Ventilation for Energy Management and Infection Prevention

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Hosted by Dr. Lynne Sehulster
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- 38 years service at U of Minnesota infection prevention.
- Visited over 400 hospitals & assisted in IAQ infection issues.
- Technical expert for ASHRAE, CDC, FGI & other organizations.
- Goal to provide evidence based training for prevention of infections during construction & maintenance practice.
- Provide guidance for infectious disease prevention design concepts.

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Why is energy important to infectious disease management?

- Mermazadeh and Xu 2012 recommend site specific risk analysis because increasing or decreasing the room air exchange rate by as little as one air change per hour can result in a difference of $150-250 per year in heating and cooling costs for that room.

Dr. Mermazadeh is the Director of Technical Services NIH.

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Electrical Usage at Typical Hospital

Process	Consumption %	Dollars $	Rank
Lighting	14	$198,800	4
Misc. Electrical	15	$213,000	3
Outdoor Air Cooling	5	$71,000	7
Space Cooling	17	$241,400	2
Fan Heat/Losses	5	$71,000	7
Cooling Tower/Cond. Pumps	9	$127,800	5
CW & HW Pumps	6	$85,200	6
Ventilation Fans	24	$340,800	1
Heating Auxiliaries	5	$71,000	7

An electric energy usage profile for a hospital in Houston (500,000 SF X $2.84/SF electric = $1,420,000/year utility cost).

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Gas Consumption in a Typical Hospital

Process	Consumption %	Dollars $	Rank
Outdoor-Air Heating	7	$32,900	3
Reheat	65	$305,500	1
Space Heating	15	$70,500	2
DHW Heating	3	$14,100	5
Dietary/Sterilizers	5	$23,500	4
Distribution Losses	5	$23,500	4

A thermal energy usage profile for a hospital in Houston (500,000 SF X $0.94/SF gas = $470,000/year utility cost).

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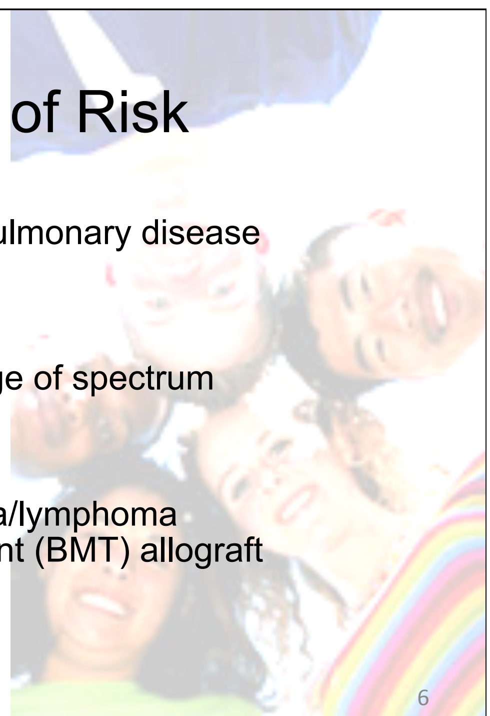
Levels of Risk



Healthy person
- Chronic obstructive pulmonary disease
- Diabetes
- Steroids
- Cancer - solid tumor
- HIV infection-end stage of spectrum
- Organ transplant
  - Kidney/heart
  - Lung/liver
- Malignancy - leukemia/lymphoma
  Bone marrow transplant (BMT) allograft

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What Drives High Energy Use in Healthcare Facilities

- Ventilation
  - -High Efficiency Filters
    - +90 to 99.97% efficiency
- Indoor Air Quality Standards
  - -12 to 20 room air exchanges per hour
  - -waste anesthetic gas, heat, electro-cautery smoke
  - -microbial shedding and surgical aerosols (no standards)
- Airborne Infection, Protective Rooms, ICU's and Surgery
  - -high air exchanges for heat and aerosol control some recirculate
  - -exhaust from airborne isolation rooms
- IAQ control for temperature, humidity, minimum outdoor air
- Domestic water temperatures
- Laboratory equipment
- Therapeutic and Diagnostic equipment
- 24/7/365 100% ready days with emergency backup

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Incidence of Healthcare Associated Infections (HAI), U.S. 2011-2012

Annual morbidity: 721,800 – Decrease from 1.7 million estimated in 2002 (NEJM, 2014)

- 1 in every 25 inpatients has at least 1 HAI
- Most common: Pneumonia and surgical site infection
- Most frequent organism: Clostridium difficile

Annual mortality: 100,000 estimated in 2002 (Klevens, Public Health Reports, 2002)

Direct costs associated with HAI: $28.4-$45 Billion (Scott, CDC Paper, 2012)

Incidence associated with construction unknown; multiple outbreak papers published

Major Site of Infection	Estimated No.
Pneumonia	157,500
Gastrointestinal Illness	123,100
Urinary Tract Infections	93,300
Primary Bloodstream Infections	71,900
Surgical site infections from any inpatient surgery	157,500
Other types of infections	118,500
Estimated total number of infections in hospitals	**721,800**

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Factors Involved in the Spread of Infectious Diseases

- Droplet nuclei transmission dynamics
- Nature of dust levels
- Health & condition of individual's nasopharyngeal mucosal lining
- Population density in a particular location
- Ventilation of the location

Standard Precautions Against Disease Transmission

- Early identification of microbes
- Development of appropriate SOPs
- Use of PPE including:
  - Masks & gloves
  - Disinfection strategies
  - Vaccination
  - Appropriate ventilation design

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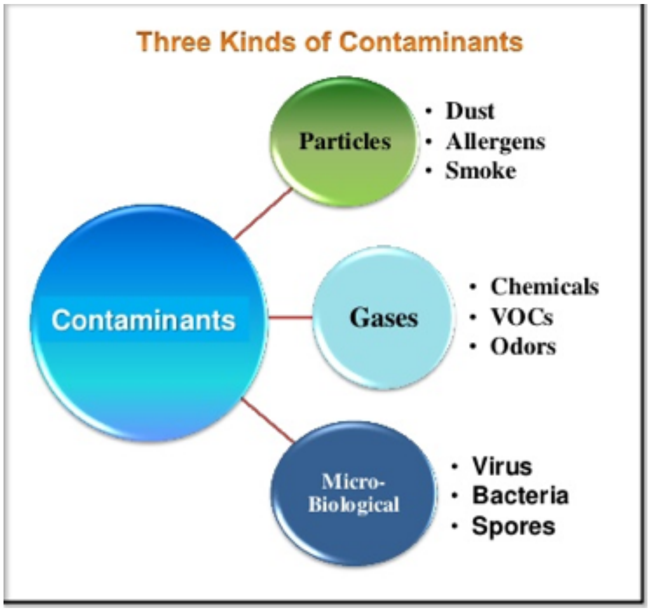
Indoor Air Quality



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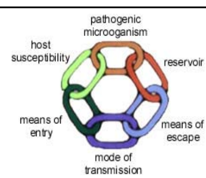

Organisms Associated with Airborne Transmission

	Fungi	Bacteria	Viruses
Numerous reports in HCF	Aspergillus spp. Mucorales	M. tuberculosis	Measles virus Varicella-zoster virus
Atypical, occasional reports	Acremonium spp. Fusarium spp Pseudoallescheria boydii Scedosprorium spp. Sporothrix cyanescens	Acinetobacter spp. Bacillus spp. Brucella spp. Staphylococcus aureus Group A. Streptococcus	Smallpox virus Influenza viruses Respiratory syncytial virus Adenoviruses Norwalk-like virus
Airborne in nature; airborne transmission in HCF not described	Coccidioides immitis Cryptococcus spp. Histoplasma capsulatum	Coxiella burnetti (Q fever)	Hantaviruses Lassa virus Marburg virus Ebola virus Crimean-Congo Virus

CDC Guideline for Environmental Infection Control Guidelines 2003

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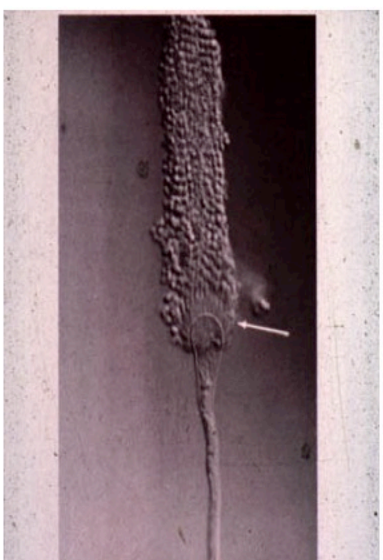
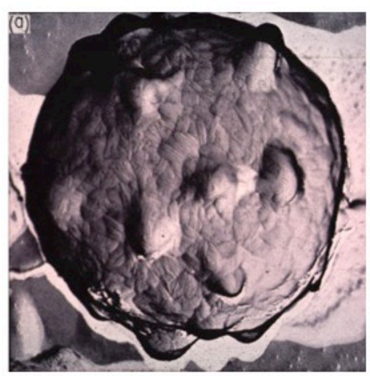


Fig. 1.15 *Aspergillus fumigatus.* The hyphalike conidiophore has expanded to form a vesicle at its apex. Upon the vesicle, a row of flask-shaped conidiogenous cells (arrow) are proliferating chains of conidia. The conidiophore and the conidiogenous cells are different. (Reproduced by permission from *Southern Medical Journal* 70:886–888, 1977.)

Aspergillus fumigatus
- prolific spore production



Aerodynamic spore
2-4µm diameter

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Recent examples of the frequency of invasive aspergillosis

Underlying condition	Incidence	Reference/year
Acute myeloid leukaemia	8%	Cornet, 2002
Acute lymphatic leukaemia	6.3%	Cornet, 2002
Allogeneic HSCT	11-15%	Grow, 2002; Marr, 2002
Lung transplantation	6.2-12.8%	Minari, 2002; Singh, 2003
Heart-lung transplantation	11%	Duchini, 2002
Small bowel tranplantation	11%	Duchini, 2002
AIDS	2.9%	Libanore, 2002

How far can Airborne Bacteria & Viruses Travel?

