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MAJOR ARTICLE

Investigation of a Prolonged and Large Outbreak of Healthcare-Associated Mucormycosis Cases in an Acute Care Hospital—Arkansas, June 2019–May 2021

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Background. Outbreaks of healthcare-associated mucormycosis (HCM), a life-threatening fungal infection, have been attributed to multiple sources, including contaminated healthcare linens. In 2020, staff at Hospital A in Arkansas alerted public health officials of a potential HCM outbreak.

Methods. We collected data on patients at Hospital A who had invasive mucormycosis during January 2017–June 2021 and calculated annual incidence of HCM (defined as mucormycosis diagnosed within ≥7 days after hospital admission). We performed targeted environmental assessments, including linen sampling at the hospital, to identify potential sources of infection.

Results. During the outbreak period (June 2019–June 2021), 16 patients had HCM; clinical features were similar between HCM patients and non-HCM patients. Hospital-wide HCM incidence (per 100 000 patient-days) increased from 0 in 2018 to 3 in 2019 and 6 in 2020. For the 16 HCM patients, the most common underlying medical conditions were hematologic malignancy (56%) and recent traumatic injury (38%); 38% of HCM patients died in-hospital. Healthcare-associated mucormycosis cases were not epidemiologically linked by common procedures, products, units, or rooms. At Hospital A and its contracted offsite laundry provider, suboptimal handling of laundered linens and inadequate environmental controls to prevent mucormycete contamination were observed. We detected *Rhizopus* on 9 (9%) of 98 linens sampled at the hospital, including on linens that had just arrived from the laundry facility.

Conclusions. We describe the largest, single-center, HCM outbreak reported to date. Our findings underscore the importance of hospital-based monitoring for HCM and increased attention to the safe handling of laundered linens.

Keywords. healthcare linens; healthcare-associated infections; mucormycosis; outbreak investigation.

Mucormycosis is an uncommon but life-threatening fungal infection caused by angioinvasive molds from the order Mucorales [1]. Clinical presentation varies depending on the affected body site, but the disease is generally characterized by progressive tissue infarction and necrosis that often requires aggressive surgical debridement and prolonged antifungal therapy [2]. Patient risk factors include neutropenia, prolonged corticosteroid use, malnutrition, uncontrolled diabetes, iron overload, hematologic malignancies, recent allogeneic stem cell or solid organ transplant receipt, severe burns, and major traumatic injury [3, 4]. At-risk patients may develop mucormycosis after exposure to spores via inhalation or traumatic inoculation. The spores that cause mucormycosis exist throughout the environment, and patients may acquire infection in community or healthcare settings [5].

Investigating healthcare-associated mucormycosis (HCM) outbreaks is challenging because affected patients often have complex medical histories and multiple healthcare exposures. Previous HCM outbreaks have been attributed to contaminated medical products (eg, bandages, tape, adhesives, medications), insufficient air filtration, water damage, and hospital construction or renovation [4]. In a recent study , investigators have reported several HCM outbreaks linked to the contamination of healthcare linens in the setting of deficient environmental controls or suboptimal handling of laundered linens [6–8].

In February 2020, a large, acute care hospital in Arkansas (Hospital A) notified the Arkansas Department of Health and US Centers for Disease Control and Prevention (CDC) of a cluster of mucormycosis cases among patients in a hematologic malignancy unit. We describe the findings and insights gained

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from an investigation of a large and prolonged outbreak of healthcare-associated mucormycosis cases at a single healthcare facility.

METHODS

Case Definition and Ascertainment

We defined a case of invasive mucormycosis as the presence of either a histopathologic specimen demonstrating angioinvasive mold infection or a positive culture or polymerase chain reaction (PCR) test result in a patient with invasive mucormycosis, as diagnosed by a treating infectious disease physician. We considered mucormycosis onset date to be the date of first positive specimen collection or mucormycosis sign or symptom (eg, development of a necrotic skin lesion), whichever occurred earlier. We classified cases as healthcare-associated based on the number of days between hospital admission and mucormycosis onset date: cases were either confirmed (>14 days), probable (7–13 days), or not healthcare-associated (<7 days). We chose these time intervals based on available estimates of the incubation period for cutaneous mucormycosis [9], the predominant form of clinical presentation seen early during the investigation.

