



## Short Communication

# Plasmid-mediated resistance and virulence mechanisms in the private health sector in KwaZulu-Natal, South Africa: An investigation of methicillin resistant *Staphylococcus aureus* (MRSA) clinical isolates collected during a three month period



Daniel G. Amoako<sup>a</sup>, Linda A. Bester<sup>b,\*</sup>, Anou M. Somboro<sup>a</sup>, Sooraj Baijnath<sup>c</sup>,  
Chetna N. Govind<sup>d</sup>, Sabiha Y. Essack<sup>a</sup>

<sup>a</sup> Antimicrobial Research Unit, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

<sup>b</sup> Biomedical Resource Unit, School of Laboratory Medicine and Medical Sciences, University of KwaZulu-Natal, Durban, South Africa

<sup>c</sup> Catalysis and Peptide Research Unit, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

<sup>d</sup> Lancet Laboratories, Durban, KwaZulu-Natal & Honorary Research Fellow, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

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## ABSTRACT

**Objectives:** Due to the lack of information on the plasmid content of MRSA strains in South Africa (SA), this study investigated the resistance and virulence mechanisms of 27 clinical isolates from the private health care sector over a period of 3 months.

**Methods:** Plasmids were extracted and the presence of MRSA confirmed by the presence of *mecA*. The isolates were subjected to antimicrobial susceptibility testing and molecular characterization of common resistance encoding genes and frequently encountered virulence factors by PCR using plasmid DNA as the template. The genetic relatedness between the isolates was determined by pulsed field gel electrophoresis (PFGE).

**Results:** All isolates were plasmid positive, and displayed ampicillin, ciprofloxacin, gentamicin, rifampicin, tetracycline, erythromycin, and clindamycin resistance. They were all fully susceptible to daptomycin, linezolid, vancomycin, tigecycline and fusidic acid. Multidrug resistance (MDR) was found in 74.1% (20/27) of the MRSA isolates. The frequency of the resistance and virulence genes ranged from 100% to 0%. PFGE analysis revealed 10 pulsotypes, designated A–J, which showed correlation with resistance profile of the isolates in each group. Of note, 85.2% (23/27) of the isolates clustered into six major PFGE types giving an indication of similar circulating MRSA clones.

**Conclusions:** This study highlights the genetic diversity and resistance mechanisms in MRSA strains from the private health sector in SA hence the need for implementing effective infection control programs.

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## 1. Introduction

MRSA is characterized by the presence of *mecA* that confers resistance to methicillin. This has far reaching consequences in the public health, economic and social sectors.<sup>1</sup> These strains also harbor mobile genetic elements (MGEs), including plasmids, pathogenicity islands, transposons, integrons and prophages, which comprise 15–25% of the genome. An understanding of these MGEs will broaden our knowledge on the genetic determinants of antibiotic

resistance (AR).<sup>2</sup> Although research has been conducted on MRSA in SA, information on the plasmid content is largely unknown, a study of this nature is important understanding AR patterns, comparing the plasmid profiles will help in effective infection control. The aim of this study was to ascertain the genetic relatedness, and characterize the plasmid-encoded antibiotic resistance and virulence profile of clinical MRSA isolates collected obtained from a private laboratory in Durban, SA over a three month period.

## 2. Methods

A total of 27 consecutive non-repetitive MRSA isolates were obtained from June to August 2015, from a pathology laboratory that caters for the private healthcare sector. The isolates were

\* Corresponding author. Private Bag X54001, University of KwaZulu-Natal, Durban, 4000.

E-mail address: [besterl@ukzn.ac.za](mailto:besterl@ukzn.ac.za) (L.A. Bester).

