Australian Commission on **Safety and Quality** in Health Care

Principles of healthcare-associated infection surveillance

Analysing and using data for quality improvement

Surveillance of healthcare-associated infections (HAIs) is important for informing an organisation's quality improvement activities, evaluating the effectiveness of its infection prevention and control strategies and improving patient outcomes.

The principles of data analysis outlined in this resource should be adapted to meet the needs of local infection prevention and control programs.

Healthcare-associated infection surveillance in Australia

The National Safety and Quality Health Services (NSQHS) Standards Preventing and Controlling Infections Standard requires health service organisations to have systems in place to monitor, assess and use surveillance data to reduce the risks associated with infections.

Local surveillance systems should include the use of existing national and jurisdictional HAI surveillance resources, such as surveillance definitions, data collection methods, and datasets, where available, to ensure a standardised and comparable approach to surveillance.[1] A number of national HAI surveillance resources have been developed to support this approach (see Table 1).

Staphylococcus aureus bloodstream infections (SABSI) is the only HAI monitored and reported at a national level in Australia. Individual states and territories set the requirements for the monitoring and reporting of other HAIs based on local needs.[2]

Table 1 National HAI surveillance resources

Indicator	Reporting pathway	National surveillance resources
Staphylococcus aureus bloodstream infections (SABSI)	Reported and published by the Australian Institute for Health and Welfare	Implementation guide for the surveillance of *Staphylococcus aureus* bloodstream infection Australian Health Performance Framework: PI 2.2.2- Healthcare-associated *Staphylococcus aureus* bloodstream infections, 2025
Central line-associated bloodstream infections (CLABSI)	Reported to the Australian and New Zealand Intensive care Society (ANZICS) CLABSI ICU core registry	Implementation guide for the surveillance of central-line associated bloodstream infections Case definition
Clostridioides difficile infection (CDI)	State/territory determined	Implementation guide for the surveillance of *Clostridioides difficile* infection Public Health Laboratory Network - Laboratory case definition - *Clostridioides difficile*
Multi-drug-resistant organisms (MDROs) - *Candida auris* - *Carbapenemase*-producing organisms - Vancomycin-resistant *enterococci* Methicillin-resistant *Staphylococcus aureus* (MRSA)	Reporting of HAIs is determined by state and territories. Reporting of clinical isolates is via participating public and private laboratories to CARAlert	National Alert System for Critical Antimicrobial Resistance (CARAlert) CARAlert data explorer
Peripheral intravenous catheters (PIVC)	State/territory determined	Management of peripheral intravenous catheters clinical care standard Indicators for the Management of Peripheral Intravenous Catheters Clinical Care Standard

Analysing HAI data

Staff who are responsible for HAI surveillance need to support this reporting, by calculating infection rates, applying risk stratification, and making statistically valid comparisons.

Calculating infection rates

The amount of infection in the patient population should be reported as the incidence or prevalence of the infection.

- **Incidence:** only new cases of infection in the patient population.
- **Prevalence:** all cases (new and old) of an infection in the patient population.[1]

Infection rates are calculated using the following information:

- The **numerator** represents the number of infections, as determined by the surveillance definition, that have occurred during the time period.
- The **denominator** represents the number of individuals at risk of getting an infection (the at-risk population) during the time period. A patient day is measured from midnight (0000 hours) to 2359 hours (overnight stay). Refer to the nationally agreed patient days definition. The reporting unit will vary depending on the infection, for example:
  - SABSIs and CDIs are usually reported per 10,000 patient days
  - Surgical site infections are reported per 100 procedures
  - CLABSIs are reported per 1,000 central line days.
- The **constant** is a multiple of 10, usually 100, and is used to make the resulting rate meaningful, as it is often difficult to understand the practical impact of an infection rate that is less than 1.[1,2]

Calculating HAI rates using a standardised method, as shown in Figure 1, ensures that infection rates can be compared between similar wards or hospitals, or before and after the implementation of quality improvement interventions.[2]

Figure 1 Standard formula for calculating HAI rates

$$\textbf{Numerator}: \frac{\text{Number of episodes of infections}}{\textbf{Denominator}: \text{Number of patient days}} \times 10{,}000\ (\textbf{Constant})$$

Statistically valid comparisons of data

A statistically valid comparison of HAI surveillance data requires the use of similar surveillance methodologies and definitions. Comparisons should take into account variation in patient numbers or patient demographics between different hospitals or clinical settings.[2,] Table 2 provides a summary of some of the methods that can be used to compare surveillance data.

