

# **Targeted Environmental Investigation Checklist for Outbreaks of Invasive Infections Caused by Environmental Fungi (e.g., Aspergillus, Mucormycetes)**



**U.S. Department of  
Health and Human Services**  
Centers for Disease  
Control and Prevention

This tool is intended to aid in performing an environmental assessment when investigating healthcare-associated disease outbreaks caused by certain fungi. This checklist is most relevant for environmental fungi like *Aspergillus* spp. and mucormycetes. It is less relevant for fungi like *Candida auris* that involve skin colonization and disperse through inadequate hand hygiene and environmental disinfection; assessment of adherence to infection control practices and environmental cleaning and disinfection are typically more relevant for those investigations.

Epidemiologic assessment should be the foundation of any investigation into outbreaks caused by environmental fungi. Environmental sampling may also be conducted, but sampling should be guided by epidemiologic findings and the environmental assessment, with an understanding that the implications of this testing are unlikely to be definitive.

Not all of sections of this checklist will pertain to every investigation. Where possible, use epidemiologic evidence to guide which sections section to complete. Please use the notes section to describe key findings and concerns. When possible, use diagrams and photos to document the locations and findings of the assessment.

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# Section 1: Initial observations and visual inspection

## Walk-through inspection

(Select patient care areas and other locations based on relevance to potential patient exposures, as informed by epidemiologic review of initial cases)

*Include the following areas in observations: windows, doors, ceilings, walls, floors, bathroom water fixtures/drains, beds including mattress and linens and furnishings*

Elements to be assessed	Notes
General cleanliness (visible dust, dirt, stains, etc.)	
Water damage present (stains, dampness, leaks around plumbing, leaks in ceiling, condensation on surfaces)	
Evidence of fungal growth and damage (visible mold and mildew, stains, mold odor, fungal growth on drywall surface or underneath wall coverings, fungal growth on building's interior support structures and building materials)	
Evidence of air intrusion from outdoors or from other adjacent spaces (note the status of window seals, seals surrounding plumbing pipe intrusions, lack of self-closing doors)	
Other observations of disrepair, lack of maintenance	

## Recent events involving the built environment (up to 6 months prior to first case)

Elements to be assessed	Notes (include date, location affected, and facility elements affected)
System disruptions (e.g., maintenance, water shut-offs, power outages)	
Internal construction, renovation, demolition, repairs	
External construction, renovation, demolition, repairs	
Flooding, heavy rains, or other water damage to facility  If yes, did the facility take steps to dry out wet structural materials within 2-3 days?  If yes, did the facility remove any wet structural materials that could not be dried out within the 2-3 day period?	

## Section 2: Heating, ventilation, and air conditioning (HVAC) system

### Heating, ventilation, and air conditioning (HVAC) system

Elements to be assessed	Notes
HVAC system characteristics including number of systems serving the area, ambient climate control, airflow direction, pressure readings, number of air changes per hour (ACH), and status of filters	
HVAC maintenance and repair including schedule and practices for: change out of filters, filter frame inspection, air duct cleaning, air handler coil maintenance, drip pan maintenance, and visual assessment of supply air grilles for dust accumulation	
Schedule and strategy for building and HVAC system routine maintenance and repair	
Building construction date (or date of the last major renovation involving the HVAC system)	
Notable events or air flow disturbances related to the HVAC system	

### Air changes

For each area/location investigated, assess:

Elements to be assessed	Notes
Total mechanical supply air changes per hour (specify in notes)	
Total mechanical exhaust air changes per hour (specify in notes)	
Outdoor air changes per hour (specify in notes, indicate how determined)	

**NOTE:** If Variable Air Volume and/or setback operations are used, record above parameters for both normal and reduced flow rates and document their operational sequence.

