Carbapenemase-producing Enterobacterales (CPE) Quarterly Surveillance Report – Q2, 2020

29 March – 27 June 2020 (Epidemiological weeks 14–26, 2020)

Summary

"Carbapenemase- producing *Enterobacterales* (CPE) infection and colonisation" was added to the list of laboratory notifiable conditions in New South Wales on 28 February 2019.

This CPE surveillance report summarises characteristics of patients who were notified with CPE infection or colonisation in NSW by laboratories during the second quarter of 2020 (29 March–27 June 2020; epidemiological weeks 14–26). In summary:

Notifications

- 58 unique notifications of carbapenemase-producing *Enterobacterales* (CPE) infection or colonisation in a total of 55 patients were received during this reporting period.

Patients

- 55 patients were identified as having CPE, two of whom had more than one notification of CPE (one patient with two notifications, and one patient with three notifications).
- The median age of patients at notification was 68 years (range: 2 weeks to 91 years). Seven patients (13%) were under 10 years of age (including five infants under 12 months of age), 38 (69%) were 10-79 years, and ten (18%) were 80 years or over.
- 32 (58%) patients were male, and 23 (42%) patients were female.

Specimens

Of the 58 notifications, specimens collected included:

- 23 (40%) for screening;
- 15 (26%) from non-sterile sites, excluding urine;
- 14 (24%) from urine; and
- 6 (10%) from sterile sites, consistent with CPE infection.

Bacteriology

- Eleven different *Enterobacterales* species were detected, mostly:
    - *Enterobacter cloacae* complex (26, 44.8%);
    - *Escherichia coli* (11, 19%);
    - *Klebsiella pneumoniae* (7, 12%); and
    - *Citrobacter freundii* (4, 6.9%).

Genetics

- Five different carbapenemase-producing resistance genes were detected (IMP, NDM, OXA-48, OXA-23 and SME), as follows:
    - IMP (44, 75.9%);
    - NDM (9, 15.5%);
    - OXA-48 like (2, 3.5%);

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    - OXA-23 like (1, 1.7%);
    - SME (1, 1.7%); and
    - IMP and OXA-48 like (1, 1.7%).
- This includes one notification which reported a single bacterial species (*Citrobacter freundii*) harbouring two different carbapenemase-producing resistance genes (IMP and OXA-48 like).

Introduction

Multi-resistant organisms are a growing threat internationally. Following expert review, NSW Health identified carbapenemase-producing *Enterobacterales* (CPE) as a high priority pathogen.

The NSW Public Health Act 2010 was amended to require laboratory notification of 'carbapenemase-producing *Enterobacterales* infection or colonisation' from 28 February 2019. An aim of implementation of a state-wide surveillance program was to assist with identification of cases and increase our understanding of the epidemiology of CPE in NSW. Management of CPE is supported by the NSW Health Guideline for Surveillance and Management of CPE in NSW Health Facilities.

Carbapenemase-producing *Enterobacterales* (CPE)

Enterobacterales are an order of Gram-negative bacilli that occur naturally in the gastro-intestinal tract. They can spread outside the gastro-intestinal tract and cause serious infections such as bacteraemia, pneumonia, urinary tract infections and wound infections.

Carbapenems are an important class of broad spectrum β-lactam antibiotics which are highly effective against most Gram-negative infections. *Enterobacterales* can acquire resistance to carbapenem antibiotics by a number of mechanisms. *Enterobacterales* which are resistant to carbapenem antibiotics, by one of a number of mechanisms, are called carbapenem-resistant *Enterobacterales* (CRE). Carbapenemase-producing *Enterobacterales* (CPE) describe *Enterobacterales* which are resistant to carbapenem antibiotics through production of carbapenemase enzymes encoded by plasmid-mediated carbapenemase genes. The carbapenemase enzymes hydrolyse carbapenems (as well as other β-lactams, such as penicillins and cephalosporins). This means that CPE infections are difficult to treat.

