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The management and outcomes of *Staphylococcus aureus* bacteraemia at a South African referral hospital: A prospective observational study

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ABSTRACT

Objectives: Data on the management and outcomes of *Staphylococcus aureus* bacteraemia (SAB) in resource-limited settings are limited. The aim of this study was to describe a cohort of South African patients with SAB, and explore the factors associated with complicated infection and death.
Methods: This was a prospective observational study of patients over the age of 13 years admitted to a South African referral hospital with SAB.
Results: One hundred SAB infection episodes occurring in 98 patients were included. SAB was healthcare-associated in 68.4%; 24.0% of all cases were caused by methicillin-resistant *S. aureus* (MRSA). Ninety-day mortality was 47.0%, with 83.3% of deaths attributable to SAB. There was a trend towards increased 90-day mortality with MRSA infection (odds ratio (OR) 1.28, 95% confidence interval (CI) 1.0–15.1) and the presence of comorbidities (OR 4.1, 95% CI 1.0–21.6). The risk of complicated infection was higher with non-optimal definitive antibiotic therapy (OR 8.5, 95% CI 1.8–52.4), female sex (OR 3.8, 95% CI 1.1–16.3), and community-acquired infection (OR 7.4, 95% CI 2.0–33.1). Definitive antibiotic therapy was non-optimal in 22.6% of all cases.
Conclusions: SAB-related mortality was high. A large proportion of cases may be preventable, and there is a need for improved antibiotic management.

Introduction

Staphylococcus aureus is a major global human pathogen, causing a wide range of infections. *S. aureus* bacteraemia (SAB) is an especially severe manifestation and a common cause of community- and hospital-acquired bacteraemia in high-income countries, with a population incidence of 10–30 per 100 000 person-years (Laupland et al., 2013). A number of clinical predictors of mortality have been identified in these settings, but there is limited knowledge regarding optimal antibiotic management (Rahal, 1986), and outcomes remain poor (Forsblom et al., 2011; Holland et al., 2014; Kaasch et al., 2014). Less is known about the incidence and impact of SAB in low- and middle-income countries (LMICs). The burden is likely comparable to high-income nations (Reddy et al., 2010), and may be higher due to the influence of HIV infection (Larsen et al., 2012) and differences in healthcare systems and infection control practices (Van Hal et al., 2012).

Three previous clinical studies of SAB amongst adult patients have been conducted in South Africa, two of which were retrospective (Perovic et al., 2006; Smidt et al., 2015; Willcox et al., 1998). In the most recent study, the number of patients with complicated SAB was not reported, and neither were the overall outcomes or the choice and timing of antibiotic therapy (Smidt et al., 2015). Because of the paucity of good quality data, the contemporary management and outcomes of SAB in South Africa are not well understood. Thus, a prospective observational study was conducted to describe a cohort of patients with SAB, assess outcomes, and explore the

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factors associated with complications and death at a South African referral hospital.

Patients and methods

Study setting and population

Participants in this study were recruited at Groote Schuur Hospital, a large academic referral centre in Cape Town, South Africa. The patient population is mainly from urban and peri-urban areas, including townships, with a low to middle socio-economic status and a high burden of HIV and related infections, largely tuberculosis.

Inclusion criteria and data collection

In 2013, the Division of Infectious Diseases and HIV Medicine at Groote Schuur Hospital initiated a policy to review all new cases of SAB in the hospital. Cases are identified using an electronic laboratory notification system whereby the results of all blood cultures positive for *S. aureus* are automatically sent via e-mail to a member of the Division of Infectious Diseases and these cases undergo clinical assessment within 36 h of notification. The analysis reported herein includes the first 100 consecutive SAB infection episodes assessed since the start of the policy. Inclusion criteria were inpatients at Groote Schuur Hospital over 13 years of age, with a pure growth of *S. aureus* in one or more blood cultures.

