Chapter IV
Surveillance system evaluation

Evaluation of the South Australian Healthcare-associated *Staphylococcus aureus* Bloodstream infection Surveillance System

To measure is to know

Lord Kelvin

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Abbreviations

AIHW	Australian Institute of Health and Welfare
CDCB	Communicable Disease Control Branch
EMR	Electronic medical records
HAI	Healthcare-associated infection
HA–SABSI	Healthcare-associated *Staphylococcus aureus* bloodstream infection
ICIMS	Infection control information management system
ICS	Infection Control Service
ICSSS	Infection Control State Surveillance System
IPC	Infection prevention and control
LHN	Local health network
MRO	Multi-resistant organism
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSSA	Methicillin-susceptible *Staphylococcus aureus*
RSS	Rural Support Service
SABSI	*Staphylococcus aureus* bloodstream infection
SAIRG	South Australian Infection Reference Group
SANIT	SA Network of Infection Control Teams

Prologue

Staphylococcus aureus (S. aureus) is the leading cause of healthcare-associated bloodstream infections worldwide and is associated with significant morbidity and mortality. Many Healthcare-associated *Staphylococcus aureus* bloodstream infections (HA–SABSI) are considered preventable by strict adherence to infection prevention and control practices and, as a result, have been subject to surveillance in many countries over the last two decades. This chapter describes the first comprehensive evaluation of the South Australian HA–SABSI surveillance system since it was established in 1997. The following Master of Applied Epidemiology course requirements have been accomplished with this chapter: evaluation of a surveillance system or other health information system and production of a lay summary.

Role

I was the lead investigator for this evaluation. I designed the study, developed the data collection instruments, coordinated all evaluation activities, conducted qualitative and quantitative data collection and analysis, and prepared the evaluation report. Christine Cope from the Infection Control Service, Communicable Disease Control Branch and Wendy Peecock from the Rural Support Service at the South Australian Department for Health and Wellbeing provided support for stakeholder engagement, reviewed data collection instruments and extracted data.

Lessons Learned

While conducting this evaluation, I gained a deeper understanding of *Staphylococcus aureus* bloodstream infections and have a greater appreciation for their considerable public health significance. I became familiar with the Australian public healthcare system, including the South Australian Health governance reforms in 2019 and the National Health Care Agreement quality and safety indicators. This project also allowed

me to observe firsthand the complexity of the surveillance of healthcare-associated infections, including the challenges associated with the surveillance of a non-notifiable condition and a system that relies significantly on the clinical expertise of data contributors. I also had the opportunity to learn more about the thematic analysis of qualitative data and how to use an open-source qualitative coding program called Open Code.

Public Health Impact

This was the first evaluation of the South Australian healthcare-associated *Staphylococcus aureus* bloodstream infections surveillance system since it was established 25 years ago. The results and recommendations from this evaluation are expected to be used to guide the next iteration of the South Australian healthcare-associated infections surveillance system, which is expected to include software program upgrades and improved automation of the collection of surveillance data. The results are expected to also be used to implement interim measures that strengthen the current system's representativeness, simplicity, and acceptability.

Acknowledgements

I want to acknowledge Christine Cope and Wendy Peecock for their time and the detailed information they provided. Both Christine and Wendy have significant institutional knowledge and clinical expertise. I learned a lot from them about the surveillance of healthcare-associated infections. I would also like to thank the data contributors and key informants, all frontline nursing and medical staff in public healthcare facilities who participated in the evaluation during a COVID-19 surge. They gave up their valuable time to share their insights and experiences using the surveillance system, which would not exist without them. I would also like to thank Dr Louise Flood for supporting and approving the evaluation and Dr Jaameeta Kurji for introducing me to Open Code and guiding me in the thematic analysis.

Abstract

Introduction

Staphylococcus aureus (S. aureus) is the leading cause of healthcare-associated bloodstream infections worldwide and is associated with significant morbidity and mortality. Healthcare-associated *S. aureus* bloodstream infections (HA–SABSI) can be caused by the insertion of invasive medical devices that breach the skin or mucosal barrier and serve as an entry portal for infectious organisms. A significant proportion of HA–SABSI are considered preventable by strict adherence to infection prevention and control practices. Given that most cases of HA–SABSI are preventable, they are considered a robust indicator of healthcare quality and safety and, as a result, have been subject to surveillance in many countries over the last two decades. South Australia (SA) established HA–SABSI surveillance in 1997 and, since 2011, has reported HA–SABSI events for all public hospitals to the Australian Institute of Health and Welfare (AIHW) as part of the National Healthcare Agreement quality and safety indicators.

Methods

This evaluation aimed to assess the performance and acceptability of the SA Health *Staphylococcus aureus* Bacteraemia Surveillance System. The evaluation framework was informed by the Centers for Disease Control and Prevention *Updated Guidelines for Evaluating Public Health Surveillance Systems.* The attributes of simplicity, stability, data quality, acceptability, representativeness, timeliness, and usefulness were assessed. The evaluation methods included a focused review of the literature, a data contributor survey, semi-structured interviews with key informants, and an analysis of surveillance data of HA–SABSI detected between 2017–2021.

Results

Sixty–three contributors from public hospital sites and five private metropolitan hospitals in SA were invited to participate in the online survey. The survey response rate was 41% (*n*=26). Nine semi-structured interviews were conducted with key informants. Between 2017–2021, 519 HA–SABSI cases were detected by the surveillance system, most (*n*=469, 90%) from metropolitan hospitals. All survey respondents agreed that HA–SABSI monitoring was important and most (*n*=21, 81%) indicated it was a valuable use of time. Case investigations and reporting were time intensive and exacerbated by understaffing and lack of infection prevention and control experience. The review of the state surveillance data found 100% data completeness for all mandatory fields. The time between laboratory receipt of blood cultures and reporting to the healthcare facility was ~85 hours for facilities using the Infection Control Information Management System (ICIMS) component of the electronic medical record software program. The timeliness of reports was, however, problematic for non-ICIMS users. The surveillance system captures HA–SABSI associated with care provided by all South Australian acute care public hospitals, equivalent to 97.3% coverage of all public hospital bed days in 2022. Only 53% (*n*=9) of private hospitals are under surveillance, and no residential aged care and day surgery facilities. No data are collected to identify Aboriginal or Torres Strait Islander peoples, despite being at considerably higher risk of developing SABSI. Real-time case reports were deemed to be useful by half of the ICIMS users (57%), however, quarterly benchmarking reports provided by the Infection Control Service, Communicable Disease Control Branch, were used by less than half of the respondents (46%). Data was available when needed (*n*=21, 81%) however, disruptions were experienced during the COVID-19 pandemic and significant concerns were raised about the age and inconsistency of the surveillance system software used by the hospitals and the stability of the system in the future.

Conclusions

SA's HA–SABSI surveillance system is a fundamental component of infection prevention and control programs in acute care hospitals and a critical mechanism to enable mandated reporting of HA–SABSI to the AIHW for all South Australian public hospitals. The surveillance system appears useful and acceptable, with high data completeness and quality, allowing it to meet its objectives. Issues associated with simplicity, timeliness and stability can be addressed with software upgrades. State-wide coverage should be targeted in the future, and consideration should be given to how the system can support further reductions in HA–SABSI rates.

Introduction

Staphylococcus aureus (S. aureus) is a gram-positive bacterium frequently found on the skin and in the gut microbiota of healthy individuals. While commonly colonising asymptomatically, *S. aureus* can be a virulent invasive pathogen that causes significant disease, including cellulitis, osteomyelitis, and pneumonia (1). Most notably, *S. aureus* is a leading cause of bloodstream infections worldwide (1), with an estimated annual incidence rate between 10 to 30 cases per 100,000 people per year (1, 2), and higher rates occur in several subpopulations (1). The burden of bloodstream and other invasive infections caused by *S. aureus,* and its ability to develop resistance to antibiotics, is so significant that vaccine development is considered an urgent public health priority despite numerous failed attempts over the last decade (3, 4).

S. aureus bacteraemia is defined as a positive blood culture for *S. aureus*, which occurs when *S. aureus* enters the bloodstream via a breach of the skin or mucosal barrier (5). *S. aureus* bloodstream infections (SABSI) are medical emergencies and can be fatal without the appropriate care. Even in the context of advanced care, SABSI are challenging to treat and are associated with significant morbidity, including lasting impairments in a third of survivors (6), and 30–day all-cause mortality between 20–30% (7, 8) higher than bloodstream infections caused by other pathogens (9). An estimated 20–45% of SABSI cases have considerable complications (10) including persistent bacteraemia (11); recurrent infection (12); and metastatic focal infections (13) such as infective endocarditis (1), vertebral osteomyelitis (14) and septic arthritis (13) or septic shock, which are all associated with an increased risk of morbidity and mortality. Persistent *S. aureus* bacteraemia, defined as two days or more despite active antibiotic therapy (11), occurs in an estimated 8–39% of SABSI cases. It is associated with extended hospitalisation, relapse of bacteraemia and higher mortality rates compared to resolving uncomplicated SABSI (11). Recurrent bacteraemia, defined as

a second episode of SABSI after the resolution of the first episode, occurs in an estimated 2–20% of SABSI cases (1, 12). Infective endocarditis occurs in an estimated 10–15% of SABSI cases without a prosthetic valve and up to 50% of SABSI cases with a prosthetic valve (15). Infective endocarditis due to *S. aureus* is also associated with a high risk of severe sepsis, major neurological events, multi-organ failure and mortality (16).

Treatment of SABSI is further complicated by antimicrobial resistance. Methicillin–resistant *S. aureus* (MRSA) was first reported in the 1960s and has developed resistance to β-lactam antibiotics, including all penicillins, cephalosporins and carbapenems (17). Over the last decade, the incidence of Methicillin–resistant SABSI has decreased; however, MRSA has been associated with poorer clinical outcomes than Methicillin-susceptible SABSI (18). The first line treatment for MRSA bloodstream infections is vancomycin or teicoplanin, which has led to selective pressure and the emergence of vancomycin–intermediate and vancomycin–resistant *S. aureus* (VISA and VRSA, respectively) (19). While VISA/VRSA infections are currently rare, they remain a major public health concern due to their inability to be treated with vancomycin.

Some subpopulations have been found to have a higher incidence of SABSI, including males; young children; older people; Indigenous peoples including Aboriginal and Torres Strait Islander and Māori and Pacific Island populations; and black populations (1, 2, 18). People dependent on haemodialysis or with an existing diagnosis of diabetes, people living with HIV infection, and people who inject drugs also have a higher incidence of SABSI (1). Several host risk factors are also associated with increased mortality risk (18, 20). Females; older people; and black populations have been found to have an increased SABSI mortality rate (8, 18). Underlying comorbidities, including cirrhosis, malignancy and chronic renal disease, have also

been associated with SABSI mortality (7, 18). The source and setting of the infection also influence mortality, as does the *S. aureus* resistance, virulence and clonal characteristics (18).

Among patients receiving healthcare, *S. aureus* is reported as the leading cause of bloodstream infections worldwide. In 2018, the World Health Organization listed *S. aureus* as a priority pathogen for new antibiotics (21). Risk factors associated with HA–SABSI include prior hospitalisation, antibiotic therapy or surgery (20); chronic renal disease (20); solid tumours (20); nasal colonisation with *S. aureus* (22); and the insertion of medical devices, including central venous catheters, peripheral intravenous catheters (23), implant materials (15), and orthopaedic prostheses (24) that serve as entry portals. Beyond the health impacts on individuals, HA–SABSI are a considerable burden on the healthcare system. For example, in South Australia in 2006, 159 HA–SABSI cases were estimated to result in A$2 million in excess costs, 32 lives lost, and ~330 years of healthy life lost (25). While HA–SABSI events are often associated with a combination of patient risk factors and healthcare interventions, it has been estimated that more than 50% of HA–SABSI are preventable with strict adherence to infection prevention and control (IPC) practices (26). Given most HA–SABSIs are preventable, they are considered a robust indicator of healthcare quality and safety (27) and, as a result, have been subject to surveillance in many countries over the last two decades (27)

Surveillance is defined as the “ongoing, systematic collection, analysis and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know” (28). Surveillance of healthcare-associated infections (HAIs), including HA–SABSI, is considered a fundamental component of IPC programs (29), enabling the identification and reporting of HAIs and acting as a monitoring and

alert system to inform action. Over the last 40 years, many HAI surveillance systems have been shown to decrease the rate of HAIs (30-32), and several countries have established national HAI surveillance systems (33-37). Australia does not currently have a national HAI surveillance system (38).

