Methods to Detect Carbapenemase Colonization

Sara J. Blosser, Ph.D., D(ABMM)
Director, Division of Clinical Microbiology and Virology
Indiana State Department of Health
sblosser@isdh.in.gov
317-921-5894

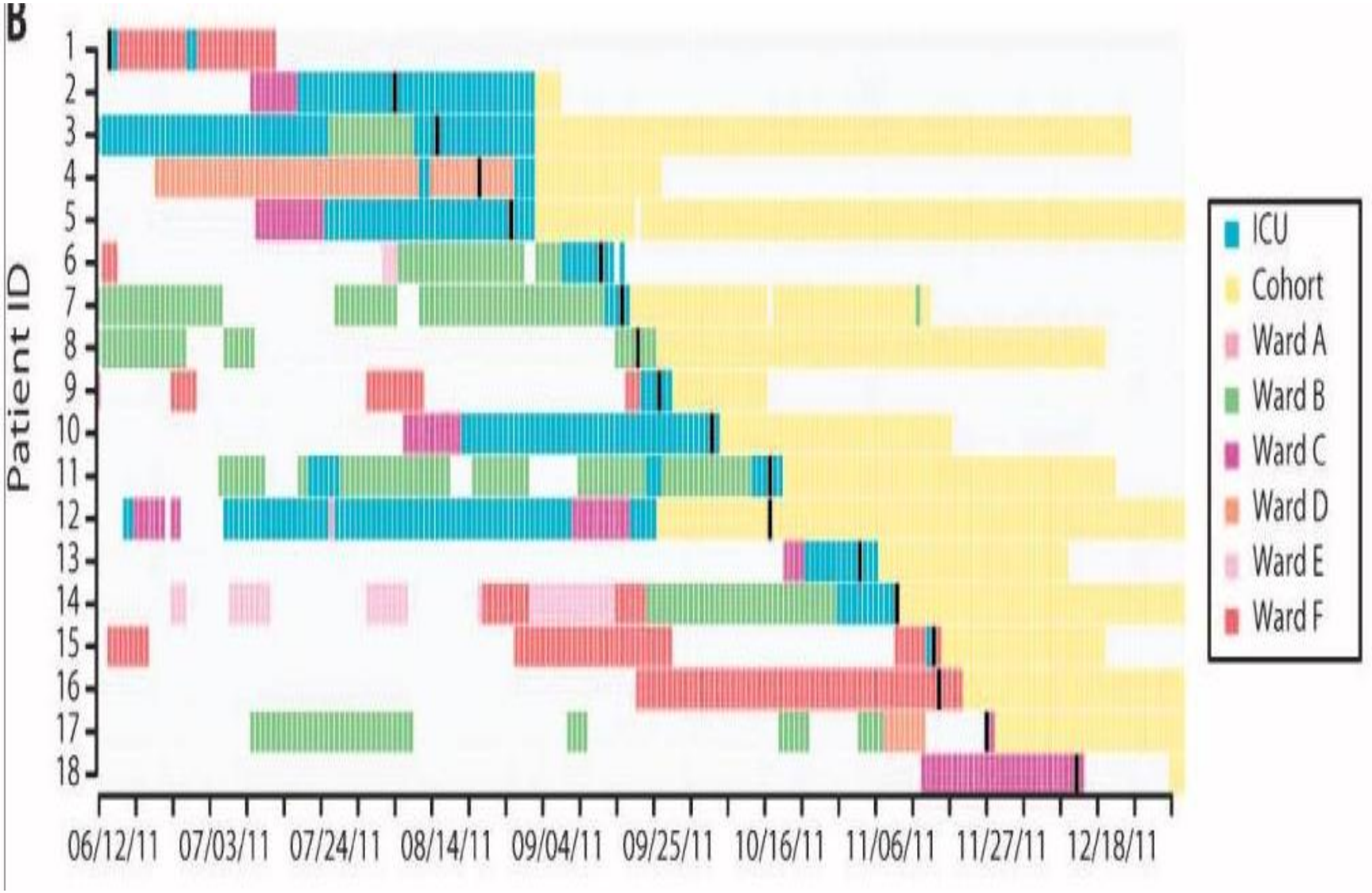
Microbiology Story Time

On 13 June 2011, patient 1 was transferred to our ICU from a hospital in New York City and was discharged on 15 July. She was known to be colonized with carbapenem-resistant *K. pneumoniae* and was immediately placed in enhanced contact isolation in a private room in which staff and visitors are required to don gloves and gowns for entry.

During her stay, she spent two 24-hour stints in the ICU.

Another instance of a KPC-*K. pneumoniae* isolate was not observed in clinical or surveillance cultures until August 5 when it was cultured from the tracheal aspirate of patient 2.

