

Keeping Healthcare Linens Clean

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Objectives

1. Identify underrecognized hazards and risks associated with laundered healthcare textiles
2. Identify measures indicating use of laundry processes that produce hygienically clean textiles
3. Describe remediation of a laundry facility in response to an outbreak of mold infections

Defining hygienically clean textiles

Defined by AAMI/ANSI¹ as:

“Free of pathogens in sufficient numbers to cause human illness”

CDC Environmental Guidelines²:

“Hygienically clean laundry carries negligible risk to health-care workers and patients, provided that the clean textiles, fabric, and clothing are not inadvertently contaminated before use.”

Defining hygienically clean healthcare textiles



Rhizopus arrhizus (a) culture, (b) columellae and (c) sporangia showing sporangiospores, sporangiophores and rhizoids.

Defining hygienically clean healthcare textiles



Rhizopus arrhizus (a) culture, (b) columellae and (c) sporangia showing sporangiospores, sporangiophores and rhizoids.



Defining hygienically clean healthcare textiles



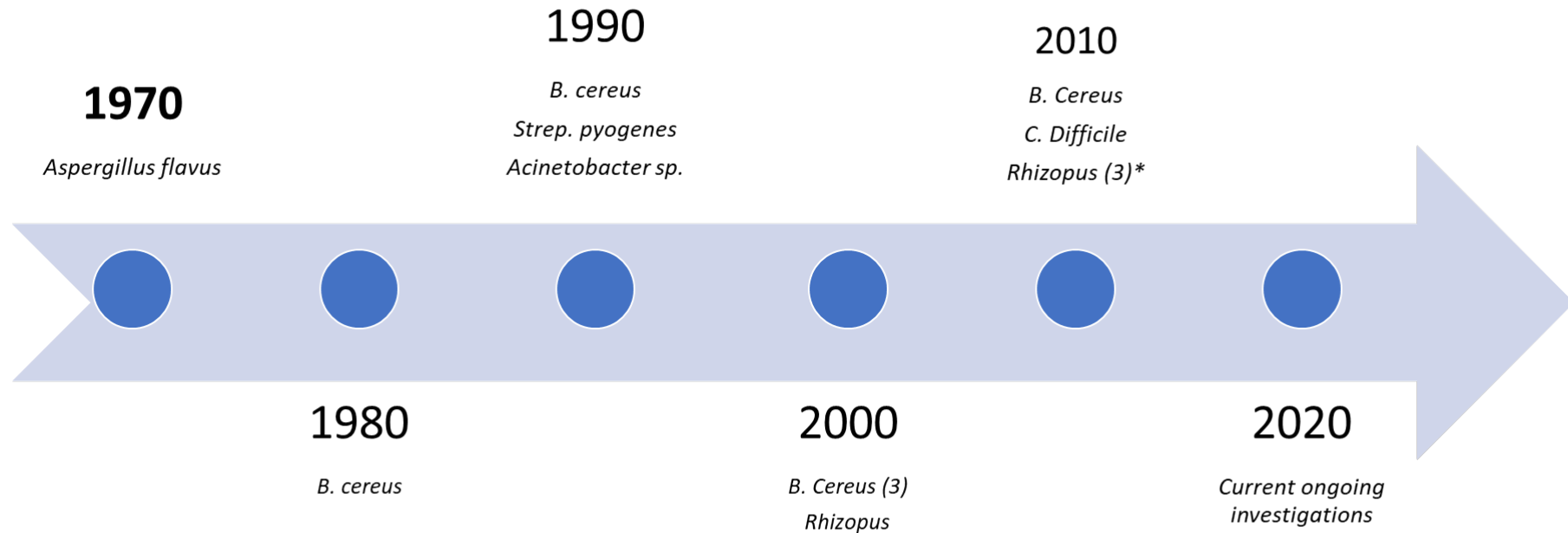
Rhizopus arrhizus (a) culture, (b) columellae and (c) sporangia showing sporangiospores, sporangiophores and rhizoids.



Textile-associated infections affect the most vulnerable patients

Year	Number and population affected	Organism/disease
2009 ¹	5 pediatric patients	Mucormycosis
2012 ²	13 newborns, 1 pediatric patient	Drug resistant <i>Klebsiella</i>
2015 ³	4 adult immunosuppressed patients	Mucormycosis
2015 ⁴	6 adult immunosuppressed patients	Mucormycosis
2017 ⁵	4 neonatal ICU patient	Aspergillus
2021 ⁶	16 adult trauma, immunosuppressed patients	Mucormycosis

Healthcare textile-associated outbreaks over the last 50 years



Mucormycosis: a medical emergency

- Can affect a variety of body sites
- Requires aggressive surgery and powerful antifungal medications
- Rare infection, affects immunosuppressed patients

**High mortality
rate**

~50%



Outbreak Response – Laundry Facility Participation is Key

Your participation in an outbreak investigation is critical to

- Prevent patient harm
- Build healthcare facility confidence in performance
- Maintain healthcare facility compliance with CMS Conditions of Participation
- Speed industry-wide changes that could protect patients

CDC learns from facilities

- This can result in evidence-based interventions and realistic expectations
- CDC is highly committed to preventing patient harm

A Case Review: Mucormycosis Outbreak

Clinical Infectious Diseases

MAJOR ARTICLE



Remediation of Mucorales-contaminated Healthcare Linens at a Laundry Facility Following an Investigation of a Case Cluster of Hospital-acquired Mucormycosis

Alexander J. Sundermann,^{1,2,a} Cornelius J. Clancy,^{1,3,a} A. William Pasculle,³ Guojun Liu,¹ Shaoji Cheng,¹ Richard B. Cumbie,³ Eileen Driscoll,³ Ashley Ayres,³ Lisa Donahue,³ Michael Buck,⁴ Andrew Streifel,⁴ Carlene A. Muto,⁵ and M. Hong Nguyen^{1,3}

¹University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, USA; ²University of Pittsburgh Graduate School of Public Health, Pittsburgh, Pennsylvania, USA; ³University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA; ⁴University of Minnesota Department of Environmental Health and Safety, Duluth, Minnesota, USA; and ⁵University of Virginia Division of Infectious Diseases and International Health, Charlottesville, Virginia, USA

A Case Review: Mucormycosis Outbreak

- Initial investigation into cases of mucormycosis at our facility
- Environmental cultures directed towards healthcare linens
- How do we culture linens?

NEWS

UPMC: Transplant program shut down as mold investigation continues



BEN SCHMITT | Monday, Sept. 21, 2015 12:00 a.m.

