GUIDELINES FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTH-CARE FACILITIES, 2003

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GUIDELINE FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES

- Review recommendations for:
  - Air
  - Water
  - Environmental Services
  - Environmental Sampling
  - Laundry and Bedding
  - Animals in Healthcare Facilities
  - Regulated Medical Waste

GUIDELINE FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES

- Ranking of Recommendations
  - Category IA-strongly recommended and strongly supported by studies
  - Category IB-strongly recommended and supported by some studies and strong theoretical rationale
  - Category IC-required by regulatory agencies
  - Category II-suggested for implementation

MECHANISMS OF TRANSMISSION

- Contact
  - Direct (actual physical contact between source and patient)
  - Indirect (transmission from source to patient through an intermediate object)
  - Droplet (transmission $\leq$3 feet)
- Airborne (true airborne phase of transmission)

MECHANISMS OF TRANSMISSION

- Common vehicle-source is common to those who acquire the disease
  - Food
  - Water
  - Medications
  - Blood
  - Equipment
- Arthropod-borne

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NOSOCOMIAL AIRBORNE FUNGAL INFECTIONS

AIRBORNE FUNGAL OUTBREAKS

Requirements

- Susceptible host
- Reservoir
- Source
- Infecting dose inhaled (most dependent on concentration of fungi in the air)

MOST COMMON PATHOGENS ASSOCIATED WITH CONSTRUCTION OR RENOVATION OUTBREAKS

- *Aspergillus* spp. (by far most important)
- Zygomycetes
- Other fungi
- Miscellaneous

Aspergillus

- *Aspergillus* spores are ubiquitous (soil, fruits, vegetables, dust, decaying organic matter) in the environment
- Conidia may travel long distances as airborne particles and are inhaled by humans (several hundred spores each day)
- In most healthy persons, spores are removed by innate defense mechanisms (macrophages)
- Severely immunocompromised (IC) hosts (hematologic, solid organ transplant) a serious complication
- Air is normally the route of fungal spore transmission

Medically-Important Mycotic Agents

Aspergillus fumigatus

NOSOCOMIAL ASPERGILLOSIS IN OUTBREAK SETTINIGS

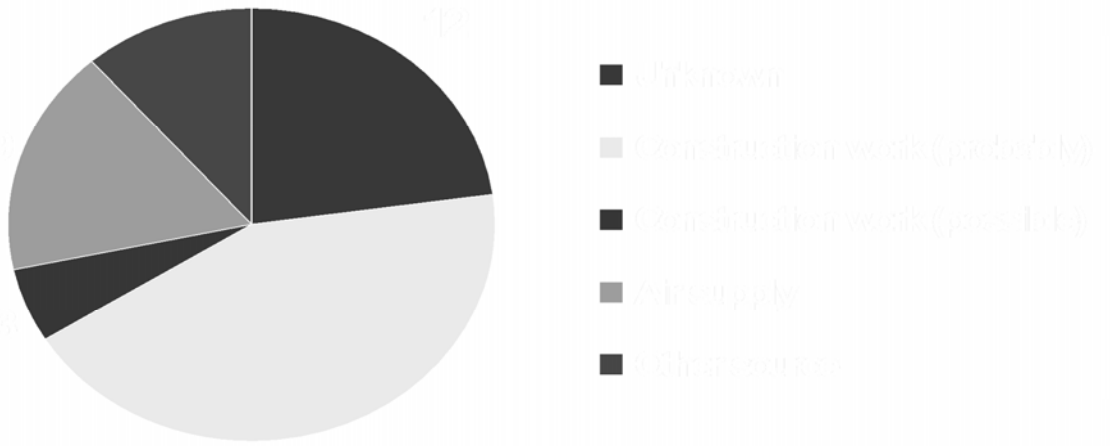
Vonberg, Gastmeier. JHI 2006. 63:245

- 53 studies with 458 patients
- 356 patients (78%) were lower respiratory tract
- *Aspergillus fumigatus* (154) and *A. flavus* (101)
- Underlying disease-hemotologic malignancies 299 (65%)
- Overall fatality rate in these 299 patients (57.6%)
- Construction or demolition probable/possible source-49%; virtually all outbreaks attributable to airborne source, usually construction
- Patients at risk should not be exposed to *Aspergillus*

UNDERLYING CONDITIONS IN PATIENTS WITH NOSOCOMIAL ASPERGILLOSIS

	No. of Patients	Mortality (%)
Hematologic malignancy	299	57.6
Solid organ transplant		55.9
● Renal transplant	36	
● Liver transplant	8	
Other immunocompromised		52.3
● High-dose steroid therapy	15	
● Neonates	5	
● Other malignancy	4	
● Chronic lung disease	2	
● ICU patients (“high-risk”)	2	
● No exact classification possible	49	
Patients without severe immunodeficiency		39.4
● Thoracic surgery	25	
● Cataract surgery	5	
● ICU patients (“low risk”)	5	
● Other surgery patients	3	
TOTAL	458	55.0

