Assessment of the Variability of Airborne Contamination Levels in an Intensive Care Unit over a 24 Hour Period

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Introduction

- Airborne transmission of infectious microorganisms is a serious public health threat, accounting for ~30-33% of all nosocomial infections.
- Current knowledge of the clinical airborne microflora is limited and there is uncertainty surrounding the contribution of airborne microorganisms to the overall transmission of nosocomial infection.
- Microorganisms originating from the human respiratory tract or skin can become airborne by coughing and sneezing, and periods of increased activity such as bed changes, staff rounds and visiting hours.
- The objective of this study was to evaluate the variability in the dynamics and levels of airborne contamination within a hospital ICU in order to establish an improved understanding of the extent to which airborne bioburden can contribute to cross-infection of patients.

Methods

- Environmental monitoring of airborne contamination levels was conducted in GRI ICU, in both occupied and unoccupied patient isolation rooms.
- A sieve impactor sampler was used to collect 500L air samples every 15 minutes over a 24 hour period (8am – 8pm).
- Samples were collected on agar plates, and bacterial contamination levels recorded as CFU/m³ of air.
- An activity log was collated to record activities that might contribute to spikes in contamination levels.

Results

- Graphical Data
- Statistical Data
- Analysis

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<thead>
<tr>
<th>Study</th>
<th>Graphical Data</th>
<th>Statistical Data</th>
<th>Analysis</th>
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<tbody>
<tr>
<td>Room occupied: 10 days</td>
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<td>Patient: 70 year old female, respiratory failure, C. difficile infection.</td>
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<td>Room occupied: 6 days</td>
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<td>Patient: Male with widespread muscle and nerve weakness from Guillain-Barre disease.</td>
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<td>Room occupied: 1 day</td>
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<td>Patient: 56 year old female, respiratory failure with background of rheumatoid arthritis.</td>
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<td>Empty Room: Unoccupied for 2 days</td>
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Fig 2: Air contamination levels over a 24 hour period in an ICU isolation room. (left) Probable CFU/m³ of air and (right) Statistical process control charts indicating upper and lower control limits and highlighting in red, data points that are “out of control” in relation to the overall dataset. n=97

Microbiology:
Visual representation of variation in air contamination levels throughout the day in an occupied patient isolation room.

Conclusions

- This study demonstrates the degree of airborne contamination that can occur in an ICU over a 24 hour period and how much it can vary.
- Numerous factors were found to contribute to microbial air contamination including patient status, length of stay, time of day and room activity.
- Peaks in airborne contamination showed a direct relation to an increase in room activity.
- Contamination levels were lower overall during the night and in unoccupied isolation rooms, whilst the highest counts were observed in an isolation room occupied by a patient with C. difficile infection.

Future Work

Consideration should be given to potential improved infection control strategies and decontamination technologies which could be deployed within the clinical environment to reduce the airborne contamination levels, with the ultimate aim of reducing healthcare-associated infections from environmental sources.

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