HA–SABSI surveillance in Australia

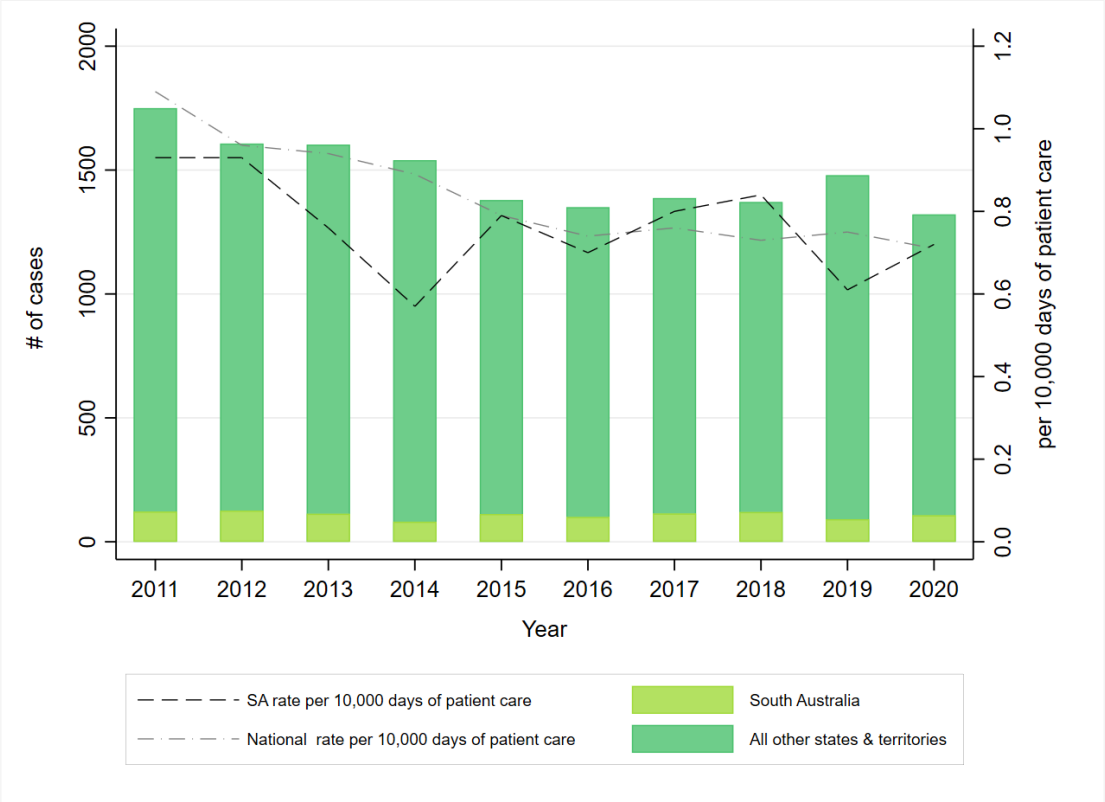
Surveillance of HA–SABSI was first proposed in Australia in 2006 as a clinical indicator and a vital monitoring and alert mechanism by a group of infection control experts (27). Three years later, mandatory reporting of HA–SABSI by public hospitals was endorsed by all jurisdictions as part of the Australian Healthcare Agreements, enabling nationwide surveillance to be established (39). In 2011, the *National Health Reform Act 2011* Council of Australian Governments (COAG) approved the National Health Reform Agreement, which set out the shared intention of the Commonwealth and state and territory governments to work in partnership to improve health outcomes for all Australians. Under the revised agreement, healthcare quality and safety indicators were established, including a target for no more than 2.0 cases of HA–SABSI per 10,000 patient bed days for each state and territory, reduced to a more ambitious target of 1.0 HA–SABSI on 1 July 2020 (39). Under the Act, HA–SABSI were monitored by the independent National Health Performance Authority until 2016, when it was transferred to the AIHW. The National Safety and Quality Health Service Preventing and Controlling Infections Standard provides details on facility level surveillance requirements (40). The HA–SABSI surveillance and reporting requirements and are stated in SA Health Health Performance Agreements.

All public hospitals in Australia report HA–SABSI data to the AIHW annually, which are published at the hospital level on the MyHospitals website. The Australian Commission on Safety and Quality in Health Care issues surveillance implementation guidelines

(39), including suggestions on how jurisdictions can analyse and use their SABSI surveillance data to better inform quality improvement (41).

Between 2011–2020, 15,873 HA–SABSI were reported to the AIHW by Australian public hospitals. 6.8% (*n*=1086) of HA–SABSI events during this period were from South Australian public hospitals, which equated to an annual average of 108.6 cases and less than 1.0 cases per 10,000 patient days annually for the entire period (Figure 1). Between 2011 to 2016, there was a downward decline in the rate of HA–SABSI cases nationally. However, since 2017, the national rate has remained stable at around 0.7 per 10,000 patient days.

Figure 1. HA–SABSI, Australia, 2011–2020



Data source: AIHW analysis of the National *Staphylococcus aureus* Bacteraemia Data Collection

Methods

Evaluation objectives

This is the first comprehensive evaluation of the South Australian HA–SABSI surveillance system since it was established in 1997. The evaluation was completed for the Infection Control Service (ICS), Communicable Disease Control Branch (CDCB) of the South Australian Department for Health and Wellbeing.

The evaluation aimed to assess the performance and acceptability of the South Australian HA–SABSI surveillance system, and the objectives of the evaluation were to:

- Describe the purpose and functionality of the HA–SABSI surveillance system.
- Determine if the surveillance system fulfils its purpose.
- Evaluate the system's performance against key attributes.
- Provide recommendations to the Director of the CDCB and the Nursing Director of the Infection Control Service.

The *Updated Guidelines for Evaluating Public Health Surveillance Systems,* published by the Centers for Disease Control and Prevention (CDC), informed the framework for the evaluation (42). The evaluation includes an assessment of the following seven system attributes: simplicity, stability, data quality, acceptability, representativeness, timeliness, and usefulness. The evaluation methods included a focused literature review, a data contributor survey, semi-structured interviews with key informants, and an analysis of surveillance data associated with cases detected between 2017–2021.

Stakeholder engagement and participant recruitment

All data contributors representing South Australian metropolitan, regional, and rural public hospitals were informed about the evaluation via an introductory letter from the Director of the CDCB and invited to participate (Appendix I). The invitation to participate was also extended to five private metropolitan hospitals that voluntarily report HA–SABSI cases. Data contributors were primarily nursing staff based within hospital IPC services, or in smaller hospitals, staff with IPC responsibilities. In addition, a subset of data contributors (representing metropolitan, regional and rural hospitals) and key stakeholders from the CDCB ICS, the Rural Support Service (RSS) and the South Australian Infection Reference Group (SAIRG) were invited to participate in a semi-structured interview. Participation in the survey and the semi-structured interview was voluntary, and informed consent was obtained from all participants.

The Australian National University Human Research Ethics Committee approved the ethical aspects of the project under protocol 2017/909 request for waiver of consent for the use of data in research for Masters in Applied Epidemiology students for '*Surveillance in Public Health'* projects.

Data sources

Information concerning the surveillance system's attributes and operation was collected from the data sources described below.

I. **Review of the literature:** The objectives of the surveillance system, the system structure and case definitions were identified from published documents, including the SA Health *Healthcare–Associated Infection Surveillance Contributor Manual* and the SA Health *Healthcare-associated Bloodstream Infection Surveillance Definition* document.

II. **Key informant interviews (KIIs):** The key informant interviews aimed to explore the experiences of data contributors (representing public metropolitan, regional and rural hospitals), stakeholders from the CDCB ICS, the RSS and the SAIRG. Purposive sampling was used to identify informants who would likely have the time and willingness to participate, with a sample target of eight representing the four key informant groups. Semi-structured interview guides were developed in consultation with the CDCB ICS and utilised open-ended questions to assess participants' perceived stability, simplicity, acceptability, and usefulness of the HA–SABSI surveillance system. Interviews were also used to confirm the system's structure and operation. All interviews were conducted via video conferencing and participant consent was requested to record the interview using audio transcription. Transcriptions were imported into Open Code for thematic analysis. See Appendix II for a list of the questions included in the KIIs.

III. **Data contributor survey:** Data contributors that did not participate in KIIs were requested to provide feedback on the surveillance system via an online survey. The survey was used to assess simplicity, stability, acceptability, and usefulness. It included dichotomous and Likert scale questions enabling experiences to be quantified, and open-ended questions for detailed information to be added. Survey questions were developed in consultation with the CDCB ICS, and once finalised the survey was built in the electronic data capture program REDCap. Pilot testing was conducted with staff from the CDCB ICS Service and the RSS. The final survey was distributed via REDCap to data contributors from four metropolitan public and five private hospitals and via email to 59 regional and remote hospitals, with weekly reminders sent to non-responders. The target recruitment rate was 65%. Survey data was extracted from REDCap and imported into Stata (StataBE 17.0) for analysis.

IV. **Surveillance data:** The ICS HAI surveillance coordinator extracted HA–SABSI surveillance data between 2017–2021 from the central Infection Control State Surveillance System (ICSSS). Data completeness, representativeness and timeliness were evaluated using the surveillance data. Data completeness was assessed by reviewing mandatory fields, including sex; birth date; place of acquisition; and infection focus. Representativeness was considered by examining the coverage of patients receiving healthcare in South Australia and data fields used to identify known healthcare-associated risk factors, including surgery; medical devices; time in intensive care; and host risk factors, including Indigenous status, older age, male sex and comorbidities. In addition, timeliness was reviewed by assessing the median number of days from laboratory receipt to reporting.

Table 1. Methods & measures, SA HA–SABSI surveillance system evaluation, 2022

Attribute	Methods	Measures & questions to assess attribute
Simplicity	Interviews & survey	• Description of system functionality • Reported time required for reporting • Reported ability to apply the case definition
Data quality	Data analysis	• Completeness of mandatory data fields
Acceptability	Interviews & survey	• Perceived public health importance • Reported effort in relation to usefulness
Representativeness	Data analysis	• Ability of the system to identify at-risk groups • Sites who report to the system
Timeliness	Data analysis	• Time between blood culture collection, notification to hospital, reporting and action
Stability	Interviews & survey	• Preservation of the system during the COVID-19 pandemic
Usefulness	Interviews & survey	• Reported usefulness of real-time case notification & surveillance reports • Reported contribution to improvements in clinical practice

Data analysis

The data were analysed using a deductive approach in Open Code for all semi-structured interviews to identify key findings associated with the evaluated attributes. Inductive analysis was also used to allow unanticipated themes to emerge, including new ideas for HA–SABSI surveillance; enablers; and barriers.

Descriptive analysis was performed in Stata (StataBE 17.0) on responses to dichotomous and Likert scale survey questions. Findings were reported as count (n) and percentage distribution (%) and disaggregated by hospital type or surveillance system where appropriate. Missing data were included in the denominator when calculating proportions. Findings were reported under each of the evaluated system attributes. Quantitative findings from the survey were triangulated with themes identified in key informant interviews to identify convergence, complementarity and divergence; and illustrate experiences. Themes or experiences that deviated, both positively and negatively, from the survey results were also described for completeness. Data quality (completeness) was disaggregated by hospital type (metropolitan, regional, and remote) and year to identify trends. Completeness was reported as a percentage (%) for each data field (e.g., date of birth, sex, location of acquisition, device type). The time required for conducting a case investigation and completing the monthly report was categorised as <30 minutes, 30–60 minutes and >60 minutes and reported as a percentage (%). Timeliness was reported as the median (IQR) number of hours between time points of interest. HA–SABSI detected events between 2017–2021 were included to contextualise the evaluation findings and presented as a count and a rate per 10,000 patient bed days. The evaluation results were used to identify and inform recommendations for modification to the HA–SABSI surveillance system.

Dissemination of results

The evaluation findings were shared with the CDCB Director and the ICS, for validation and feedback before finalisation. The final report was sent to the CDCB Director and the SAIRG. An executive summary (Appendix III) was also prepared for dissemination to all data contributors.

Results

Description of the system

The ICS CDCB of the South Australian Department for Health and Wellbeing coordinates the South Australian Healthcare-associated Infection (HAI) Surveillance Program. The Program includes the collection of data on multidrug–resistant organisms (MROs), hospital-identified *Clostridioides difficile* infection, surgical site infection and healthcare associated bloodstream infections including HA–SABSI. The HA–SABSI surveillance system is an active case-based surveillance system. All state HAI surveillance activities, including for HA–SABSI, are managed by the fulltime (1.0 FTE) HAI Surveillance Coordinator in the ICS CDCB. The HA–SABSI surveillance reporting for six large regional and 55 small rural hospitals is coordinated by the RSS Infection Prevention & Control, Sterilisation Services Nurse Manager. Contributing hospitals also have nominated FTE staff from within each facility responsible for the surveillance, reporting and actions in relation of HA–SABSI.