	Large/Small Droplets	Droplet Nuclei
1. Coughing	1-5 feet	160+ feet
2. Sneezing	8-15 feet	160+ feet
3. Singing, Talking	1-3 feet	160+ feet
4. Mouth Breathing	1-3 feet	160+ feet
5. *Diarrhea	5 feet+	160+ feet

*As a Result of Toilet Water Aerosolization and Mechanical Fan Dispersion into outdoor air (2003 Hong Kong SARS Virus Epidemic)

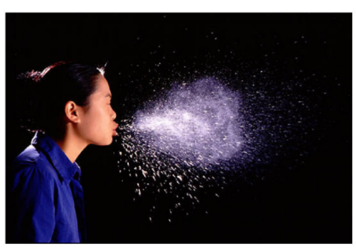

Figure 2. Particle mist created upon sneezing. (Davidhazy, 2007)

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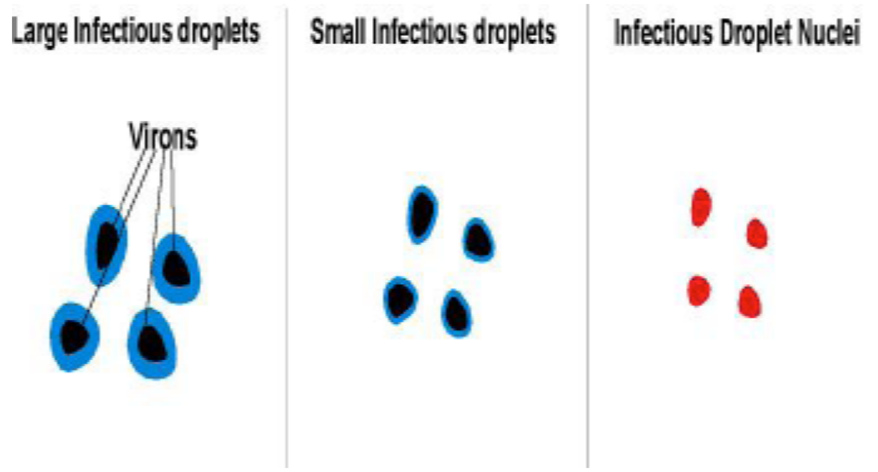
Stages of Infectious Droplets & Droplet Nuclei



1. Mucus/water encased by the infector or by toilet water. These quickly fall to the ground after traveling up to 1-3 feet.

2. Mucus/water coating starts to evaporate. These will travel 3-5 feet before falling to the ground. These droplets can become droplet nuclei.

3. Mucus/water coating has totally evaporated coating the viron particles. These are Droplet Nuclei which are so microscopic they can float in the air.

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Evaporation Time & Falling Distance of Droplets Based on Size

Diameter of Droplet (μm)	Evaporation time (sec)	Distance fallen in ft. (before evaporation)
200	5.2	21.7
100	1.3	1.4
50	0.31	0.085
25	0.08	0.0053

Adapted from: Wells, W.F., 1955, *Airborne contagion and air Hygiene,* Harvard University Press, Cambridge, Mass.

*particles discharged at 6 ft. > 140μm tend to fall to the ground

*particles discharged at 6 ft. < 140μm evaporate to **droplet nuclei**

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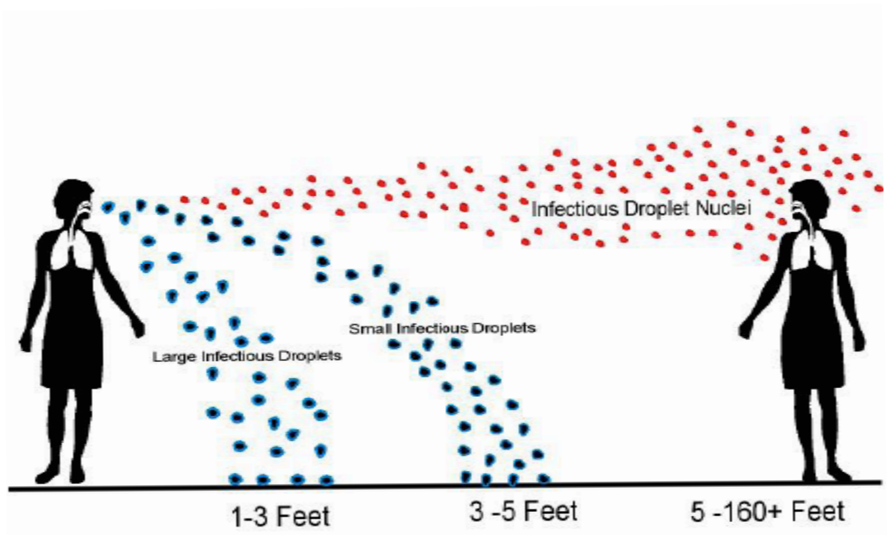
Infectious Droplets & Droplet Nuclei travel lengths



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Airborne Transmission depends on people to launch viruses into the air.

People can shed this many Flu Viruses into the air as tissue culture infecting doses (TID)

1. Coughing	3,000+ TID
2. Sneezing	3,000+ TID
3. Breathing:	Nose-None
4. Talking/Singing	1,000+ TID
5. Vomiting	1,000+ TID
6. *Diarrhea	20,000+ TID

* As a result of Toilet Water Aerosolization

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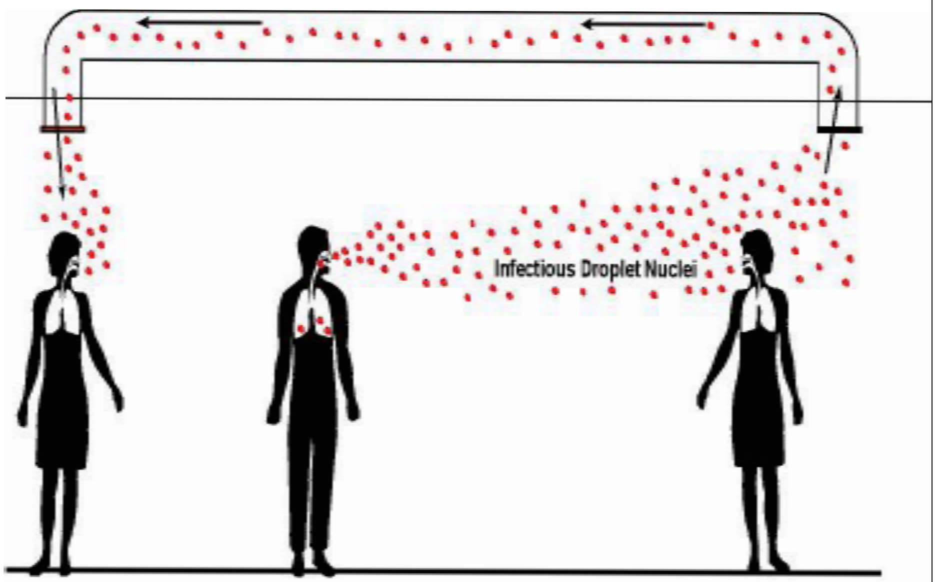
Droplet Nuclei Travel Within Buildings



In hospitals re-circulated air is filtered > 90%

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Low Indoor Humidity Increases Droplet Nuclei Levels (winter)

- Viruses Evaporate faster in Low Humidity levels thus creating **More** Droplet Nuclei.
- Low humidity allows droplet nuclei to stay airborne longer as the droplets do not absorb water weight which would cause them to fall to the ground.
- Indoor Air currents both created by HVAC systems and people movement assure that droplet nuclei will remain airborne *Indefinitely*.
- This allows HVAC systems to remove and redistribute droplet nuclei throughout the building to infect more occupants.

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There is a DIRECT correlation between low indoor humidity in winter and increases in influenza morbidity and mortality

1) Indoor humidity levels (winter) in the Northern Hemisphere especially in North America and Europe are between 15-35%.

2) Studies have proven that there is no "flu season" in the tropics where indoor humidity levels stay above 40% all year long.

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Facility Guidelines Institute

Design Parameters of Selected Areas

Function of Space	Relative Humidity %	Design Temperature °F/°C
Classes B & C Operating Rooms	20-60	68-75/20-24
Burn unit	40-60	70-75/21-24
Newborn intensive care	20-60	70-75/21-24
Patient room(s)	max 60	70-75/21-24
Protective environment room	max 60	70-75/21-24
Airborne Isolation anteroom	N/R	N/R

ASHRAE STD 170 HEALTHCARE VENTILATION 20% RH CHANGE

ASHRAE Standard 55-1992 recommends: Relative Humidity between 20% and 60%

Less than 50% RH for dust mite control

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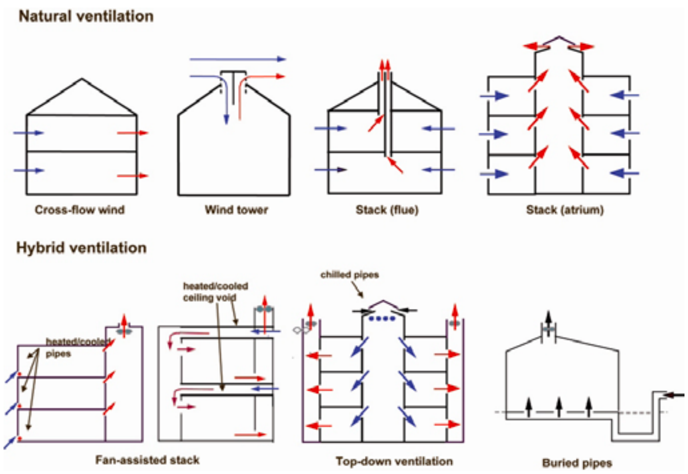

There are six basic types of natural ventilation systems:

- single-side corridor
- central corridor
- courtyard
- wind tower
- atrium and chimney
- hybrid (mixed-mode) ventilation.