## Filters

For each area/location investigated, assess:

Elements to be assessed	Notes
Filter efficiency (MERV and/or HEPA)	
Location of the filter (room or area)	
Filtration efficiency and performance complies with FGI standards	
Frequency of filter performance monitoring (specify in notes)	
Method used to monitor filter performance (specify in notes)	
Filter situated in frame so that air does not bypass filter	
First filtration bank is upstream of heating and cooling coils	
Second filtration bank is downstream from wet-air cooling coils and supply fan	
Filters (including rough-in and pre-filters) in good repair without excess dust and debris	
Final filter for each fan unit intact	
Filters and fans maintained according to manufacturer's instructions (review maintenance log)	
Seal in for fan and filter access doors HVAC system design	

## HVAC system design and components

Elements to be assessed	Notes
Fans in good condition and operational	
Type of cooling system (specify in notes)	
Presence/type/set points for humidification system (specify in notes)	
Review cooling coils maintenance plan and observations from last inspection	
Cooling coil drip pans clean (e.g., no evidence of standing water)	
Room average temp (winter/summer; specify)	
Room average relative humidity (winter/summer; specify)	
Are there documented episodes where humidity exceeds acceptable upper limit? (See FGI guidelines listed on page 18)  If yes, describe frequency	

## Ductwork diffusers and grille plates

Elements to be assessed	Notes
Ductwork, diffusers, and grille plates unobstructed (i.e. not blocked by furniture or equipment)	
If space reconfigured, are diffusers located appropriately for the current workspace?	
Ductwork, diffusers, and grille plates clean and free of excess dust and debris	
Insulation dry and free of visible mold/mildew	
Insulation more than 15 feet downstream of humidifiers	
Air supply diffusers not redirected?	
Exhaust in good condition and functioning properly?	
Shadow present on the ceiling along the air pathway away from the supply grille	
Supply air grille located in the room	
Room a laminar flow room (if yes, indicate horizontal or vertical)	

## Pressurization and air flow

Elements to be assessed	Notes
Airflow direction and magnitude (Provide map and specify direction & magnitude in notes)	
Continuous visual and/or engineered (e.g. manometer) monitoring of pressure and air flow direction	

## Section 3: Built environment and environmental services

### General

Elements to be assessed	Notes
Year building was constructed (Specify in notes)	
Dates of renovations of outbreak space (Please list dates in notes)	
Evidence or history of interstitial water intrusion	
Roof composed of hard, non-organic materials (i.e. not a green roof)	
Roof undergoing repairs or construction	
Roof free of leaks If no to above, note location of leaks and estimated length of time it was present	
Have the leak(s) been repaired?	

### Environmental cleaning processes

Elements to be assessed	Notes
Facility has established and follows a schedule for areas and equipment to be cleaned and serviced regularly	
Cleaning solutions prepared daily or as needed	
Separate clean cloths used for each room	
Mopheads and cleaning cloths laundered daily	
Rooms cleaned and disinfected daily and terminally as needed If yes, indicate EPA disinfectant used If no, specify cleaning schedule	
Surfaces wet-dusted	
Cleaners and disinfectants used according to manufacturer's instructions	
Furniture with smooth surfaces cleaned	
Privacy curtain replaced or cleaned with scheduled frequency. (Specify schedule, if possible)	
In protected environments (positive pressure rooms), EVS staff wear gowns and gloves while cleaning in these rooms	



## Service area(s)

Include the following areas in observations: mechanical rooms, storage areas corridors, janitorial areas, elevators, and stairwells

Elements to be assessed	Notes
Free of water damage, dampness, dust/debris, visible mold/mildew	
Boilers or steam-producing equipment located away from patient care areas	
Areas adjacent to rooms with boilers or steam-producing equipment dry (i.e. no visible condensation)	
Critical care equipment storage and patient care areas separated	
Storage for patient care items located away from loading docks	

## Indoor public areas (e.g. atria, corridors)

Elements to be assessed	Notes
Free of water damage, dampness, dust/debris, visible mold/mildew	
All surfaces able to be reached for cleaning If no, plan in place to address hard-to-reach surfaces	
Area free of water features (e.g., fountains, water walls, etc.) and fish tanks If no, policies in place to ensure regular cleaning and/or disinfecting of water features	
If the corridor floor is carpeted, it is regularly vacuumed and/or shampooed (Describe frequency in notes)	
Non-care rooms (e.g., conference rooms) immediately adjacent to patient care areas If yes, are these rooms carpeted?	
If yes, describe vacuum/shampoo frequency in notes	

## Section 4: Laundry and healthcare textiles (HCT)

### HCT storage room

Elements to be assessed	Notes
Specify location of inspection: Hospital Contract laundry Other (Please explain in notes)	
HCT storage room located away from facility loading dock	
Clean HCT storage room under positive pressure	
Protocols to minimize dust entry at loading dock	
Storage room has self-closing doors that are kept closed	
Room traffic kept to a minimum	
Surfaces clean and free of dust	
Rooms cleaned and disinfected regularly	
Room temp (winter/summer; specify)	
ACH per hour (specify)	
Airflow direction (specify)	