NOSOCOMIAL ASPERGILLOSIS IN OUTBREAK SETTINGS



Vonberg R-P, Gastmeier P. J Hosp Infect 2006;63:246-54

Characteristics of Patients and Causative *Aspergillus spp* in Nosocomial Outbreaks

Vonberg, Gastmeier. JHI 2006. 63:245

Table I Characteristics of patients and causative *Aspergillus* spp. in nosocomial outbreaks

Author (year, country)	Patient group (*N* patients)	Patients (*N* fatal)	Primary site of infection (*N*)	Clinical *Aspergillus* spp. isolates (*N*)
Gage *et al.* (1970, USA)[53,54]	T-SURG (4)	4 (3)	Endocarditis (4)	*fumigatus* (3); *glaucus* (1)
Burton *et al.* (1972, USA)[55]	RTX (4)	4 (0)	LRTI (4)	*fumigatus* (4)
Rose (1972, USA)[39]	HEMA (?); others (?)	Total: 23 (total: 12)	LRTI (23)	*fumigatus* (≥12)
Aisner *et al.* (1976, USA)[40]	HEMA (8)	8 (≥3)	LRTI (7); sinusitis (1)	Unknown (8)
Kyriakides *et al.* (1976, USA)[56]	RTX (3)	3 (1)	LRTI (3)	*fumigatus* (3)
Arnow *et al.* (1978, USA)[57]	RTX (3)	3 (1)	LRTI (2)	*fumigatus* (3)
Mahoney *et al.* (1979, USA)[58]	HEMA (5)	5 (3)	Sinusitis (3); LRTI (2)	*fumigatus* (1); unknown (4)
Lentino *et al.* (1982, USA)[49]	RTX (7); HEMA (3)	Total: 10 (total: 4)	LRTI (10)	Unknown (10)
Sarubbi *et al.* (1982, USA)[59]	HEMA (?); others (?)	Total: 22 (total: 1)	LRTI (1)	*flavus* (22)
Gustafson *et al.* (1983, USA)[60]	RTX (9)	9 (7)	LRTI (8); epidural abscess (1)	*fumigatus* (3); unknown (6)
Gerson *et al.* (1984, USA)[61–63]	HEMA (15)	15 (?)	LRTI (15)	Unknown (15)
Grossman *et al.* (1985, USA)[64]	HEMA (6)	6 (0)	Skin infection (6)	*flavus* (3); *fumigatus* (2); *niger* (1)
Krasinski *et al.* (1985, USA)[65]	Neonates (1)	1 (1)	Skin infection (1)	Unknown (1)
Rotstein *et al.* (1985, USA)[66,67]	HEMA (10)	10 (10)	LRTI (9); sinusitis (1)	*fumigatus* (7); *flavus* (3)
Opal *et al.* (1986, USA)[68]	HEMA (7); steroids (3); ONCO (1)	7 (7) 3 (3) 1 (1)	LRTI (11)	*flavus* (4); *fumigatus* (1); *niger* (1); unknown (5)
Allo *et al.* (1987, USA)[69]	HEMA (9)	9 (2)	Skin infection (9)	*flavus* (8); unknown (1)
Perraud *et al.* (1987, France)[70,71]	HEMA (22)	22 (18)	LRTI (22)	*fumigatus* (22)
Ruutu (1987, Finland)[72,73]	HEMA (8)	8 (8)	LRTI (8)	*fumigatus* (8)
Sherertz *et al.* (1987, USA)[3]	HEMA (14)	14 (13)	LRTI (14)	*fumigatus* (?); *flavus* (?)
Weems *et al.* (1987, USA)[74]	HEMA (3)	3 (3)	LRTI (3)	Unknown (3)
Harvey *et al.* (1988, UK)[75]	ICU patients low risk (2);	2 (2)	Endocarditis (3)	*fumigatus* (≥3)

Fungal Outbreaks and Infections Associated with Construction, Renovation and demolition, 1975-2014

Kanamori, Rutala, Sickbert-Bennett, Weber. Clin Infect Dis 2015;61:434

Table 1 continued.