World Health Organization Pub/Natural Ventilation for Infection Control in Healthcare-2009 25

4.2 Ventilation flow rate

As a rule of thumb, wind-driven natural ventilation rate through a room with two opposite openings (e.g. a window and a door) can be calculated as follows:

$$\text{ACH} = \frac{0.65 \times \text{wind speed (m/s)} \times \text{smallest opening area (m}^2) \times 3600\ \text{s/h}}{\text{room volume (m}^3)}$$

$$\text{Ventilation rate (l/s)} = 0.65 \times \text{wind speed (m/s)} \times \text{smallest opening area (m}^2) \times 1000\ \text{l/m}^3$$

Table 4.1 provides estimates of the ACH and ventilation rate due to wind alone, at a wind speed of 1 m/s, assuming a ward of size 7 m (length) × 6 m (width) × 3 m (height), with a window of 1.5 × 2 m² and a door of 1 m² × 2 m² (smallest opening).

Table 4.1 Estimated air changes per hour and ventilation rate for a 7 m × 6 m × 3 m ward

Openings	ACH	Ventilation rate (l/s)
Open window (100%) + open door	37	1300
Open window (50%) + open door	28	975
Open window (100%) + closed door	4.2	150

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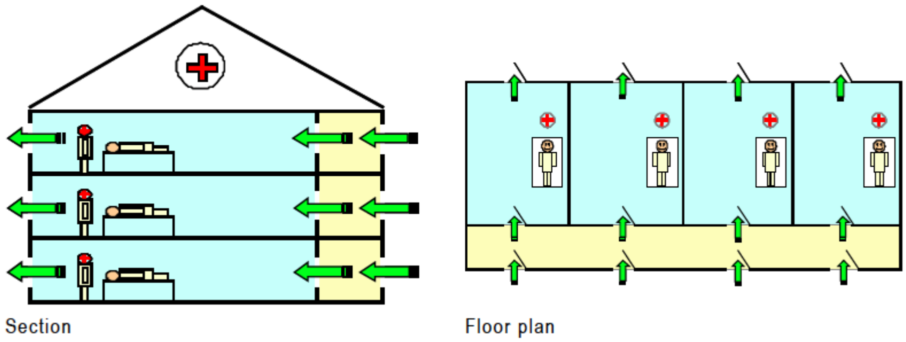

Note: This conceptual drawing should be used with care, and realistic limitations need to be considered.

Figure 5.5 **Wind-driven natural ventilation in the single-side corridor type hospital with wind entering the corridor**

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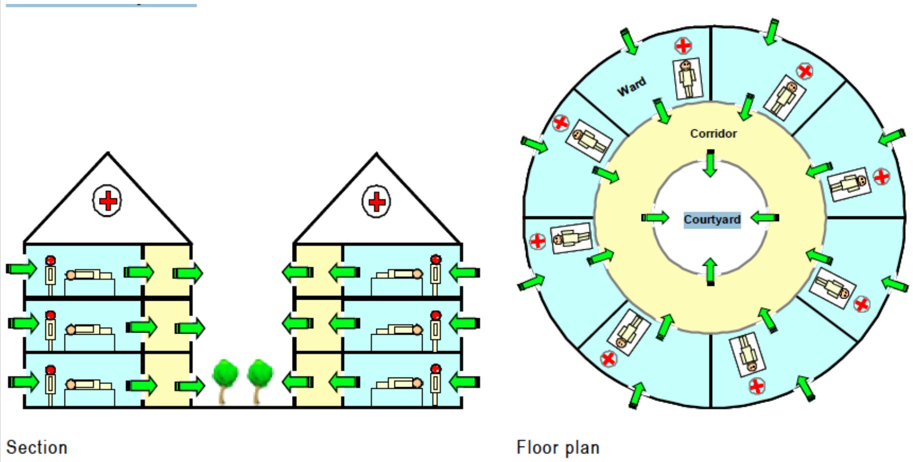

Note: This conceptual drawing should be used with care, and realistic limitations need to be considered.

Figure 5.6 **Combined wind and buoyancy-driven natural ventilation in the courtyard type (inner corridor) hospital**

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Table 5.1 Potential applicability of natural ventilation solutions in ideal conditions (consensus of a WHO systematic review)

Climate	Natural ventilation					Hybrid (mixed-mode) ventilation	Mechanical ventilation
	Single-sided corridor	Stack (atrium/ chimney)	Courtyard		Wind tower		
			Outer corridor	Inner corridor			
Hot and humid	★★	★	★★	★★	★	★★★	★★★★
Hot and dry	★★★	★	★★★	★★★	★★★	★★★★	★★★★
Moderate	★★★	★★★	★★★	★★★	★★★	★★★★	★★★★
Cold	★	★★	★	★	★	★★	★★★★

Note: The actual achievement is not always up to the potential and care must be taken with all ventilation designs in the critical setting of health-care facilities with airborne infectious agents known or expected to be present.

Applicability of natural ventilation systems

★ The performance in either thermal comfort or infection control is unsatisfactory. In terms of infection control, it means the magnitude of the ventilation rate.
★★ The performance is fair.
★★★ The performance is acceptable, but compromise may be needed in terms of thermal comfort.
★★★★ The performance is good in terms of both thermal comfort and airborne infection control.
★★★★★ The performance is very good (satisfactory) in terms of both thermal comfort and infection control.

Natural ventilation for infection control in health-care settings.

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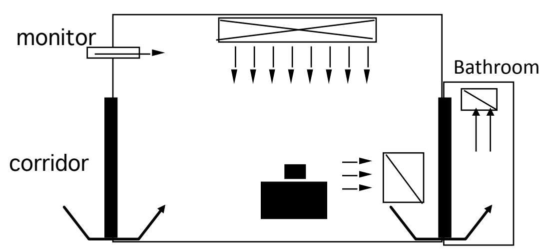
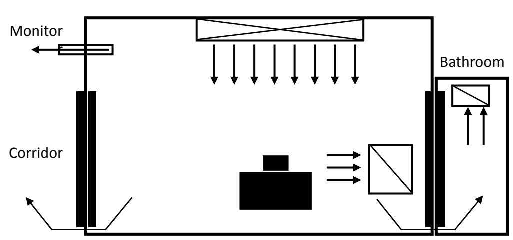
Negative Pressure Room for Airborne Infection Isolation



Positive Pressure Room for Protective Environment



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CDC EIC MMWR JUNE 6, 2003

Table 6. Engineered specifications for positive- and negative pressure rooms*

	Positive pressure areas (e.g., protective environments [PE])	Negative pressure areas (e.g., airborne infection isolation [AII])
Pressure differentials	> +2.5 Pa§ (0.01″ water gauge)	> -2.5 Pa (0.01″ water gauge)
Air changes per hour (ACH)	>12	≥12 (for renovation or new construction)
Filtration efficiency	Supply: 99.97% @ 0.3 µm DOP¶ Return: none required**	Supply: 90% (dust spot test) Return: 99.97% @ 0.3 µm DOP¶ ⊥
Room airflow direction	Out to the adjacent area	In to the room
Clean-to-dirty airflow in room	Away from the patient (high-risk patient, immunosuppressed patient)	Towards the patient (airborne disease patient)
Ideal pressure differential	> + 8 Pa	> - 2.5 Pa

* Material in this table was compiled from references 35 and 120. Table adapted from and used with permission of the publisher of reference
35 (Lippincott Williams and Wilkins).
§ Pa is the abbreviation for Pascal, a metric unit of measurement for pressure based on air velocity; 250 Pa equals 1.0 inch water gauge.
¶ DOP is the abbreviation for dioctylphthalate particles of 0.3 µm diameter.
** If the patient requires both PE and AII, return air should be HEPA-filtered or otherwise exhausted to the outside.
⊥ HEPA filtration of exhaust air from AII rooms should not be required, providing that the exhaust is properly located to prevent re-entry into
the building.

AIA & ASHRAE DESIGN GUIDELINES FOR VENTILATION

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Ventilation:

PROPOSED ENERGY EFFICIENCIES
Displacement
Chill beams
Heat wheels
Minimal leakage

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- Exterior Testing
  - Water proof
  - Air infiltration
  - Condensation
  - Cooling
  - Heating
  - Structural

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Condensation Prevention

- Dynamic Testing
  - Use pipe grid system to spray water
  - Use a propeller engine to simulate wind conditions
  - At 12 PSF for 15 minutes
  - Check for leaks

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Thermal Testing by Cooling

Thermal Testing by Heating

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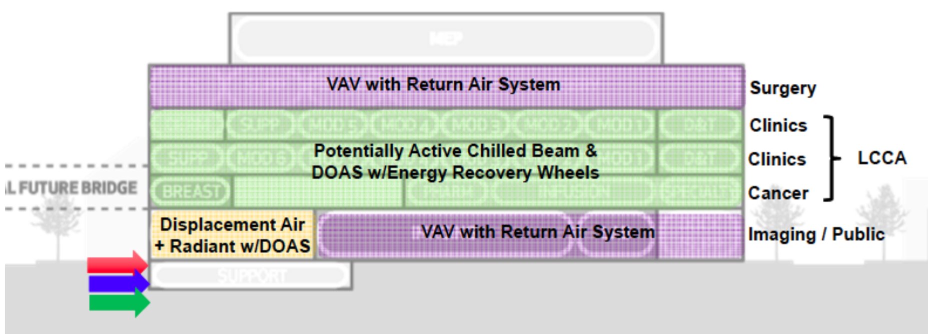
Planning for New Ambulatory Care Center University of Minnesotan Medical Center 2014



Benefits of Active Beams in Healthcare
Reduction in air handling equipment
Minimization and elimination of ductwork
Reduction in reheat
Quiet operation
Improved indoor air quality
Reduced risk of cross contamination

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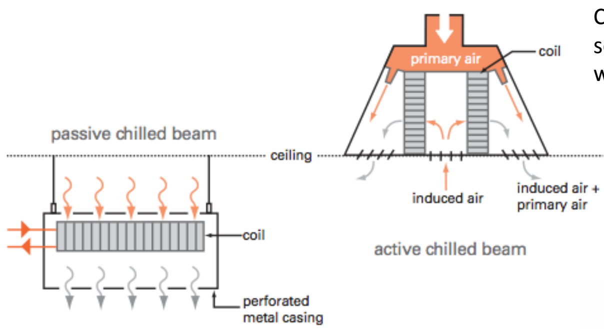
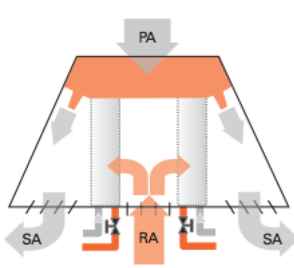
Chill beam advantage is to separate the cooling component with the air supply to save energy.