HA–SABSI has been part of the SA Health ICS Surveillance Program since 1997 (43), when SA became one of the first jurisdictions in Australia to do so (27). When the program commenced, the HA–SABSI surveillance system included seven major metropolitan hospitals (five public and two private). In 2002, enhanced surveillance using revised national HA–SABSI definitions was rolled out, and an additional ten hospitals began contributing data. In 2009, six regional hospitals commenced contribution. HA–SABSI is not a notifiable condition under the *South Australian Public*

Health Act 2011. However, in 2011, national reporting of HA–SABSI became mandatory for all acute care[7], including sub-acute[8] and non-acute[9], public hospitals in Australia under the National Healthcare Agreement requiring 71 public hospitals in the state to report HA–SABSI events, which resulted in formalising the surveillance program in SA (39). National reporting for private hospitals remains voluntary, and without being a notifiable condition in SA, they are also not required to report to the CDCB ICS.

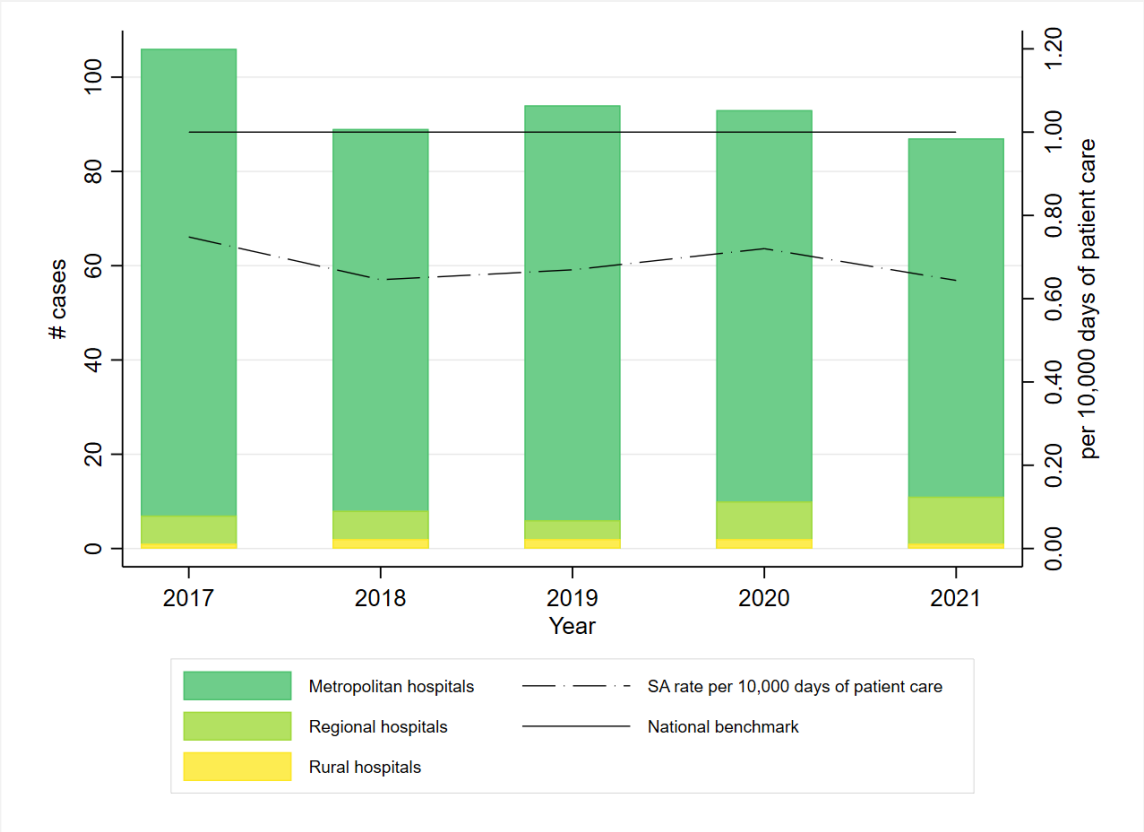
The surveillance system contributors currently include eight metropolitan hospitals, nine regional hospitals and 55 small rural hospitals, covering all patients receiving inpatient or outpatient care from SA acute, sub-acute and non-acute public hospitals in the state. Nine private metropolitan hospitals also contribute HA–SABSI data voluntarily. The list of contributing hospitals can be found in Appendix IV. The system does not capture SABSI cases considered community-acquired, nor cases associated with healthcare in the community that is not delivered by SA Health, for example, by private general practitioners.

Between 2017–2021, 519 HA–SABSI cases were detected by the surveillance system. The majority (*n*=469, 90.4%) were reported from metropolitan hospitals, followed by (*n*=42, 8.1%) from regional and (*n*=8, 1.5%) from rural facilities. The average number of cases per 10,000 days of patient care over the period was 0.69 (range: 0.64–0.75) and was below the national benchmark of 1.0 every year (Figure 2). When disaggregated by hospital type, metropolitan hospitals had the highest rates ($\bar{x}$=0.77, range: 0.70–0.89), followed by rural hospitals ($\bar{x}$=0.47, range: 0.22–0.62) and regional

[7] Acute care includes Medical (care not involving a procedure), Surgical (involving an operating room procedure), Childbirth, Specialist mental health and Acute other (non-surgical procedures, such as endoscopy)
[8] Non-acute care is where the primary clinical purpose or treatment goal is support for a patient with impairment, activity limitation or participation restriction due to a health condition. This is also known as 'maintenance care'.
[9] Subacute care is specialised multidisciplinary care in which the primary need for care is optimisation of the patient's functioning and quality of life.

hospitals (x̄=0.33, range: 0.23–0.43) Several individual hospitals were above the national benchmark during the period (Appendix V).

Figure 2. HA–SABSI cases by hospital type, SA, 2017–2021



System purpose and objectives

There is no explicit purpose or objectives of the HA–SABSI surveillance system. However, the principal goal of the ICS Healthcare-associated Infections Surveillance Program, which HA–SABSI is contained within, is *"the systematic collection of data to provide continuous statewide monitoring of the incidence of healthcare-associated infections".* Specific objectives to assist in achieving this goal include:

- *"Promotion of contributor involvement in the development of HAI surveillance methods and definitions.*
- *Provision of standardised definitions for selected infection indicators.*
- *Assistance with interpretation and application of the definitions.*

- *Provision of aggregated, standardised data for individual institution monitoring and benchmarking.*
- *Continuous monitoring and improvement of surveillance data collection, analysis and reporting methods."*

Case definition

Identification of a SABSI requires laboratory confirmation, defined as a positive blood culture of *S.aureus*, and resistant strains are detected by antimicrobial susceptibility testing. Those considered healthcare-associated are identified using the criterion in Table 2. Once a case is classified as healthcare-associated, the following attributes are determined: place of acquisition; associated clinical criteria (device associated, surgery associated, procedure associated, neutropenia associated); intensive care unit associated; focus of infection; and the responsible clinical unit. All information relating to the HA–SABSI case definition and case attributes are described in the SA Health *Healthcare-associated Infection Surveillance Contributor Manual.*

Table 2. HA–SABSI case definition, SA Health, 2022

A SABSI is considered healthcare-associated if Criterion A1 or 2, or Criterion B1, 2, 3 or 4 are met.

Criterion A

The patient's first *Staphylococcus aureus* positive blood culture was collected:

A1. More than 48 hours after admission, with no documented evidence that infection was present (including incubating) on admission;

OR

A2. Less than 48 hours after discharge.

OR

Criterion B

The patient's first positive *Staphylococcus aureus* blood culture was collected less than or equal to 48 hours after admission, and one or more of the following key clinical criteria is met:

- B1. SABSI is a complication of the presence of an indwelling medical device
- B2. SABSI occurs within 30 days of a surgical procedure where the SABSI is related to the surgical site, or 90 days for deep incisional/organ space infections related to a surgically implanted device
- B3. SABSI was diagnosed within 48 hours of a related invasive instrumentation or incision
- B4. SABSI is associated with neutropenia contributed to by cytotoxic therapy and is unrelated to the presence of an indwelling medical device.

If neither Criterion A1 or 2, nor Criterion B1, 2, 3 or 4 are met, then the SABSI is considered to be community-acquired for the purposes of surveillance.

For surveillance purposes, only the first isolate per patient is counted, unless at least 14 days has passed without a positive culture, after which an additional episode is recorded.

Components and operation of the surveillance system

Case detection

All inpatient SABSI cases are reported to the treating hospital's Infection Prevention and Control (IPC) Service. All metropolitan[10] and six large regional[11] public hospitals receive real-time reports of the final SABSI pathology results or the interim pathology results for multi-resistant SABSI isolates. These reports are automated from the SA Pathology database (Millennium) to the Infection Control Information Management System (ICIMS) component of the clinical information system OACIS (Open Architecture Clinical Information System). ICIMS is an integrated module of OACIS that brings together information from other relevant health databases to detect, notify and monitor targeted infections and procedures. For 55 smaller public hospitals, cases are

[10] Flinders Medical Centre, Lyell McEwin Hospital, Modbury Hospital, Queen Elizabeth Hospital, Repatriation General Hospital, Royal Adelaide Hospital and Women's & Children's Hospital
[11] Mount Gambier Hospital, Port Augusta Hospital, Port Lincoln Hospital, Port Pirie Hospital, Riverland (Berri) Regional Services and Whyalla Hospital

reported monthly on the Secure Server Report from SA Pathology to individual hospital IPC services and Local Health Network (LHN) IPC staff.

Once a SABSI report is received, the site's IPC staff member or team is responsible for identifying and acknowledging HA–SABSI cases. This often involves the review of medical records and discussions with the treating and infectious diseases teams, where available, to determine the likely source, if is a HC-SABSI or community acquired and any contributing factors, including noncompliance with IPC procedures.

Data collection and response

Once a case is confirmed healthcare-associated, all sites collect all data elements for state ICS HAI surveillance program (Table 3). ICIMS users complete an electronic case report form on ICIMS, with demographic data prepopulated, and all other hospitals input the data into a CDCB ICS–developed Microsoft Excel template. Alongside surveillance activities, site IPC staff/teams identify any immediate IPC action in response to individual cases and complete a report on the SA Health Safety and Learning System in the event of an identified IPC breach. All Safety and Learning System incidents are notified to the responsible division manager and the safety and quality divisional managers. Significant events are also notified to the hospital chief operating officer and all events are monitored by the hospital, LHN and state safety and quality teams. All Safety and Learning System events require a response from the division manager detailing the remedial actions.

Table 3. Comparison of data elements, SA ICS surveillance and AIHW, 2022

Data element	SA ICS surveillance	AIHW recommended
Person identifier		✓#
Family name		✓#
Given name(s)		✓#

Indigenous status		✓#
Date of birth	✓*	✓#
Sex*	✓*	✓#
Address line (person)		✓#
Suburb/town/locality name (person)		✓#
Australian state/territory identifier		✓#
Australian postcode (address)	✓*	✓#
Hospital identifier	✓*	✓*
Clinical unit	✓	✓#
ICU status	✓*	
Focus of infection	✓*	
Device or procedure	✓*	
Device type	✓*	
Device or procedure details	✓*	
Neutropenia	✓	
Acquisition	✓*	
Organism	✓*	✓#
Resistance details	✓	✓#
Admission date		✓#
Separation date		✓#
Specimen collection date	✓*	✓#
Specimen collection time		✓#
Laboratory number		✓#
Specimen identifier		✓#
Laboratory result identifier		✓#
SAB methicillin susceptibility		✓#
Establishment number		✓#

*Mandatory field #Optional

Hospital reporting

All contributors are required to submit a monthly report to the CDCB ICS. The report is a line list, with SA Health data elements, for the previous month. For ICIMS users, electronic surveillance reporting forms (SRF) are run using a reporting software program called Business Objects and exported to Excel, where quality assurance checks can be performed. All other public sites (non-ICIMS users) and private hospitals work directly with Excel templates prepared by the CDCB ICS, which have macros embedded to facilitate quality assurance.

ICIMS users must submit a second monthly report, the Safety and Quality Performance Agreement indicator report, for HA–SABSI in the previous month. These reports are due to be submitted to the ICS on the tenth working day of the month. All sites also report HA–SABSI cases monthly to their Standard 3 Committee (Preventing and Controlling Healthcare Associated Infections), however, this is not a surveillance reporting requirement.

All public metropolitan[1], six large regional[2] hospitals (ICIMS users), and private hospitals submit reports directly to the CDCB ICS, and all other sites (non-ICIMS users) submit completed Excel reports to the RSS IPC and Sterilisation Services who conduct quality assurance before loading into the CDCB ICS state surveillance database - Infection Control State Surveillance System (ICSSS).

