Government of **Western Australia**
Department of **Health**

Healthcare Infection Surveillance of Western Australia (HISWA)

Surveillance Manual

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This publication has been produced by the
Infection Prevention, Policy and Surveillance Unit,
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Foreword

Healthcare-associated infections (HAIs) are one of the most common causes of unintended harm suffered by health consumers. These infections cause the patient unnecessary pain and suffering and utilise significant human and financial resources within healthcare systems. It is increasingly recognised that HAIs are preventable adverse events rather than an inevitable complication of medical care. Establishment of baseline HAI rates and ensuring ongoing monitoring is essential to measure the effectiveness of infection prevention strategies that are implemented to reduce the occurrence of HAIs.

Both private and public healthcare facilities (HCFs) in Western Australia (WA) voluntarily commenced contributing data to the Healthcare Infection Surveillance WA (HISWA) program in 2005. The introduction of mandatory indicators for all public HCFs and private HCFs contracted to provide care for public patients commenced in 2007. Private HCFs continue to contribute data to HISWA voluntarily. The indicators collected for HISWA are described in Table 1.

The goals of the HISWA program are to ensure:

- all WA hospitals utilise standardised definitions and methodology
- ensure the validity of data through formal and informal validation exercises
- trends are identified and clinicians engaged to review clinical care to minimise infection risks and thus reduce the incidence of HAIs activities are aligned, where possible, with Australian and international surveillance programs to allow for relevant external benchmarking
- support is provided to surveillance personnel contributing data to HISWA.

HISWA data is analysed by staff at the Infection Prevention, Policy and Surveillance Unit (IPPSU). Aggregated data and detailed hospital-specific reports are produced and distributed. All contributors are encouraged to internally review their own data to identify issues and trends in a timely manner. This surveillance manual contains the technical information to allow standardised definitions and methodology to be utilised by surveillance personnel reporting data to HISWA. If any hospital requires assistance with their surveillance program, the IPPSU team are available to provide support.

Table 1: HISWA indicators

HISWA Indicators	Data collection commenced	Frequency for reporting	Requirements for data submission	Status (mandatory status assigned)	Comments Any private HCF can voluntarily submit data to HISWA where indicator is relevant to their facility.
Surgical site infection following hip and knee arthroplasty	July 2005	Monthly	Within 30 days from the end of the reporting month. All data shall be subject to internal validation processes prior to submission.	**Mandatory (October 2007)**	SSI surveillance following hip and knee arthroplasty is subject to a 90 day surveillance period. Mandatory for all public metropolitan, regional resource centres and integrated district HCFs where arthroplasty procedures are performed.
Surgical site infection following elective or non-elective caesarean section	April 2011	Monthly		**Voluntary**	Any public or private HCF performing the procedure.
Healthcare associated bloodstream infection due to *Staphylococcus aureus* (MSSA and MRSA)	October 2007	Monthly		**Mandatory (October 2007)**	***Requirement under National Healthcare Agreements 2009** Mandatory for all public metropolitan, regional resource centres and integrated district HCFs **and** private HCFs contracted to provide care to public patients.
Central line associated bloodstream infections in adult intensive care units (ICU)	July 2005	Monthly		**Mandatory (January 2009)**	Mandatory for all public metropolitan, regional resource centres and mandatory for all public hospitals with an adult ICU.
Central line associated bloodstream infections (CLABSI) in haematology or oncology units	July 2005	Monthly		**Voluntary**	Any private or public HCF where the indicator is relevant to the provision of care
Haemodialysis access-associated bloodstream infections	July 2005	Monthly		**Mandatory (July 2009)**	Mandatory for all public metropolitan, regional and integrated district HCFs **and** private HCFs contracted to provide care to public patients for haemodialysis. It includes all licensed private satellite day dialysis facilities.
Healthcare associated infections due to methicillin-resistant *Staphylococcus aureus* (MRSA)	July 2005	Monthly		**Mandatory (October 2007)**	Mandatory for all public metropolitan, regional resource centres and integrated district HCFs **and** private HCFs contracted to provide care to public patients.

HISWA Indicators	Data collection commenced	Frequency for reporting	Requirements for data submission	Status (mandatory status assigned)	Comments Any private HCF can voluntarily submit data to HISWA where indicator is relevant to their facility.
Hospital-identified *Clostridioides difficile* infection (HI-CDI)	January 2010	Monthly	Within 30 days from the end of the reporting month. All data shall be subject to internal validation processes prior to submission.	**Mandatory* (January 2010)**	***Requirement under National Healthcare Agreements 2009** Mandatory for all public metropolitan, regional resource centres and integrated district HCFs **and** private HCFs contracted to provide care to public patients.
Sterile site vancomycin-resistant enterococci (VRE) healthcare and community associated infections	January 2012	Monthly		**Mandatory (January 2012)**	Mandatory for all WA HCFs as VRE infection or colonisation is a notifiable disease under the *Public Health Act 2016*.
Carbapenemase-producing Organisms (CPO)	January 2012	Monthly		**Mandatory (August 2023)**	Mandatory for all WA HCFs as CPO infection or colonisation is a notifiable disease under the *Public Health Act 2016*. This includes all isolates of carbapenemase producing *Enterobacterales, Acinetobacter baumanii* and *Pseudomonas aeruginosa*.
Candida auris (C. auris)	July 2019	Monthly		**Mandatory (October 2023)**	Mandatory for all WA HCFs as *C.auris* infection or colonisation is a Notifiable disease under the *Public Health Act 2016*.
Occupational exposure to blood and/or body fluids	January 2008	Monthly		**Mandatory (January 2008)**	Mandatory for all public metropolitan, regional resource centres and integrated district HCFs **and** private HCFs contracted to provide care to public patients.

Abbreviations

ACHS	Australian Council for Healthcare Standards
ANC	Absolute neutrophil count
ASA	American Society of Anaesthesiology
AVF	Arteriovenous fistula
AVG	Arteriovenous graft
BBV	Blood-borne virus
BC	Blood culture
BSI	Bloodstream infection
CA-CDAD	Community-associated *Clostridioides difficile*-associated diarrhoea
CAI	Community-associated infection
CARAlert	Critical antimicrobial resistance alert system
CC	Cuffed catheter
CDC	Centers for Disease Control and Prevention
CDI	*Clostridioides difficile* infection
CI	Centrally-inserted (central line)
CLABSI	Central line-associated bloodstream infection
CLUR	Central line utilisation ratio
CPAB	Carbapenemase-producing *Acinetobacter baumanii*
CPE	Carbapenemase-producing *Enterobacterales*
CPO	Carbapenemase-producing organisms
CPPA	Carbapenemase-producing *Pseudomonas aeruginosa*
CRE	Carbapenem-resistant *Enterobacteriaceae*
CSF	Cerebrospinal fluid
CT	Computed tomography
CVC	Central venous catheter
ECMO	Extracorporeal membrane oxygenation
EIA	Enzyme immunoassay
GES	Guiana Extended Spectrum carbapenemase
GI GVHD	Gastrointestinal graft versus host disease
HAI	Healthcare-associated infection
HA-SABSI	Healthcare-associated *Staphylococcus aureus* bloodstream infection
HBV	Hepatitis B virus
HCA	Healthcare-associated
HCF	Healthcare facility
HCW	Healthcare worker
HCV	Hepatitis C virus
HD	Haemodialysis
HD-BSI	Haemodialysis bloodstream infection

HeRO	Haemodialysis reliable outflow
HI-CDI	Hospital-identified *Clostridioides difficile* infection
HICWA	Healthcare Infection Council of Western Australia
HISWA	Healthcare Infection Surveillance of Western Australia
HITH	Hospital in the home
HIV	Human immunodeficiency virus
IABP	Intra-aortic balloon pump
ICU	Intensive care unit
IMP	Imipenemase
IPPSU	Infection Prevention, Policy and Surveillance Unit
IV	Intravenous
IVD	Intravascular device
KPC	*Klebsiella pneumoniae* carbapenemase
LUSCS	Lower uterine segment caesarean section
MBI	Mucosal barrier injury
MRI	Magnetic resonance imaging
MRO	Multi-resistant organism
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSSA	Methicillin-sensitive *Staphylococcus aureus*
NDM	New Delhi metallo-ß-lactamase
NHSN	National Healthcare Surveillance Network
NICU	Neonatal intensive care unit
NSQHS	National Safety and Quality Health Service
OE	Occupational exposure
OXA	Oxacillinase
PCR	Polymerase chain reaction
PDS	Post-discharge surveillance
PEG	Percutaneous endoscopic gastrostomy
PI	Peripherally-inserted (central line)
PICC	Peripherally-inserted central catheter
PIVC	Peripheral intravenous catheter
RCF	Residential care facility
SABSI	*Staphylococcus aureus* bloodstream infection
SEMD	Safety-engineered medical devices
SSI	Surgical site infection
TMS	Theatre management system
VRE	Vancomycin-resistant enterococci
VIM	Verona integron-encoded metallo-ß-lactamase
WA	Western Australia
WACHS	Western Australia Country Health Services
WBC	White blood cell count

