Carbapenemase Producing Organisms

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Objectives

- Discuss Laboratory detection of CPO
- Summarize the Epidemiology of CPO in Fraser Health Authority
- Discuss Infection Control measures implemented at FHA to prevent transmission of these organisms

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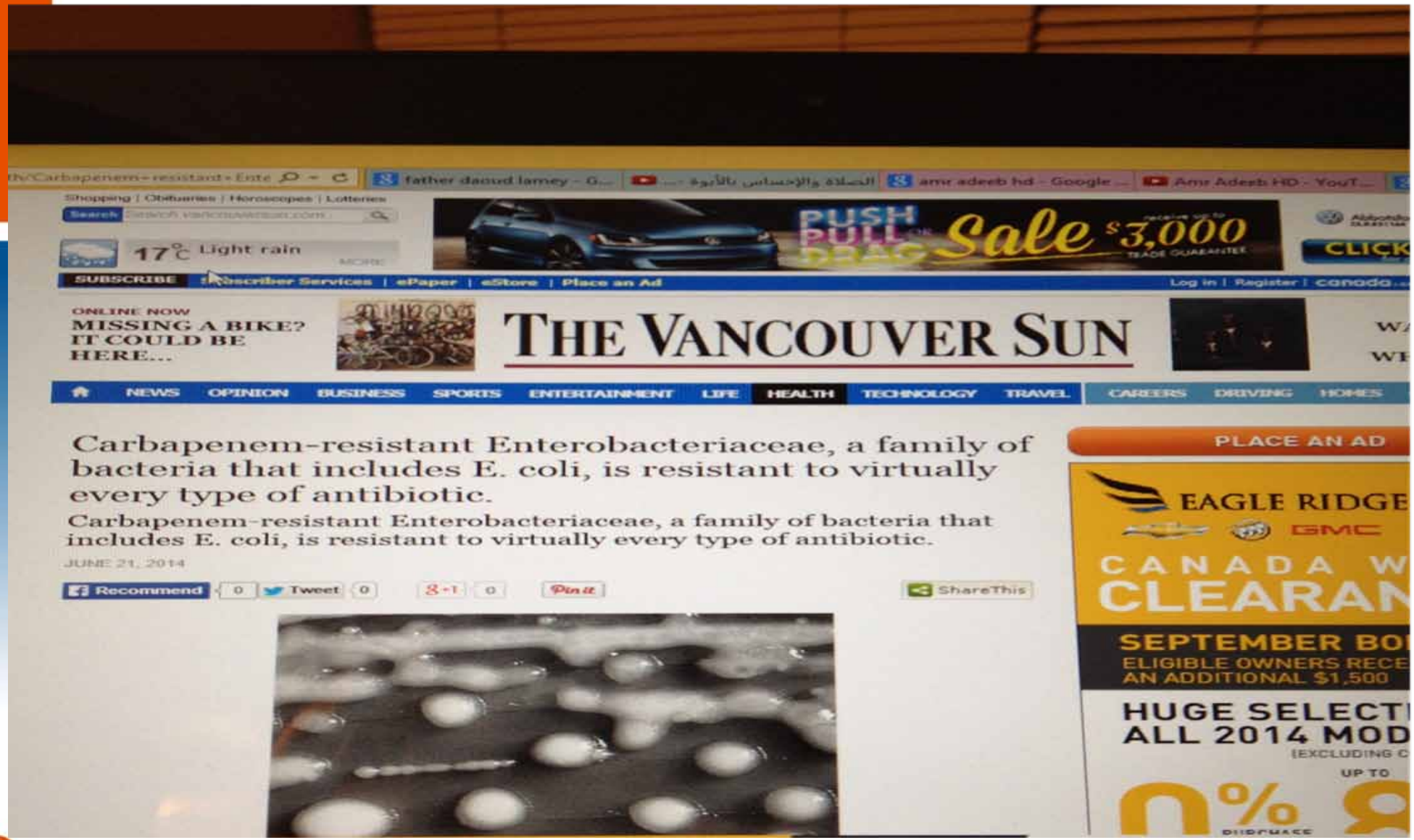

