Contaminated Sinks May be an Environmental Source for Serial Transmission of Carbapenem-Resistant Enterobacteriaceae (CRE) to ICU Patients

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Abstract

Background: We performed an investigation after noting an increase in hospital-acquired (HA) KPC-producing Enterobacteriaceae (KPC-E) infections in patients admitted to a tertiary referral hospital in North Carolina. Methods: We defined pre-outbreak (17/11/2013/30/2017), outbreak (1/7/17/11/2017), and post-outbreak (1/1/2017/7/2018) phases. A clinical case was defined as any positive clinical or surveillance culture collected on hospital day ≥ 3. Patients were mapped in space and time to inform targeted environmental sampling. Whole genome sequencing (WGS) was performed on selected KPC-K. pneumoniae environmental and patient isolates to determine relatedness. In October 2017, a CRE prevention bundle was implemented that included daily communication of CRE patient movement, increased audits/feedback of HCW compliance with hand hygiene and UVC disinfection, and weekly rectal surveillance screens in 4 adult ICUs. Results: 0.67 clinical cases/KPC-E per month were observed during the pre-outbreak period compared to 7.75 clinical cases/KPC-E per month during the outbreak period. K. pneumoniae was the most common species (Figure 1). Mapping of patients revealed probable direct and indirect transmission of KPC-based CRE control measures (Figure 2). Conclusions: We mitigated a multi-species outbreak of KPC-producing Enterobacteriaceae through implementation of evidence-based CRE control measures. Ongoing post-acute screening measures demonstrate that sub-clinical transmission continues in high-risk units despite implementation of control measures. Additional study is needed to understand the prevalence of CRE in sink drains, factors that drive drain colonization, and contribution of CRE in sink drains to hospital transmission of CRE.

Primary Objective

To understand and mitigate transmission of KPC-producing Enterobacteriaceae (CRE) at a 957-bed tertiary care hospital using standard epidemiologic methods

Definitions

- **Outbreak periods**
  - Pre-outbreak: 1/1/2017-6/30/2017
  - Outbreak: 7/1/2017-10/30/2017
  - Post-outbreak: 11/1/2017-7/31/2018
- **Clinical case**
  - Any positive clinical or surveillance culture for KPC-producing Enterobacteriaceae
- **Rectal surveillance culture**
  - A positive rectal surveillance culture for KPC-producing Enterobacteriaceae
- **Hospital-onset** (HO): Positive clinical or surveillance culture collected on hospital day ≥ 3

Results

- **Mapping of patients in time and space revealed probable direct and indirect transmission between patients in multiple hospital units.**
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- Targeted environmental sampling was performed in the room in Unit 2 with multiple patient acquisitions of KPC K pneumoniae and revealed KPC-colonization of in-room sink drain and P-trap of ICU room.
- Additional CRE-prevalent colonies of KPC producing Enterobacteriaceae in 3 units confirmed a high burden of in-room sink drain colonization.

Conclusions

- We mitigated a multi-species outbreak of KPC-producing Enterobacteriaceae through implementation of evidence-based CRE control measures.
- Ongoing positive rectal surveillance screens demonstrate that sub-clinical transmission continues in high-risk units despite implementation of control measures.
- The high rate of in-room sink KPC colonization in 3 units implicates sinks as high-risk sources of CRE. Additional study is needed to understand the prevalence of CRE in sink drains, factors that drive drain colonization, and contribution of CRE in sink drains to hospital transmission of CRE.