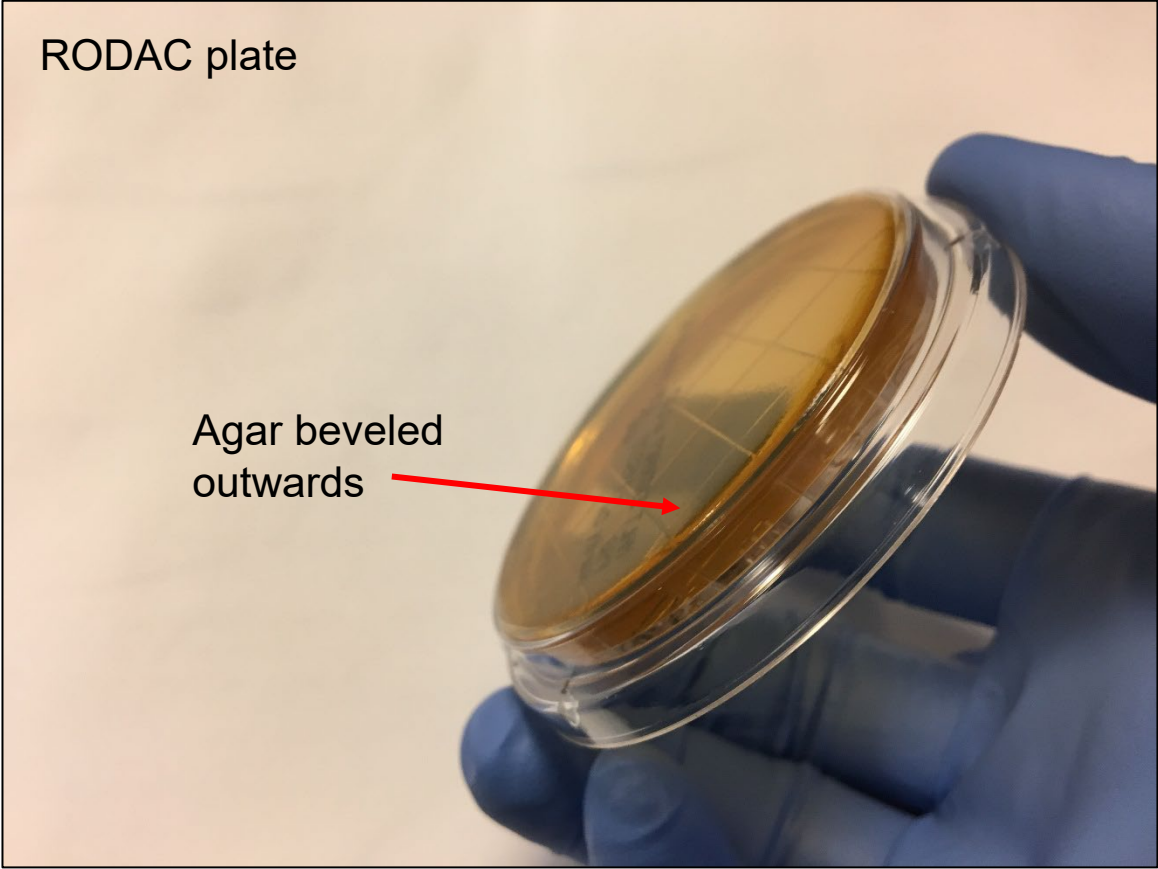
health Life, But Better Fitness Food Sleep Mindfulness Relationships

Mold at two Pittsburgh hospitals linked to 5 deaths

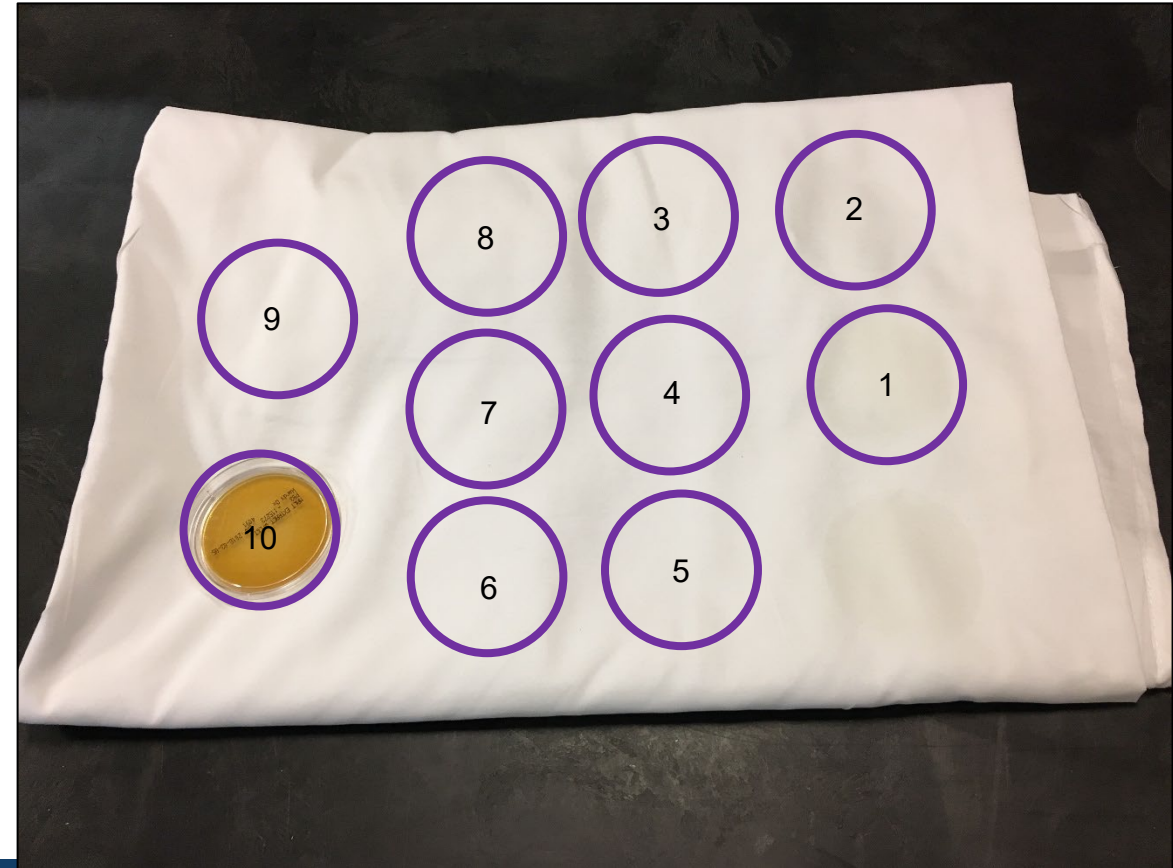
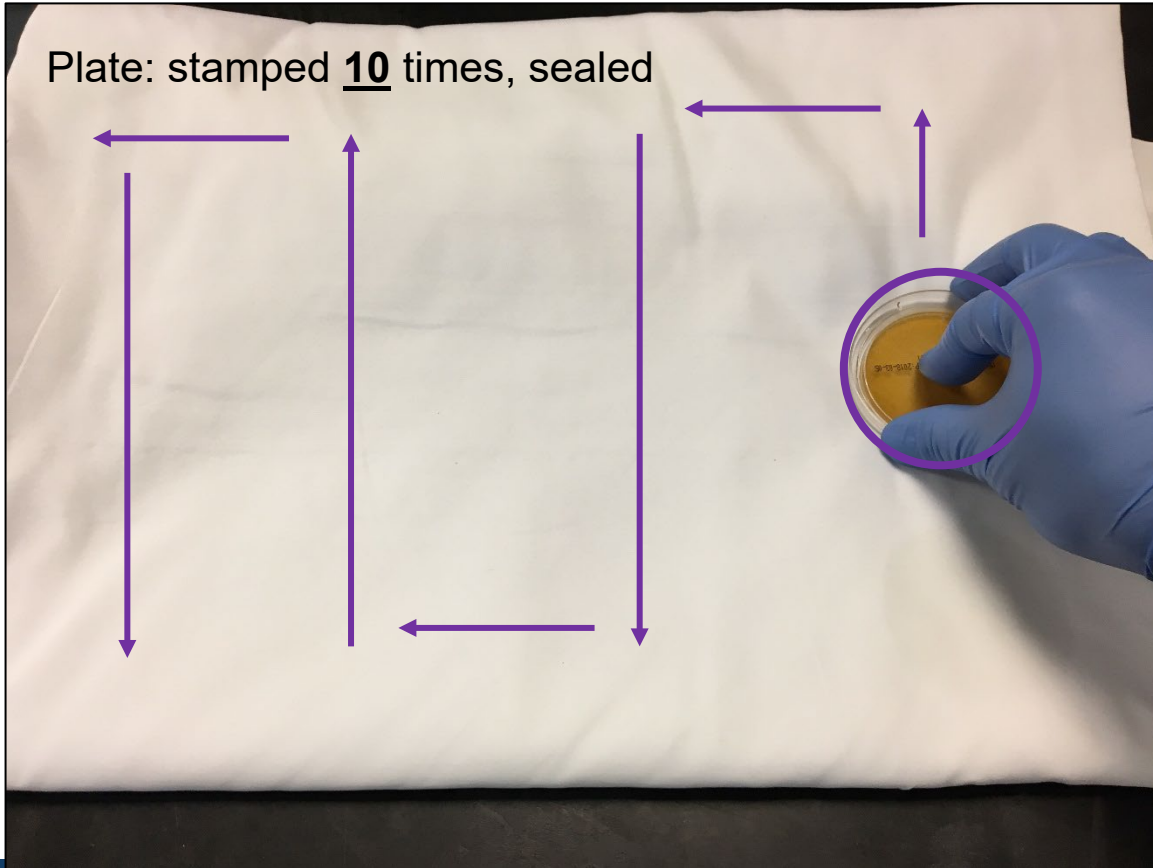
By Lauren Del Valle, CNN

