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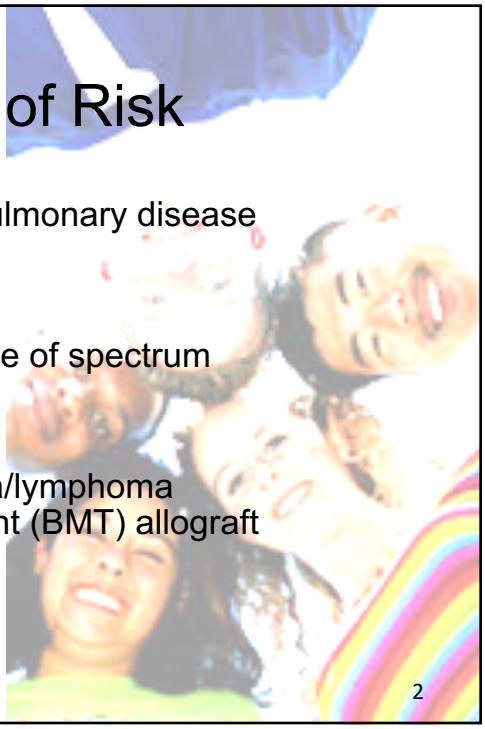
Hosted by Dr. Lynne Sehulster

www.webbertraining.com October 24, 2019

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

Greatest Risk

2

New Construction

- Hand cleansing
- Ventilation pressure management
- Bathrooms # of sinks
- Water quality temperature/stagnation/conserve
- Utility rooms
- Construction quality best practice
- ICU/OR/NNICU/special vent rooms
- Energy and water conserve
- Surge capacity
- Water damage response
- Tie-ins and utility outages

3

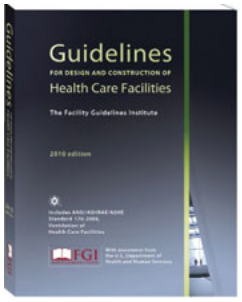
What and Where Risk During Construction AIR & WATER

- Patients
  - Immune suppressed
  - Convalescent areas
- Departments
  - Surgery
  - Radiation
  - Catheterization
  - Equipment cleaning
- Procedures
  - Bedside or areas
- Issues for Environmental Infection Control
  - Utility planning emergent and routine outages
  - Ventilation management during projects
  - Water quality assurance (opportunistic pathogens)

4

Design Guidelines

- Design criteria
  - Facilities Guidelines Institute
  - Centers for Disease Control & Prevention
  - Uniform Building Code
  - International Building Code
  - National Fire Protection Association
  - Plumbing code
  - Electrical code
  - Mechanical code
  - Pharmacy code USP 797
  - other



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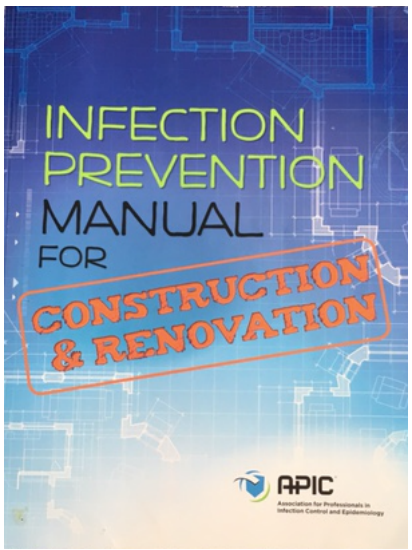
Best Practice Manual from APIC



- Policies
- Construction Documents
- Dust Control
- Water Sampling
- Air Monitoring
- Education and Training
- Equipment Resources
- Architectural and Design
- Floor Recovery and Mold Abatement
- Trends and Issues
- Construction Resources
- Glossary

2015

6

POLICY: CONSTRUCTION AND RENOVATION

Purpose:

To provide parameters for safe design, construction, maintenance, and sustainability in the healthcare environment.

Policy:

I. Infection risks, interventions, and control strategies must be considered in planning for new construction and/or renovation of healthcare facilities.

II. An Infection Control Risk Assessment (ICRA) is developed for all projects that may impact the health of patients.

III. The ICRA is multidisciplinary, documented assessment process intended to proactively identify and mitigate risks from infection that could occur during construction activities.

IV. The ICRA process must take into account the patient population at risk, the nature and scope of the project, and the functional program of the healthcare facility.

V. The ICRA determines the potential risk of transmission of various air- and waterborne biological contaminants in the facility.

VI. The ICRA shall be a part of integrated facility planning, design, construction, and commissioning activities.

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Definitions:

Infection Control Risk Assessment—tool used to stratify infection control risks associated with construction or renovation

Project Manager—assigned person(s) responsible to the project, may be corporate or entity assigned

Design phase—Components include conceptual phase, schematic and structural considerations, programming needs, financial aspects

Project Team—a multidisciplinary planning group that at a minimum should include representation from infection prevention, administration, facility operations, architect, engineer, project manager, and the contractor

Procedure:

see also **: Lakes : Northland : Ridges : Southdale : University of Minnesota Medical Center, Fairview**

I. Fairview Infection Prevention Process Elements:

A. The infection prevention department will be notified prior to onset of construction/ renovation projects that meet project notification criteria.

B. The owner will ensure that architects and project planners follow the Facility Guidelines Institute (FGI) when designing and planning for construction activities.

C. The infection prevention department reserves the right to seek outside consultant services as appropriate to the project.

D. Contracted workers will receive training and/or information on infection prevention and control practices and risks in any Fairview facility. The project manager will ensure contracted worker education prior to the start of any project.

E. Breaches in infection control practices will be reported to the assigned project manager(s)/infection prevention services.

F. The project manager arranges for final construction cleaning, followed by a terminal/deep clean by environmental services prior to occupancy.

G. The infection prevention department may request to conduct a walk-through upon completion of the project and prior to occupancy.

H. Facility services/plant operations will develop a system that communicates all respective projects.

I. The infection prevention department in collaboration with facilities will determine which projects require the completion and documentation of an Infection Control Risk Assessment (ICRA).

J. The infection prevention department will communicate the findings and recommendations of the ICRA to the project manager(s) for review and distribution.

In addition:
ICRA based on FGI
-timing
-team
-design
-surfaces/finishes
-construction
-compliance
-mitigation response
-monitoring
-communication

CODE requirements
Interim Life Safety
-coordination
-fire watch inspection
-IP elements

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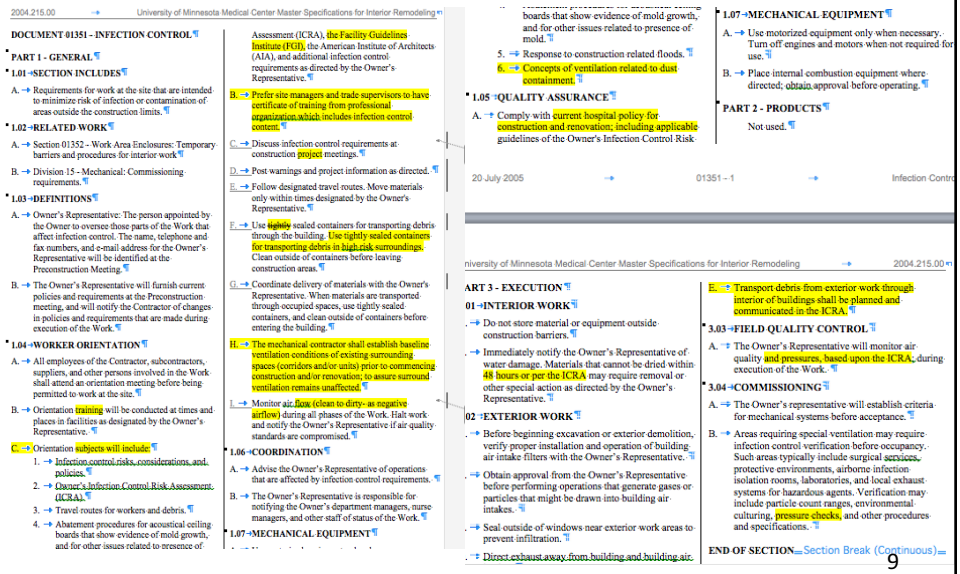
Master Specifications for UMMC



2004.215.00 → University of Minnesota Medical Center Master Specifications for Interior Remodeling

DOCUMENT 01351 - INFECTION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for work at the site that are intended to minimize risk of infection or contamination of areas outside the construction limits.