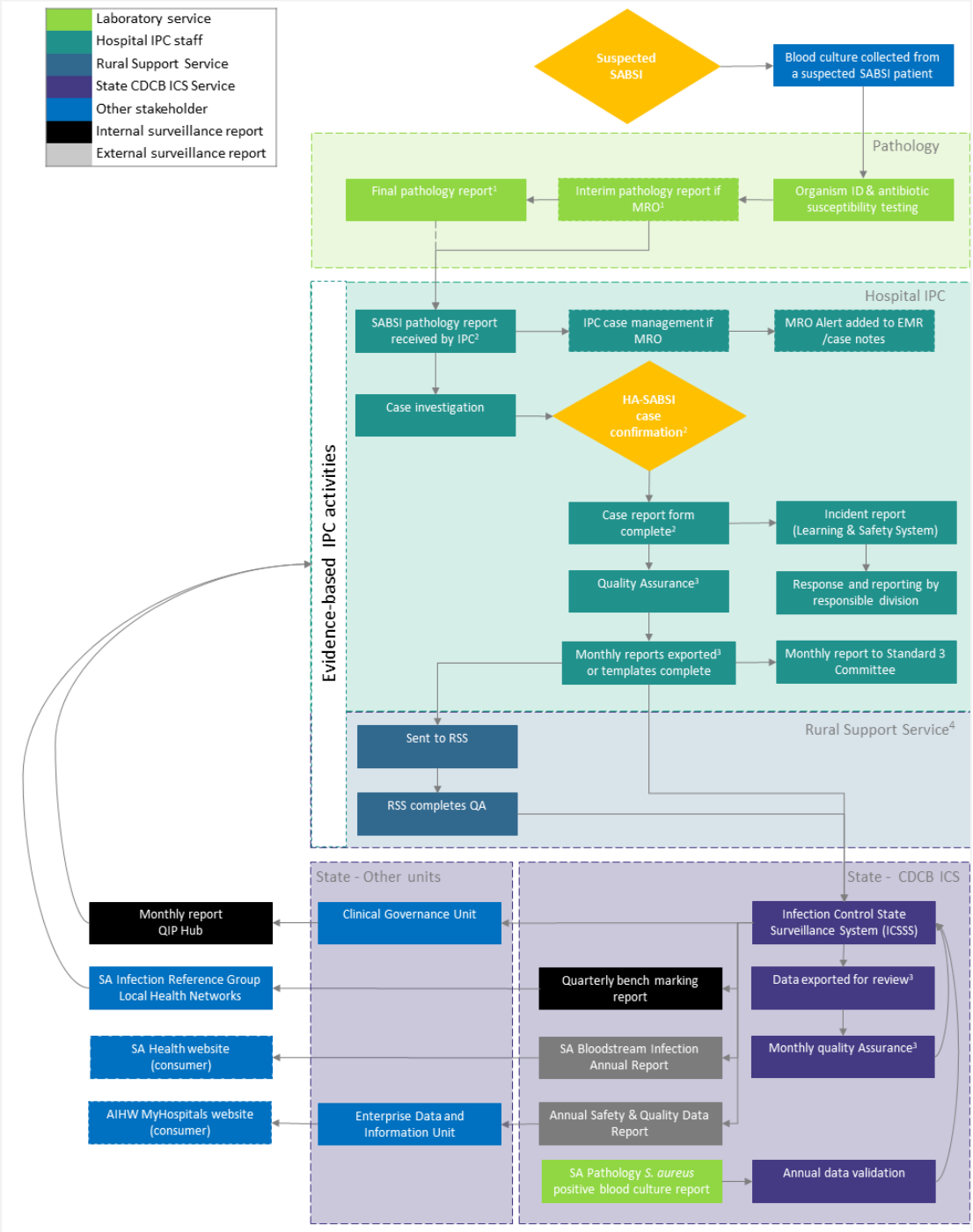
State surveillance

Excel reports from ICIMS users and private hospitals are imported into ICSSS by the CDCB ICS and the RSS imports reports for non-ICIMS public hospitals. CDCB ICS undertakes quality assurance for all data via Business Objects reports. Data queries are flagged with data contributors and corrected in the ICSSS. Every 6–12 months, ICS performs data validation whereby all SABSI detected by SA Pathology are reviewed and assessed against those reported in ICSSS to ensure no HA–SABSI are missed.

On the 16th of each month, the SA Department for Health and Wellbeing Safety and Quality Performance Agreement indicator data is automatically extracted from the ICSSS by the Clinical Governance Unit, who subsequently publish HA–SABSI counts and rates per 10,000 bed days on the Quality, Information and Performance Hub (QIP Hub) — previously LHN Analytics and Reporting Service (LARS) — on the SA Health Intranet. Data can be viewed at the network and hospital levels.

The ICS reports HA–SABSI cases in the Quarterly Benchmarking reports, which are distributed to the contributors and provide a quarterly summary for the South Australian Infection Reference Group (SAIRG). The SAIRG is accountable to the Director of the CDCB and provides SA Health with a reference group for expert advice on priorities and policies relating to infectious disease management and IPC, with the understanding that operational coordination and implementation occur at the LHN level. Annually the CDCB ICS reports all HA–SABSI cases for public hospitals at the hospital level to the AIHW via SA Department for Health and Wellbeing Enterprise Data and Information Unit, which is then published on the MyHospitals website. CDCB ICS also prepare an annual Bloodstream Infection report, which includes HA–SABSI cases, made publicly available via the SA Health website. System operation is shown in Figure 3 below.

Figure 3. Operation of the South Australian HA–SABSI surveillance system, 2022



MRO: Multidrug-resistant organism; EMR: Electronic medical record system

[1] Millennium to OACIS, [2] ICIMS users – real-time case report and electronic case report form, [3] Business Objects for ICIMS users, [4] Monthly reports sent to RSS for non-ICIMS users only

Assessment of system attributes

Response rates

Between November and December 2022, nine semi-structured interviews were conducted with key informants representing the three stakeholder groups: data custodians, data contributors and the SAIRG. No rural or non-ICIMS data contributors responded to the interview request, however one LHN IPC staff member was interviewed, who oversees both ICIMS and non-ICIMS sites (Table 4).

Sixty-three other contributors across metropolitan, regional, and rural public hospital sites and five private metropolitan hospitals were invited to participate in the online survey between 28 November and 12 December 2022. The survey response rate was 41% (*n*=26), representing all hospital types. Only one of the five private hospital contributors completed the survey. Unfortunately, due to the de-identified nature of the survey, they could not be excluded from the analysis. Most survey respondents were nurses (*n*=25, 96%), and one (4%) was in a management role. Just over half were ICIMS users (*n*=14, 54%) (Table 4). Descriptive analysis of all survey responses can be found in Appendix VI.

Table 4. Participants, SA HA–SABSI surveillance system evaluation, 2022

		KII	Survey	
		N=9	N=26	%
Hospital type	Metropolitan[12]	5	5	19
	Regional	4	6	23
	Rural	-	15	58
Role	Hospital nurse	5	25	96
	Hospital management	1	1	4
	Member SAIRG	2	-	-
	Data custodian	2	-	-
System	ICIMS	9	14	54
	Non-ICIMS	-	12	46

[12] Four public and one private hospital

Acceptability

All respondents believed the monitoring of HA–SABSI was 'Very important' (*n*=19, 73%) or 'Important' (*n*=7, 27%), and the majority (*n*=21, 81%) believed monitoring HA–SABSI was a valuable use of their time. One respondent was unsure of the value, and four (15%) reported it was not a valuable use of their time. Respondents stated that surveillance was important for identifying immediate problems or breaches in infection control, identifying trends and reducing HA–SABSI in the future, ultimately preventing future patient harm. One respondent stated the importance of centralised state surveillance as *"a common thread may result in a shared solution".* Several experienced staff had cared for SABSI cases and flagged the high associated mortality and potential to prevent a significant proportion of cases.

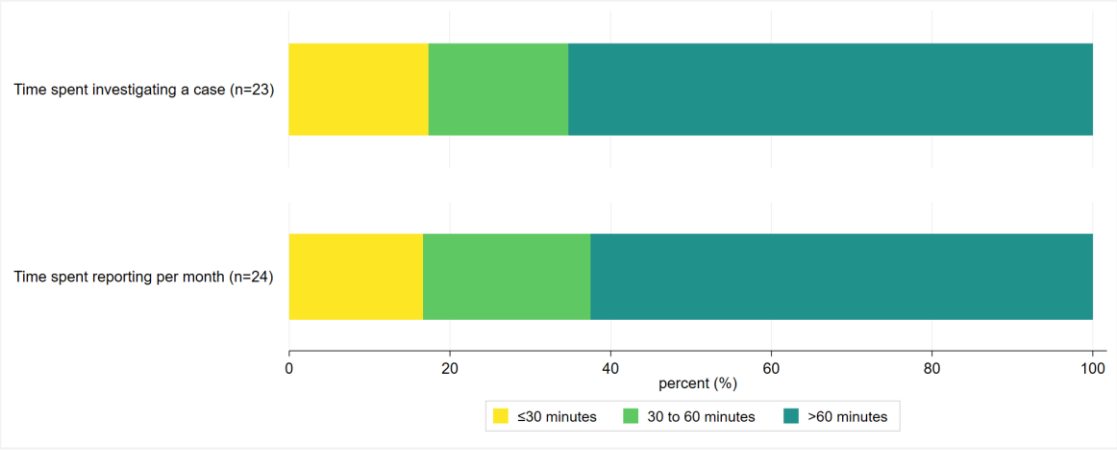
No collected data could be used to assess reports' timeliness subjectively; however, key informants reported their experiences. Monthly reports sent by ICIMS users were reportedly mostly on time, with sites usually sending their two monthly reports (i.e., the line list of cases for the month and the Safety and Quality Performance Agreement indicator report) by the tenth working day. Non-ICIMS users reportedly required more follow-up to submit reports on time. The lack of staff or staff time was the primary reason for reports being overdue. Three out of 14 non-ICIMS user respondents flagged challenges regarding the necessary time to spend on surveillance activities in the context of staff shortages, and that auto-collection of data may help reduce the burden of surveillance activities in the future.

Simplicity

Most respondents (*n*=15, 58%) reported spending >60 minutes investigating a single HA–SABSI case (Figure 4). The median amount of time was 61 minutes. The most frequently (*n*=16, 61%) stated time-intensive task was the review of case notes and

identifying a source of the infection. The monthly SABSI reporting requirements also took most respondents >60 minutes (*n*=15, 58%) (Figure 4), and the median amount of time was 80 minutes. The most time-intensive tasks were reported to be preparing reports and completing quality assurance. Feedback from five of the key informants indicated that the time spent investigating cases and reporting differed depending on the contributor's experience and the number of cases. While metropolitan sites had the most cases to report, they reported having experienced IPC teams. Rural sites rarely had cases, so when cases did arise, reporting was more challenging due to limited prior experience using the system. Regional sites reported a challenging mix of cases occurring intermittently with insufficient human resources or staff new to IPC, which reportedly resulted in considerable time commitments. Attempts have been made to address these issues via annual one-day training provided by CDCB ICS for all new data contributors, on HAI surveillance and remote technical support when requested.

Figure 4. Time spent contributing to the SA HA–SABSI surveillance system, 2022



Applying the HA–SABSI case definition and identifying the source of acquisition was deemed easy by 46% (*n*=12) of survey respondents and not easy by eleven (42%). One respondent was unsure of what the case definition was, and another reported they had not had to use it yet. Reported challenges in applying the case definition and attributes included guidelines being "*too wordy*", difficult to apply to *"a complex patient*

with complex conditions", and complex to apply for new staff. Factors that reportedly enabled case definition use included surveillance experience, using the definitions document while investigating a case, seeking help from the CDCB ICS, and consulting other clinicians. Respondents suggested that the definitions document could be improved by incorporating a simplified flowchart and ensuring the case report form in ICIMS reflects exactly what is in the definitions document. Regional staff also flagged that they have found some ward nurses to be unfamiliar with acronyms including MSSA (methicillin-susceptible *S.aureus)* and MRGN (multi-resistant Gram-negative micro-organisms), impacting on their ability to decide what immediate IPC action should be taken.

