The dissemination of $bla_{NDM-5}$ was mediated by both vertical (via *Escherichia coli* ST-167) and horizontal (via an IncX3 plasmid) transfer.

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Who are we?

Why CREs were targeted?

How this has been done?

What have we found?
- Founded in 1892
- Over 10000 employees
- Ranked 2nd in China
- Teaching Hospital
- 4,300 beds
- 5,060,000 outpatients per year
- 210,000 inpatients per year
- 2nd largest hospital in the world
- Expanding as we speak…
Nosocomial Infection Control Department

Center of Infectious Disease

Medical Staff in Wards of Inpatients

CONTENTS

Who
- Why
- How

What
**Definition of CRE**

Carbapenem-Resistant *Enterobacteriaceae* (CREs)
- Carbapenem-resistant
  - e.g. NDM, KPC, etc.
- *Enterobacteriaceae*
  - e.g. *Escherichia coli, Klebsiella pneumoniae*, etc.

**Clinical Significance**

- *Enterobacteriaceae* are the most common bacteria related to your health
- >50% of them isolated from patients encoding ESBLs, rendering them ONLY susceptible to carbapenem
- Genes encoding carbapenemase usually reside on plasmids, conferring a horizontal transfer among *Enterobacteriaceae*
Tracking CRE

☑ Nosocomial infection control

☑ How genes of carbapenemase disseminates in our local setting
  
  e.g. favourite strain(s) and plasmid(s)

☑ Any other findings behind and etc.
Sample Collection

Stage ONE
- Anal swabs
- 1st one at admission
- When required

Stage TWO
- Anal swabs
- Blood, urine and sputum
- Preliminary-screen by Vitek II automated microbiology system

Stage THREE
- Illumina Hiseq-X Ten
- 150bp paired-end
- About 200x coverage

Who

Why

How

What

Expanded to all units

Started from ICU
- Anal swabs
- 1st one at admission
- When required

January 2014 - Today
The origins of samples
How these patients distributed in terms of beds
Is there spatial connect
Any other potential relevance

What are they
How sequence types distributed
How many SNPs among closely related strains
Where are CRE genes
Focusing on $bla_{NDM-5}$

First reported in China by our team
✓ An *Escherichia coli* carrying $bla_{NDM-5}$ was isolated from a 75-year-old patient in West China Hospital 2013

Fewer reports than other CRE genes
✓ Genes such as $bla_{NDM-1}$, $bla_{KPC-2}$ are widely spread and reported even in the local area

Less complexed gene environments
✓ Nearly all the reported cases of $bla_{NDM-5}$ in China share a common carrier —— an IncX3 plasmid
Strains carrying $\text{bla}_{\text{NDM-5}}$

- **Escherichia coli**
- **Klebsiella pneumoniae**
- **Enterobacter sp.**

Who

Why

How

What
**E. coli strains carrying bla\textsubscript{NDM-5}**

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Vertical dissemination of $bla_{NDM-5}$

- A total of 12 *E. coli* ST-167 strains
- A total of 11 patients (plus a control sample)
- Found in neonatal patient (Zhu et al., 2016)
- Found in various parts of China (Huang et al., 2016)
- *E. coli* ST-167 as a main platform carrying $bla_{NDM-5}$
Nosocomial infection

- Closely Related \( \leq 12 \)
- Unrelated \( >12 \)

(Salipante et al., 2015)
Nosocomial infection

◆ *E. coli* ST-167 strains A, B & C

◆ *E. coli* ST-167 strains F & G (controls)
  ✓ Anal swab & blood, a week apart
**Horizontal dissemination of** $bla_{NDM-5}$

pNDM5_WCHEC0215

- 47kb in size
- Self-transmissible
- IncX3

All other 26 strains harboring an IncX3 almost identical to the reference
Lessons

1. Medical staff should be alerted by such outbreaks and efforts should be made to strengthen nosocomial infection control.

2. Surveillance is needed to tracking dissemination of ST-167 E. coli strains harboring $bla_{NDM-5}$.

3. IncX3 plasmids should be monitored as well due to its cross-species transmission.
Future Perspective

1. Strengths:
   - LARGEST and FIRST clinical CRE epidemic study in the South-West of China
   - Expended to multi-center
   - A long-termed study

2. Limitations:
   - Sample collection
   - Completed Meta-Data
   - Too few for epidemic study
   - Focus on $bla_{NDM-5}$ only
Thank you
Reference