Module 1

Introduction to surveillance of healthcare-associated infections

Contents

Introduction

1. Surveillance overview

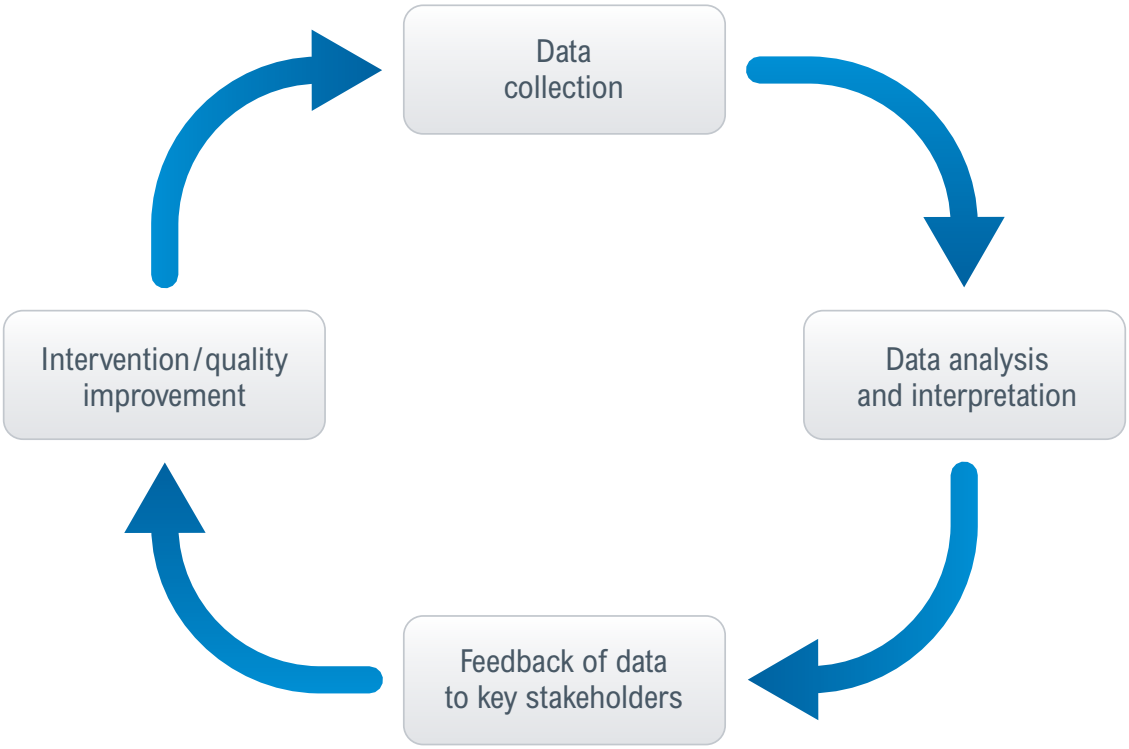
Surveillance is the systematic collection, management, analysis, interpretation and reporting of data for use in the planning, implementation and evaluation of the provision of health care.[1] The purpose of undertaking HAI surveillance is to monitor and support improvement in the quality and safety of patient care within a HCF.[1]

Data should not be collected just for the purpose of collecting data – the data need to be used to support the implementation of strategies that will reduce the risk of patients acquiring HAIs. Effective surveillance systems are the drivers for change and make it possible to evaluate the effectiveness of interventions. An effective surveillance system is one that provides timely feedback to HCF clinicians and managers to enable change to happen.[2]

Surveillance complements other prevention strategies including clinical interventions to improve the quality of care, adoption of evidence-informed practice and outbreak identification and management.

The National Safety and Quality Health Service (NSQHS) Standards requires HCFs to perform HAI surveillance in order to gather data on the incidence and prevalence of infection within their organisation.[3] A robust surveillance strategy that collects data on HAIs relevant to the size and scope of the HCF, that monitors the surveillance data to guide risk reduction strategies and reports on the surveillance data to the key stakeholders, the governing bodies and the consumers, is required in order to comply with the NSQHS Standards.[3]

Figure 1: Essential components of the surveillance cycle



2. Rationale for surveillance

Surveillance of HAIs provides objective data on which to base decisions. Surveillance data enables us to determine whether a problem exists, identifies the size of the problem, and allows observation of trends over time. A sound surveillance system should:

- determine baseline HAI rates
- detect changes in rates or distribution of HAI
- facilitate investigation of significant increases in HAI rates
- determine the effectiveness of infection prevention measures
- monitor compliance with established infection prevention practices
- evaluate interventions and change in practice
- identify areas where research would be beneficial.[1]

3. Types of HAI surveillance

As it is not practical to conduct facility-wide surveillance for all HAI events, surveillance is often targeted, with a focus on specific sites of infection, specific populations, specific organisms, or specific locations within the HCF.[1] There are two main methods of surveillance – outcome and process.[1]

3.1 Outcome surveillance

Outcome surveillance involves measuring adverse healthcare events, a proportion of which are preventable.[1] Data may be expressed as:

- **rates:** time-series of HAI counts or proportions.
- **point prevalence:** the proportion of patients with HAIs at the time of the prevalence survey.
- **incidence over time:** the number of patients who develop a new HAI.

Examples of outcome surveillance include capturing the incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia and surgical site infections (SSIs).[1]

3.2 Process surveillance

Process surveillance involves auditing actual practice against evidence-informed infection prevention strategies that are linked to improved outcomes.[1] This methodology is useful because data can be captured quickly, and can capture instances of inappropriate care that did not actually result in patient harm.[1] Improved processes should result in lower infection rates.

Examples of process surveillance include auditing compliance of antibiotic surgical prophylaxis or bundles of care for insertion of central lines and hand hygiene compliance.[1]

4. Selection of surveillance indicators

Infection prevention and control teams need to identify surveillance activities that will meet their facility's priorities and objectives. The traditional hospital-wide surveillance, where data were collected on every infection identified, has been largely replaced by targeted surveillance that focuses on specific HAIs, organisms, medical devices or high-risk populations.

Jurisdictional surveillance allows aggregation of data from many HCFs, leading to a larger dataset with increased statistical value. Statewide trends can be identified to inform priorities for statewide infection prevention policies. Indicators selected for jurisdictional HAI surveillance are generally:

- procedures that are high volume or high risk for infection and are associated with high morbidity and mortality e.g. hip and knee arthroplasty
- medical device use in high-risk groups e.g. central venous catheters used in intensive care unit (ICU) patients
- significant organisms associated with antibiotic resistance and high morbidity and mortality.

5. Surveillance methodology

The value of surveillance is enhanced by providing high quality comparative data. For participating hospitals to make a valid comparison of their infection rates, the methodology used must be similar. HISWA aims for high sensitivity and specificity of reported HAIs. Sensitivity is based on false-negative HAIs i.e. true HAIs that are not reported and specificity is based on false-positive HAIs i.e. reported infections that do not meet the HAI surveillance definitions.

Processes are required to ensure that surveillance personnel automatically receive copies of all microbiology reports, in real-time, for patients presenting to their facility, including outpatient and emergency presentations. HISWA requires surveillance personnel to implement active, prospective, patient-based surveillance.[4]

The use of the flow charts provided in each indicator chapter is recommended to assist with each case review.