Author, Year	Patient Population	No. of Patient Infected	No. of Patient Deaths	Type of Infection (Site)	Type of Fungi	Reservoir or Source	Airborne Fungal Level(s)	Molecular Typing	Control Measures
Brincker, 1991 [18]	Acute leukemia	10	4	*Aspergillus* infection (lung)	Unknown	Indoor building renovation, Increased spores in ward locations with heavy traffic of patients and staff	At least 11.2 *Aspergillus* per 24h-settle plate	Unknown	Unknown
Flynn, 1993 [20]	BMT recipients, acute myeloid leukemia, or disseminated choriocarcinoma	4	4	*Aspergillus* infection (lung)	*A. terreus*	Hospital renovation, entry of fungal organisms from corridors, stairwells, elevator, shafts serving the ICU and renovation areas due to the negative air pressure gradient	Fungal spores >71/m^3 at elevator shafts during renovation	Unknown	Reestablished positive pressure and unidirectional airflow
Iwen, 1994 [22]	Neutropenic patients who underwent high-dose chemotherapy	5	Unknown	Invasive *Aspergillus* infection (unknown)	*A. fumigatus*, *A. flavus*	Hospital construction, increase in molds in the air occurred in the patient rooms and corridor adjacent to construction staging area, windows in the adjacent corridor as the most likely source of mold contamination	0.14 cfu fungi per hour per settle plate (before construction) to 0.40 cfu fungi per hour per settle plate (after construction)	Unknown	Special care unit closed to incoming patients, window casements, plumbing penetrations, electrical outlets, and other sources for potential air leaks visually examined and sealed, HEPA filters replaced, each room terminally cleaned with subsequent follow-up testing by air-settling plates
Buffington, 1994 [21]	Acute leukemia or aplastic anemia	7	6	Invasive *Aspergillus* infection (unknown)	*A. flavus*, *A. fumigatus*, *Aspergillus* sp.	Construction activity, staff and visitors frequently walking through breezeway by the construction	Unknown	Randomly amplified polymorphic DNA (R different pattern, similar pattern banding from case patient, healthcare worker, and environmental source)	Laminar air flow rooms with HEPA filters, air intake ducts decontaminated with formaldehyde vapor
Loudon, 1994 [23]	Hematologic malignancies (acute lymphoblastic leukemia, acute myeloid leukemia, lymphoma, Hodgkin's disease)	7	5	Invasive *Aspergillus* infection (lung)	*A. fumigatus*, *A. flavus*	Extensive building work was ongoing on the ground floor beneath the hematology unit, *Aspergillus* for showerhead	Unknown	Silver staining of sodium dodecyl sulphate-polyacrylamide gels, immunoblot fingerprinting, and random amplification of polymorphic DNA (3 cases indistinguishable)	Itraconazole prophylaxis

AIRBORNE FUNGAL OUTBREAKS

Portal of Entry	Number of Outbreaks
Respiratory tract	27
Skin	7
Operative site	3
Peritoneal dialysis catheter	1
Mixed	1
Not stated	2

Fungal Outbreaks and Infections Associated with Construction, Renovation and demolition, 1975-2014

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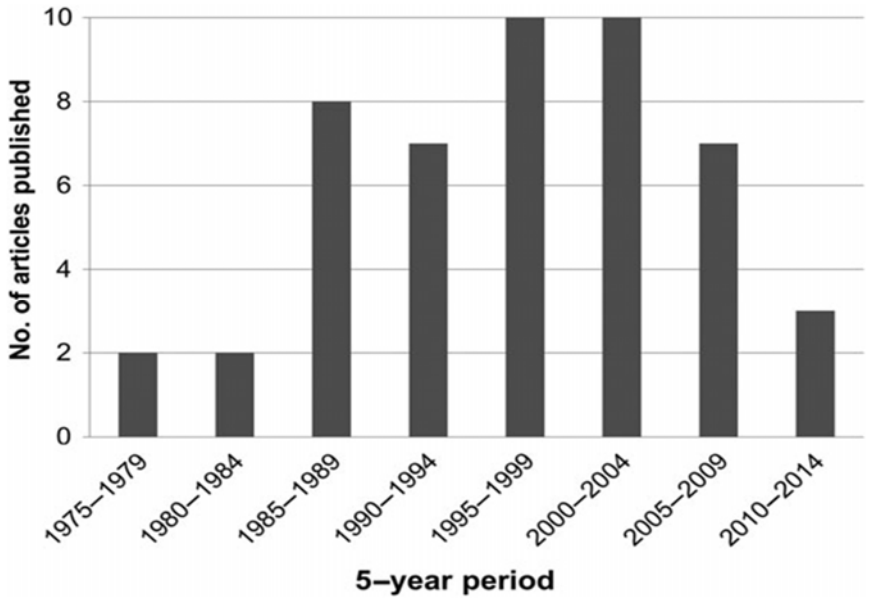


AIRBORNE FUNGAL OUTBREAKS

- Shown to increase the amount of airborne fungal spores dramatically (and in consequence increases the risk of *Aspergillus* infection in susceptible patients)
  - Internal renovation/construction/excavation-construction is a never-ending phenomenon
  - Ceiling access
  - Contaminated or defective air supply
- Minimal airborne concentration of *Aspergillus* necessary to cause infection in IC patients remains unknown