Whether the two KPC-*K. pneumoniae* infections were related was unclear, especially because the two patients were never housed in the same ward at the same time


B
Patient ID
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09/25/11
10/16/11
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11/27/11
12/18/11
ICU
Cohort
Ward A
Ward B
Ward C
Ward D
Ward E
Ward F

In the following weeks, an average of 1 new case of colonization or active infection with KPC-*K. pneumoniae* was detected each week…. with a total of 17 cases as of 1 January 2012 (10 deaths).

To identify asymptomatically colonized patients, three rounds of rectal surveillance cultures were performed on all hospital patients, augmented with more frequent rectal surveillance cultures performed on patients in selected hospital wards.

At least three independent transmission events from the index patient led to two major clusters of colonized patients.

…our results demonstrate the importance of having ongoing, effective surveillance protocols in place before outbreaks occur.

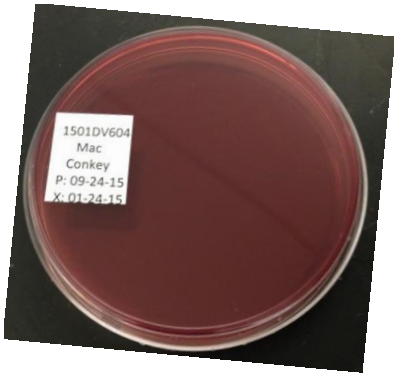
Sci Transl Med 2012, 4(148):148ra116

What are ‘effective surveillance protocols’ for the detection for CP-CRE?

CDC Method

- Day 1 –
  - Add an Ertapenem Disk to 5mL TSB
  - Inoculate broth with rectal swab
  - Incubate overnight at 35°C

- Day 2 –
  - Vortex broth and plate 100µL onto a MacConkey Agar Plate
  - Incubate plate overnight at 35°C



- Day 3 +
  - Examine MacConkey Plate for growth
  - Subculture & Identify Suspicious Colonies
- Day 4+
  - Perform Modified Hodge or CarbaNP and Antimicrobial Susceptibilities on Enterobacteriaceae isolates

CDC Method

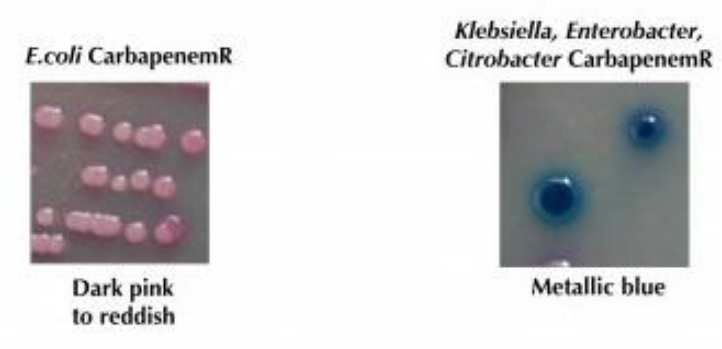
Pros

- Inexpensive
- Most likely have reagents on hand already
- Fairly sensitive

Cons

- Time intensive
- Many ‘false positives’
- TAT slow

Chromogenic ‘CRE’Agar



CHROMagar Method

- Day 1 –
  - Inoculate saline with rectal swab
  - Vortex saline and plate 100µL onto a CHROMagar plate
  - Incubate overnight at 35°C
- Day 2 –
  - Examine CHROMagar Plate for growth
  - Report Presumptive Positives: BLUE or PINK colonies
  - Subculture to Confirm Presumptive Positive Colonies
- Day 3+
  - Perform Modified Hodge or CarbaNP and Antimicrobial Susceptibilities on *Enterobacteriaceae* isolates

Manufacturers of Chromogenic 'CRE' Agar

Name	Detects (Manufacturers Claim)	Sensitivity/ Specificity
CHROMagar KPC	All CRE	
chromID CARBA	All CRE	
chromID OXA-48	Enhanced detection of OXA-48	
chromID CARBA SMART	Biplate of chromID Carba & OXA-48	
Spectra CRE	All CRE	

Pink (*E. coli*)
Blue (*Klebsiella/Enterobacter/Citrobacter*)

Chromagar Method

Pros

- Sensitivity
- Selectivity
- Easy to Read
- Quicker than CDC Method

Cons

- $
- Some false negatives (chromogenic negatives)

LTC Facility Study – NYC, 2014

- Facility: 320-beds, 80 ventilator unit
- Specimens: rectal swabs from non-diarrheal patients
- 72 of 300 patients were KPC positive (24%)
  - Sensitivity:
    - Spectra CRE (97.2%)
    - CDC Method (77.8%)
  - Time:
    - Spectra CRE (18 hours)
    - CDC Method (36 hours)

