INFECTION CONTROL FOR CONSTRUCTION IN HEALTHCARE

APIC COLORADO


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## What we'll talk about

- Construction renovation in an occupied healthcare facility
- Infection control considerations in the
  - planning/design,
  - bidding,
  - building and
  - commissioning phases

## Course Objectives

- Review air quality criteria in a healthcare environment
- Discuss particle generation and dynamics related to construction and routine facilities maintenance activies
- Learn how to design and implement infection controls
  - Using a revised ICRA

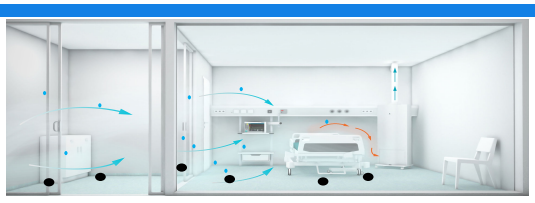
## Course Objectives

- Review a turnover sequence for a simple and a complex construction renovation project
- Understand the elements of an Infection Control Commissioning Plan
- Learn how to respond to unexpected water release events

## Air Quality in Healthcare

- ANSI/ASHRAE/ASHE Standard 170-2013
  - Air change rates
  - Differential pressure values
  - Filtration efficiency
  - Air handing unit and duct construction and design
  - OA intake criteria

## Control particle movement with directional airflow in an isolation room



Large particles settle

Small particles follow airstream

## Filtration: Minimum Efficiency Rating Value (MERV)

**ASHRAE 52.2-1999 Table 12-1, MERV Parameters**

| Standard 52.2 Minimum Efficiency Reporting Value | Composite Average Particle Size Efficiency, % in Size Range | | | Average Arrestance, % by Standard 52.1 Method | Minimum Final Resistance | |
|---|---|---|---|---|---|---|
| | Range 1 0.30 to 1.0 | Range 2 1.0 to 3.0 | Range 3 3.0 to 10.0 | | Pa | Inches of water column |
| 1 | N/A | N/A | $E_1 < 20$ | $A_{avg} < 65$ | 75 | 0.3 |
| 2 | N/A | N/A | $E_1 < 20$ | $65 \le A_{avg} < 70$ | 75 | 0.3 |
| 3 | N/A | N/A | $E_1 < 20$ | $70 \le A_{avg} < 75$ | 75 | 0.3 |
| 4 | N/A | N/A | $E_1 < 20$ | $75 \le A_{avg}$ | 75 | 0.3 |
| 5 | N/A | N/A | $20 \le E_2 < 35$ | N/A | 150 | 0.6 |
| 6 | N/A | N/A | $35 \le E_2 < 50$ | N/A | 150 | 0.6 |
| 7 | N/A | N/A | $50 \le E_2 < 70$ | N/A | 150 | 0.6 |
| 8 | N/A | N/A | $70 \le E_2$ | N/A | 150 | 0.6 |
| 9 | N/A | $E_1 < 50$ | $85 \le E_3$ | N/A | 250 | 1.0 |
| 10 | N/A | $50 \le E_2 < 65$ | $85 \le E_3$ | N/A | 250 | 1.0 |
| 11 | N/A | $65 \le E_2 < 80$ | $85 \le E_3$ | N/A | 250 | 1.0 |
| 12 | N/A | $80 \le E_2$ | $90 \le E_3$ | N/A | 250 | 1.0 |
| 13 | $E_1 < 75$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 14 | $75 \le E_1 < 85$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 15 | $85 \le E_1 < 95$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 16 | $95 \le E_1$ | $95 \le E_2$ | $95 \le E_3$ | N/A | 350 | 1.4 |

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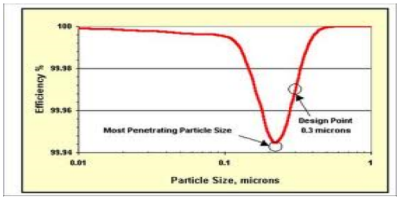
| 10 | N/A | $50 \le E_2 < 65$ | $85 \le E_3$ | N/A | 250 | 1.0 |
| 11 | N/A | $65 \le E_2 < 80$ | $85 \le E_3$ | N/A | 250 | 1.0 |
| 12 | N/A | $80 \le E_2$ | $90 \le E_3$ | N/A | 250 | 1.0 |
| 13 | $E_1 < 75$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 14 | $75 \le E_1 < 85$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 15 | $85 \le E_1 < 95$ | $90 \le E_2$ | $90 \le E_3$ | N/A | 350 | 1.4 |
| 16 | $95 \le E_1$ | $95 \le E_2$ | $95 \le E_3$ | N/A | 350 | 1.4 |

Stage 1 → Admin; food prep; soiled holding; bulk storage; laundry; assisted living

Operating Rms; Inpatient: Care, Tx, diagnosis; Clean supply; Clean Processing

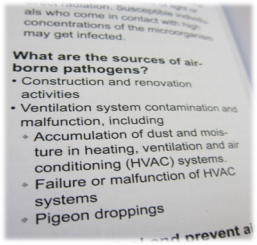
Stage 2 → In-patient hospice care

## HEPA filtration efficiency required for BMT and PE (MERV 17)




High Efficiency Particulate Arrestance filter – 99.97% efficient at 0.3 micron particle diameter

## What do the guidelines say about sources of airborne pathogens?

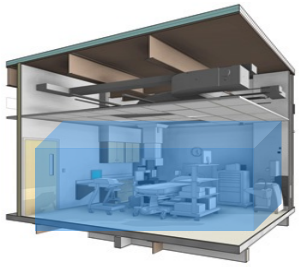




## Air contaminants generated during construction projects

- General particles – Aerosols
  - Construction dusts (sheet rock, fiberglass, wood dust, concrete dust)
  - Metal fumes and metal dusts
- Vapors – adhesives, paints, solvents
- Organic particles – Bioaerosols
  - Fungi – *Aspergillus* sp., *Fusarium* sp., *Rhizopus* sp.
  - Bacteria – water systems

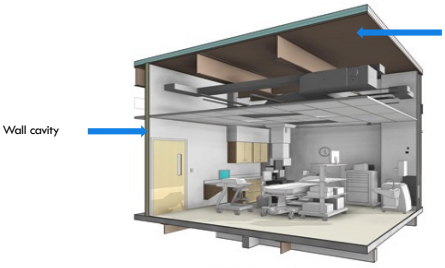
## Do we all agree that construction is not a sterile process?

