

Health care-associated *Staphylococcus aureus* bloodstream infections: a clinical quality indicator for all hospitals

Peter J Collignon, Irene J Wilkinson, Gwendolyn L Gilbert, M Lindsay Grayson and R Michael Whitby

Staphylococcus aureus bloodstream (SAB) infections are common and serious causes of morbidity and mortality worldwide.^{1,2} They add considerably to the cost of health care.^{3,4} In Australia, there are an estimated 7000 episodes of SAB infection a year, most of which are health care associated: about half of all episodes are acquired in hospitals, and about a third of community-acquired infections are related to health care procedures or devices such as dialysis, intravenous catheters or urinary catheters.^{2,5} Regardless of whether SAB infections have their onset in the community or in hospitals, they are associated with a high mortality rate.¹⁻⁷ The median mortality rate with methicillin-sensitive *S. aureus* (MSSA) infections is about 25%, and the rate is closer to 35% with methicillin-resistant *S. aureus* (MRSA) infections.⁶

In Australia, MRSA causes about a quarter of all SAB episodes,² but rates of 50% or more are seen in many other countries.^{2,8,9,10} Reporting of SAB infections caused by MRSA has been mandatory in the United Kingdom since 2003.^{8,9}

The incidence of health care-associated SAB infections in Australian hospitals should be a very useful clinical indicator of the standard of infection control practice, as many of these infections are potentially preventable.^{11,12} The case definition is simple — isolation of *S. aureus* from a blood culture — and the data can be reported automatically by laboratory information systems (as is the case for other notifiable diseases). There are few problems associated with the definition of what constitutes an *S. aureus* infection, as the organism is an uncommon blood culture contaminant and thus there will be few false positive isolates. The proportion of SAB infections that are due to MRSA should be a good indicator of a hospital's level of MRSA control.

Why collect data on SAB infections?

The prospective collection of data on bloodstream infections caused by susceptible and resistant strains of *S. aureus* will allow clinicians to better identify and address the many different factors surrounding serious health care-associated infections and their causes. Collecting data on community-onset infections is also important, as many of these are also health care associated.^{2,5} Knowing the relative proportion of episodes caused by MRSA and MSSA would give additional information on the burden of infection due to antibiotic-resistant strains.

Feedback on and review of infection rates is of proven efficacy in infection control.^{11,12} Data from 14 South Australian hospitals,¹³ the Canberra Hospital¹⁴ and the Austin Hospital¹⁵ show that the number of SAB episodes has fallen after interventions that use rates of SAB infection (or MRSA bacteraemia, at the Austin hospital) as a measure of quality improvement.

Examining health care-associated SAB episodes will focus attention on associated system problems in hospitals. Tackling these problems by quality improvement interventions can then prevent many SAB episodes. As each SAB event is costly, any quality improvement effort will almost certainly be cost-effective.

Analysis of community-associated SAB episodes will allow us to assess what is happening with the emergence, spread and scale of

ABSTRACT

- *Staphylococcus aureus* bloodstream (SAB) infections are common and serious causes of morbidity and mortality that incur considerable health care costs and are potentially preventable.
- It should be relatively easy for hospitals to collect data on the incidence of SAB episodes, to determine whether infections were acquired in hospital or in the community, and to establish whether they were health care associated.
- The proportion of SAB infections caused by methicillin-resistant *S. aureus* strains should be a useful indicator of the level of control of antibiotic resistance in the community and in the health care setting.
- Continuous monitoring of infection incidence would enable health care facilities to determine the effectiveness of interventions designed to minimise SAB infections.

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SAB infections in the community (especially community-acquired MRSA strains). This will help clinicians to make the most appropriate empirical antibiotic choices when people present with severe sepsis. It will also alert public health authorities, with the possibility of action to stem local outbreaks.