1.02 RELATED WORK

A. Section 01352 - Work Area Enclosures: Temporary barriers and procedures for interior work.

B. Division 15 - Mechanical: Commissioning requirements.

1.03 DEFINITIONS

A. Owner's Representative: The person appointed by the Owner to oversee those parts of the Work that affect infection control. The name, telephone and fax numbers, and e-mail address for the Owner's Representative will be identified at the Preconstruction Meeting.

B. The Owner's Representative will furnish current policies and requirements at the Preconstruction meeting, and will notify the Contractor of changes in policies and requirements that are made during execution of the Work.

1.04 WORKER ORIENTATION

A. All employees of the Contractor, subcontractors, suppliers, and other persons involved in the Work shall attend an orientation meeting before being permitted to work at the site.

B. Orientation training will be conducted at times and places in facilities as designated by the Owner's Representative.

C. Orientation subjects will include:

1. Infection control risks, considerations, and policies.
2. Owner's Infection Control Risk Assessment (ICRA).
3. Travel routes for workers and debris.
4. Abatement procedures for acoustical ceiling boards that show evidence of mold growth, and for other issues related to presence of

Assessment (ICRA), the Facility Guidelines Institute (FGI), the American Institute of Architects (AIA), and additional infection control requirements as directed by the Owner's Representative.

B. Prefer site managers and trade supervisors to have certificate of training from professional organization which includes infection control content.

C. Discuss infection control requirements at construction project meetings.

D. Post warnings and project information as directed.

E. Follow designated travel routes. Move materials only within times designated by the Owner's Representative.

F. Use rigidly sealed containers for transporting debris through the building. Use tightly sealed containers for transporting debris in high risk surroundings. Clean outside of containers before leaving construction areas.

G. Coordinate delivery of materials with the Owner's Representative. When materials are transported through occupied spaces, use tightly sealed containers, and clean outside of containers before entering the building.

H. The mechanical contractor shall establish baseline ventilation conditions of existing surrounding spaces (corridors and/or units) prior to commencing construction and/or renovation; to assure surround ventilation remains unaffected.

I. Monitor air flow (clean to dirty- as negative airflow) during all phases of the Work. Halt work and notify the Owner's Representative if air quality standards are compromised.

1.06 COORDINATION

A. Advise the Owner's Representative of operations that are affected by infection control requirements.

B. The Owner's Representative is responsible for notifying the Owner's department managers, nurse managers, and other staff of status of the Work.

1.07 MECHANICAL EQUIPMENT

boards that show evidence of mold growth, and for other issues related to presence of mold.

5. Response to construction related floods.
6. Concepts of ventilation related to dust containment.

1.05 QUALITY ASSURANCE

A. Comply with current hospital policy for construction and renovation; including applicable guidelines of the Owner's Infection Control Risk

1.07 MECHANICAL EQUIPMENT

A. Use motorized equipment only when necessary. Turn off engines and motors when not required for use.

B. Place internal combustion equipment where directed; obtain approval before operating.

PART 2 - PRODUCTS

Not used.

20 July 2005 → 01351 – 1 → Infection Contro

niversity of Minnesota Medical Center Master Specifications for Interior Remodeling → 2004.215.00

ART 3 - EXECUTION

01 INTERIOR WORK

. Do not store material or equipment outside construction barriers.

. Immediately notify the Owner's Representative of water damage. Materials that cannot be dried within 48 hours or per the ICRA may require removal or other special action as directed by the Owner's Representative.

02 EXTERIOR WORK

. Before beginning excavation or exterior demolition, verify proper installation and operation of building air intake filters with the Owner's Representative.

. Obtain approval from the Owner's Representative before performing operations that generate gases or particles that might be drawn into building air intakes.

. Seal outside of windows near exterior work areas to prevent infiltration.

. Direct exhaust away from building and building air.

E. Transport debris from exterior work through interior of buildings shall be planned and communicated in the ICRA.

3.03 FIELD QUALITY CONTROL

A. The Owner's Representative will monitor air quality and pressures, based upon the ICRA, during execution of the Work.

3.04 COMMISSIONING

A. The Owner's representative will establish criteria for mechanical systems before acceptance.

B. Areas requiring special ventilation may require infection control verification before occupancy. Such areas typically include surgical services, protective environments, airborne infection isolation rooms, laboratories, and local exhaust systems for hazardous agents. Verification may include particle count ranges, environmental culturing, pressure checks, and other procedures and specifications.

END OF SECTION Section Break (Continuous)

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The Document initiated: January 3, 2008. Multiple drafts throughout the project were developed.
Final document: July 5, 2011

UNIVERSITY OF MINNESOTA
CHILDREN'S HOSPITAL, FAIRVIEW
REPLACEMENT HOSPITAL (UMACH)
&
ANCILLARY RENOVATION
INFECTION CONTROL RISK ASSESSMENT
(ICRA)

Note: This is a living process/document throughout the project.

New Construction
ICRA in APIC Infection Prevention Manual for Construction and Renovation 2015

Overview for Planning Large Projects

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Construction Worker Hospital Training
First Day First Hour
TABLE OF CONTENTS

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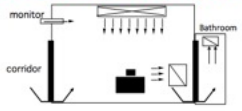
X. The UMMC/UMACH Infection Control ICRA Planning and Design Elements: Considerations and Discussion

ICRA Planning and Design Elements for Consideration and Discussion:

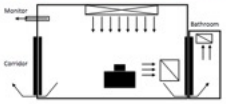
	Yes	No	Responses & Notes
Note: First Formal ICRA Review was conducted on February 1st, 2008 at HGA.	X		**FHS:** ICRA Review Participants: TK&A, HGA, Jacobs, KA representatives, including engineers. UMMC: ~~John Marshall, Andy Streifel & Christine Hendrickson~~.
	X		**TK&A-HGA:**
DESIGN DOCUMENT:	**Yes/ Agree**	**No**	**Responses & Notes**
Infection risk assessment: IC is attending all design meetings with user groups to provide ongoing consultation and risk assessment, the following is in addition to user group participation.	X		**FHS:** Agree
The following considerations were included in ongoing user group meetings and/or meetings/discussions with Fairview, TK&A and HGA:			
Special procedure rooms Based on programming: Consideration for endoscopy, bronchoscopy and other procedures are made to accommodate the handling of clean vs. contaminated equipment, including storage. Design to prevent cross contamination.	X		**FHS:** A lot of this work is stated at the beginning of the ICRA table, is being addressed at User group meeting (Andy/Chris). At this time, there are no concerns. 2/08
	X		**TK&A-HGA:**
Determination of # of All Rooms.	X		**FHS:** Ok
Note: Include anterooms for BMT All.	X		**TK&A-HGA:**
Anterooms are not required for non-BMT, All rooms.	X		**FHS:**
	X		**TK&A-HGA:**
Sink locations, e.g. avoid near HOB for sinks in patient rooms. Sinks: general guidelines for other clinical spaces. All sinks per AIA at a minimum.	X		**FHS:**
	X		**TK&A-HGA:**
Sinks-place on right as enter patient's room.	X		**FHS:**
	X		**TK&A-HGA:**
Sinks-design to avoid storage underneath	X		**FHS:**
	X		**TK&A-HGA:**
Placement PPE in rooms: consider volumes, protection from contamination.	X		**FHS:**
Mask with face shield, gloves (sm., med., l.g. & x l.g.)	X		**TK&A-HGA:**
Dishwashing machines, e.g. toy cleaning.	X		**FHS:** ok
Appropriate locations.	X		**TK&A-HGA:**
Review need: high-level disinfection or sterilization needs, related to reprocessing. Locations? Departments?	X		**FHS:**
	X		**TK&A-HGA:**
Patient flow, OR, ED, Radiology support to support IC practices, AORN.	X		**FHS:** no issues IC perspective
	X		**TK&A-HGA:**