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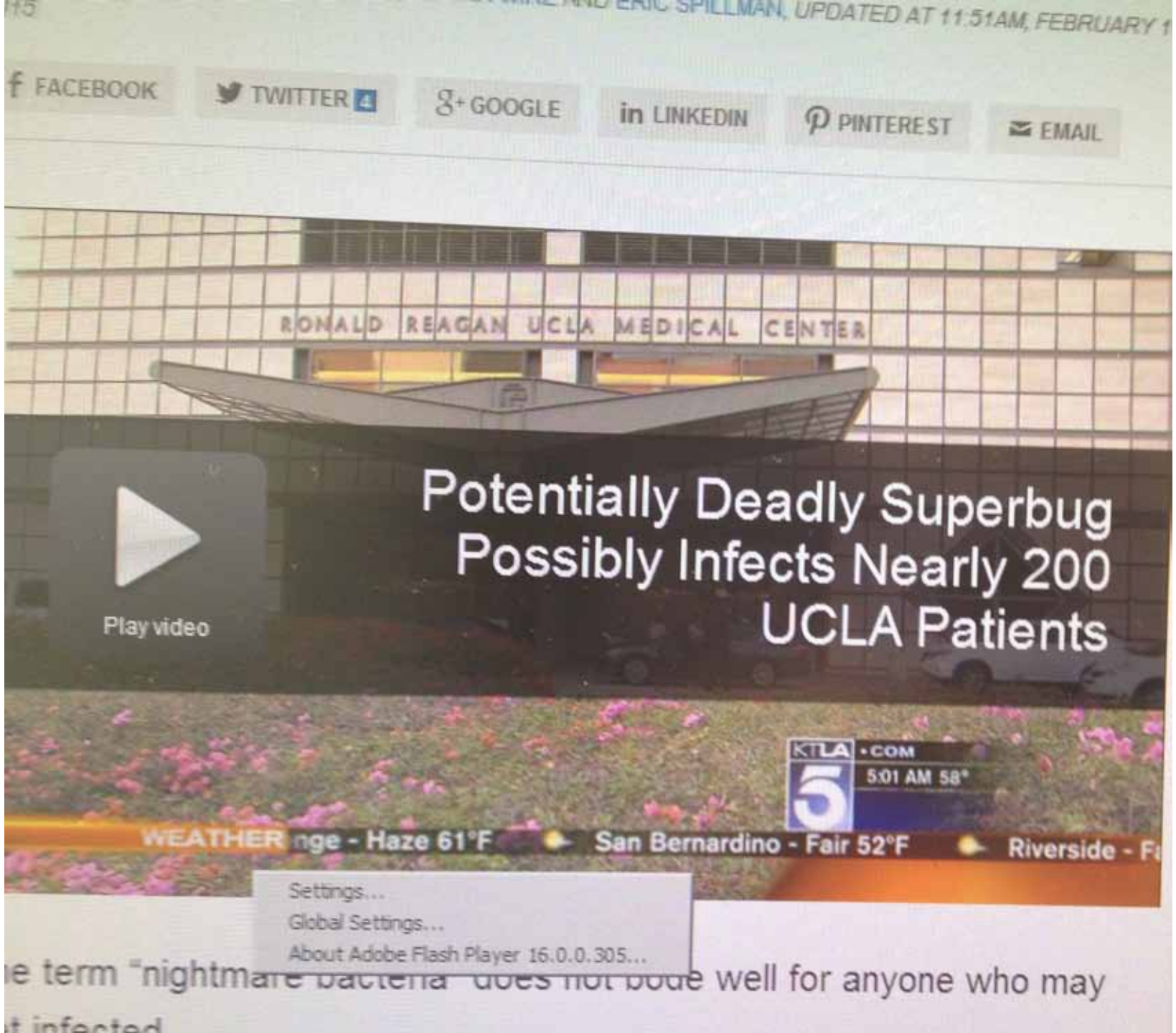
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e term "nightmare bacteria" does not bode well for anyone who may

I. Laboratory Detection of Carbapenemase Producing Organisms

- From Clinical Specimens: All CPO
- From Surveillance Specimens: In FH: Only CPE are detected

A. Clinical Specimens

Organism flagged as NS to ertapenem+/- meropenem

Phenotypic+/- Genotypic confirmation

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B. Screening Specimens for CPE:

- Rectal Swab (fecally stained)
- Stool

- As required by Infection Control:
- Urine
- Wounds
- Sputum
- ETT aspirate

Primary Screening: available methods:

	Sensitivity	Specificity	Cost of plate	Shelf-Life
CDC method	65.6%	49.6%	$1.29	Up to expiration date under appropriate storage conditions
MacConkey + 1µg/ml imipenem	84.9%	94.3%	NA	NA
MacConkey agar + carbapenem disks	75.8%-87%	89.6%-100%	$0.64	Up to expiration date
SUPERCARBA media	96.5%	70.6%	US $0.75	10-14 d

Primary Screening: available methods:

	Sensitivity	Specificity	Cost of plate	Shelf-Life
CHROM agar KPC (Chromagar)	43%	67.8%	US $ 4	2 years (manufacturer's data)
Brilliance CRE(Oxoid)	76.3%	57.1%	US $ 4	12 months (manufacturer's data)
ChromID ESBL(bioMérieux):	NA	NA	NA	NA
Chrom ID Carba (bioMérieux	100%	93%	NA	NA
ChromID® OXA-48 (bioMérieux)	91%	100%	NA	NA

N/A= information not available

OXA-48 Detection

- Challenging to detect as MIC can be quite low
- Inhibited on many of the chromogenic media
- Phenotypic confirmation can also be challenging as no enzyme inhibitor

FH CPE Screening Method

§ SUPERCARBA medium (more selective/shorter TAT)

Drigalski/MacConkey for selection of Gram negative rods.

§ Medium supplemented with a carbapenem for the inhibition of ESBL and carbapenem susceptible isolates, cloxacillin for inhibition of AmpC overproducers and Zinc Sulphate

§ Fully implemented at FHA in December 2014 after verification.

§Sensitivity was 100% and Specificity was 87.8%.

§No change in yield of CRE organisms at 48 h compared to 18 h.