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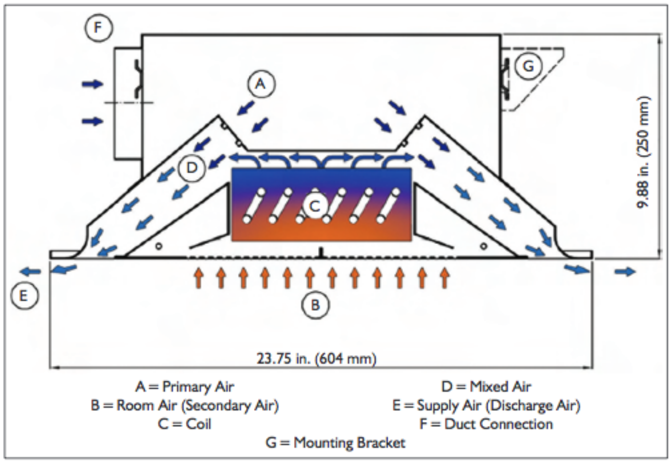

Figure 2: Schematic operation of an active chilled beam.

- Must have access for cleaning
- Must not condense on the surfaces of the chill beam
- A sealed curtain wall helps keep humidity out of the building

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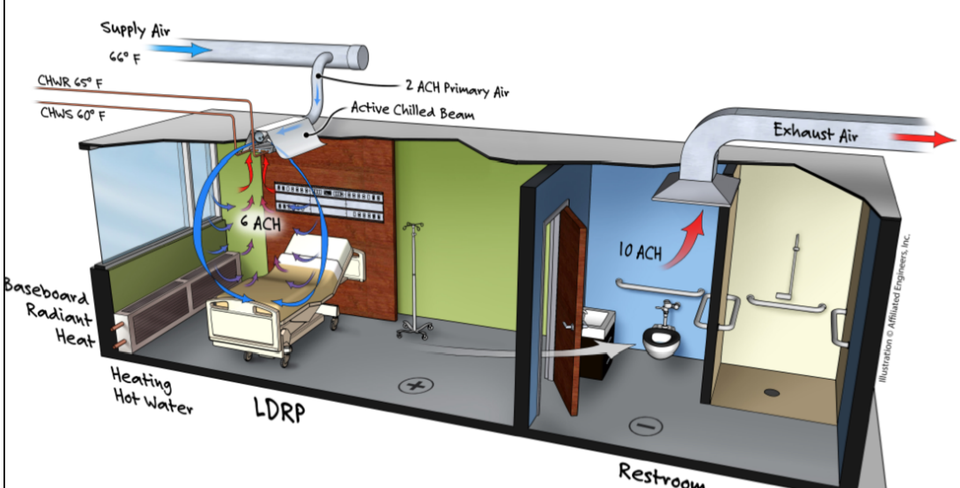

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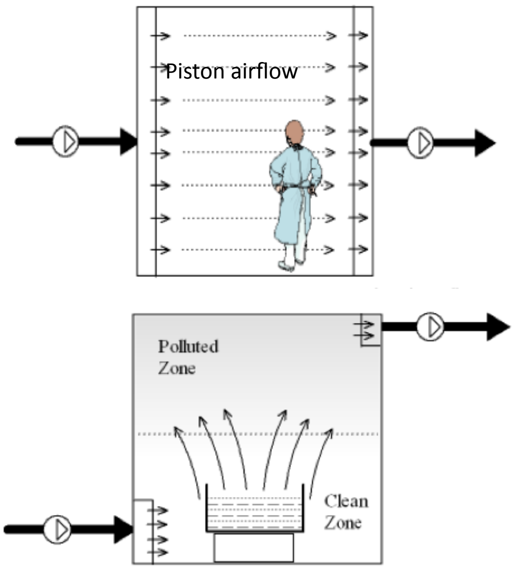
What is displacement ventilation?



Displacement like piston airflow moves air in single direction that displaces air as it moves The intent being not to mix the air but pushes is it.

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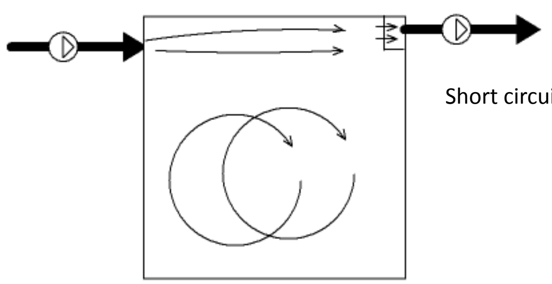
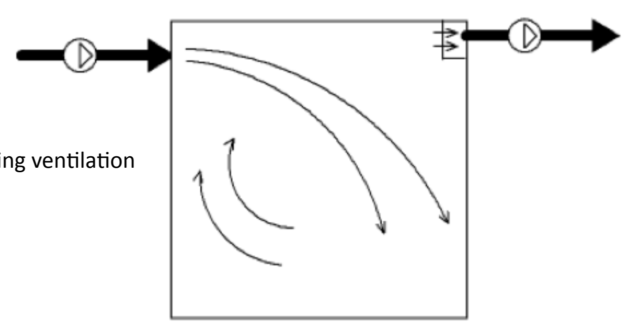
Normal Room Ventilation Conditions



Short circuiting airflow

Mixing ventilation



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The advantages of Displacement ventilation

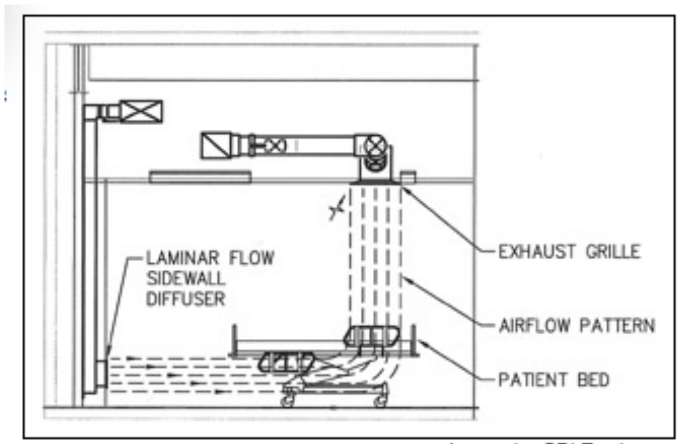

Image by CDi Engineers

In a displacement ventilation system, warmer air enters through vents near the floor, then rises and exits through exhausts in the ceiling, carrying out contaminants without mixing them into the room air.

Energy saving and moving air out of the breathing zone

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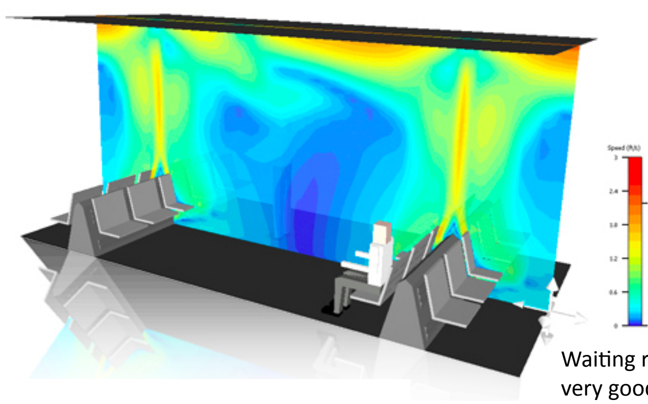

Waiting rooms and atriums are very good applications for using this kind of air delivery. DV is also common in auditoriums

Unique diffusor design allows them to be Incorporated into building structure at lower Elevations in respective rooms.

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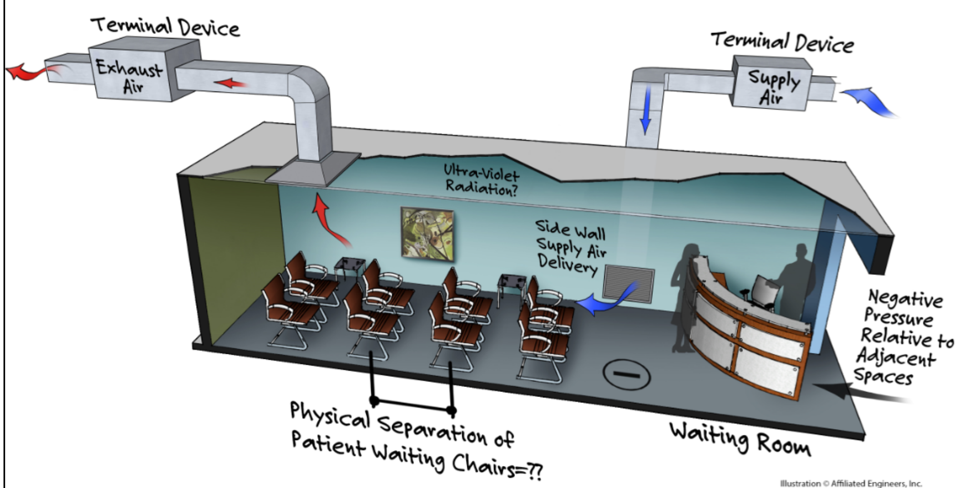

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Advantage of Displacement Ventilation for Infection Prevention and Energy Management

Infection Prevention
- -Room temps may seem warmer due to delivery temp higher.
- -Rising temp creates upward buoyancy to lift particles
- -When infectious particle above breathing zone safe?