Enrolled participants were followed up for the duration of their admission. Routinely collected clinical information was entered on hardcopy case report forms. This included data on demographics, medical comorbidities, clinical profile, timing of blood cultures, timing and choice of antibiotic therapy, duration of hospital stay, and inpatient mortality. The requirement for informed consent was waived by the ethics review committee, as data were collected as part of an ongoing approved clinical registry. Vital status at 90 days was ascertained from Clinicom, the Provincial digital record and appointment system. Microbiological data were obtained from the National Health Laboratory Service (NHLS) data warehouse, and included antibiotic susceptibility profiles, the vancomycin minimum inhibitory concentration (MIC) for methicillin-resistant *S. aureus* (MRSA) isolates, and time to notification of blood culture results to the treating physicians.

Definitions

A new infection episode was defined as a blood culture positive for *S. aureus* ≥30 days after a previously sterile blood culture. SAB was classified as community-acquired (CA-SAB) if a blood culture positive for *S. aureus* was first obtained at the time of admission or within 48 h of admission. Bacteraemia was classified as healthcare-associated (HCA-SAB) if a blood culture positive for *S. aureus* was first obtained more than 48 h after admission, or if the first positive blood culture was within 48 h of admission but the patient had (1) received intravenous therapy in the previous 30 days; (2) attended a hospital or received dialysis in the previous 30 days; or (3) resided in a nursing home or long-term care facility.

Complicated SAB was defined by the presence of one or more of the following: (1) persistent bacteraemia ≥72 h after therapy with an antibiotic to which the isolate had in vitro susceptibility; (2) metastatic infection or deep-seated abscess, or (3) endocarditis (Corey, 2009). Death was considered to be infection-related if there were persistent signs and symptoms of SAB or if bacteraemia was present in the last culture prior to death.

Antibiotic prescriptions were designated 'definitive' once the treating physicians had been notified of a blood culture positive for *S. aureus*. The optimal choice and administration of definitive antibiotic therapy for methicillin-sensitive *S. aureus* (MSSA) was defined as the use of intravenous cloxacillin 2 g 6-hourly in uncomplicated infection, or 3 g 6-hourly in the case of a complicated infection (or guideline-recommended alternatives). For MRSA, optimal therapy included a loading dose of vancomycin at 25–35 mg/kg, followed by 15–20 mg/kg 12-hourly. The duration of antibiotic therapy was classified according to local (Wasserman et al., 2014) and international (Liu et al., 2011) guidelines and best practice (Thwaites et al., 2017). The optimal duration was ≥14 days for uncomplicated SAB or ≥28 days for complicated SAB (Thwaites et al., 2017). Overall definitive antibiotic management was designated as non-optimal if either the administration or duration was outside of these guidelines.

Empiric therapy was defined as an antibiotic administered at the time of the index blood culture, prior to the notification of the presence of SAB. This was classified as inadequate in the following situations: the use of an antibiotic to which the isolate was not susceptible, or the use of cloxacillin or vancomycin at less than half of the standard dose for SAB (or without a loading dose of vancomycin).

Statistical analysis

Data captured in Microsoft Excel (2013) were analysed using R (R Core Team, 2016). Descriptive statistics were used to summarize the data, stratified by HCA/CA. Multivariable logistic regression with a priori variables identified from the literature was used to identify factors associated with complicated infection and 90-day mortality. Variables selected for inclusion in the final model were age (Forsblom et al., 2011), sex (Smit et al., 2017), MRSA (Cosgrove, 2006; Naidoo et al., 2013), healthcare-associated infection (Fowler et al., 2003), presence of comorbidities (Fitzgerald et al., 2017; Larsen et al., 2012), and time to definitive antibiotic therapy (Lodise et al., 2003; Marchaim et al., 2010); these were included based on their effect size on the outcomes of interest. Model selection was performed using the Akaike information criterion (AIC). Kaplan–Meier estimates were used for inpatient survival and time to initiation of antibiotics. For all statistical tests, a p-value of ≤0.05 was considered significant.

Ethics approval

This study was approved by the Human Research Ethics Committee at the University of Cape Town (Ref. 643/2015).

