Critical Elements of Containment and Ventilation Practice for Healthcare Microbial Remediation

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Background

When conducted in healthcare facilities, construction and microbial remediation present health risks:

- susceptible patients
- hospital staff
- contractor employees
Background – Cont’d

Well documented & recognized

- CDC
- OSHA
- EPA
- AIHA
- IICRC
- IOM
HEPA filtered “negative pressure” containment:

- limit spread of bacteria, fungal elements, odors, and dust
- limit impact, risk of infection, other potential adverse health affects
- exhausted directly to the outdoors
Topics

- Types of containments and ventilation
- Appropriate use of Local HEPA ventilation (scrubbing)
- Importance of structural hygiene outside of containment
Impact of “negative pressure” exhaust on existing HVAC systems

Criteria for evaluation of effective containment

Case study using a novel, multi-chambered HEPA filtered exhaust system
Terms used

- Remediation
  - correcting a fault
  - return structural elements to initial condition or better

- IICRC Condition 1
  - International Institute of Cleaning and Restoration Certification
  - “Indoor environment which is primarily contaminated with settled spores, fungal fragments or traces of actual growth whose identity, location and quantity are reflective of a normal fungal ecology for a similar indoor environment”

- ICRA
  - Infection control risk assessment - CDC
Who Are Susceptible Patients?

- Immunosuppressive therapy patients
- Immuno-deficient
- Premature
- Severe underlying illness
- Open wounds or surgery
What is a Containment?

- Any physical barrier that is intended to limit contamination
- Can be simple (drop cloth)
- Or complex (full containment)
Containment - 2

- Separation of addition from existing construction
  - May simply use exterior walls
  - Need to ensure occupied space is positive relative to new work
  - Need to ensure dust/debris is not entrained

- Cabling
  - Portable systems
  - Use HEPA vacuum
Containment - 3
Containment - 4

Negative Air Machine

Decontamination Chamber
**Full Containment**

- **Should include:**
  - **Isolation (Critical) Barriers**
    - Short term – 2 fire retardant poly layers
    - Long term – hard walls with sealed seams & inside lined with poly
  - **Personnel Decontamination Unit**
    - 1 or 2 stage
  - **HEPA Filtered Negative Air**
    - –0.02” w.g. & 4 ACH
Local HEPA ventilation

- Scrubbing
- Small projects, short duration
- Make sure exhaust does not move debris
- Can be HEPA vacuum
- Never use fans without HEPA
Structural Hygiene/
Infection Control

- Relocate high risk patients
- Work off hours
- Mop or HEPA vacuum exterior surfaces
- Seal and clean all materials before movement through hospital
- Limit travel to low risk areas
- Restrict entry to containment
Limit use of existing HVAC systems for negative pressure exhaust

Seal supplies and returns

Decontaminate people and articles

Transport bagged debris in sealed cart after cleaning

Constant contractor monitoring and communication
Negative Pressure Considerations

- Impact Existing HVAC Systems?
  - Depends on size and pressure
- Can change throughout day
  - Prevailing winds, heat loads, etc.
- Check balance after supplies and returns sealed and dampers shut
Negative Pressure - 2

- Over-pressure on existing system can cause backflow in branches
- HEPA devices
  - New
  - Clean
  - Verify function – filters, seals, flow rates, particle counts
  - Seal before removal
Negative Pressure v. Positive Pressure

- OR, Bone Marrow, other positive pressure isolation to protect patients
- Free supply air?
- May require excess negative capacity
- Could modify airflow in corridor
- Generally should increase positive into other areas, but caution in reversing pressure relationship to areas intended to be negative (e.g. corridor)
Make-up Air

- Enough negative pressure could change pressure relationship
- Bone Marrow Transplant
Evaluating the Containment

- Visual
  - No penetrations
  - HEPA intake away from decon
  - Contents sealed

- Particulates
  - Before and during

- Smoke
  - Ensure entrainment
Evaluating the Containment - 2

- **Manometer**
  - Sufficient number
  - Proper location of ports (not decon, represent the space relative to)
  - -0.02” w.g. to -0.03” w.g.
  - More than that will destroy containment
  - Less may not work and does not allow for variability
Remediation in an OR

- Large Hospital
- 20 Operating Rooms, Recovery Area (PACU), Holding Area, Sterile Storage
- Below Grade
- Category III Water Intrusion
Conditions and Limitations

- No major operations interruptions
- Remediation only after hours on weekend
- Known previous microbial contamination
- Could not run through clean areas
- Remediation would take weeks
Fungal Growth on Interior of Wall
Fungal Growth on Interior of Wall
Considerations for Using Serial Filtration Enclosures

- Contractor must be competent
- Risk of other options MUST outweigh risk of exhausting indoors
- Communicate risks to Hospital
- Good insurance
Serial Filtration Enclosure
Serial Filtration Enclosure

- At exhaust ~2500 cfm
- Ideal configuration - 2 chambers
  - 5 feet X ~6 feet X 5 feet
  - Box 2 was 5 to 10 ft³ less than Box 1
- Two layer poly with steel support
- Flexible connecting ductwork
- Match HEPA’s & same circuit
Affected Area
Core Through Deck
Exhaust into Chamber 1
Serial Filtration Enclosure
First Chamber
First Chamber
Second Chamber
Results

- **Critical particle sizes (0.5 to 5.0 um)**
  - Differential – 4, 2, 1, 1, 0
  - Primarily due to entrainment from background
- **Exhaust and 1st Chamber not greatly different**
- **Marked reduction in exhausted particulate compared to Mechanical Room, OR, and PACU**
Average Particulate Concentrations

Ave. Particulate Counts (Differential)

Particle Size (um)

Particle Concentration (x10^4)

Exhaust
Chamber
Mechanical Room - Near
Mechanical Room - Far
PACU
Sub-sterile Corridor
Contact Information

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