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Transmission dynamics for gram negative bacterial pathogens in the anesthesia work area

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Background: Gram negative organisms are a major healthcare concern with increasing prevalence of infection and community spread. Little is known regarding their transmission dynamics. Our primary aims were to characterize the transmission dynamics of frequently transmitted gram negative isolates from bacterial reservoirs in the anesthesia work area (AWE) of the operating room environment and to examine potential links between these transmission events and 30-day postoperative healthcare-associated infections.

Methods: Gram negative isolates previously obtained from bacterial reservoirs relevant to the AWE (patient nasopharynx and axilla, anesthesia provider hands, and the adjustable pressure-limiting valve and agent dial of the anesthesia machine) at three major academic medical centers were identified as possible intraoperative bacterial transmission events by class of pathogen, temporal association, and phenotypic analysis [analytical profile indexing (API)]. They were then subjected to antibiotic disk diffusion sensitivity for transmission event confirmation. Isolates involved in confirmed transmission events were further analyzed to characterize the frequency and mode of transmission, reservoir of origin, and the location of transmission events. Confirmed transmission events were compared by pulsed-field gel electrophoresis to disease causing bacteria for 30-day postoperative healthcare-associated infections.

Results: AWE reservoir surveillance resulted in 1448 gram negative isolates obtained during the study period. Of those, 945 were identified as possible transmission events and stratified by species. *Acinetobacter*, *Pseudomonas*, *Brevundimonas*, *Enterobacter*, and *Moraxella* spp. explained 81% (767/945) of possible transmission events. Twenty-two percent (167/767) of these isolates were confirmed with antibiotic susceptibility (Table 1) to have some role in an intraoperative transmission sequence. Seven (54/767) and 5.4 (41/767) percent of isolates were actually transmitted via the horizontal (between case) and vertical (within case) modes of transmission, respectively. Provider hands, patients, and the environment were identified as the reservoir of origin for isolates involved in a transmission sequence in 95% (727/767), 4% (34/767) and 1% (6/767) of cases, respectively. Vertical transmission locations included provider hands (83%, 34/41), patient skin sites (10%, 4/41), and the environment (7%, 3/41). Horizontal transmission sites included provider hands (83%, 45/54) and patient skin sites (16.7%). Overall, 4.0% (23/548) of patients suffered from HCAs and had some intraoperative exposure to gram negative isolates. In 8.0% (2/23) of those patients, gram negative bacteria were linked by pulsed-field gel electrophoresis to the causative organism of infection.

Conclusions: Healthcare provider hands serve as the most frequent reservoir for between and within case transmission of gram negative organisms in the AWE. However, the patient and environmental reservoirs were also implicated in some instances. As such, a multi-modal program is indicated to maximally suppress AWE transmission of gram negative pathogens. AWE transmission of gram negative pathogens is linked by pulsed-field gel electrophoresis to 30-day postoperative infections.

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