A majority of ICIMS users (*n*=9, 64%) reported that they did not find ICIMS easy to use, and most of these (*n*=8, 89%) were from non-metropolitan sites. Six (57%) ICIMS users reported that the critical databases (EPLIS, ICIMS and Care Connect) were well integrated. Suggestions for improving ICIMS users' experience included online training that does not require regional staff to travel; and a detailed orientation manual which includes basic information such as the process for getting an ICIMS login, which was noted as time-consuming and difficult for new users. One informant also suggested establishing a state-wide network of IPC staff to improve information sharing. It is unclear if these respondents were aware of the SA Network of Infection Control Teams (SANIT), which was established in 1997 and meets four times yearly. One person did note that despite being responsible for surveillance, they had not always been invited. Instead, invites went to more senior staff, and that before COVID-19, non-metropolitan sites attended remotely via the phone, making it difficult to know who was speaking and what was being presented.

Data Quality

The state surveillance program collects seven of the 23 AIHW-recommended data elements (Table 3). Only data elements that are used for reporting are collected. Completeness of data in the ICSSS was 100% for all the following mandatory reporting fields: date of birth; sex; ICU status; the focus of infection; acquisition ward; and organism. Key informant interviews credited this completeness to the extensive quality assurance processes. Resistance details, including antibiotic sensitivity, have been included for all MRSA isolates since 2018. However, data completeness ranged from 0%–40% between 2018–2021, with no improvement by year or hospital type. Key informants reported that there is no clear location to report the resistance details in the ICIMS case report form.

Table 5. Data completeness, SA HA–SABSI surveillance system evaluation, 2022

Year		Number		% With complete data							
		# of cases	MRSA cases	DOB	Sex	ICU status	Focus of infection	Acquisition	Acquisition ward	Organism	Resistance details
Metropolitan	2017	106	19	100%	100%	100%	100%	100%	100%	100%	N/A
	2018	89	18	100%	100%	100%	100%	100%	100%	100%	33%
	2019	94	15	100%	100%	100%	100%	100%	100%	100%	40%
	2020	93	11	100%	100%	100%	100%	100%	100%	100%	36%
	2021	87	20	100%	100%	100%	100%	100%	100%	100%	40%
Regional	2017	7	2	100%	100%	100%	100%	100%	100%	100%	N/A
	2018	8	4	100%	100%	100%	100%	100%	100%	100%	0%
	2019	6	2	100%	100%	100%	100%	100%	100%	100%	0%
	2020	10	4	100%	100%	100%	100%	100%	100%	100%	0%
	2021	11	2	100%	100%	100%	100%	100%	100%	100%	0%
Rural	2017	1	0	100%	100%	100%	100%	100%	100%	100%	N/A
	2018	2	1	100%	100%	100%	100%	100%	100%	100%	0%
	2019	2	0	100%	100%	100%	100%	100%	100%	100%	N/A
	2020	2	0	100%	100%	100%	100%	100%	100%	100%	N/A
	2021	1	0	100%	100%	100%	100%	100%	100%	100%	N/A

The majority of survey respondents were 'Very confident' (*n*=13, 50%) or 'Confident' (*n*=4, 16%) that the system can detect an increase in SABSI cases. Six (24%) were 'Unsure', and one (4%) was 'Not confident'. Smaller sites noted that a single case would be an increase and a cause for concern. The majority were also 'Confident' (*n*=8, 31%) or 'Very confident' (*n*=5, 19%) that the system can identify specific groups at risk of HA–SABSI. Six (24%) were unsure, and three (12%) were not confident.

Thirteen (50%) survey respondents said that cases were likely to be misclassified 'Sometimes'. For example, incorrectly defining cases as community-associated rather than healthcare-associated. Reasons for potential misclassification included:

- Lack of education and understanding of the definitions among staff
- Limited staff time because of understaffing
- Lack of documentation, including at the time of pathology collection
- Difficulty applying the definitions, especially for complex cases
- Issues with the case definition not capturing outpatient care in the community.

Concerns were also voiced about defaulting to an intravenous line when another source could not be identified. However, there was some consensus that evidence indicates this is the most common source of HA–SABSI, and it was probably unlikely to result in many misclassified cases.

While this evaluation did not assess the sensitivity of the case definition, the SA Health HAI surveillance coordinator reported that 3598 SA Pathology SABSI reports were reviewed between 2019–2021 as part of the annual data validation. Reportedly the checks detected a maximum of six additional HA–SABSI cases, 2 per year, suggesting the case definition has a sensitivity ≥98%[13]. Reasons for the missed cases included

[13] Sensitivity estimate: 6 false negative cases, 306 true positive cases = 98.1%

not being reported by the laboratory, or misclassified by the hospitals, i.e., community-associated instead of hospital-associated.

Timeliness

For ICIMS users, the median number of hours between laboratory acceptance of a blood culture and reporting in ICIMS was 85 (IQR: 56–114 hours). No difference was seen when comparing MRSA and MSSA results. The median number of hours for non-metro ICIMS users was 206 (IQR: 129–402 hours) compared with 85 hours (IQR: 56–114 hours) for metro ICIMS users. Despite the discrepancy in the data, regional ICIMS users reported that SABSI reports were timely and case investigations could be done before the patient was discharged.

No data were available to evaluate the timeliness of notifications for non-ICIMS users subjectively. However, given that laboratory reports are only received once a month by the IPC staff via the Secure Server Report, the maximum number of days between blood culture results being reported and notification for surveillance purposes would likely be close to 30 days. However, insights from key informant interviews suggest this could be longer depending on when the staff member with surveillance responsibilities was next working. The significant time between case onset and laboratory results being reported was considered problematic by this group (non-ICIMS users). It resulted in retrospective case investigation after the patient was discharged or transferred and on occasion, cases for surveillance missed by sites. Any missed cases were reportedly detected by the RSS. While the Secure Server Reports were not considered timely, missed cases were also reported as an outcome of smaller sites having one staff member responsible for surveillance activities and having their IPC time allocation as only a small component of their role. The RSS, which also receives the monthly Secure Server Reports, reportedly played a role in identifying missed cases, however, they

could be set up to receive daily Secure Server Reports of all cases in their six LHNs and provided more real-time reporting for non-ICIMS users.

Representativeness

The system captures HA–SABSI associated with any care provided by South Australian acute care public hospitals, which includes all five public intensive care units (Table 5). In 2022 this equated to 97.3% coverage of all public hospital bed days. While there is not legislation to mandate reporting of HA–SABSI in private hospitals, 53% of acute care private hospitals in the state voluntarily contribute surveillance data, covering all seven (100%) private intensive care units. Only one mental health hospital and one rehabilitation hospital are under surveillance; both public facilities. The surveillance system does not capture HA–SABSI associated with care provided by the 241 aged care facilities, estimated to be 18,000 residents in June 2022 (44), or any of the day surgery or procedure facilities (*n*=10, 0%).

Table 6. Healthcare facility representativeness HA–SABSI surveillance, SA, 2022

	ICU public	Acute care public hospitals	ICU private	Acute care private hospitals	Aged care facilities	Mental health hospitals	Rehabilitation hospitals	Day surgery/ procedure facilities
Total facilities in SA	5	71	7	17	241	3	3	11
Under surveillance	5	71	7	9	0	1	1	0
Percentage covered	100%	100%	100%	53%	0.0%	33%	33%	0.0%

All participating hospitals (*n*=80) collect the same data elements for all HA–SABSI cases. Data elements include the following: date of birth; sex; healthcare-associated

risks; ICU status; the focus of infection[14]; device or procedure device type, device or procedure details; and neutropenia. In addition, data are collected on the patient's ward at the time of acquisition. These data allow state-level analysis of the primary focus and clinical speciality at acquisition. For example, between 2019 and 2020, most cases were associated with haematology/oncology and intravenous lines. No data are collected on critical host-related risks, for example, prior hospitalisation and renal disease or MRSA carriage; nor is Aboriginal and Torres Strait Islander identity captured. Therefore, the system cannot accurately describe HA–SABSI cases in these at-risk sub-populations.

The data highlight a higher prevalence of MRSA HA–SABSI cases in regional hospitals. Key informants reported that this was likely associated with some regional areas providing care to a higher proportion of Aboriginal and Torres Strait Islander patients. Key informants also reported that the resistance profile of MRSA in one region is different to that in metropolitan areas. The data incompleteness described earlier, and no data on Aboriginal and Torres Strait Islander status means the system cannot detect these trends. However, SA Pathology does monitor the resistance profiles of all MRSA bloodstream infections and produces antibiograms.

Table 7. Proportion of MRSA HA–SABSI by hospital type, SA, 2017–2021

	Total cases	MRSA cases	%
Metropolitan	469	83	17.7%
Regional	42	14	33.3%
Rural	8	1	12.5%
Total	519	98	18.9%

[14] Bone and joint, Central nervous system, Cardiovascular system, Disseminated, Genital tract, Gastrointestinal tract, Head and neck, Intra-abdominal, IV line-associated, Maternally-acquired, Other body site, Respiratory tract, Skin and soft tissue, Urinary tract and Unknown

Despite the associated complications of SABSI, the system does not currently collect data on outcomes such as 30–day all-cause mortality and infective endocarditis. The system does not aim to monitor the outcomes of HA–SABSI events, and key informants reported that the human resources to do so currently do not exist. Finally, due to several administrative structures, HA–SABSI reports do not include HA–SABSI data for all SA Health sites despite the data being available. For example, the QIP Hub and annual reports contain data for nine of the ten LHNs and cover 14 public hospitals. The SAIRG quarterly reports cover all hospitals but are separated by metropolitan and regional/rural, and currently only report an aggregated count and rate.

Usefulness

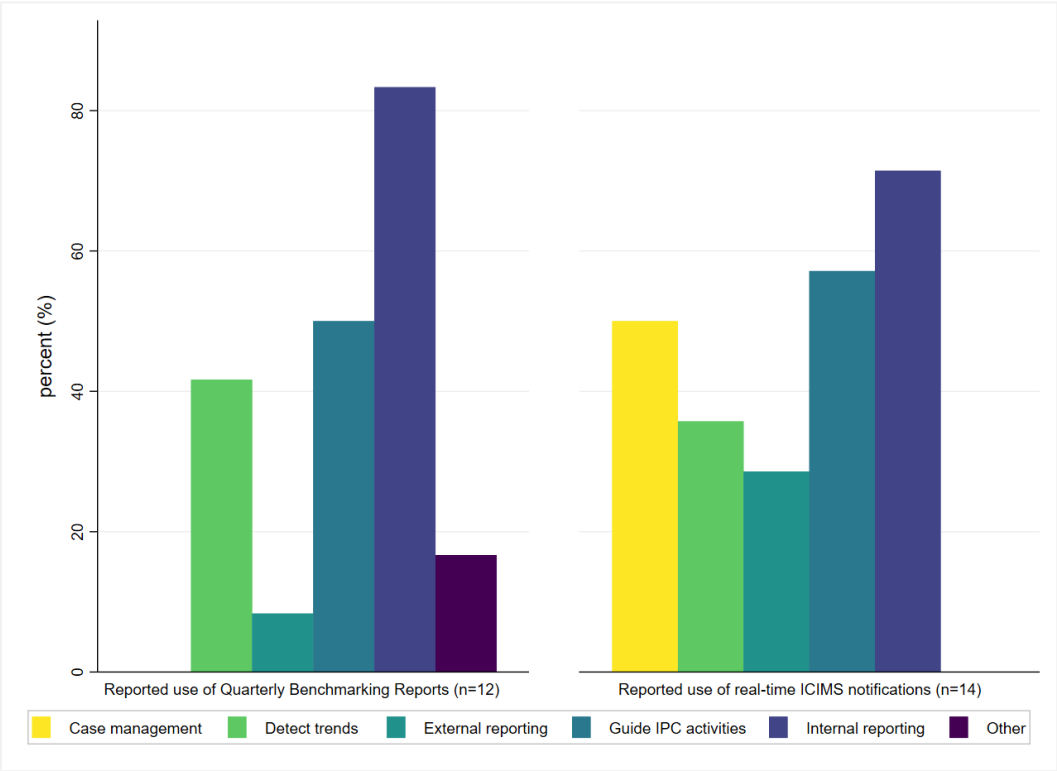
Among respondents using ICIMS (*n*=14), eight found the real-time case reporting to be ‘Useful’ (*n*=1, 7%) or ‘Very useful’ (*n*=7, 50%), and one (7%) was ‘Unsure’. Five respondents (36%) did not answer the question. Real-time case reporting was primarily used for internal reporting (*n*=10, 71%), guiding IPC activities (*n*=8, 57%), and case management (*n*=7, 50%) (Figure 6). The Secure Server Reports were ‘Always’ used by 14 respondents (54%) to identify SABSI cases and ‘Never’ used by ten respondents (39%). The reasons why the reports are not used was not captured. Among those that 'Always' use the Secure Severe Reports, the majority (*n*=11, 42%) were from regional and rural sites. The majority of respondents (*n*=21, 81%) said that once reported, they investigated every SABSI case. All those that did not respond to every case (*n*=5, 19%) were from Regional and Rural facilities, four of which had real-time reporting via ICIMS. Several metropolitan informants said most case reports resulted in a Root Cause Analysis to determine what happened, why it happened and how it could be prevented in the future.

