

# Antibiograms of Carbapenemase Producing Organisms - October, 2016

Notes: Carbapenemase producing organism isolates identified or submitted to the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL) between 01/01/2012 and 14/10/2016, with available susceptibility data are included in the analysis below. Antimicrobial susceptibility tested by VITEK 2 (bioMérieux) unless otherwise indicated. All organism and carbapenemase gene combinations comprising fewer than five isolates have been excluded. Aggregate antibiograms are categorised by carbapenemase gene sub-type(s) and isolates may contain other antimicrobial resistance (AMR) mechanisms not indicated. Carbapenemase genes tested by PCR include blaKPC, blaIMP, blaNDM, blaVIM, blaOXA-23-like, blaOXA-24/40-like, blaOXA-48-like, blaOXA-51-like and blaOXA-58-like. Carbapenemase gene subtypes have been determined by Sanger sequencing or whole genome sequence analysis. Aggregate antibiograms exclude antimicrobials for an organism and carbapenemase gene combinations where fewer than five valid results were available. CLSI breakpoints have been used for all susceptibility interpretation, except piperacillin tazobactam in *Pseudomonas* and *Serratia* species and colistin in all Enterobacteriaceae, which have been interpreted using EUCAST guidelines<sup>1,2</sup>. Intermediate susceptibility included as non-susceptible in aggregate antibiograms. Interpretive criteria for fosfomycin and aztreonam in *Acinetobacter* species and fosfomycin in *Pseudomonas* were not available; MIC data for these antimicrobials are presented on page 2.

**Table 1: Aggregate antibiogram, carbapenemase producing organisms isolates by number and percentage susceptible to each antimicrobial on VITEK 2 or e-test as indicated, received by MDU PHL 01/01/2012-14/10/2016**