Results

Patient and infection characteristics

One hundred consecutive, distinct SAB infection episodes in 98 patients were identified between November 2013 and January 2015. Baseline characteristics, stratified by place of acquisition of infection, are shown in Table 1. The median duration from the time the blood culture was taken to notification of the treating physician of confirmed *S. aureus* blood culture results was 44 h (interquartile range (IQR) 37–53 h). SAB was healthcare-associated in 67 (68.4%, n = 98) cases of infection, with 57 (85.1%, n = 67) of these linked to intravenous catheter site infection. MRSA accounted for 23.5% of all infections, of which 82.6% were healthcare-associated. MICs of vancomycin for MRSA strains ranged from 0.5 μg/ml to 2 μg/ml, with four (19.0%, n = 21) having a MIC >1 μg/ml. Full antibiotic susceptibility profiles are shown in Figure 1. There were no significant univariate predictors for infection with MRSA (data not shown).

Table 1
Patient and infection characteristics.[a]

	Healthcare-associated ($n=67$)	Community-acquired ($n=31$)	Total ($n=100$)
Age, years	48.3 ± 18.4	49.1 ± 18.6	
Age >60 years	17 (25)	10 (32)	27 (28)
Male sex	43 (64)	27 (87)[b]	70 (71)
Comorbidities (any)	55 (85)	23 (74)	78 (81)
HIV-positive	14 (26)	3 (12)	17 (22)
Diabetes mellitus	11 (17)	8 (26)	19 (20)
Renal failure	22 (33)	8 (26)	30 (31)
Cardiac disease	18 (28)	11 (36)	29 (30)
MRSA	19 (28)	4 (13)	23 (24)
Source of infection			
Drip site definite	12 (20)	NA	12 (16)
Drip site probable	22 (37)	NA	22 (29)
SSTI	5 (9)	11 (65)	16 (21)
Central line	4 (7)	NA	4 (5)
Dialysis catheter	5 (9)	NA	5 (7)
Pneumonia	3 (5)	2 (12)	5 (7)
Surgical wound	4 (7)	1 (6)	5 (7)
UTI	2 (3)	2 (12)	4 (5)
Other	2 (3)	1 (6)	3 (4)
Drip site sepsis	19 (29)	NA	19 (20)
Metastatic foci	12 (19)	15 (50)[b]	27 (28)

MRSA, methicillin-resistant *Staphylococcus aureus*; SSTI, skin and soft tissue infection; UTI, urinary tract infection; NA, not applicable.

[a] Data are *n* (%) or mean ± standard deviation. Percentages given have a denominator of '*n*' as shown in the column heading.

[b] No characteristic differed significantly between the study groups ($P \leq 0.05$ at baseline according to Fisher's exact test for categorical data or the Wilcoxon rank-sum test for continuous data), with the exception of male sex ($p = 0.0195$) and the presence of metastatic foci ($p = 0.0015$).

Endocarditis

Patients underwent echocardiography, according to local guidelines, for the following indications: presence of prosthetic heart valves, clinical evidence of endocarditis, or community-acquired SAB. Of the 22 patients who underwent echocardiography, seven (31.8%) had evidence of endocarditis; the overall prevalence of echocardiography-confirmed endocarditis was 7.1%. Of the three indications, clinical evidence for endocarditis was the only significant predictor of echocardiography-confirmed endocarditis, with a sensitivity and specificity of 57.1% (95% confidence interval (CI) 18.4–90.1%) and 93.3% (95% CI 86.1–99.8%), respectively (Table 2).

Table 2
Echocardiography testing.

		Echocardiography result		Total	*p*-Value
		Positive	Negative		
Clinical endocarditis	Yes	4	1	5	0.020
	No	3	14	17	
Prosthetic material	Yes	1	0	0	0.318
	No	6	15	21	
CA vs. HCA	CA	4	4	8	0.342
	HCA	3	11	14	

CA, community-acquired; HCA, healthcare-associated.