Published 2:24 AM EST, Sat January 28, 2017

Methods: RODAC Plates



Methods: RODAC Plates



The Life Cycle of Healthcare Linen

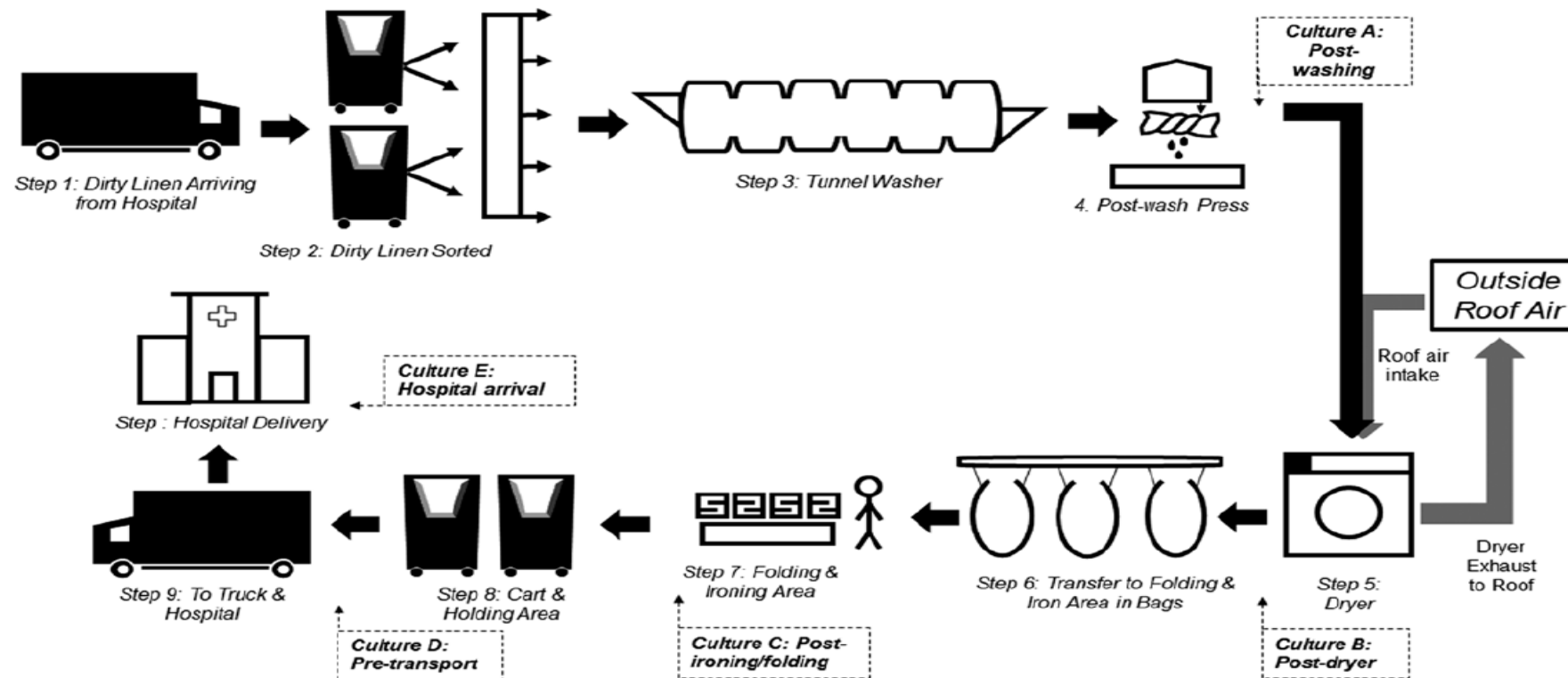
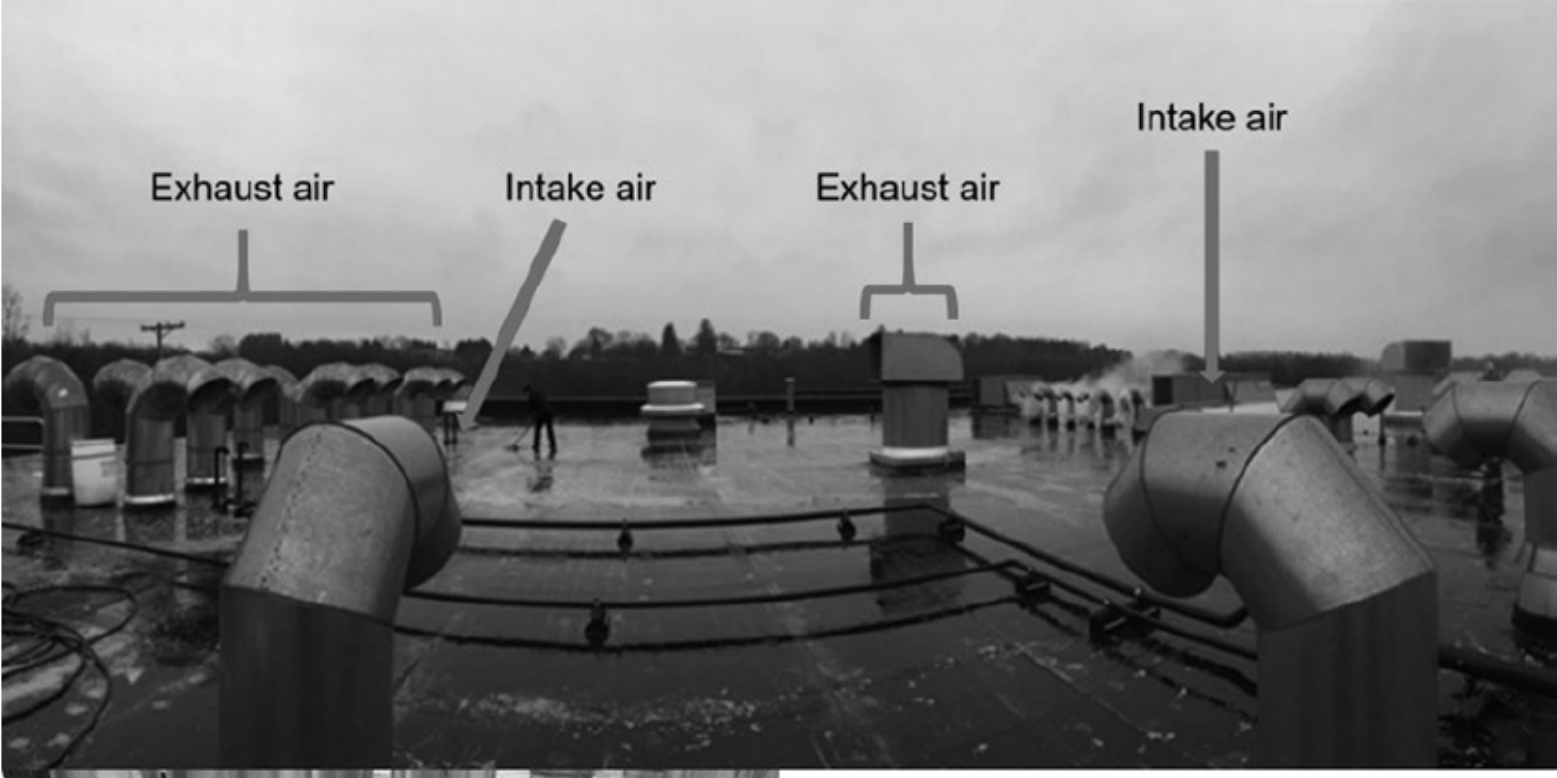
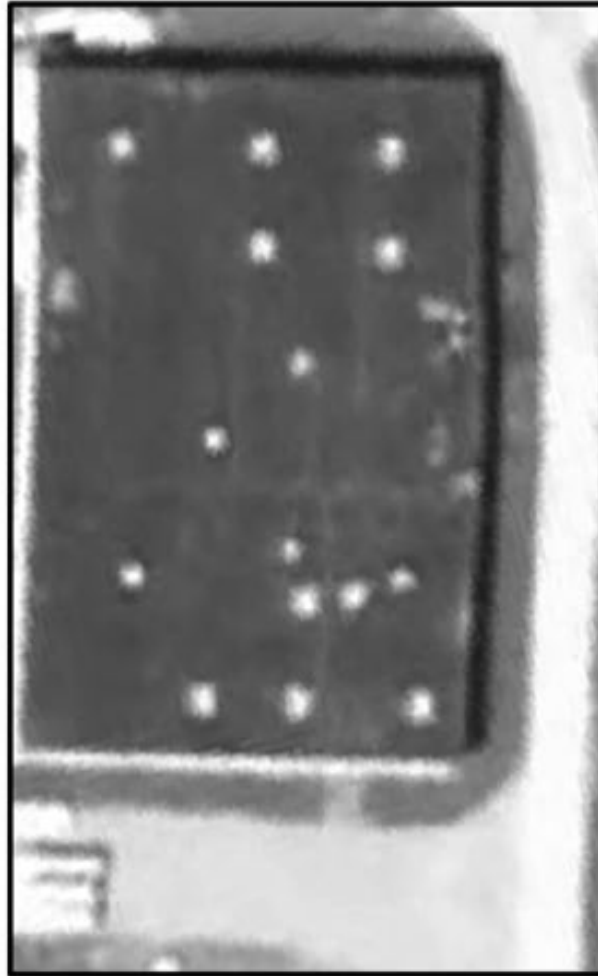


Figure 2. Step-wise healthcare linen processing at the offsite facility. Steps at which surveillance cultures were performed are shown within dashed boxes (culture A–E). Note that outside roof air was brought into driers via intake vents to cool down HCLs upon completion of the drying cycle (step 4). Air from driers was then recirculated to the roof via exhaust vents. Abbreviation: HCL, healthcare linens.

Source of Contamination: Roof



Remediation & Lint Control



September 2010
Estimated Contaminated Area: 0 m²



April 2012
Estimated Contaminated Area: 388.41 m²



April 2014
Estimated Contaminated Area: 918.13 m²



September 2017
Estimated Contaminated Area: 0 m²

The *Mucorales* on Unclean Linen Discovery Study (MOULD)

- How common are contaminated linens?
- How do we best measure the current quality measures?
- What makes linens contaminated?



