

# Antimicrobial susceptibility patterns of selected invasive pathogens from public sector hospitals in South Africa, 2007

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Retrospective antibiotic surveillance data of selected invasive pathogens isolated from blood and cerebrospinal fluid at public sector hospitals in South Africa in 2007 are presented. Antimicrobial susceptibilities were determined according to the 2007 Clinical and Laboratory Standards Institute criteria. *Klebsiella pneumoniae* remains a highly resistant pathogen, with approximately half of all strains producing extended-spectrum beta-lactamases. All laboratories reported considerable resistance among *Acinetobacter* spp. Approximately 50-60% of *Staphylococcus aureus* isolates from blood were resistant to cloxacillin. Among *Streptococcus pneumoniae* isolates from blood and cerebrospinal fluid, resistance to penicillin ranged from 0% to 6% at most laboratories and 16-42% of isolates were classified with intermediate resistance to penicillin. Resistance to ceftriaxone in *S. pneumoniae* was rare.

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## Introduction

Ongoing retrospective surveillance of selected invasive pathogens isolated from blood and cerebrospinal fluid specimens at academic hospitals has been carried out for the past 30 years, initially by the Antibiotic Study Group of South Africa and subsequently by the National Antibiotic Surveillance Forum (NASF).<sup>1</sup> The NASF's key objectives include the monitoring of antimicrobial resistance patterns in the public and private health sectors in South Africa.<sup>2</sup> The public sector surveillance study reported here was confined to academic hospitals. Primary healthcare facilities and secondary hospitals which could have provided a broader base of patients exposed to antimicrobial selection pressure in different settings were not included. Based on this limitation and the lack of clinical information to assess treatment outcome, we were unable to recommend empirical antimicrobial treatment guidelines based on the findings of this survey. Here we present details of public sector laboratory-based surveillance of antimicrobial resistance for 2007 conducted at academic hospitals in South Africa.

## Methodology

Participating National Health Laboratory Service (NHLS) laboratories (see Table 1) submitted data on specified organisms isolated from blood and cerebrospinal fluid. Duplicate isolates were excluded to minimise bias due to over-representation of those patients who were cultured most frequently.<sup>3</sup> To ensure quality, only data on final authorised results were included and all data were checked by a dedicated local pathologist before submission. Data were submitted quarterly and collated nationally. Antimicrobial susceptibilities were determined according to the contemporary 2007 Clinical and Laboratory Standards Institute (CLSI) criteria.<sup>4</sup>

Table 1: National Health Laboratory Service laboratories participating in public sector antimicrobial surveillance, 2007

Abbreviation	Name
CHBH	Chris Hani Baragwanath Hospital
CMJAH*	Charlotte Maxeke Johannesburg Academic Hospital
SBAH**	Steve Biko Academic Hospital
DGM	Dr George Mukhari Hospital
BFT	Universitas Hospital, Bloemfontein
GSH	Groote Schuur Hospital
TBH	Tygerberg Hospital
GP	Green Point NHLS Laboratory

\* formerly Johannesburg Academic Hospital

\*\* formerly Tshwane Academic Hospital

## Results and discussion

The antimicrobial susceptibilities of specified organisms are listed in Tables 2-7. Different laboratories service varying combinations of primary, secondary and tertiary level hospitals and this may influence their resistance profile, for example Green Point laboratory serves predominantly primary level hospitals and this is reflected in the low levels of resistance with 70% of *Staphylococcus aureus* isolates at this laboratory susceptible to cloxacillin.