Antibiotic management

An empiric antibiotic with adequate activity and dose for SAB was prescribed in 45 (47.9%) cases. Empiric antibiotic choices included carbapenems in 24%, third-generation cephalosporins in 17%, beta-lactam/beta-lactamase inhibitors in 15%, vancomycin in 20%, cloxacillin in 14%, aminopenicillins in 2%, quinolones in 4%, and aminoglycosides in 5%. The median time to definitive therapy from the initial blood culture was 51.5 h (IQR 41–67 h, range 4–156 h), with no significant difference between HCA and CA ($p = 0.47$) or between MSSA and MRSA infections ($p = 0.28$; Figure 2). Time to definitive therapy was not associated with complicated infection or mortality on multivariate analysis (Table 3). Empiric antibiotic therapy was non-optimal in 52.1% of all cases and in 90.9% of those with MRSA bacteraemia. Definitive antibiotic therapy was non-optimal in 22.6% of all cases and in 35.3% of those with MRSA bacteraemia. The median duration of therapy was 14 days for both MSSA and MRSA bacteraemia (IQR 5–16 days). Of the MRSA-infected patients, 21 (64.7%, $n = 33$) received a vancomycin loading dose. Therapeutic drug monitoring of vancomycin was performed on at least one occasion in all but one case, at a median of 48 h (IQR 24–72 h) after the initial dose. The vancomycin trough concentration ranged from below the lower limit of detection to 48.9 μg/ml, with eight (47%) cases below the recommended target of 15 μg/ml. Source control was potentially indicated for 36 patients and was performed in 21 (58.8%).

Outcomes

Inpatient mortality was 41.8% (95% CI 31.9–52.2%) and 90-day mortality was 47.0% (95% CI 36.9–57.2%), with 30 (83.3%, $n = 36$) deaths attributable to SAB. The unadjusted survival estimates are

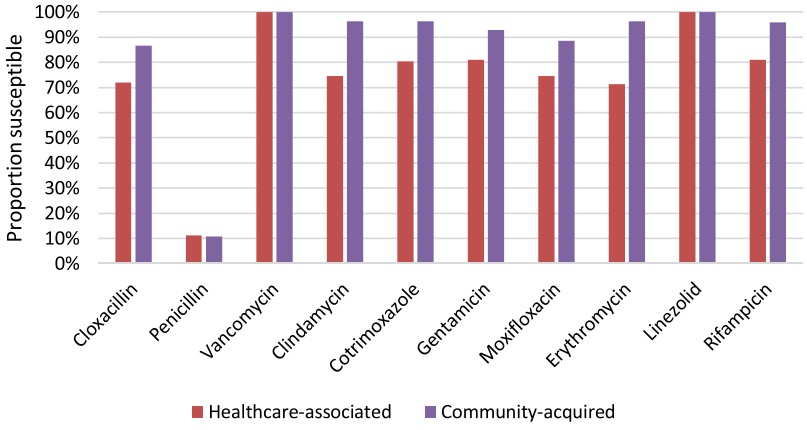

Figure 1. Antibiotic susceptibility profiles of *Staphylococcus aureus* isolates.