We ascertained potential mucormycosis cases by screening Hospital A laboratory records for patients who received a culture or PCR result positive for Mucorales during January 1, 2017–June 30, 2021. Through discussions with Hospital A's infectious disease clinicians, we identified 1 additional potential case whose only positive diagnostic test for mucormycosis was histopathology; however, we did not systematically screen histopathology reports to ascertain potential cases.

Epidemiologic Investigation and Statistical Analysis

We abstracted clinical and laboratory data from the medical records of patients who had invasive mucormycosis during January 1, 2017–May 21, 2021. For cases occurring during 2018–2020 (the time period during which hospital denominator data were available), we calculated annual hospital-wide and unit-level incidences of HCM in the hematologic malignancy unit, medical/neurology intensive care unit, and surgical intensive care unit.

We compared the demographic features, clinical characteristics, and outcomes of patients who had a HCM case during the outbreak period (defined as June 2019–May 2021 based on the timeframe during which HCM case clustering was observed) with patients who had non-healthcare-associated mucormycosis (NHCM) cases during January 2017–October 2020. Other tertiary hospitals near Hospital A were contacted to ascertain whether they had detected an increase in invasive mucormycosis cases during the outbreak period. We compared categorical variables using χ^2 or Fisher's exact tests for proportions and continuous variables using Wilcoxon signed-rank test ($\alpha = 0.05$).

Environmental Assessments

Using a standardized environmental assessment tool, we evaluated conditions at Hospital A that might increase the risk of patient exposures to Mucorales spores [10]. Hospital A hired an industrial hygienist to support environmental assessments. Environmental assessment included the following: visual inspection of the hematologic malignancy and bone marrow procurement units; observation of linen intake and processing procedures; review of unit maintenance orders; measurement of air pressure relationships in patient rooms and linen storage rooms; evaluation of environmental cleaning practices; and visual inspection for areas of potential water intrusion. Hospital A infection prevention personnel performed an in-person environmental assessment of the offsite laundry facility that was contracted to reprocess Hospital A's healthcare linens (Laundry Facility A).

Environmental Sampling

During March 9–10, 2021, we sampled linens (including blankets, gowns, pillowcases, sheets, and towels) at Hospital A to ascertain the presence of Mucorales spores at various stages of the linen lifecycle (ie, newly arrived linens from Laundry Facility A, linens stored in the receiving area, linens in the storage closet of the hematologic malignancy unit, and linens in rooms staged for patient use on the hematologic malignancy unit) at Hospital A (Supplementary Methods). We also performed convenience sampling of certain nonlinen items (eg, tape) and surfaces. We measured room temperatures and used MMD7NP moisture meters to obtain moisture readings from sampled linens.

Fungal Species Identification

Clinical laboratories serving Hospital A conducted initial patient specimen testing, identifying isolates to the genus level. Hospital A also sent available specimens to the CDC, where isolates from patient and environmental samples underwent internal transcribed spacer (ITS) sequencing using previously published methodology [11, 12]. Because of the genetic diversity of Mucorales strains found in the environment [13, 14], and because an environmental source of infection was suspected, we did not perform molecular typing of clinical isolates.

Ethics Statement

Collection of human subject data was determined by the CDC to be routine public health outbreak investigation and was not subject to CDC institutional review board approval. This activity was reviewed by the CDC and was conducted consistent with applicable federal law and CDC policy (see eg, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.).

Patient Consent Statement

Collection of patient data was part of routine public health outbreak investigation and patient consent was not required.

RESULTS

Epidemiologic Investigation

During January 2017–June 2021, 50 patients had a positive culture, PCR, or histopathology test result for Mucorales; 30 (60%) patients had infections that fit the criteria for invasive mucormycosis, 17 (57%) of which were HCM (11 confirmed, 6 probable). Sixteen HCM cases occurred during the outbreak period (Figure 1). An additional HCM case, which was diagnosed before the outbreak period (May 2017), was excluded from further analyses.