5.1 Active, prospective case-finding

- Active case-finding processes are required to identify patients who develop HAIs from the time of their admission until discharge, and on readmission with infection.
- All microbiological results relevant to a surveillance indicator should be investigated and interpreted in conjunction with information from clinical sources.
- Each case-finding method has some merit and limitations, therefore, in addition to the review of all relevant laboratory reports, a combination of case-finding methods that can be applied to eligible patients should be applied that include:
  - total chart review for clinical data i.e. medical records, wound management plan, temperature chart, diagnostic and imaging reports e.g. x-ray, bone scan, ultrasound, biopsy and medication chart (antibiotics)
  - liaison with clinical staff and regular ward rounds
  - use of patient management systems for admission histories
  - formal notification from clinical staff e.g. infection notification forms
  - administration and coding reports e.g. ICD-10-AM
  - pharmacy dispensing reports
  - medical referrals e.g. for microbiologist or infectious disease physician
  - the use of infection control management software where available.[4]

5.2 Patient-based surveillance

- Patient-based surveillance requires identification of all eligible patients for inclusion in the surveillance indicator. For example, in a reporting period:
  - all patients undergoing a specific surgery must be counted for SSIs
  - all patients that have had a central line in situ in ICU must be counted for ICU CLABSI surveillance.
- Surveillance personnel are required to determine the optimal method for obtaining denominator data for each surveillance indicator at their HCF. This may include the utilisation of:
  - theatre management systems/theatre booking slips/coding reports
  - medical records systems/business administration systems
  - ward staff on wards relevant to the surveillance indicator
  - the use of infection control management software where available.

5.3 Definitions

Standardised surveillance definitions are essential for successful data collection and analysis. The definitions developed by the National Healthcare Surveillance Network (NHSN) within the Centers for Disease Control and Prevention (CDC) in the United States of America are the most comprehensive and widely used definitions for HAI surveillance.[4] Adoption of these definitions allows for benchmarking opportunities with large international datasets. Data collection for many of the HISWA indicators is based on the NHSN definitions in addition to those developed for the Australian Council for Healthcare Standards (ACHS).[2]

To improve the inter-rater reliability of HAI classification, contributors should ensure:

- surveillance personnel are trained in the use of surveillance definitions
- surveillance personnel consistently apply methodology for data collection and application of definitions
- infections are classified strictly according to the definition and only include HAI that fulfil the criteria in the definition
- liaison occurs with appropriate medical/surgical teams to assist in determining the source of the infection
- investigation of the patient's hospitalisation history to identify the attributable HCF
- any queries or ambiguities in relation to the application of the surveillance definitions are referred to the IPPSU.

6. Data validation

All HISWA contributors need to have internal validation processes in place to confirm the data they are submitting is reliable and valid. Surveillance personnel should ensure:

- prior to submission of data, that the clinical, laboratory and other diagnostic information collected meets the criteria in the definition and communication has occurred with relevant stakeholders e.g. review of all SSIs with a designated member of the surgical team
- they generate appropriate facility-specific reports to enable cross-checking of cases admitted for procedures and with infections e.g. ICD-10-AM reports
- they use HISWA hospital level raw data report i.e. data entered in the HISWA database, to cross-check with internal records prior to submission.
- they use consolidated laboratory reports and cross-check to ensure all relevant cases have been investigated.
- administrators providing bed-day data are informed of the data requirements outlined in Module 12.

- denominator data received from administrators and other external departments is cross-checked with data from previous months to identify potential outliers.

7. Data entry to HISWA

Prior to utilising the HISWA database, contributors should familiarise themselves with the HISWA information for new contributors. A username and password is assigned to each hospital to allow login to the database. Education and guidance on performing HISWA surveillance for new contributors can be arranged with members of the IPPSU team by emailing IPPSU@health.wa.gov.au

All contributors have access to the HISWA Database Manual to assist with the technical details of data entry to the HISWA database. This can be accessed from the menu page of the database following login. All contributors need to ensure they:

- enter data accurately into the HISWA database
- save each record after data entry
- use the Raw Data Report in the Reports module to check both numerator and denominator data prior to finalising data
- have entered the HAIs in the appropriate modules when they meet the definition for multiple indicators e.g. a MRSA bloodstream infection (BSI) needs to be entered in the Significant Organism module and the Specific Organism Bloodstream module
- use the Finalisation Page as a means of checking data and advising IPPSU that data submission is complete
- finalise data monthly for the previous month e.g. April data must be finalised by the last day of May.

7.1 Additional data sets

Some specific surveillance indicators have separate data collection processes to the HISWA database. This includes those multi-resistant organisms (MROs) that have been added to the list of Notifiable Infectious Diseases under the *Public Health Act 2016* in more recent years. These include:

- vancomycin-resistant enterococci (VRE)
- carbapenemase producing organisms (CPO), specifically carbapenemase-producing *Enterobacterales, Acinetobacter baumanii* and *Pseudomonas aeruginosa*
- *Candida auris (C.auris)*.

These MROs are notified to the Department of Health via PathWest Laboratory Medicine WA reporting and the IPPSU assists in the collation and reporting of these data. The IPPSU maintains data collections for these MROs but also require hospital infection prevention and control (IPC) staff to provide further information to meet enhanced surveillance requirements for these MROs.

8. Data analysis

Data analysis is an essential component of the surveillance cycle so that HAIs can be described and communicated in a meaningful way.

8.1 Calculation of rates

A rate indicates a relationship between 2 measurements with different units of measure and is used in HAI surveillance to describe HAIs in patient populations of different sizes and in different time periods.

A rate has 3 components:

- **numerator:** the number of infections
- **denominator:** the number of patients at risk
- **constant:** a multiple of 10 that results in a number greater than zero.

Mathematically, the rate is calculated as the numerator ÷ denominator x constant. Rates are generally expressed according to the denominator and the constant used e.g. per 100 surgical procedures or per 1,000 central line days.

8.2 The p-value

The p-value determines the probability that the difference between 2 rates has arisen by chance. If the probability is low (<0.05 or 5%) then the difference in rates is considered to be unlikely due to chance alone and therefore represents a significant difference.

8.3 Confidence intervals

HISWA rates are calculated with 95 per cent confidence intervals which provides an indication of the true infection rate. The confidence interval displays the lowest and highest values that the true infection rate is likely to fall between 95 per cent of the time. As a general rule, a larger sample size results in a narrower confidence interval and thus gives a better indication of the true rate.

8.4 Risk stratification

Risk stratification categorises patients at risk of infection into homogenous groups so that comparisons of infection rates can be made between groups with similar risk factors.[2]

Examples of risk stratification used by HISWA include:

- a risk index score for surgical patients based on their estimated risk of infection relative to other patients undergoing the same surgery
- categorisation of MRSA infections according to ICU and non-ICU settings
- categorisation of haemodialysis access device associated infections according to the type of access device
- categorisation of surgical procedures by elective or emergency status.

8.5 Benchmarking

Benchmarking involves comparing an infection rate with another point of reference which gives an indication of performance. Benchmarking should only be used as a guide and interpreted with caution due to potential variability in case mix, size of population and surveillance practice.

9. Interpretation of reports

Collection of valid surveillance data and calculation of infection rates may facilitate investigation of abnormally high rates and implementation of interventions. However, comparisons of infection rates must be made with care and an understanding of relevant assumptions, variations in methodology and an awareness of the inclusions and exclusions in different data sets. The following information further assists with the interpretation of specific HISWA reports produced by the IPPSU e.g. the hospital quarter report.

9.1 WA aggregate rate

This is an infection rate calculated from combined data submitted to HISWA from all contributing hospitals in WA for a specified period. It provides a useful benchmark with which individual hospitals can compare their infection rate for the same period. These are currently calculated by quarter.

9.2 Cumulative WA aggregate rate

The cumulative aggregate rate is the overall rate for WA for an indicator using previous 5 years of data. The cumulative aggregate rate is the total number of infections divided by the total relevant denominator for WA.

9.3 Cumulative hospital infections and rate

The cumulative number of infections for a hospital is the total number of infections that have been reported for an indicator for the previous 5 years of data. The cumulative hospital rate is the total number of infections divided by the total relevant denominator since reporting commenced.

9.4 Rate previous 2 quarters

This measure provides an internal benchmark to determine short term trends in the infection rate over time. It is the number of infections over the previous 2 quarters divided by the relevant denominator over the previous 2 quarters.