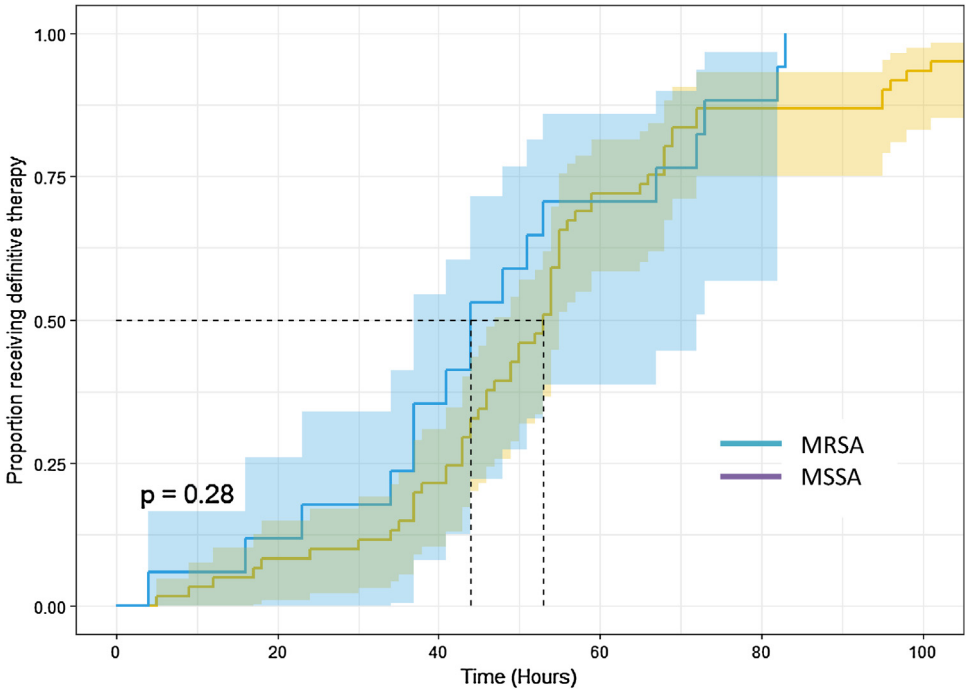

Figure 2. Kaplan–Meier plot for time to definitive antibiotic therapy, stratified by MRSA and MSSA; 95% confidence interval indicated by the shaded region.

Table 3
Univariate and multivariate logistic regression analysis for (a) 90-day mortality, and (b) complicated infection.

(a) Mortality

Covariate	Univariate analysis			Multivariate analysis		
	OR	95% CI	*p*-Value[a]	OR	95% CI	*p*-Value[a]
Age >60 years	3.3	1.3–8.7	0.01*	2.6	0.8–8.9	0.1
Female sex	0.6	0.3–1.6	0.3	0.5	0.2–1.7	0.28
MRSA	2.3	0.9–6.1	0.08	3.6	1.0–15.1	0.06
Community-acquired infection	1.6	0.7–4.0	0.3	0.9	0.3–2.9	0.89
Non-optimal definitive AB therapy	0.7	0.2–2.0	0.5	0.66	0.1–2.7	0.56
Comorbidity present	3.9	1.3–14.6	0.03*	4.07	1.0–21.6	0.06
HIV	1.1	0.4–3.2	0.9			
Renal failure	2.7	1.1–6.8	0.03*			
Cardiovascular disease	1.1	0.5–2.6	0.9			
Time to definitive therapy	1.0	0.9–1.1	0.5	1	0.9–1.1	0.81
Time to notification of results	1.0	0.9–1.1	0.2			

(b) Complicated infection

Covariate	Univariate analysis			Multivariate analysis		
	OR	95% CI	*p*-Value[a]	OR	95% CI	*p*-Value[a]
Age >60 years	0.7	0.3–1.9	0.5	0.9	0.2–3.0	0.8
Female sex	1.8	0.2–1.9	0.2	3.8	1.1–16.3	0.05*
MRSA	1.3	0.5–3.6	0.5	0.9	0.2–3.5	0.9
Community-acquired infection	2.7	1.1–6.8	0.03*	7.4	2.0–33.1	0.01*
Non-optimal definitive AB therapy	1.5	0.5–4.3	0.4	8.5	1.8–52.4	0.01*
Comorbidity present	0.8	0.3–1.9	0.7	2	0.5–9.9	0.36
HIV	0.6	0.2–1.9	0.4			
Renal failure	0.9	0.3–2.3	0.8			
Cardiovascular disease	1.5	0.6–3.8	0.4			
Time to definitive therapy	0.97	0.95–1.0	0.03*	1	0.9–1.1	0.2
Time to notification of results	1.0	0.9–1.1	0.7			

OR, odds ratio; CI, confidence interval; MRSA, methicillin-resistant *Staphylococcus aureus*; AB, antibiotic.
[a] Significant, *$p < 0.05$.

shown in Figure 3; median time to death was 35 days (IQR 17–62 days).