## Yet, after construction, we place patients into rooms

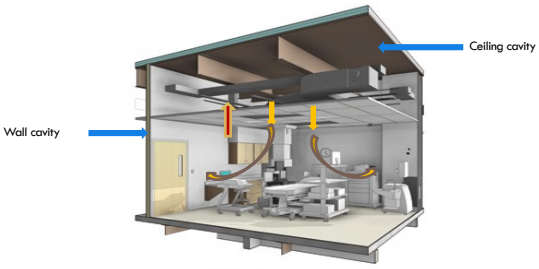


We clean all surfaces and equipment within the room

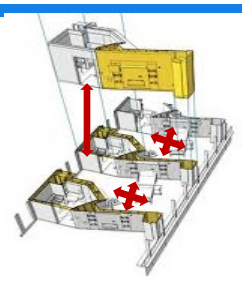
## Cavities not cleaned – Microbes are in cavities



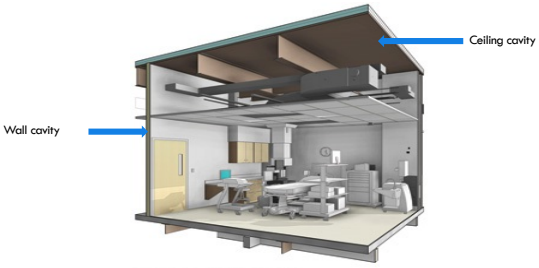

## Ventilation



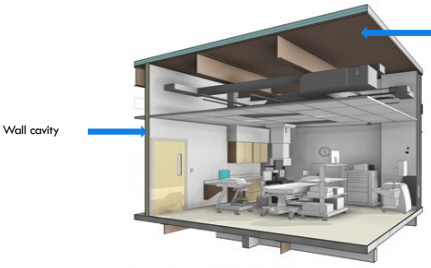

## Ventilation creates air pressure



## Cavities are not "dead air" spaces




## Pathogens located in cavities




Pathogens are located in:

- Wall cavities
- Ceiling cavities
- Electrical boxes
- Med gas panels
- Light fixtures
- Carpet
- Your clothing & equipment
- Construction materials
- Construction waste

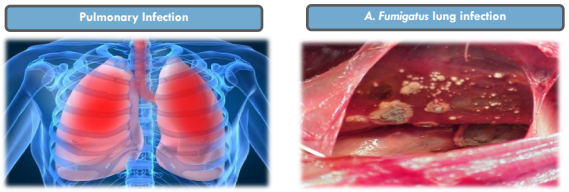
## Pathogen (Microbe) exposure

When the cavities are open, air pressure and airflow within the cavities are disrupted

Microbes within the cavities are agitated, become airborne and move into the occupied space

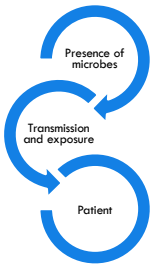
Patients occupy this space

## Fungal Infections




Once the *A. fumigatus* infection has become established, the fungus produces poisonous toxins which may damage various tissues.

## Relationship between construction & patient infections

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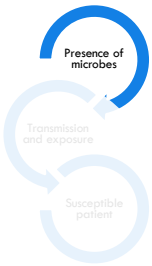
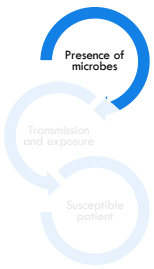
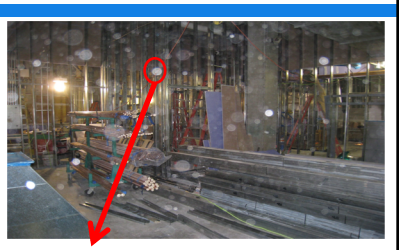



## Relationship between construction & patient infections

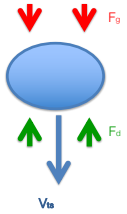


**How big are these particles?**

**Why does particle size matter?**

## Particle settling

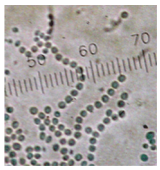



Gravitational forces

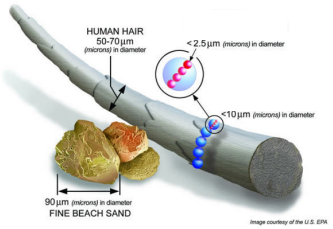
Frictional forces

Terminal settling velocity

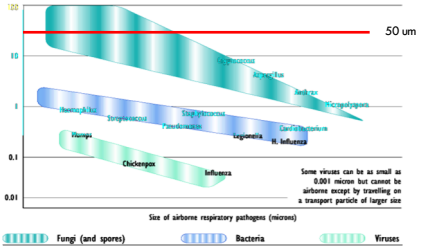
## We can't see dust less than 50 um diameter



Aspergillus spore diameter about 2 microns

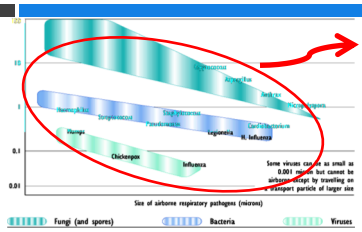



## Relative Sizes of Bioaerosols




## Seeing Dusty Jobs

## Take home message

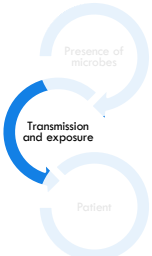



Microbes are located on:

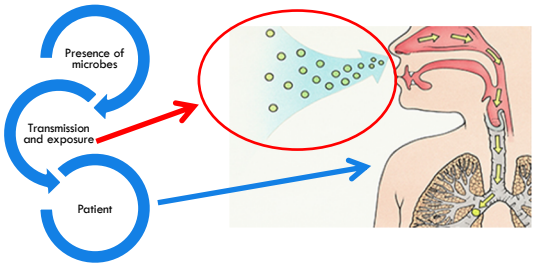
- Wall cavities
- Ceiling cavities
- Electrical boxes
- Med gas panels
- Light fixtures
- Carpet
- Your clothing & equipment
- Construction materials
- Construction waste

## BREAK TIME – 10 MINUTES

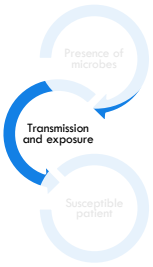
## Relationship between construction & patient infections



## Relationship between construction & patient infections

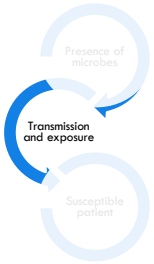



## Relationship between construction & patient infections



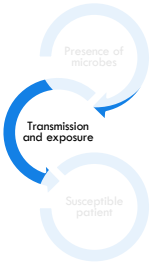

Dirty clothing → Walk through patient area → Airborne microbes → Patient Exposure

## Relationship between construction & patient infections



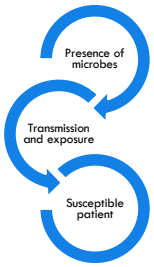

Containment failure → Adjacent to patient area → Airborne microbes → Patient Exposure

## Relationship between construction & patient infections




Improper use of HEPA Cart → In patient area → Airborne microbes → Patient Exposure

## Relationship between construction & patient infections




**Patient with disease caused by construction dust**

## Construction in healthcare

- Contractor personnel and equipment are a part of the healthcare environment

Clean construction can be conducted in the healthcare environment!