9.5 Trend

Trend is a term used to describe the general movement in rates over time. HISWA reports describe trends in terms of quarterly rates as either having increased, decreased, or remained stable.

9.6 Comparator rate

Where possible, a comparator rate from another Australian state or overseas country will be used for external benchmarking. Comparators are selected based on the use of the same definitions and methodology to HISWA and the sample size is sufficiently large to calculate a valid infection rate.

9.7 Infection rates from small hospitals

High infection rates and wide confidence intervals may be reported when there are small denominator numbers reported from small hospitals. This also means that a small increase in the number of infections can result in a large increase in the infection rate. Therefore rates should always be interpreted carefully and in conjunction with other information.

10. Reporting and feedback

Feedback of analysed data in a timely manner to key stakeholders is an important requirement of surveillance programs to drive change and improve outcomes and has been demonstrated to be effective in reducing infections when provided to clinicians.[2]

Appendix 1: Key actions for new HISWA contributors

1. Connect with the Infection Prevention Policy and Surveillance Unit

The IPPSU is part of the Communicable Disease Control Directorate within the Public and Aboriginal Health Division, Department of Health. Contact the IPPSU via email to arrange a suitable time for a meeting or teleconference to discuss the HISWA program and your participation. The IPPSU team is readily available to provide support to all staff responsible for surveillance as required. Please note the following:

- all queries and communication should be sent to the generic IPPSU@health.wa.gov.au email
- there are many resources to assist with your surveillance program and these can be found on the IPPSU tools and resources website
- quarterly forums are held and this is a great opportunity for you to network with IPC staff from other hospitals. Meetings are held via Microsoft Teams. You can check for all our Key Dates on the IPPSU website.
- the IPPSU reports to the Healthcare Infection Council of WA (HICWA) Executive Committee which is comprised of nursing, medical and safety and quality executive representatives from WA health services. HICWA meets quarterly to discuss HISWA reports, and issues associated with HAIs.

2. Identify the indicators for surveillance relevant to your hospital

Certain indicators are mandatory for those hospitals that are part of the WA health system. This includes all public hospitals and all private facilities contracted to provide care to public patients including Joondalup and Midland hospitals and the privately operated haemodialysis facilities. Table 1 describes the surveillance indicators covered by the HISWA Program.

3. Identify surveillance processes and your methodology to find cases

Familiarise yourself with the indicators appropriate to your facility by reading the indicator modules in this manual. This will assist you to understand the data collection requirements you need to perform in order to submit data. Your data collection needs to incorporate all the HISWA Data Fields described in each indicator Module.

Collect relevant data for potential HAIs for each indicator

a) For ICNet Users: Ensure you have set up ICNet correctly to get notified of all your alerts and tags e.g. latest alert organisms, surgeries, surgical site infection readmissions, otherwise liaise with your laboratory service and ensure you are receiving all relevant positive laboratory results from all hospital departments, including emergency and outpatient departments.

b) identify and document case-finding methods for consistency.

Investigate all potential HAIs and consistently apply the definition outlined in the HISWA Surveillance Manual to every potential HAI in order to:

- classify as HAI or community associated infection (CAI) and
- identify the attributable healthcare facility.

Contact the IPPSU to assist with classification of HAI cases if necessary.

4. Identify denominator data required and the source of the data

Liaise with your Business Intelligence Unit that provides bed-day/separation data for your hospital and ensure the data submitted to HISWA aligns with the requirements outlined in the HISWA Surveillance Manual: Module 12 Bed-day and separation data

WA Country Health Services (WACHS) bed-day and separation data will be emailed to you by the IPPSU on a monthly basis. You are responsible for entering this data.

SSI denominators: requires the total number of procedures performed for each type of surgery. This can be obtained from the Theatre Management System (TMS) or theatre admission lists/databases.

Haemodialysis: liaise with haemodialysis staff who will collect the data and send to you monthly. The patient-month data collection forms are available on the IPPSU website under Tools and Resources.

CLABSI ICU line day data: collected by either ICU or IPC staff. ICU line day data collection form is available from the IPPSU website under Tools and Resources.

Contact the IPPSU before commencing haematology or oncology unit CLABSI surveillance and to obtain the data collection tool for these units.

Ensure you receive all denominator data from external sources monthly and by the HISWA data deadlines published in HISWA Key Dates.

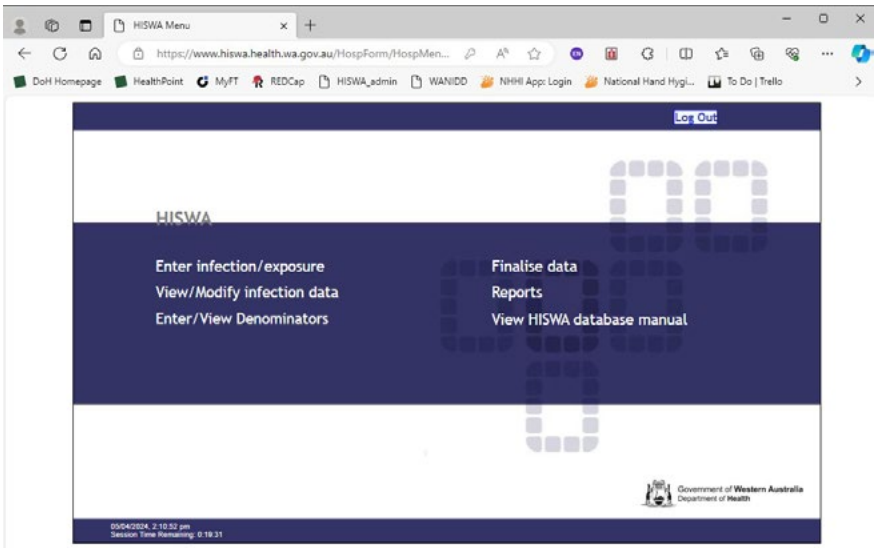
5. Submit HAIs and denominator data to the HISWA database

To enter data into HISWA you will require a username and password and the link to the Login page of the HISWA database. This is organised for you by the team at IPPSU. Once you have logged in to HISWA, go to the **Menu** page and click on the link **View HISWA Database Manual** (Figure 1). This manual contains instructions for using the database and is only available via the HISWA website due to security reasons.

Data must be submitted monthly and finalised within 30 days from the end of the reporting month. See Key dates on the IPPSU website.

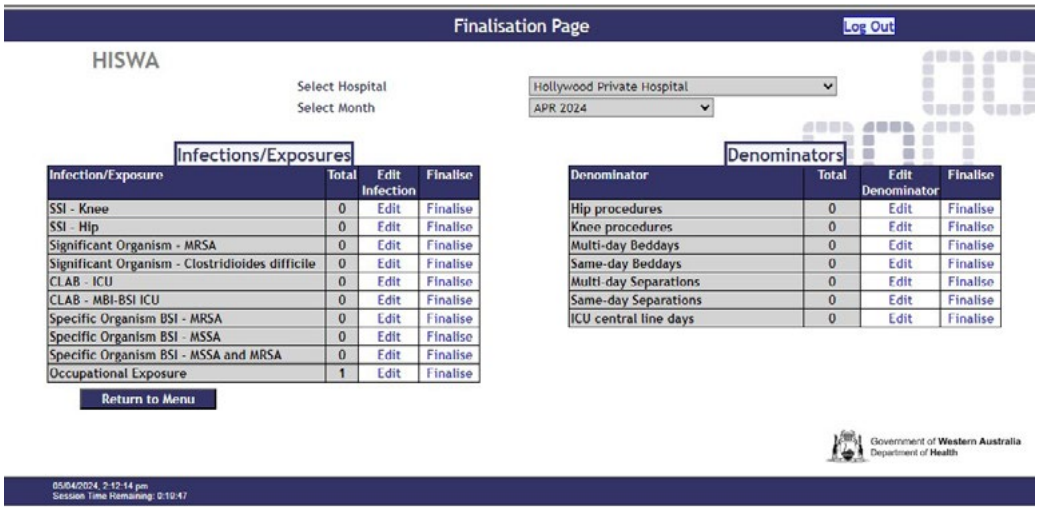
Your data needs to undergo your own internal validation before finalising your data in the HISWA database e.g. correct date of birth, unit medical record number, removal of any duplicate entries. A raw data Report for your hospital can be run from HISWA (Refer Figure 1 and the HISWA Database Manual). From the **reports** page you will be able access a **Raw Data Report** which can generate a line listing of all your infection data for the purpose of internal validation.