§OXA-48 detected

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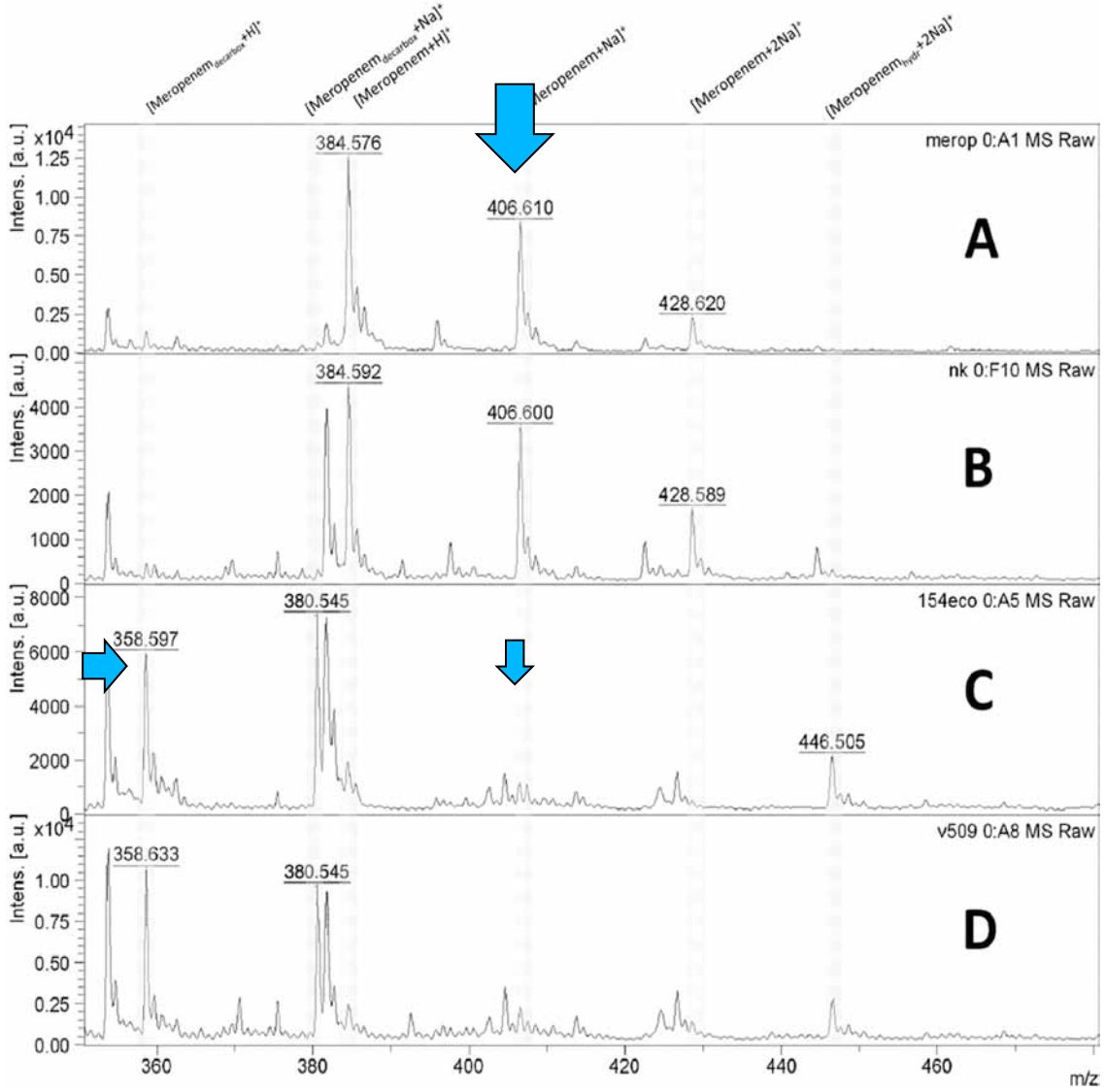
Phenotypic Confirmatory Methods

Vitek2 (automated AST) + E tests

In addition:	Sensitivity	Specificity	TAT (Turnaround Time)	Cost per test
ROSCO Disks	80%	93%	18-24 h	$6.6
Mastdiscs	78%	93%	18-24 h	NA
CarbaNP	98%	100%	60 min	$1
MALDI Imipenem / Meropenem Hydrolysis Assay	95.2%	100%	60 min	$1

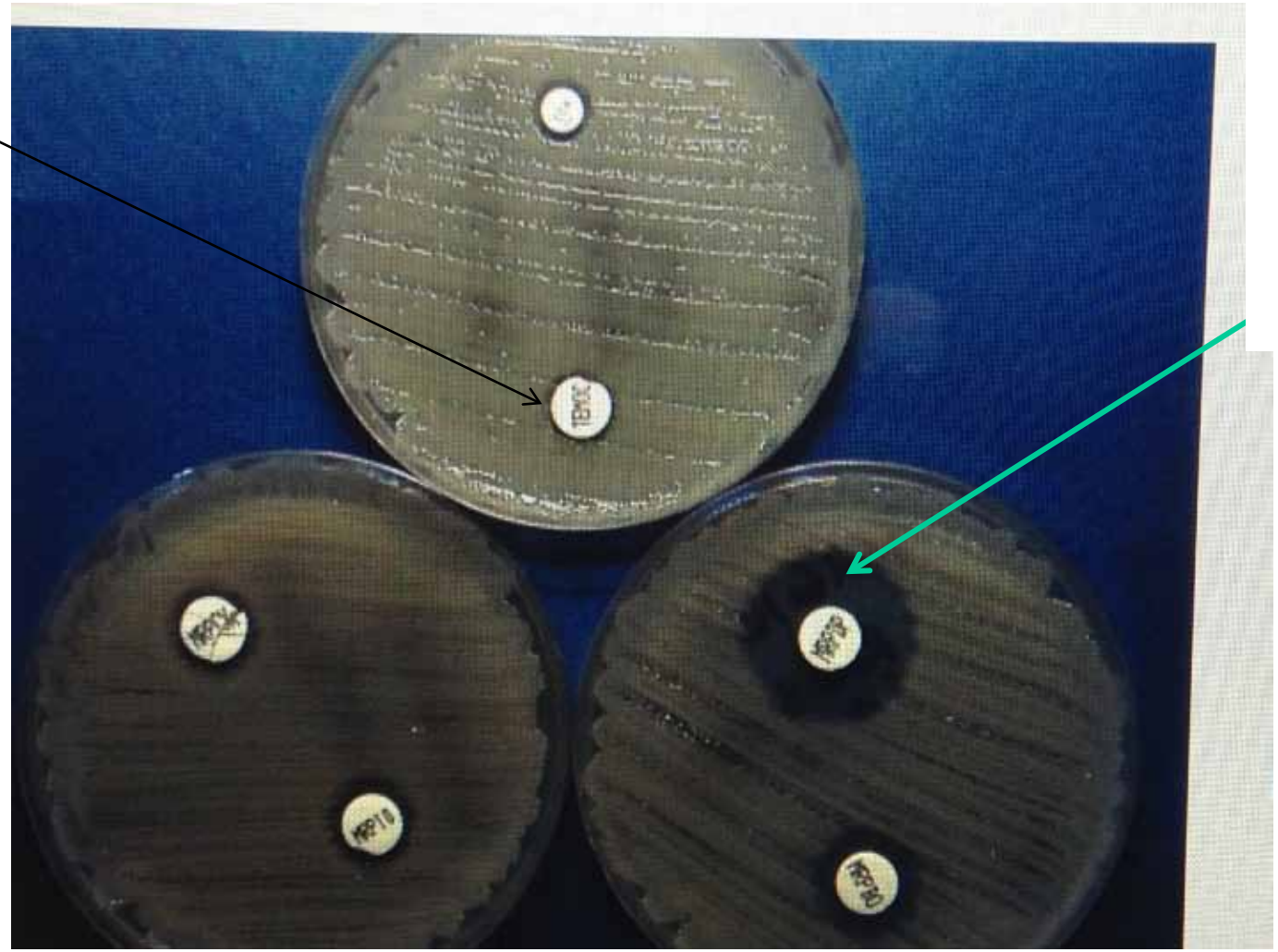
MALDI-TOF MS spectrum showing meropenem, sodium salts of meropenem, and degradation products.