## What is Infection Control?

- Systematic process that reduces the risk of infection to patients during construction projects
  - A. Infection Control Risk Assessment (ICRA)
  - B. ICRA Permit
    - Identifies infection controls for the task
  - C. Infection Control Plan
    - Details on how the infection controls will be implemented

## A. Infection Control Risk Assessment

- Multidisciplinary Infection Control Team
  - Infection Preventionist
  - Construction Coordinator
  - Facilities Operations
  - Safety & Security
  - Environmental Services
  - Construction Project Manager
  - Architect

## A. Infection Control Risk Assessment (ICRA)

- Determines level of risk to patients and defines controls to reduce risk
- 3 step method
  - Identify type of construction (nature & scope)
  - Identify patient or staff risk group
  - Determine the level of infection control classification
    - Defines the controls that are needed to reduce or eliminate risk to patients

## A. Infection Control Risk Assessment (ICRA)

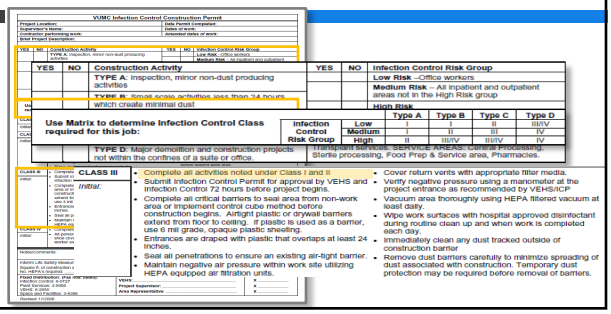
Step 1


Step 2


## Step 3 – Determine infection controls

| Risk Group | Construction Activity | | | |
|---|---|---|---|---|
| | Type 'A' | Type 'B' | Type 'C' | Type 'D' |
| Group 1 | Class 1 | Class 2 | Class 2 | Class 3/4 |
| Group 2 | Class 1 | Class 2 | Class 3 | Class 4 |
| Group 3 | Class 1 | Class 3 | Class 3/4 | Class 4 |
| Group 4 | Class 3 | Class 3/4 | Class 3/4 | Class 4 |

## B. ICRA Construction Permit


VUMC Infection Control Construction Permit

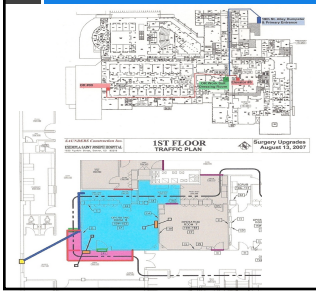
Use Matrix to determine Infection Control Class required for this job:

| Infection Control Risk Group | Type A | Type B | Type C | Type D |
|---|---|---|---|---|
| Low | I | II | III | III/IV |
| Medium | I | II | III | IV |
| High | II | III/IV | III/IV | IV |

CLASS III

- Complete all activities noted under Class I and II
- Submit Infection Control Permit for approval by VEHS and Infection Control 72 hours before project begins.
- Complete all critical barriers to seal area from non-work area or implement control cube method before construction begins. Airtight plastic or drywall barriers extend from floor to ceiling. If plastic is used as a barrier, use 6 mil grade, opaque plastic sheeting.
- Entrances are draped with plastic that overlaps at least 24 inches.
- Seal all penetrations to ensure an existing air-tight barrier.
- Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- Cover return vents with appropriate filter media.
- Verify negative pressure using a manometer at the project entrance as recommended by VEHS/ICP
- Vacuum area thoroughly using HEPA filtered vacuum at least daily.
- Wipe work surfaces with hospital approved disinfectant during routine clean up and when work is completed each day.
- Immediately clean any dust tracked outside of construction barrier
- Remove dust barriers carefully to minimize spreading of dust associated with construction. Temporary dust protection may be required before removal of barriers.

## C. Infection Control Plan




- Written documents, guidelines and procedures that detail the infection controls for the project
  - Floor plans
  - List of emergency personnel
  - Infection control procedures
  - Required signage
  - Waste removal methods
  - Cleaning requirements
  - Clothing requirements
  - Start-up procedures for facility equipment

Does the information in the ICRA Permit provide sufficient information for the contractor or Facilities Maintenance to prepare and implement effective infection controls?

## Construction interpretation of infection controls ≠ IP expectations

Activity – above ceiling investigation in OR corridors

**Step 3: Assign a Class Based on Prior Assessments:**

| Risk Level | Construction Activity | | | |
|---|---|---|---|---|
| | Type 'A' | Type 'B' | Type 'C' | Type 'D' |
| Lowest Risk | Class 1 | Class 2 | Class 2 | Class 3/4 |
| Medium Risk | Class 1 | Class 2 | Class 3 | Class 4 |
| High Risk | Class 1 | Class 2 | Class 3/4 | Class 4 |
| Highest Risk | Class 2 | Class 3/4 | Class 3/4 | Class 4 |

## Class 2 Controls

| | | |
|---|---|---|
| **CLASS 1**<br>Date:<br>Initial: | **A. Minimize raising dust from construction operations.**<br>B. Doors within the travel path of construction activity shall be kept closed.<br>C. Immediately replace any ceiling tile displaced during visual inspection.<br>D. Immediately clean any dust that may have been created from all surfaces. | E. Areas suspected of water damage, past or present should be sprayed with copper 8-quinolinolate or equivalent and Infection Prevention notified.<br>F. Building Materials will remain dry and will be discarded if cannot be completely dried in 48 hours. |
| **CLASS 2**<br>Date:<br>Initial: | **A. Provide active means of preventing airborne dust from dispersing into atmosphere.**<br>B. Seal off room doors with duct tape or Long Mask tape.<br>C. Block off and seal air vents.<br>D. Remove or isolate HVAC system in areas where work is being performed.<br>E. Outside exhaust locations must be 30 feet from air intake locations unless otherwise noted.<br>F. Lightly mist debris and contain construction waste before transport in tightly covered containers. Debris should be removed daily. Do not board elevators containing patients when removing. | G. Water-mist work surfaces to control dust while cutting.<br>H. Wet mop and/or vacuum with HEPA – filtered vacuum before leaving area.<br>I. Wipe all surfaces with hospital-approved disinfectant.<br>J. Place adhesive mat at entrance and exit of work area. Adhesive mats should be type to remove dust and debris from footwear exiting the construction zone.<br>K. All items in previous class (es) must also be performed. |

## What are the IP expectations?

- Clean equipment
- Clean personnel clothing
- Bunny suit ensemble
- Containment cube
- HEPA filtered equip
  - Vacuum
  - Negative air machine
- No patients in ORs
  - Task conducted after hours

## What do these expectations mean to an unprepared contractor?

- An increase in costs
  - Labor
  - Materials
- Grumpy guys that take shortcuts to save time and money

## Shortcuts!

## The Nuts and Bolts of Infection Control

What are we really doing?