Patient room special ventilation

Negative Pressure Room for Airborne Infection Isolation



Positive Pressure Room for Protective Environment



Special order sinks with offset drain

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Therapeutic tubs, concern with jets.	X		**FHA:** Infection control would like any water movement to be external in design, to prevent biofilm development.
	X		**TK&A-HGA:** No therapeutic tubs.
Traffic through sliding or pocket doors between patient rooms. Infection control recommends solid walls and/or solid with windows. To help assure transmission prevention and maintain air quality.	X		**FHA:** Agreement Core Team 2/08
	X		**TK&A-HGA:**
Engineering /Design:			
Electronic Monitoring (EM) Refrigerators: Patient refrigerators central monitoring. **All Rooms** (Airborne Infection Isolation) **BMT** **BMT All rooms** with ante-see comments Ø Ok with selection for All and/or BMT.	X X X X X		**FHS:** Refrigerators: central monitoring. JM to determine vendor. Discussed @ HGA J.Marshall-Facilities to weigh in on type of EM. E.g. TSI. (Yes-TSI) IC-separate monitors for BMT. (EM monitors pt. space, and monitor negative ante-room in relation to hallway. Mount EM system on outside hallway corridors. **Agreement:** Combined monitor for dual purpose is ok, as long as nursing personnel can easily identify, which system is alarming; e.g. negative space vs. positive space.
	X		**TK&A-HGA:** Alarms sound locally and/or centrally. (local minimum) Note: UMACH: approved new system.
Air Filtration Considerations: Immune suppressed/OR's & Special Procedure rooms • Immune compromised concepts for oncology service to be incorporated. • Pre-filter: for spores all incoming air. - Enhanced pre-filtration protect coils (e.g. 5 microns) • All patient Rooms 12 air changes/hr - >95% (Merv 15) filters • AIA 2006 (see note in shaded FHS area) 2/08 • OR HEPA @ 99.97% filtration (Merv 16). - OR Pressure: 8 Pa, doors closed • OR and Spec. Procedures: ceiling real-estate, e.g. lights, radiant panels, supply, fire etc. • OR smoke management • Separate systems OR enhanced exhaust • Special procedure like rooms: additional electrical outlets available for PAPR recharging. Consideration for storage of accessible All PPE for staff protection. • How will the diffusers, diffuse the air in the room?	X		**FHS:** We will use the current 2006 AIA Guidelines for design. However, if there is new compelling research and/ or regulatory change-New considerations will be reviewed and "potentially" implement between now and the finished product, in collaboration with TK&A and HGA.
	X X X X X X X X		**TK&A-HGA:** Immune concepts discussed 2/08. New concepts/requests - notify TK& A. All bullets discussed and agreement. *(this was discussed during review of the HVAC plans) agreement. Low return for BMT. Supply near window.* Diffusers discussed: agreement on design.
Emergency Department • Ventilation, design for IC management. • Includes two All rooms. • Waiting rooms – Displacement ventilation • Decontamination room (Advise UMMC-Emergency Management Specialist) • Level II Trauma – IC considerations. • Infectious Airborne Disease & Surge Infection Capacity and Management • Patient care area or wait room 100% outside air.	X X X X X		**FHS:** Yes, ventilation. Two All rooms ED Wait areas discussed-agreement. Trauma: agreement with design. ED surge capacity - available system following some additional actions. ED – current ventilation plans ok, FHS would like a design to allow for surge capacity (balance off ED from the rest of the facility). Discussed-agreement. Yes-capable.
	X		**TK&A-HGA:**

Water issues with auto endoscope processors

Ceiling ventilation in surgery

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Means and Methods

CONSTRUCTION Considerations for Kraus-Anderson and all other sub-contractors.	Yes	No	Responses and Notes: MEANS and METHODS
• Establishes communication process for individual phasing ICRAs. • Establishes communication plan or process for roles/ responsibilities related to quality infection control monitoring. • Assures that all contractors are provided infection control training.	X X X		**KA:** To distribute sub ICRA to all stakeholders for the phase.
Existing HVAC conditions: • **Need Riverside East and West Assessment/Evaluation** of existing systems and measurements: Filtration and pressures (e.g.-fan systems for filtration) • Purpose is to assure that space is returned to existing condition and/or better – per design.	X X X		**FHS:** Infection Control will provide the assessment/ evaluation **KA:**
Construction site management • Movement of workers: outside contract workers must not enter occupied space, except in an emergency (tornado). • If necessary, prior to entry into the occupied space-must apply clean covers.	X X		**FHS:** **KA:**
• Break Areas, including sanitation facilities must be provided to workers on site. • The external workers shall avoid entrance to existing buildings and not use occupied space for any routine services. This would include access to food, sanitation, phone, etc. • Improper disposal of food, snacks etc. are not supportive of sustainability concepts. • Develop an IC approved emergency response plan for water damage.	X X-all		**FHS:** **KA:**

Ventilation evaluation

Break room area with trash cans

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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.

FGI & ASHRAE DESIGN GUIDELINES FOR VENTILATION

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Materials plan of management: • All materials will be stored to protect from moisture or other mold causing events. Must review plans with IC. • A transportation and storage plan to be developed and reviewed by Infection Control. - Contractor to develop an IC approved water-damage mold response plan. - No storage of materials on the ground, e.g. includes piping for plumbing, drywall, ductwork - Recycle metal/paper/sheet rock etc.	X X X		**FHS:** **KA:**
Debris plan of management: • Including abatement and removal of materials, must be approved by an infection control representative. • Site will be kept free of excessive trash, debris, etc. • Prevention of tracking into occupied spaces. • Back Fill storage: Plan • Dust control, prn-e.g. streets (arrange for street cleaning) • Control soil drainage/contain	X X		**FHS:** **KA:**
Dust: • The construction site will be maintained in a manner that provides reasonable control or dust/dirt and will consider any local air intakes or potential access. • A separate ICRA (sub) will be required for all existing spaces under renovation. (Unless otherwise determined by IC) • Barriers will be planned and implemented to prevent the migration of debris, dust and/or smoke. • All construction in occupied buildings will be conducted under negative pressure. • Visible monitoring of mechanical (negative airflow) during renovation of existing spaces. • Windows are to be kept close unless approved as part of a barrier plan.	X X		**FHS:** **KA:**
Local Air intakes to all existing buildings: • The contractor will protect existing local air intakes which may be impacted. • Potential changes will be brought forward for discussion. Met	X X		**FHS:** KA to avoid changes, unless approved. Met **KA:**
Design build out: • Water damage prevention and management • Prevent rodent and pest infiltration.	X X		**FHS:** Need construction monitoring. **KA:** Met
Building outer wall: • Surface-glass • Water proof exterior-include: drainage plans for outer walls. • Roof-flashing, penthouse • Entrance-access, auto traffic • Exterior wall flashing	X X		**FHS:** **KA:** Met