Clinical Infectious Diseases

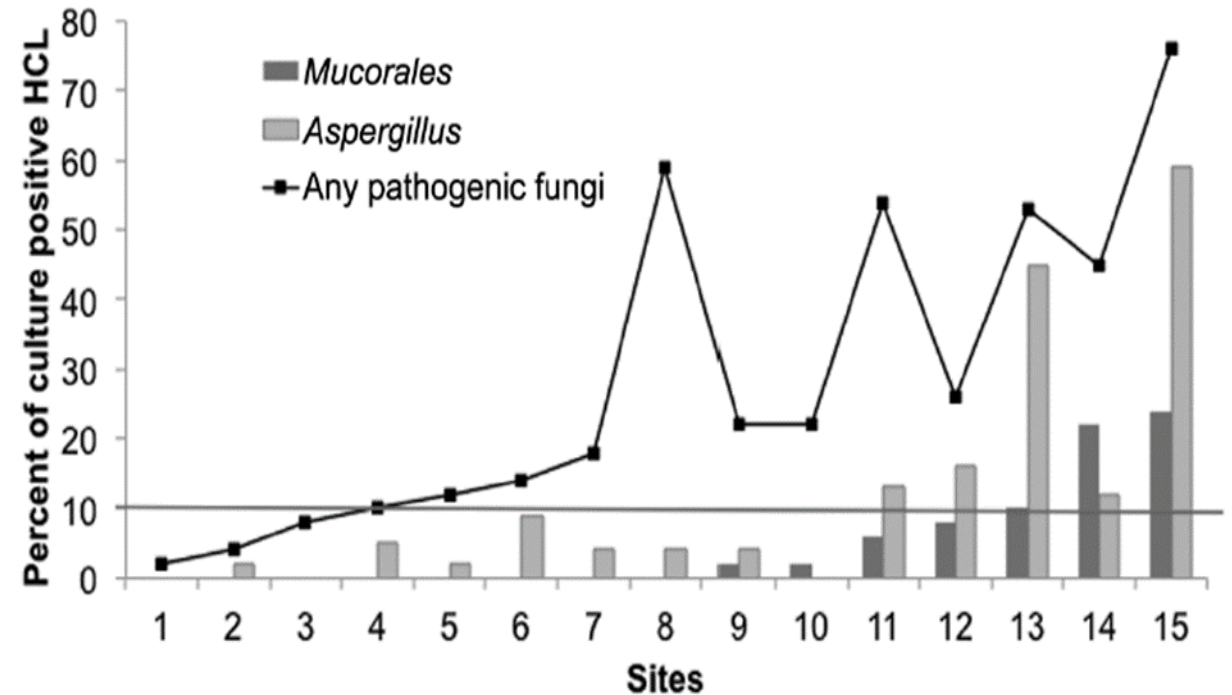
BRIEF REPORT

How Clean Is the Linen at My Hospital?
The *Mucorales* on Unclean Linen
Discovery Study of Large United States
Transplant and Cancer Centers

Alexander J. Sundermann,^{1,2,a} Cornelius J. Clancy,^{3,a} A. William Pasculle,^{1,2}
Guojun Liu,³ Richard B. Cumbie,² Eileen Driscoll,³ Ashley Ayres,² Lisa Donahue,²
Steven A. Pergam,⁴ Lilian Abbo,⁵ David R. Andes,⁶ Pranatharthi Chandrasekar,⁷
Alison L. Galdys,⁸ Kimberly E. Hanson,⁹ Kieren A. Marr,¹⁰ Jeanmarie Mayer,¹¹
Seema Mehta,¹⁰ Michele I. Morris,¹² John Perfect,¹³ Sanjay G. Revankar,⁷
Becky Smith,¹³ Sankar Swaminathan,¹⁴ George R. Thompson III,¹⁵ Merin Varghese,¹⁶
Jose Vazquez,¹⁷ Estella Whimbey,¹⁸ John R. Wingard,¹⁹ and M. Hong Nguyen³

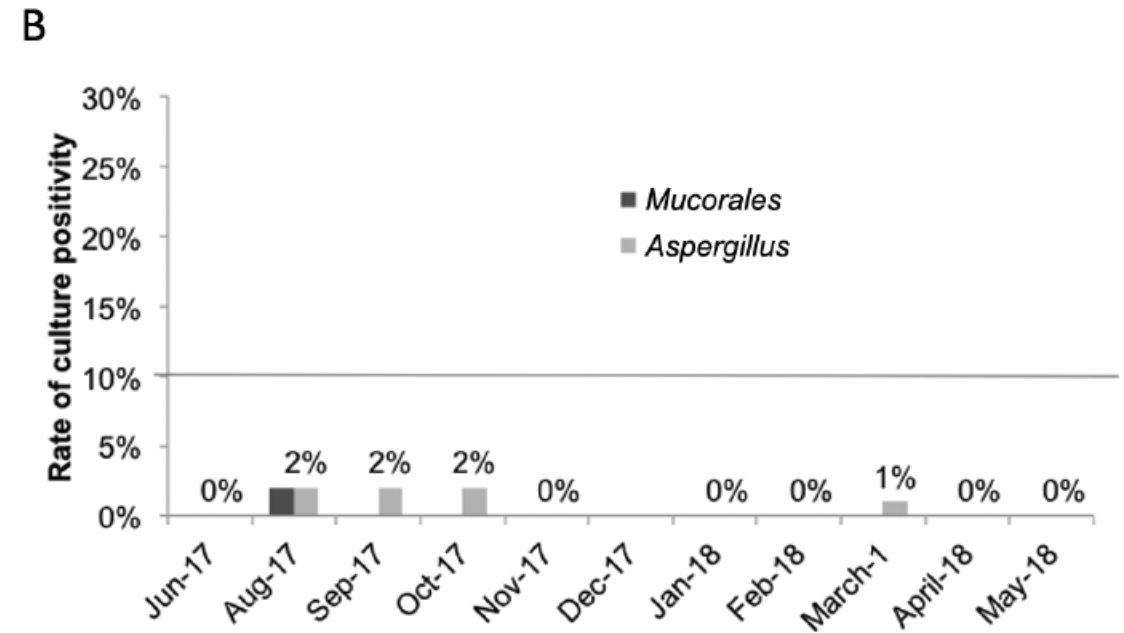
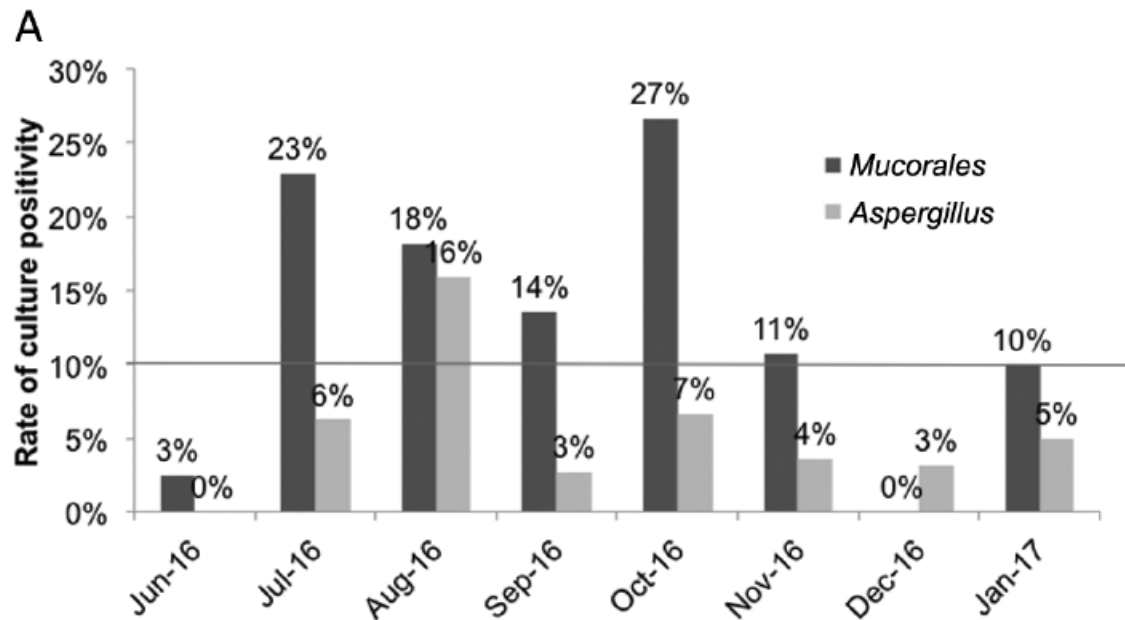
The Mucorales on Unclean Linen Discovery Study (MOULD)

