



## Short report

# Reduction in *Staphylococcus aureus* bacteraemia rates in patients receiving haemodialysis following alteration of skin antiseptics procedures

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## SUMMARY

This study examined all cases of *Staphylococcus aureus* bacteraemia (SAB) in the haemodialysis cohort at the Royal Darwin Hospital, Australia over a seven-year period. Midway through this period, antiseptics for arteriovenous fistulae (AVF) and central venous catheters (CVC) changed from 0.5% chlorhexidine solution to 2% chlorhexidine solution. Rates of SAB episodes were calculated using registry data. Trends in SAB over time were analysed using an interrupted regression analysis. Following the change to 2% chlorhexidine, average SAB rates decreased by 68%, and it is estimated that 0.111 cases of SAB/patient-year were prevented. CVC-related SAB rates remained low throughout. These results support the use of 2% chlorhexidine in skin antiseptics for patients with AVF.

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## Introduction

*Staphylococcus aureus* bacteraemia (SAB) is a principal cause of haemodialysis-associated infection, and a significant cause of mortality and morbidity for patients receiving haemodialysis.<sup>1</sup>

These patients have numerous risk factors for SAB, including regular interaction with the healthcare environment, long-term vascular access [arteriovenous fistulae (AVF) and central venous catheters (CVC)] and a dysfunctional immune response.<sup>1,2</sup>

Measures used to reduce the incidence of SAB in patients receiving haemodialysis include antiseptic disinfection for AVF and CVC, topical antibiotic ointments at CVC exit sites, and combined antimicrobial–anticoagulant locking solutions in the CVC lumen.<sup>2</sup>

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The Royal Darwin Hospital (RDH) is the nephrology referral centre for the Top End of the Northern Territory (NT), serving a cohort of predominantly Indigenous Australians. High rates of SAB among patients receiving haemodialysis at RDH were noted for several years preceding 2010, but SAB was typically seen in patients using AVF, rather than CVC. This contrasts with the usual pattern of increased risk of infectious complications with CVC.<sup>3</sup> This study assessed the efficacy of a protocol change in haemodialysis antisepsis by conducting a retrospective review of the incidence of SAB in the haemodialysis cohort at RDH over a seven-year period.

## Methods

All episodes of SAB in patients receiving haemodialysis at RDH between 2007 and 2013 were identified retrospectively by linking lists from the microbiology and haemodialysis patient databases. The likely focus of each SAB episode and presence of a CVC was determined by infection control nurses. The Australia and New Zealand Dialysis and Transplant Registry (ANZDATA) was accessed for data on patient-years of haemodialysis at the RDH for each calendar year to calculate the rate of unique SAB episodes.<sup>4</sup>

The nurse-led change in skin and CVC preparation was deployed over several months in 2010, and was based on the 2011 Guidelines of the US Centers for Disease Control and Prevention (CDC),<sup>5</sup> informed by the 2009 CDC Dialysis Bloodstream Infection Prevention Collaborative Project.<sup>6,7</sup> Pre-intervention, AVF were disinfected with 0.5% chlorhexidine/70% isopropyl alcohol solution [3M Avagard (9250) (3M, North Ryde, New South Wales, Australia)], and this was changed to 2% chlorhexidine/70% isopropyl alcohol solution [SOLUMED, SOLU-IV (3M, North Ryde, New South Wales, Australia)]. The preparation of CVC prior to haemodialysis was changed over the same time period from 10% povidone-iodine [Pfizer #610035034 (Sydney, New South Wales, Australia)] solution to 2% chlorhexidine/70% isopropyl alcohol solution. In addition, there was renewed emphasis on appropriate cleansing and care of the AVF site. On review of the fistula care practices at the time of the intervention, staff were discouraged from using adherent marker dots at needle sites following a dialysis session.

No other changes in infection control practices or line care were introduced during the study period, and there was no change in the proportion of patients using AVF or CVC for dialysis. AVF were accessed by a step-ladder approach; the button-holing technique was phased out at the study centre prior to the study period. Trends for SAB rates over time were assessed using interrupted time series segmented least-squares regression analysis.<sup>8</sup> Pre- and post-intervention plots, pre- and post-intervention slope gradients, and a comparison of predicted vs measured rates after the intervention were computed using R Statistics<sup>9</sup> and the *itsa* command in Stata 13 (Stata Corp., College Station, TX, USA). Ethical approval for the study was granted by the Human Research Ethics Committee of the NT Department of Health (Ref.: 2014-2179).

## Results

Following alteration of AVF and CVC decontamination procedures in 2010, the SAB rate was reduced by 58% from 0.116/patient-year in 2009 to 0.049/patient-year in 2011. The SAB

**Table 1**

Data related to patient-years on haemodialysis (Australia and New Zealand Dialysis and Transplant Registry), number of cases of *Staphylococcus aureus* bacteraemia (SAB) related to vascular access devices, and the total number of cases of SAB in patients receiving haemodialysis. The proportion of haemodialysis-associated SAB vs total SAB at the Royal Darwin Hospital (RDH) was also assessed

Year	Patient-years on haemodialysis	CVC-related SAB	Total SAB	Total SAB per patient-year	% Haemodialysis SAB at RDH
2007	151.544	2	18	0.119	23.4
2008	167.788	7	24	0.143	31.6
2009	173.016	6	20	0.116	17.1
2010	186.248	2	18	0.097	20.0
2011	203.576	7	10	0.049	9.1
2012	210.156	4	8	0.038	10.7
2013	216.682	2	6	0.028	8.7

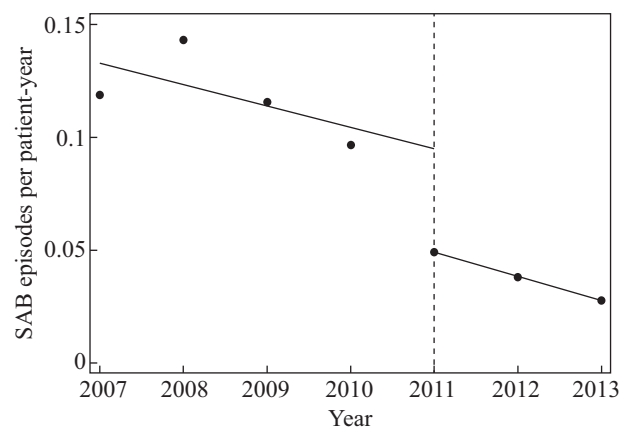
CVC, central venous catheter.

rate at the end of the study in 2013 was reduced by 77% compared with the level in 2007. Over the four pre-intervention years, the average rate of SAB/patient-year was 0.119, compared with 0.038 over the three post-intervention years, representing an average reduction of 68%. The rate of CVC-related SAB remained low and unchanged throughout the study period (Table 1).

Pre- and post-intervention linear regression slopes did not differ ( $-0.009$  vs  $-0.011$ ). The rate of SAB in 2013 was 36% of the value calculated by the pre-intervention slope.

By calculating the area between the post-intervention slope and extended pre-intervention slope for the post-intervention period, it is estimated that 0.111 cases of SAB/patient-year were prevented (Figure 1).

Prior to the intervention, haemodialysis-related SAB accounted for 23% of all SAB recorded at RDH. Following the intervention, this was reduced to 9.5% (Table 1).



**Figure 1.** An interrupted time series linear regression analysis of *Staphylococcus aureus* bacteraemia (SAB) rates in the haemodialysis cohort at the Royal Darwin Hospital. Each point represents the actual rate in episodes per patient-year, and the two regression lines are fitted for the periods before (2007–2010) and after (2011–2013) the change in antisepsis protocol.

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