OBJECTIVES
To evaluate the performance of a new mobile air-treatment unit that uses nonthermal-plasma reactors for lowering the airborne bioburden in critical hospital environments and reducing the risk of nosocomial infection due to opportunistic airborne pathogens, such as Aspergillus fumigatus.

DESIGN IMPLICATIONS
Mobile air contamination systems can be used as auxiliary means to enhance a hospital’s air quality system without having to modify the building’s HVAC system.

Decreasing Airborne Contamination Levels in High-Risk Hospital Areas Using a Novel Mobile Air-Treatment Unit

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Key Concepts/Context
Hospital-acquired infections are a prominent concern in healthcare settings. Although there is, till date, very little research linking airborne pathogen levels to HAI, causally, it is accepted as an overarching goal that lowering the bioburden in the air can provide environments with lesser risk of nosocomial infection. Various strategies are being implemented, and tested, today, towards this goal. This paper focuses on the efficacy of mobile air-treatment units in critical hospital environments.

Methods
An alternative mobile air decontamination system is tested that actively treats and distributes recycled air through out the room. The system uses nonthermal-plasma reactors to filter the air, instead of the conventional mechanical filters; and removes airborne particles through electrostatic capture in highly porous, dielectric media. To test the effectiveness of this system in lowering the airborne bioburden in high risk areas of the hospital first the efficiency of the non-thermal plasma reactors was tested using a single-pass test which showed that there was a single-pass reduction of biological airborne contamination (at efficiencies greater than 99%) for a wide range of microorganisms. An experimental functional test was then conducted (without patients or staff present) in an operating room in Paris, France, to evaluate the effectiveness of the unit under different operating room conditions. The rate of contamination removal achieved during simulated surgical conditions was studied, alongwith the overall lowering of the bioburden. Additionally clinical tests were performed with patients in the pediatric hematology service at a different hospital. The clinical study monitored and compared steady-state levels of airborne fungal flora in an occupied patient room with the mobile air-contamination unit, with levels
in a room without the unit. Tests were carried out over a period of 12 days under normal working conditions. Finally, air sampling was carried out by an independent, external firm, on both sites.

**Findings**

The functional tests (without patients) revealed the following:

1. Effective rate of air change increased from 11 to 26 air changes per hour, after installing the air decontamination unit
2. The enhanced air treatment dramatically increased the decontamination rate and significantly lowered the steady-state levels of airborne particles and the bioburden in the operating room.
3. Time required to lower level of larger airborne particles decreased from 12 minutes with the HEPA filtration system to 2 mins with the novel units tested.
4. The airborne total mesophilic mobile air-treatment unit to decrease airborne contamination 1185 flora levels dropped by a factor of more than 2 and no airborne fungal species were detected while the units were in operation.

The clinical tests (on patients) revealed the following:

1. Over the 12-day test period, an average reduction of 75% was observed for airborne levels of opportunistic fungal species
2. A reduction of 82% was observed for levels of nonpathogenic fungal species

Overall, the data indicates that the mobile, nonthermal-plasma air treatment unit tested in this study can rapidly reduce the levels of airborne particles and significantly lower the airborne bioburden in high-risk hospital environments.

**Limitations**

Clinical and functional tests were conducted at different sites. Also, the study does not give a lot of detail about the clinical tests and control for confounding variables. Finally, the comparison of the efficacy of mobile units, to HEPA filters, is not under strictly controlled conditions, and the study does not support the use of mobile units as a replacement to more integrated systems.

Another limitation is due to the sample and the location of the study. By replicated the study in other locations and collecting data from nurses working in different types of settings within the hospital, the results can be better generalized.