Hrabák J et al. J. Clin. Microbiol. 2012;50:2441-2443

ROSCO disks: Used at FH

TEMOCILLIN
no zone ?OXA-48



Enzyme inhibitor in disk helps identification of carbapenemase.
In this case: MBL

Genotypic Confirmation

- Multiplex PCR testing for 5 common Carbapenemase encoding genes (NDM, KPC, OXA-48, VIM, IMP)
- Result also includes ESBL/AmpC encoding genes

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CPE Screening Specimen Work up

Non-Enterobacteriaceae → Discard

Enterobacteriaceae

KB for Imi, Mero, Erta

ROSCO disks

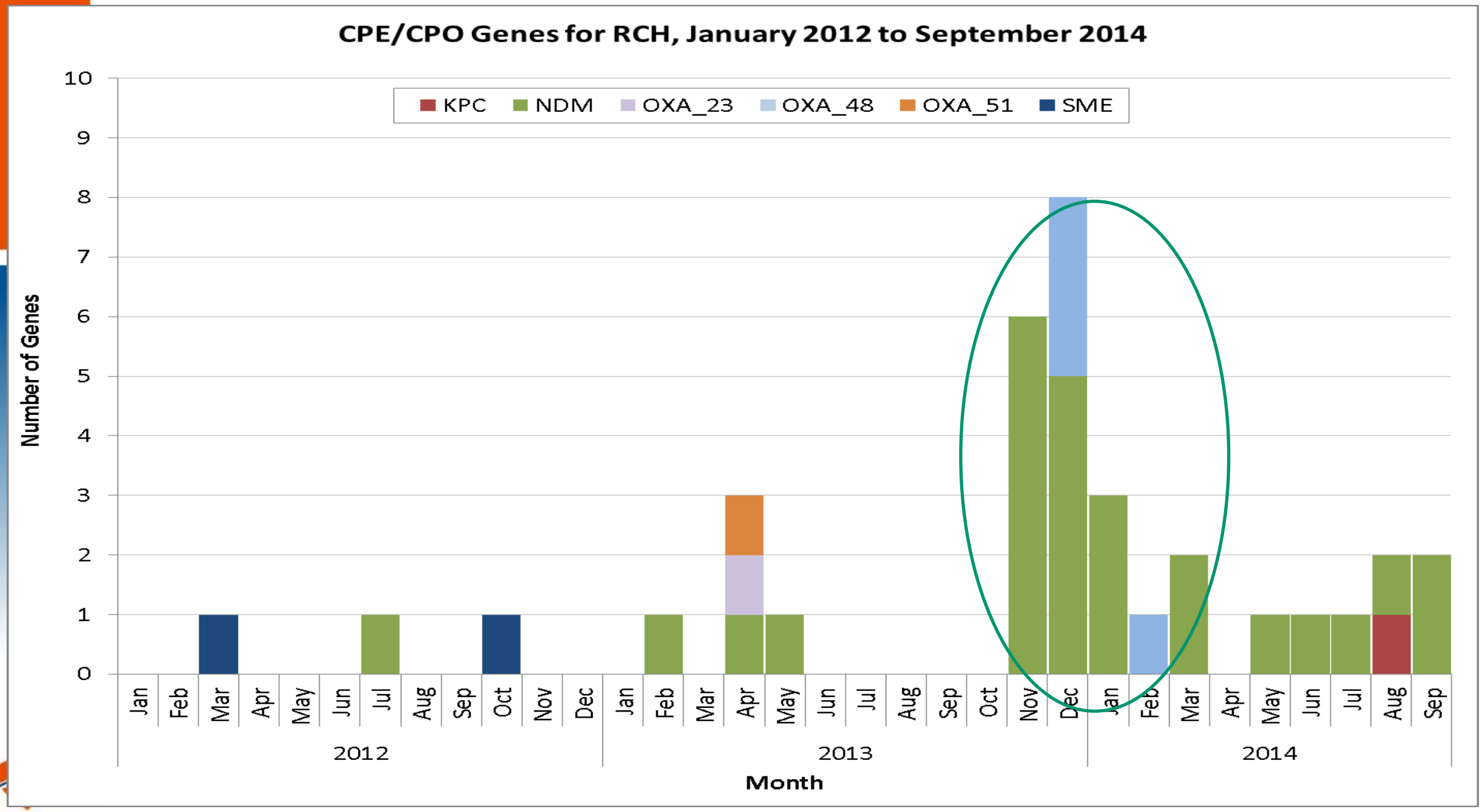
? CPE

Molecular testing for Carbapenemase producing genes

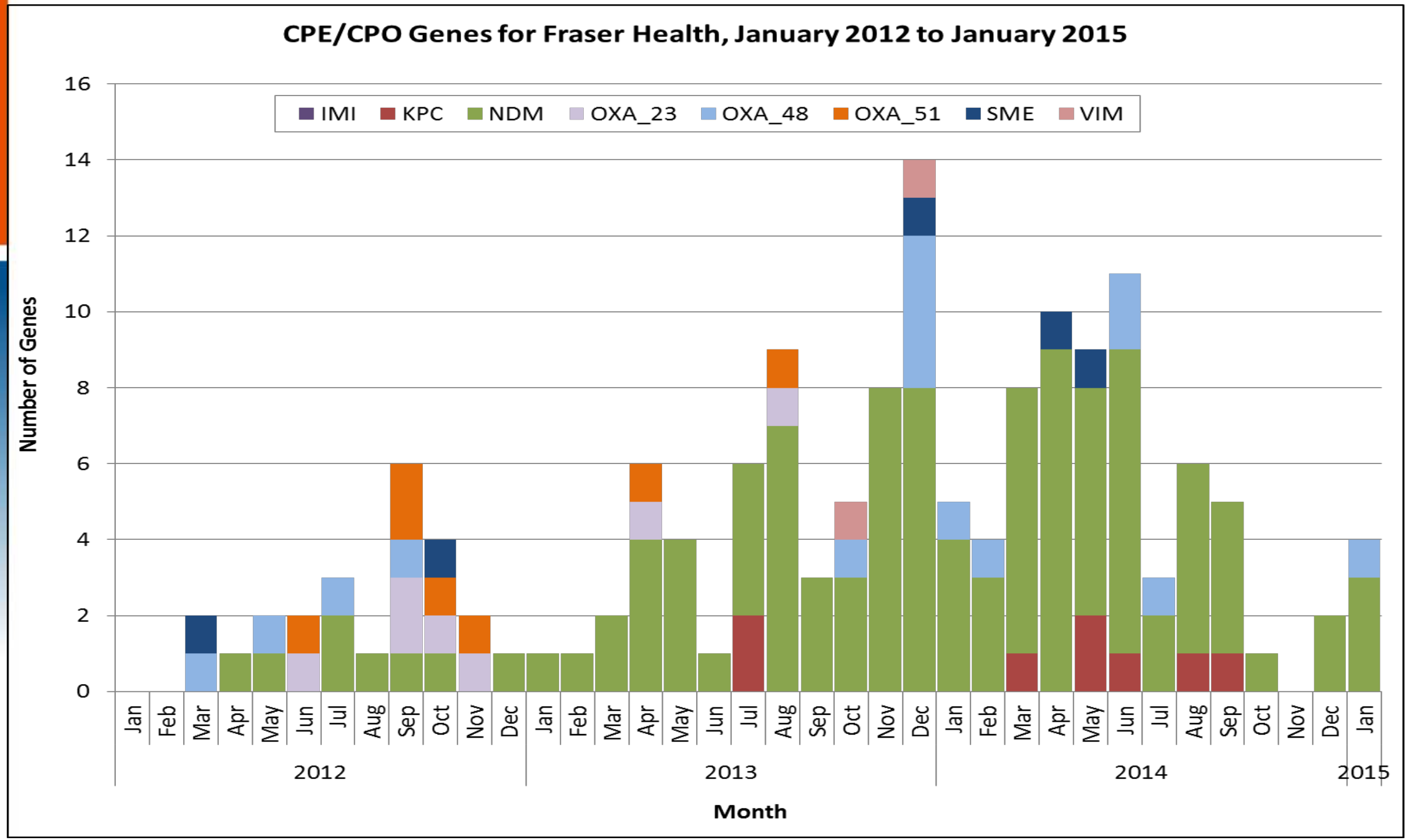
II. The Epidemiology of CPO in Fraser Health: A Tale of Two Sites

What is a CPE/CPO Outbreak ?

On going transmission despite implementation of standard Infection Control Practices



Prepared by Tara Donovan, Epidemiologist


CPE/CPO Genes for Fraser Health, January 2012 to January 2015
IMI
KPC
NDM
OXA_23
OXA_48
OXA_51
SME
VIM
Number of Genes
0
2
4
6
8
10
12
14
16
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
2012
2013
2014
2015
Month

Why is there an increase in the number of CPO isolates in 2014 ?

- **Active surveillance** for high risk patients (started January 2014 at SMH and March 2014 Fraser Health wide)
- High risk areas: ICU/HAU October 2013: Universal surveillance for all admissions
- Who gets screened ? Who is considered high risk?....
- Potential for extending the screening question ?

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Why is there an increase in the number of CPO isolates in 2014 ?

- Identifying some travel related cases (e.g. in dialysis program) some cases had minimal HC exposure
- Multiple point prevalence screens prompted by single nosocomial cases on any unit

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Why is there an increase in the number of CPO isolates in 2014 ?