## Laundry operations

Elements to be assessed	Notes
Laundry services provided by contractors other than the healthcare facility	
Laundry equipment used and maintained according to manufacturer's instructions	
Dryers have in-line filters on the incoming air source	
Sanitizers and disinfectants used in wash cycles	
Processes in place to ensure HCT do not touch floor during laundering	
Water recycling procedures are used	
Wash and dry process procedures are specified (i.e., wash water temperatures, dryer temperatures)	
HCT are dry to the touch when bundled	
Typical holding time for bundled HCT prior to transport to facility is short (specify average hold time if possible)	
Facility is clean (i.e., no visible dust or lint)	
No lint release visible on roof	
Receiving and soiled sort area are at negative pressure	
Areas where clean textiles are manipulated are at positive pressure	
Laundry areas have handwashing facilities/products and appropriate PPE for workers	
Clean laundry protected from dust and lint during blowdown	
Outdoor air infiltration allowed inside the plant? If yes, determine why this is allowed	
Does the laundry have a packroom for surgical textiles	
Storage/holding area for sterilized HCT separate from clean holding area	
Bundled HCT held indoors prior to transport	
Truck cargo bay clean and door closes properly	
Truck cargo bays provide for separation of clean and dirty loads	

## HCT bundles

Elements to be assessed	Notes
HCT bundles covered when stored	
Wrapped HCT bundles are dry (i.e., not moist to the touch)	
If HCT bundles not wrapped, they are protected from dust	
Carts used to transport HCT are clean	
Carts protected from contamination while in storage or during transit	
Bed/bath HCT changed on regular schedule (indicate frequency interval; e.g, daily, weekly)	
EVS staff perform hand hygiene before changing HCT in patient rooms	
HCTs changed when wet in a timely fashion (i.e. do not stay wet for several hours)	
Personnel handle soiled HCT with personal protective equipment and with minimum agitation	
Contaminated HCT bagged or contained at point of use	
Contaminated HCT labeled, color-coded, or otherwise marked	
Linens indicated for use on specialty beds laundered by the hospital's laundry provider	
Hospital use a laundry chute to move soiled textiles	

## Section 5: Equipment and medical devices

For each relevant piece of equipment or device implicated as a possible source of exposure.

Elements to be assessed	Elements to be assessed
Check for presence of water, condensate, dust, fans and filter status (if applicable).	
Check cleaning and disinfection strategy and practice. List devices assessed and findings in notes.	

## Section 6: Construction, renovation, demolition, and repair

### Internal construction

Elements to be assessed	Notes
<p>Internal construction, renovation, demolition or repairs in previous 6-12 months prior to outbreak (or as appropriate for fungal agent)</p> <p>If yes, record date, location, and facility elements affected</p>	
<p>External construction, renovation, demolition, or repairs in previous 6-12 months prior to outbreak (or as appropriate for fungal agent)</p> <p>If yes, record date, location, and facility elements affected.</p>	
<p>Facility conducted an ICRA prior to start of construction</p> <p>If yes, ICRA documentation available for review</p>	
<p>Negative air pressure in construction zone maintained and verified</p>	
<p>Adjacent spaces under positive pressure</p>	
<p>Portable HEPA filters used if needed for dust control in construction zone</p> <p>If yes, HEPA filter units tested and functioning</p>	
<p>Exhaust from construction zone directed away from air intakes</p>	
<p>Plans developed to manage removal of debris, dust control at entrance/exit, and construction personnel cleanup</p>	
<p>Carts with construction debris covered</p>	
<p>Demolition managed to minimize dust dispersion</p>	
<p>Impermeable barriers effectively maintained negative pressure in construction zone</p>	
<p>Plastic sheets or other barriers used</p> <p>If yes, note location and type</p>	
<p>Action plan in place if there are infection control breaches identified</p>	
<p>Breaches in infection control associated with the construction project have been identified</p> <p>If yes, describe what was done to correct them</p>	

Elements to be assessed	Notes
<p>Construction personnel diverted away from patient care areas</p> <p>If no, is there space for changing clothing, equipment, access to food service?</p>	
<p>If equipment or tools leave construction zone, are they vacuumed or wet-dusted to control dust?</p>	
<p>Building materials in good condition with no evidence of physical and/or water damage, dampness, dust, visible mold, or mildew</p>	