Construction material recycling

Air intake relocation for surgery

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Management of humidity/moisture: • There will be a well laid out plan on how to manage humidity caused by nature (rain/humidity), paint, concrete, plaster, sheetrock, etc. • The plan is designed to prevent the formation of mold in the facility due to normal construction processes and natural events. • The HVAC system should normally not be used for this purpose and should be discussed during planning. • Storm protection: Summer/winter • Prevent water from pooling, e.g. flat surfaces (roof). • Prevention/ protection of ducts-prior to installation. • Gypsum board will be water-resistant and protected from water damage. • Damaged gypsum board will not be installed. • Gypsum board will be raised off the slab 1/4th to ½ inch.	X		**FHS:** Request Response Plan
	X		**KA:** Met
	All X		
Ventilation Installation: • Prevention/ protection of ducts-prior to installation.	X		**FHS:** Infection control will be consulted prior to construction related value decisions. This was discussed at the Feb. 1, 08 meeting at HGA.
	X		**KA:**
Value Engineering: Considerations re: Value Engineering discussions	X		**FHS:** Jacobs: Discussed/introduced the concept for monitoring new tower and Riverside during all phases. KA shared that they have a quality program. KA will be required to fill out FHS daily Infection Control quality checks. However, UMMC still needs independent "eyes" to assure that risks are being managed. Jacobs assigned. Also discussed that the FHS representative for LSC/Safety monitoring-could potentially be cross trained for IC issues. In addition, the Dept. of Environmental Health and Safety (Andy) will remain engaged and consulted throughout all phases – on site; also as IC specialist.
	X		**KA:**
Monitoring of Construction/Renovation: Who will represent FHS during all phases? Jacobs/UMMC Discussed at 2/1/08 meeting Ø Met	X		**FHS:**
	X		**KA:**
Coordination of other Sustainability Concepts: Collaboration with TK&A, HGA, KA, UMMC; Met	X		**FHS:**
	X		**TK&A-** **HGA**

Water damage prevention

Window exhaust problem

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COMMISSIONING

Commissioning & Pre-occupancy Considerations:			
Performance reports are made available.	X		**FHS:**
	X		**KA:**
Cleanliness issues: Scheduling	X		**FHS**
	X		**KA:**
Culture clearance (Air and surface) for specialized areas.	X		**FHS**
			KA:
Specialized Rooms Specifications are met prior to occupancy. E.-g. BMT, PeriOp, air and surface culturing, review of balance report. Coordination to include final cleaning and assuring that "all construction/installations are completed prior to culturing and occupancy.	X		**FHS:**
	X		**KA:**
Timing of acceptance: Nov. 2010	X		**FHS & KA:** Met

Validating the specification requested for infection prevention

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Key Components

- Exterior of building
  - Keeps out water and air infiltration
- Ventilation Systems
  - Provides comfort and infection safety of air
  - Need evaluation tools
- Water Systems
  - Becoming important for sustainability
  - Protect for drinking, sanitation and clinical application
  - Out of control water in healthcare

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

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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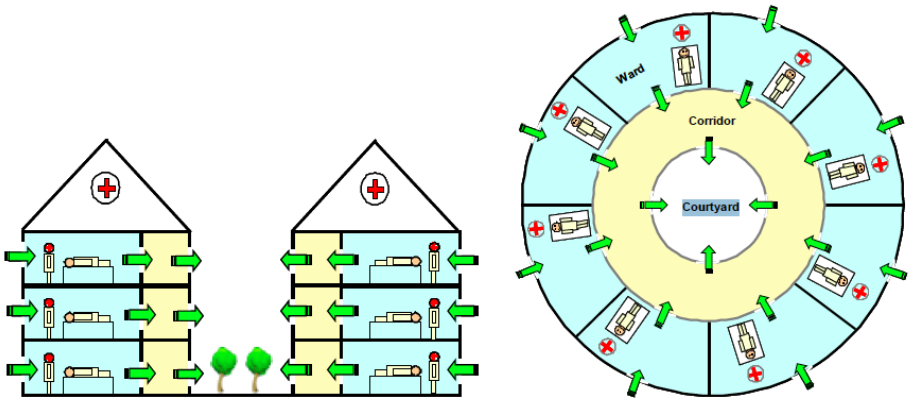
NATURAL VENTILATION



Section

Floor plan

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.

WHO Natural Ventilation 2009

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Ventilation:

PROPOSED ENERGY EFFICIENCIES
Displacement
Chill beams
Minimal leakage

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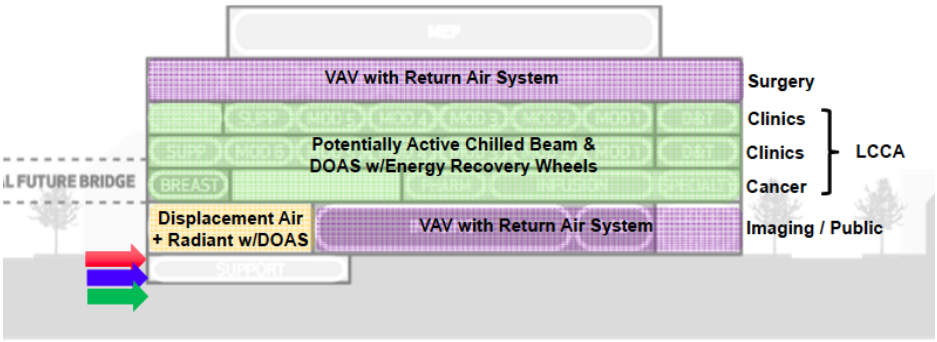
Planning for New Ambulatory Care Center University of Minnesotan Medical Center 2014



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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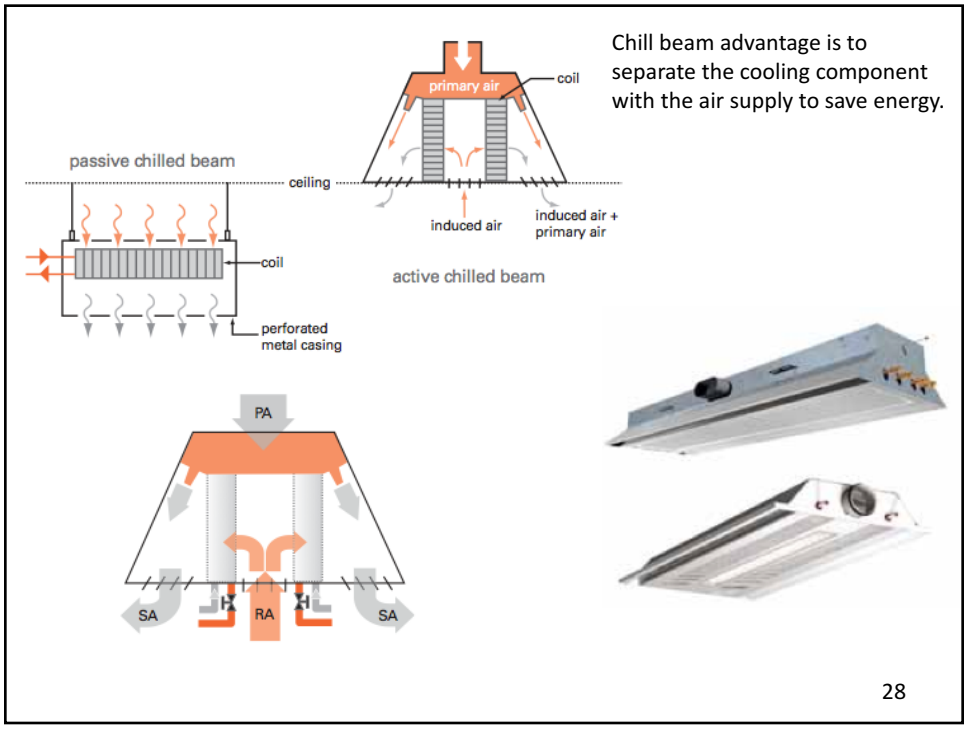
Chill beam advantage is to separate the cooling component with the air supply to save energy.
primary air
coil
passive chilled beam
ceiling
induced air
induced air + primary air
active chilled beam
coil
perforated metal casing
PA
SA
RA
SA
28

Ventilation:

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

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Phases of Construction

* Baseline Preliminary Review & Program Analysis

*Pre-design

*Schematic Design

*Design Development

*Construction Documents

*Construction Implementation

*Facilities Commissioning

*Occupancy

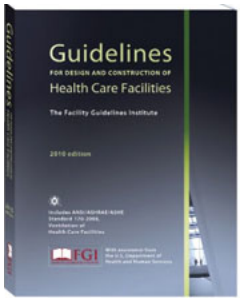
*Certification for Use

•What infection control principals need to be developed?
-ventilation
-plumbing
-airborne infection isolation
-surgery
-immune suppression
-disaster planning
•Identify locations for need.
-user group collaboration
•Construction methods
-water damage management
-construction methods
-validation process