Energy Management
- -Air delivered to room for comfort already >60F
- -Lower energy costs
- -Decrease air exchange for room by using 6 ft instead of 8 ft for calculation

Disadvantage: Difficult to find space in a patient room to deliver air low

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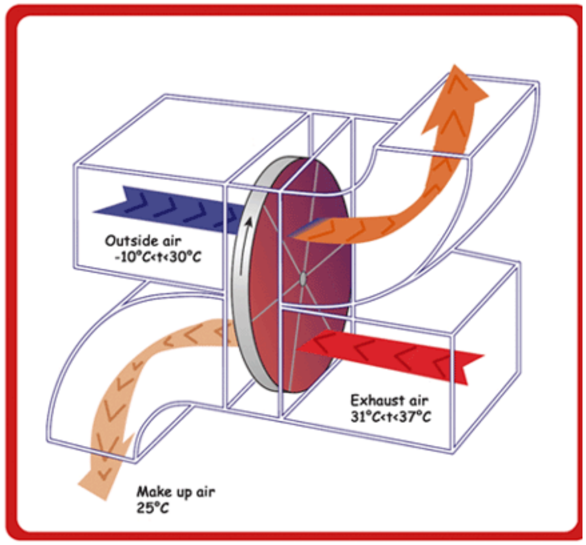
Heat Wheels can Reclaim Energy



A diagram of a rotary heat exchanger, or "heat wheel" (From Uptime Technology BV

Aware of air flow direction (clean to dirty) and need to clean the wheel

How is it maintained?

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Causes of Ventilation Deficiencies

- Plugged Filters
- Plugged Temperature Control Coils
- Duct Leakage
- Dust on Fan Blades
- Fan Belt Slippage
- Uncalibrated Control Equipment
  - Digital Controls
  - Pneumatic Controls
    - Plugged sensors

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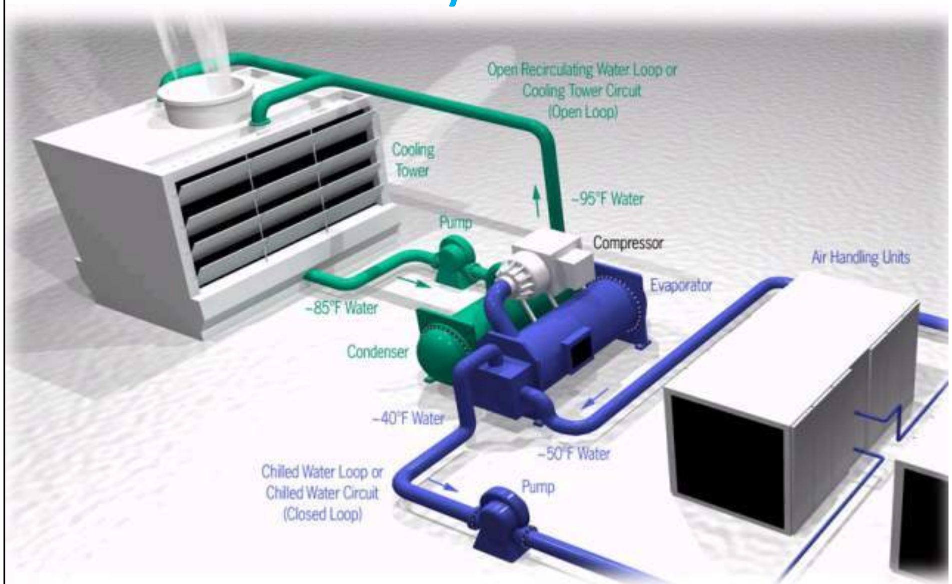
HVAC – Chilled Water System



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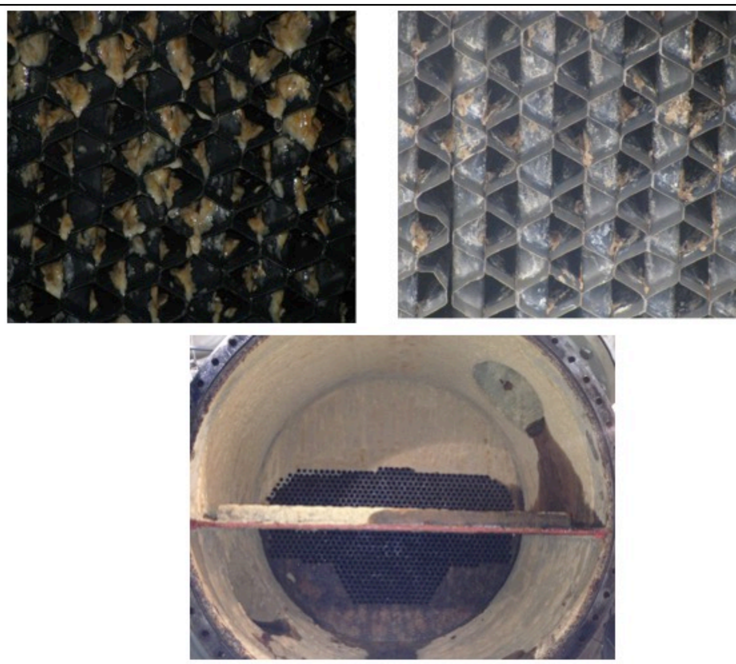

Punching the tubes and cleaning heat exchanger allows efficient energy transfer

HVAC Problems

IAQ/Odor: Risks to Distribute, Particles, Odors, Bacteria and Mold Through the Entire Facility

Biological Growth

Dirty Coils

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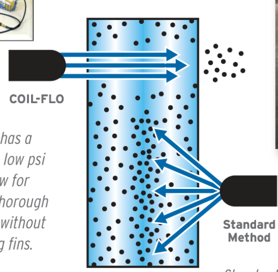
Deep Cleaning Process

Recover Coil Heat Transfer Performance

COIL-FLO versus Standard Cleaning Method

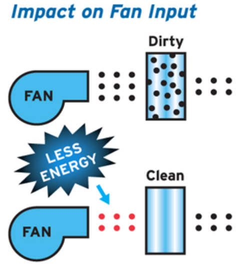


COIL-FLO has a targeted, low psi water flow for deeper, thorough cleaning without damaging fins.

Standard cleaning methods often push debris further into coils, blocking airflow.

Result: More air and cooler air

Coil Condition - Impact on Fan Input



Dirty coils create a high pressure drop, resulting in less airflow. Using variable fan speed, you get the same airflow output with less energy.

52

Dirty pre filters and final filters

DIRTY

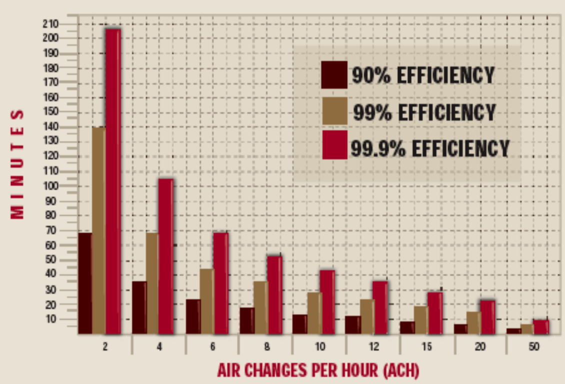
CLEAN

53

Impact of Air Flow On Room Particle Contamination

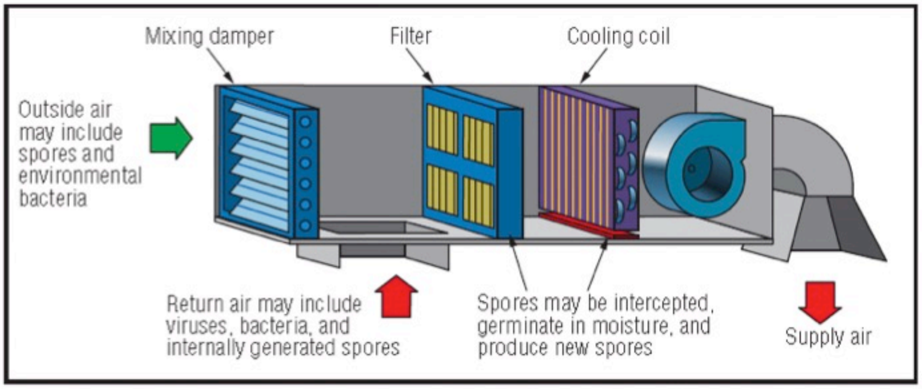
ACH	90% EFFICIENCY	99% EFFICIENCY	99.9% EFFICIENCY
2	69	138	207
4	35	69	104
6	23	46	69
8	17	35	52
10	14	28	41
12	12	23	35
15	9	18	28
20	7	14	21
50	3	6	8

Modified from Table B.1, CDC Guidelines for Environmental Infection Control in Health-Care Facilities, 2003.[5]



Perfect mixing of air is assumed. For rooms with stagnant air spaces, the time required may be much longer than shown. This is intended only as an approximation and is for ideal ventilation configurations.