**Table 1**  
Clinical data, minimum inhibitory concentrations (MIC), and results of PCR for 27 MRSA isolates

Isolate No.	Clinical data					MIC (mg/l) <sup>b</sup>												PCR								
	Hos. code <sup>c</sup>	Source <sup>a</sup>	Ward type <sup>a</sup>	Sex	Age <sup>a</sup>	AP	CP	GT	ET	RF	TT	CM	DP	VM	LZ	FA	TG	mecA	blaZ	ermC	aac-aph	tetK	hla	hld	eta	lukS/F-PV
B11970	1	Blood	Neo ICU	F	NB	>512	0.5	32	8	≤0.25	2	≤0.25	1	1	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P10781	15	Nasal	OPD	M	86	>512	256	64	32	512	256	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P10747	2	CVP	ICU	F	66	>512	4	>64	64	512	128	≤0.25	0.5	0.5	1	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
S37938	-	-	-	-	-	>512	256	16	32	256	64	2	0.5	1	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
S18155	3	ETT	ICU	F	76	>512	256	64	64	256	128	≤0.25	0.25	0.5	2	≤0.25	≤0.25	+	+	-	+	-	+	-	-	-
B13178	5	Blood	LW	F	26	>512	256	>64	64	512	128	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
440260	-	-	-	-	-	>512	>512	>64	64	256	128	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
S18970	-	-	-	-	-	>512	256	64	32	512	64	≤0.25	0.5	0.5	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P11520	6	Pus	OPD	M	62	512	>512	0.25	0.5	≤0.25	≤0.25	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	-	-	-	+	+	-	-
T5683	7	Nasal	OPD	F	43	>512	8	0.5	0.5	256	32	≤0.25	0.5	1	1	≤0.25	≤0.25	+	+	-	-	-	+	+	-	-
B15227	1	Blood	Neo ICU	F	NB	>512	4	64	8	≤0.25	≤0.25	≤0.25	1	1	1	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P13563	-	-	-	M	49	>512	128	>64	0.5	128	16	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
S22589	4	Sputum	ICU	M	49	>512	128	>64	0.5	128	64	≤0.25	1	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
B15612	8	Blood	ICU	M	46	>512	128	>64	16	512	256	≤0.25	1	1	2	≤0.25	≤0.25	+	+	-	+	-	+	-	-	-
B15810	5	Pus	Surgical	M	41	>512	256	32	16	128	64	≤0.25	0.5	1	2	0.5	≤0.25	+	+	+	+	-	+	+	-	-
B15583	1	Blood	ICU	F	37	>512	16	>64	2	64	2	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
S24463	10	ETT	ICU	F	59	512	1	32	1	≤0.25	≤0.25	1	0.5	0.5	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P15045	1	Wound	Surgical	F	47	>512	64	64	16	256	64	≤0.25	0.25	0.25	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P15028	10	Eye	Nursery	F	NB	512	4	16	0.5	0.5	≤0.25	≤0.25	0.25	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P14890	11	Wound	ICU	F	41	512	256	64	0.5	256	128	≤0.25	0.5	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P15558	1	CVP	Medical	F	94	512	>512	0.12	1	256	≤0.25	>512	0.5	0.5	1	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P15469	12	Humerus	General	F	68	128	64	1	0.5	≤0.25	0.5	≤0.25	0.25	0.5	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P15490	13	Bone	General	M	63	>512	128	32	16	128	64	≤0.25	0.25	0.5	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P15742	6	cheek	Trauma	M	29	256	0.5	0.5	16	≤0.25	64	≤0.25	0.25	0.5	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
P15825	14	Buttock	Paediatric	M	5	512	1	0.5	0.5	≤0.25	0.25	≤0.25	0.25	1	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-
P15793	2	Head	Surgical	M	10	512	256	64	32	256	32	≤0.25	0.5	0.5	2	≤0.25	≤0.25	+	+	+	+	-	+	+	-	-
T8060	-	-	-	-	-	512	4	4	16	128	64	≤0.25	0.5	0.5	2	≤0.25	≤0.25	+	+	-	+	-	+	+	-	-

<sup>a</sup> ETT, Endotracheal tube; CVP, Central venous catheter; ICU, Intensive/High care unit; LW, Labour ward; OPD, outpatient department, NB, Newborn (day 0), -, No information.

<sup>b</sup> AP, ampicillin; CP, ciprofloxacin; GT, gentamicin; ET, erythromycin; RF, rifampicin; TT, tetracycline; CM, clindamycin; DP, daptomycin; VM, vancomycin; LZ, linezolid; FA, fusidic acid; TG, tigecycline.

<sup>c</sup> The numbers 1–15 indicates codes of the hospital centers where the MRSA isolates were collected.

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