CPO gene(s)	Organism	N	Number susceptible (%)																	
			Ampicillin	Amoxicillin Clavulanic Acid	Ticarcillin Clavulanic Acid	Piperacillin Tazobactam	Meropenem	Ceftazolin	Cefoxitin	Ceftriaxone	Ceftazidime	Cefepime	Ciprofloxacin	Norfloxacin	Tobramycin	Gentamicin	Amikacin	Nitrofurantoin	Trimethoprim	Cotrimoxazole
IMP-4	<i>P. aeruginosa</i>	11			0 (0%)	1 (9%)	0 (0%)			0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (36%)	6 (55%)			
	<i>C. freundii</i>	7	0 (0%)	0 (0%)	0 (0%)	2 (29%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (43%)	5 (71%)	6 (86%)	0 (0%)	0 (0%)	7 (100%)		5 (71%)	5 (71%)	
	<i>E. cloacae</i> complex	20	0 (0%)	1 (5%)	0 (0%)	3/15 (20%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	7 (35%)	14 (70%)	16 (80%)	0 (0%)	1 (5%)	20 (100%)		8 (40%)	8 (40%)	
	<i>E. coli</i>	10	0/9 (0%)	0/9 (0%)	0 (0%)	4/9 (44%)	0 (0%)	0/9 (0%)	0/9 (0%)	0/9 (0%)	8 (80%)	8 (80%)	8/9 (89%)	2 (20%)	2 (20%)	10 (100%)	7/9 (78%)	4 (44%)	4 (44%)	
	<i>K. oxytoca</i>	10	0 (0%)	1 (10%)	0 (0%)	2 (20%)	1 (10%)	0 (0%)	0 (0%)	0 (0%)	10 (100%)	9 (90%)	10 (100%)	0 (0%)	1 (10%)	10 (100%)		10 (100%)	10 (100%)	
	<i>K. pneumoniae</i>	21	0 (0%)	0 (0%)	0 (0%)	3 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	12 (57%)	19 (90%)	19 (90%)	0 (0%)	1 (5%)	21 (100%)		9 (43%)	9 (43%)	
	<i>S. marcescens</i>	33	0 (0%)	0 (0%)	2 (6%)	30/31 (97%)	2 (6%)	0 (0%)	2 (6%)	2 (6%)	1 (3%)	22 (67%)	23 (70%)	27 (82%)	2 (6%)	18 (55%)	33 (100%)	31 (94%)	30 (91%)	
IMP-7	<i>P. aeruginosa</i>	6			0 (0%)	0 (0%)	0 (0%)			0 (0%)	0 (0%)	0/1 (0%)		0 (0%)	0 (0%)	0 (0%)				
KPC-2	<i>C. farmeri</i>	9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (22%)	2 (22%)	0 (0%)	0 (0%)	9 (100%)			0 (0%)	0 (0%)	
	<i>C. freundii</i>	5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (20%)	0 (0%)	1 (20%)	0 (0%)	0 (0%)	4 (80%)			0 (0%)	0 (0%)	
	<i>K. oxytoca</i>	6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (33%)	0 (0%)	0 (0%)	3 (50%)	2 (33%)	2 (33%)	0 (0%)	0 (0%)	6 (100%)		0 (0%)	0 (0%)	
	<i>K. pneumoniae</i>	83	0 (0%)	1 (1%)	0 (0%)	0/81 (0%)	0 (0%)	0 (0%)	3 (4%)	0 (0%)	0 (0%)	35 (42%)	2 (2%)	2 (2%)	5 (6%)	80 (96%)	21 (25%)	20 (24%)	22 (27%)	
NDM-1	<i>E. coli</i>	12	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (17%)	2 (17%)	2 (17%)	2 (17%)	3 (25%)	5 (42%)		9 (75%)	3 (25%)	2 (17%)	
	<i>K. pneumoniae</i>	12	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (17%)	0 (0%)	0 (0%)	2 (17%)	6 (50%)	6 (50%)		1 (8%)	1 (8%)	
NDM-5	<i>E. coli</i>	22	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)	1 (5%)	7 (32%)	7 (32%)	13 (59%)	10 (45%)	1 (5%)	2 (9%)	
	<i>K. pneumoniae</i>	9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (22%)	2 (22%)	1 (11%)	2 (22%)	5 (56%)		2 (22%)	2 (22%)	
NDM-5, OXA-232	<i>K. pneumoniae</i>	9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
NDM-7	<i>E. coli</i>	6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	3 (50%)	5 (83%)	3 (60%)	1 (17%)	1 (17%)	
OXA-181	<i>E. coli</i>	12	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (8%)	0 (0%)	0 (0%)	2 (17%)	4 (33%)	12 (100%)	3 (25%)	3 (25%)	3 (25%)	
	<i>K. pneumoniae</i>	7	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (43%)	0 (0%)	3 (43%)	1 (14%)	1 (14%)	4 (57%)	2 (29%)	2 (29%)	2 (29%)	5 (71%)	7 (100%)	4 (57%)	4 (57%)	
OXA-232	<i>K. pneumoniae</i>	12	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (8%)	0 (0%)	1 (8%)	1 (8%)	3 (25%)	3 (25%)	1 (8%)	1 (8%)	4 (33%)	5 (42%)		1 (8%)	1 (8%)	
OXA-48	<i>E. coli</i>	12	0 (0%)	0 (0%)	0 (0%)	0/11 (0%)	6 (50%)	0 (0%)	2 (17%)	4 (33%)	8 (67%)	10 (83%)	5 (42%)	5 (42%)	5 (42%)	7 (58%)	12 (100%)	9 (75%)	2 (17%)	
	<i>K. pneumoniae</i>	13	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (46%)	0 (0%)	6 (46%)	4 (31%)	5 (38%)	8 (62%)	5 (38%)	5 (38%)	5 (38%)	5 (38%)	10 (77%)		0 (0%)	
OXA-23-like	<i>P. mirabilis</i>	5	1 (20%)	1 (20%)	5 (100%)	5 (100%)	5 (100%)	0 (0%)	3 (60%)	5 (100%)	5 (100%)	5 (100%)	5 (100%)	4 (80%)	5 (100%)	5 (100%)		4 (80%)	4 (80%)	
OXA-23-like, OXA-51-like	<i>A. calcoaceticus- baumannii</i> complex	22			0 (0%)	0 (0%)	0 (0%)			2 (9%)	0 (0%)	0 (0%)		10 (45%)	4 (18%)	15 (68%)			9 (41%)	
VIM-1	<i>K. pneumoniae</i>	7	0 (0%)	1 (14%)	1 (14%)	1 (14%)	1 (14%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	1 (14%)	6 (86%)	7 (100%)	0 (0%)	1 (14%)	7 (100%)		0 (0%)	

<sup>1</sup> CLSI. *Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Third Informational Supplement*. CLSI document M100-S23. Wayne, PA: Clinical and Laboratory Standards Institute; 2013.

<sup>2</sup> The European Committee on Antimicrobial Susceptibility Testing. *Breakpoint Tables for Interpretation of MICs and Zone Diameters*. Version 6.0, 2016. Available: <http://www.eucast.org>.