30

AIA 2010 Guidelines for Design And Construction of Hospitals & Health Care Facilities

- Latest in an over 60-year series of guidelines specific for design and construction of hospital and other health care facilities
  - Nursing Facilities; Outpatient Facilities
  - Rehabilitation Facilities; Psychiatric Hospital
  - Mobile, Transportable, and Relocatable Units
  - Hospice Care; Assisted Living
  - Adult Day Care Facilities
  - Glossary Tables
  - ASHRAE Std 170 Ventilation for HCF inclusion



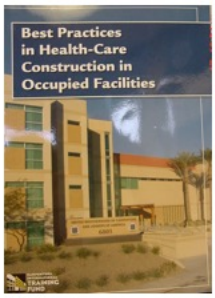
31

Built Environment Projects

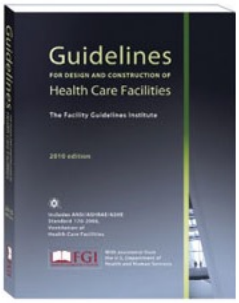
- Renovation
  - Program changes
  - Maintenance & utility upgrade
  - Preconstruction
    - Discovery/Utilities, shutoffs, etc.
    - Recycle equipment
- New Construction
  - Planning Design and Construction

What infection control training is needed for contractor supervisors and workers?

32



Environmental Management Training



ASHE
American Society for Healthcare Engineering
of the American Hospital Association

IC Infection CONTROL

33

PRECAUTIONS DURING CONSTRUCTION

INDOOR PROJECTS (RENOVATION)

Employee training

- **Barrier management**
- **Water damage**
- **Demolition precautions**
- **Dust migration and control**
- **Debris and material transport**
- **Access routes to work area**
- **Outages (electrical and plumbing)**
- **Portable filter usage**
- **Noise and vibration**
- **Sanitation and break areas**
- **Commissioning -air & water**

Communication

- **Emergency response**
- **Water damage reporting**
- **Changing work phases**

ICRA precautions during occupancy

Water Quality

- **Stagnant water flushing**
- **Testing water requirements**
- **Punch list**
- **Critical sinks drinking water**

OUTDOOR PROJECTS (NEW)

Employee training

- **Dust control**
- **Noise and vibration**
- **Pest control**
- **Building material storage**
- **Water damage management**
- **Sanitation and break areas**
- **Tie in building issues**
- **Commissioning-air & water**
- **Shell spaced-build out**

Communication

- **Emergency response**
- **Water damage reporting**
- **Material crane location**

Changing ICRA precautions pre occupancy

Water Quality

- **Stagnant water flushing**
- **Testing water requirements**
- **Punch list**
- **Critical sinks drinking water**

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Awareness Factors by Trade

	Plumber	HVAC	Electrician	Painter	Laborer	IT Specialist	Riggers	Specialty Trade
Awareness Factors								
Water damage	x		x	x	x	x		x
Mold discovery	x		x	x	x	x		x
Outages	x	x	x					x
ICRA	x	x	x	x	x	x	x	x
Water event response	x				x			
Stagnant water	x							
Building material storage/stocking	x	x	x	x	x	x	x	x
Noise/vibration	x	x	x		x	x	x	x
Track dirt	x	x	x	x	x	x	x	x
Wall/slab penetrations	x	x	x		x	x		
Material transport	x	x			x		x	x
Biocide application				x	x			x
Room/wall seal application				x	x			

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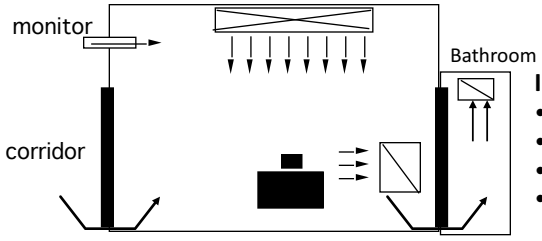
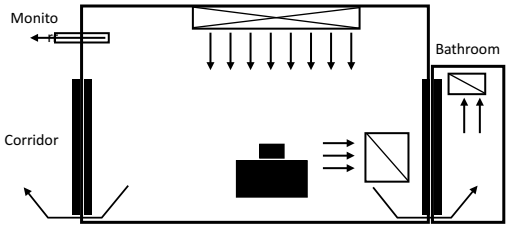
Negative Pressure Room for Airborne Infection Isolation



Intended Usages:
- Procedure/Treatment Rooms
- Bronchoscopy
- Autopsy
- Emergency Rooms

Positive Pressure Room for Protective Environment



Intended Usages:
- Immune Compromised Patient Rooms
- Operating Rooms

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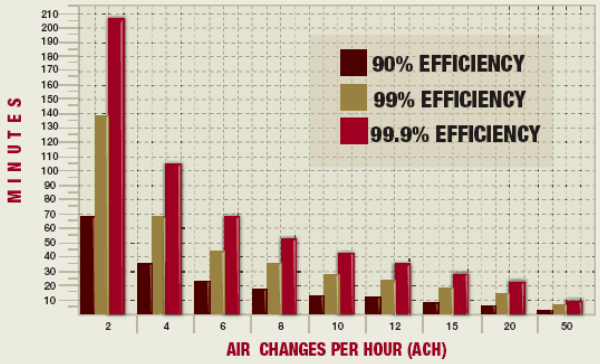
The solution to pollution is dilution……

FIGURE 2 ACH AND TIME REQUIRED FOR REMOVAL EFFICIENCIES

90%, 99% and 99.9% of Airborne-Contaminants Time (minutes) required for removal:

ACH	90% EFFICIENCY	99% EFFICIENCY	99.9% EFFICIENCY
2	69	138	204
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.[4]



Higher room air exchanges purify if filters are working.

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Operating Room Ventilation

- Comfort control
  - Temperature and humidity
    - Cooling capacity for heat gain essential
  - Anesthetic gas management
    - Problematic due to no permissible exposure limit
    - Scavenging and high room air exchange needed
  - Infectious disease control
    - Smoke plume management
    - Airborne microbes? Contact microbes?

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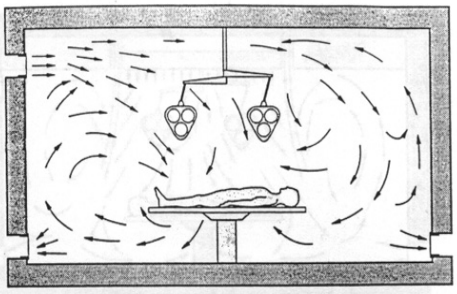