Figure 1 Raw data report and HISWA database manual



Finalisation of data for your hospital each month is essential because the IPPSU cannot generate any reports until all hospitals have completed this step (Refer Figure 2). Click on the **Finalise data** link on the **Main Menu** page to open the **Finalisation Page** and refer to Section 6 of the HISWA Database Manual to complete finalisation process.

Figure 2 Finalisation page



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Module 2

Surgical site infection surveillance

Contents

Introduction

A SSI is an infection that develops as a result of an operative procedure. They are associated with increased morbidity and mortality, prolonged hospital stay and increased healthcare costs.[1,2] Surveillance of SSIs, coupled with prompt feedback of data to surgeons and key stakeholders, has been shown to be an important strategy to reduce SSIs.[1,2]

The World Health Organization *Global Guidelines for the Prevention of Surgical Site Infection 2016* [3] highlights the importance of a sound SSI surveillance system and along with the CDC *Guideline for the Prevention of Surgical Site Infection 2018* [4] provide extensive evidence-informed resources for the prevention of SSIs.

The HISWA SSI surveillance module is based on the National Healthcare Safety Network (NHSN) Patient Safety Component Manual, and the CDC in the United States of America.[5]

Additional information on surgical site infection surveillance can be found in the Australian Commission on Safety and Quality in Healthcare publication. Approaches to Surgical Site Infection Surveillance 2017

1. Methodology

For participating hospitals to make a valid comparison of their SSI rates the methodology must be similar and infection definitions consistently applied. The preferred HISWA methodology is active, prospective, patient-based surveillance and this needs to be performed by trained infection prevention and control personnel. Refer to Module 1 for an introduction to surveillance of HAIs.

1.1 Denominator data

Patient-based surveillance requires identification of all eligible patients undergoing the selected operative procedure (see Table 1: Procedure inclusions and exclusions).[1] Eligible patients can be determined in liaison with operating theatre management systems/theatre bookings/theatre coding/medical record systems and notifications from theatre staff.

1.2 Numerator data

Patient-based surveillance requires monitoring of all patients undergoing a HISWA procedure for identification of an SSI within the designated surveillance period for that specific procedure i.e. either 30 or 90-day surveillance (see Table 1: Procedure inclusions and exclusions). Active, prospective case-finding is required to monitor SSIs from the time of the surgical procedure and during the post-operative stay until discharge.[2]

Processes are required to detect patients who are readmitted to a hospital for treatment of SSIs.

1.3 Classification of SSI

To improve the classification inter-rater reliability, HISWA contributors should:

- classify SSI strictly according to the definitions
- liaise with the surgical team, other contributors and the IPPSU via ippsu@health.wa.gov.au for difficult classifications.

Table 1: Procedure inclusions and exclusions

Procedure	Include	Exclude
Numerator		
Hip and knee arthroplasty	• Superficial SSI detected up to 30 days after the procedure • Deep or organ/space SSI detected within 90 days of the procedure • SSI detected following a revision for infective reasons where SSI definitions are met again i.e. new infective episode with the same or different infecting organism • Primary and non-primary closures	• Superficial SSI detected more than 30 days after procedure • Deep or organ/space SSI detected more than 90 days after the procedure
Caesarean Section	• Superficial and deep or organ/space SSI detected up to 30 days after the procedure following both elective and emergency procedures	• Superficial and deep or organ/space SSI detected more than 30 days after the procedure
Note: organ/space infections must meet the CDC/NHSN specific criteria		
Denominator		
Hip and knee arthroplasty	• All total, partial, primary and revision procedures as listed in Appendix 1: HISWA operative procedures and ICD-10-AM codes • Both elective and emergency procedures are included • Revision procedures for both mechanical and infective reasons • Bilateral hip or knee procedures performed during the same trip to the operating room and counted as two separate procedures • Primary and non-primary closures	• Procedures not listed in Appendix 1: HISWA operative procedures and ICD-10-AM codes e.g. hip-resurfacing, hemiarthroplasty of fractured neck of femur
Caesarean Section	• Classical and lower uterine segment caesarean section (LUSCS) • Both emergency and elective procedures	• Procedures not listed in Appendix 1: HISWA operative procedures and ICD-10-AM codes

2. Definitions

2.1 HISWA operative procedures

A HISWA operative procedure is a procedure that is included in Appendix 1: HISWA operative procedures and ICD-10-AM codes and takes place during an operation where at least one incision, including laparoscopic approach, is made through the skin or mucous membranes, or re-operation via an incision that was left open during a prior procedure and takes place in an operating room including a caesarean section room, interventional radiology room, and cardiac catheterisation lab.[1,5]

Both types of incisional closure methods are included in HISWA operative procedures.

Both emergency and elective operative procedures are to be included for each procedure listed.

2.2 Primary and non-primary closure

Primary closure: is the closure of the skin level during the original surgery, regardless of the presence of wires, wicks, drains, or other devices or objects extruding through the incision. This category includes surgeries where any portion of the incision is closed at skin level by any means. For procedures which have multiple incisions or laparoscopic trocar sites, the procedure is classed as primary closed if any of the incisions are primarily closed.[1]

Non-primary closure: is the closure that leaves the skin level completely open following the surgery. The deep tissue layers may be closed by some means or the deep and superficial layers may both be left completely open. Wounds with non-primary closure may be described as “packed”, covered with plastic, or have “wound vacs” or other devices.[1]

2.3 Emergency and elective procedures

Elective: a planned procedure at a time to suit the patient and surgical team.

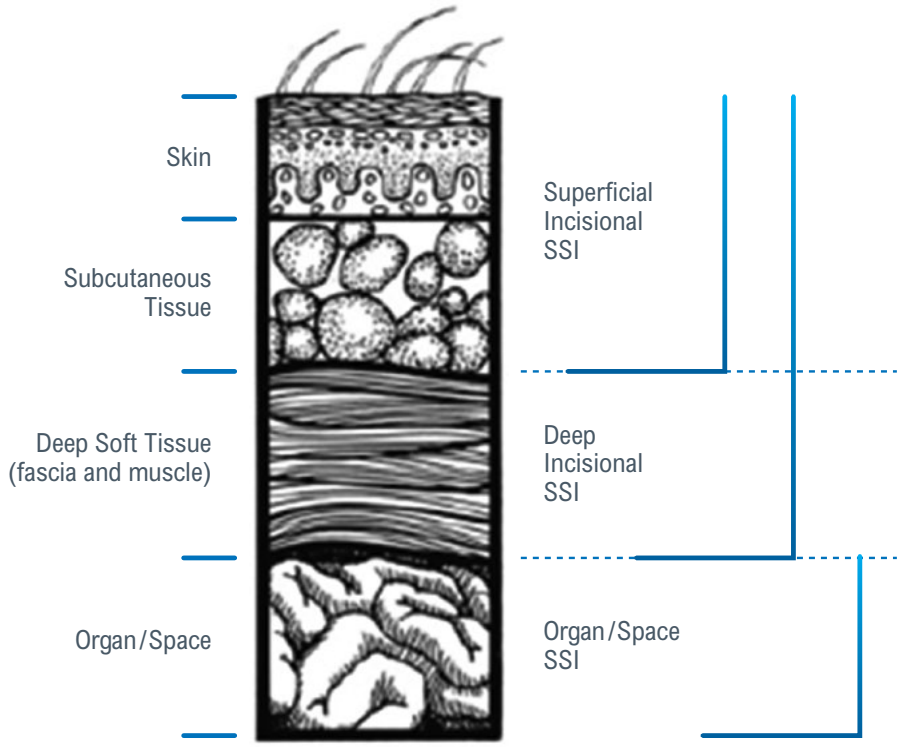
Emergency: a non-elective, unscheduled operative procedure that does not allow for the standard preoperative preparation normally done for a scheduled operation e.g. stabilisation of vital signs, pre-operative showering, adequate antiseptic skin preparation.

Emergency caesarean section: an unplanned procedure for reasons determined as compromising the mother or foetus requiring earlier than planned delivery.[6]

2.4 Types of SSI

An SSI can be classified as a superficial incisional, deep incisional or an organ/space infection, see Figure 1.[1] HISWA data combines deep incisional and organ/space infections to allow for more meaningful statistical analysis and align with published reports from other jurisdictions.