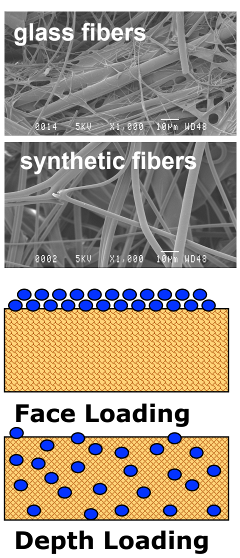
54

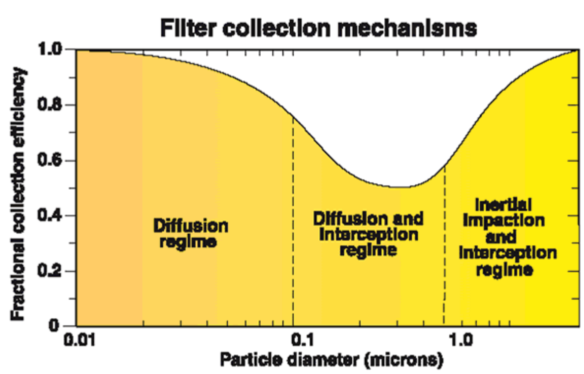


MAINTAIN

Filter Engineering Solutions

Impact of Innovative Filter Technologies





Synthetic electro static fibers may degrade quickly

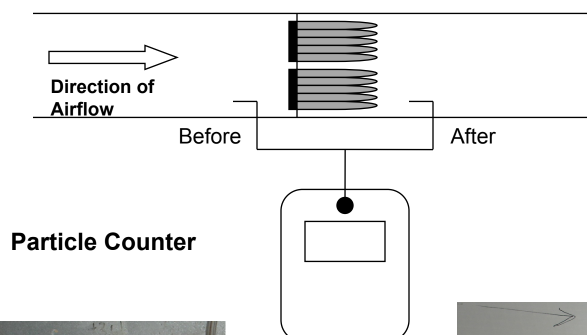
56

Reality Check!

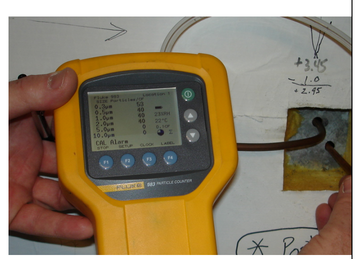
While the filter bank of bag filters looks good?

You might not be able to see it all…..
When filters oscillate they wear & tear.

Removal Efficiency In-Situ by Particle Size and Resistance to Flow



Before filter
12176 p/ft^3



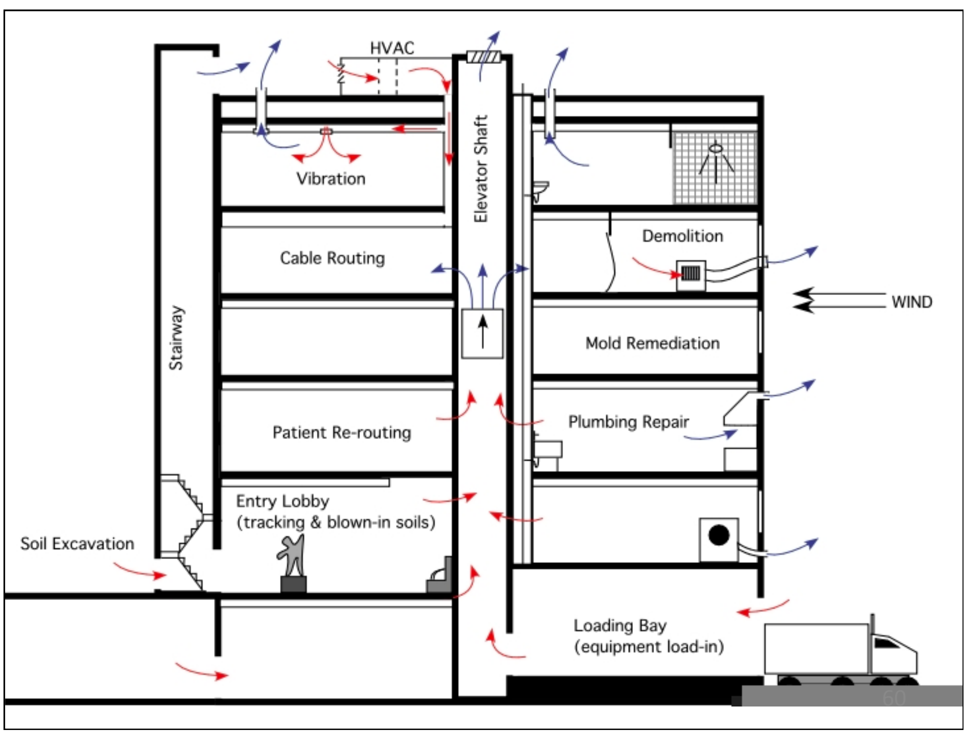
After filter
40 p/ft^3

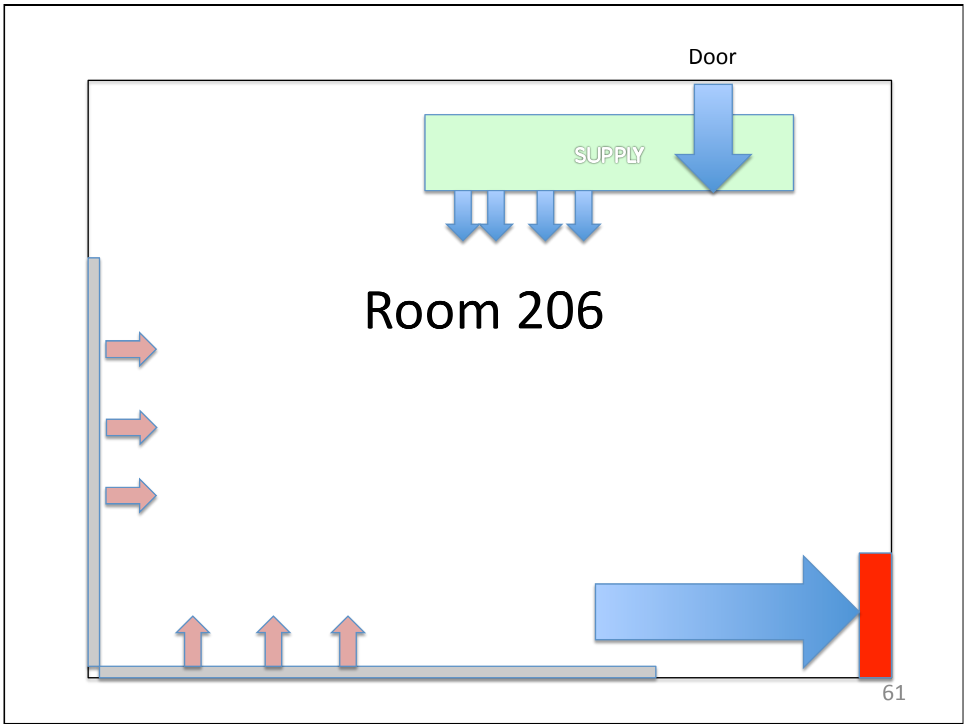
>99% reduction 58

Joint Commission Findings

Top 11 out of 20 are Building Related

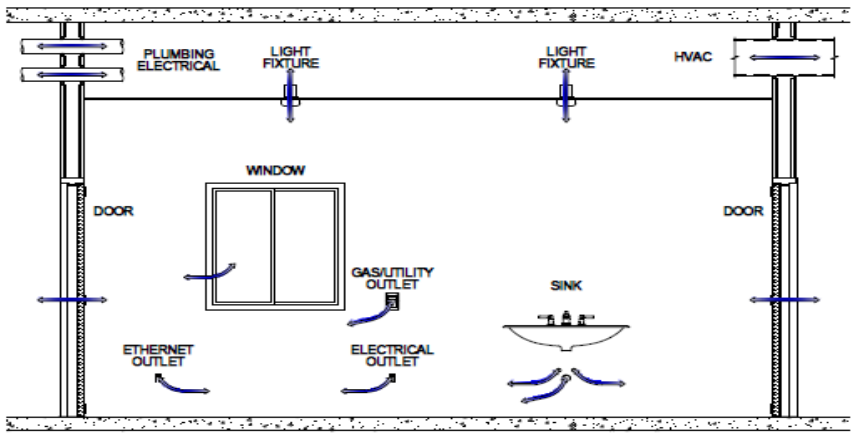
Top 20 Rank	Standard	1st Half 2012 RFIs	2011 RFIs	Subject
2	LS.02.01.20	52%	56%	Means of Egress
3	LS.02.01.10	47%	52%	General LSC Requirements
4	EC.02.03.05	40%	40%	Features of Fire Safety
7	LS.02.01.30	36%	45%	Life Safety Protection
8	LS.02.01.35	35%	31%	Fire Suppression Systems
9	EC.02.06.01	32%	29%	Built Environment
10	EC.02.02.01	29%	23%	Hazardous Materials & Waste
11	EC.02.05.01	28%	25%	Utility Systems (Ventilation)
16	EC.02.05.09	24%	22%	Medical Gases
17	EC.02.05.07	23%	26%	Emergency Power
20	EC.02.03.01	19%	21%	Fire Safety




Door
SUPPLY
Room 206
61


MSL HEALTHCARE CONSULTING

Patient Mock-up Room Leakage Application Overview



Why should we seal rooms anyway??

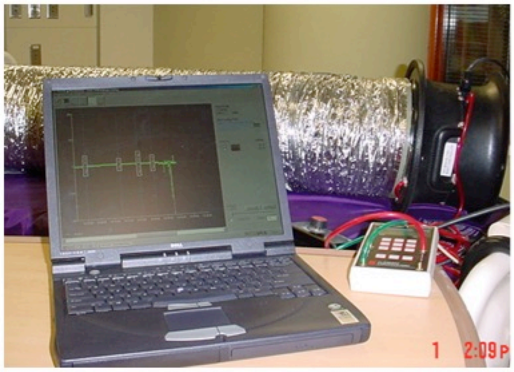
63

Ventilation:

Blower doors allow for leakage testing by applying pressure and using smoke stick to find leaks for sealing

64

Duct Blaster evaluation of AII room



Depressurize room and record air flow volume to determine room leakage. Four AII rooms evaluated with average of 22 inch^2/100ft^2; two sealed rooms 3.1 in^2/100ft^2.

