water system shutdowns, and flood and water mitigation. b. If no, begin the process whereby policies, procedures or permits are reviewed and revised to include infection control concerns into the PM process in a timely and

<p>effective manner.</p> <p>c. Revise or create IP policies to reflect activities and responsibilities as determined in steps 2a and 2b above.</p>
<p>3. Spend some time with the FO Team Leads for the purposes of learning how to read plumbing and mechanical drawings. Learning how to read these drawings is critical for developing effective ICRMR for construction/renovation projects in occupied facilities.</p>
<p>4. Determine the FO group’s level of infection control knowledge. Identify deficiencies and prepare and deliver routine education sessions. Education content for the FO personnel might include:</p> <ul style="list-style-type: none"> a. Purpose of infection control b. Importance of preparing an ICRA for routine and non-routine FO activities c. Reviewing and learning how to implement Infection Control Risk Mitigation Recommendations for routine and non-routine FO activities

Table 9. Topics to discuss with the “Construction Team” often made up of contractors, such as the Project Superintendent, Manager and Foreman.

Discuss with Contractors – Project Superintendent, Manager and Foreman (aka Construction Team)
<p>In order to develop effective ICRMRs, the IP must have a thorough understanding of the construction scope of work. The following list can be used to discuss the construction project with the Contractor.</p> <ol style="list-style-type: none"> 1. <u>Nature</u> – Big picture information <ol style="list-style-type: none"> a. How long will it take for the project to be completed? <ol style="list-style-type: none"> i. Hours, days, weeks, months b. How invasive will the project be? <ol style="list-style-type: none"> i. Investigation only ii. Above ceiling cable pulls iii. Install card readers iv. Drywall cutting v. Remove carpet / vinyl flooring vi. Patch and paint vii. Major demolition and build-back 2. <u>Scope</u> – The details <ol style="list-style-type: none"> a. Exact location of work – floor plans & walking the work area b. IP will need to characterize the work location <ol style="list-style-type: none"> i. Pressurized or depressurized to adjacent/adjoining rooms ii. Ventilation in work area <ol style="list-style-type: none"> 1. Ducted supply and return air 2. Plenum return air 3. Exhaust present iii. Occupants in or near the area iv. Hospital materials moving through the area c. Will wall and/or ceiling cavities be opened? d. What tools will be used? <ol style="list-style-type: none"> i. Hand tools – drywall saws, sand paper block, hammer ii. Power tools – tin cutters, hammer drill, finishing sander e. Is HVAC system part of the scope? f. What downstream rooms will be affected? g. Will AHU be turned off? <ol style="list-style-type: none"> i. What areas will be affected? h. For above ceiling work, determine if ceiling cavity is pressurized.

- i. What building materials and equipment will be transferred to the work location?
- j. What waste materials will be generated?
 - i. Where will recycle and waste dumpsters be located?
 - ii. Can waste be removed through window chute?
 - iii. What noise levels will be generated and when?
- k. Will vibration be generated and when?
- l. Will there be disruptions to:
 - i. Medical gases
 - ii. Electrical power
 - iii. Fire detection / suppression
 - iv. Water supply
 - v. Emergency exit routes
- m. Will there be core drilling through floors?
- n. Does the scope include new domestic plumbing?

Determine the Construction Team’s (and subcontractors) level of infection control knowledge. Identify deficiencies and prepare and deliver routine education sessions. Education content for the construction personnel might include:

- a. Purpose of infection control
- b. Importance of preparing an ICRA for construction activities
- c. Reviewing and learning how to implement Infection Control Risk Mitigation Recommendations for construction activities

Documentation and Reporting

The construction process can be very long, taking six months to five years from planning and design to facility acceptance. The importance of obtaining, reviewing and archiving important infection control documentation is critical. In addition to ensuring all facility procedures and policies are updated and maintained, the following information should be maintained for each construction/renovation project or Facilities Operations PM activities.

Exercise #5: For any Construction/Renovation project in your facility be sure to obtain the documentation from the groups listed Table 10.

Table 10. Documentation from various Construction/Renovation related groups.

Construction Related Group	Documentation
Construction Coordinators/Property Planning Group	Request copies of minutes for all construction design and planning meetings, and meetings for the development of <i>Construction Documents</i> and <i>Bid Packages</i> . Review these minutes to make sure all infection control considerations were noted and acceptable resolutions documented.
Facilities Operations Group AND Contractors (and subcontractors)	<ol style="list-style-type: none"> 1. Maintain all ICRA permits and make sure the FO Team Lead can reproduce work orders for specific tasks and/or dates and times. This documentation may be helpful for retrospective infectious disease investigations. 2. Prepare infection control inspection criteria to evaluate the effectiveness of ICRMRs assigned to the FO activity. 3. For every infection control inspection performed, document the following: <ul style="list-style-type: none"> a. Date and time enter/exit the construction site