Table 2 Analysing HAI surveillance by comparison

Method	Purpose
Comparison between clinical settings	To identify if there is a greater risk or incidence of HAIs in certain clinical areas or for different patient populations.
Comparison of resistant and non-resistant organisms	To identify changes in the proportion of resistant infection over time. This type of comparison is useful to inform antimicrobial prescribing, monitor local trends and understand the burden of infection due to resistant organisms.
Comparison of community-onset to hospital onset infections	To compare number of infections that are due to healthcare provision verses those emerging in the community.
Comparison over time	To monitor changes in trends in infection rates or to evaluate the effectiveness of infection control interventions.
Comparison of risk factors	To identify risk factors for infections such as modifiable (e.g., indwelling devices, surgical skin preparations) and non-modifiable factors (e.g., age, gender, underlying conditions) can be used to inform targeted interventions to reduce the risk of infections.[1]

Case study 1: Calculation of CDI rates

Seven new cases of hospital-identified CDI were reported in Hospital A in one month. Three cases met the case definition for severe CDI disease. Hospital records show that 10,750 patient days were recorded for this month.

1. Calculate the rate of CDI per 10,000 patient days for one month:

Numerator (number of cases) = 7 cases of CDI x 10,000
Denominator (total patient days for one month) = 10,750 total patient days

(7 ÷ 10,750) x 10,000 = 6.5

The rate of hospital-identified CDI for one month was 6.5 cases per 10,000 patient days. This calculation informs on how frequent CDI occurred in this hospital in the month.

2. To find the proportion of CDI with severe CDI disease for the same month, use the following formula:

Numerator (number of cases with severe disease) = 3 cases of severe disease
Denominator (number of ALL cases of CDI in one month) = 7 (all cases of CDI)

3 ÷ 7 = 0.4

The proportion of total CDI cases with severe disease in the month is 0.4 cases (can also be represented as 40% of all CDI cases). This calculation describes the magnitude of severe CDI among patients with CDI in the hospital in the month.

Case study 1: Calculation of CDI rates continued

3. The percentage of severe disease in the total patient population also can be calculated:

Number of cases of serve CDI disease **= 3 cases of severe disease x 100**
total patient days **= 10,750 total patient days**

(3 ÷ 10,750) x100 = 0.27 %

This means that less than 0.3% of patients that were admitted to the hospital in this month had severe CDI. This calculation gives a sense of the magnitude of severe CDI in the whole patient population in the month.

Applying risk stratification

When analysing HAI data, it is important to consider the impact of variation when comparing data sets from different clinical settings, patient populations or health service organisations.

Risk stratification is a method used to improve the comparability of different datasets and ensure that the findings are meaningful and relatable to a particular clinical context. Risk stratification uses standardised criteria and recognises that the level of infection risk can vary within the population. For example, people who are immunocompromised may be more likely to acquire an infection than someone who is immunocompetent, or patients with an indwelling device may have a greater risk of bloodstream infection (BSI) compared to those without a device.

The level of infection risk and the comparability of infection surveillance data can be affected by the differences between:

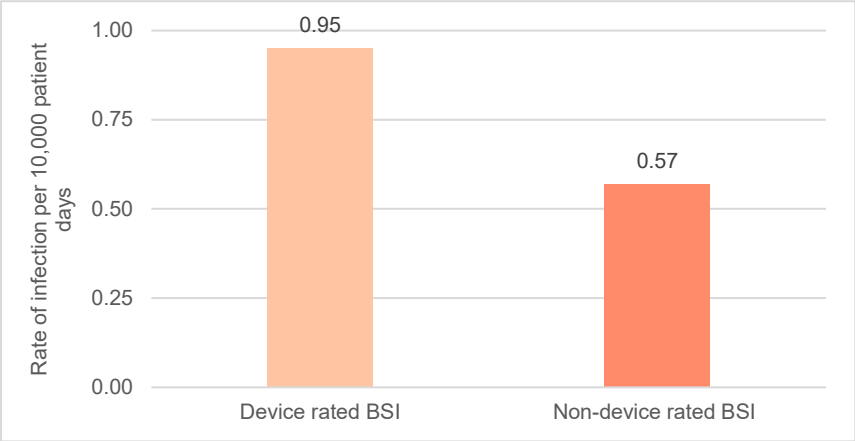
- procedure type
- facility type
- patient case mix
- role delineation (complexity of care).