Figure 1: Schematic of SSI anatomy and classification[1]



2.4.1 Superficial SSI

A superficial incisional SSI involves only the skin and subcutaneous tissue of the incision and the date the SSI is identified occurs within 30 days of the operative procedure.[1]

2.4.2 Deep SSI

A deep incisional SSI involves deep soft tissues e.g. fascia and muscle layers and the date the SSI is identified occurs within 30 or 90 days of the operative procedure depending on operation type.[1]

2.4.3 Organ/space SSI

An organ/space SSI involves any part of the body deeper than the fascia or muscle layers that are opened or manipulated during the operative procedure and the date the SSI is identified occurs within 30 or 90 days of the operative procedure depending on operation type.[1]

Specific criteria must be met to be classified as an organ/space SSI event. The full listing of site-specific organ/space SSI and criteria are outlined in the CDC/NHSN Patient Safety Component Manual.[1]

The CDC updates this document on an annual basis, therefore the reproduction of the contained text is not advised and HISWA contributors should source this document when required to apply the organ/site specific criteria.

2.5 Criteria for SSI

The criteria for each type of SSI is defined in Table 2: Criteria for superficial, deep and organ/space SSI.

Note: In Table 1 the term surgeon or attending physician includes surgeon(s), infectious diseases or emergency physician, another physician involved in the case or physician's designee e.g. nurse practitioner or physician's assistant. The prescription of antimicrobials alone is not sufficient evidence of a diagnosis of SSI. These cases need to be carefully evaluated by the surveillance personnel to ensure the definition of an SSI has been met. If the reason for treatment has not been documented the case requires discussion with the surgeon or attending physician.

Table 2: Criteria for superficial, deep and organ/space SSI

To classify as a superficial incisional SSI the following criteria must be met:
Infection occurs within 30 days of the operative procedure (day one = day of procedure) **and** involves only skin or subcutaneous tissue of the incision **and** the patient has at least **one** of the following: a. Purulent discharge from the superficial incision. b. Organisms isolated from an aseptically obtained specimen from the superficial incision or subcutaneous tissue by culture or non-culture based microbiological testing method which is performed for purposes of clinical diagnosis or treatment. **Note:** a negative culture result from a specimen does not meet this criterion c. A superficial incision that is deliberately opened by a surgeon or attending physician and culture or non-culture based testing of the superficial incision or subcutaneous tissue is not performed **and** the patient has at least **one** of the following signs or symptoms: **pain or tenderness; localised swelling; erythema or heat**. d. Diagnosis of superficial incisional SSI by the surgeon or attending physician.
Comments
Do not report the following as an SSI: • a stitch abscess alone (minimal inflammation and discharge confined to the points of suture penetration) • a localised stab wound e.g. drain incision site or pin site infection. • diagnosis or treatment of cellulitis (redness, warmth, swelling) by itself, does not meet criterion d) for a superficial SSI. Conversely, an incision that is draining or that has organisms identified by culture or non-culture based testing is not considered a cellulitis. • superficial incisions that are shown to be colonised with microorganisms by the collection of a wound swab and that are without clinical signs of infection. • **Note:** a laparoscopic trocar site is considered a surgical site incision Classify SSIs that involve **both superficial and deep incisional** sites as deep incisional.

To classify as deep incisional SSI the following criteria must be met:

Infection occurs within 30 or 90 days (depending on procedure type) of the operative procedure (day one = day of procedure) **and** involves deep soft tissues (fascial and muscle layers) **and** the patient has at least **one** of the following:

a. Purulent drainage from the deep incision.

b. A deep incision that spontaneously dehisces or is deliberately opened by a surgeon or attending physician **and** an organism(s) is identified from the deep soft tissues by culture or non-culture based microbiological testing method or a specimen is not obtained and the patient has at least **one** of the following signs or symptoms: **fever (>38°C), localised pain or tenderness**.

   Note: A negative culture result from a specimen does not meet this criterion.

c. An abscess or other evidence of infection involving the deep incision that is detected on direct examination or histopathologic examination or imaging test.

Comments

Classify SSIs that involve **both deep incisional and organ/space** as organ/space SSIs

To classify as organ/space SSI the following criteria must be met:

Infection occurs within 30 or 90 days (depending on procedure type) of the operative procedure (day one = day of procedure) **and** involves any part of the body, deeper than the fascial/muscle layers that are opened or manipulated during the operative procedure **and** the patient has at least **one** of the following:

a. Purulent drainage from a drain that is placed into the organ/space e.g. closed suction.

b. Organisms identified from fluid or tissue in the organ/space by culture or non-culture microbiological testing method, performed for the purpose of clinical diagnosis or treatment.

c. An abscess or other evidence of infection involving the organ/space that is detected on direct or histopathologic examination or imaging test **and** meets at least one criterion for a specific organ/space infection site.

Comments

As an organ/space SSI involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the procedure, the criterion for infection at these body sites must be met in addition to the organ/space SSI criteria. Examples of specific organ/space infection sites are endometritis following a caesarean section or osteomyelitis following an arthroplasty procedure. Refer to CDC/NHSN Specific Classification of an Organ/Space SSI for infection criterion for body sites relevant to HISWA operative procedures.

2.6 Specimen classification

Classification of a specimen as either sterile or non-sterile assists in interpreting the clinical significance and determining if the criteria for classification as an SSI are met.

2.6.1 Sterile specimen

Sterile specimens are wound aspirates and tissue biopsies that are aseptically obtained i.e. obtained in a manner to prevent the introduction of organisms from surrounding tissues into the specimen being collected e.g. specimens collected intra-operatively. Sterile specimens are unlikely to be contaminated with skin micro organisms and therefore positive results are significant evidence of infection.

2.6.2 Non-sterile specimen

Non-sterile specimens can be potentially contaminated and therefore positive results require a clinical assessment to determine if an infection is actually present and the organisms isolated are not representing skin flora or contamination during collection e.g. swabs of the incision, dehisced and debrided tissue.

2.7 Point of detection of SSI

Infections may be detected at three possible points and are reported accordingly.

2.7.1 Detected during initial admission

The SSI is detected during the initial hospitalisation following the procedure and prior to discharge of the patient from the hospital or Hospital in the home (HITH).

2.7.2 Detected on readmission

The SSI is detected on readmission to a hospital or to a HITH service for treatment of the SSI e.g. intravenous antimicrobial therapy, surgical washout, removal of a prosthesis and includes readmission to another hospital.

2.7.3 Detected on representation

The SSI is detected on representation to a hospital including emergency departments and outpatient clinics (including HITH) and treatment (antibiotics and/or wound care) is initiated for the management of the SSI.
Note: If the SSI is detected by other post discharge surveillance (PDS) and the patient is admitted to a HITH service then this shall be included as detected on readmission.

2.7.4 Detected by other post-discharge surveillance

The SSI is identified by other post discharge surveillance e.g. general practitioners reporting and the patient does not present or readmitted to a hospital or a HITH service for treatment of the SSI. This information may be identified by active post-discharge surveillance (PDS). Due to the lack of uniformity for formal PDS between healthcare facilities (HCFs), this data should be recorded by the facility and reported to HISWA but is not included in calculation of HISWA SSI rates used for benchmarking purposes.

2.8 Surveillance period

All eligible patients under surveillance for SSI must be followed up during the initial admission period until discharge and monitored for readmission. To detect an SSI, HISWA procedures are to be monitored for the following periods:

- **caesarean section:** follow-up period post-procedure is 30 days
- **hip and knee arthroplasty:** follow-up period post-procedure is 90 days.

2.9 SSI risk index score

The risk index score is a method of stratification of risk for infection associated with surgery. The higher the patient's risk index score, the higher the risk the patient has of developing an SSI. Risk-adjusted rates allow statistical adjustment for differences across participating hospitals.

Risk index factors and scores are described in detail in Appendix 2: Risk index score calculation for SSI.

2.9.1 Calculation of risk index score

The risk index score consists of three risk factors that are host and procedure-related. These are the American Society of Anaesthesiology (ASA) classification, the duration of surgery and the surgical wound classification.