There are limited data on overseas experience of hospital-acquired SAB infections.^{2,5,8-10,16} Information on large numbers of SAB episodes has been collected in a few countries, such as Denmark and the UK (however, in the latter case, only MRSA episodes are reported).^{8,9,16} An increasing number of laboratories and hospitals in Europe are collecting and disseminating data on SAB infections (eg, the European Antimicrobial Resistance Surveillance System¹⁰). Our proposal for Australia (Box 1 and Box 2) improves on these systems and allows immediate feedback to the areas where these infections have occurred. This will increase the likelihood that changes in procedures will occur after problems are identified, and should lead to a fall in SAB episodes throughout Australia.

How should this be done?

Core data should be easily obtainable directly from the pathology systems servicing each hospital. There are very few false positive *S. aureus* isolates from blood cultures and hence all episodes can be regarded as true infections. The infection control staff of each hospital should record whether the infection had a hospital or community onset and whether the episode was health care associated. The most likely primary site of infection for each episode (eg, intravenous lines, wound sites) and other potential risk factors (eg, previous medical procedures) should also be recorded.

Rates of SAB infection per 1000 separations or per 10 000 occupied bed days (OBDs) should be calculated using denomina-

1 Proposal for collection of data

We propose:

- That each episode of *Staphylococcus aureus* bloodstream (SAB) infection be notified by laboratories to the relevant hospital infection control service and relevant basic clinical data be collected for each case. This can then be expressed as the number of episodes per 1000 separations and per 10000 occupied bed days;
- That the data be further divided into methicillin-resistant *S. aureus* versus methicillin-sensitive strains;
- That SAB episodes be grouped into one of three categories: "health care associated (inpatient)", "health care associated (non-inpatient)" or "community onset", according to nationally agreed definitions.¹⁷ ◆

2 Proposal for using the data to prevent further infections

We propose:

- That each *Staphylococcus aureus* bacteraemia episode be investigated. For those that are health care related, possible causes of the episode should be identified by the hospital's infection control service.
- That measures to improve compliance with appropriate clinical practices and/or changes in protocols should be introduced to prevent future episodes;
- That data on the number of episodes be collected over time to enable the effectiveness of interventions to be monitored. ◆

tors that are readily available from hospital administration/finance departments. The advantage of using separations (ie, completed admissions) as a denominator is that the derived figures are more readily understood by hospital staff and the general public. However, using OBDs as a denominator may better reflect the activity of a hospital. Therefore, we suggest that both denominators be used. As all episodes of SAB infection need to be captured, there is an argument for including "day-only" patients (eg, dialysis patients) in the denominator, given that these patients will be among those who contract SAB infections. An example of the data that can be collected and how rates can be calculated is shown in Box 3.

Using these data to prevent future infections

Each SAB episode should be regarded as a "critical" episode or "signal event".^{18,19} All affected patients should be seen by a member of the hospital's infection control service (or other designated doctor or nurse) during their hospital stay to assess whether the SAB infection was health care associated (community-onset infections should be included).

We also need to determine what factors were involved that may have been preventable. For example, if an intravenous line was the cause, was the appropriate line used? Was the line left in longer than necessary? If contamination at a surgical site was the cause, was appropriate antibiotic prophylaxis given? Was there a collection that should have been drained earlier? Collecting information in this way increases the likelihood of timely intervention at the local level, as medical and nursing staff will be notified of any problems at or near the time they are caring for the patient.

Continuous monitoring of the incidence of SAB infection will allow the effectiveness of interventions to be assessed.

Data analysis and reporting

Staff time will be required to collect and collate this information. However, available published data² suggest that even the largest hospitals should have fewer than 150 episodes of *S. aureus* bacteraemia per year (an average of about three a week). Small hospitals, including private hospitals, would also be expected to collect SAB infection data, but as the numbers of affected patients would be proportionately lower, the extra workload would be less than in large hospitals.