AIRBORNE FUNGI AT UNC HEALTH CARE, 2013

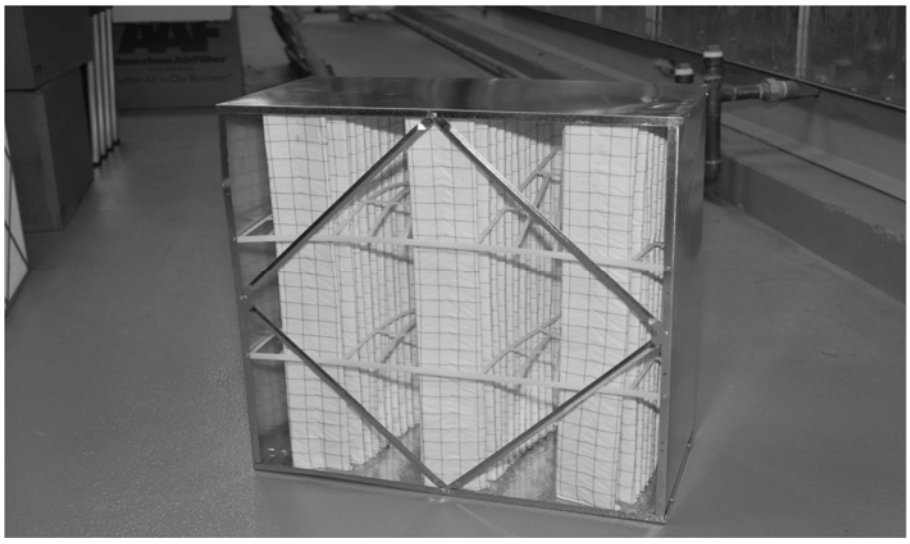
- Air sampling conducted using large volumes (>1000L) to increase likelihood of detecting a low level of spores
- BMTU Air Sampling
  - 1 fungal colony (no *Aspergillus*)
- Outside Air Sampling
  - 85 fungal colonies-100L (850 fungal colonies in 1000L)

Heating, Ventilation and Air Conditioning

Four HVAC Systems In Cancer Hospital

Heating, Ventilation and Air Conditioning

MERV 14 (90-95% in 0.3-1u)



RELEVANT GUIDELINES

- 2003: Guidelines for preventing health-care-associated pneumonia (HICPAC)
- 2003: Guidelines for environmental infection control in health-care facilities (CDC, HICPAC)
- 2000: Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients (CDC, IDSA, ASBMT)
- American Institute of Architects Academy of Architecture for Health. Guidelines for Design and Construction of Hospital and Health Care Facilities , 2006. (telephone #: 888-272-4115)
- Construction and Renovation, 3rd Edition ,and Infection Prevention for Construction DVD, Association for Professionals in Infection Control and Epidemiology, 2007 ($173 member price) APIC store: www.apic.org/
- APIC Text of Infection Control and Epidemiology, 3rd ed. Association for Professionals in Infection Control and Epidemiology, 2009. www.apic.org/
- ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers

INFECTION CONTROL RISK ASSESSMENT (ICRA)

- ICRA is an multidisciplinary, organizational, documented process that after considering the facility's patient population and type of construction project (non-invasive to major demolition):
  - Focuses on reduction of risk from infection
  - Acts through phases of facility planning, design, construction, renovation, facility maintenance and
  - Coordinates and weights knowledge about infection, infectious agents, type of construction project and care environment permitting the organization to anticipate potential impact

MATCH RISK GROUP WITH CONSTRUCTION TYPE

	Construction Project Type			
Patient Risk Group	**TYPE A**	**TYPE B**	**TYPE C**	**TYPE D**
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that Class III or Class IV control procedures are necessary.

INFECTION CONTROL BY CLASS

	During construction	After construction
CLASS IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Dept. 2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 3. Contain construction waste before transport in tightly covered containers. 4. Cover transport receptacles or carts. Tape covering unless solid lid. 5. Vacuum work area with HEPA filtered vacuums. 6. Wet mop area with cleaner/disinfectant. 7. Upon completion, restore HVAC system where work was performed.

SURVEILLANCE[1]

- Maintain a high index of suspicion for healthcare-associated pulmonary aspergillosis in severely immunocompromised patients (ANC <500/mm^3 for 2 weeks or <100/mm^3 for 1 week)(IA)
- Surveillance cultures
  - Do NOT perform routine, periodic cultures of nasopharynx (IB)
  - Do NOT perform routine, periodic cultures of equipment or devices used for respiratory therapy, PFTs, or dust in rooms of HSCT recipients (IB)
  - NO recommendation for routine microbiologic air sampling before, during, or after facility construction or renovation (Unresolved)
- Perform routine surveillance of the ventilation status of PEs: room air exchanges, pressure relations, filtration efficacy (IB)

[1]Tablan OC, et al. Guidelines for preventing health-care-associated pneumonia, 2003

PREVENTION

- Well designed and maintained ventilation system
  - Appropriate placement of intake ducts
  - Filter all hospital air (90-95% efficient filters)
  - Maintain filter integrity
  - Maintain appropriate pressure relationships
  - Proper maintenance of fans and filters
- Review all construction and renovation activities
- HEPA filters in HVAC in “high” risk areas

