



## KEY POINT SUMMARY

### OBJECTIVES

The study aimed at investigating the causes of an outbreak of invasive aspergillosis in a hematologic oncology unit and examining the effectiveness of HEPA filters in reducing infection risks.

### DESIGN IMPLICATIONS

The study demonstrated the effectiveness of environmental intervention in preventing airborne infections. Despite the limitations, the study strongly suggested that HEPA filters and LAF should be provided in nursing units for specific groups of immune-compromised patients, such as those with hematologic malignancies and prolonged neutropenia.

## Efficacy of High-Efficiency Particulate Air Filtration in Preventing Aspergillosis in Immunocompromised Patients With Hematologic Malignancies

Hahn, T., Cummings, K. M., Michalek, A. M., Lipman, B. J., Segal, B. H., McCarthy Jr., P. L.

*2002 / Infection Control and Hospital Epidemiology  
Volume 23, Issue 9, Pages 525-531*

### Key Concepts/Context

Invasive aspergillosis is the most serious type of infections caused by the fungus *Aspergillus*, affecting organs such as heart, lung, brain, and kidneys and causing symptoms such as chest pain, cough, fever, joint pain, shortness of breath, and unintentional weight loss. The fungus *aspergillus* is widely spread in the nature and rarely causes problems in healthy individuals. However, it can cause serious infections in hematologic oncology patients whose immunity system (e.g. cellular defenses, mucosal immunity) is weakened by immunosuppressive agents used in treatment.

Inhalation of conidia (fungal spores) is the main route of entry of *Aspergillus*. Air contamination of *Aspergillus* conidia is an important risk factor of nosocomial invasive aspergillosis. One effective environmental measure in preventing nosocomial invasive aspergillosis is the use of high-efficiency particulate air (HEPA) filters which are capable of removing at least 99.97% of airborne particles measuring 0.3 micrometers ( $\mu\text{m}$ ) in diameter.

### Methods

Following an outbreak of invasive aspergillosis, a retrospective investigation was conducted to identify causes of the outbreak. Retrospective data including rate of invasive aspergillosis, air concentration of *aspergillus*, patient characteristics, mortality rate, autopsy rate, and admitting location were compared between two patient care wings sharing one nursing station in a cancer care hospital. Ninety-one hematologic oncology patients who stayed for 4 or more consecutive days were



### The Center for Health Design: Moving Healthcare Forward

The Center for Health Design advances best practices and empowers healthcare leaders with quality research providing the value of design in improving patient and performance outcomes in healthcare facility planning, design, and construction, optimizing the healthcare experience and contributing to superior patient, staff, and performance outcomes.

Learn more at  
[www.healthdesign.org](http://www.healthdesign.org)

included in the study. Air sampling was routinely conducted using air samplers in the two wings. HEPA filters and laminar air flow units were only installed in one wing. Except for this, the two wings were basically the same in terms of environmental design and operation (including procedures of staff, cleaning personnel, and maintenance). Additional comparisons were conducted on rate of invasive aspergillosis before and after infection control measures (including HEPA filters, wall insulation decontamination, and air tight barriers sealing nearby construction site) were implemented in the wing initially without HEPA filters.

## Findings

Air concentration of aspergillus was much higher in the wing without HEPA and LAF ( $>150$  cfu/m<sup>3</sup>) than the other wing with HEPA and LAF ( $<4$  cfu/m<sup>3</sup>). (In microbiology, cfu [colony-forming unit] is a metric of estimated number of viable bacteria or fungus). Patients in the wing with HEPA experienced fewer (1 vs. 9) invasive aspergillosis infections even though these patients were at higher risks of invasive aspergillosis as determined by other risk factors. Contaminated wall insulation near the nursing station and construction work on the lower floor were identified as possible sources of aspergillosis conidia. The rate of invasive aspergillosis was reduced after additional infection control measures (see description on “methods”) were implemented in the wing initially without HEPA filters.

## Limitations

There were several limitations of this study:

- The infection rate reported in the study might have been lower than the actual rate because of the limitation of diagnostic techniques. This also resulted into a smaller sample size and a lower statistical power in detecting differences in infection rates between two groups of patient.
- DNA analytic technique was not available at the time of study therefore it was difficult to precisely identify the sources of outbreak. Wall insulation was identified as one main source only because of high count of aspergillus conidia in the nearby area.
- Patients were assigned to the two wings based on different diagnoses. Even though the risk of contracting infections was higher in the wing with HEPA, there might be other factors impacting infection rates that were not controlled in the study.
- The effects of HEPA filters were combined with other environmental measures such as laminar air flow and wall insulation decontamination. The contributions of individual factors could not be separated out.