Several different carbapenemase genes have been reported in *Enterobacterales*. Five of the most important types globally are:

1. Imipenemase (IMP)
2. Klebsiella pneumoniae carbapenemase (KPC)
3. New Delhi metallo-β-lactamase (NDM)
4. Verona integron-encoded metallo-β-lactamase (VIM)
5. Oxacillinases (OXA)

Individuals who have acquired CPE can either carry it harmlessly in their gut, like other *Enterobacterales*, termed colonisation, or may develop an infection with the CPE. A person who is colonised will not have any symptoms.

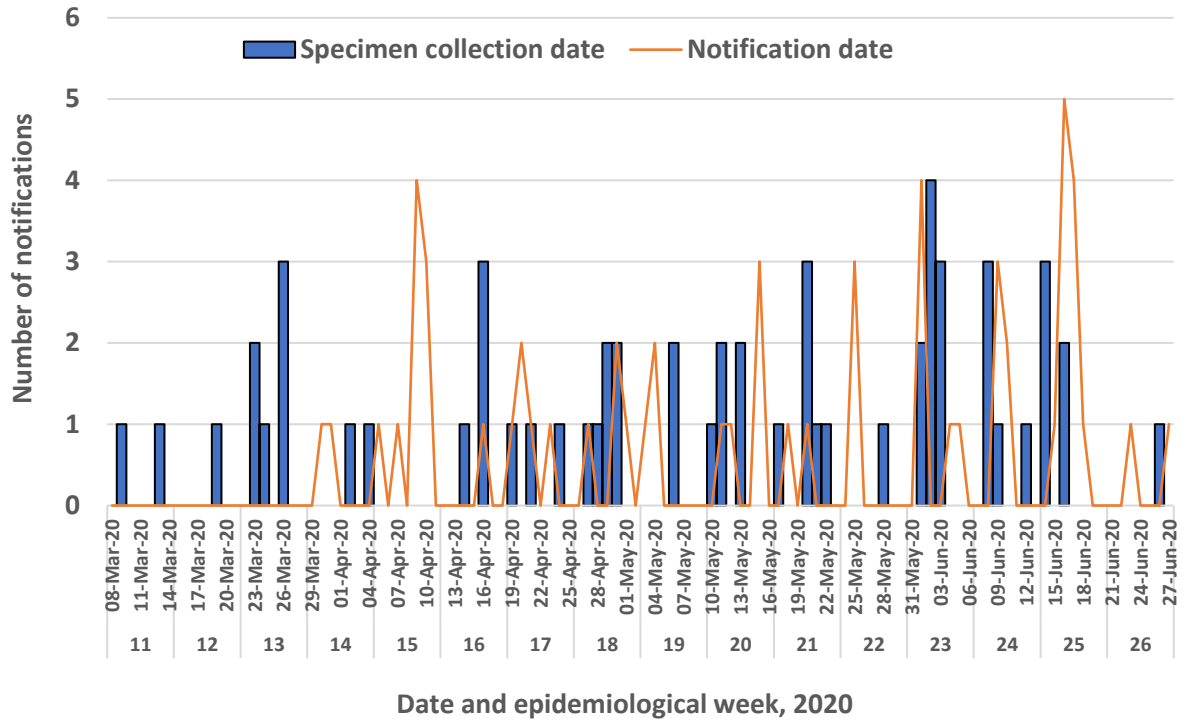
Here we report on the characteristics of patients who were notified in the second quarter of 2020 (epidemiological weeks 14–26, 2020).

CPE infection or colonisation in NSW: 29 March – 27 June 2020

Notifications

Between 29 March and 27 June 2020, 58 unique notifications have been received relating to specimens collected from 55 patients.