- Extensive contact tracing
- Nosocomial transmission (Limited)
- Carbapenem usage/other factors ?
- About 10% of patients carried >1 CPE gene
- Patient population served by some FH hospitals

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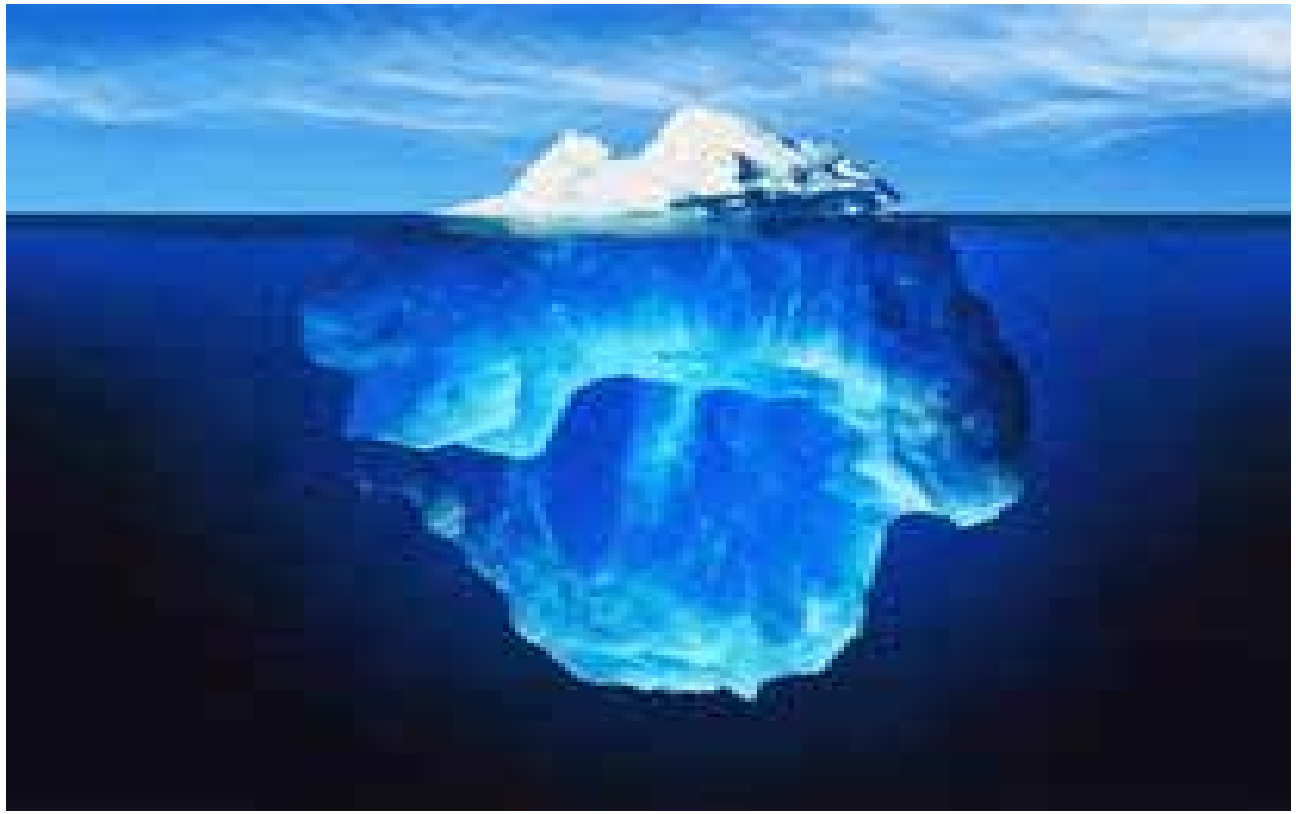
Infection to Colonization Ratio



Ratios of infection to colonization range from 1:3.5 to 1:12

Apisarnthanarak et al CID 2008

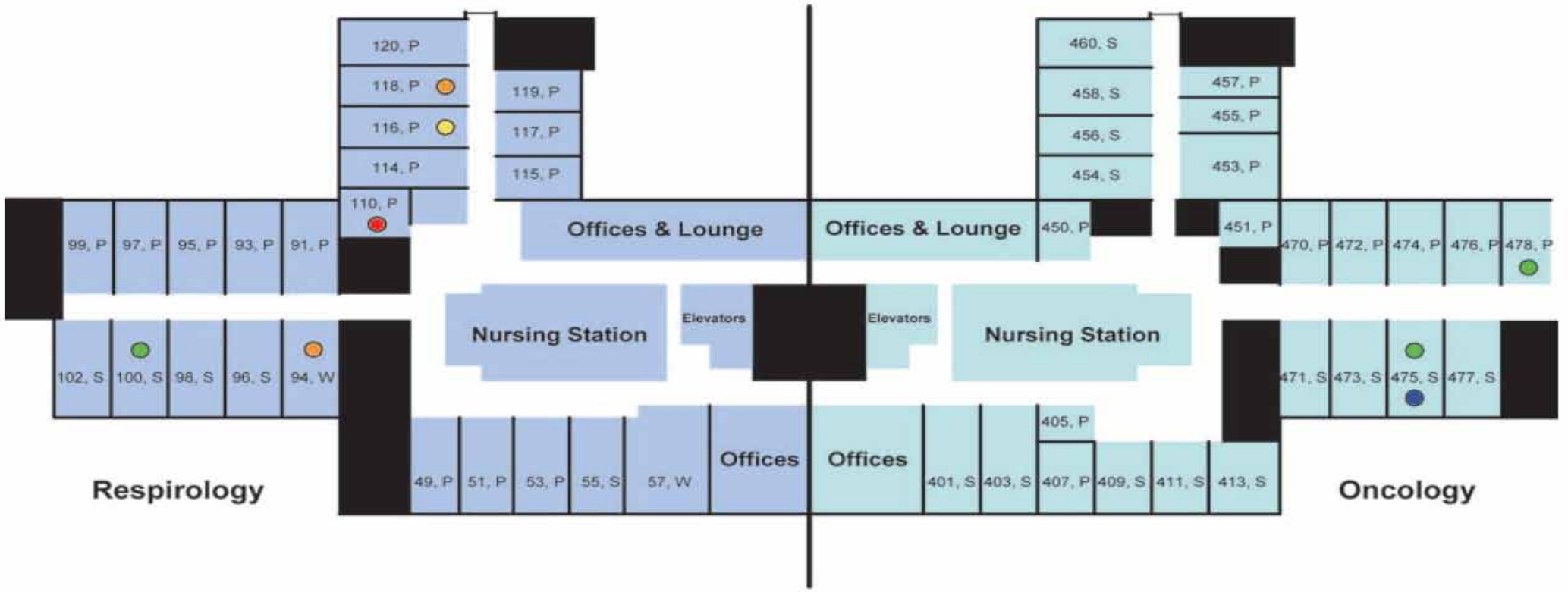
Current Status

- RCH: No CPE transmission since March 2014 on outbreak unit. Very limited activity on other units