Some simple ways to risk adjust infection surveillance data include:

- Comparing similarly aged patient populations (for example, analyse healthcare-associated BSIs in children separately to adults).
- Analysing infections in high-risk patients and clinical settings separately to other patient groups and settings (for example, analyse infections occurring in intensive care units or among haematology or oncology patients separately to infections presenting in general medical or surgical wards).

Case study 2: Risk stratification for bloodstream infections in intensive care units

Monthly data is collected on the rates of SABSI in the intensive care unit (ICU). Comparing rates of SABSIs for patients with invasive devices to patients without invasive devices is a simple method of risk stratification.



By applying this risk stratification to monthly SABSI data, staff in this ICU will learn that risk of infection is higher among patients with an invasive device.

Staff can use this information to review:

- current invasive device policies and procedures
- compliance with aseptic technique for the insertion and maintenance of invasive devices
- hand hygiene compliance
- infection prevention and control culture and practices.

Interpreting HAI surveillance data

When interpreting HAI surveillance data to understand the clinical significance of the data, it is important to consider the context or clinical setting in which the data was collected as well as other factors that could influence the findings, such as outbreaks of infectious disease, changes in clinical practice, changes in surveillance definitions or data collection methods.

For example, a HAI in a small hospital is an uncommon event and is an unreliable indicator of practice change. For these settings, a structured process such as a Root Cause Analysis (RCA) can identify contributing factors, identify risk reduction strategies and assist in the implementation of solutions. Monitoring compliance with infection prevention processes, such as aseptic technique compliance and antimicrobial stewardship compliance, also may complement an organisation's HAI surveillance strategy.

Clinical significance reflects the impact of HAIs on a patients' wellbeing and quality of life, as well as the impact on the delivery of clinical services. Statistical significance is a good marker of the reliability of the results of an analysis, but it can be influenced by the size of the population in a hospital and may not necessarily represent a clinically important result for patients.

Feedback and reporting HAI data

It is critical that the prevalence and incidence of HAIs in a health organisation is known and shared with the organisation's workforce.

Clinician feedback

Providing timely and relevant feedback to clinicians on clinical practice is known to have a positive effect on improving infection rates.[3] Providing clinicians with feedback can help increase awareness of preventative measures and recognition of risk factors. Regular feedback also reinforces policy and organisational expectations to improve patient safety outcomes. Reporting HAI data formally and informally at clinician and departmental meetings also provides opportunities to feedback on existing quality improvement initiatives, recognise improvements in practice, and highlight best practice outcomes.

Organisational feedback

Action 3.05 Surveillance of the Prevention and Controlling Infections Standard requires health service organisations to report surveillance data to workforce, the governing body, consumers and other relevant groups.

Regular reporting of HAI data to peak governance committees is important for raising awareness and accountability for infection prevention and seeking resourcing to support infection prevention activities. A hospital's peak governance committee usually will include clinical or medical services, infection prevention and control, antimicrobial stewardship, drug and therapeutics, clinical governance, and quality assurance.[1] Once local HAI reports are endorsed by peak committees, feedback should be provided to other key stakeholders, such as stream managers, and ward level management.

Putting HAI surveillance into practice

Case study 3: Using HAI data for quality improvement

Case study 2 presented the SABSI rate for patients in the ICU with and without invasive devices.

Drill down into the data to identify the risk factors for infections

The ICU compared their rates of infection to other similar sized ICUs at different hospitals and found they had a higher rate of line associated infections than other units.