Figure 1: Notifications of carbapenemase-producing *Enterobacterales*, by date of specimen collection and date of notification, NSW, 29 March–27 June 2020



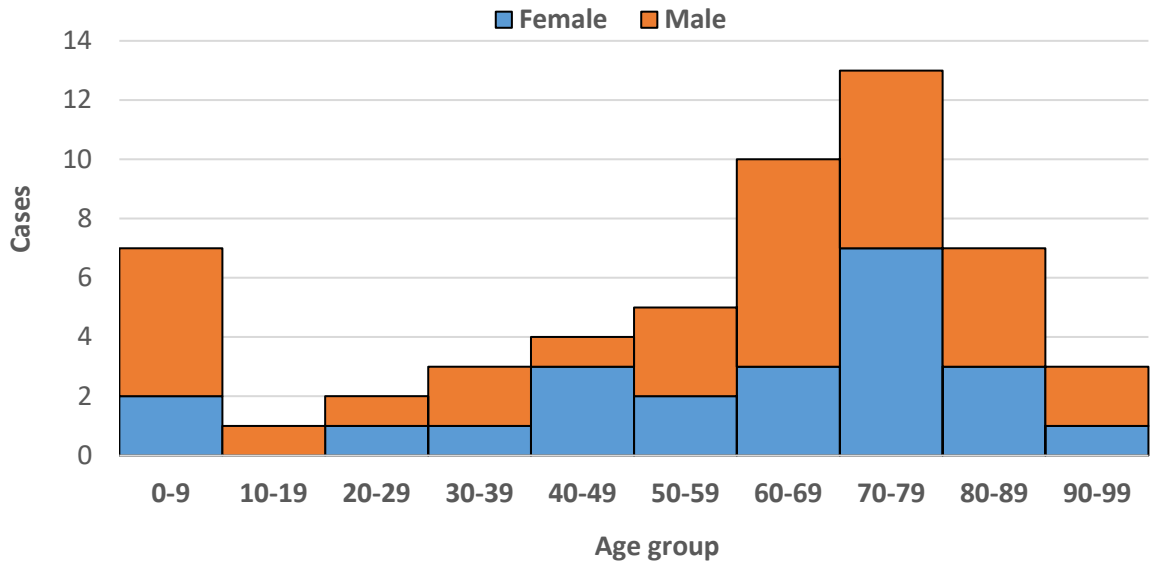
Notes on Figure 1:

- Displays all notifications received between 29 March and 27 June 2020 (epidemiological weeks 14–26) (n = 58); date of specimen collection may precede the surveillance reporting period specified.
- Where multiple *Enterobacterales* species are cultured from a single isolate, each species is counted as a separate CPE notification (but a single case).
- Where molecular testing has identified multiple carbapenemase genes from a single *Enterobacterales* species, this will be counted as one notification.

Demographics

Of the 55 patients, the median age of patients at notification was 68 years (range: 2 weeks to 91 years). Seven patients (13%) were under 10 years of age (including five infants under 12 months of age), 38 (69%) were 10-79 years, and ten (18%) were 80 years or over. In terms of gender distribution, 32 (58%) patients were male, and 23 (42%) patients were female.