Figure 5 *Conventional wall supply (turbulent).*

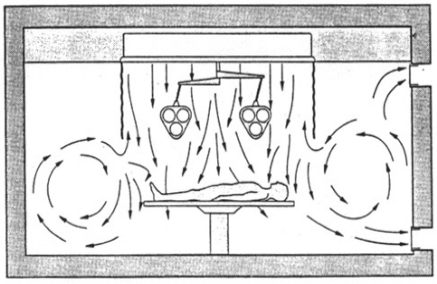


Figure 11 *Unidirectional downflow with curtains (Schmidt 1987).*

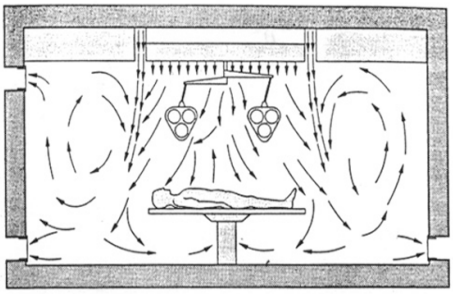
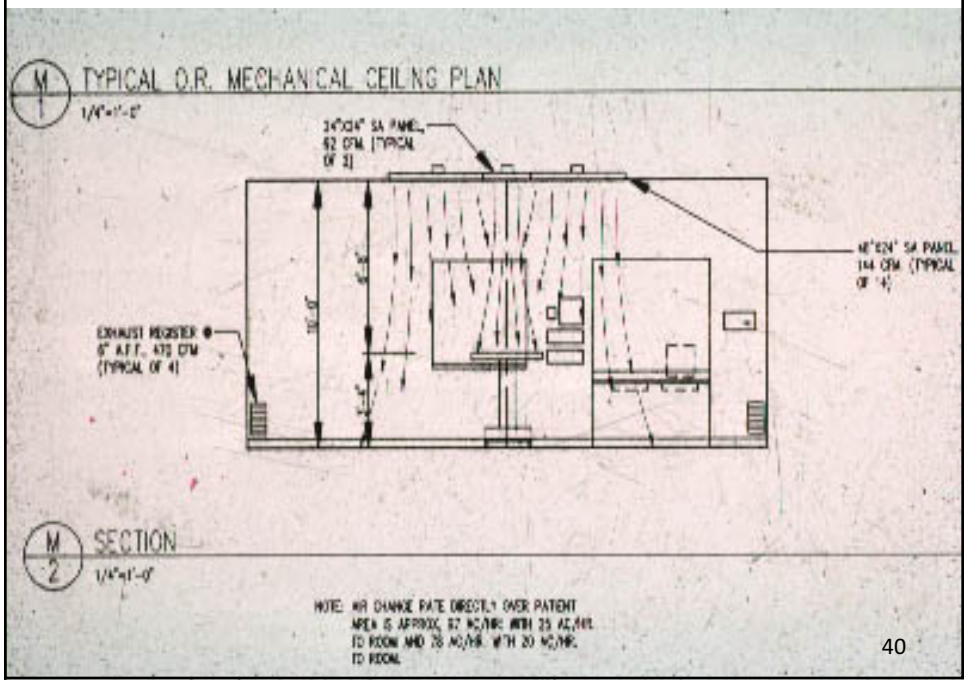


Figure 9 *Air curtain around the working area (Schmidt 1987).*

The airflow pattern in OR's must overcome thermal buoyance and maintain a down ward flow of air

39

Vertical airflow 30 to 40 lfpm at surgery site



40

Age of Air Concept for particle movement

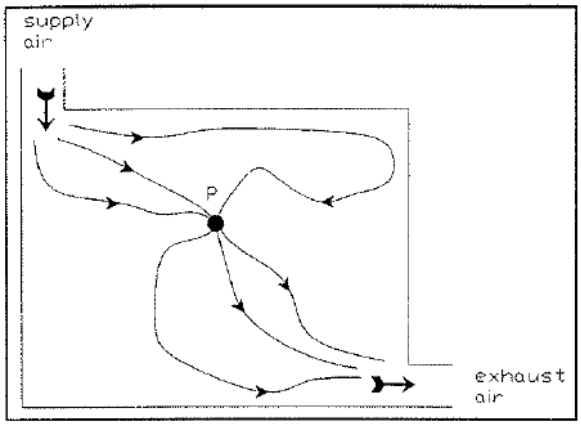
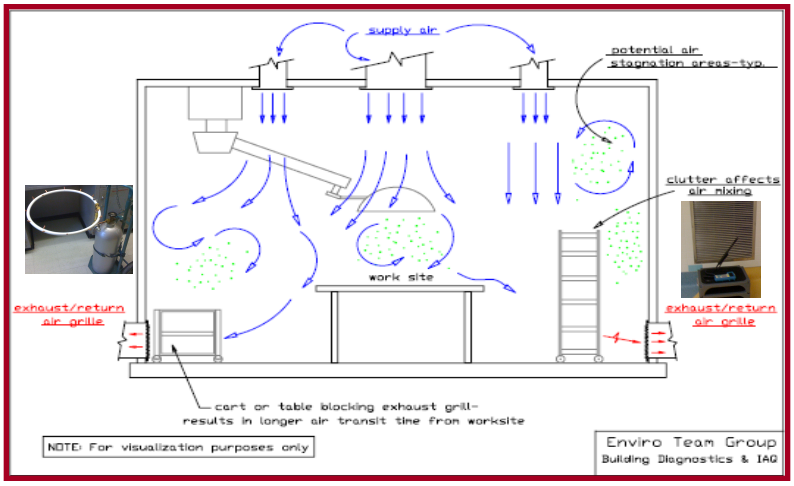


Figure 1. Diagram to illustrate the concept of "age of air." Parcels of air starting at the supply (top left) may reach the point "P" by many possible routes and take different times to get there; so, the age of individual parcels of air arriving at P may be described by a statistical distribution function.

41



Air movement velocity (fps) and decay of carbon dioxide can demonstrate ventilation efficacy.

42

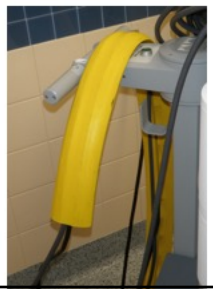
Avoiding vent blockage will promote good ventilation

Placement of lights important to preserve consistent flow of air

43

Does ventilation cause infections in surgery?

OPERATING ROOM STAFF CLAIMED VENTILATION WAS AN INFECTION PROBLEM. *WHAT DO YOU THINK?*



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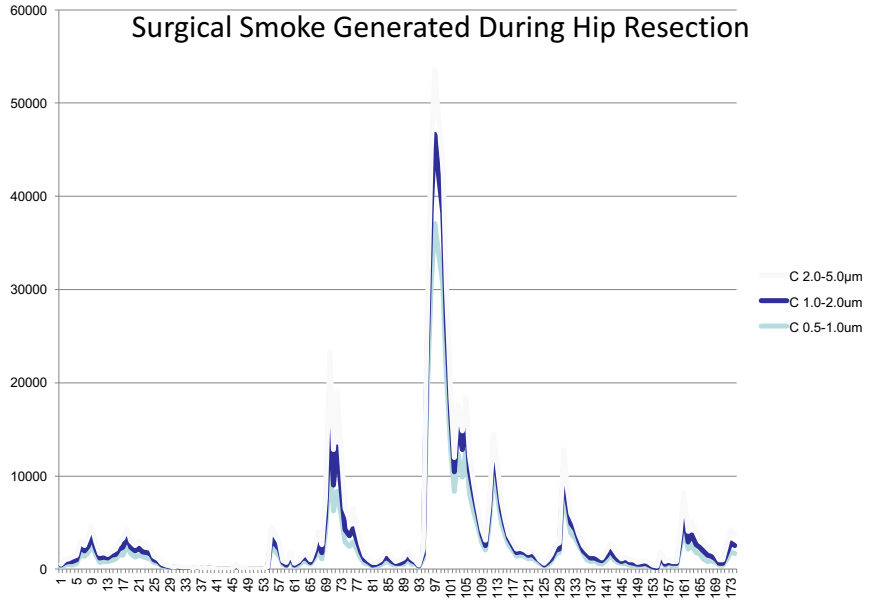

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Controlling Airborne Infectious Agents in Surgery

- Extra pulmonary disease (TB, BBP)
  - Scavenging of smoke or aerosol?
  - Personal protective equipment
- Human shed microbes
  - Air velocity over surgical site
  - Overcome thermal plume with 35-40 lfpm velocity
- Air handling deficiencies
  - Booster steam or humidification problems (condensation)
  - Insufficient air flow (gas accumulation)
  - Depressurized operating rooms (air balance)

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Functional Performance Testing