JCM (2015), 53(9):2823-6

wikipedia.org

Point Prevalence Survey

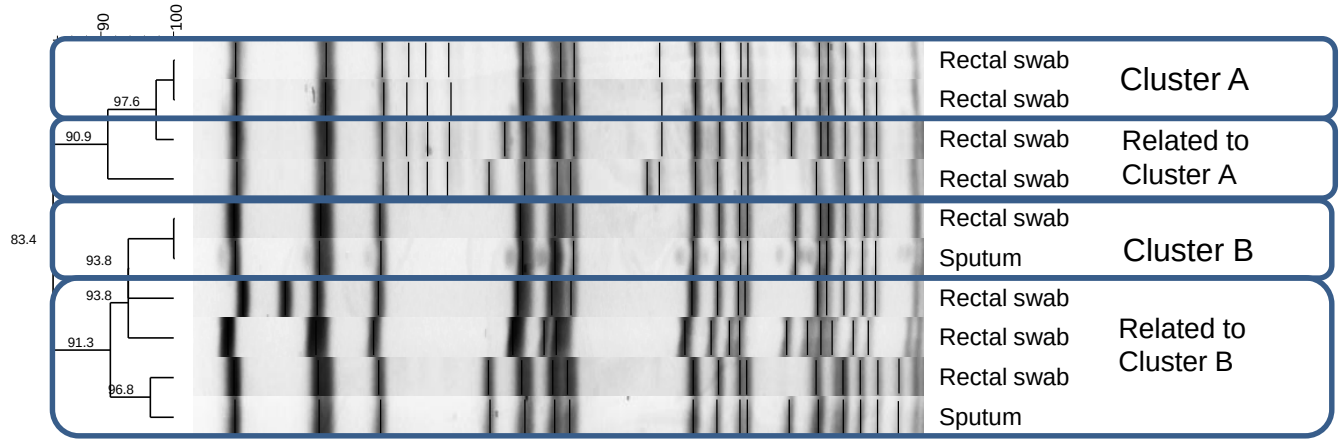
- A facility contacted ISDH in 2016 with concerns regarding their multi-year prevalence of MDRO *Pseudomonas aeruginosa*, *Acinetobacter baumanii* complex, and *Klebsiella pneumoniae*.
- After reviewing these cases, and in consultation with the CDC, it was determined that a point prevalence survey would be most advantageous place to start an investigation.
- The facility collected two specimens on all inpatients on a single day:
  - tracheal aspirates or sputum
  - Rectal swabs
- Testing was split between a hospital laboratory and ISDH

Point Prevalence Summary for KPC-producing *Klebsiella pneumoniae*

- 41 patients surveyed
  - 19.5% positivity (8 patients)
- Rectal swabs were much more sensitive than tracheal aspirates/sputum specimens for recovery of KPC-producing *K. pneumoniae*
- PFGE results demonstrated a combination of transmission and importation.

percent similarity

CDC Lab# relatedness



HOW ELSE CAN WE SCREEN?

CP-CRE Molecular Detection…

Xpert® Carba-R

On-demand detection and differentiation of KPC, NDM, VIM, IMP-1 and OXA-48 (now covering OXA-181 & OXA-232)

FDA approved for **isolate confirmation** and **direct specimen** detection

Sireck

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Conventional PCR Molecular Test

CMY, DHA, CTX-M-14, CTX-M-15, VIM, NDM, IMP, KPC, OXA-48

The kit includes 2 control vials and a primer vial. A 2X Supermix vial, which includes a tracking dye, is also included.

Click here to see patents that may be applicable to this product.

For Research Use Only. Not for Use in Diagnostic Procedures.

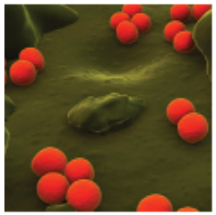
Multiplex Real-Time PCR Detection of Klebsiella pneumoniae Carbapenemase (KPC) and New Delhi metallo-β-lactamase (NDM-1)

http://www.cdc.gov/HAI/settings/lab/kpc-ndm1-lab-protocol.html

Nanosphere

GRAM-NEGATIVE BLOOD CULTURE TEST

US/FDA-Cleared
IMP (carbapenemase)
KPC (carbapenemase)
NDM (carbapenemase)
OXA (carbapenemase)
VIM (carbapenemase)



Antibiotic Resistance Genes

mecA – methicillin resistant
vanA/B – vancomycin resistant
KPC – carbapenem resistant

FilmArray® Blood Culture Identification Panel

"Homebrew" Multiplex PCRs

What would work in your facility?

What are limitations/barriers to implementing a screening program at your facility?

NEXT UP: Post-Test

THEN: Lab Tour