- Identifying conditions and factors related to the transmission of infectious disease agents that can be released during construction
- Designing and implementing transmission controls
- Continuously evaluating the effectiveness of controls

## Infection Controls Interrupt Transmission Pathways


## The Nuts and Bolts of Infection Control

Let's Focus On:

- Identifying conditions and factors related to the transmission of infectious disease agents that can be released during construction

Transmission: the movement of contaminant from source to patient

## The Nuts and Bolts of Infection Control

Let's Focus On:

- Identifying conditions and factors related to the transmission of infectious disease agents that can be released during construction

Conditions and Factors:
Identified once the nature and scope of the construction project is understood

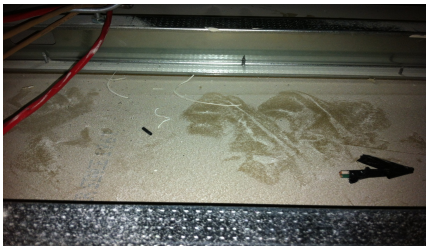
## Example: Above ceiling investigation in OR corridor

| Nature | Scope |
|---|---|
| ▫ Investigation | ▫ Location is OR corridors<br>▫ Remove ceiling tiles<br>▫ Poke head above ceiling and look around |

## Conditions and Factors of Contaminant Transmission

| Contaminant Source | Transmission | Pathway to patient |
|---|---|---|
| Personnel clothing | Fall off walking through corridors | Airborne and re-entrainment<br>Shared traffic route |
| Equipment (ladder) | Fall off during movement | Airborne and re-entrainment<br>Shared traffic route |
| Ceiling tiles | Damage during removal and placement | Airborne and re-entrainment<br>Shared traffic route |
| Ceiling cavity | Pressurized cavity | Airborne (small particle diameter)<br>Shared traffic route |

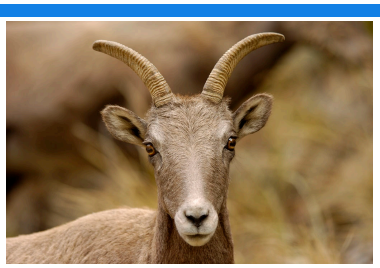
## Dust in the ceiling cavity



## Contaminant Transmission Controls

| Contaminant Source | Transmission | Controls |
|---|---|---|
| Personnel clothing | Fall off walking through corridors | Vacuum clothing<br>Bunny suit ensemble<br>Night/weekend |
| Equipment (ladder) | Fall off during movement | Vacuum and then wipe clean with disinfectant<br>Night/weekend |
| Ceiling tiles | Damage during removal and placement | Containment cube with HEPA filtered negative air machine |
| Ceiling cavity | Pressurized cavity | Containment cube with HEPA filtered negative air machine |
| Additional controls: Emergent cases in pre-assigned OR, EVS terminal clean | | |

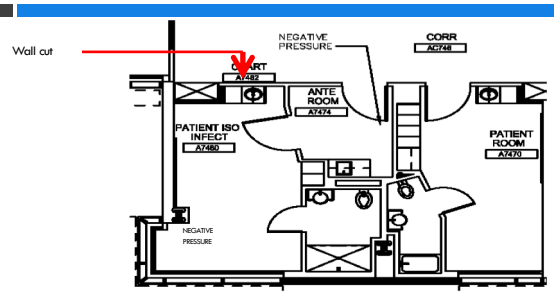
## Break 10 minutes



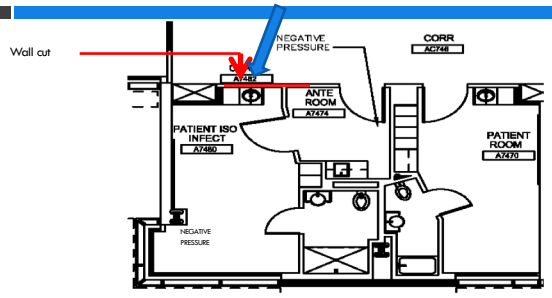
## Example: Cutting in an outlet box

- Nature
  - Small scale, short duration, cutting drywall
- Scope
  - Corridor wall shared with isolation room
  - Cut drywall, box installed, cover plate installed
  - Waste materials generated
  - Wires pulled later

## Location of new outlet box



## Location of new outlet box




## Conditions and Factors of Contaminant Transmission

| Contaminant Source | Transmission | Pathway to patient |
|---|---|---|
| Personnel clothing | Fall off walking through corridor | Airborne and re-entrainment<br>Shared traffic route |
| Equipment (drywall saw) | Fall off during movement | Airborne and re-entrainment<br>Shared traffic route |
| Drywall dust & waste | Generated during cutting and removal | Airborne<br>Direct proximity to patients and staff |
| Wall cavity | Depressurized wall cavity into isolation room | Airborne (small particle diameter)<br>Direct transmission to patient room |

## The Cutout Box

## Contaminant Transmission Controls

| Contaminant Source | Transmission | Controls |
|---|---|---|
| Personnel clothing | Fall off walking through corridors | Vacuum clothing |
| Equipment (drywall saw) | Fall off during movement | Vacuum and then wipe clean with disinfectant |
| Drywall dust | Generated during cutting and removal | Containment – cutout box, poly walls, side panel HEPA Cart, filtered directional airflow |
| Waste materials | Generated during movement | Tight and clean waste container |
| Wall cavity | Depressurized cavity | Directional airflow, Remove patient from room |

Additional controls: Limit staff traffic, Limit visitor traffic, Tacky mats, HEPA filtered portable air scrubber, Contractor wipe walls and floors, EVS terminal clean

## Effective infection control requires…

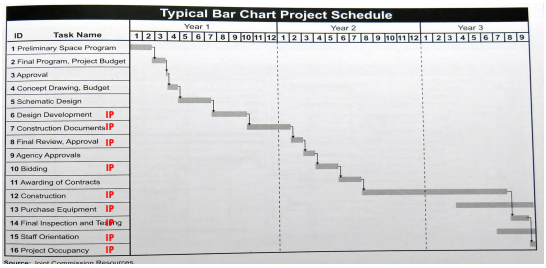
Cooperative interaction and shared responsibility among colleagues!