There was a strong trend towards increased 90-day mortality with the presence of comorbidities (OR 4.1, 95% CI 1.0–21.6; $p = 0.06$) and MRSA infection (OR 3.6, 95% CI 1.0–15.1; $p = 0.06$) on multivariable regression analysis (Table 3).

SAB was complicated by persistent infection (blood culture positive ≥72 h on therapy), deep abscess formation, or endocarditis in 30 (31.6%, $n = 95$) cases. The odds of complicated infection

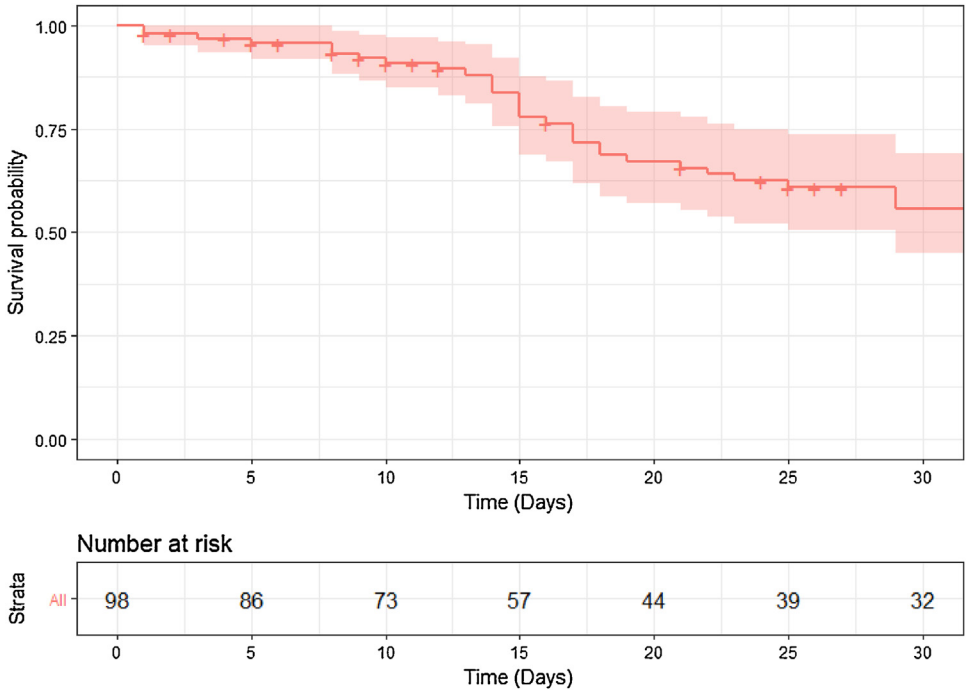

Figure 3. Kaplan–Meier survival plot for inpatient mortality; 95% confidence interval indicated by the shaded region.

were higher with non-optimal definitive antibiotic therapy (OR 8.5, 95% CI 1.8–52.4), female sex (OR 3.8, 95% CI 1.1–16.3), and community-acquired infection (OR 7.4, 95% CI 2.0–33.1) (Table 3).

Discussion

Complicated infection and SAB-related mortality were high in this well-characterized clinical cohort from South Africa. Most infection episodes were healthcare-associated and related to intravenous peripheral catheter infection, suggesting that many were preventable. Of concern, definitive antibiotic therapy was non-optimal in almost a quarter of cases, and this was strongly associated with complicated infection.

At 47%, all-cause mortality was similar to that found in other studies from South Africa (Perovic et al., 2006; Smidt et al., 2015) and other LMICs (Nickerson et al., 2009), but was substantially worse than in high-income countries, where mortality ranges between 20% and 30% (Pierre Braquet et al., 2016; Kaasch et al., 2014; Laupland et al., 2008). This may be related to the high prevalence of comorbidities and MRSA infection in the present study population, both of which have been associated with an increased risk of mortality with SAB (Allard et al., 2008; Braquet et al., 2016; Cosgrove, 2006; Naidoo et al., 2013). Although the short-term outcomes of medical patients at Groote Schuur Hospital are generally poor, with only 65% surviving to 12 months post-discharge (Stuart-Clark et al., 2012), this does not fully explain the poor early outcomes observed in this study, where the majority of deaths were possibly SAB-related. Over a fifth of the patients had an HIV co-infection, but this was not associated with mortality or complicated infection, in contrast to other reports (Jaliff et al., 2014). This suggests that specific host- or pathogen-related factors may account for the worse outcomes observed compared to other settings.