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Notes: Each row in the follow individual isolate graphical antibiograms corresponds to one isolate of the specified carbapenemase gene and organism combination. Travel location data collection methods have varied across the included time period and data are not complete. Absence of travel location should not imply local acquisition. Where known, cases have been classified by country and region of travel in the 12 months prior to isolation. Please note, patients reporting multiple risk factors for CPO acquisition have not been excluded, and additional risk factors and/or travel locations may be present. As such, acquisition of CPE may not have occurred in the categorised location. Duplicate isolates of the same organism and gene combination for a given patient have been excluded. For further information and exclusions, please see notes on page 1.

**Table 2: Individual isolate graphical antibiograms by VITEK 2 or e-test, as indicated, amongst those reporting travel in 12 months prior to isolation, by country of travel, received by MDU PHL 01/01/2012-14/10/2016**

Travel group	Gene	Organism	Travel location(s) (12 months prior to identification)	Overseas hospitalisation	Ampicillin	Amoxicillin Clavulanic Acid	Ticarcillin Clavulanic Acid	Piperacillin Tazobactam	Meropenem	Meropenem MIC (Vitek)	Cefazolin	Cefoxitin	Ceftriaxone	Ceftazidime	Cefepime	Ciprofloxacin	Norfloxacin	Tobramycin	Gentamicin	Amikacin	Nitrofurantoin	Trimethoprim	Colimoxazole	Year		
Greece	KPC-2	<i>K. pneumoniae</i>	Greece~	Yes						>=16														2014		
			Greece~	Yes							>=16															2014
			Greece~	Yes							>=16															2014
			Greece~	Yes							>=16															2015
			Greece~	Yes							>=16															2016
			Greece~	Yes							>=16															2016
			Greece~	Yes							>=16															2016
	NDM-1	<i>K. pneumoniae</i>	Greece~	Yes						>=16														2015		
	VIM-1	<i>K. pneumoniae</i>	Greece~	Yes						<=0.25														2015		
India and south Asia	NDM-1	<i>E. coli</i>	Bangladesh~	Yes						>=16														2016		
			India~	Yes							>=16														2016	
	NDM-5	<i>E. coli</i>	India	No							>=16														2016	
			India	No							>=16														2016	
			India~	Yes							>=16														2016	
			India	No							>=16														2016	
			India	No							8														2016	
			India~	Yes							>=16															2016
			India	No							>=16															2016
			India~	Yes							>=16															2016
			India~	Yes							4															2016
			India~	Yes							>=16															2016
	India~	Yes							>=16															2016		
	NDM-7	<i>E. coli</i>	Pakistan~	Yes						>=16														2015		
OXA-181	<i>E. coli</i>	India	No							<=0.25														2015		
		India	No							2													2015			
		India, Jordan	No							1														2015		
		India	No							1														2016		
OXA-232	<i>K. pneumoniae</i>	India~	Yes							>=16														2015		
		India~	Yes							>=16														2015		
		India~	Yes							>=16														2015		
South-east Asia	KPC-2	<i>K. pneumoniae</i>	Vietnam	No						>=16														2014		
			Vietnam~, Thailand~	Yes							>=16														2014	
	NDM-1	<i>E. coli</i>	Thailand~	Yes						>=16														2016		
	NDM-5	<i>E. coli</i>	Cambodia~, Vietnam	Yes						>=16														2016		
	NDM-7	<i>E. coli</i>	Philippines~	Yes						>=16														2016		
	OXA-181	<i>K. pneumoniae</i>	Vietnam~	Yes							>=16														2015	
Thailand~			Yes							2														2016		
OXA-48	<i>E. coli</i>	Malaysia~, India, Egypt, Israel, Jordan	Yes							2														2016		
		Vietnam~	Yes							1														2016		
Other	KPC-2	<i>K. pneumoniae</i>	New Zealand	No						>=16														2012		
			USA, New Zealand	No							>=16														2016	
	NDM-1	<i>E. coli</i>	China~	Yes						>=16														2016		
	NDM-5	<i>E. coli</i>	China~, USA, Europe NFS	Yes						>=16														2016		
	OXA-48	<i>E. coli</i>	Lebanon~	Yes							.5														2016	
			Turkey~	Yes							.5														2016	
	OXA-48	<i>K. pneumoniae</i>	Turkey	No							>=16														2015	
Malta~			Yes							8														2015		

~Location of hospitalisation