PREVENTION

- Procedures during construction and renovations
  - Seal hospital construction areas behind impervious barriers
  - Clean construction area daily (i.e., remove dust)
  - Assure that ventilation system does not transport dust from inside construction area to other locations
  - Move immunocompromised patients from adjacent areas
  - Thoroughly clean construction area prior to patient use
  - Conduct surveillance for airborne fungal infections
  - Avoid transporting construction material through patient areas

AIR-HANDLING SYSTEMS IN HCF

- Ensure HVAC filters are properly installed and maintained (IB)
- Monitor areas with special ventilation (AII, PE) for ACH and pressure differentials (IB)
- Inspect filters periodically (IC)
- Ensure intakes (>6 ft above ground) and exhaust outlets (>25 ft from intake) are located properly (IC)

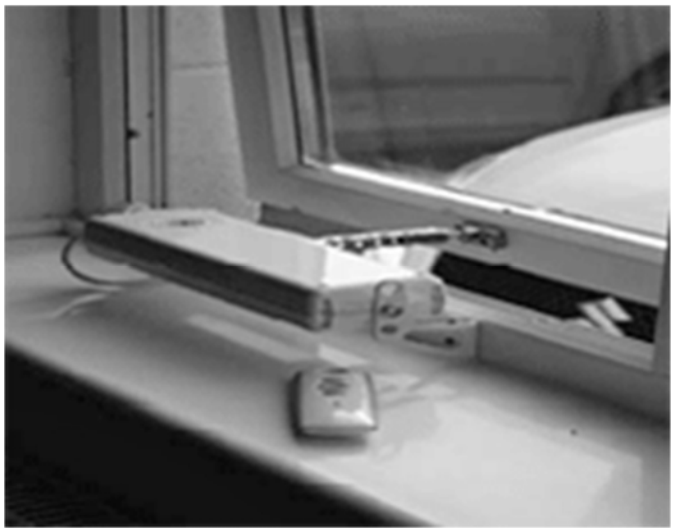
Heating, Ventilation and Air Conditioning

Filter Bank of MERV 8

AIR-HANDLING SYSTEMS IN HCF

- Do not use through-the-wall ventilation units (air induction ventilation) for PE (IC)
- Seal windows with centralized HVAC, especially PE areas (IB, IC)
- Do not shut down HVAC for other than required maintenance, filter changes, and construction (IB, IC); coordinate to allow relocation of IC (IC)
- Keep emergency doors and exits in PE (protective environments) closed (II)

Windows Closed



CONSTRUCTION, RENOVATION, REPAIR

- Establish a multi-disciplinary team to coordinate construction (IB,IC)
- Educate both the construction team and healthcare staff in IC patient-care areas about the airborne infection risk (IB)
- Incorporate mandatory adherence agreements for infection control into construction contracts (IC)

CONSTRUCTION, RENOVATION, REPAIR

- Using active surveillance, monitor for airborne infections in IC patients (IB)
- Implement infection control measures: define the need for barriers (IB), ensure proper operation of the HVAC system (IB), implement dust control measures (IB), relocate IC patients as needed (IB), clean work zones daily (IB), create negative pressure in work areas relative to adjacent patient-care areas (IB), provide crews with designated entrances, corridors, elevators (IB)

SPECIAL HEALTHCARE SETTINGS

High Risk Patients (PE, Solid Organ Transplants, Neutropenic)

- Planning new units for high-risk patients
  - Air-filtration: Install HEPA filters (99.97% efficient in filtering 0.3µ-sized particles) either centrally or point of use (IB)
  - Directed airflow: Place air-intake and exhaust ports so that room air flows across patient's bed and exits on opposite side of the room (IC)
  - Well-sealed room (IB)
  - Room-air pressure: Maintain room at positive pressure with respect to corridor (IB)
  - Room-air changes: Maintain at ≥12 per hour (IC)

SPECIAL HEALTHCARE SETTINGS

High Risk Patients (PE, Solid Organ Transplants, Neutropenic)

- Do not routinely use laminar airflow (100-400 ACH) in PE (II).
- Minimize exposure of high-risk patients to activities that might cause aerosolization of fungal spores (eg, vacuuming, disruption of ceiling tiles) (IB)
- Patients leave their room, provide respiratory protection (eg, N95, surgical mask) (II)
- Minimize time the IC patients are outside their rooms for diagnostic procedures and other activities (IB)

SPECIAL HEALTHCARE SETTINGS

(Airborne Infection Isolation-AII)

- Planning new or renovating AII units
  - Directed airflow: exhaust air to the outside, away from air-intake and populated areas (IC)
  - Well-sealed room (IB)
  - Room-air pressure: Maintain continuous negative room with respect to corridor; monitor air pressure periodically (IB).; install self-closing doors (IC)
  - Room-air changes: Maintain at ≥12 per hour (IB)