## ICRA and the Facility Guidelines Institute

**A1.2-3.2 ICRA.** The infection control risk assessment is a documented process to proactively:

a. Identify and plan safe design elements, including consideration of long-range infection prevention.
b. Identify and plan for internal and external building areas and sites that will be affected during construction/renovation.
c. Identify potential risk of transmission of airborne and waterborne biological contaminants during construction and/or renovation and commissioning.
d. Develop infection control risk mitigation recommendations (ICRMRs) to be considered.

## Typical Construction Project Schedule




## Information needed for the ICRA and Construction Permit

- Nature – big picture information
  - How long is task?
    - Hours, days, weeks, months
  - How invasive?
    - Investigation only
    - Above ceiling cable pulls
    - Install card readers
    - Drywall cutting
    - Remove carpet / vinyl flooring
    - Patch and paint
    - Major demolition and build-back

## Information needed for the ICRA and Construction Permit

- Scope – share the details!
  - Exact location of work – floor plans & walking the work area
  - IP will need to characterize the work location
    - Pressurized or depressurized to adjacent/adjoining rooms
    - Ventilation in work area
      - Ducted supply and return air
      - Plenum return air
      - Exhaust present
    - Occupants in or near the area
    - Hospital materials moving through the area

## Information needed for the ICRA and Construction Permit

- Will wall and/or ceiling cavities be opened?
- What tools will be used?
  - Hand tools – drywall saws, sand paper block, hammer
  - Power tools – tin cutters, hammer drill, finishing sander
- Is HVAC system part of the scope?
  - What downstream rooms will be affected?

## Information needed for the ICRA and Construction Permit

- Will air handling unit (AHU) be turned off?
  - What areas will be affected?
- For above ceiling work, determine if ceiling cavity is pressurized.
- What building materials will be transferred to the work location?
- What equipment will be transferred to the work location?

## Information needed for the ICRA and Construction Permit

- What waste materials will be generated?
  - Where will recycle dumpster be located?
  - Where will waste dumpster be located?
  - Can waste be removed through window chute?
- What noise levels will be generated and when?
- Will vibration be generated and when?

## Information needed for the ICRA and Construction Permit

- Will there be disruptions to:
  - Med gases
  - Electrical power
  - Fire detection / suppression
  - Water supply
  - Emergency exit routes
- Will there be core drilling through floors?
- Does the scope include new domestic plumbing?
- Will existing domestic plumbing be interrupted?

## BREAK TIME – 10 MINUTES

## Class Exercise: Transmission

Problem: Central Sterile Supply (Sterile Processing, SPD) humidity is to low.

Solution: Install a duct humidifier downstream of the Reheat Coil (RHC)

| Contaminant Source | Transmission | Pathway to Patient |
|---|---|---|
| Personnel clothing | Fall off walking through corridors | Airborne, shared route |
| Equipment | Fall off during movement | Airborne, shared route |
| Ladder | Fall off during movement | Airborne, shared route |
| Waste containers | Dust/dirt dislodged during movement. Lids not tight fitting | Airborne, shared route |
| Building & Waste materials | Dust/dirt dislodged during movement. | Airborne, shared route |
| Ceiling cavity | Dust/dirt settled on upper surface of ceiling tiles. Dust/dirt dislodged during movement. Pressurized ceiling cavity. | Airborne, shared route |

## Class Exercise: Transmission

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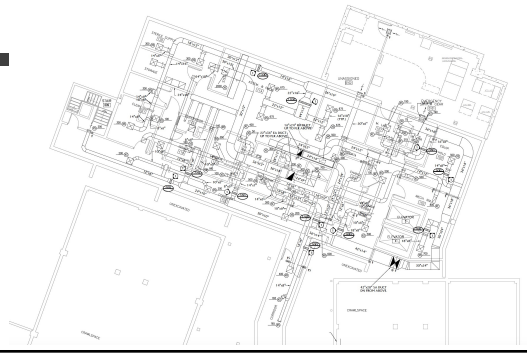


## Let's look at some mechanical drawings and notes

- SPD walls
- SPD Ventilation and Mechanical Legend
- Mechanical Demo and Notes
- Mechanical Remodel and Notes

## Lunch

## Interrupt the Transmission Pathway

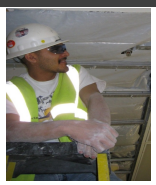

## Patient control systems

- Patient relocation
- Unit closures
- Work Hours
  - Day-time or night-time
- Workers do not ride in elevators with patients

Separate patients and construction area by
- Distance
- Time

## Control transmission along the traffic route

**Demolition**



**Bunny suit ensemble**

Take off bunny suit in work area – Step into anteroom – Vacuum clothing – Exit anteroom

## Control transmission along the traffic route

**Wiped clean**

**Covered and wipe wheels**

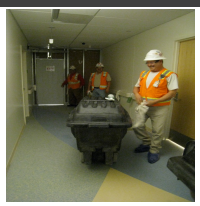
## Control transmission along the traffic route

**Waste from demolition zone**

**Move container to pre-clean station**

## Control transmission along the traffic route

Clean waste cart prior to entry into anteroom



Clean personnel clothing/shoes in anteroom

## Control transmission along the traffic route

Clean cart moves through hospital

Cart cleaned again after dumpster

## Control transmission along the traffic route

Staging large materials

Tacky mats

Frequent mopping or vacuuming traffic route

## Pathway controls: Special Clothing

Hair Covering

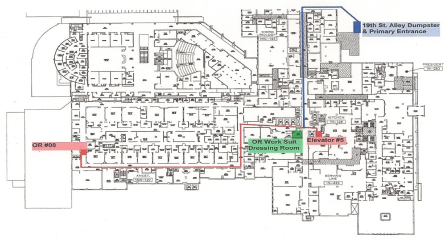
Surgical Cover

Shoe Cover

Bunny Suit

Booties

## Control construction traffic flow




## The bootie dilemma

- Wear booties in the work area only

  OR

- Wear booties outside of the work area (walking through hospital)

  OR

- Wear booties in both locations, changing each time worker exits work area

## Summary: Controls along the traffic route

- Designated traffic routes– patients, staff & construction crew
- Contractor or EVS cleans traffic route
- Movement of construction materials
  - Clean carts / covered materials
- Removal of waste materials
  - Clean carts out of work zone & into facility
- Bunny suits and shoe covers
- Vacuum personnel clothing

## Interrupt the Transmission Pathway

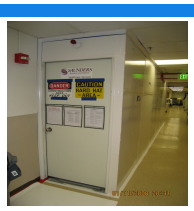

## Source controls: Containment Barriers

- Design and placement of containment barriers
  - Directional airflow
  - Pressure differentials
  - Entry & Exit protocols
  - Adhesive mats
  - Dust suppression
  - HEPA filtered equipment