A score is assigned for each risk factor and the total score is calculated by adding the three scores together i.e. ASA + duration of surgery + surgical wound classification.

If an operative procedure is performed through the same incision within 24 hours e.g. for complications, the procedure duration times are combined and the higher surgical wound class and ASA score is reported, if they have changed.

2.9.2 Reporting of risk index

Hospitals performing more than 100 of each procedure type per year **are required** to calculate the risk index score for all eligible patients.

Hospitals performing less than 100 of each procedure type per year are not required to calculate the risk index score, however, risk index classification is encouraged to allow for more meaningful data analysis. Under the risk index exemption, eligible patients are classified as 'All'. Do not submit a mixture of risk index and 'All' data.

3. HISWA dataset

3.1 Numerator data fields

Data described in Table 3 is required to be entered in the HISWA database.

Table 3: SSI numerator data fields and descriptors for HISWA database

Data field	Descriptor
Patient ID	Unique patient identifier • **public hospital:** medical record number • **private hospital:** patient initials or medical record number
Date of birth	Patient date of birth
Procedure	Select correct operative procedure from drop down list e.g. primary hip arthroplasty, revision knee arthroplasty, emergency caesarean section
Date of procedure	Date the operative procedure was performed
Date infection identified	Date the SSI infection criterion were met
Risk index score	Patient risk index classified as 0, 1, 2, 3, N/A (not available) For hospitals not assigning a risk index score use 'All'
Point of detection	Detected during initial admission Detected on readmission Detected on representation Detected by other PDS
Infection classification	Superficial SSI Deep SSI or organ/space infection 2.4.1 Superficial SSI
Specimen	Sterile specimen Non-sterile specimen Not obtained
Organism 1	The 1st pathogenic organism isolated from a specimen
Organism 2	The 2nd pathogenic organism isolated from a specimen
Organism 3	The 3rd pathogenic organism isolated from a specimen

3.2 Numerator reporting instructions

If a patient has several procedures performed on different dates e.g. primary followed by revision, attribute the SSI to the procedure performed closest to the date of infection onset, unless there is evidence that the infection was associated with a different operation.

If during the post-operative period the surgical site has an invasive manipulation for diagnostic or therapeutic purposes e.g. needle aspiration and following this manipulation an SSI develops, this infection is not attributed to the operation. This does not apply to closed manipulation e.g. closed reduction of a dislocated hip or wound packing.

If the SSI is detected at a HCF that did not perform the initial procedure, contributors must inform the IPPSU by emailing ippsu@health.wa.gov.au The SSI will be assigned to the HCF where the initial procedure was performed.

- SSI detected at another HCF following transfer during the primary hospitalisation period are to be reported as detected on 'initial admission' for the HCF that performed the procedure
- SSI detected on readmission to another HCF are to be reported as detected on 'readmission' for the HCF that performed the procedure.

3.3 Numerator reporting instructions for specific post-operative infection scenarios

A SSI that meets the definitions should be reported without regard to post-operative accidents, falls inappropriate showering or bathing practices, or other occurrences that may or may not be attributable to patients' intentional or unintentional postoperative actions.

A SSI should be reported regardless of the presence of certain skin infections e.g. dermatitis, blister, impetigo that occur near an incision.

A SSI should be reported regardless of the possible occurrence of a 'seeding' event from an unrelated procedure e.g. dental work.

3.4 Denominator data fields

Data described in Table 4 is required to be entered in the HISWA database. The total number of eligible patients meeting each risk index score for each type of procedure is required.

Table 4: SSI denominator data fields for HISWA database

Procedure names are listed	Risk 0	Risk 1	Risk 2	Risk 3	N/A	All
Revision hip arthroplasty						
Elective caesarean section						

The risk index descriptors and method to calculate a risk index score are described in Appendix 2: Risk index score calculation for SSI and the risk index score reporting requirements are outlined in 2.9.2 Reporting of risk index.

3.5 Denominator reporting instructions

If a patient returns to the operating room within 24 hours of the original procedure for another procedure through the same incision or into the same surgical space, only one procedure is counted in the denominator. Combine the duration cut point for both procedures and use the wound classification that reflects the highest degree of contamination.

Bilateral procedures performed during the same episode of care in the operating room, are counted as two separate procedures.

If a patient dies in the operating room, do not count in the denominator.

4. Specific information for HISWA operative procedures

4.1 Procedure inclusions and exclusions

Refer to Table 4 for the numerator and denominator inclusions and exclusions for hip and knee arthroplasty and caesarean section procedures. Refer to Appendix 1: HISWA operative procedures and ICD-10-AM codes for specific procedure codes.

An infection associated with a procedure that is not included in the operative procedures and ICD-10-AM codes is not considered a HISWA reportable SSI. However, the infection may be investigated and reported locally as a HAI.

5. Calculation of SSI rate

The SSI rate for each procedure is expressed per 100 procedures and is stratified according to the risk index score.

HISWA rates do not include SSI detected as an outpatient or by other post-discharge surveillance methods.

The SSI is included in the numerator of a rate, based on the date the operative procedure was performed, not the date the SSI was identified.

Rate calculation: $\frac{\text{number of SSI}}{\text{number of procedures}} \times 100$

Appendix 1: HISWA operative procedures and ICD-10-AM codes

Specialty	ICD-10-AM Code	Description
Orthopaedic		**Hip Arthroplasty**
	4931800	Total arthroplasty of hip, unilateral
	4931900	Total arthroplasty of hip, bilateral
	4932400	Revision of total arthroplasty of hip
	4932700	Revision of total arthroplasty of hip with bone graft to acetabulum
	4933000	Revision of total arthroplasty of hip with bone graft to femur
	4933300	Revision of total arthroplasty of hip with anatomic specific allograft to femur
	4933900	Revision of total arthroplasty of hip with anatomic specific allograft to acetabulum
	4934200	Revision of total arthroplasty of hip with anatomic specific allograft to femur
	4934500	Revision of total arthroplasty of hip with anatomic specific allograft to acetabulum and femur
	4931500	Partial arthroplasty of hip
	4934600	Revision of partial arthroplasty of hip; liner/ spacer exchange
		Knee Arthroplasty
	4951700	Hemiarthroplasty of knee
	4951800	Total arthroplasty of knee, unilateral
	4951900	Total arthroplasty of knee, bilateral
	4952100	Total arthroplasty of knee with bone graft to femur, unilateral
	4952101	Total arthroplasty of knee with bone graft to femur, bilateral
	4952102	Total arthroplasty of knee with bone graft to tibia, unilateral
	4952103	Total arthroplasty of knee with bone graft to tibia, bilateral
	4952400	Total arthroplasty of knee with bone graft to femur and tibia, unilateral
	4952401	Total arthroplasty of knee with bone graft to femur and tibia, bilateral
	4952700	Revision of total arthroplasty of knee
	4953000	Revision of total arthroplasty of knee with bone graft to femur
	4953001	Revision of total arthroplasty of knee with bone graft to tibia
	4953300	Revision of total arthroplasty of knee with bone graft to femur and tibia
	4953400	Total replacement arthroplasty of patello-femoral joint of knee
	4955400	Revision of total arthroplasty of knee with anatomic specific allograft
Obstetrics		**Elective Caesarean Section**
	1652002	Elective lower segment caesarean section
	1652000	Elective classical caesarean section
		Emergency Caesarean Section
	1652001	Emergency classical caesarean section
	1652003	Emergency lower segment caesarean section

Exclusions:

4752200	Hemiarthroplasty of femur- Austin Moore arthroplasty
9060700	Resurfacing of hip, unilateral,
9060701	Resurfacing of hip, bilateral
5021503	En bloc resection of lesion of soft tissue affecting the long bones of lower limb, with intercalary reconstruction using prosthesis
5021803	En bloc resection of lesion of long bone of lower limb with replacement of adjacent joint

Appendix 2: Risk index score calculation for SSI

1. ASA classification

The ASA classification system is a numerical quantification of disease severity in patients undergoing general anaesthesia. Studies have demonstrated that ASA class is a useful indicator of host susceptibility to infection for epidemiological purposes. A score of 0 can be entered when the ASA score cannot be established. Patients with an ASA score of 6 (organ retrieval in brain dead patients) are excluded.