Many small hospitals, particularly in Queensland and South Australia, have already adopted "signal infection" surveillance systems that capture data on all bloodstream infections.¹⁹ Thus it would not seem an onerous task for all hospitals to undertake SAB infection surveillance as part of their quality management program. In most cases, members of hospital infection control services would already collect most of the required information as part of their daily routine. Hospitals that are unable to assess all community-onset SAB episodes and identify those that were health care associated should separately report their hospital-onset episodes. Each hospital-onset case needs to be assessed in detail to identify potential preventive strategies.

Ideally, SAB infection would become a nationally notifiable disease and data would be collated at state and national levels, based on data provided by hospitals (rather than public health units, as is currently the case for most notifiable diseases). This would allow estimation of disease burden and monitoring of trends in different parts of Australia. It would also provide a basis for investigating apparent sustained increases in incidence and for evaluating the effectiveness of interventions.

Furthermore, publication of data stratified by type of hospital (eg, tertiary hospitals, community hospitals) would allow hospitals to compare their own data with those of similar hospitals. However, this would have to be done with great caution, as figures can be both misleading and unfair because of variation associated with relatively small sample sizes and the different populations served by different hospitals.^{20,21} This is currently occurring in at least one state in Australia, and interventions implemented across a group of metropolitan hospitals have already demonstrated positive change, with a 19% drop in SAB infection rates across 14 metropolitan hospitals since 2002.¹³

3 Staphylococcus aureus bloodstream (SAB) infections at the Canberra Hospital, 2005*

	MSSA	MRSA
Community associated	29	1†
Inpatient health care associated	23	10†
Non-inpatient health care associated	3	1
Total	55	12

MRSA = methicillin-resistant *S. aureus*. MSSA = methicillin-sensitive *S. aureus*.

* In 2005, there were 51 122 separations, of which 29 361 were same-day patients, and 177 239 occupied bed days (OBDs). There were 37 health care-associated SAB episodes. Thus, the rates for health care-associated SAB infection were 0.7 per 1000 separations and 2.1 per 10 000 OBDs. † One episode in each group involved non-multiresistant MRSA. ◆

Summary

Data on all *S. aureus* bacteraemia episodes will be relatively easy to collect. This will give an accurate indication of the current incidence in individual hospitals of SAB infections. These data will also measure the proportion of infections due to MRSA. When individual hospitals look for the causes of health care-associated SAB infections, they will identify preventable factors. This should result in changes to clinical practice and protocols in those hospitals. Ongoing surveillance will allow the effectiveness of control measures to be assessed and should reduce the number of these serious and life-threatening infections in Australia.

Competing interests

None identified.

Author details

Peter J Collignon, FRACP, FRCPA, FASM, Director;¹ and Professor²
Irene J Wilkinson, BSc(Hons), MPH, MASM, Manager, Infection Control Service³

Gwendolyn L Gilbert, MD, FRACP, FRCPA, Director;⁴ and Clinical Professor⁵

M Lindsay Grayson, MD, FRACP, FAFPHM, Director;⁶ and Professor of Medicine⁷

R Michael Whitby, FRACP, FRCPA, Director;⁸ and Clinical Professor⁹
1 Infectious Diseases Unit and Department of Microbiology, Canberra Hospital, Canberra, ACT.

2 Canberra Clinical School, Australian National University, Canberra, ACT.

3 Communicable Disease Control Branch, Department of Health, Adelaide, SA.

4 Centre for Infectious Diseases and Microbiology, Institute of Clinical Pathology and Medical Research, Sydney, NSW.

5 Medicine and Infectious Diseases, University of Sydney, Sydney, NSW.

6 Infectious Diseases Department, Austin Health, Melbourne, VIC.

7 University of Melbourne, Melbourne, VIC.

8 Infection Management Services, Princess Alexandra Hospital, Brisbane, QLD.

9 Medicine and Infectious Diseases, University of Queensland, Brisbane, QLD.

Correspondence: Peter.Collignon@act.gov.au

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