## Source controls: Containment barriers – 3 main types

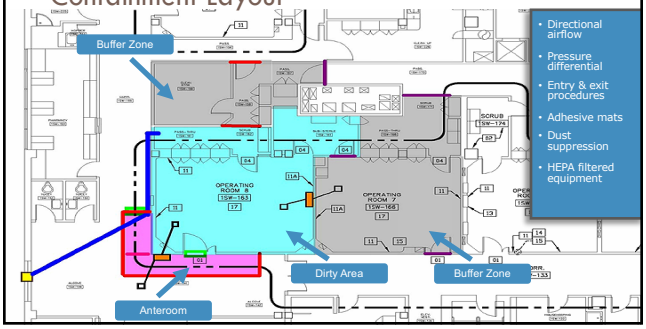
Environmental containment unit (ECU)

Non-rigid containment barrier

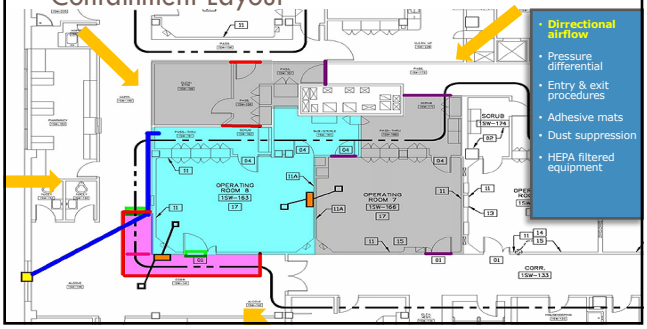


Rigid containment barrier

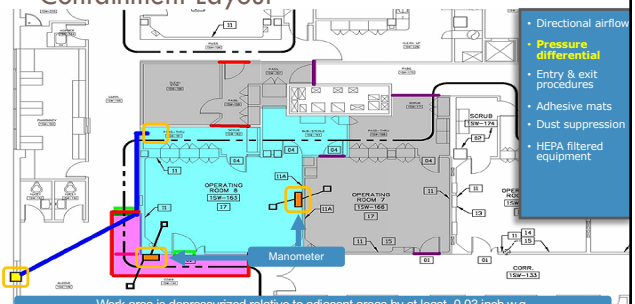
## Containment Layout




## Containment Layout

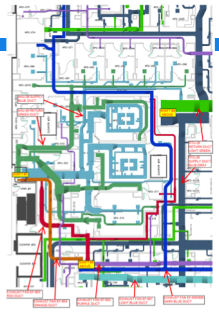


## Containment Layout



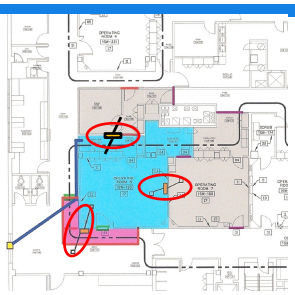

## Manometer placement

- Review HVAC drawings
- Understand design pressure differentials
- Determine all pressure relationships that surround the construction containment

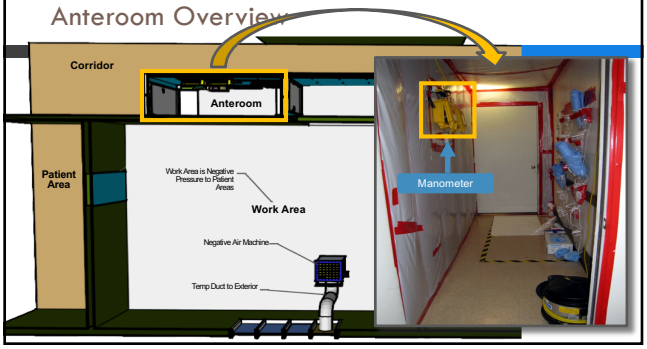


## Manometer placement

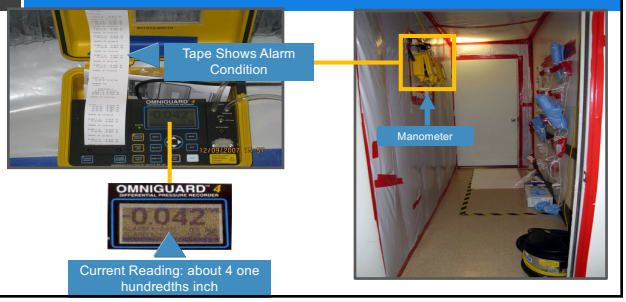
3 pressure relationships requires 3 manometers

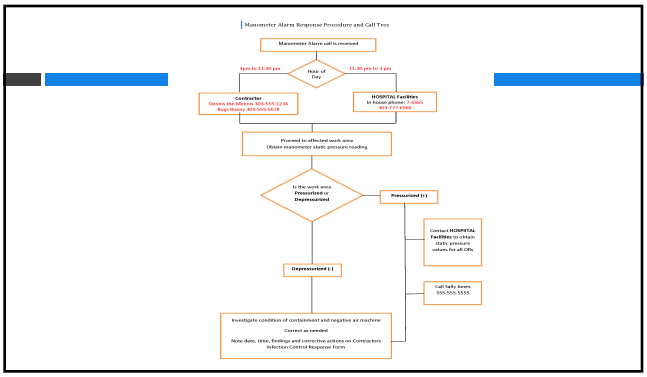


## Anteroom Overview




## Reading the Manometer



## Break – 10 minutes

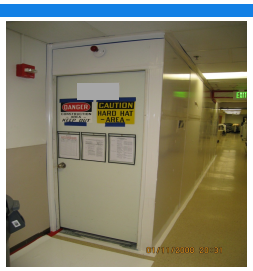
## Entry and Exit Procedures

- Vacuum work clothing
- Wear appropriate clean clothing
- Clean equipment
- Cover equipment
- Walk over tacky mats

- Directional airflow
- Pressure differential
- **Entry & exit procedures**
- Adhesive mats
- Dust suppression
- HEPA filtered equipment

## Containment Postings

- Posted at work area
- Contact information
  - Name
  - Office phone
  - Cell phone
  - Affiliation
- Facility required signage




## Dust suppression within containment

Clean Job Site

Wet Controls With Vacuum

- Directional airflow
- Pressure differential
- Entry & exit procedures
- Adhesive mats
- **Dust suppressior**
- HEPA filtered equipment

## Tackymat

**Incorrect**: Pulled

**Correct:** Tightly Rolled

## Class Exercise: Hazards and Controls

Problem: Central Sterile Supply (Sterile Processing, SPD) humidity is to low.