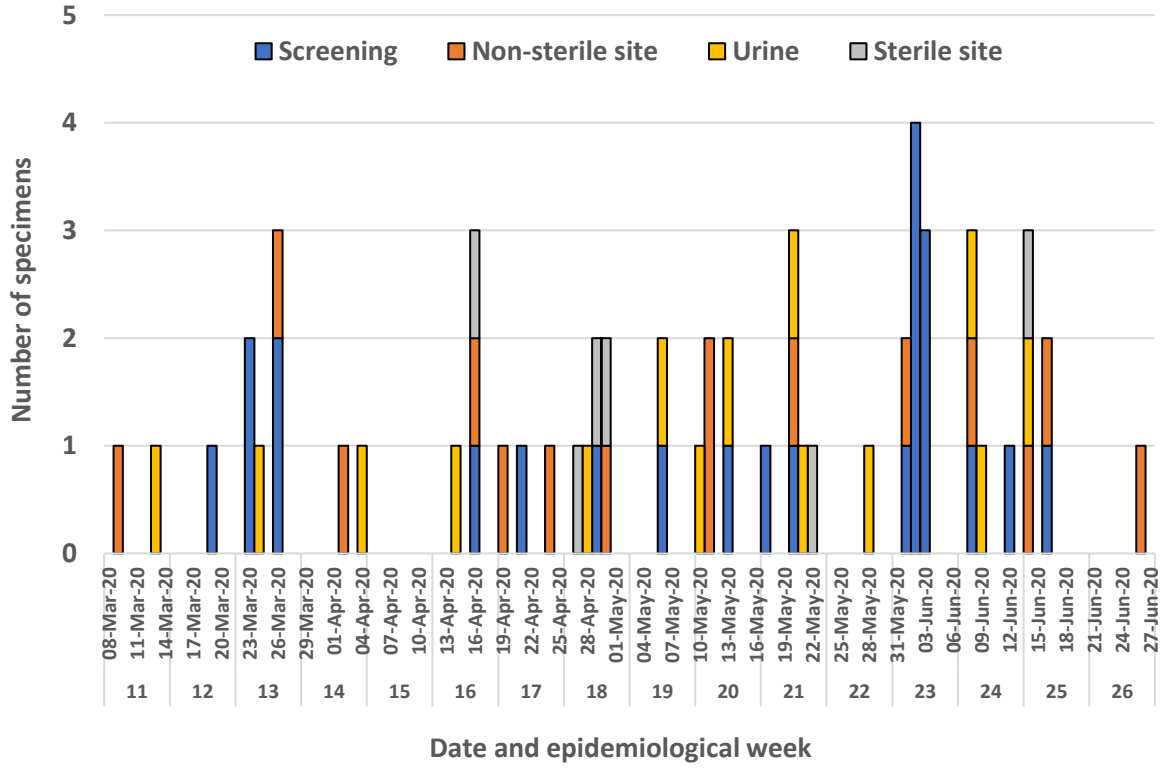
Figure 2: Carbapenemase-producing *Enterobacterales* cases, by gender and ten-year age group, NSW, 29 March–27 June 2020



Specimen type

Of the 58 notifications (excluding duplicates and confirmatory testing), 23 (40%) were specimens collected for screening purposes; and 15 specimens (26%) were collected from non-sterile sites, excluding urine (e.g. wound culture, sputum, unspecified sites). There were 14 (24%) urine specimens and could therefore represent either infection or colonisation. Six (10%) specimens were collected from sterile sites, consistent with CPE infection.

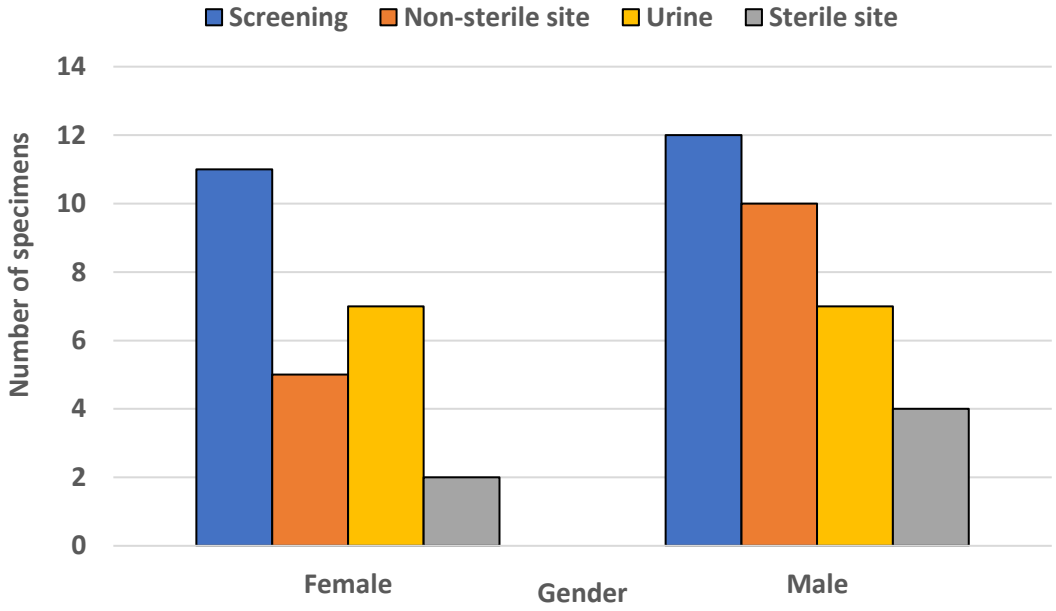
Figure 3: Daily notifications of carbapenemase-producing *Enterobacterales* by specimen type and date of specimen collection in NSW, 29 March–27 June 2020