At their monthly department meeting, ICU staff considered possible reasons for line-associated infections in their unit:

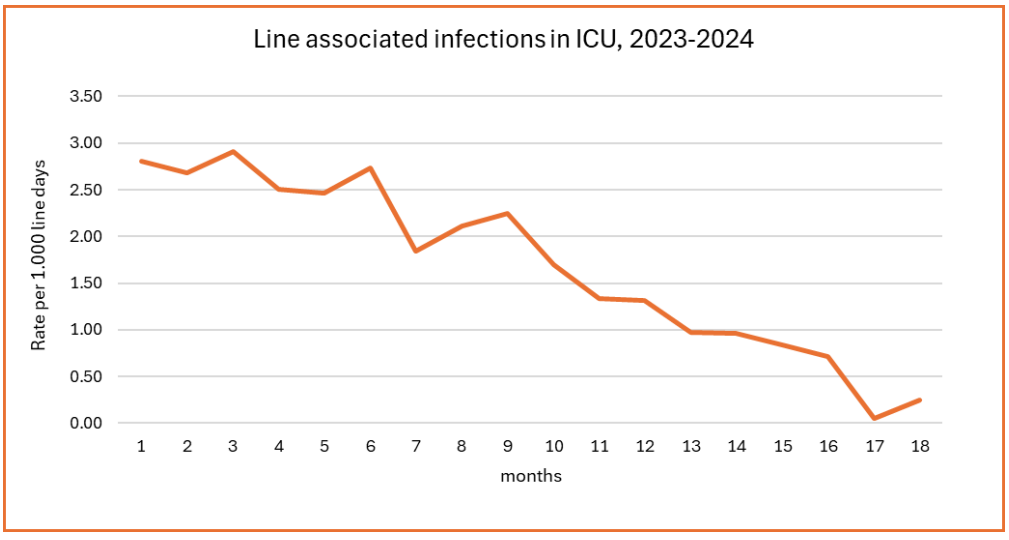
- were specific patients more at risk of line-associated infections than others? (For example, gender, age group, chronic disease, trauma or surgical patients)
- were appropriate devices always being used? (For example, did patients require antimicrobial treatment, total parenteral nutrition, continuous output monitoring?)
- was the anatomical location of the device a risk factor?
- where or when were these devices inserted? Were devices inserted under emergency conditions, where asepsis may have been compromised? Or under controlled conditions with aseptic technique?
- were devices removed as soon as they are no longer clinically indicated, as per hospital policy or when signs and symptoms of complications are evident (e.g. pain, redness, swelling, purulent discharge)?
- how were these devices managed? Did staff use aseptic technique to access lines and manage insertion sites?
- what are the hand hygiene compliance rates or other infection prevention and control practices like in the ICU?

Introduce quality improvement interventions

The ICU staff identified devices were being left in situ when there was no clinical indication that device was still required and there was poor management and accessing technique of devices. Interventions were introduced aimed at improving line insertion and management techniques.

Compare HAI over time to measure quality improvement interventions

Data collected on CLABSI rates prior to and after introducing the quality improvement interventions were compared over time to measure the impact of the intervention.



Reporting the findings

CLABSI rates were reported at the department meeting each month, and at monthly governance meetings. Results from line insertion audits were feedback to staff who inserted the line in real time.

Other resources

- Australian Guidelines for the Prevention and Control of Infection in Healthcare
- National Safety and Quality Health Service Standards
- *Staphylococcus aureus* bloodstream infection (SABSI) prevention resources
- Surveillance for *Staphylococcus aureus* bloodstream infection (SABSI)
- Surveillance of *Clostridioides difficile* infection (CDI)
- Surveillance for central line-associated bloodstream infection

References

1. Australian Commission on Safety and Quality in Health Care. Infection Prevention and control Workbook Sydney: ACSQHC; 2022.
2. Australian Commission on Safety and Quality in Health Care. Implementation Guide for the Surveillance of *Staphylococcus aureus* bloodstream infection. Sydney ACSQHC 2021.
3. Kok J, O'Sullivan MV, Gilbert GL. Feedback to clinicians on preventable factors can reduce hospital onset *Staphylococcus aureus* bacteraemia rates. J Hosp Infect. 2011 Oct;79(2):108-14.

For more information

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