SPECIAL HEALTHCARE SETTINGS

(Operating Rooms)

- Infection control measures for operating rooms
  - Room-air pressure: Maintain positive-pressure ventilation with respect to corridors and adjacent areas (IC)
  - Room-air changes: Maintain at ≥15 per hour (IC) with at least 3 ACH of fresh air (20 AC/hr per FGI)
  - Directed Airflow: Introduce air at the ceiling and exhaust air near the floor (IC)
  - Doors: Keep room doors closed except for essential personnel, patients, equipment ; limit entry to essential personnel (IB)

SPECIAL HEALTHCARE SETTINGS

(TB in Operating Rooms)

- If possible, last case of the day to allow for maximum removal of air contaminates (II)
- OR personnel should use N95 respirators (IC)
- Intubate in the OR or AII (IB); extubate in AII (IB); keep OR door closed after intubation until 99.9% air contaminants are removed (IC)
- Use portable HEPA if the ACH does not meet specifications for negative pressure (II)

Portable HEPA Units

Rutala et al. ICHE 1995;16:391

Can rapidly reduce levels of airborne particles (0.3µ, for example, 90% in ~5 m); used in construction worksite and reduce risk to TB exposure.

SUMMARY

- Airborne fungal infections cause significant morbidity and mortality for immunocompromised patients
- Despite understanding of the usual sources and reservoirs of these pathogens outbreaks continue to occur
- Well-designed and maintained ventilation systems and use of proper infection control techniques during construction will prevent most fungal outbreaks

SUMMARY

- Surveillance is key to early detection of outbreaks
- In the event of an outbreak careful evaluation of cases and an environmental evaluation will usually uncover a correctable cause
- New tools of molecular epidemiology may prove useful to link specific reservoirs with outbreaks

GUIDELINE FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES

- Review recommendations for:
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  - Water
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  - Environmental Sampling
  - Laundry and Bedding
  - Animals in Healthcare Facilities
  - Regulated Medical Waste

Water As A Source of Nosocomial Outbreaks

WATER AS A SOURCE OF NOSOCOMIAL OUTBREAKS

WATER RESERVOIRS

- Potable water
- Sinks
- Faucet aerators
- Showers
- Tub immersion
- Toilets
- Dialysis water
- Ice and ice machines
- Water baths
- Flowers
- Eye wash stations

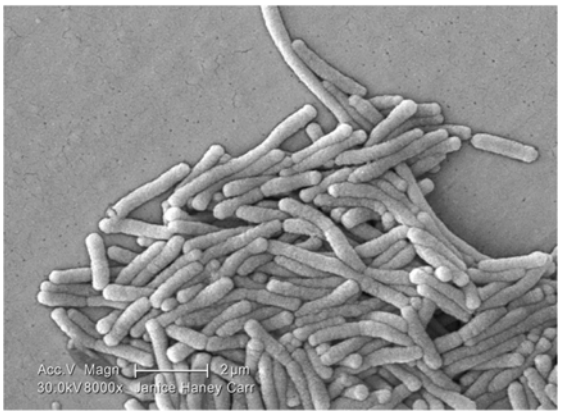
LEGIONELLA: EPIDEMIOLOGY

- 10,000 - 40,000 cases/yr (1-5% of adult pneumonia)
- Reservoir: Ubiquitous in aquatic environments
- Associated with devices that produce potable or non-potable water aerosols (e.g., cooling towers, evaporative condensers, showers, faucets, decorative water fountains, whirlpool baths, ice machines, medication nebulizers, nasogastric feedings diluted in tap water)
- Transmission: Inhalation of aerosols (no person-to-person transmission)

CONTROLLING WATERBORNE MICROORGANISMS

- Water Systems in HCF
  - Hot water temp at the outlet at the highest temp allowable, preferable >124^{o}F (IC)
  - When state regulations do not allow hot water temp >120^{o}F, chlorinate the water or periodically increase >150^{o}F (II)
  - Water disruptions: post signs and do not drink tap water (IB, IC)

LEGIONELLA
What's in your water?



LEGIONELLA: CONTROL MEASURES

- Establish surveillance system to detect Legionnaires disease (IB); provide clinicians with lab tests (e.g., urine antigen, DFA, culture)
- No recommendation on culturing water in HCF that do not have patients at high-risk for *Legionella* (transplant)(unresolved issue)
- One laboratory-confirmed case of *Legionella,* or two cases suspected in 6 mo in facility that does not treat IC patients, conduct epidemiological investigation (IB).