The hospital-wide HCM incidence (per 100 000 patient-days) was 0 in 2018, 3 in 2019, and 6 in 2020; unit-level incidence also increased during this time period (Figure 2). Patients who had HCM during the outbreak period did not differ significantly from NHCM patients in terms of demographic features, underlying medical conditions, or outcomes (Table 1). Among the 16 patients with HCM, the median age was 54 (range 23–77); 8 (50%) patients were women; 11 (69%) were non-Hispanic White. The most common infection sites were cutaneous (n = 8, 50%), deep tissue (n = 3, 19%), and pulmonary (n = 3, 19%). Most HCM patients had a hematologic malignancy (n = 9, 56%), including 6 with leukemia. Eight (53%) HCM patients had neutropenia, and 11 (79%) had lymphopenia during the 30 days before mucormycosis diagnosis. Major traumatic injury during the 90 days before mucormycosis diagnosis was also common (38%). One HCM patient was diagnosed with COVID-19 2 months before mucormycosis onset. In-hospital mortality for patients with HCM was 38%; another 25% of HCM patients were discharged to hospice.

During the 30 days before mucormycosis onset date, the 16 HCM patients had spent time in 7 distinct hospital units throughout Hospital A and 7 patients had spent time in more than one unit; less than half (n = 6, 38%) had been admitted to the hematologic malignancy unit where the initial case cluster was detected (Figure 3). Patients lacked commonalities in terms of patient rooms, medical products, or relevant medical procedures.

The most common genera of Mucorales isolated for HCM patients were *Rhizopus* (n = 8, 50%), *Mucor* (n = 3, 19%), and *Rhizomucor* (n = 2, 13%). Specimens from four HCM patients were identified as *Rhizopus* spp by the Hospital A laboratory and confirmed as *Rhizopus microsporus* at CDC by sequencing D1/D2 of 28S and the ITS regions of rDNA locus. No other hospitals in Hospital A's vicinity reported any increase in invasive mucormycosis cases during the outbreak period.

Environmental Assessments

Environmental assessments of the hematologic malignancy unit identified visible dust on ceiling tiles, light fixtures, bathroom air vents, shower exhaust vents, and ledges in patient rooms. We observed nonsterile patient care supplies left open to the environment in supply storage, medication, and patient rooms on the unit. We observed moisture and debris under a sink cabinet in a staff lounge but found no associated water leaks. Nursing staff reported multiple leaks in the hallways in previous years, all of which had been repaired by the time of the investigation. The heating, ventilation, and air conditioning (HVAC) system supplying the hematologic malignancy unit patient and supply rooms was under appropriate pressurization, and filtration was as expected without unintentional bypass of the filter.

During observations of healthcare linen management at Hospital A, we noted that the plastic used to cover linen carts arriving from Laundry Facility A was frequently torn. Hospital staff reported that newly arrived linens from Laundry Facility A were sometimes left on the loading dock for several hours due to inadequate space in the linen storage rooms. We noted visible bird droppings, dust, and used laundry carts on the multiuse loading dock where laundered healthcare linens arrived.

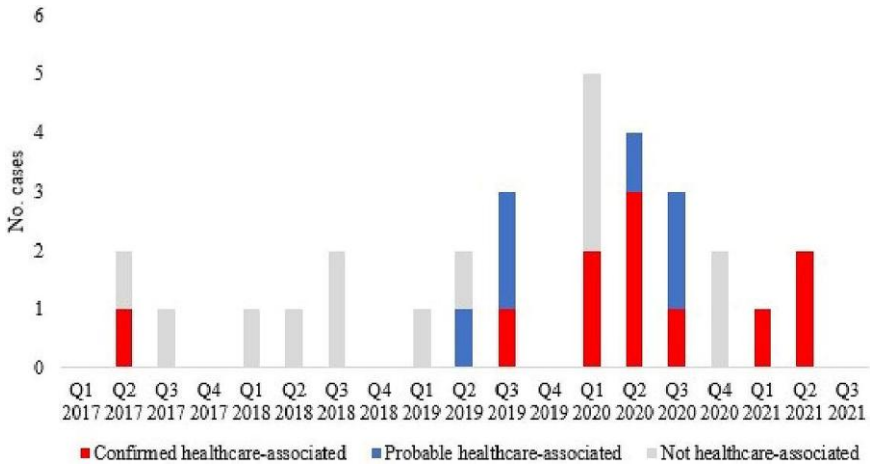

Figure 1. Timeline of mucormycosis cases at Hospital A by quarter-year—Arkansas, January 2017–September 2021.