Baseline Data for Future Reference

Unit	Room # FMG	Actual Room #	Room Name	BAS MONITORING ONLY	LOCAL DISPLAY WITH ALARM	ACHR	dif.pressure	off-set	ROOM POSITIVE/ NEGATIVE	SQ. FT.	S CFM	R/E CFM
ED	A1747	3	INFECTIOUS Negative Airflow Rm	Monitored by BAS only		22	-100	-125	(-)	150	300	425
ED	A1549	9	INFECTIOUS Negative Airflow Rm	Monitored by BAS only	***	25	-200	-125	(-)	150	350	475
ED-OBS	A1902	8	INFECTIOUS Negative Airflow Rm		Local display and alarm	17.7	-502	-100	(-)	150	300	400
ED	A1903	38	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	17.7	691	125	+	150	500	400
ED	A1901	39	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	17.7	691	125	+	150	500	400
ED	A1549	40	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	17.7	691	130	+	150	500	400
OR	A2535	1	OR 1 Positive Airflow		***	27.3	815		+	420	1965	1965
OR	A2542	2	OR 2 Positive Airflow		***	28.7	825		+	400	1865	1865
OR	A2544	3	OR 3 Positive Airflow		***	29	777		+	420	2060	1770
OR	A2548	4	OR 4 Positive Airflow		***	29	830		+	420	2060	1770
OR	A2587	5	OR 5 Positive Airflow		***	29	822		+	420	2060	1770
PICU	A3950	4	PROTECTIVE Positive Airflow Rm		***	23.5	808	200	+	260	520	320
PICU	A3955	5	PROTECTIVE Positive Airflow Rm		***	13.5	891	200	+	260	520	320
PICU	A3890	14	PROTECTIVE Positive Airflow Rm		***	17.9	891	E WAV	+	260	700	600
PICU	A3870	15	PROTECTIVE Positive Airflow Rm		***	17.9	892	E WAV	+	260	700	600
PICU	A3974	6	INFECTIOUS Negative Airflow Rm		Local display and alarm	20.9	no test	patient	(-)	260	600	800
PICU	A3982	7	INFECTIOUS Negative Airflow Rm		Local display and alarm	16	-510	-300	(-)	260	600	800
Kidney Center	A4305	7	INFECTIOUS Negative Airflow Rm		Local display and alarm	15	-504	-170	* suppose to be (-)	171	400	600
NICU	A4359	50	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	8.5	891	100	+	230	300	250
NICU	A4365	51	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	8.5	891	100	+	230	300	250
NICU	A4320	1	INFECTIOUS Negative Airflow Rm		Local display and alarm	21.2	-574		(-)	230	550	700
NICU	A4340	2	INFECTIOUS Negative Airflow Rm		Local display and alarm	21.2	-574		(-)	230	550	700
7 - Onc	A7301	708	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	14.7	693		+	240	530	350
7 - Onc	A7485	712	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	15.5	816		+	230	530	350
7 - Onc	A7476	713	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	15.3	856		+	230	530	350
7 - Onc	A7465	714	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	14.7	854		+	240	530	350
7 - Onc	A7446	715	PROTECTIVE Positive Airflow Rm	Monitored by BAS only	***	14.7	843		+	240	530	350
7 - Onc	A7313	with 724	WHITE ROOM		Local display and alarm	24	-115		(-)	97	700	300
7 - Onc	A7315	726	INFECTIOUS Negative Airflow Rm		Local display and alarm	20	826		* +	230	650	450
7 - Swing beds	A7381	705	PROTECTIVE Positive Airflow Rm		Local display and alarm	14.7	843		+	240	530	350
7 - Swing beds	A7429	706	PROTECTIVE Positive Airflow Rm		Local display and alarm	14.7	857		+	240	530	350
7 - Swing beds	A7430	707	PROTECTIVE Positive Airflow Rm		Local display and alarm	14.7	874		+	240	530	350
7 - BMT	A7440	708	PROTECTIVE Positive Airflow Rm		Local display and alarm	14.7	856		+	240	530	350
7 - BMT	A7460	709	PROTECTIVE Positive Airflow Rm		Local display and alarm	14.7	830		+	240	530	350
7 - BMT	A7470	710	PROTECTIVE Positive Airflow Rm		Local display and alarm	15.3	824		+	230	530	350
7 - BMT	A7474	with 711	WHITE ROOM		Local display and alarm	23.5	-12		(-)	97	700	300
7 - BMT	A7480	711	INFECTIOUS Negative Airflow Rm		Local display and alarm	20	668		* +	240	720	450

* Anteroom is negative to the hallway and the patient room is positive to the ante room.
RED is negative airflow room. BLUE is positive airflow room

&AC = Building Automation System (Currently monitored)

List:
- patient care unit
- room number
- type of room
- monitoring system
- local display monitor
- AC/hr
- differential pressure
- offset
- airflow direction
- room size square feet
- supply volume
- return/exhaust volume

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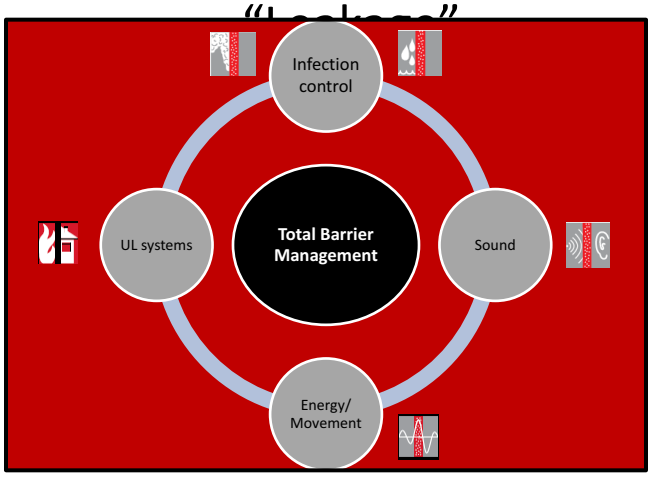
Case Study- Barrier Management

"Leakage"



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

DISCLOSURE HILTI SPONSORED STUDY

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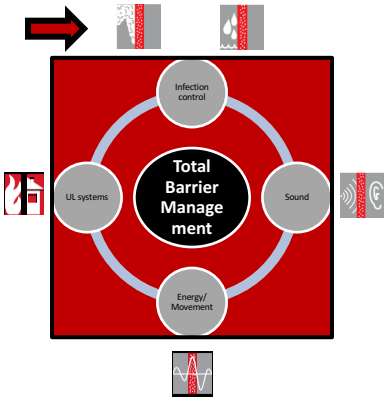
Case Study- Barrier Management

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

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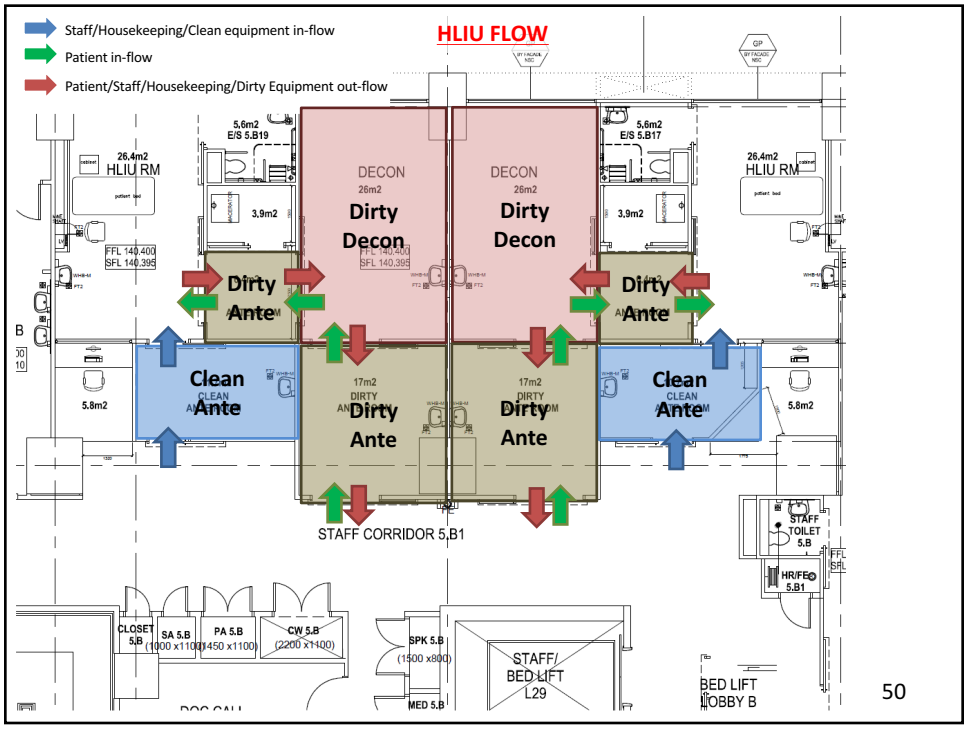