Only two (14%) ICIMS respondents (*n*=14) reported using the Quality Information & Performance Hub (QIP Hub), and half had never heard of it (*n*=7, 50.0%). One ICIMS

respondent said they used the SABSI information from the QIP Hub, one said they did not use it, and 12 did not complete the question. The low response rate may indicate this report is not being used by IPC staff. Key informants stated that the information is used by hospital executives, who use the QIP Hub regularly.

Quarterly benchmarking reports were used by 46% (*n*=12) of respondents, and most found them to be 'Useful' (*n*=4, 33%) or 'Very useful' (*n*=4, 33%). Four (33%) stated they were 'Unsure' about the usefulness of the quarterly benchmarking reports. The majority reported using the reports for internal reporting (*n*=10, 83%), guiding IPC activities (*n*=6, 50%) and detecting trends in HA–SABSI cases over time (*n*=5, 42%) (Figure 6).

Figure 5. Use of surveillance data, SA HA–SABSI data contributors, 2022



Several metropolitan sites reported keeping their own HA–SABSI database and writing internal reports for their Standard 3 Committee (Preventing and Controlling Healthcare

Associated Infections), which they reported to every month. The SAIRG members found the quarterly benchmarking reports helpful but wondered, given the group's remit, if data should be at the facility level, as aggregated data could conceal problems at individual sites.

National HA–SABSI annual reports were reviewed by seven respondents (27%), five had never heard of them (19%), and 14 stated they had not viewed them (54%). Only one (4%) respondent reported viewing HA–SABSI data on the AIHW My Hospital website and six (23%) had never heard of it.

Stability

Most survey respondents (*n*=21, 81%) agree that HA–SABSI data were available when needed. All four (16%) respondents who stated data were unavailable when needed were from non-metropolitan hospitals, and three were non-ICIMS users. The primary reason reported was that the monthly Secure Server Reports were not frequent enough. Several ICIMS users also said that Business Objects could be slow, and modifications often required support from CDCB ICS. Many key informants reported ICS always being available to problem-solve when required. The inequity caused by ICIMS not being rolled out to all sites was also a common theme, as well as the potential risk of using a database without sufficient developer support available. CDCB ICS and Digital Health SA were also acutely aware of this problem and a solution was prepared for tender, however no action has been undertaken to progress software replacement since a recent change in government in 2022.

Half (*n*=13) of the respondents said the COVID-19 pandemic impacted SABSI surveillance activities. Most of those reporting an impact were from non-metropolitan hospitals (*n*=9, 69%). Challenges were associated with the volume of additional work caused by COVID-19, which resulted in IPC staff being moved to fill staff shortages on

the wards; an increase in new staff; and a lack of IPC-trained staff able to pick up SABSI surveillance. One staff member reported taking SABSI surveillance work home to complete out-of-hours, and one metropolitan site reported upskilling several team members on surveillance to reduce the impacts of COVID-19. Key informants stated that these pressures resulted in unreported cases in 2021 from non-ICIMS users. Beyond COVID-19, key informants also noted that attrition of experienced IPC nurses in the last few years was problematic for HAI surveillance activities.

Eleven (42%) survey respondents felt that improvements could be made to SABSI surveillance. Suggested improvements from survey respondents included improved integration with electric medical records to reduce the volume of manual data entry; processes to ensure real-time reporting of all cases in regional and rural sites; enhanced reporting to include divisional and ward level data; and enhanced training of staff. Other suggestions included developing guidance on evidence-based IPC responses, especially non-intravenous line infection sources. Informants noted that this might not be the role of CDCB ICS but thought they could help facilitate. Some also suggested enhancing surveillance, noting the HA–SABSI prevention assessment tool developed recently developed in Australia (45).

Discussion

This is the first comprehensive evaluation of the South Australian HA–SABSI surveillance system. The evaluation found widespread acceptability, and that the overarching objective of the surveillance system — to provide continuous state-wide monitoring of the incidence of HA–SABSI— is mostly being met, except that it is not state-wide. This limited coverage is unlikely to change unless SABSI becomes a notifiable condition under the *South Australia Public Health Act 2011* or a national HAI surveillance program is established (36). While the overarching objective is being met, there is scope to broaden the system's aims to capture the intended public health use

of the data; for example, the Victorian HAI surveillance system aims to reduce the occurrence of healthcare-associated infections (46). It would be valuable to formally describe such objectives.

The system's robust quality assurance process ensures data completeness of all mandatory fields and reportedly high data quality, although data validity was not able to be formally evaluated for this report. Hospital-level monitoring is facilitated by real-time or monthly pathology reports, and internal databases. State-level monitoring is done via a series of internal and external facing reports, with varying degrees of reported usefulness. The annual HA–SABSI report is the most detailed, describing trends in healthcare-associated risks; however, this report only included ICIMS and private hospitals before 2023. The QIP Hub reports do not appear to be utilised by hospital infection prevention and control units, but are reportedly important for hospital executives.

Evaluation participants widely recognised the clinical and public health significance of HA–SABSI, and surveillance appears to lead to feedback, remedial action and IPC activities within individual hospitals. At a state level, South Australia has remained below the national benchmark for HA–SABSI, a likely outcome of surveillance and improved clinical practices. However, the rate appears to have stabilised, as it has nationally, and there are individual hospitals above the benchmark. The scope to which further reductions can be made will likely require more nuanced surveillance and response, for example, by determining the level of preventability of individual HA-SABSI as proposed by several Australian IPC experts (45). On this point, while the current system effectively captures data on the risk associated with healthcare interventions, improvements could be made to better ascertain whether epidemiological trends are associated with patient risk factors. For example, Aboriginal and Torres Strait Islander peoples are considered to have one of the highest SABSI

rates in the world (47). They are at significantly greater risk of SABSI than non-Indigenous Australians (47-49) and have higher mortality rates (47-49). While it is unclear if this equates to a greater risk of HA-SABSI, the structural racism in the healthcare system (50) and the inequalities in healthcare treatment that Aboriginal and Torres Strait Islander peoples experience (51), could result in an increased HA-SABSI risk. Therefore the relationship between Aboriginal and Torres Strait Islander identity and HA–SABSI needs to be examined to determine if they are overrepresented. This will be especially important if the system aims to make further reductions in rates and determine the level of case preventability going forward. Poor data completeness of antibiotic susceptibility results also means the system has little understanding of the epidemiology of the antibiotic resistance profile of cases. For the data on antibiotic susceptibility to be useful, the gaps need to be addressed. Otherwise, they should be removed from the system if they are not being used.

While the usefulness of the system surveillance was also widely acknowledged, surveillance activities were found to be resource-intensive and complicated for some IPC staff and facilities. The most time-consuming task was case investigation, and challenges were associated with staff skills or lack of IPC staff, applying the case definition and learning ICIMS. These findings are consistent with the experiences of contributors of other HAI surveillance systems (52) and also attributed to manual data collection from patient medical records (52), the complexity of case definitions (53) and the lack of skilled staff (38, 53). Proposed short-term solutions to these challenges included developing a step-by-step orientation guide and online training, and ensuring the language used in the ICIMS case report form is consistent with the case definition. Furthermore, not all contributors seem to be familiar with existing resources, including the case definitions document and flowchart, and the SANIT. As the healthcare system stabilises post-pandemic, additional efforts may need to be made to communicate these resources with data contributors and engage them in meetings and trainings.

These efforts may become particularly critical in the coming years if the attrition of senior experienced IPC staff continues.

The most significant issues with the current system were the age and incomplete coverage of ICIMS. While ICIMS currently meets the needs of the surveillance system, and alternative processes have been established for non-ICIMS users, it impacts data timeliness for some users and is at considerable risk of not functioning in the future. Firstly, no IT staff within the Department for Health and Wellbeing are familiar with the software and able to provide technical support. Secondly, the reported decommissioning of OACIS means that ICIMS will become obsolete. The CDCB ICS have been acutely aware of these risks for some time and are ready to go to tender once priority is given back to the replacement project. While the delays have been frustrating, the confirmed state-wide rollout of the new electronic medical record system (Sunrise); advances in electronic surveillance software for HAIs (54); and lessons learned from COVID-19 provide an exciting and timely opportunity. Any new electronic surveillance system should be available to all facilities in the state; respond to the aims of the surveillance system, including articulating how the HA–SABSI data should be used; and take advantage of automation where appropriate. Several reviews have been published in the last 5 years on the design and implementation of automated surveillance for HAIs (54, 55). The consistent access may also help facilitate near real-time monitoring and transparent reporting, at the state, LHN and facility level, reducing the reporting burden and improving the usefulness of the HA–SABSI reports.

Recommendations

The evaluation findings have informed the following recommendations to further strengthen the HA–SABSI surveillance system.

1. Review the purpose of the surveillance system. Include **a description of the desired public health use** and impact of, for example, to reduce HA-SABSI in public hospitals and facilitate national reporting, and consider the use of the term statewide.
2. **Strengthen new data contributors' onboarding,** for example, by developing a detailed orientation guide and online training, and ensuring they are invited to participate in relevant meetings and networks.
3. Create **daily Secure Server SABSI Report for the RSS**. The RSS could then report cases directly to hospital IPC staff to improve the reporting timeliness for non-ICIMS users.
4. Consider conducting a retrospective study using surveillance data to **assess the epidemiology of HA–SABSI in key sub-populations,** including Aboriginal and Torres Strait Islander peoples and MRSA carriers. If associations are identified, the scope of the surveillance system should be expanded to ensure it can better characterise and monitor HA-SABSI cases in these populations.
5. **Determine if resistance details of MRSA isolate are useful for surveillance** and if so, make it a mandatory field and conduct quality assurance to improve data completeness.
6. **Consider reporting at the facility level** in the Quarterly Report, for example, adding facility-level counts and rates as an appendix allows those with higher rates to be identified.
7. **Consider analysis in the annual report by patient risk factors**, for example, age, sex, and comorbidities.

8. Plan to **upgrade the ICIMS software** in the next 1–2 years to ensure the future stability and sustainability of the system.
9. **Consider the feasibility and importance of determining case preventability** to reduce HA–SABSI rates in the future.
10. **Consider the feasibility and usefulness of collecting outcome data** and the role of surveillance in improving outcomes of HA–SABSI cases, and if useful, the necessary resources required.

Limitations

This study has several limitations which should be noted. To ensure all the evaluation findings were representative of all data contributors, the survey was sent to everyone that did not participate in an interview. However, participation in the survey was voluntary and the survey response rate was only 41%, below the 65% target. This lower response rate may have introduced a nonresponse or participation bias, whereby the experiences of responders do not represent those of non-responders. If true, this may have resulted in data contributors with less interest or expertise not being accurately represented in the evaluation findings and the experiences of contributors with more substantial views being overrepresented. The views of private hospitals are also unlikely to be accurately represented. However, despite the low response rate, all hospital types (metropolitan, regional and rural), ICIMS users and non-users were represented. Survey responses also indicate that several contributors with less HA–SABSI surveillance experience participated. Furthermore, key informant interview findings were consistent with results from the survey suggesting data saturation was reached.

Conclusions

The SA HA–SABSI surveillance system is a fundamental component of IPC for acute care hospitals in the state and a critical mechanism to enable mandated reporting of HA–SABSI for all public hospitals to the AIHW. The system appears useful and acceptable, with high data completeness and quality levels, allowing it to meet its objectives. Simplicity, timeliness and stability could be significantly improved by upgrading the ICIMS surveillance system software and ensuring it is rolled out to all public healthcare facilities in the state. Data representativeness is unclear; a retrospective review should be done to determine if subpopulations not currently captured are at increased risk of HA-SABSI in the state. In the longer term, consideration should be given to true state-wide coverage of all acute healthcare facilities at a minimum, which national HAI surveillance would facilitate if established. Further reflection may also be needed on how the system can support further reductions in HA–SABSI rates, which will likely be more challenging to achieve.

Appendix I: Introduction letter

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Infection Prevention and Coordinators
Regional Local Health Networks
SA Health

Dear Infection Control Coordinator

RE: Master of Applied Epidemiology (MAE) Project

I am writing to advise you about a Master of Applied Epidemiology (MAE) project that is being undertaken by Erin Flynn in collaboration with the Department for Health and Wellbeing's Infection Control Service (ICS).