LEGIONELLA: CONTROL MEASURES

- One case in IC patient, conduct a combined epidemiological and environmental investigation (IB)
- If evidence of HA transmission, conduct environmental investigation to determine source: collect water samples from potential source of aerosolized water and subtype isolates of *Legionella* from patients and environment (IB)
- If source identified, institute water system decontamination (IB) and assess the efficacy of implementing control measures (IB)
- Culturing for *Legionella* in water from transplant units can be performed as part of comprehensive strategy (II)

LEGIONELLA: CONTROL MEASURES

- If *Legionella* spp are detected in water of a transplant unit, do the following:
  - Decontaminate the water supply (IB)
  - Restrict immunocompromised patients from showers (IB)
  - Use non-contaminated water for sponge baths (IB)
  - Provide sterile water for drinking, tooth brushing (IB)
  - Do not use water from faucets in patient rooms (IB)

DIALYSIS WATER

- Excessive levels of gram-negative bacilli in the dialysate have been responsible for pyrogenic reactions in patients
- Hazard caused by bacteria or endotoxin gaining entrance into the blood from the dialysate

DIALYSIS WATER

Control Measures

- Sample dialysis water (input) monthly (IA)
  - Maintain water <200 bacteria/mL
- Sample dialysate (output) monthly (IA)
  - Maintain water <2,000 bacteria/mL
- Perform endotoxin testing (IA)
- Disinfect water distribution system on a regular basis (monthly recocommended) (IA)

ICE AND ICE MACHINES

- Occasional source for nosocomial outbreaks
- Large outbreaks have developed when ice machines have become contaminated and ice used for cooling drinking water
- Typical pathogens
  - *Mycobacteria*
  - *Cryptosporidium*
  - *Salmonella*
  - *Legionella*

ICE AND ICE MACHINES

Control Measures

- Do not handle ice by hand (II)
- Use scoop to dispense ice and keep scoop on chain (not in ice bin)(II)
- Do not store pharmaceuticals or medical solutions on ice intended for consumption (IB)
- Limit access to ice-storage chests (II)
- Machines that dispense ice are preferred (II)
- Clean and disinfect ice-storage chests on a regular basis (eg, monthly)(II)

HYDROTHERAPY TUB

HYDROTHERAPY TANKS AND POOLS

- Used in hospitals for physical therapy for cleaning of burn wounds and birthing
- Skin infections have occurred related to water immersion
  - "Hot tube" folliculitis
  - Cellulitis (rare)
- Typical pathogens
  - Folliculitis: *Pseudomonas aeruginosa*
  - Cellulitis: *Citrobacter*

HYDROTHERAPY TANKS AND POOLS

- Drain after each patient, and disinfect surfaces and components per recommendations (II)
- Add disinfectant to the water: 15 ppm in small hydrotherapy tanks and 2-5 ppm in whirlpools (II)
- Disinfect after using tub liners (II)
- No recommendation for antiseptic in water during hydrotherapy session (unresolved)

DENTAL UNIT WATER

- Problem: Water delivered to dental handpieces and air/water syringes may become contaminated
- Contamination level = 10^2-10^6 microorganisms/ml
- Risk for disease acquisition most likely with immunocompromised patients
- Control measures (between patients)
  - Flush dental instruments with water and air for 20-30s from any dental device connected to the dental water system that enters the patient's mouth (e.g., handpieces)(II)
  - Ensure water in dental unit meets standards (<500 CFU/ml)(IC)

GUIDELINE FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES

- Review recommendations for:
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  - Animals in Healthcare Facilities
  - Regulated Medical Waste

TRANSMISSION

- Person to person
  - Airborne: Influenza
- Environment to person
  - Airborne: *Aspergillus*
- Person to environment to person
  - *Enterococcus* (VRE), *S. aureus* (MRSA)
- Person to fomite (e.g., bronchoscope) to person
  - Indirect contact: Tuberculosis (MDR-TB)

ENVIRONMENTAL SURFACES

- Disinfect noncritical medical equipment surfaces with a EPA-registered hospital disinfectant (II)
- Keep housekeeping surfaces visibly clean using an EPA-registered disinfectant (II) or detergent and water
- Clean walls, blinds, and window curtains when visibly soiled (II)
- Do not do disinfectant fogging (IB)
- Clean/disinfectant blood spills per OSHA (IC)
- Prepare cleaning solutions daily or as needed (II)

CARPETS

- Carpets are heavily colonized with potential pathogens (10^5 bacteria/sq in)
- No evidence that carpets influence healthcare-associated infections
- Control measures: avoid in high-traffic zones in patient-care areas or where spills are likely (IB), clean carpet periodically (II)

FLOWERS

- Flower vases and potted plants are heavily colonized with potential pathogens
  - Vase water colonized with 10^7 - 10^{10} bacteria/ml
- No outbreaks directly linked to flower vases or potted plants
- Control Measures: Flowers and potted plants need not be restricted from immunocompetent patients (II); designate the care of flowers and potted plants to staff not involved in patient care (II); do not allow fresh or dried flowers, or potted plants in patient-care areas for immunosuppressed patients (II)