  No evidence of CPE transmission since July 2014
- SMH: 1 ?nosocomial transmission on our CPE cohort unit in December 2014.
- This unit has had very few transmissions despite the colonization pressure.
- Five negative point prevalence screens since this last transmission

III.TRANSMISSION AND INFECTION CONTROL:

Feco-oral Transmission



Borgia et al, CID 2012:55

Transmission patterns seen:

- **Molecular analysis provided evidence of transmission through:**

1- Direct Contact (Roommates/Role of hands of HCW)

2- Environmental Contact (Role of soiled environment as a reservoir)

3- Shared nursing assignments (Role of hands of HCW/shared equipment)

4- Plasmid analysis result have sometimes prompted further investigation

(e.g. patients in 2 different units having identical plasmid profiles), revealing other modes of transmission; such as allied HCW

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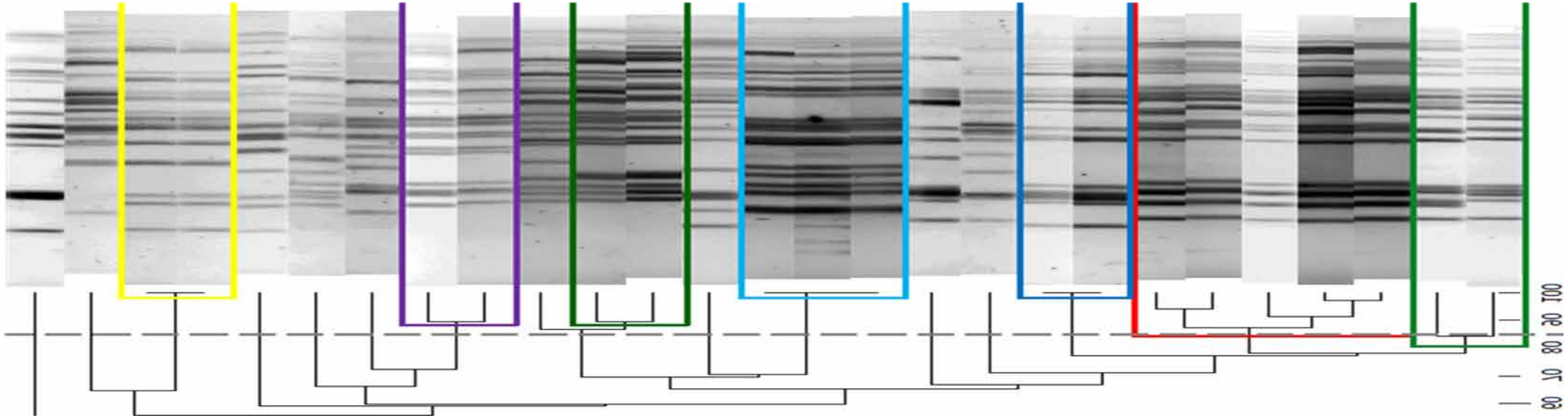
Clonal Transmission vs Plamid Transmission



Courtesy of Dr. L.Hoang BCPHMRL

Comparing Resistance-Genes in *E.cloacae* isolates

KPC	NDM	IMP	VIM	SHV	TEM	CTX-M	OXA-1	CMY-2	CMY-1	CMY-2/LAT	DHA	ACC	MIR/ACT	FOX	
Neg	Pos	Neg	Neg	Neg	Pos	Pos	Pos	Neg	Neg	Neg	Pos	Neg	Neg	Neg	
Neg	Pos	Neg	Neg	Neg	Pos	Pos	Pos	Neg	Neg	Neg	Pos	Neg	Neg	Neg	
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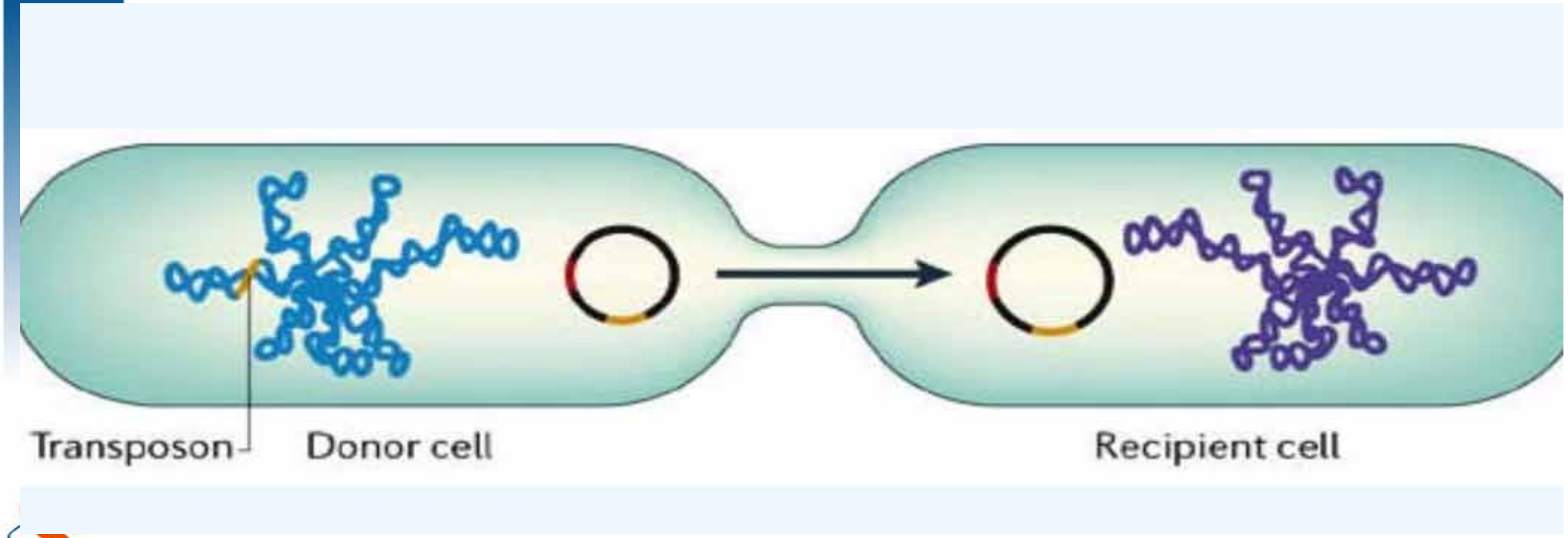
Courtesy of Dr. L.Hoang BCPHMRL