- Cultured linens upon arrival at 15 major hospitals across the United States
 - Were contaminated with Mucorales at 47% of hospitals
 - Were not hygienically clean at 20% of hospitals



The Mucorales on Unclean Linen Discovery Study (MOULD)

- Remediation is possible!



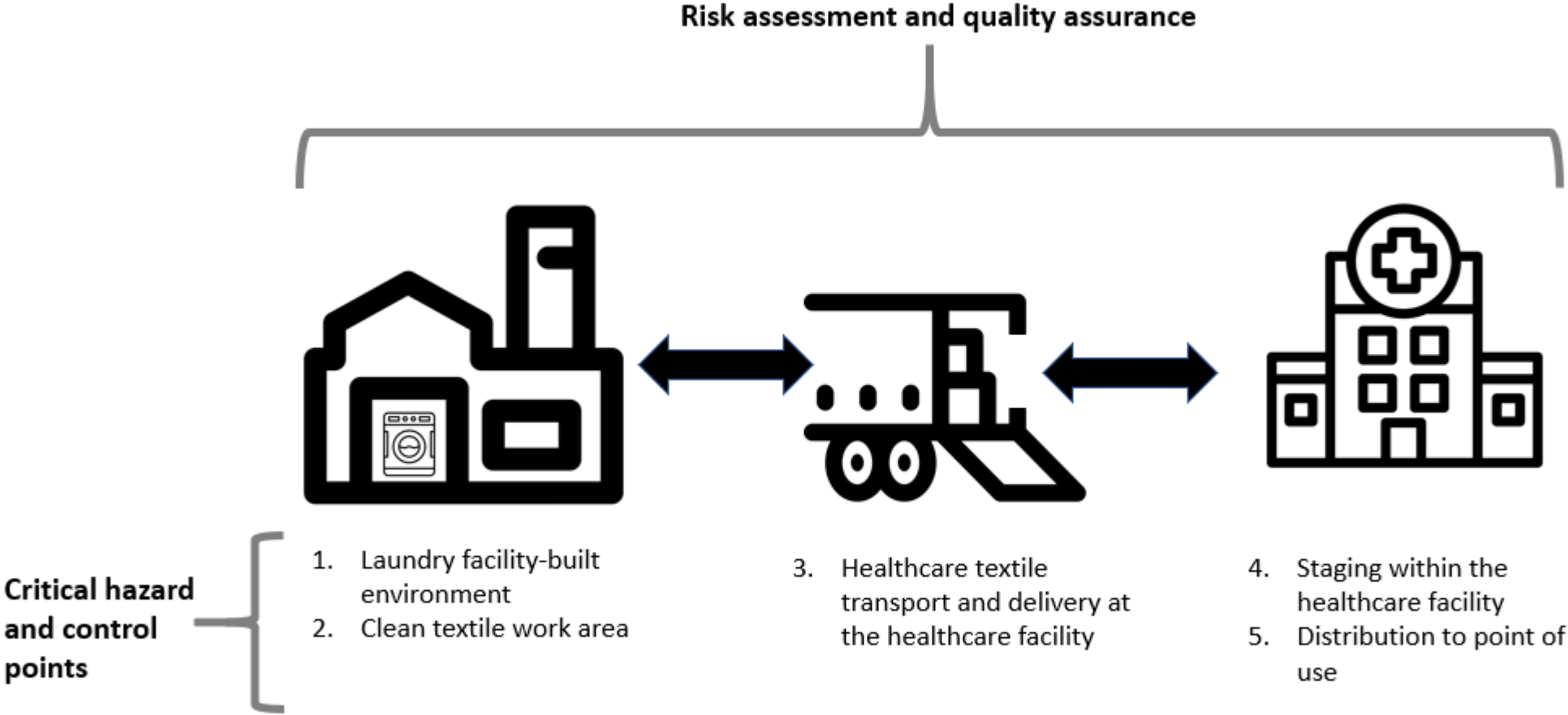
The Mucorales on Unclean Linen Discovery Study (MOULD)

- Accreditation was not associated with hygienically clean criteria (at the time of study)
- Temperatures associated with criteria

Factor	Status of hygienically clean HCT by center		p-value
	Met criteria	Did not meet criteria	
Certification status of laundry			
TRSA-certification	42% (5/12)	67% (2/3)	0.57
HLAC-accreditation	50% (6/12)	67% (2/3)	1.0
Visual inspection of HCT and carts			
No soilage of HCT	75% (9/12)	33% (1/3)	0.24
No soilage of carts	83% (10/12)	67% (2/3)	0.52
No soilage of either HCT or carts	67% (8/12)	33% (1/3)	0.53
Meteorologic factors in the 2 days preceding HCT delivery			
Maximum temperature	60°F	84°F	0.04
Maximum relative humidity	52%	68.5%	0.08
Precipitation	0.3 inches	0	0.73