Notes on Figure 3:

- Duplicate notifications and confirmations are excluded.
- Date of specimen collection may precede the surveillance reporting period specified.

Figure 4: Notifications of carbapenemase-producing *Enterobacterales* by specimen type and gender in NSW, 29 March–27 June 2020



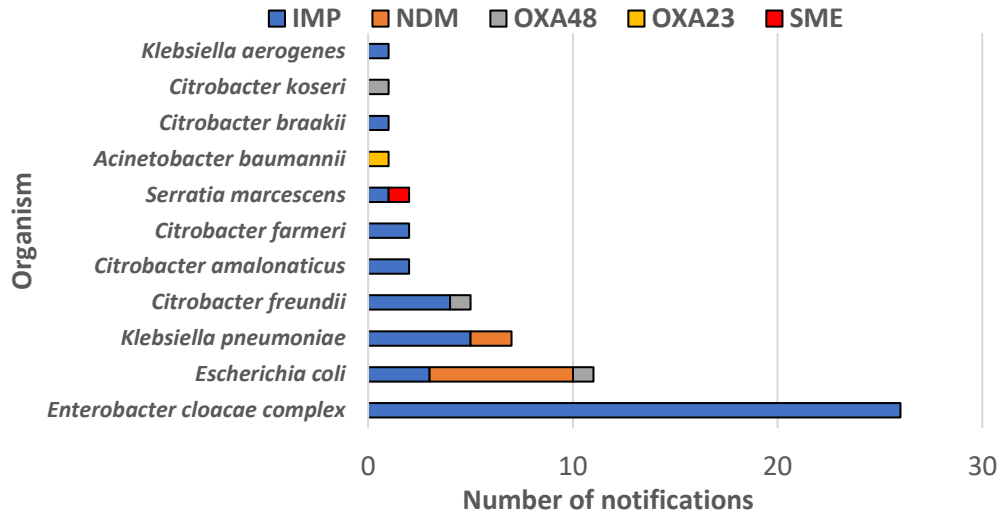
Notes on Figure 4:

- Duplicate notifications and confirmations are excluded.
- A specimen marked "screening" or some variation is considered to be part of a deliberate screen for CPE. The two remaining categories, namely non-sterile site and urine, could represent either an infection or colonisation.

Bacteriology

Eleven different *Enterobacterales* species were detected in the notified cases, as follows: *Enterobacter cloacae* complex (26, 44.8%); *Escherichia coli* (11, 19%); *Klebsiella pneumoniae* (7, 12%); *Citrobacter freundii* (4, 6.9%); *Citrobacter amalonaticus* (2, 3.4%); *Citrobacter farmeri* (2, 3.4%), *Serratia marcescens* (2, 3.4%); *Acinetobacter baumannii* (1, 1.7%); *Citrobacter braakii* (1, 1.7%); *Citrobacter koseri* (1, 1.7%); and *Klebsiella aerogenes* (1, 1.7%).