Plasmids and Transposons



Infection Control Measures That Worked

MAJOR ARTICLE

Containment of a Country-wide Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* in Israeli Hospitals via a Nationally Implemented Intervention

Mitchell J. Schwaber,[1] Boaz Lev,[2] Avi Israeli,[2] Ester Solter,[1] Gill Smollan,[1] Bina Rubinovitch,[1] Itamar Shalit,[1] Yehuda Carmeli,[1] and the Israel Carbapenem-Resistant Enterobacteriaceae Working Group[a]

[1]National Center for Infection Control, Israel Ministry of Health, Tel Aviv, and [2]Israel Ministry of Health, Jerusalem, Israel

Screening, Testing and Surveillance for Antibiotic-Resistant Organisms (AROs)

In All Health Care Settings

Provincial Infectious Diseases Advisory Committee (PIDAC)

Infection Control Measures That Worked

- **HH and Contact Precautions** for presumptive /confirmed CPE cases (Borgia et al, CID 2012:55)

Proper use of Contact Precautions

- Perform hand hygiene before donning a gown and gloves
- Don gown and gloves before entering the affected patient's room
- Remove the gown and gloves and perform ha to exiting the affected patient's room

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Infection Control Measures That Worked

- **Active surveillance** (Ben David et al ICHE 2010; 31:620-626):

4.7 fold reduction in the incidence of CRKP following implementation of active surveillance.

Active surveillance comprises more than one entity:

admission screening for high risk patients/ point prevalence screening/screening of contacts

Infection Control Measures That Worked

- Daily as well as terminal **cleaning** of all rooms (Borgia et al, CID 2012:55)
- **Cohorting of patients/staff** (Schwaber et al, CID 2011:52:848-855): For each increase of 10% in compliance, there was a decrease in incidence of 0.6 cases per 100,000 patient-days (P = .02)

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Infection Control Measures That Worked

- **Limiting use of devices** (CDC CRE toolkit, 2012)
- **Antimicrobial Stewardship** (AJIC 2007; 35:S165-193)
- **Laboratory notification**
- Chlorhexidine bathing

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IC Measures Implemented at FHA to Limit Spread of CPE

- **Outbreak control measures:**
- Weekly meetings of the OMT, including the Site Director, Medical Microbiologists, unit staff, ancillary staff, housekeeping, other site leadership and the IPC team
- Communication with the unit, site and public. Signage and barriers were placed on the unit.
- Declaration of the outbreak on the FH public website

- All colonized patients were placed in private rooms with dedicated nursing.
- Dedicated equipment for colonized patients
- Emphasis on hand hygiene and PPE for staff working on the unit: education/audits and feedback
- Enhanced twice daily cleaning of the entire unit with the CPE cohort being cleaned last
- Implementing hand wipes prior to meals/medication delivery for all patients on the unit
- Closing unit kitchenettes
- Daily CHG baths for CPE + patients

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- Admission and weekly point prevalence CPE screening for all patients on the unit (except know positive CPE patients).
- Team Huddles
- Multidisciplinary team approach different health care workers sharing information together
- Role of allied HCW (RT, PT, OT)
- Unit Champion (PCC)

- Creation of CPE Outbreak Unit:
- Transmissions to non-positive patients were minimized by doing early isolation of suspected patients, and cohorting of all lab-positive patients. Separate area of the unit transformed into a mini unit with a separate nursing station and dirty utility room. “Barrier room” between CPE outbreak section and the rest of the unit
- After the outbreak, this section of the unit is serving as the CPE cohort unit.

Ongoing CPE Control Measures

- Creation of a CPE cohort unit on site with dedicated staffing
- Discussion on when to cohort 2 patients in a semi-private

- Cohorting of allied HCW when possible

Ongoing CPE Control Measures

- Unit champions HH/PPE audits/ a culture of IC on the unit (CPE police)

- Continued HH audits with feed back
- Enhanced cleaning: - increased frequency of cleaning of high touch surfaces

  - perform terminal cleans of the CPE patient rooms every 2 weeks while long-stay patients are admitted

Acknowledgement

- Sandeep Baddan & Amanda Giesbrecht and SMH IC team
- Tara Donovan
- Adriana Mendes and RCH IC team
- Dr. Elizabeth Brodkin
- Dr. Dale Purych
- Dr. Ben Mack
- Dr. Susan Roman
- Dr. Joan Tomblin

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