Reduction of Bacterial Air Burden During Routine Patient Care by a Novel Mobile Air Purification System (PhotoxAir)

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Abstract

Background: Airborne transmission of pathogens such as Mycobacterium tuberculosis can result in the rapid spread of disease. This project assessed the ability of PhotoxAir, a novel mobile air purification system (MAPS) based on photocatalytic oxidation, to minimize the bacterial air burden during routine patient care in an emergency department (ED).

Methods: Fifty patients admitted to the ED underwent air sampling in their respective rooms during routine care activities. One six-stage Andersen Air Sampler each was placed at the head and foot of a patient’s bed and at the exit/entrance doorway. The MAPS was positioned near the foot of the bed. All samples were collected on blood agar plates. Baseline air burden was assessed for 20 minutes without MAPS activated, followed by a wash-out phase with MAPS activated (eight total air exchanges per room), and a 20 minute air sampling with MAPS activated. Colony-forming units (CFUs) were counted and summed for each location. Significance was assessed using the signed Wilcoxon rank-sum test.

Results: A significant reduction in bacterial CFUs was observed from baseline to MAPS use. The greatest decrease was seen at the head of the bed (7 CFUs; 54%; p < 0.001) followed by the foot of the bed (4.5 CFUs; 47%; p < 0.001) and the exit (3.5 CFUs; 27%; p < 0.001). The room total (sum across all sampling locations) also showed a significant reduction (-15 CFUs; 46%; p < 0.001) under MAPS use.

Conclusions: The MAPS significantly reduced the bacterial load observed under routine care in an ED setting. The foot of the bed and the exit showed smaller decreases probably affected by higher traffic/activity patterns in these areas as compared to the head of the bed. Application of this new technology promises to reduce the airborne pathogen burden, and decrease exposure risk providing a safer environment for patient care.

Introduction

Airborne transmission of pathogens can result in the rapid spread of disease. The current understanding of aerosol transmission assumes that a number of human pathogens are spread by respiratory secretions and/or inject by way of the respiratory tract (1). However, data on how to protect areas as compared to the head of the bed. This study assesses the efficacy of the PhotoxAir filtration system in broadly eliminating the amount of bacterial contaminants in the air in a real-life clinical (emergency department) setting.

Mobile Air Purification System (MAPS)

The PhotoxAir filtration system is an innovative photocatalytic oxidation (PCO) system that effectively clears the air of volatile organic compounds (VOCs) and has ancillary evidence supporting elimination of broad classes of pathogens. It is different from many of the current PCO systems on the market because it maximizes the number of air treatment cycles in a room and optimizes the PCO reaction process through the use of novel catalyst reaction materials.

Results

A total of 70 participants were consented and enrolled in the study. Out of the 70 participants, 20 participants were excluded due to leaving the ED room before completion of sampling (n = 16) or withdrawing (n = 4). Samples of the remaining 50 participants were analyzed. Table 1 shows the bacterial counts in CFU by location at baseline and under MAPS use. The following observations were made:

- MAPS did not interfere with routine care and was well tolerated by staff.
- The highest baseline bacterial CFUs were found close to the patient head.
- A significant reduction in bacterial CFUs was observed from baseline to MAPS use at all locations (-15 CFUs; 46%; p < 0.001).
- The greatest decrease was seen at the head of the bed (7 CFUs; 54%; p < 0.001) followed by the foot of the bed (4.5 CFUs; 47%; p < 0.001) and the exit (3.5 CFUs; 27%; p < 0.001).

Conclusions

MAPS significantly reduced the bacterial load under routine care in an ED setting by a range of 26.7% (exit location) to 54.2% (head location). The foot of the bed and the exit locations showed overall smaller decreases probably affected by higher traffic/activity patterns in these areas as compared to the head of the bed. The device was well tolerated by the ED staff. In conclusion, use of the PhotoxAir instrument in an ED setting leads to a significant reduction of the airborne bacterial load. Applications of this new technology promise to reduce the pathogen load, reduce exposure, and provide a safe environment for patient care.

References