Among the Enterobacteriaceae (Table 2), *Klebsiella pneumoniae* remains a highly resistant pathogen, with approximately half of all strains producing extended-spectrum beta-lactamases (ESBLs). These isolates were frequently multi-resistant with only 41-55% susceptible to gentamicin and 69-85% susceptible to ciprofloxacin. However, these figures are similar to those reported in 2004.<sup>1</sup>

**Table 2: Antimicrobial susceptibility profile of selected Enterobacteriaceae isolated from blood at participating public sector laboratories in 2007**

<i>K. pneumoniae</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	340	297	635	37	54	181	128	106
Gentamicin	41	51	54	46	54	46	55	47
Ciprofloxacin	71	69	69	78	85	77	77	78
% ESBL producers	51	52	49	43	43	54	38	43

<i>E. coli</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	337	275	313	53	47	229	110	160
Ampicillin	5	16	22	11	19	14	15	14
Gentamicin	83	89	86	75	94	73	84	85
Ciprofloxacin	82	88	90	79	81	84	86	87
% ESBL producers	12	11	9	26	15	19	10	10

Enterobacter species								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	133	112	242	10	29	63	60	18
Gentamicin	75	79	69	70	90	81	82	67
Ciprofloxacin	86	83	89	100	97	95	93	100
% ESBL producers	15	20	16	20	10	17	20	39

**Table 3: Antimicrobial susceptibility profile of *Pseudomonas aeruginosa* and *Acinetobacter* species isolated from blood at participating public sector laboratories in 2007**

<i>P. aeruginosa</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	105	139	273	9	8	59	52	14
Gentamicin	61	82	65	67	100	71	50	79
Cefepime	72	89	64	44	87	90	77	93
Piptazobactam	70	88	68	100	100	95	79	86
Ciprofloxacin	77	82	64	100	100	80	90	93
Ceftazidime	75	87	46	100	87	90	77	86
Imipenem	74	86	49	100	100	88	65	100
Meropenem	71	82	63	100	87	88	75	100

<i>Acinetobacter</i> species								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	252	76	333	38	33	158	123	25
Piptazobactam	20	51	32	53	15	34	18	92
Ciprofloxacin	46	54	33	45	15	47	23	92
Ceftazidime	49	53	42	32	15	56	28	88
Imipenem	33	54	37	61	21	37	20	92
Meropenem	26	51	75	47	18	37	20	92

**Table 4: Antimicrobial susceptibility profile of *Salmonella* species isolated from blood at participating public sector laboratories in 2007**

<i>Salmonella non-typhi</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	160	67	94	7	5	37	4	27
Ampicillin	55	84	67	86	80	78	75	89
Cotrimoxazole	59	90	78	86	100	86	75	93
Ceftriaxone	89	99	98	100	100	92	100	96
Ciprofloxacin	99	100	100	100	100	100	100	96

<i>Salmonella typhi</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	3	3	8	3	0	2	1	3
Ampicillin	100	100	100	100	-	100	100	67
Cotrimoxazole	67	100	100	100	-	100	100	67
Ceftriaxone	100	100	100	100	-	100	100	100
Ciprofloxacin	100	100	100	100	-	100	100	100

**Table 5: Antimicrobial susceptibility profile of selected Gram-positive organisms isolated from blood at participating public sector laboratories in 2007**

<i>S. aureus</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	518	292	624	61	51	227	135	132
Cloxacillin	48	56	60	31	55	67	58	70
Erythromycin	52	50	50	92	51	70	60	73
Clindamycin	56	74	52	95	69	74	63	78

<i>E. faecalis</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	172	75	165	21	24	53	28	30
Ampicillin	98	96	85	62	100	96	96	93
High level gentamicin	63	93	49	62	71	68	89	100

Group B <i>Streptococcus</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	74	37	41	11	2	27	13	18
Penicillin	100	100	100	91	100	93	100	100

**Table 6: Antimicrobial susceptibility profile of *S. pneumoniae* isolated from blood and cerebrospinal fluid at participating public sector laboratories in 2007**

<i>S. pneumoniae</i> from blood cultures								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	262	397	307	43	12	164	64	112
Penicillin intermediate (MIC 0.12 -1mg/l)	22	36	38	16	42	33	25	29
Penicillin resistant (MIC ≥ 2mg/l)	16	4	6	5	0	0	0	0
Ceftriaxone resistant	0	1	0	2	0	0	0	0