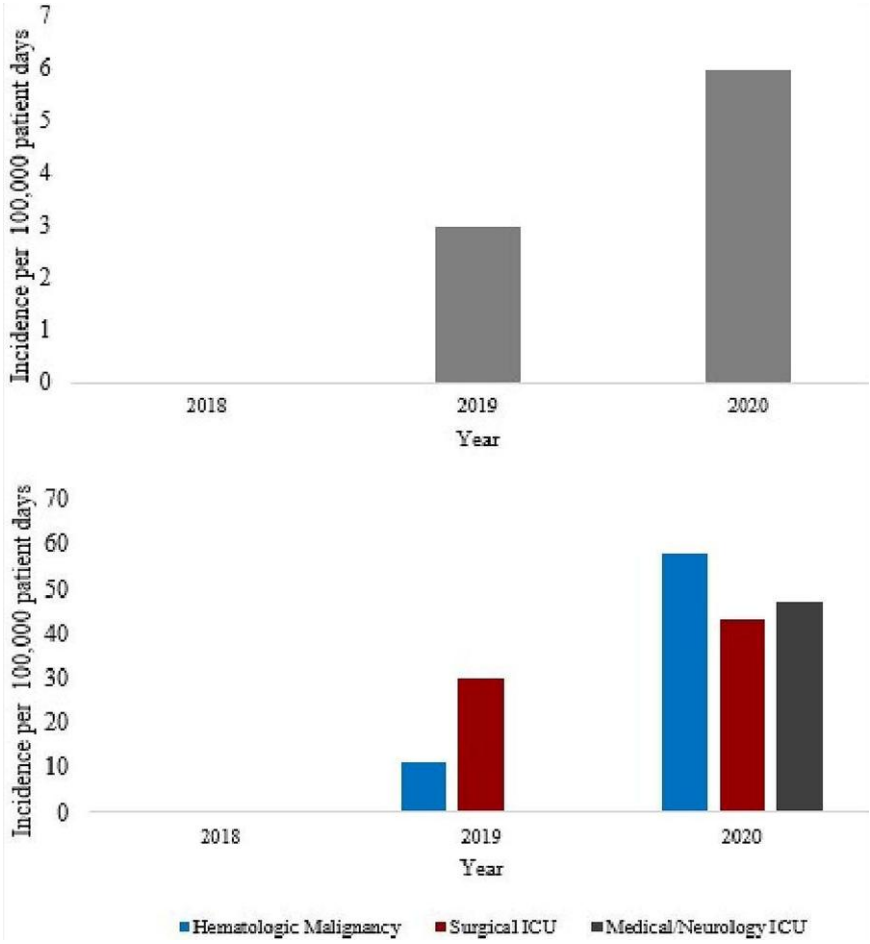

Figure 2. Incidence of healthcare-associated mucormycosis at Hospital A (A) and on select hospital units (B)—Arkansas 2018–2020.

Unit staff also reported that clean linens sometimes arrived with visible debris and staining. Hospital A linen storage and staging rooms were kept under appropriate positive pressure, and the air exchange rate exceeded the clean linen storage room standard of two air changes per hour [15].

Hospital A's onsite environmental assessment of Laundry Facility A identified substantial dust and lint accumulation on washing and drying equipment and on floors. Separation between the soiled and clean sides of the facility was maintained by air curtains. No environmental controls (eg, HVAC system with a single filter bed) were present. To maintain a tolerable indoor temperature for workers, personnel left window louvers and loading dock doors open to the outdoor environment and used oscillating and ceiling fans to increase air flow, including across the area in which laundered linens were dried, folded, and stored.

Environmental Sampling

We focused environmental sampling primarily on linens, because they were one of the few environmental exposures that could have affected all HCM patients, and because of the concerns identified regarding the reprocessing and handling of laundered linens. We performed convenience sampling of 98 linens, 12 rolls of tape or gauze, and 3 other surfaces from the hematologic malignancy unit, including a shower vent in a patient bathroom, a grate on a patient bathroom door, and a used blood pressure cuff (Table 2). Of the 113 total samples obtained, 12 (11%) grew Mucorales spp, all of which were *Rhizopus oryzae*. Of the 98 linens sampled, 9 (9%) tested positive for Mucorales, including 4 (18%) of 22 samples taken from laundered linens immediately after their arrival from Laundry Facility A and 4 (10%) of 40 samples from linens that had been in storage at Hospital A for 24–48 hours before sampling. Of samples from 31 unused linens on the hematologic malignancy unit, 1 (3%) tested positive for Mucorales. Of the 12 linen carts from which linens were sampled, 6 (50%) contained at least 1 linen with a positive result for Mucorales. Of the 4 sampled linen carts newly arrived at Hospital A, 3 (75%) contained at least 1 linen positive for Mucorales. No moisture was detected in any of the sampled linens.