### At-risk patients

Elements to be assessed	Notes
<p>Construction does not directly involve at-risk patient area</p>	
<p>Protected environment patients relocated away from construction and construction traffic areas</p>	
<p>Construction occurring in areas separate from (i.e., not adjacent to) at-risk patient care areas</p>	
<p>HVAC system serving at-risk patient care areas is independent or isolated from remainder of HVAC system</p>	

### External construction

Elements to be assessed	Notes
<p>Is the hospital directly adjacent to construction project?</p> <p>If yes, air intakes protected or sealed</p>	
<p>Strategy in place to prevent overloading of HVAC filters</p>	
<p>Windows are well-sealed</p>	
<p>Pedestrian entrances facing construction are closed</p>	
<p>Loading dock redirected if facing construction areas</p>	
<p>Water is monitored for contamination from construction</p>	

## Section 7: Protective environments (PE) and at-risk patients

Elements to be assessed	Notes
Filter bank efficiency: First filter bank: MERV 7 minimum	
Second filter bank with minimum HEPA efficiency is present OR second filter bank with MERV-14 filters if a tertiary terminal filter with minimum HEPA efficiency is provided for these spaces	
Filters situated in frames or housing	
12 total (minimum) air changes per hour (ACH)	
Relative humidity $\leq$ 60%	
Positive pressure per FGI and monitored/recorded daily	
Junctures where ceiling meets walls and walls meet floor are sealed and continuous?	
Supply air diffuser located at or near ceiling	
Planned redundancy for ventilation supplying PE	
No carpeting or upholstered furniture used in patient room or care areas	
No fresh or dried flowers or potted plants in patient care area	
Allogenic patients wear N95 outside of PE, if needed (e.g. construction in other areas)	
Water leaks cleaned and repaired within 72 hours	



## Abbreviations:

**ACH:** Air changes per hour

**ASHRAE:** American Society of Heating, Refrigerating, and Air conditioning Engineers

**EPA:** US Environmental Protection Agency

**EVS:** Environmental services

**FGI:** Facility Guidelines Institute

**HCT:** Healthcare textiles

**HEPA:** High efficiency particulate air

**HVAC:** Heating, ventilation, air conditioning

**ICRA:** Infection control risk assessment

**MERV:** Minimum efficiency reporting value

## Source documents and key references:

FGI Guidelines, 2014

<https://www.fgiguuidelines.org/guidelines/2014-fgi-guidelines/>

FGI Guidelines, 2018

<https://www.fgiguuidelines.org/guidelines/2018-fgi-guidelines/>

ASHRAE standard 170, 2013

[https://www.techstreet.com/ashrae/standards/ashrae-170-2013?product\\_id=1869692](https://www.techstreet.com/ashrae/standards/ashrae-170-2013?product_id=1869692)

ASHRAE standard 170, 2017

[https://www.techstreet.com/ashrae/standards/ashrae-170-2017?product\\_id=1999079&ashrae\\_auth\\_token=12ce7b1d-2e2e-472b-b689-8065208f2e36](https://www.techstreet.com/ashrae/standards/ashrae-170-2017?product_id=1999079&ashrae_auth_token=12ce7b1d-2e2e-472b-b689-8065208f2e36)

CDC Environmental Infection Control Guidelines, 2003

<https://www.cdc.gov/infectioncontrol/guidelines/environmental/index.html>

CMS Hospital Infection Control Worksheet, 2014

<https://www.cms.gov/medicare/provider-enrollment-and-certification/surveycertificationgeninfo/downloads/survey-and-cert-letter-15-12-attachment-1.pdf>

Premier Safety Institute: Infection Control Risk Assessment

<https://www.premiersafetyinstitute.org/safety-topics-az/building-design/infection-control-risk-assessment-icra/>

ASHE Life Safety Risk Assessment Tool

<https://www.ashe.org/system/files/media/file/2019/11/ASHE-LifeSafetyRiskAssessmentFinal.xlsx>

Kanamori et al., 2015. Clinical Infectious Diseases. Aug 1; 61(3).

<https://www.ncbi.nlm.nih.gov/pubmed/25870328>

Tomblyn et al., 2009. Biol Blood Marrow Transplant. Oct; 15(10).

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3103296/>

Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients, 2000

<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr4910a1.htm>



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