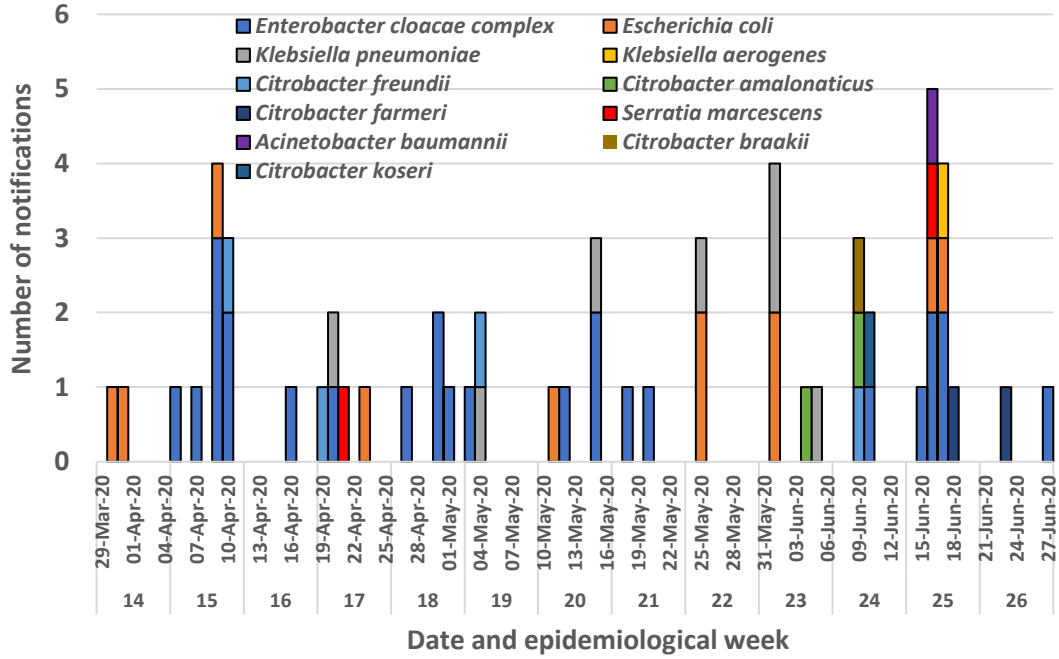
Figure 5: Notifications of carbapenemase-producing *Enterobacterales* by host bacterial species and carbapenemase gene type in NSW, 29 March–27 June 2020



Note on Figure 5:

- Duplicate notifications and confirmations are excluded.

Figure 6: Daily carbapenemase-producing *Enterobacterales* notifications by organism in NSW, 29 March–27 June 2020



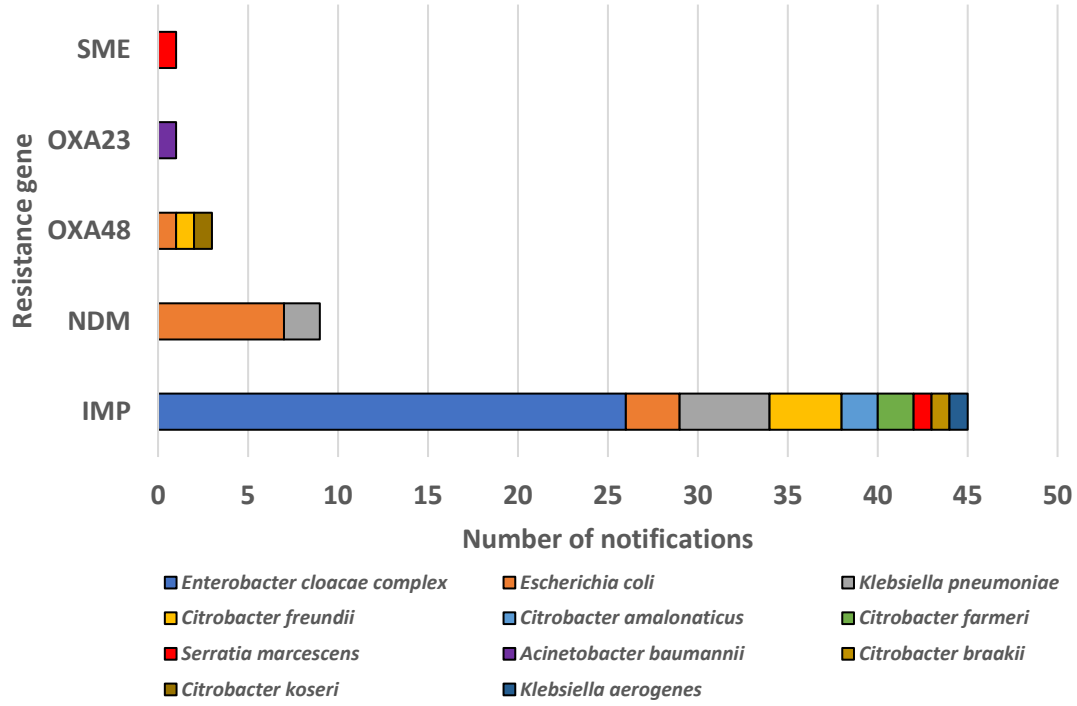
Note on Figure 6:

- Duplicate notifications and confirmations are excluded.

Genetics

During the surveillance period, the carbapenemase-producing resistance genes reported were IMP (44 notifications, 75.9%); NDM (9 notifications, 15.5%); OXA-48 like (2 notifications, 6.8%); OXA-23 like (1, 1.7%); and SME (1, 1.7%). One notification reported a single bacterial species (*Citrobacter freundii*) harbouring two different carbapenemase-producing resistance genes (IMP and OXA-48 like) (1, 1.7%).

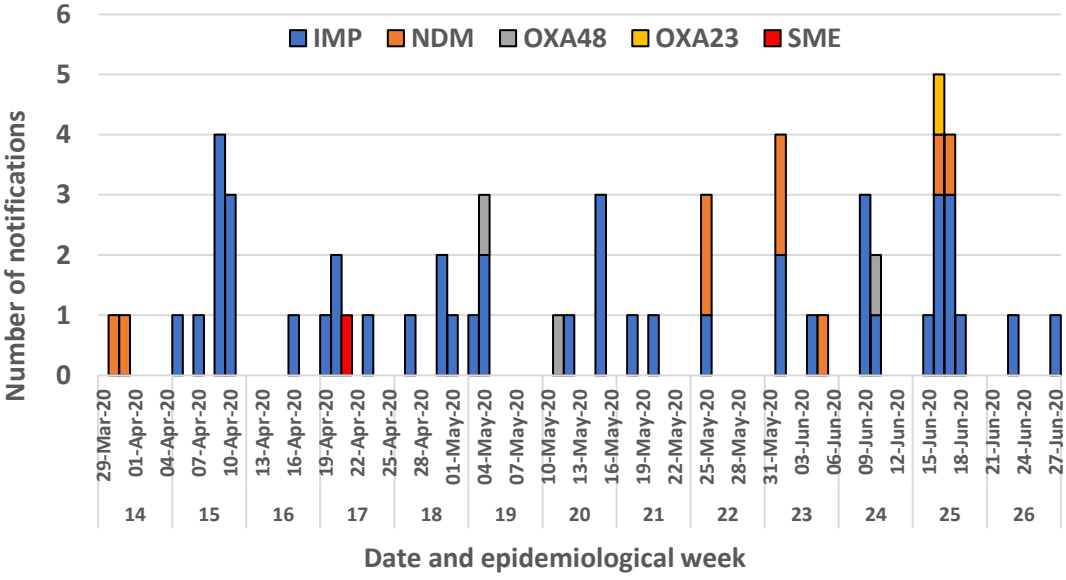
Figure 7: Notifications of carbapenemase-producing *Enterobacterales* by gene type and bacterial species in NSW, 29 March–27 June 2020



Note on Figure 7:

- Duplicate notifications and confirmations are excluded.

Figure 8: Daily carbapenemase notifications by gene in NSW, 29 March–27 June 2020



Note on Figure 8:

- Duplicate notifications and confirmations are excluded.