Nonlinen items positive for Mucorales included paper tape left open on a mobile workstation in the hallway on the

Table 1. Demographic Features, Clinical Characteristics, and Outcomes of Patients With Invasive Mucormycosis (N = 29): Hospital A, January 2017–May 2021

Characteristic[a]	Healthcare-Associated Invasive Mucormycosis: June 2019–May 2021 *n* = 16 (%)	Non-HCM: January 2017–Oct 2020 *n* = 13 (%)	*P* Value[b]
Demographics			
Age in years, median (range)	54 (23–77)	49 (21–67)	>0.99
Female sex	8 (50)	5 (39)	.71
Race/Ethnicity			
Non-Hispanic White	11 (69)	7 (54)	.31
Non-Hispanic Black	2 (13)	5 (39)	
Hispanic or Latino	3 (19)	1 (8)	
Type of Infection			
Cutaneous[c]	8 (50)	3 (23)	.56
Deep tissue[d]	3 (19)	2 (15)	
Pulmonary	3 (19)	4 (31)	
Rhinocerebral	1 (6)	3 (23)	
Disseminated	1 (6)	1 (8)	
Mucorales Genus			
Rhizopus	8 (50)	7 (54)	.90
Mucor	3 (19)	3 (23)	
Rhizomucor	2 (13)	0 (0)	
Lichtheimia	1 (6)	0 (0)	
Syncephalastrum	1 (6)	1 (8)	
Cunninghamella	0 (0)	1 (8)	
Unspecified	1 (6)	1 (8)	
Time from admission to onset, median (IQR)	17 (10.5–26.5)	—	
Underlying Medical Conditions			
Hematologic malignancy[e]	9 (56)	5 (38)	.46
Leukemia (% hematologic malignancy)	6 (67)	5 (100)	.26
Relapsed or refractory disease (%leukemia)	5 (83)	4 (80)	>.99
Lymphoma (% hematologic malignancy)	0 (0)	0 (0)	—
Multiple myeloma (% hematologic malignancy)	3 (33)	0 (0)	.26
Other hematologic malignancy (% hematologic malignancy)	1 (11)	1 (20)	>.99
Hematopoietic stem cell transplant (% hematologic malignancy)	3 (33)	4 (80)	.27
Solid organ malignancy	0 (0)	1 (8)	.44
Diabetes mellitus	5 (31)	7 (54)	.27
Traumatic injury in 90 days before onset	6 (38)	2 (15)	.24
Pulmonary disease[f]	2 (13)	3 (23)	.63
Neutropenia (within 30 days before mucormycosis diagnosis)[g]	8 (53)	4 (36)	.45
Lymphopenia (within 30 days before mucormycosis diagnosis)[h]	11 (79)	5 (45)	.11
Treatments Received During 90 Days Before Illness Onset			
Systemic antibacterial drugs	16 (100)	10 (77)	.08
Prolonged corticosteroids use[i]	8 (53)	3 (25)	.24
Noncorticosteroid immunosuppressive drugs	9 (56)	5 (38)	.46
Chemotherapy (% hematologic malignancy)[j]	7 (88)	4 (100)	>.99
Outcome on Date of Chart Abstraction			
Died During Hospitalization	6 (38)	2 (15)	.24
Discharged to Hospice	4 (25)	3 (23)	
Discharged Nonhospice	3 (19)	7 (54)	
Hospitalized	3 (19)	1 (8)	

Abbreviations: HCM, healthcare-associated mucormycosis; IQR, interquartile range.

[a]Data are presented as n (%) unless otherwise specified.

[b]*P* values were used to compare features of patients with hospital- versus nonhospital-associated cases of invasive mucormycosis; χ^2 or Fisher tests for proportions were used to compare categorical variables, and the Wilcoxon signed-rank test was used to compare continuous variables.

