A Prospective, Controlled Study of Multidrug-Resistant Organism Colonization among Healthcare Personnel

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Background

Nosocomial acquisition of multidrug-resistant organisms (MDROs) has been associated with multiple risk factors including duration of hospitalization, severity of illness, and MDRO colonization density, and antibiotic exposure. The role of healthcare provider colonization in MDRO transmission is a frequent source of concern, but remains unknown. Prior studies have evaluated healthcare personnel MDRO colonization in outbreak settings, but little is known about transmission in nonoutbreak settings. Prior studies have not included a nonclinical control group to determine the contribution of patient care exposure to colonization. We are conducting a prospective, controlled study to determine the extent of healthcare personnel intestinal colonization with MDROs.

Methods

The NIH Clinical Center is a 240-bed research hospital in Bethesda, Md. A voluntary convenience sample of Clinical Center healthcare providers and a control group of participants who work on the NIH campus but do not have clinical contact with patients or patient microbiology samples have been enrolled in this ongoing (>75% recruited) study. Participants submitted two self-obtained perirectal swabs and a demographic survey assessing age, sex, personal health, occupation, and occupational and family MDRO exposures.

Participants were compensated, and provided with BBL™ CultureSwab™ instructions, to return the first swab within 1 hour of collection, and the second swab within 24-48 hours of the first swab.

Swabs were processed using selective media to detect vancomycin-resistant enterococci following broth enrichment (VRE chroMID, BioMerieux), extended-spectrum β-lactamase-producing organisms (ESBL CHROMagar, Gibson Laboratories), and carbapenem-resistant Enterobacteriaceae (CRE CHROMagar, Hardy Diagnostics). Susceptibility testing was performed following 2014 CLSI M100-S24 guidelines. Statistical analyses were performed using Fisher’s exact test and the Kruskal-Wallis test for singly-ordered data.

Results

608 participants (392 healthcare personnel and 216 controls) submitted a survey and at least one perirectal swab. The majority of participants were women (78%). Among 392 healthcare personnel, 32% reported having patient contact at facilities other than NIH. The only participant who reported a history of colonization with an ESBL had negative cultures in this study. No participants reported a history of known VRE or CRE colonization.

Thirty phenotypic ESBL organisms (29 E. coli and 1 Klebsiella pneumoniae) were detected in 22 individuals (3.8%), including 16 healthcare personnel. One additional participant had a swab that grew Enterobacter cloacae resistant to aztreonam, ceftriaxone, and piperacillin/tazobactam.

Table 1: Demographic data stratified by ESBL colonization status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>No ESBL</th>
<th>ESBL</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58-67</td>
<td>144</td>
<td>50</td>
<td>0.045</td>
</tr>
<tr>
<td>Male</td>
<td>242</td>
<td>135</td>
<td>84</td>
<td>0.035</td>
</tr>
<tr>
<td>Female</td>
<td>366</td>
<td>249</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>MD/DDS/NP/PA</td>
<td>182</td>
<td>125</td>
<td>55</td>
<td>0.413</td>
</tr>
<tr>
<td>RN/CTA</td>
<td>406</td>
<td>270</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Non-HCP</td>
<td>226</td>
<td>162</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Patient contact</td>
<td>264</td>
<td>160</td>
<td>104</td>
<td>0.009</td>
</tr>
<tr>
<td>Work experience</td>
<td>102</td>
<td>64</td>
<td>38</td>
<td>0.003</td>
</tr>
<tr>
<td>Family experience</td>
<td>186</td>
<td>129</td>
<td>57</td>
<td>0.565</td>
</tr>
<tr>
<td>Medical history</td>
<td>294</td>
<td>199</td>
<td>95</td>
<td>0.554</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>194</td>
<td>129</td>
<td>65</td>
<td>0.135</td>
</tr>
<tr>
<td>Any of the demographic questions we asked</td>
<td>608</td>
<td>486</td>
<td>122</td>
<td>0.0592</td>
</tr>
</tbody>
</table>

No difference in antimicrobial susceptibility patterns were seen between groups (Table 3).

Figure 2: Piechart showing participant age and occupation

Figure 3: Heat-map of ESBL isolate resistance (some are repeated as more than one organism was detected)

Conclusions

At a point near completion of our study, only a small fraction of healthcare personnel and control subjects have demonstrated colonization with MDROs. The only MDROs isolated were ESBLs (by phenotypic classification).

Colonization with an ESBL organism was not associated with any of the demographic questions we asked.

The rate of colonization with ESBL organisms is low, and similar among healthcare personnel and controls in a non-outbreak setting, suggesting that community exposures may be responsible for the ESBL colonization found in both groups.

Despite detection in our patient population, no VRE or CRE colonization was detected among healthcare personnel or controls.

Resistance patterns in our ESBL isolates varied, with no discernible difference in resistance patterns between isolates from healthcare personnel and controls.

The study will continue to enroll to completion, and all isolates resistant to three or more β-lactam antibiotics will undergo molecular testing for ESBL genes.

Acknowledgments

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Limitations

† Participants were limited to an anonymous convenience sample, which may not be representative of all healthcare providers within the hospital; ICU healthcare providers were overrepresented.
† Techniques of swab self-collection likely varied in quality.
† The sensitivity of perirectal surveillance cultures in healthy people is unknown.
† ESBL classification is phenotypic; molecular testing is pending.
† The study is still in progress, and final results may differ.

References