Comparison of five testing modalities for the assessment of patient environment cleanliness

Elizabeth Salgiver MPH,1, Elena Martin BS,2, Katrina Callan BS,3, Djamshid Niazi MD,1 Rachid Ouni MD,1 Lars F. Westblade PhD,1,2
Christopher E. Mason MD,1 Matthew S. Simon MD MSC,1,2, Lisa Saiman MD MPH,1,2, E. Yoko Furuya MD MS1,2, and David P. Calfee MD MS1,2
1Weill Cornell Medicine, New York, NY; 2NewYork-Presbyterian Hospital, New York, NY; 3Jacobs Technion-Cornell Institute, Cornell Tech, New York, NY; 4University of California, Riverside, CA; 5Columbia University Irving Medical Center, New York, NY

INTRODUCTION

• Microbial contamination of the patient environment has been associated with healthcare-associated infections.
• Objective assessment of environmental cleanliness is recommended by the CDC to identify improvement opportunities.
• Methods currently used to assess cleanliness and microbial dynamics differ:
  1. ATP and RODAC plates both provide useful quantitative cleanliness data, though high ATP values did not always necessarily represent the opinions, interpretations or policy of the State of New York.
  2. NGS had 99% concordance with organisms identified by CC.

METHODS

<table>
<thead>
<tr>
<th>Comparison of Methods:</th>
<th>ATP LT</th>
<th>RODAC</th>
<th>CDDB</th>
<th>SGS</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>100%</td>
<td>100%</td>
<td>16%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Turnaround time (hr)</td>
<td>Immediate</td>
<td>96</td>
<td>Present/absent</td>
<td>48-72</td>
<td>48-72</td>
</tr>
<tr>
<td>Resources needed</td>
<td>Pouch/Pat</td>
<td>Incubator</td>
<td>Incubator</td>
<td>Kinetic, vial/computational resources</td>
<td>Incubator, technician, equipment</td>
</tr>
<tr>
<td>Advantages</td>
<td>Automated, live, objective, easy/rapid outcome</td>
<td>Sensitivity/ specificity, Kinetic/Quantitative susceptibility</td>
<td>C difficile identification, no aerosol exposure needed</td>
<td>Sensitivity/ specificity, Kinetic/Quantitative susceptibility</td>
<td>High sensitivity/ specificity, Kinetic/Quantitative susceptibility</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>No real-time turnaround of ATP</td>
<td>Sensitivity/ specificity, Kinetic/Quantitative susceptibility</td>
<td>No real-time identification of organisms</td>
<td>No real-time identification of organisms</td>
<td>No real-time identification of organisms</td>
</tr>
</tbody>
</table>

Sampling and Processing (per surface):

• ATP LT: A Clean-Trace swab was rolled over a 16 in2 area of each surface and tested immediately.
• RODAC: A RODAC plate was placed on each surface for 30 seconds and incubated for 48 hours at 37°C. Only overlaid tables and toilet seats were tested using this method as a flat surface is required.
• CDDB, CC, NGS sampling: An ESwab was rolled over a 144 in2 area of the surface for 3 minutes. Fluid from each ESwab was then aliquoted: 100 μL for CDDB (following sensitivity testing), 150 μL for CC, and ~750 μL for NGS. A "control" ESwab, held in the air for 3 minutes, was collected from each room.
• Following sampling, swabs and plates were processed as follows:
  1. ATP test sampling
  2. RODAC plate sampling

RESULTS

• 140 samples of various surfaces from 35 rooms were sampled:
  1. C difficile in 2 surfaces in 1 room; C difficile was also identified by NGS in this room.
• CC
  1. NGS had 99% concordance with organisms identified by CC. NGS identified 20 additional organisms per surface.
  2. 57 rooms were sampled in which the patients had known infections; NGS identified 65% of the associated organism(s) in their respective rooms. Of the organisms capable of being identified by CC, 50% were identified.
  3. No correlations were found between the primary quantitative assessments (RODAC bacterial concentrations and ATP LT ATP concentrations) and quantitative components of CC (presence/absence of organisms) and NGS (read numbers).

CONCLUSIONS

• ATP LT and RODAC plates both provide useful quantitative cleanliness data, though high ATP values did not always indicate the presence of viable aerobic bacteria.
• CDDB may be a useful method for identifying C difficile in the environment, but larger studies of the performance characteristics of CDDB are needed.
• CC and NGS provided useful organism identification information and demonstrated that the rooms of patients with known infections are frequently contaminated with the patient’s associated organism(s). NGS had higher sensitivity for detecting organisms; however, it is not possible to determine if the organisms identified on each surface are viable organisms versus non-viable residual genetic material. The clinical implications of NGS results must be further studied and cost and technical expertise are important considerations.

ACKNOWLEDGMENTS/Funding Source: The C diff Banana Broth™ (CDDB) used in this study was provided by Hardy Diagnostics. This study was funded by the New York State Department of Health (NYSDOH) (CD86681) as a part of the Healthcare-Associated Infection Prevention Prevention. The data and conclusions reported here do not necessarily represent the opinions, interpretations or policy of the State of New York.