Recognizing Risk, Preventing Outbreaks

Hazard analysis and critical control point framework



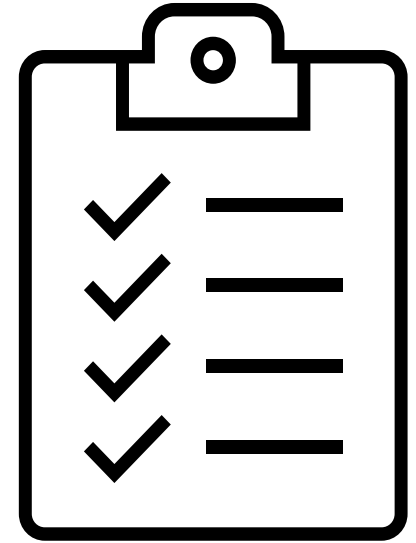
Risk assessment

A formal activity, conducted annually by the healthcare facility Infection Preventionist

- Describes the patients that receive services

Takes into account:

- The potential severity of the outbreak
- The likelihood patients will be affected by an outbreak
- The facility's preparedness to identify an outbreak
- What steps can be taken to mitigate risk



Risk Assessment for the Infection Surveillance, Prevention and Control (ISPC) Program

Year: 2022

Organization Name: Fictional Acute Care Hospital

Date of Report: 1/15/2022

Event or Condition	What is potential impact of event/condition on patients and staff?				What is probability of event/condition occurring?				What is organization's preparedness to deal with this event/condition?				Numerical risk level
	High	Medium	Low	None	High	Medium	Low	None	None	Poor	Fair	Good	
Potential for specific infection:													
Mucormycosis													
MRSA													

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	High (3)	Medium (2)	Low (1)	None (0)	High (3)	Medium (2)	Low (1)	None (0)	None (0)	Poor (1)	Fair (2)	Good (3)	
Potential for specific infection:													
Mucormycosis	3												
MRSA	3												

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Potential for specific infection:													
Mucormycosis	3				3								
MRSA	3				3								

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Potential for specific infection:													Total
Mucormycosis	3				3				3				27
MRSA	3				3						1		9

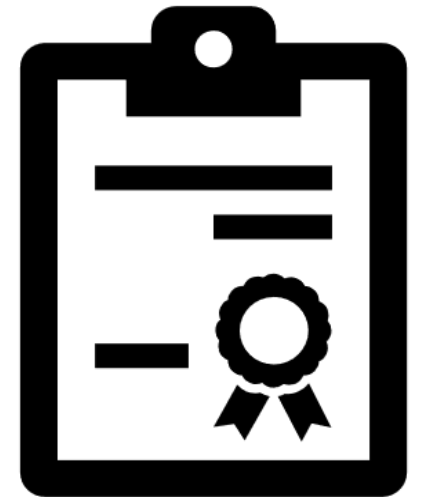
To arrive at a total score - the scores are multiplied.
Higher scores are prioritized at higher levels

Quality assurance for contracted services

The Combined Federal Regulations require the Governing Board of hospitals
or Administrators of Long-Term Care facilities to ensure quality services

Contractual elements:

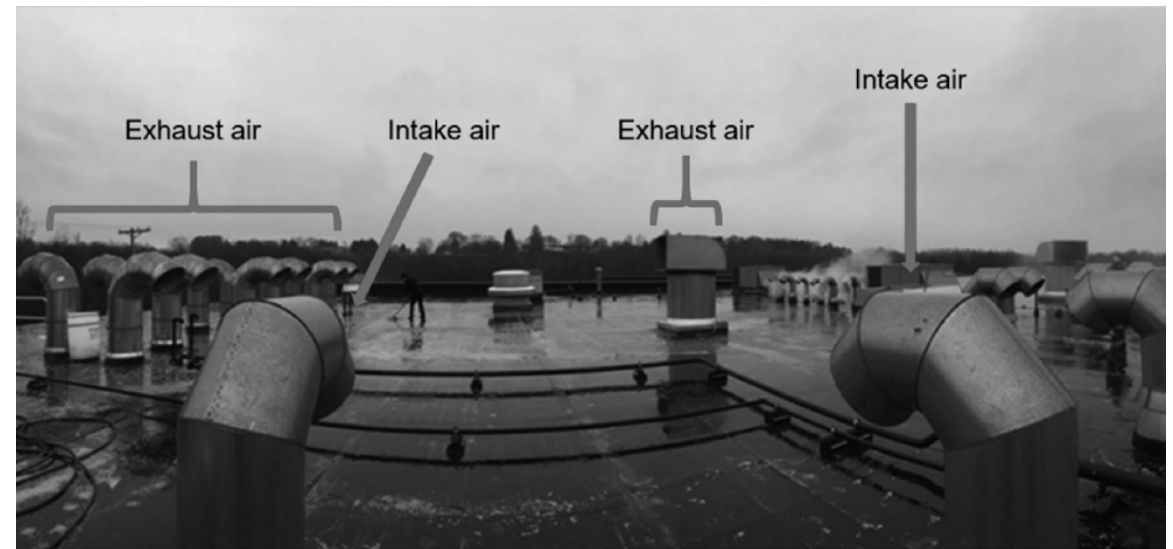
- Expectations for conditions of textiles upon arrival
- Annual, unscheduled assessments of the laundry facility
- Notification of the healthcare facility of construction projects at the laundry facility
- Ongoing operational communication