Solution: Install a duct humidifier downstream of the Reheat Coil (RHC)

| Contaminant Source | Transmission | Controls |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

## ICRA Exercise

Problem: Central Sterile Supply (Sterile Processing, SPD) humidity is to low.

Solution: Install a duct humidifier downstream of the Reheat Coil (RHC)

## Sequence to build containments

1. Do your math – how does blocking SA, RA, EX affect system balance?
2. Depressurize the space by isolating SA
3. Filter RA – MERV 8
4. Build containment walls and anteroom
5. Place tacky mats
6. Install micromanometers

## Sequence to build containments

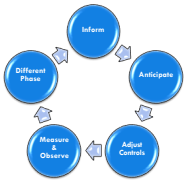
6. Install HEPA filtered negative air machines (isolate RA)
7. Collect pressure measurements in adjacent rooms
8. Install above ceiling sheeting – monitor pressures with ceiling open
9. Perform IP inspection

## The IP inspection

- Check pressure measurements under all conditions
  - Open ceiling
  - Holes in walls
  - Core drill holes in floors
- Will require multiple inspections throughout the project

## IP & Construction Superintendent must work together!

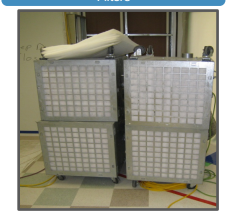

- Pressure conditions will change as project moves through phases




## Break 10 minutes

## HEPA Filters

Negative Air Machines With HEPA Filters

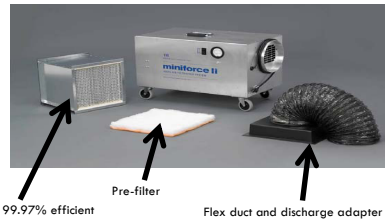


Vacuums in Anterooms Use HEPA Filters

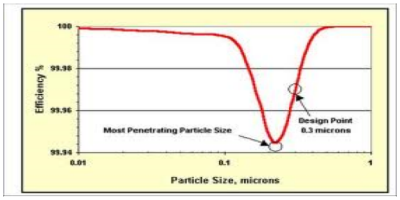
- Directional airflow
- Pressure differential
- Entry & exit procedures
- Adhesive mats
- Dust suppression
- **HEPA filtered equipment**

HEPA filter – 99.97% efficient

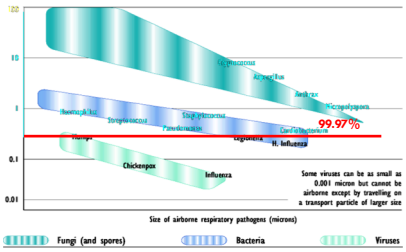
## Negative air machine with High Efficiency Particulate Air (HEPA) filter



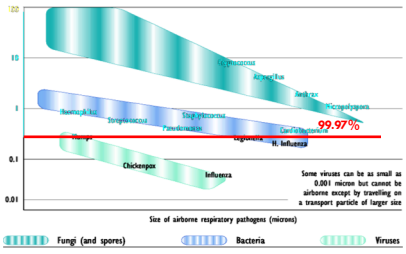

## HEPA filtration efficiency (MERV 17)



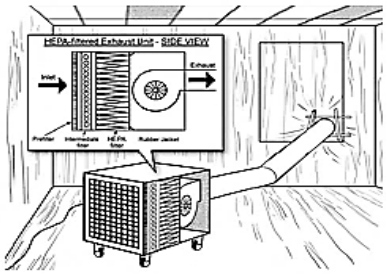

## MERV 17 (HEPA) Filtration




## MERV 17 (HEPA) Filtration




## NAM schematic

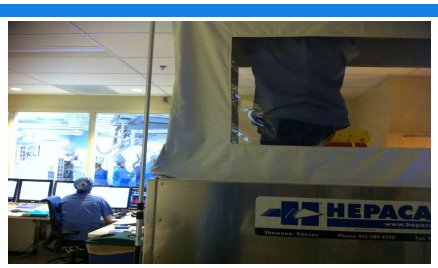


## Negative air machine inspection

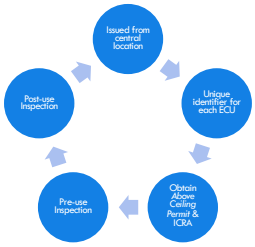

## Negative air machine cleaning


## Negative air machine storage


## The environmental containment unit (ECU)




## ECU Issuing, Monitoring, Maintenance




## Exercise: ECU Handout

## BREAK TIME – 10 MINUTES

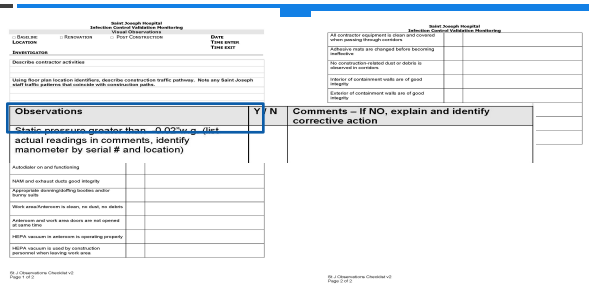
## Inspections
## Visual validation of infection controls

- Clean clothing - vacuuming
- Controlled traffic patterns
- Wet-wiping carts
- Double-bagged waste
- Adhesive floor mats
- Dust suppression methods
- No access to elevators with patients
- Daily, weekly and monthly inspections

## Use the buddy system!

Keep the patients safe while you keep each other safe!

## Inspections
## Visual validation of infection controls



Saint Joseph Hospital
Infection Control Validation Monitoring
Visual Observations

Observations | Y | N | Comments – If NO, explain and identify corrective action

Saint Joseph Hospital
Infection Control Validation Monitoring

## Inspections
## Numeric validation of infection controls

- Directional airflow
- Pressure differentials
- Environmental monitoring
  - Particle counts
  - Bioaerosols – fungi
  - Water quality

Write down this information – keep in a safe and secure location and easily retrievable

## Review: What is Infection Control?

- Systematic process that reduces the risk of infection to patients during construction projects
  - A. Infection Control Risk Assessment (ICRA)
  - B. ICRA Permit
    - Identifies infection controls for the task
  - C. Infection Control Plan
    - Details on how the infection controls will be implemented

## Infection Control Plan (ICP)

- Written documents that detail the infection controls for the project
  - ICRA Permit & attachments
  - Floor plans
  - Waste removal methods
  - Cleaning requirements
  - Clothing requirements
  - List of emergency personnel
  - Required signage
  - HEPA equip inspections

## Infection Control Plan

- Manometer calibration requirements and methods
- Auto-dialer installation and program methods
- Auto-dialer contact list
- Response to manometer alarms
- Documentation of manometer readings
- Clean-duct protocols

## Infection Control Plan

- Construction area entry during non-work hours
- Construction cleaning requirements
- Infection control inspections and corrective actions
- Bringing building systems back on-line

- Turnover sequence and responsibilities
- Infection Control Commissioning

## Returning the space back to the facility - Two levels of cleaning

**Construction cleaning before barrier removal**

Remove all dust and debris. Surfaces will be visibly clean.