	<p>b. Violations or deficiencies</p> <ol style="list-style-type: none"> i. Date and time deficiencies were corrected ii. If corrections were not made, note circumstances, relevant observations and comments, and “report up” documentation
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Other Issues

Depending on FO group involvement in building systems going off-line or coming on-line, and facility acceptance following new construction, be sure to discuss the water system and plumbing activities with FO Team Leads. Topics of discussion can include:

1. Make sure no “dead-legs” or shortcuts in plumbing loops are present in the plumbing design. These pipe configurations lead to stagnant water and microbial contamination.
2. Schedule water interruptions during low use activity
3. Flush and treat water lines prior to use (hyperchlorinating or superheat, >140F)
4. Perform water quality testing prior to patient admittance
5. Observe for discolored water
6. Ensure water temperature meets the standards set by the healthcare facility
7. Ensure the use of materials such as gaskets that do not support the growth of *Legionella*
8. Ensure faucet aerators are not installed or used
9. Maintain as dry an environment as possible and report any water leaks that occur to walls and substructures

Resources

Helpful/Related Readings

- Joint Commission Resources. *Infection Prevention and Control Issues in the Environment of Care*. (2nd Edition). Oak Brook, IL; 2009.
- Joint Commission Resources. *Planning, Design, and Construction of Health Care Facilities*. (2nd Edition). Oak Brook, IL; 2009.
- The Facilities Guidelines Institute. *Guidelines for Design and Construction of Health Care Facilities*. 2010 Edition. American Society for Healthcare Engineering, Chicago, IL
- Bennett G, Morrell G and Green L, ed. *Infection Prevention Manual for Hospitals*; revised edition. Rome, GA: ICP Associates, Inc.; 2010. Section 10
- Lautenbach E, Woeltje KF and Malani PN, eds. *SHEA Practical Healthcare Epidemiology* (3rd Edition). Chicago, IL: University of Chicago Press; 2010.
 - Chapter 34, Infection Prevention in Construction and Renovation, by L Ruhl and LA Herwaldt
- Bartley JM, et al. APIC State-of-the-Art Report: The role of infection control during construction in health care facilities. *American Journal of Infection Control*. 2000: volume 28, issue 2, pages 156-169.
- Mayhall, C.G. ed. *Hospital Epidemiology and Infection Control* (4th Edition). Philadelphia, PA: Lippincott Williams & Wilkins, a Wolters Kluwer business; 2011.
 - Chapter 82, Elements of Design Aimed at Infection Prevention and Patient Safety in the Built Environment of the Healthcare Facility, by JM Bartley and RN Olmsted
 - Chapter 83, Prevention of Infections Related to Construction, Renovation and Demolition in Healthcare Facilities, by JM Bartley and RN Olmsted
 - Chapter 84, Design and Maintenance of Hospital Ventilation Systems and the

Prevention of Airborne Healthcare-Associated Infections

Helpful Contacts (in WY or US)

- Cynthia Ellwood, PhD, CIH, Principal Industrial Hygienist, Associates in Occupational + Environmental Health, LLC, Black Hawk, Colorado, 303-582-3020, cynell@h2net.net

Related Websites/Organizations

- Wyoming Department of Health, Infectious Disease Epidemiology Unit, Healthcare-Associated Infection Prevention: www.health.wyo.gov/phsd/epiid/HAIgeneral.html
- National Institute for Occupational Safety and Health (NIOSH): www.cdc.gov/niosh/
- American Society for Healthcare Engineering (ASHE): www.ashe.org specifically the Healthcare Facility management and Construction course on Infection Prevention: www.ashe.org/learn/seminars_and_workshops/IC/
- Association for Professionals in Infection Control and Epidemiology (APIC), specifically their site on “Construction Issues” at: www.apic.org/Professional-Practice/Practice-Resources/Construction-Issues

My Facility/City/County Contacts in this Area

Role in Construction/Renovation Project	Name	Email address	Phone number
Facility Operations Manager/Supervisor			
Construction Coordinator			
Property Planning Manager			
Superintendent			
Project Manager			
Project Foreman			

References

1. Joint Commission Resources. *Infection Prevention and Control Issues in the Environment of Care*. 2nd ed. 2009.
2. Joint Commission Resources. *Planning, Design, and Construction of Health Care Facilities*. 2nd ed. 2009.
3. The Facilities Guidelines Institute. *Guidelines for Design and Construction of Health Care Facilities*. 2010 Edition. American Society for Healthcare Engineering, Chicago, IL
4. Carrico R., et al, eds. *APIC TEXT of Infection Control and Epidemiology*. 3rd ed. Chapters 104, 105 and 106. 2009. Also see text.apic.org/.



WIPAG welcomes your comments and feedback on these sections.
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October 2014