Hazard #1: The Laundry facility-built environment



Source: Google Earth Pro v. 7.3.2.5776, Google LLC

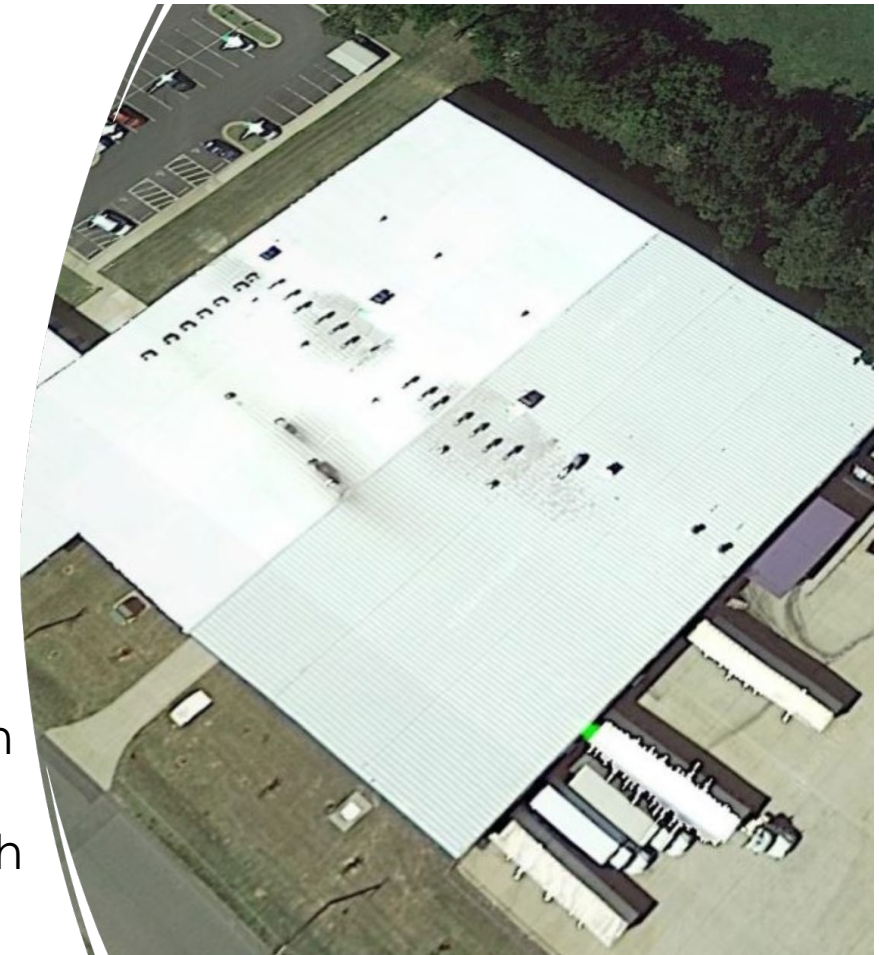


Critical Control Point 1: Laundry facility-built environment

CDC recommends construction of facilities in accordance with American Institute of Architects (AIA) / Facility Guidelines Institute (FGI) at the time of construction. Infection Preventionists should:

When evaluating the built environment ask:

- Are external horizontal surfaces free from excessive lint?
- Is there an HVAC system, with records of preventive maintenance?
- Are pressure relationships continuously maintained?
- What is used to separate the soiled and clean sides of the laundry?
- What measures prevent air from the soiled side entering the clean side?
- Does ventilation on the clean side have at least one filter bed with a minimum efficiency reporting value (MERV) of 8?



Hazard #2: The laundry facility clean textile work area

Conditions that may be associated with outbreaks of textile associated infections include:

- Failure to maintain positive pressure
- Introduction of outside, unfiltered air
- Lack of access to supplies for hand cleaning
- Failure to perform daily cleaning and disinfection of surfaces
- Buildup of excessive lint on horizontal surfaces



Critical Control Point 2: Clean textile work area

CDC recommends:

- Adherence to AIA/FGI guidelines which call for at least one filter bed with a MERV of 8.
- Disinfection of environmental surfaces with EPA-registered products used in accordance with their label.

Infection Preventionists should:

- Verify routine preventive cleaning and disinfection of equipment like cart washers
- Verify disinfectants are EPA-registered
- Verify they are used according to the label instructions



Hazard #3: Textile transport and delivery

Environmental contamination has been associated with outbreaks of mucormycosis.

Failures may include:

- Insufficient cleaning and disinfection of transport carts
- Barriers that fail to ensure cleanliness during transport
- Exposure to unfiltered outside air
- Unsanitary conditions on the loading dock at the laundry or healthcare facility



Critical Control Point 3: Textile transport and delivery

CDC recommends packaging laundered textiles using methods that ensure their cleanliness during transport.

Infection Preventionists should:

- Occasionally observe the receipt of laundered textiles
- Inspect the receiving dock on a weekly or monthly basis
- Ensure sanitary conditions
- Be familiar with methods used to control air flow in proximity to the dock



Hazard # 4: Staging within the healthcare facility

During outbreak investigations CDC has observed:

- Evidence of vermin, bird droppings on loading docks
- Insufficient and broken coverings
- Evidence of water intrusion in staging areas
- Exterior doors that do not seal



Critical Control Point 4: Staging within the healthcare facility

CDC recommends storing laundered textiles in a manner that ensures their cleanliness.

The AIA standards specify storing laundered textiles at positive pressure, with a minimum of one filter bed, MERV 8

The Infection Preventionist should:

- Collaborate with the facility manager to verify air pressure relationships
- Inspect the staging area on a weekly or monthly basis
- Report any signs of water intrusion or dust for immediate remediation
- Ensure daily cleaning of areas by Environmental Services



Hazard #5: Distribution to the point of use

During outbreaks CDC has observed:

- Inappropriate storage of patient gowns
- Placement of textiles within the splash zone of sinks
- Placement of textiles on the lids of toilets



Critical Control Point 5: Distribution to the point of use

CDC recommends storing in a manner that ensures cleanliness.

AIA/FGI standards related to positive pressure apply to any enclosed areas (linen closets, clean supply rooms) where laundered textiles are stored.

The Infection Preventionist should:

- Collaborate to educate personnel about proper textile handling
- Monitor for misuse or improper storage
- Work with facilities management to ensure proper air pressure relationships in storage areas



Outbreak Response – Underlying Principles

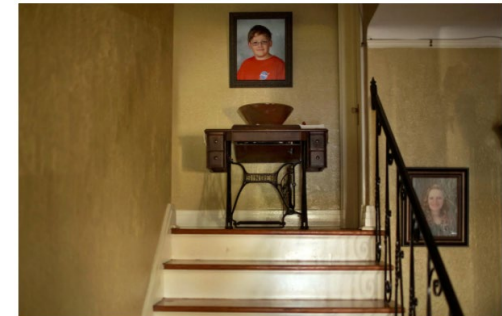
- **An early and thorough investigation can stop transmission**
- **A low threshold (1-2 infections) should prompt an investigation**
- **Transparency with patients is very important**

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

<https://www.cdc.gov/fungal/pdf/targeted-environmental-investigation-checklist-508.pdf>

The New York Times

A Deadly Fungus and Questions at a Hospital



A portrait of Zachary Malik Tyler hangs in the home of Stephen Tyler and Dolly Malik. Zachary underwent surgeries after contracting a fungal infection while at Children's Hospital in New Orleans. Edmund D. Fountain for The New York Times

By Ian Urbina and Sheri Fink

April 28, 2014

How does CDC learn about healthcare textile-associated outbreaks?

- **CDC is**
 - Contacted by a State Health Department
 - Invited to investigate
- **CDC is not a regulatory agency.**
- **Each State Health Department has a nonregulatory healthcare-associated infection prevention program.**

How CDC Helps Resolve Outbreaks in Healthcare Facilities

Milestones in an Epi-Aid Investigation



CDC reviews the situation for lessons learned and takes steps to prevent similar outbreaks



Summary

- **Dangerous molds (mucormycetes) were common on laundered textiles at some hospitals**
- **Molds caused most textile-associated outbreaks since 2010**
- **Mold on linens can kill patients**
- **Keep laundered textiles clean!**

Thank you:

Division of Foodborne Waterborne and Environmental Diseases
Mycotic Diseases Branch
Jeremy Gold and Mitsuru Toda

Division of Healthcare Quality Promotion
Prevention and Response Branch

Infection Prevention Department
University of Arkansas for Medical Sciences
Frankie Wolfe and Amy Smith

Infection Prevention Department
University of Pittsburgh

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the authors' institutional affiliations.

QUESTIONS