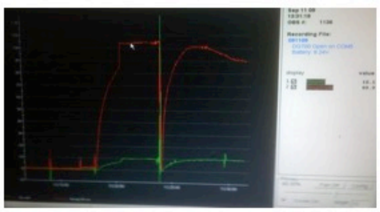
AIR TIGHT HOUSES STANDARD AT 2.5 inch^2 /100ft^2

Leakage defined as # cfm @ x pressure Pascal's or WC

65

Finding leakage points in rooms helps assure consistent pressure management

Design for airborne infection isolation rooms the size at UMMC when sealed will move 84 cfm air at 10 Pascal's pressure to achieve 2.5 in^2/100ft^2 surface area. Leakage at about 0.1 cfm/ft^2.



A sealed room has two advantages:
- -controlled sound movement
- -ventilation control for infectious disease management

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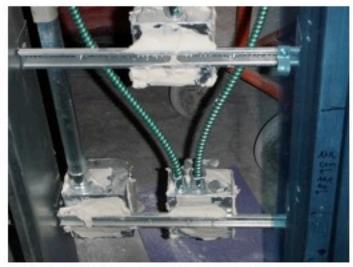
Room Seal Necessary for Special Ventilation Management

- Cracks can result in room air leakage.
- Supply air volume differential allows for airflow direction control.
- Low pressure differential can result in airflow reversal.
- Substantial room pressure design should provide a sealed "vessel".
- Design criteria are necessary for control.



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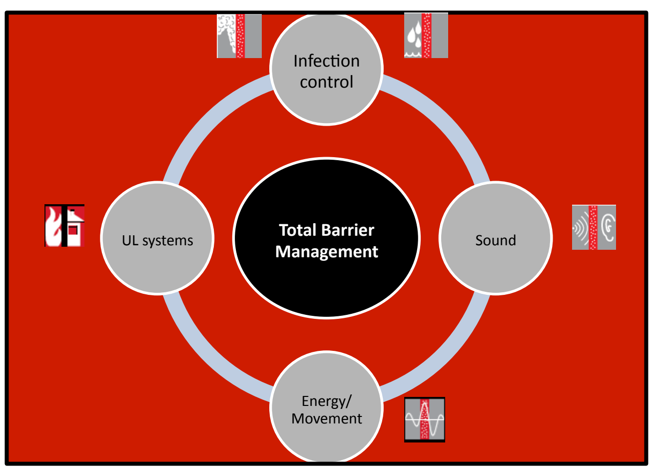
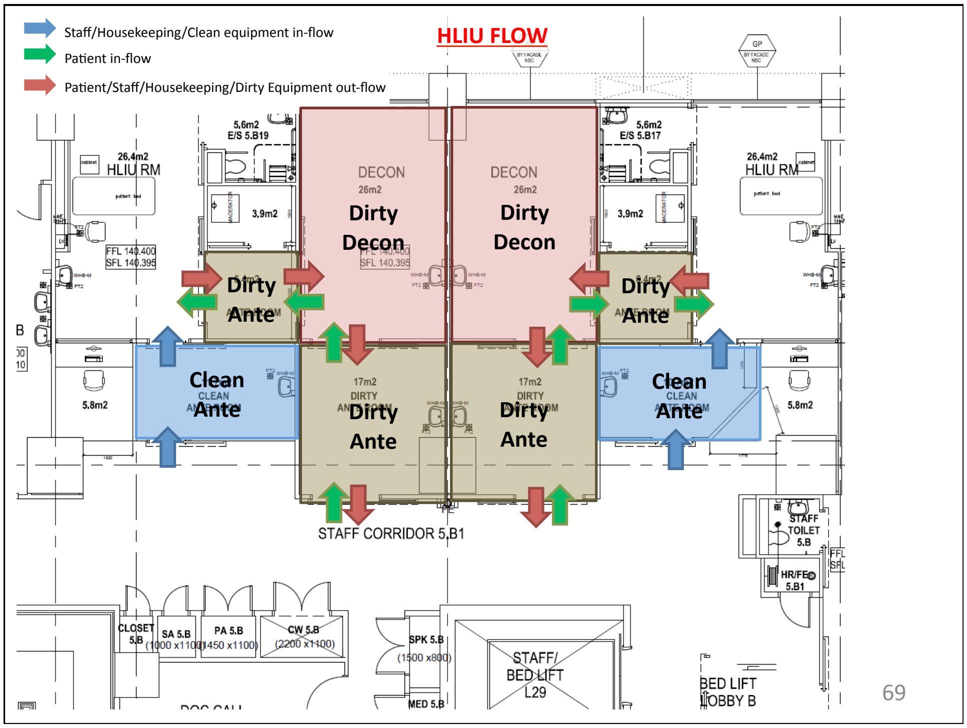
Case Study- Barrier Management "Leakage"

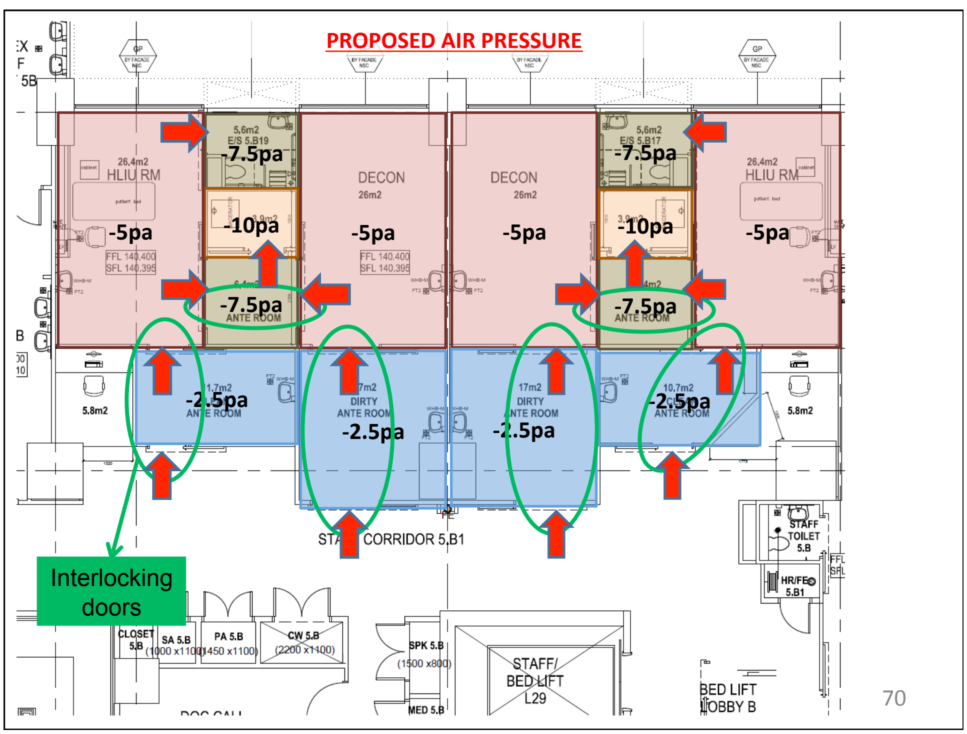


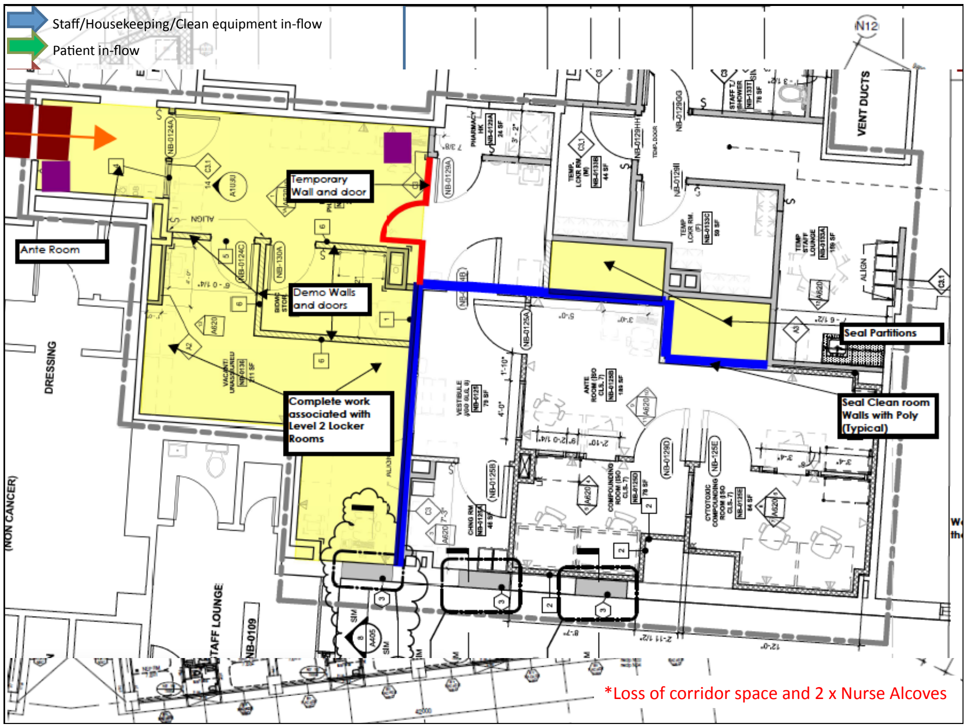
Total Barrier Management practices increase build integrity beyond UL systems with additional secondary attributes