SPECIAL PATHOGENS

(VRE, MRSA, *C. difficile*)

- Ensure compliance with disinfection procedures (IB)
- Pay special attention to cleaning and disinfecting high-touch surfaces (carts, charts, bedrails) (IB)
- With CP patients, use disposable items when possible (IB)
- Use appropriate handwashing and PPE during cleaning and disinfecting procedures (IB)

GUIDELINE FOR ENVIRONMENTAL INFECTION CONTROL IN HEALTHCARE FACILITIES

- Review recommendations for:
  - Air
  - Water
  - Environmental Services
  - Environmental Sampling
  - Laundry and Bedding
  - Animals in Healthcare Facilities
  - Regulated Medical Waste

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- History
  - Pre-1970, hospitals regularly cultured air and surfaces
  - By 1970, AHA advocated discontinuation because HAI not associated with levels of microbes in the air and surfaces; not cost-effective
  - In 1981, CDC recommended targeted sampling (eg, sterilizers and dialysis water)

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Targeted microbiological sampling
  - Support of an investigation of an outbreak
  - Research
  - Monitor a potentially hazardous environmental condition
  - Quality assurance

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Do not conduct random microbiological sampling of air, water, and surfaces (IB)
- When indicated, conduct microbiologic sampling as part of an epidemiologic investigation (IB)
- Limit microbiologic sampling for QA to: biological monitoring, dialysis water, or evaluation of infection control measures (IB)

MICROBIOLOGIC SAMPLING OF THE ENVIRONMENT

- Select a high-volume sampler if level of microbial contamination are expected to be low (II)
- When sampling water, choose media and incubation temp to facilitate recovery (II)
- When conducting environmental sampling, document departures from standard methods (II)

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LAUNDRY AND BEDDING

- Although fabrics in healthcare facilities can be a source of large numbers of microorganisms 10^6-10^8 CFU/100 cm^2, the risk of disease transmission during the laundry process appears to be negligible
- OSHA defines contaminated laundry as “soiled with blood or OPIM or may contain sharps”

LAUNDRY AND BEDDING

- Bag or contain contaminated laundry at the point of use (IC)
- Do not sort or pre-rinse fabrics in patient-care areas (IC)
- Do not conduct routine microbiological sampling of clean linens (IB)
- Use sterilized linens, drapes, and gowns for situations requiring sterility (IB)
- Use hygienically clean textiles (i.e., laundered) in NICU (IB)

LAUNDRY AND BEDDING

- If hot-water laundry cycles are used, wash with detergent in water at least 160^{o}F for at least 25 min (IC)
- If low-temperature (<160^{o}F) cycles are used, use chemicals suitable for low temperature washing at proper use concentration (II)
- Package, transport and store clean fabrics by methods that ensure their cleanliness and protect them from dust and soil (II)

LAUNDRY AND BEDDING

- Clean and disinfect mattress covers by using disinfectants that are compatible (IB)
- Keep mattresses dry (IB)
- Replace mattress if they become torn (II)
- Air-fluidized beds: change the polyester filter sheet at least weekly (II); clean/disinfect the polyester filter thoroughly, especially between patients (IB)

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ANIMALS

- General Infection Control
  - Minimize contact with animal saliva, urine, feces (II)
  - Practice hand hygiene after animal contact (II)
- Protection for Immunocompromised Patients
  - Conduct a case-by-case assessment to determine animal contact is appropriate (II)
  - No recommendation on pet visits to terminally IC patients outside their PE units (unresolved)

SERVICE ANIMALS

ANIMALS

- Service Animals
  - Avoid the use of nonhuman primates/reptiles (IB)
  - Allow service animals unless the animal creates a threat to other persons or interferes with the provision of services (IC)
  - If separated from handler, designate a responsible person to supervise (II)

PET THERAPY

ANIMALS

- Pet Visitation, Pet Therapy
  - Enroll animals that are fully vaccinated, healthy, clean, negative for enteric pathogens (II)
  - Ensure the animals are trained and supervised (II)
  - Conduct pet therapy in a public area of the facility (II)
  - Use routine cleaning protocols for surfaces (II)
  - Restrict animals from access to patients-care areas, ORs, isolation, PE, places where people eat (II)

ANIMALS

- Animals as patients in human HCF
  - If animal brought to HCF for care, avoid use of OR or area where invasive procedures are performed (II)
  - If reusable medical or surgical instruments are used in an animal procedure, restrict future use of these instruments to animals only (II)

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REGULATED MEDICAL WASTE (RMW)

- Major categories of RMW: microbiology; pathology; bulk blood; sharps (II)
- Develop a plan for collection and disposal of RMW (IC)
- Sharps into puncture-resistant containers (IC)
- Biosafety levels 1 and 2 should autoclave on-site (II); BL 3 must autoclave/incinerate (II)
- Decontaminate blood VHF before disposal (IC)

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Thank you

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