Notifications by Local Health District and Speciality Networks

Notifications were received from patients in 11 of 15 NSW Local Health Districts (LHD), as well as private hospitals and speciality networks. Notifications relate to the location of the patient at the time the specimen was collected, not the location of resistance gene acquisition.

Table 1: Notifications by Local Health District in NSW, 29 March–27 June 2020

LHD/Speciality Network	Notifications	Percentage
Northern Sydney	10	17.2
Hunter New England	9	15.5
South Western Sydney	8	13.8
Western Sydney	8	13.8
Specialty - Sydney Children's	7	12.1
Illawarra Shoalhaven	4	6.9
Sydney	4	6.9
Northern NSW	2	3.4
Other	2	3.4
Murrumbidgee	1	1.7
Nepean Blue Mountains	1	1.7
South Eastern Sydney	1	1.7
Western NSW	1	1.7
Total	**58**	**100.0**

Notes on Table 1:

- Duplicate notifications and confirmations are excluded.
- "Other" represents specimens with unspecified location, private hospitals and pathology service providers.

Glossary

Term	*Definition*
Carbapenemase-producing *Enterobacterales* (CPE)	*Enterobacterales* which produce a carbapenemase, by means of an acquired carbapenemase gene.
Carbapenem-resistant *Enterobacterales* (CRE)	*Enterobacterales* which are resistant to carbapenem antibiotics, by a number of means, including carbapenemase gene acquisition.
Carbapenemase enzyme	Beta-lactamase which hydrolyses carbapenems, usually along with other beta-lactams
CPE colonisation	The presence of the CPE bacteria in or on a body surface without signs of invasive infection. The primary site of CPE colonisation is usually the lower gastro-intestinal tract.
CPE infection	The invasion of a person's bodily tissues by the CPE bacteria and their subsequent multiplication, typically resulting in disease-causing symptoms and the reaction of host tissues to these organisms and the toxins they produce.
Enterobacterales	Gram-negative bacilli that occur naturally in the gastro-intestinal tract
MRO	Multidrug-resistant Organism

Appendices

Appendix 1: Methods

Surveillance data were collected and analysed as part of routine public health action.

Notifications were received in the form of "doctor's reports" of the genetic test for carbapenemase genes. The data available on these reports was limited to details of the organism and gene and basic demographic information on the patient.

Diagnosis of CPE required identification of a CPE gene through genotypic testing in a species of *Enterobacterales*, following a laboratory's standard diagnostic protocol.

Notifications were included in this report if they were received by the NSW Ministry of Health (notification date) between 29 March and 27 June 2020 (epidemiological weeks 14–26), represented a NSW case, and met the case definition.

Notifications are counted as NSW cases where the residential address:

- is in NSW or
- is recorded as unknown; or
- overseas visitors or interstate residents diagnosed with CPE in NSW

Notifications are defined as any laboratory result that diagnosed CPE. Patients are individuals with a diagnosis of CPE colonisation or infection. Due to the natural history of CPE individual patients may generate multiple notifications representing different organism or genes.

- Each patient is counted once regardless of how many notifications received
- For notifications, each separate organism with a CPE gene is counted as a new notification. (Excluding for duplicate notifications).
- Organisms with more than one gene are counted as one notification

Demographic data is based on patient count.

Time series data is based on date of notification.

The total number of notifications received is reported, however duplicate notifications (i.e. repeat sending or confirmation from second lab for the same specimen) are excluded from further analysis.

Data were analysed by organism, genotype, specimen type, age, and sex where information was available.

Notifications were defined as screening if the specimen was reported as "screening", "MRO screen" or "swab, screening", sterile specimens were defined as isolation of CPE from normally sterile sites. The category of non-sterile included specimens from sites that would not be sterile, such as wound swabs. The category "urine" included any variation of mid-stream urine, urine, catheter urine.

Analysis was undertaken using statistical software.

Surveillance of CPE is a collaboration between health care providers, Local Health Districts, Specialist Health Networks, laboratories, the Clinical Excellence Commission and Health Protection NSW.