Around a third of the study patients were assessed as having a complicated infection, which is lower than the rate described in a large cohort from the USA (43%) using similar definitions (Fowler et al., 2003). There are limited data on rates of complicated SAB, likely due to inconsistent definitions and the difficulties in ascertaining this outcome, allowing limited conclusions from direct comparisons. Half of the community-acquired infections in the study cohort presented with metastatic foci, supporting previous reports of community-acquired infection as a clinical predictor of complicated infection (Fowler et al., 2003), presumably due to later presentation and treatment. As observed in other settings (Smit et al., 2017), female patients were found to be at increased risk of complicated infection, suggesting that sex may need to be considered when risk-stratifying patients. This association is likely multifactorial and subject to the confounders present in observational studies. However, it has been speculated that distinct sex differences in immune responses to infection may play a role (Humphreys et al., 2015).The only modifiable factor associated with complicated SAB in the present study cohort was the administration of non-optimal antibiotic therapy, which is of concern.

The administration of optimal empiric and directed antibiotic therapy has an important influence on the outcomes of both MSSA and MRSA (Van Hal et al., 2012). In one study, the administration of adequate initial therapy for MRSA bacteraemia was shown to confer an almost two-fold survival benefit (OR 1.84, 95% CI 1.25–2.71) (Paul et al., 2010). Definitive antibiotic therapy was non-optimal in almost a quarter of the present study patients and in a third of those with MRSA. The inadequacy of both empiric and definitive antibiotic therapy, especially for MRSA infections, possibly contributed to the trend of increased 90-day mortality associated with MRSA bacteraemia. An additional concern is that when indicated, early source control was performed in fewer than 60% of cases. These findings clearly identify a need for improved management of SAB in this setting. Surveys of South African medical students have found a low level of antibiotic knowledge, including for the treatment of SAB (Wasserman et al., 2017), and this should have a greater emphasis in both undergraduate and postgraduate medical training as a measure to improve SAB management. The involvement of infectious diseases (ID) specialists and use of bedside management protocols are an important aspect of SAB care: recommended management strategies are conducted significantly more frequently among patients assessed by an ID specialist, contributing to the survival benefit associated

with this intervention (Liu, 2013; Paulsen et al., 2015; Vogel et al., 2016). Although all patients in this study were followed up by members of the ID division, adherence to management advice was not evaluated. Most South African hospitals do not have access to ID specialists, but should consider implementing evidence-based bundle interventions, including early source control and early use of intravenous cloxacillin. These are simple and cheap to implement, and result in a mortality reduction for SAB (López-Cortés et al., 2013).

In contrast to high-income countries, where the highest case burden of SAB is seen in the elderly (Laupland et al., 2013), only 28% of the present study cohort was over the age of 60 years. This may reflect the higher incidence of comorbidities, such as HIV, in younger members of the population. Similarly to other settings (Allard et al., 2008; Asgeirsson et al., 2011; Huggan et al., 2010; Klevens et al., 2007), a high proportion of SAB cases were healthcare-associated. This is related to increased exposure to intravascular access devices, including short-term peripheral venous catheters, which are an important cause of bloodstream infection (Mermel, 2017). The finding that the majority of SAB episodes were related to peripheral venous catheter use emphasizes the need for improved infection prevention practices in local healthcare settings, such as the implementation of evidenced-based bundles of care to reduce intravascular line infection (Fitzgerald et al., 2017; Larsen et al., 2012; Wilson et al., 2008).