Erin is a Master of Applied Epidemiology scholar with the National Centre for Epidemiology and Population Health at the Australian National University and the South Australian Health and Medical Research Institute (SAHMRI). Erin has worked in Australia, Cambodia, Nigeria, and the United Kingdom, coordinating research on hygiene and sanitation, maternal-child health, and infectious diseases. She is a registered nurse and holds a Master of Public Health.

Erin has been approved to undertake an evaluation of the South Australian *Staphylococcus aureus* bloodstream infection (SABSI) Surveillance System. This evaluation aims to assess the system's performance and acceptability among stakeholders and contributors. The evaluation will be undertaken in accordance with the Centers for Disease Control and Prevention (CDC) guidelines for evaluating Public Health Surveillance Systems (see https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm).

The results of this evaluation will be used by the Communicable Disease Control Branch to identify the benefits of the program, as well as any areas for improvement. It is planned that a project summary will be tabled at the South Australian Infection Reference Group (SAIRG) on 28 March 2023. Further distribution of the results will be at the discretion of the Director of the Communicable Disease Control Branch.

As a contributor to the SABSI Surveillance System, you are invited to contribute to this evaluation. Your involvement is completely voluntary. Participants will be asked to complete a short online survey, and additionally a subset of stakeholders and contributors will be contacted to undertake a more detailed interview likely via MS Teams.

Erin will contact all contributors directly via email with additional details about the study. If you have any questions or concerns regarding the study, please contact Erin on Erin.Flynn@sahmri.com. Alternatively, I can be contacted on louise.flood@sa.gov.au

Yours sincerely

Louise Flood

Dr Louise Flood
Director
COMMUNICABLE DISEASE CONTROL BRANCH

Appendix II: Semi-structured interview guide

Simplicity

1. How are you notified of a SABSI case?

2. How easy or difficult do you find:
    a. *Identifying a SABSI case? And identifying those that are HAI?*
    b. *Completing quality assurance activities?*
    c. *Undertaking data analysis?*
    d. *Completing reporting?*

3. After receiving a SABSI notification, how much time is required to investigate each case and complete reporting?

Acceptability

4. What do you see as the purpose of SABSI surveillance?

5. How important do you think the surveillance of HA–SABSI is for your hospital and SA public hospitals in general?

6. How would you describe the balance of effort and usefulness in SABSI surveillance?

Usefulness

7. How do you monitor trends in HA–SABSI over time?

8. How does the system identify groups at-risk of SABSI?

9. What action do you take in response to a single case?

10. What action do you take if you observe a trend in HA–SABSI cases?

11. Do you use the LARS or Quarterly Benchmarking reports, and for what purpose?

Stability

12. Did the COVID-19 pandemic impact any HA–SABSI surveillance processes? If so, please describe the impact and any changes

13. Are there any other challenges you regularly face in your ability to investigate SABSI cases, collect relevant data, complete reporting, analyse data and take action?

Any other feedback

14. Is there any other feedback you would like to provide on the SABSI surveillance system?

Appendix III: Executive summary

Executive Summary
Evaluation of the South Australian Healthcare-associated *Staphylococcus aureus* Bloodstream Infection Surveillance System

Erin Flynn

Staphylococcus aureus (*S. aureus*) is the leading cause of healthcare-associated bloodstream infections worldwide and is associated with significant morbidity and mortality. Most healthcare-associated *S. aureus* bloodstream infections (HA–SABSI) are preventable and considered a robust indicator of healthcare quality and safety.

This evaluation assessed the performance and acceptability of the South Australian (SA) *S. aureus* Bacteraemia Surveillance System. The evaluation assessed the following seven system attributes: simplicity, stability, data quality, acceptability, representativeness, timeliness, and usefulness. The methods included a literature review, a data contributor survey, semi-structured interviews with key informants, and an analysis of SA HA–SABSI surveillance data from 2017–2021.

Results

Between November and December 2022, nine semi-structured interviews were conducted with key informants, and sixty-three contributors from public hospitals and five private metropolitan hospitals were invited to participate in the online survey. The survey response rate was 41% (n=26).

System description

HA-SABSI has been part of the SA Department for Health and Wellbeing Communicable Disease Control Branch (CDCB) Infection Control Service (ICS) Surveillance Program since 1997. In 2011, national reporting of HA-SABSI became mandatory for all acute public hospitals in Australia under the National Healthcare Agreement, which formalised the surveillance

program in SA. Between 2017–2021, 519 HA–SABSI cases were detected by the surveillance system. The majority (n=469, 90%) were reported from metropolitan hospitals, and the average number of cases per 10,000 days of patient care was 0.69 (range: 0.64–0.75), below the national benchmark of 1.0 every year.

All inpatient SABSI cases are reported to the treating hospital's Infection Prevention and Control (IPC) Service. All public metropolitan[1] and six large regional hospitals[2] receive real-time pathology reports. These reports are automated from the SA Pathology database (Millennium) to the Infection Control Information Management System (ICIMS) - an integrated module of OACIS (Open Architecture Clinical Information System) which brings together information from other relevant health databases for detection, notification and surveillance of targeted infections and procedures. For 55 smaller public hospitals, cases are reported monthly on the Securer Server Report from SA Pathology to individual hospital IPC services and Local Health Network (LHN) IPC staff.

Once confirmed healthcare-associated, as per the case definition, all sites collect all data elements for state surveillance. ICIMS users complete an electronic case report form on ICIMS, and all other hospitals input the data into a CDCB ICS–developed Microsoft Excel template. All sites are required to submit a monthly report, with details of HA-SABSI cases. ICIMS-users report directly to CDCB ICS and non-ICIMS users report via the Rural Support Service (RSS). ICIMS-users must also submit a second monthly report, the Safety and Quality Performance Agreement indicator report.

All data are imported into the Infection Control State Surveillance System (ICSSS). Monthly Safety and Quality Performance Agreement indicator data are published on Performance Hub (QIP Hub) on the SA Health Intranet. Quarterly Benchmarking reports are published and distributed to contributors and the South Australian Infection Reference Group SAIRG. Annually, all HA–SABSI cases for public hospitals at the hospital level are reported to the Australian Institute of Health and Welfare (AIHW) via the SA Department for Health and Wellbeing Enterprise Data and Information Unit, which is then published on the MyHospitals website. CDCB ICS also prepare an annual Bloodstream Infection report, which includes HA–SABSI cases, made publicly available via the SA Health website.

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[1] Flinders Medical Centre, Lyell McEwin Hospital, Modbury Hospital, Queen Elizabeth Hospital, Repatriation General Hospital, Royal Adelaide Hospital and Women's & Children's Hospital

[2] Mount Gambier Hospital, Port Augusta Hospital, Port Lincoln Hospital, Port Pirie Hospital, Riverland (Berri) Regional Services and Whyalla Hospital

Acceptability

Monitoring of HA–SABSI was considered 'Very important' (n=19, 73%) or 'Important' (n=7, 27%) and valuable use of staff time (n=21, 81%). HA–SABSI surveillance was described as necessary for identifying immediate problems or breaches in infection control, identifying trends, and reducing HA–SABSI in the future, ultimately preventing future patient harm.

Timeliness

The median hours between laboratory acceptance of a blood culture and reporting in ICIMS was 85 hours (IQR: 56–114 hours) for metropolitan ICIMS users. Contrastingly, the median number of hours for non-metropolitan ICIMS users was 206 hours (IQR: 129–402). However, for non-ICIMS users, laboratory reports are only received once a month via the Secure Server Report.

Simplicity

On average, investigating a single HA–SABSI case required >60 minutes. The most time-intensive tasks were reviewing case notes and identifying the source of the infection. On average, monthly SABSI reporting also required >60 minutes. The most time-intensive tasks were preparing reports and completing quality assurance.

Applying the HA–SABSI case definition and identifying the source of acquisition was deemed easy by 46% (n=12) of survey respondents and not easy by eleven (42%). Reported challenges included guidelines being "too wordy" and difficulty applying them to "a complex patient with complex conditions".

Usefulness

ICIMS users (n=14) found the real-time case reporting from the laboratory to be 'Very useful' (n=7, 50%) and 'Useful' (n=1, 7%). The laboratory results were primarily used for internal reporting (n= 10, 71%), guiding IPC (infection prevention and control) activities (n=8, 57%), and case management (n=7, 50%). Quarterly benchmarking reports were used by 46% (n=12) of respondents, and most found them to be 'Useful' (n=4, 33%) or 'Very useful' (n=4, 33%). Reports informed internal reporting (n= 10, 83%), guided IPC activities (n = 6, 50%) and detected trends in HA–SABSI cases (n = 5, 42%).

Data quality

Data completeness was 100% for all mandatory data fields, credited to the extensive quality assurance processes. Completeness of resistance details for Methicillin-resistant *S. aureus* (MRSA) isolates ranged from 0%–40%, with no improvement by year or hospital type. Key informants reported no precise location to document the resistance details in the ICIMS case report form.

Thirteen (50.0%) survey respondents reported cases were likely to be misclassified 'Sometimes', for example, incorrectly defined as community-associated rather than healthcare-associated.

Representativeness

The system captures HA–SABSI associated with any care provided by South Australian acute care public hospitals, including all five public intensive care units. Over half (53%) of acute care private hospitals in the state are also under surveillance, which covers all 7 (100%) private intensive care units. The system does not capture HA–SABSI associated with care provided by the 241 aged care facilities or any day surgery or procedure facilities in the state.

All participating hospitals (n=80) collect the same data elements for all HA–SABSI cases. Data are collected on known healthcare-associated risks for all cases, for example, ICU status and device or procedure. No data are collected on critical host-related risks, for example, prior hospitalisation and renal disease, MRSA carriage. Nor is Aboriginal and Torres Strait Islander identity captured. Therefore, the system cannot accurately describe HA–SABSI cases in these at-risk sub-populations.

Stability

Most survey respondents (n=21, 81%) agree that SABSI data were available when needed; however, disruptions were experienced during the COVID-19 pandemic. Challenges were associated with the volume of additional work caused by COVID-19. Concerns were also raised about the age and inconsistent coverage of the ICIMS surveillance system software, with only one ICS staff member familiar with the system and the system's stability in the future.

Conclusions

The SA HA–SABSI surveillance system is a fundamental component of IPC for acute care hospitals in the state and a critical mechanism to enable mandated reporting of HA–SABSI for all public hospitals to the AIHW. The system appears useful and acceptable, with high data completeness and quality levels, allowing it to meet its objectives. Simplicity, timeliness and stability could be improved by upgrading the surveillance system software and ensuring it is rolled out to all public healthcare facilities in the state. Immediate efforts to improve representativeness could be addressed by adding data elements identifying subpopulations at risk. In the longer term, consideration should be given to true statewide coverage, which national healthcare-associated infection surveillance would facilitate if established. Further reflection may also be needed on how the system can support further reductions in HA–SABSI rates, which will likely be more challenging to achieve.

Recommendations

1. Review the purpose of the surveillance system. Include a description of the desired public health use and impact, for example, to reduce HA-SABSI in public hospitals and facilitate national reporting and consider the use of the term statewide.
2. Strengthen new data contributors' onboarding, for example, by developing a detailed orientation guide and online training, and ensure they are invited to participate in relevant meetings and networks.
3. Create daily Secure Server SABSI Report for the RSS. The RSS could then report cases directly to hospital IPC staff to improve the reporting timeliness for non-ICIMS users.
4. Consider conducting a retrospective study using surveillance data to assess the epidemiology of HA-SABSI in key sub-populations, including Aboriginal and Torres Strait Islander people and MRSA carriers. If associations are identified, the scope of the surveillance system should be expanded to ensure it can better characterise and monitor HA-SABSI cases in these populations.
5. Determine if resistance details of MRSA isolate are useful for surveillance and if so, make it a mandatory field and conduct quality assurance to improve data completeness.
6. Consider reporting at the facility level in the Quarterly Report. For example, adding facility-level counts and rates as an appendix allows those with higher rates to be identified.
7. Consider analysis in the annual report by patient risk factors, for example, age, sex, and comorbidities.
8. Plan to upgrade the ICIMS software in the next 1 – 2 years to ensure the future stability and sustainability of the system.
9. Consider the feasibility and importance of determining case preventability to reduce HA–SABSI rates in the future.
10. Consider the feasibility and usefulness of collecting outcome data and surveillance's role in improving outcomes of HA–SABSI cases, and if useful the necessary resources required.

