SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The objective of this study was (a) to examine the microbiological contamination of air in those departments of a hospital where patients with higher susceptibility to hospital infections were admitted, and (b) assess the ventilation system vis-à-vis HEPA filter location.

Microbiological surveillance of hospital ventilation systems in departments at high risk of nosocomial infections

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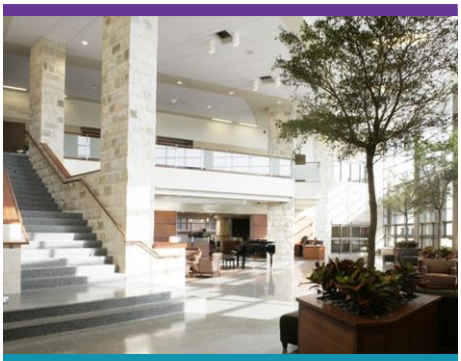
Key Concepts/Context

Bacteria exist in large numbers in moist, organic environments and are also found in the air, in water, and on surfaces, particularly in healthcare environments. Patients who are considered high risk are more susceptible to infection by some of these bacteria given the nature of their illness and the treatment they undergo. These patients are those admitted or undergoing care in areas like the intensive care unit, high risk surgery, hematology, and bone marrow transplant. The risk of contamination of the air in these departments necessitates the installation of mechanical ventilation systems (having the right air change capability), HEPA filters, and positive air pressure. In this paper the authors present the findings from their evaluation of the microbiological content of air samples and the ventilation system in departments of a hospital in Genoa, Italy, where high risk patients were being treated. The study found fewer bacterial and fungal colony-forming units in mechanically ventilated departments than in naturally ventilated ones. Also, peripherally placed HEPA filters were more effective than centrally placed filters in filtering out contaminants.

Methods

Air samples were collected from seven departments (considered at high risk for infections) in an Italian hospital in Genoa. These departments were two hematology departments, bone marrow transplant centre, emergency intensive care unit, first anesthesia and resuscitation service and neurosurgical intensive therapy ward. Of these, six had mechanical ventilation systems. The departments were grouped according to the location of the HEPA filters – group 1 had peripheral HEPA filters, group 2 had the filters located inside main air ducts or centrally, and group 3 was naturally ventilated. Air samples were collected using a surface air sample device



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that contained plates prepared for (a) bacterial growth and (b) fungal growth. This device with both plates were placed strategically (so as not to collect other deposits) near the ventilation and aspiration openings for five minutes. The plates were then placed in incubation to allow for bacteria and fungi to grow. Air samples were also collected from the middle of the room in the two hematology departments. In the hematology department with no mechanical ventilation the air sample was collected at only the middle of the room at about 1.7 meters off the floor. In all, air samples were collected from 11 points (six at emission openings, three in the middle of the room, and two at aspiration openings) in these seven departments. The numbers of positive samples, their percentages, averages, etc., were then analyzed statistically – descriptive tests, chi-square tests, and student t-tests were carried out.

Findings

On analyzing the data, it was found that more than 60% of all samples collected at the emission openings were positive for bacterial contaminants. In the two hematology departments with a ventilation system, it was seen that the middle of the room collected more bacterial contaminants than the emission or aspiration openings. The naturally ventilated hematology department collected more positive samples of bacteria than the mechanically ventilated ones. All middle of the room samples (three departments) were also positive with very high values for colony-forming units.

The samples collected at all points were also positive for fungal contaminants, but their presence was much lower than the number of bacterial microbes.

The air quality (regarding presence of bacterial contaminants) was significantly better in the departments with ventilation systems equipped with peripherally placed HEPA filters than in those placed centrally or inside the air duct (chi-square=9.778, p=0.002). Fungal contaminants were also fewer in peripherally placed HEPA filters, but this was not statistically significant. There was no fungal contaminant found in the samples collected from the hematology department having peripheral HEPA filters.

The paper also presented a season-wise presence of bacterial (B) and fungal (F) contaminants in the air samples (in 2002 when samples were collected) – winter: B=47%. F=0%; spring and summer: B=93%, F=13%; autumn: B=65%, F=7%.

Limitations

The authors did not identify any limitations for this study.

Design Implications

Irrespective of the placement of the HEPA filter, this study found that artificial ventilation was more effective than natural ventilation in keeping out bacterial and fungal contaminants. HEPA filters placed peripherally or near emission openings were more effective than filters placed centrally at filtering these contaminants, especially for fungal contaminants.