[c]All 8 HCM patients with cutaneous infection had hematologic malignancy; 1 HCM patient with cutaneous infection had experienced traumatic injury in the 90 days before infection onset.

[d]All 3 HCM patients with deep tissue infection had experienced traumatic injury in the 90 days before infection onset.

[e]Some patients had more than 1 type of hematologic malignancy.

[f]Underlying pulmonary conditions included multifocal pneumonia (1 non-HCM), lung abscess (1 non-HCM), Goodpasture syndrome (1 HCM), asthma (1 non-HCM), and coronavirus disease 2019 (1 HCM).

[g]Two patients were missing data on neutropenia.

[h]Three patients were missing data on lymphopenia.

[i]Prolonged corticosteroid use was defined as a dose of ≥20 mg of prednisone (or the bioequivalent dose of another corticosteroid drug) for ≥7 days. One HCM case and 1 non-HCM case were missing data on the duration of corticosteroid treatment.

[j]Two patients missing data on chemotherapy.

hematologic malignancy unit, gauze that was open to the air in the hematologic cancer unit medication room, and a shower vent in a patient room on the hematologic cancer unit. Temperature in sampled rooms ranged from 21°C to 26°C, and relative humidity ranged from 36% to 45%.

Throughout the outbreak investigation, the infection prevention and control staff at Hospital A took numerous actions to remediate potential sources of mold exposures within the hospital healthcare environment. Remediation efforts included the following: adjusting linen intake workflow to minimize the amount of time that laundered healthcare linens spent on the loading dock; doubling the layer of plastic used to cover linen carts during transportation; educating laundry personnel about the need to inspect carts and reject those containing visibly

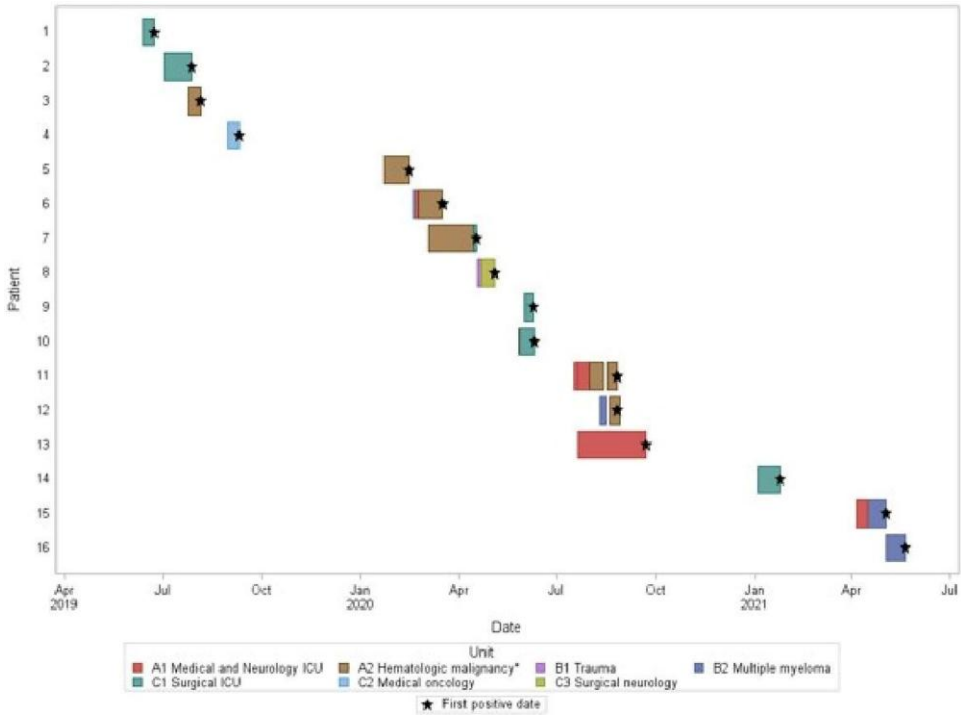

Figure 3. Location of patients with healthcare-associated mucormycosis cases before disease onset, Hospital A—Arkansas, June 2019–May 2021.