DISCLOSURE HILTI SPONSORED STUDY

68

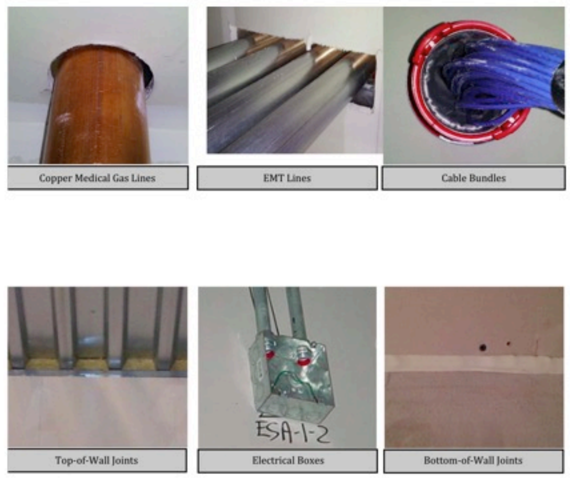

Staff/Housekeeping/Clean equipment in-flow
Patient in-flow
Patient/Staff/Housekeeping/Dirty Equipment out-flow
HLIU FLOW
HLIU RM
DECON
Dirty Decon
DECON
Dirty Decon
HLIU RM
Dirty Ante
Dirty Ante
Clean Ante
Dirty Ante
Dirty Ante
Clean Ante
STAFF CORRIDOR 5.B1
STAFF TOILET 5.B
STAFF/ BED LIFT L29
BED LIFT LOBBY B
69


PROPOSED AIR PRESSURE
HLIU RM
-5pa
-7.5pa
-10pa
-7.5pa
DECON
-5pa
DECON
-5pa
-7.5pa
-10pa
-7.5pa
HLIU RM
-5pa
-2.5pa
-2.5pa
-2.5pa
-2.5pa
Interlocking doors
STAFF CORRIDOR 5.B1
STAFF/ BED LIFT L29
BED LIFT LOBBY B
70



MOCK UP ROOM CREATED TO TEST WALL PENETRATIONS WITH A BLOWER DOOR

Wall Penetrations Can Circumvent Ventilation Parameters



Plugging holes will help maintain pressure goals

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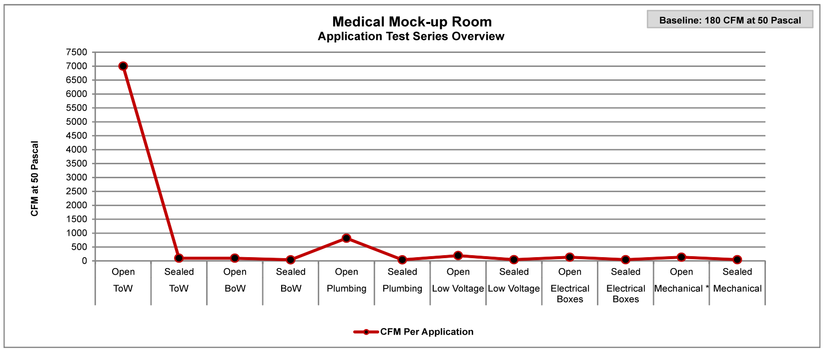
TESTING PENETRATIONS WITH BLOWER DOOR PRESSURIZATION

Application Test Series – Complete Overview



Blower Test #	Test Application	Status	CFM Per Application
1	ToW	Open	**7000**
2	ToW	**Sealed**	**98.85**
3	BoW	Open	**98.85**
3	BoW	**Sealed**	**40.63**
4	Plumbing	Open	**816.3**
5	Plumbing	**Sealed**	**41.3**
6	Low Voltage	Open	**191.8**
7	Low Voltage	**Sealed**	**45.96**
8	Electrical Boxes	Open	**135.6**
9	Electrical Boxes	**Sealed**	**46.52**
10	Mechanical *	Open	**135.6**
11	Mechanical	**Sealed**	**46.59**

Source: Testing implemented by The Energy Conservatory. Testing completed w/ Duct Blaster fan and micromanometer measuring flows from 10 to 1500 CFM.

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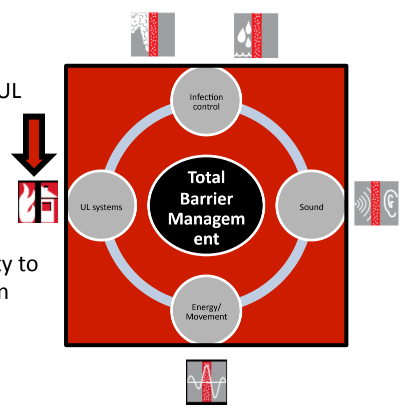
Case Study- Barrier Management

LIFE SAFETY/FIRE

- The most common requirement for control is the UL or life safety considerations as they pertain to fire and smoke control. Hospital corridors and other potential fire hazard need to be sealed
- Fire management in healthcare has provided safety to millions of healthcare building occupants resulting in enormous strides in fire management through regulation. NFPA, Life safety 99 and 101.
- What additional benefits can be realized?



Total Barrier Management practices increase build integrity with life Safety and fire secondary attributes

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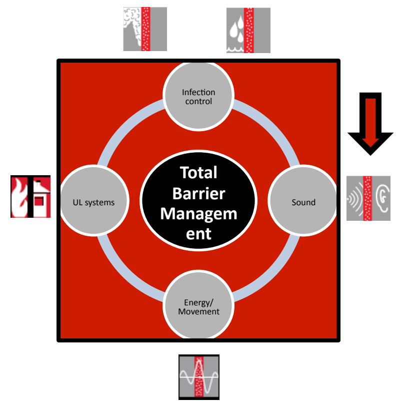
Case Study- Barrier Management

SOUND MITIGATION

- Additional benefits of a sealed room include sound mitigation. It is common acoustical knowledge that sound transmission can be partially mitigated by impeding air movement. This practice occurs where airport noise is managed with sealed houses to minimize sound wave infiltration. HIPPA requires privacy from hearing patient conditions.
- Explain some of the physics of sound transmission



Total Barrier Management practices increase build integrity and sound migration secondary attributes

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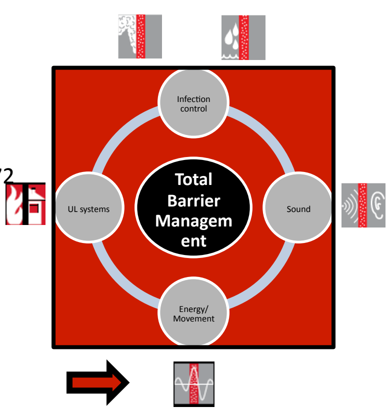
Case Study- Barrier Management

ENERGY/COMFORT

- Building design in healthcare includes inoperable windows to prevent infiltration of uncontrolled air. Comfort factors are essential to convalescence therefore to maintain temperature between 68 and 72 can be difficult without controlled ventilation.
- Leakage reduction will require less heating and cooling??
- Does a sealed room/building provide ventilation energy efficiency?
- Provide some energy statistics??



Total Barrier Management practices increase build integrity and energy & comfort secondary attributes

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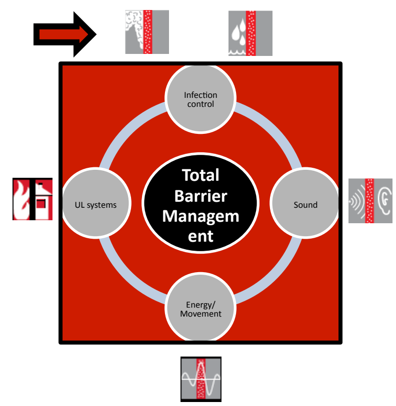
Case Study- Barrier Management

INFECTION PREVENTION

- Control of aerosol important principal for airborne infectious agents causing tuberculosis or aspergillosis depends on airflow control. Aerosol management due to patient derived symptoms needs masking and special room ventilation. Aerosol control is dependent on airflow direction intensity.

- Excess room leakage will diminish pressure management design. A sealed room will help provide consistent direction for prevention of occupational exposures to droplet nuclei containing Mycobacterium tuberculosis or chicken pox



Total Barrier Management practices increase build integrity and infection prevention secondary attributes

79

Infection Prevention and Ventilation

- Air volumes must be maintained to assure cleaning the air of contaminants
- Impediments include: plugged equipment that needs cleaning or change out of filters
- Aspiring to have good air quality requires routine maintenance to assure AC/hr, filtration and pressure.

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University of Minnesota Medical Center-1986

UMMC Amplatz Children's Hospital-2011

Questions & Answers

strei001@umn.edu

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Coming Soon

September 24 (Free Teleclass)
EVIDENCE VS. TRADITION: EXAMINING THE EVIDENCE OF BATHING TO REDUCE HAI'S
Kathleen Vollman, Advanced Nursing LLC
Sponsored by Sage Products (www.sageproducts.com)

September 28 (Free British Teleclass ... Broadcast live from the 2015 IPS conference)
WHAT DID THE ROMANS EVER DO FOR US?
Carole Fry, Healthcare Infection Society

September 29 (Free British Teleclass ... Broadcast live from the 2015 IPS conference)
FAECAL TRANSPLANT TO TREAT *CLOSTRIDIUM DIFFICILE* DISEASE
Dr. Jonathan Sutton, Betsi Cadwaladr University Health Board, Wales

September 30 (Free British Teleclass ... Broadcast live from the 2015 IPS conference)
THE EMERGENCE OF MERS: FROM ANIMAL TO HUMAN TO HUMAN
Professor Ziad Memish, Prince Mohammed Bin Abdulaziz Hospital, Saudi Arabia

October 14 (FREE WHO Teleclass - Europe)
THE USE OF SOCIAL MEDIA IN SUPPORT OF GLOBAL INFECTION PREVENTION AND CONTROL

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