Clusters of *Klebsiella pneumoniae* Carbapenemase (KPC) with Potential Links to Hand Hygiene Sink Drains in an Intensive Care Unit

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Disclosure

I declare no conflict of interest.
Objective

The objective of the study was to investigate sink drains as a possible reservoirs of CPE in an ICU

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Introduction

What are Enterobacteriaceae?

- The largest family of gram-negative bacteria causing human infection
- Include common pathogens such as Escherichia coli, Klebsiella pneumoniae, Enterobacter cloacae and Proteus.
- Colonize the normal human gastrointestinal tract, generally without causing disease
- They can also cause common infections, including urinary tract infections (UTIs), abdominal infections and bloodstream infections

What are Carbapenemase Producing Enterobacteriaceae (CPE)?

- CPE are members of Enterobacteriaceae that are resistant to carbapenems, a class of ‘last resort’ antibiotics for treating serious infections
- Resistance is achieved through the production of the enzyme carbapenemase
What is Carbapenemase?
- Carbapenemase is an enzyme that inactivates all the common members of the carbapenem antimicrobial class
- The most common way that *Enterobacteriaceae* become resistant to carbapenems
- In Ontario, the most common carbapenemases include: (NDM), (KPC), (OXA-48) and (VIM)

Why is CPE a Concern?
- Limited treatment options
- High mortality rate: Can contribute to death in up to 50% of infected patients
- Rapid spread: CPE can spread by person-to-person contact, through contaminated medical equipment, and environmental surfaces. It can also enter the host at specific body sites causing infections (e.g. pneumonia, UTI)
- Horizontal gene transfer: The genes that enable CPE to produce carbapenemases can be transferred between bacteria
Methods

Trillium Health Partners is one of Canada's largest academically affiliated tertiary care hospitals, consisting of highly specialized regional programs. It comprises the Credit Valley Hospital (CVH), the Mississauga Hospital, and the Queensway Health Centre.

The study was conducted in the ICU at CVH, which has 24 private rooms admitting both medical and surgical patients.

- The study was part of a pilot to retrospectively review all positive CPE results from January to September 2022.
- Each patient with a positive CPE result was enrolled in the study once.
- Swabs were collected from hand hygiene and washroom sink drains.
- Any colonies of *Acinetobacter* spp., *Pseudomonas* spp., or *Enterobacterales* were screened for carbapenemase using the NG-test Carba 5.
Results

Patient CPE Isolates

15 non-duplicate CPE isolates were recovered from 14 patients

Age range: 26 to 82 years old

Four female and ten male

Out of the 14 patients
  • Four stayed in the ICU <72 hour
  • Ten stayed in the ICU >72 hour

Median length of stay: 28.5 days

Sink Drain CPE Isolates

33 sink drains in the ICU were tested

24 were hand hygiene sinks, nine were patient washroom sink drains

Hand Hygiene sink

Patient Washroom sink
Results cont.
Sinks Tested and Instances of CPE Contamination in the ICU

<table>
<thead>
<tr>
<th>Hand hygiene</th>
<th>Patient washroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sinks tested</td>
<td>24 (100%)</td>
</tr>
<tr>
<td>Number of positive for CPE</td>
<td>9 (37.5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient washroom</th>
<th>Number of sinks tested</th>
<th>Number of positive for CPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 (37.5%)</td>
<td>0 (zero%)</td>
</tr>
</tbody>
</table>
Results cont.
Distribution of CPE Genes in Patient and Sink Isolates

<table>
<thead>
<tr>
<th>CPE Genes</th>
<th>Sink CPE genes</th>
<th>Patient CPE genes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIM producing Acinetobacter spp</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>OXA 48 like-producing Klebsiella aerogenes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OXA 48 like-producing Enterobacter cloacae</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NDM producing Klebsiella pneumoniae</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>NDM producing Escherichia coli</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NDM producing Citrobacter freundii</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>KPC producing Klebsiella pneumoniae</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>KPC producing Enterobacter cloacae</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>KPC producing Citrobacter freundii</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>
Recommendations and Conclusions

• The study suggests that sinks contaminated with CPE could spread bacteria to patients, as evidenced by KPC producing *C. freundii* found in both patient and sink samples.

• To effectively eliminate CPE from hand hygiene sink drains, a collaborative effort is required between various teams, including the infection prevention and control team, microbiology team, environmental team, and facilities team.

• Ongoing education and training for ICU staff on proper infection prevention and control measures, with a special focus on safe disposal practices.

• Additional research needed to confirm possibility of sink-to-patient transmission through molecular genotyping of CPE-positive isolates.
References

Thank You!