Table 2. Results from Environmental Sampling[a] Performed During an Outbreak of Healthcare-Associated Mucormycosis at a Single Acute Care Hospital

Room/Area	Material Sampled	Total No. Linen Carts Sampled	Total No. of Samples Collected	No. Positive for Mucorales (%)	No. Carts With Linen Positive (%)	Mucorales Species Identified
Newly Arrived Linens						
On delivery truck	Linens	1	5	1 (20)	1 (100)	*Rhizopus oryzae*
Linen storage room[b]	Linens	3	17	3 (18)	2 (67)	*R oryzae*
Linens and Items in Central Linen Storage (for 24–48 hours)						
Linen storage room	Linens	4	20	2 (10)	1 (25)	*R oryzae*
Linen staging room	Linens	4	20	2 (10)	2 (50)	*R oryzae*
Utility closet in linen storage	Tape/Gauze	—	2	0 (0)	—	—
Linens and Items in Storage on Hematologic Malignancy Unit						
Large clean utility closet	Linens	—	12	0 (0)	—	—
	Tape/Gauze	—	5	0 (0)	—	—
Small clean utility closet	Linens	—	14	1 (7)	—	*R oryzae*
	Tape/Gauze	—	1	0 (0)	—	—
Medication storage room	Tape/Gauze	—	1	0 (0)	—	—
Medication storage room	Tape/Gauze	—	1	1 (100)	—	*R oryzae*
Linens and Items in Patient Rooms on Hematologic Malignancy Unit						
Cleaned patient room	Linens	—	5	0 (0)	—	—
Uncleaned patient room	Linens	—	5	0 (0)	—	—
	Tape/Gauze	—	1	0 (0)	—	—
	Other[c]	—	3	1 (33)	—	*R oryzae*
Hallway	Tape/Gauze		1	1 (100)	—	*R oryzae*
Total	—	—	113	12	10.6%	

[a]All environmental samples were collected during March 9–10, 2021.

[b]These linens were sampled immediately after arrival in linen storage from the linen delivery truck.

[c]Other material sampled includes a shower vent, grate on the bathroom door, and a blood pressure cuff.

soiled or damp linens or with torn covering; and reinforcing the importance of keeping linen carts covered when not in use. Other actions taken to decrease patient risk for exposure to Mucorales included enhancement of environmental cleaning efforts of patient rooms in the hematologic malignancy unit and training for healthcare staff on the importance of rejecting or discarding linens with visible soilage. In addition, Hospital A renovated its laundry storage room and its hematologic malignancy wing.

DISCUSSION

We report findings from the largest, single-center, healthcare-associated outbreak of mucormycosis published to date in the United States, involving 16 patients at an Arkansas acute care hospital during June 2019–May 2021. Hospital A continues to perform prospective monitoring for cases and has identified no further HCM cases as of March 2022. Although the HCM outbreak was initially identified among patients in the hematologic malignancy unit, review of laboratory data and medical records found that affected patients spanned multiple hospital units, had a broad range of underlying conditions, and experienced a variety of mucormycosis presentations. The initial focus on HCM cases in the hematologic malignancy unit may reflect a greater degree of suspicion for HCM clusters on hospital units caring for patient populations historically considered to be at higher risk of mucormycosis. Epidemiologic and laboratory investigations did not pinpoint a definitive infectious source among patients with HCM cases, nor did they definitively prove that each case defined as HCM was acquired in the hospital, but we identified multiple sources of potential Mucorales exposure that required remediation, particularly with regards to the handling and storage of laundered healthcare linens.

Similar to other published reports, many HCM patients described in this outbreak had preexisting immunocompromising conditions, had received immunosuppressive medications, and had poor outcomes. In addition, although cutaneous presentations may be responsible for ∼20% of all mucormycosis infections in general [16], half of the HCM patients in this investigation had cutaneous infections. The greater proportion of cutaneous infections is consistent with previous linen-associated HCM outbreaks [6–8]. We did not detect statistically significant differences in patient characteristics or potential exposures when comparing HCM cases with non-HCM cases during and before the outbreak period (data not shown). Our findings may reflect an underpowered statistical analysis rather than a true lack of differences between the patient groups.