<i>S. pneumoniae</i> from cerebro-spinal fluid								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	119	90	23	8	8	29	13	61
Penicillin intermediate (MIC 0.12 -1mg/l)	36	17	26	38	38	41	15	16
Penicillin resistant (MIC ≥ 2mg/l)	3	2	4	0	0	0	0	0
Ceftriaxone resistant	0	0	0	0	0	0	0	0

**Table 7: Antimicrobial susceptibility profile of *H. influenzae* type b and *N. meningitidis* isolated from blood at participating public sector laboratories in 2007**

<i>H. influenzae</i> type b								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	34	27	10	2	1	14	13	14
Ampicillin	79	89	60	100	100	79	85	93

<i>N. meningitidis</i>								
	Percentage susceptible							
Laboratories	CHBH	CMJAH	SBAH	DGM	BFT	GSH	TBH	GP
n = number of isolates	3	32	12	0	0	14	1	8
Penicillin susceptible	100	100	100	-	-	93	100	87
Penicillin intermediate	0	0	0	-	-	7	0	13

(No penicillin resistant isolates from any laboratory)

*Escherichia coli* strains exhibited less resistance than *K. pneumoniae*, with 73-89% susceptible to gentamicin, 79-88% susceptible to ciprofloxacin and only 9-26% producing ESBLs. Considerable resistance was also reported among *Enterobacter* spp, with ESBL rates ranging from 10-20%. Steve Biko Academic Hospital, Chris Hani Baragwanath Hospital and Tygerberg Hospital have the highest levels of resistance among *Pseudomonas aeruginosa* isolates as shown in Table 3, while all laboratories reported considerable resistance among *Acinetobacter* spp. Variations in the percentage of carbapenem-resistant *Acinetobacter* spp. may be due to differences in reporting, with some laboratories reporting only on the *Acinetobacter baumannii* complex, which is generally more resistant than other *Acinetobacter* spp. About 50-60% of *S. aureus* isolates from blood were resistant to cloxacillin (see Table 5), indicating that methicillin-resistant *S. aureus* (MRSA) remains an important pathogen in South African hospitals.

*Streptococcus pneumoniae* isolates from both blood and cerebrospinal fluid (Table 6) were categorised as intermediate (minimum inhibitory concentration (MIC) 0.12 -1 mg/l) or resistant (MIC ≥2mg/l) to

penicillin according to 2007 CLSI criteria. Resistance to penicillin remains low, ranging from 0-6% at most laboratories, except for Chris Hani Baragwanath Hospital where 16% were reported as resistant. Between 16% and 42% of isolates at all laboratories were intermediate to penicillin. Resistance to ceftriaxone was rare, with only two laboratories reporting resistant isolates (≤2%).

## Concluding remarks

The major limitations of this laboratory-based study are the retrospective collection of data, susceptibility testing performed at each site, and lack of demographic data to distinguish community *versus* hospital-acquired infections and the failure to correlate clinical findings with antimicrobial resistance of isolates. In addition, the submission of blood and cerebrospinal fluid specimens for culture is dependent on clinicians whose test request practices may vary between different institutions. While attempts are made to ensure the quality of data, this report is dependent on the standards of laboratory practices maintained in the participating institutions. Considering these deficiencies, it would be beneficial to have a central reference facility for standardised surveillance, characterisation of multidrug-resistant pathogens, molecular typing of selected nosocomial pathogens and assistance with outbreak investigations and transmission prevention of resistant pathogens at national level.

Despite the limitations outlined above, we may conclude that the numbers of resistant pathogens, particularly MRSA and ESBL-producing *K. pneumoniae*, remain high in most institutions in the public sector in 2007 and that ongoing regular surveillance is indicated.

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## References

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