**Facility Terminal Clean**

Disinfect all surfaces

## Infection Control Commissioning

Verification that newly renovated or constructed patient care areas meet infection prevention design criteria

- ✓ Visual inspections
- ✓ Pressure differential measurements
- ✓ Air quality monitoring
- ✓ Water quality monitoring

## Infection Control Commissioning

- Rooms meet ACH design criteria
- Space meets design pressure relationships
- AHU and/or point of use filtration efficiency
- EVS Terminal cleaning efficiency
- Water Quality and Air Quality

## Infection Control Commissioning

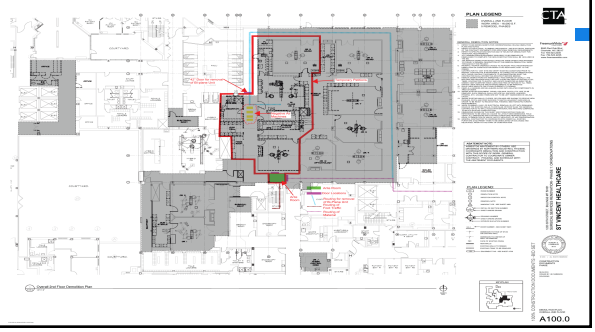
- Review Document

## Air Sampling – Decisions to be made before sample collection

- What is baseline? What is acceptance criteria?
- What is the sampling methodology?
- Where to sample?
- How many samples to collect?
- When to sample?

- How to interpret sample results
  - Compare to baseline?
  - Compare to another standard?

## Air sampling strategy




## How to address sample results

| Acceptable | Unacceptable |
|---|---|
| Communication | Communication |
| Written documentation | Who |
| | Patient safety |
| | Investigation |
| | Corrective actions |
| | Repeat air sampling |

## Water systems back on-line

- Flush-Disinfect-Flush
  - Thermal eradication
  - Hyperchlorination
  - Copper-silver ionization
  - Point-of-use filters
  - Chlorine dioxide
- Water Sampling Analyses
  - Legionella
  - Heterotrophic plate count (HPC)
  - Fecal coliform / *E. coli*
- When to sample
- What sinks to sample

The need for water quality testing should be determined in the planning phase.

Timing of disinfection and water flushing must be discussed!

TURNOVER SEQUENCE for Medium/Low Risk Areas
STEP-BY-STEP PROCEDURE

| Step | Date/Time Start | Date/Time Complete | Description | Action By | Completed |
|---|---|---|---|---|---|
| 1 | | | Plumbing tie-ins complete; plumbing disinfection performed | MEP | |
| 2 | | | Daily water flush | GC | |
| 3 | | | All supply and return air grills are securely covered. HEPA filtered negative air is still depressurizing the work area. | GC | |
| 4 | | | Perform and complete a detailed construction clean – remove dust and debris from ALL surfaces | GC | |
| 5 | | | Infection Prevention inspection | IP | |
| 6 | | | EVS performs a triple terminal clean | EVS | |
| 7 | | | Infection prevention inspection | IP | |
| 8 | | | Barriers are removed, negative air machines off, plastic over supply and return grills is removed. | GC | |
| 9 | | | EVS performs terminal clean. | EVS | |
| 10 | | | Testing, adjusting and balancing can occur. ICRA needed for access above the ceiling. | MEP | |
| 11 | | | EVS performs daily terminal clean each day to the date of first patient occupancy | EVS | |
| 12 | | | TAB and Commissioning complete | GC | |
| 13 | | | CO awarded | GC | |
| 14 | | | Daily water flush to the date of first patient occupancy | EVS | |

TURNOVER SEQUENCE for Operating Rooms
STEP-BY-STEP PROCEDURE

| Step | Date/Time Start | Date/Time Complete | Description | Action By | Completed |
|---|---|---|---|---|---|
| 1 | | | Plumbing tie-ins complete; plumbing disinfection performed | MEP | |
| 2 | | | Daily water flush | GC | |
| 3 | | | All supply and return air grills are securely covered. HEPA filtered negative air is still depressurizing the work area. | GC | |
| 4 | | | Perform and complete a detailed construction clean – remove dust and debris from ALL surfaces | GC | |
| 5 | | | Infection Prevention inspection | IP | |
| 6 | | | EVS performs a triple terminal clean | EVS | |
| 7 | | | Clean AHU, install new pre and final filters | | |
| 8 | | | Infection Prevention inspection of AHU and supply air diffusers in OR – after completion of final filter installation | IP | |
| 9 | | | Conditioned supply air on; work area depressurized using construction exhaust; return air grills filtered; return air exhausted at the AHU | GC | |
| 10 | | | GE install equipment with access to above ceiling | Vendor | |
| 11 | | | GE out of ceiling | Vendor | |
| 12 | | | EVS terminal clean followed by daily terminal cleaning to the date of first patient occupancy | EVS | |
| 13 | | | IP inspection of AHU, supply air diffusers and all work area | IP | |
| 14 | | | Particle counting monitoring and viable samples in all work areas – if acceptable, perform terminal clean and remove barriers (return air functional/exhaust air removed) | IP | |
| 15 | | | EVS to perform terminal clean after barriers down | EVS | |
| 16 | | | Testing, adjusting and balancing can occur. ICRA needed for access above the ceiling. | MEP | |
| 17 | | | TAB and Commissioning complete | GC | |
| 18 | | | CO awarded | GC | |
| 19 | | | Daily water flush to the date of first patient occupancy | EVS | |

## Water release and damage plan

- Roof leaks
- Sewage back-up
- Pipe damage
- Groundwater infiltration
- Fire sprinkler release

In the planning phase of the project, identify potential sources or activities that may cause a water loss. Prepare controls in advance.

## Responding to the water loss

- Inclination is to respond speedily – NO!
- Response should be systematic & controlled
  - Follow the facility's plan & involve infection control personnel
  - Keep a handle on remediation subcontractors
  - Determine if your insurance company should be contacted

## Water release and damage plan

- Comply with facility policy
- Remediation variables
  - Potable water v. gray water v. black water
  - Porous verses non-porous materials
  - Time that has passed before materials are dry
  - Use of in-house industrial hygienist or third party (independent) industrial hygienist

## The clean & quick flood cut

## Questions

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