Environmental sampling identified *R. oryzae* at multiple points in the linen lifecycle and on several nonlinen items in Hospital A. This pathogenic Mucorales species has been implicated in previous HCM outbreaks [2]. Our finding of Mucorales on linens that had just arrived from an offsite laundry facility, indicating contamination before arrival at Hospital A, is consistent with a previous study that identified Mucorales contamination of freshly laundered linens received by transplant and cancer centers across the United States [17]. Because much of the remediation of the linen storage area at Hospital A occurred before the environmental sampling was performed, our environmental sampling results could not be used to assess the degree to which remediation efforts at the healthcare facility might have decreased contamination. Still, our results indicate the potential for linens to have served as a vehicle for Mucorales exposure during the outbreak. The suboptimal laundry management practices observed, the lack of adequate environmental controls at the laundry facility, and the fact that all HCM patients would have been exposed to linens during their hospitalization support epidemiologic data (ie, preponderance of cutaneous and deep tissue cases, lack of other shared exposures) suggested that healthcare linens could have played a substantial role in this outbreak. However, given the cross-sectional, nonrepresentative sampling scheme used and the identification of a Mucorales species that differed from those speciated from HCM patients, our results did not definitively link linens with HCM cases.

The finding of multiple hospital units and patient populations affected by HCM and the severity of HCM outcomes during this investigation reinforce the importance of comprehensive hospital-based surveillance for HCM cases at tertiary care centers. Surveillance for mold infections in healthcare settings is needed to understand baseline case rates, detect potential upticks in HCM, and guide efforts to remediate conditions that might put patients at risk for mold exposures. Guidelines from Infectious Disease Society of America (IDSA) state that leukemia and transplant centers should perform regular surveillance of cases of invasive mold infection [18], but routine surveillance practices for invasive mold infections vary widely across US hospitals [19]. In our investigation, approximately half of HCM patients lacked hematologic malignancy or history of recent transplant, suggesting that hospitals need to consider surveillance for invasive mold infections in a broader population of patients than suggested by IDSA. In response to the outbreak, Hospital A remediated numerous potential sources of Mucorales exposure and implemented routine reporting of any positive mucormycosis laboratory result to the hospital's infection prevention and control team and Arkansas Department of Health to enhance surveillance for rapid detection and investigation of additional mucormycosis cases. In addition, infectious diseases physicians prescribed Mucorales-active antifungal prophylaxis to select patients with hematologic malignancies, a practice that might partially explain the decline in HCM cases by the end of the investigation period.

At Laundry Facility A, the absence of an HVAC system and the presence of doors and louvers left open to the outdoor air were concerning. These findings indicated that the laundry

facility was unable to properly condition the indoor air or maintain appropriate humidity or pressure differentials between the clean and soiled sides of the facility. Consequently, laundered healthcare linens could have been exposed at the facility if spores entered from unfiltered outdoor air or from the soiled section of the facility. Laundry Facility A management declined remediation of their facility, citing that their facility had been accredited by the Healthcare Laundry Accreditation Council (HLAC), a nonprofit organization that inspects and accredits laundries that process reusable textiles for healthcare facilities. Hospital Governing Boards and infection preventionists should be aware that organizations that accredit or certify healthcare laundries may not promote industry standards fully aligned with CDC guidelines [20] and do not supplant the healthcare facility's oversight of contracted services. Of note, accreditation or certification of laundry facilities by HLAC and the TRSA were not found to be associated with decreased detection of fungal pathogens on healthcare linens in one study [17]. To ensure the safe provision of healthcare linens to patients, healthcare facility infection preventionist and facility engineer or plant operations manager should evaluate the laundry facility in accordance with established evidence-based guidelines [21, 22].

CONCLUSIONS

As illustrated by this prolonged outbreak, HCM can cause severe mortality, and investigations may not definitively pinpoint a source of infection. Nonetheless, our investigation identified multiple opportunities to improve patient safety by remediating possible sources of Mucorales exposure in the healthcare setting. The population of patients susceptible to HCM in the United States may be expanding due to the increasing number of persons living with immunosuppression from medical conditions, disease, or immunosuppressive medications [23]. Reports of mucormycosis cases are increasing nationwide and globally, particularly among patients with COVID-19 [24, 25]. Therefore, healthcare facilities should consider prioritizing surveillance for HCM and enhanced efforts to protect at-risk patients from this disease.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Potential conflicts of interest. All authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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