The prevalence of endocarditis in this study was 7%, similar to the proportion of SAB with endocarditis in the USA (Klevens et al., 2007). While some form of echocardiography is generally recommended for all patients with SAB (Holland et al., 2014), this is not always feasible in low-resource settings, particularly for transoesophageal echocardiography, which has a higher yield than transthoracic imaging. Clinical guidelines may be a useful strategy to identify low risk patients not requiring echocardiography. Although the study was not designed to evaluate this, and the denominator was small ($n = 22$), echocardiography testing according to local guidelines, namely those patients with implanted prosthetic heart valves, clinical evidence of endocarditis, or community-acquired infection, was able to identify endocarditis with an accuracy of 72.7%. Only one case was diagnosed on echocardiography in the absence of these indications, suggesting that these clinical indicators are useful in ruling out endocarditis. Future studies should be undertaken to define the indications for echocardiography for SAB in LMICs.

The proportion of patients with MRSA infection, at 24%, was lower than that reported from South African tertiary hospitals in Gauteng during a similar period (36%) (Smidt et al., 2015), but is on par with other results from local state sector hospitals in earlier periods (Naidoo et al., 2013; Perovic et al., 2006), suggesting that the incidence of MRSA bacteraemia is stable. However, local rates of HCA-MRSA are substantially higher than those reported in high-income countries, which are generally under 10% (Forsblom et al., 2011; Tom et al., 2014). This reflects challenges in infection prevention and control (IPC) services in South African public hospitals, many of which do not have antibiotic stewardship programs or dedicated IPC nurses. As expected, almost all MRSA cases were healthcare-associated, reflecting the absence of the ST8:USA300 strain of community-associated MRSA in South Africa (Goering et al., 2008). However, a small number of cases of community-acquired MRSA bacteraemia were found in the cohort, emphasizing the need for clinician awareness and ongoing microbiological surveillance with accurate ascertainment of the site of SAB acquisition (CA versus HCA).

Despite definitive treatment being delayed by 24 h or more from initial blood culture in most patients, this was not associated with an increased risk of mortality, as has been observed in other studies (Lodise et al., 2003; Marchaim et al., 2010). It is possible that the negative impact of delayed therapy might have been more clearly seen if a higher proportion of cases had received optimal definitive treatment. This delay in definitive treatment reflects a delay in the identification and susceptibility profiling of *S. aureus* from positive blood cultures. The use of novel tools to identify *S. aureus* directly from blood cultures, such as fluorescence in situ hybridization (FISH), PCR, immunochromatographic assays for PBP2a, and other methods, has been shown to quickly and reliably identify *S. aureus* (Buchan et al., 2015; Delport et al., 2016; Felsenstein et al., 2016; Oliveira et al., 2002; Thomas et al., 2007). The use of such tools in the present setting could be valuable in encouraging prompt antimicrobial treatment of SAB and an improvement in patient outcomes, although cost may be an important limiting factor.

A major strength of this study was the ability to accurately evaluate the setting of infection acquisition and prospectively capture well-defined clinical outcomes and management practices. There were, however, a number of important limitations. The relatively small sample size resulted in reduced statistical power and generalizability. As a result, important risk factors in the greater South African population may not have been detected in this cohort. For example, because source control was only indicated in 36 patients, this variable was not included in the prediction models. It is possible that the use of the electronic notification system may have resulted in cases of SAB during the study period being missed, which could have biased the findings if the loss was non-random. SAB incidence has been shown to vary between hospitals within South Africa (Smidt et al., 2015), which may further reduce the external validity of the results of this single-site study. Future studies should attempt standardized collection and analysis of pooled data from various hospitals across South Africa, with a particular focus on SAB management.

In conclusion, SAB is strongly related to intravenous peripheral catheter infection in the present study setting, and mortality is notably higher relative to higher-income countries. Non-optimal antibiotic management, especially for MRSA, is a significant problem and may contribute to these poor outcomes. Cost-effective prevention and treatment strategies should be implemented as a priority to reduce the burden of SAB in South African public hospitals.

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Conflict of interest

All authors report that they do not have a commercial or other association that might pose a conflict of interest.

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