Appendix IV: List of HA–SABSI surveillance system contributors

Hospital name	Local Health Network	Hospital type	ICIMS user
Flinders Medical Centre	Southern Adelaide	Metro	✓
Lyell McEwin Hospital	Northern Adelaide	Metro	✓
Modbury Hospital	Northern Adelaide	Metro	✓
Queen Elizabeth Hospital	Central Adelaide	Metro	✓
Repatriation General Hospital	Southern Adelaide	Metro	✓
Royal Adelaide Hospital	Central Adelaide	Metro	✓
Women's & Children's Hospital	Women's and Children's	Metro	✓
Noarlunga Hospital	Southern Adelaide	Metro	✓
Riverland (Berri)	Riverland Mallee Coorong	Regional	✓
Mount Barker District Hospital	Barossa Hills Fleurieu	Regional	
Mt Gambier & Districts Health Services	Limestone Coast	Regional	✓
Murray Bridge Hospital	Riverland Mallee Coorong	Regional	
Port Augusta Hospital	Flinders & Upper North	Regional	✓
Port Lincoln Health Service	Eyre & Far North	Regional	✓
Port Pirie Regional Health Service	Yorke & Northern	Regional	✓
South Coast District Hospital	Barossa Hills Fleurieu	Regional	
Whyalla Hospital and Health Services	Flinders & Upper North	Regional	✓
Angaston District Hospital	Barossa Hills Fleurieu	Rural	
Balaklava Hospital	Yorke & Northern	Rural	
Barmera Health Service	Riverland Mallee Coorong	Rural	
Booleroo Centre District Hospital	Yorke & Northern	Rural	
Bordertown Memorial Hospital	Limestone Coast	Rural	
Burra Hospital	Yorke & Northern	Rural	
Ceduna District Health Service	Eyre and Far North	Rural	
Central Yorke Peninsula Hospital	Yorke & Northern	Rural	
Cleve District Hospital and Aged Care	Eyre & Far North	Rural	
Coober Pedy Hospital and Health Service	Eyre & Far North	Rural	
Cowell District Hospital and Aged Care	Eyre & Far North	Rural	
Crystal Brook and District Hospital	Yorke & Northern	Rural	
Cummins and District Memorial Hospital	Eyre & Far North	Rural	
Elliston Hospital	Eyre & Far North	Rural	
Eudunda Hospital	Barossa Hills Fleurieu	Rural	
Gawler Health Service	Barossa Hills Fleurieu	Rural	
Gumeracha Hospital	Barossa Hills Fleurieu	Rural	
Hawker Memorial Hospital	Flinders & Upper North	Rural	
Jamestown Hospital and Health Service	Yorke & Northern	Rural	
Kangaroo Island Health Service	Barossa Hills Fleurieu	Rural	
Kapunda Hospital	Barossa Hills Fleurieu	Rural	
Karoonda Hospital	Riverland Mallee Coorong	Rural	
Kimba District Hospital and Aged Care	Eyre & Far North	Rural	

Kingston Soldiers' Memorial Hospital	Limestone Coast	Rural	
Lameroo District Health Service	Riverland Mallee Coorong	Rural	
Laura and District Hospital	Yorke & Northern	Rural	
Lower Murray District Hospital	Riverland Mallee Coorong	Rural	
Lower North Health Clare Centre	Yorke & Northern	Rural	
Loxton Hospital Complex	Riverland Mallee Coorong	Rural	
Mannum District Hospital	Riverland Mallee Coorong	Rural	
Meningie Hospital	Riverland Mallee Coorong	Rural	
Millicent Hospital and Health Service	Yorke & Northern	Rural	
Mount Pleasant District Hospital	Barossa Hills Fleurieu	Rural	
Naracoorte Health Service	Limestone Coast	Rural	
Northern Yorke Peninsula Health Service	Yorke & Northern	Rural	
Orroroo and District Health Service	Yorke & Northern	Rural	
Penola War Memorial Hospital	Limestone Coast	Rural	
Peterborough Hospital	Yorke & Northern	Rural	
Pinnaroo Soldiers' Memorial Hospital	Riverland Mallee Coorong	Rural	
Port Broughton and District Hospital	Yorke & Northern	Rural	
Quorn Health Service	Flinders & Upper North	Rural	
Renmark Paringa District Hospital	Riverland Mallee Coorong	Rural	
Riverton Hospital	Yorke & Northern	Rural	
Roxby Downs Health Service	Flinders & Upper North	Rural	
Snowtown Hospital and Health Service	Yorke & Northern	Rural	
Southern Yorke Peninsula Health Service	Yorke & Northern	Rural	
Strathalbyn and District Health Service	Barossa Hills Fleurieu	Rural	
Streaky Bay Hospital	Eyre & Far North	Rural	
Tanunda War Memorial Hospital	Barossa Hills Fleurieu	Rural	
Tumby Bay Hospital and Health Services	Eyre & Far North	Rural	
Waikerie Health Service	Riverland Mallee Coorong	Rural	
Wudinna Hospital	Eyre & Far North	Rural	
Ashford Hospital	-	Private	-
Burnside Hospital	-	Private	-
Calvary North Adelaide Hospital	-	Private	-
Calvary Adelaide Hospital	-	Private	-
Flinders Private Hospital	-	Private	-
Memorial Hospital	-	Private	-
North Eastern Hospital	-	Private	-
St. Andrews Hospital	-	Private	-
Western Hospital	-	Private	-

Appendix V: HA–SABSI, cases above the national benchmark, SA, 2016–2019

Reporting unit	Time period	Cases	Rate per 10,000 patient days	Peer group average
Flinders Medical Centre	2017–18	36	1.12	1.00
Lyell McEwin Hospital	2016–17	17	1.06	0.74
Lyell McEwin Hospital	2018–19	18	1.03	0.70
Lyell McEwin Hospital	2019–20	26	1.41	0.70
Mount Gambier Health Service	2017–18	3	1.05	0.51
Mount Gambier Health Service	2019–20	4	1.36	0.48
Naracoorte Health Service	2018–19	1	1.11	0.39
Northern Yorke Peninsula Health Service	2017–18	1	1.74	0.25
Port Augusta Hospital	2018–19	2	1.18	0.54
Port Lincoln Health Service	2017–18	2	1.62	0.25
Port Lincoln Health Service	2018–19	3	2.30	0.39
Port Pirie Regional Health Service	2017–18	2	1.11	0.25
Royal Adelaide Hospital	2016–17	43	1.49	1.09
Royal Adelaide Hospital	2018–19	32	1.04	1.01
Royal Adelaide Hospital	2017–18	34	1.22	1.00
The Queen Elizabeth Hospital	2016–17	16	1.23	0.74
Whyalla Hospital and Health Services	2017–18	4	1.64	0.51
Women's and Children's Hospital	2017–18	10	1.14	1.45
Women's and Children's Hospital	2019–20	14	1.59	0.91

Datasource: AIHW Healthcare-associated *Staphylococcus aureus (S. aureus)* bloodstream infections

Appendix VI: HA–SABSI surveillance system evaluation, survey results, 2022

	Metropolitan N=5		Regional N=6		Rural N=15		Total N=26	
System used								
OACIS - Infection Control (ICIMS)	3	60%	4	67%	7	47%	14	54%
Excel	1	20%	2	33%	6	40%	9	35%
Other	1	20%	0	0%	2	13%	3	11%
Acceptability								
On a scale of 1 - 5, how important is it to monitor HA–SABSI								
1 - Not at all important	0	0%	0	0%	0	0%	0	0%
2 - Low importance	0	0%	0	0%	0	0%	0	0%
3 - Neutral	0	0%	0	0%	0	0%	0	0%
4 - Important	1	20%	1	17%	5	33%	7	27%
5 - Very Important	4	80%	5	83%	10	67%	19	73%
Is collecting and reporting HA–SABSI cases a valuable use of your time?								
No	0	0%	1	17%	3	20%	4	15%
Yes	5	100%	5	83%	11	73%	21	81%
Unsure	0	0%	0	0%	1	7%	1	4%
Usefulness								
*How useful is the ICIMS real-time case notification (n=14)**								
1 - Not at all useful	0	0%	0	0%	0	0%	0	0%
2 - Low usefulness	0	0%	0	0%	0	0%	0	0%
3 - Neutral	0	0%	0	0%	1	14%	1	7%
4 - Useful	1	33%	0	0%	0	0%	1	7%
5 - Very Useful	2	67%	2	50%	3	43%	7	50%
Missing	0	0%	2	50%	3	43%	5	36%
Do you use the secure server report to identify cases?								
Always	3	60%	3	50%	8	53%	14	54%
Sometimes	0	0%	1	17%	1	7%	2	8%
Never	2	40%	2	33%	6	40%	10	38%
Do you investigate every case of SABSI?								
No	0	0%	1	17%	4	27%	5	19%
Yes	5	100%	5	83%	11	73%	21	81%
*Do you use the QIP Hub? (n=14)**								
No	3	100%	1	25%	1	14%	5	36%
Yes	0	0%	1	25%	1	14%	2	14%
I've never heard of it	0	0%	2	50%	5	71%	7	50%
*How useful do you find the LARS/Quality Improvement Reports (n=14)**								
1 - Not at all useful	0	0%	0	0%	0	0%	0	0%
2 - Low usefulness	0	0%	0	0%	0	0%	0	0%
3 - Neutral	0	0%	0	0%	0	0%	0	0%
4 - Useful	0	0%	0	0%	0	0%	0	0%
5 - Very Useful	0	0%	0	0%	1	14%	1	7%
Missing	3	100%	4	100%	6	86%	13	93%
Do you use the SABSI information in the Quarterly Benchmarking reports?								
No	2	40%	4	67%	8	53%	14	54%
Yes	3	60%	2	33%	7	47%	12	46%
How useful do you find the Quarterly Benchmarking reports?								
1 - Not at all useful	0	0%	0	0%	0	0%	0	0%
2 - Low usefulness	0	0%	0	0%	0	0%	0	0%
3 - Neutral	0	0%	1	17%	4	27%	4	15%
4 - Useful	2	40%	6	100%	1	7%	4	15%
5 - Very Useful	1	20%	6	100%	2	13%	4	15%

Missing	2	40%	4	67%	8	53%	14	54%
Do you look at the National SABSI annual reports?								
No	3	60%	2	33%	9	60%	14	54%
Yes	2	40%	2	33%	3	20%	7	27%
I've never heard of it	0	0%	2	33%	3	20%	5	19%
Do you review SABSI data on the My Hospitals website?								
No	4	80%	4	67%	11	73%	19	73%
Yes	1	20%	0	0%	0	0%	1	4%
I've never heard of it	0	0%	2	33%	4	27%	6	23%
Data quality								
How confident are you the system can detect an increase in SABSI cases?								
1 - Not at all confident	0	0%	0	0%	1	7%	1	4%
2 - Low confidence		0%	0	0%	0	0%	0	0%
3 - Neutral	0	0%	4	67%	2	13%	6	23%
4 - Confident	0	0%	1	17%	3	20%	4	15%
5 - Very confident	5	100%	1	17%	7	47%	13	50%
Missing	0	0%	0	0%	2	13%	2	8%
Simplicity								
Do you consider the ICIMS easy to use?								
No	1	20%	2	33%	6	86%	9	64%
Yes	2	40%	2	33%	0	0.0%	4	29%
Missing	0	0%	0	0%	1	14%	1	7%
Are EPLIS, ICIMS, and Care Connect Clinical systems well integrated?								
No	1	20%	1	17%	4	27%	6	23%
Yes	2	40%	2	33%	1	7%	5	19%
Other	0	0%	1	17%	2	13%	3	12%
Is it easy to apply the SABSI case definitions?								
No	2	40%	3	50%	6	40%	11	42%
Yes	3	60%	2	33%	7	47%	12	46%
Other	0	0%	1	17%	2	13%	3	12%
How likely are cases misclassified?								
Never	2	40%	1	17%	2	13%	5	19%
Rarely	2	40%	2	33%	3	20%	7	27%
Sometimes	1	20%	3	50%	9	60%	13	50%
Missing	0	0%	0	0%	1	7%	1	4%
Time investigating a SABSI case	61	(61-171)	74	(31-111)	66	(28-120)	61	(31-120)
Time completing monthly reports	229	(77-239)	92	(59-167)	61	(21-120)	80	(49-198)
Stability								
Is SABSI data available when you need it?								
No	0	0%	1	17%	3	20%	4	15%
Yes	5	100%	4	67%	12	80%	21	81%
Missing	0	0%	1	17%	0	0%	1	4%
Did COVID-19 impact your SABSI surveillance activities?								
No	1	20%	3	50%	8	53%	12	46%
Yes	4	80%	2	33%	7	47%	13	50%
Missing	0	0%	1	17%	0	0%	1	4%
Other								
Are there any improvements that could be made to the system?								
No	2	40%	4	67%	7	47%	13	50%
Yes	3	60%	0	0%	8	53%	11	42%
Missing	5	100%	2	33%	0	0%	2	8%

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