Laboratory Response to a KPC Outbreak at the NIH Clinical Center

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INTRODUCTION

Klebsiella pneumoniae carbapenemase-producing K. pneumoniae (KPC-KP) are notorious nosocomial pathogens that are resistant to nearly all antibiotics and can rapidly develop further resistance upon exposure to the remaining active agents.

The epidemiological challenge of KPC-KP along with high attributable mortality (60-80%) has prompted heavy investment on infection control and preventive measures.

Between June to December 2011, the NIH Clinical Center experienced its first KPC-KP outbreak in the ICU. Prompt laboratory response was crucial for hospital epidemiological guidance and limiting the spread of disease.

OUTBREAK TIMELINE

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DATA SUMMARY

A total of 602 pts were screen between 6/2011 & 1/2012 (674 throat, 699 groin & 3,335 rectal)

KPC-KP was isolated from 18 pts
- 5 (28%) were colonized only
- 11 (72%) developed KPC-KP infections
  - 8 (52%) were bloodstream infections
  - 3 were co-infected with MDRAB
  - 1 was co-infected with KPC-E. cloacae
- 1 pt died (overall mortality 61%)
  - 7 from KPC-C. aerogenes isolates by rep-PCR (4agent)

99% similarity was established between KPC-KP isolates by rep-PCR (4agent)

KPC PCR Development & Validation

KPC Chromagar Validation

KPC PCR (KPCV) was tested in parallel with the CDC laboratory protocol for the “Detection of Carbapenemase-producing Enterobacteriaceae on a 4-Panel Rectal Swab”

In addition, 10 KPC-positive, 10 NPE-negative and 10 KPE-positive controls were added to ensure KPC-Chromagar protocol sensitivity. All Candida spp. were eliminated.

KPC PCR

KPC PCR was developed to detect a 246bp fragment of the KPC gene (inclusive of the 11bp probe) in KPC-KP isolates.

- The assay was validated in parallel with KPC-Chromagar
- High correlation efficiency was 1. No cross-reactivity was observed with human DNA, stool flora or other carbapenem-resistant non-KPC organisms (eg. MDRAB)

KPC RESPONSE ALGORITHM

Following this outbreak and the changes implemented, we have developed the following algorithm for laboratories to respond to future KPC outbreaks:

PREFERENCE

1. Laboratory response: KPC direct detection and identification of KPC-KP isolates in as few as 24 hours
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub Santa Barabara agar (SBA) & MAC for 10μg KPC
   - Subbed onto SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

2. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

3. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

4. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

5. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

6. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
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   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

7. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

8. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

9. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
   - MALDI-TOF MS
   - 10μg Chromagar E. cloacae
   - Initial plating for possible growth
   - Incubation at 10°C
   - Sub SBA
   - Incubation overnight
   - Direct plating to Chromagar KPC
   - Incubation at 10°C
   - Subbed onto SBA
   - Incubation overnight

10. Laboratory response: KPC indirect detection and identification of KPC-KP isolates in as few as 24 hours
    - MALDI-TOF MS
    - 10μg Chromagar E. cloacae
    - Initial plating for possible growth
    - Incubation at 10°C
    - Sub SBA
    - Incubation overnight
    - Direct plating to Chromagar KPC
    - Incubation at 10°C
    - Subbed onto SBA
    - Incubation overnight

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