No-Touch Disinfection Methods to Decrease Multidrug-Resistant Organism Infections: A Systematic Review and Meta-analysis

Alexandre R. Marra, MD; Marin L. Schweizer, PhD; Michael B. Edmond, MD

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Background

• Risk of patient-to-patient transmission associated with prior room occupancy exists

• No-touch technologies, as adjuncts to traditional environmental cleaning, have become increasingly common
  – Devices that utilize ultraviolet light (UVL)
  – Devices that utilize hydrogen peroxide mist or vapor (HPV)

• Large amount of conflicting data
Objectives

• To review the literature on the impact of no-touch disinfection methods (UVL and HPV) on HAIs due to MDROs, such as
  – Methicillin-resistant *Staphylococcus aureus* (MRSA),
  – Vancomycin-resistant *Enterococci* (VRE),
  – *Clostridium difficile*,
  – and other MDROs
Methods

• PRISMA statement and MOOSE guidelines
  – Involved human inpatients; conducted in acute-care settings
  – From database inception to April 30, 2017
    • PubMed, CINAHL, Cochrane, Database of Abstracts of Reviews of Effects (DARE), and Scopus (which includes EMBASE abstracts)
  – Scales employed by Aboelela et al and Cohen et al to evaluate study quality
  – Natural log of the risk ratios (RR) and standard errors (SE) for UVL and HPV systems independently using 2 outcomes: CDI and VRE infection
Results

• 20 studies included in the final review: 13 UVL, 7 HPV
  – 18 nonrandomised, quasi-experimental; 2005-2014
  – 17 in US (all UV), 2 in UK and 1 in Australia
  – After terminal cleaning: 4 hospital wide, 2 oncology, 2 ICU, contact prec

• Outcomes
  – CDI rates for 11 UVL and 6 HPV
  – MRSA: 7 studies, 4 UVL and 3 HPV
  – VRE: 6 studies, 4 UVL and 2 HPV
  – GN-MDRO: 2 studies
Results

• Quality assessment
  – 9 studies completely adequate for reporting compliance rates
  – 12 with clearly defined outcome

• UVL no-touch technology
  – *Clostridium difficile* infection (CDI): pRR = 0.64 (0.49–0.84) P = 0.001
  – VRE infection rates: pRR = 0.42 (0.28–0.65) P < 0.001
  – MRSA: pRR = 0.78 (0.51–1.20) P = 0.26
  – Gram-negative MDRO pathogens: pRR = 1.83 (0.49–6.82) P = 0.37
Results

A

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Risk Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2017</td>
<td>0</td>
<td>0.25</td>
<td>29.0%</td>
<td>1.00 [0.61, 1.63]</td>
</tr>
<tr>
<td>Bernard 2015</td>
<td>-0.53</td>
<td>0.38</td>
<td>12.6%</td>
<td>0.59 [0.28, 1.24]</td>
</tr>
<tr>
<td>Haas 2014</td>
<td>-0.19</td>
<td>1.67</td>
<td>0.7%</td>
<td>0.83 [0.03, 21.83]</td>
</tr>
<tr>
<td>Levin 2013</td>
<td>-0.76</td>
<td>0.57</td>
<td>5.6%</td>
<td>0.47 [0.15, 1.43]</td>
</tr>
<tr>
<td>McMullen 2016</td>
<td>-0.17</td>
<td>1.71</td>
<td>0.6%</td>
<td>0.84 [0.03, 24.08]</td>
</tr>
<tr>
<td>Miller 2015</td>
<td>-1.02</td>
<td>0.4</td>
<td>11.3%</td>
<td>0.36 [0.16, 0.79]</td>
</tr>
<tr>
<td>Nagajara 2015</td>
<td>-0.25</td>
<td>1.46</td>
<td>0.9%</td>
<td>0.78 [0.04, 13.62]</td>
</tr>
<tr>
<td>Napolitano 2015</td>
<td>-0.62</td>
<td>1.52</td>
<td>0.8%</td>
<td>0.54 [0.03, 10.58]</td>
</tr>
<tr>
<td>Pegues 2017</td>
<td>-0.29</td>
<td>0.20</td>
<td>23.2%</td>
<td>0.75 [0.43, 1.30]</td>
</tr>
<tr>
<td>Sampathikumar 2016</td>
<td>-0.94</td>
<td>0.35</td>
<td>14.8%</td>
<td>0.39 [0.20, 0.78]</td>
</tr>
<tr>
<td>Vianna 2016</td>
<td>-0.92</td>
<td>1.0</td>
<td>0.6%</td>
<td>0.59 [0.02, 20.25]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0%</td>
<td>0.64 [0.49, 0.84]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 7.98, df = 10 (P = 0.63); I² = 0%
Test for overall effect: Z = 3.29 (P = 0.0010)

B

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
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<th>SE</th>
<th>Weight</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson 2017</td>
<td>-0.89</td>
<td>0.22</td>
<td>95.5%</td>
<td>0.41 [0.27, 0.63]</td>
</tr>
<tr>
<td>Haas 2014</td>
<td>-0.21</td>
<td>1.58</td>
<td>1.9%</td>
<td>0.82 [0.04, 18.12]</td>
</tr>
<tr>
<td>Napolitano 2015</td>
<td>-0.13</td>
<td>1.46</td>
<td>2.2%</td>
<td>0.88 [0.05, 15.36]</td>
</tr>
<tr>
<td>Vianna 2016</td>
<td>-0.69</td>
<td>2.97</td>
<td>0.5%</td>
<td>0.50 [0.00, 169.20]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0%</td>
<td>0.42 [0.28, 0.65]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 0.45, df = 3 (P = 0.93); I² = 0%
Test for overall effect: Z = 4.00 (P < 0.0001)
Results (stratified)

C.Diff high rates

C.Diff low rates

Controlled trials

Non-Controlled

Marra ICHE 2017
Results

- HPV no-touch technology
  - CDI rates: pRR = 0.52 (0.15–1.81) P = .30
  - MRSA infection rates: pRR = 0.54 (0.07–4.13) P = .55
Discussion

• UVL no-touch technology to enhance environmental hygiene can decrease CDI and VRE
  – benefit for hospitals with high baseline CDI rates

• Some evidence of a decrease in and VRE infection with HPV

• No clinical trials evaluating HPV systems

• Many studies that were before-and-after quasi-experimental studies, which are subject to multiple biases
Discussion

• Disadvantage of no-touch technologies
  – Patient room must be vacated and cleaned before
    • Logistical problems
    • Room equipment and furniture must be moved away from walls to prevent shadowing for U VL
    • Air vents, doors, and windows must be isolated and sealed for the use of HPV
  – Contact time, device distance, inability of UV to reach corners
  – Costs: 1\textsuperscript{st} year 300 000$ and 200 000$ 2\textsuperscript{nd} year
Thank you for your attention

@Gbirgand