



## THE EVOLUTION OF CARBAPENEMASES IN MAJOR GRAM-NEGATIVE BACTERIA IN AUSTRALIA

The Table below documents the number and type of carbapenemases detected in major gram negatives in AGAR surveys since 2004

| Year | Source of isolates | Population sampled | Organism set                  | Total Isolates | Isolates and Carbapenemases detected  | %    | Comments                       |
|------|--------------------|--------------------|-------------------------------|----------------|---|------|--------------------------------|
| 2004 | Multiple           | All patients       | EKE <sup>a</sup>              | 2390           | 1 = 1 <i>bla</i> <sub>IMP-4</sub>   | 0.04 |                                |
| 2006 | Multiple           | All patients       | EKE                           | 2285           | 1 = 1 <i>bla</i> <sub>IMP-4</sub>   | 0.04 |                                |
| 2008 | Urine              | Non-inpatients     | EKE                           | 3010           | None  | 0    |                                |
| 2009 | Multiple           | Inpatients         | EKE                           | 2574           | 6 = 6 <i>bla</i> <sub>IMP-4</sub>   | 0.23 |                                |
| 2010 | Urine              | Non-inpatients     | EKE                           | 2938           | 3 = 3 <i>bla</i> <sub>IMP-4</sub>   | 0.10 | 0.16% for 2009-10<br> combined |
| 2011 | Multiple           | Inpatients         | EKE                           | 2633           | 8 = 8 <i>bla</i> <sub>IMP-4</sub>   | 0.30 |                                |
| 2012 | Urine              | Non-inpatients     | EKE                           | 2802           | 1 = 1 <i>bla</i> <sub>IMP-4</sub>   | 0.04 | 0.17% for 2011-12<br> combined |
| 2013 | Blood              | All patients       | All <i>Enterobacteriaceae</i> | 4958           | 14 = 9 <i>bla</i> <sub>IMP-4</sub> , 3 <i>bla</i> <sub>KPC-2</sub> <sup>b</sup> , 2 <i>bla</i> <sub>NDM-7</sub> <sup>c</sup>  | 0.28 | 3 in non-EKE species           |
| 2014 | Blood              | All patients       | All <i>Enterobacteriaceae</i> | 5796           | 14 = 7 <i>bla</i> <sub>IMP-4</sub> , 3 <i>bla</i> <sub>KPC-2</sub> , 2 <i>bla</i> <sub>VIM-1</sub> ,<br>1 <i>bla</i> <sub>NDM-4</sub> , 1 <i>bla</i> <sub>OXA-181</sub> | 0.24 | 0 in non-EKE species           |
| 2015 | Blood              | All patients       | All <i>Enterobacteriaceae</i> | 6567           | 20 = 14 <i>bla</i> <sub>IMP-4</sub> <sup>d</sup> , 4 <i>bla</i> <sub>OXA-48</sub> <sup>e</sup> , 1 <i>bla</i> <sub>KPC-2</sub> , 1 <i>bla</i> <sub>NDM+OXA-48</sub>     | 0.30 | 4 in non-EKE species           |
|      |                    |                    | <i>Pseudomonas aeruginosa</i> | 658            | 2 = 1 <i>bla</i> <sub>GES-5</sub> , 1 <i>bla</i> <sub>IMP-4+VIM-2</sub>   | 0.30 |                                |
|      |                    |                    | <i>Acinetobacter</i> species  | 103            | None  | 0    |                                |

<sup>a</sup> EKE = *E. coli*, *Klebsiella* spp., and *Enterobacter* spp. only

<sup>b</sup> Two KPC from same with repeat episode of bacteraemia

<sup>c</sup> NDM from same patient with repeat episode of bacteraemia

<sup>d</sup> Two IMP-4 from one patient (*E. cloacae* complex) with repeat episode of bacteraemia

<sup>e</sup> Two OXA-48 from same patient with repeat episode of bacteraemia

**Notes:**

- All strains with a meropenem MIC > 0.25 mg/L were requested for molecular screening for at least IMP, VIM, KPC, NDM and OXA-48-like genes. Not all isolates were available for testing.
- Many strains of Enterobacteriaceae with elevated MICs to meropenem do NOT harbour a carbapenemase, but possess other non-transmissible mechanisms (e.g a combination of ESBL or AmpC enzymes with porin changes). Most strains of *Pseudomonas aeruginosa* with elevated MICs to meropenem do not harbor carbapenemases
- The years 2009 and 2010, and 2011 and 2012 were combined to determine an overall rate of outpatients + inpatients over those two years
- The IMP-4 metallo- $\beta$ -lactamase (a type of carbapenemase) is endemic in Australia at a very low level.