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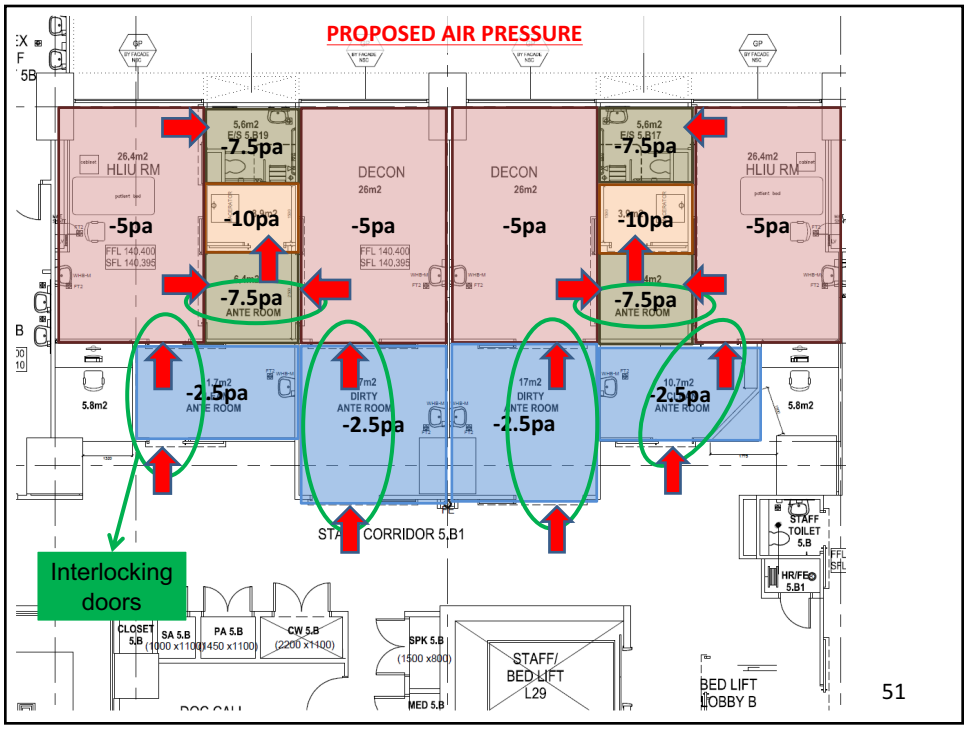

Competency Principals for Hospital Design to Control Certain Infectious Diseases

- Ventilation indoor air quality control
  - Pressure intensity
  - Air exchanges for dilution
  - Filtration for cleanliness
  - Clean to dirty airflow
- Surface management
  - Durable and Cleanable
- Water Quality assurance
  - Flush or Disinfect

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IC CONSIDERATION EXAMPLES

Moisture detectors are useful decision makers for water detection & drying

Keep moisture content <20% &<90%RH
Maintain air movement
Remove moisture physically or by evaporation

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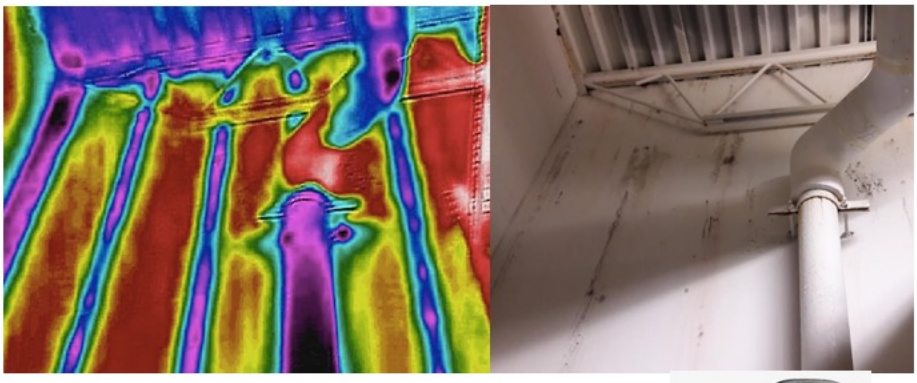
Infrared camera reveals source of mold



Evaporative cooling shows up on colored display.

Real time analysis shows the extent of water damage

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Mold Concerns

Leaky sink

MOLD SOURCES ARE COMMON

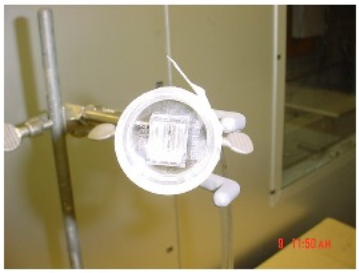
Aerosol management during mitigation is necessary

Leaks plastic laminate lack of caulk

Pressure release valve stuck open with rust

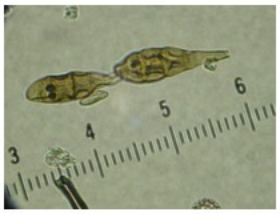
55

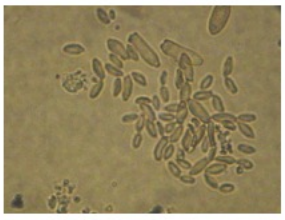
Common Air Sample Method



Sticky slide impaction

Real time analysis of spore Morphology. Genus only ID





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Air sample interpretation
(problem)

- Indoor/Outdoor ratio >1 (Precipitation not present)
- Indoor problem area different from indoor control
- Indoor organisms are not similar to outdoor organisms
- Aggressive samples have higher counts than passive samples.

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Surface sampling strategy

- Indoor problem
- Indoor control
- Plate control

Looking for:

- Suspected poor maintenance
- Area with previous water damage

METHODS
Rodac contact plate (viable)
Swab plate (viable)
Tease tape (non-viable)
Vacuum method (viable)

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- Particle counters tell the rank order
- Pressure gauges give air velocity
- Balancing hoods verify air exchanges

These parameters should be kept stable and should be checked when changes or adjustments in the HVAC system occur.

MONITORING PARAMETERS DEMONSTRATE EXISTING VENTILATION CONDITIONS

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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

VENTILATION ASSURANCE BEFORE PATIENT OCCUPANCY

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Objectives for Infection Control during Construction in Healthcare Facilities

- Respectful of patients
- Control aerosols
- Maintain a clean environment
- Prevent water damage
- Respond to emergencies
- Provide documentation
- Be trained & communicate

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QUESTIONS?

Andrew Streifel
<strei001@umn.edu>

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www.webbertraining.com/schedulep1.php

November 7, 2019	HEALTHCARE-ASSOCIATED PNEUMONIA THAT IS NOT VENTILATOR-ASSOCIATED: BIG PROBLEM, BUT GUIDELINE-FREE ZONE Speaker: **Martin Kiernan**, University of West London
November 12, 2019	*(FREE European Teleclass)* THE ROLE OF CLEANERS IN INFECTION PREVENTION - NEGLECTED FRONT LINE WORKERS IN HEALTHCARE FACILITIES Speaker: **Prof. Wendy Graham**, London School of Hygiene & Tropical Medicine, and **Claire Kilpatrick**, The Soapbox Collaborative ***Sponsored by the World Surgical Infection Society*** WSIS
November 14, 2019	*(FREE Teleclass)* AHEAD – A CONSOLIDATED FRAMEWORK FOR BEHAVIOURAL INFECTIOUS RISKS IN ACUTE CARE – PART 2 Speaker: **Prof. Hugo Sax** and **Dr. Lauren Clack**, University of Zurich Hospitals, Switzerland
November 21, 2019	PRIORITIZING RESEARCH AREAS FOR ANTIBIOTIC STEWARDSHIP PROGRAMS

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World Health Organization — Infection Prevention and Control Global Unit — www.who.int/gpsc/en