ASA Class	Description	Risk index score
1	A normal healthy patient	0
2	A patient with mild systemic disease	0
3	A patient with severe systemic disease	1
4	A patient with incapacitating systemic disease that is a constant threat to life	1
5	A moribund patient who is not expected to survive for 24 hours with or without the operation	1

2. Duration of the operative procedure

The interval in hours and minutes between the time of skin incision and surgery finish time i.e. the time when all instrument and sponge counts are completed and verified as correct, all postoperative radiological studies in the operating room are completed, all dressings and drains are secured, and the surgeons have completed all procedure-related activities on the patient. Duration cut points approximate the 75 percentile of the duration of surgery. Australian data (VICNISS)[7] is used to determine the cut points. If a procedure is longer than the reported duration cut point then 1 risk point is scored.

Surgery duration cut point

Procedure	Duration cut point
Hip arthroplasty	120 minutes
Knee arthroplasty	103 minutes
Caesarean section	48 minutes

3. Wound classification

This is an assessment of the degree of contamination of a surgical wound at the time of the operation. The wound classification should be assigned by a person involved in the surgical procedure e.g. surgeon, circulating nurse.

Classification	Description	Risk index score
Clean	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed (closure of all tissue levels) and, if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating (blunt) trauma (injury) should be included in this category if they meet the criteria.	0
Clean-contaminated	An operative wound in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.	0
Contaminated	Open, fresh, accidental wounds. In addition, operation with major breaks in sterile technique e.g. open cardiac massage or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.	1
Dirty/infected	Old traumatic wounds with retained devitalised tissue and those that involve existing clinical infection or perforated viscera suggest that the organisms causing postoperative infection were present in the operative field before the operation.	1

Examples for wound classification scoring

Primary arthroplasty procedures will have a wound classification of “clean” and the wound classification score will be 0. If there is a major breach in sterile technique during the surgery the wound classification is contaminated, and the wound classification score will be 1.

Revision arthroplasty procedures for non-infective reasons will have a wound classification of clean and the wound class score will be 0. If there is a major breach in sterile technique during the surgery the wound classification is contaminated, and the wound class score will be 1.

Revision arthroplasty procedures for infective reasons will have a wound classification of ‘dirty/infected’ and the wound score will be 1.

Caesarean section procedures will have a wound classification of “clean-contaminated”, with a wound class score of 0. If the membranes have ruptured >6 hours, then classify as contaminated with a wound class score of 1, unless other factors are present as per the wound class classification.

Appendix 3 Specific classification of an organ/space SSI

Specific criteria must be met to be classified as an organ/space SSI event. The full listing of site specific organ/space SSI and criteria are outlined in the *CDC/NHSN Surveillance Definitions for Specific Types of Infections* [3] available at CDC Surveillance.pdf. This document does undergo an annual review and HISWA contributors need to stay informed of any surveillance definition changes. The criteria for specific organ/space SSI sites relevant to HISWA operative procedures are described below.

Bone and joint infection

Osteomyelitis must meet at least one of the following criteria:

Criterion 1: Patient has organism(s) identified from bone by culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis and treatment

Criterion 2: Patient has evidence of osteomyelitis on direct examination of the bone identified during an invasive procedure or histopathologic exam.

Criterion 3: Patient has at least 2 of the following localized signs or symptoms:

- fever (>38.0°C), swelling*, pain or tenderness*, heat*, or drainage* at suspected site of infection (*with no other recognised cause)

AND at least one of the following:

- a) organism(s) identified from blood by culture or non-culture based microbiologic testing e.g. antigen testing, which is performed for purposes of clinical diagnosis and imaging test evidence definitive for infection e.g. x-ray, CT scan, MRI, which if equivocal is supported by clinical correlation, specifically, physician documentation of antimicrobial treatment for osteomyelitis.
- b) imaging test evidence definitive for infection e.g. x-ray, computed tomography (CT) scan, magnetic resonance imaging (MRI), which if equivocal is supported by clinical correlation, specifically, physician documentation of antimicrobial treatment for osteomyelitis.

Reproductive tract infection

Endometritis must meet at least one of the following:

Criterion 1: Patient has organism(s) identified from endometrial fluid or tissue by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment.

OR

Criterion 2: Patient has suspected endometritis with at least 2 of the following signs or symptoms:

- fever (>38.0°C), pain or tenderness (uterine or abdominal)* OR purulent drainage from the uterus (*with no other recognised cause).

Report as an organ space SSI if a C-section was performed on a patient with chorioamnionitis, and the patient later develops endometritis.

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Module 3

Methicillin-resistant *Staphylococcus aureus* (MRSA) healthcare-associated infection

Contents

Introduction

Infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA) can cause significant morbidity and mortality, prolong hospital stay and contribute to increased healthcare costs[1,2]. MRSA HAIs are an indicator of compliance, by healthcare workers (HCWs) with appropriate hand hygiene, skin antisepsis and aseptic techniques for invasive procedures. The risk of developing an MRSA HAI may be reduced if patients known to be colonised with MRSA receive decolonisation treatment prior to any invasive procedure[3].

1. Methodology

For participating HCF to make a valid comparison of their MRSA HAI rates the methodology must be similar and definitions consistently applied. The preferred HISWA methodology is active, prospective, patient-based surveillance and this needs to be performed by trained surveillance personnel. Refer to Module 1 for an introduction to surveillance of HAIs.

Surveillance personnel are required to:

- implement processes to ensure that all MRSA positive laboratory reports of specimens obtained at their HCF are received from the laboratory
- review and investigate all MRSA positive laboratory reports, including those from emergency and outpatient departments, to determine if the infection is healthcare-associated and identify the attributable HCF
- liaise with the clinicians, other contributors and the IPPSU by emailing ippsu@health.wa.gov.au for difficult classifications.

The methodology to assist with the classification of MRSA isolates is described in Appendix 1: Methodology to identify MRSA HAI.

2. Definitions

2.1 Methicillin-resistant *Staphylococcus aureus* (MRSA)

Staphylococcus aureus that tests resistant to oxacillin, cefoxitin, methicillin or flucloxacillin by standard susceptibility testing methods.

2.2 MRSA Colonisation

Colonisation refers to MRSA isolated from a non-sterile site without any signs of clinical infection and the person is not treated with MRSA-specific antibiotic therapy.

2.3 MRSA infection:

Is the presence of clinical signs of illness or inflammation e.g. fever, pus, localised pain, tenderness, redness, warmth, swelling and the patient has one of the following:

- a positive culture for MRSA from any sterile body site e.g. blood, cerebrospinal fluid (CSF), joint fluid

  OR
- a positive culture for MRSA from a non-sterile site and antimicrobial therapy is prescribed to treat the MRSA infection by a clinician, i.e. there is intent to treat.

MRSA isolated from blood, CSF and joint specimens are always considered significant and thus are reported as infections regardless of whether an antibiotic was commenced. Isolates from other sites cannot always be attributed to infection and require clinical assessment to determine if an infection is present.

> **Note:** Patients, who are given empirical treatment for a suspected MRSA infection, even if they are a known MRSA carrier, and no MRSA infection is proven, should not be reported in surveillance data.

2.4 Criteria for MRSA healthcare-associated infection

An MRSA infection is considered to be an HAI if either criterion A or B is met:

- **Criterion A:** an infection acquired more than 48 hours after hospital admission or less than 48 hours after discharge and the infection was not present or incubating on admission i.e. no signs or symptoms of the MRSA infection were evident.
- **Criterion B:** an infection acquired 48 hours or less after admission and at least one of the following criteria is met:
  1. Is a complication of the presence of an indwelling medical device e.g. intravascular line, cerebrospinal fluid shunt, urinary catheter, external fixators and no other focus of infection is identified.
  2. The infection is related to the surgical site and occurs within 30 or 90 days of a surgical procedure depending on the procedure type (refer to Appendix 2: MRSA SSI).
  3. An invasive instrumentation or incision related to the infection was performed within 48 hours. If longer than 48 hours, there must be compelling evidence that the MRSA infection was related to the procedure.
  4. Is associated with neutropenia contributed to by cytotoxic therapy.

2.5 Neutropenia

Neutropenia is defined as at least 2 separate calendar days with values of absolute neutrophil count (ANC) <500cells/mm^3 (<0.5 x 10^9/L) on or within a 7-day time period which includes the date the positive blood specimen was collected (day one), the 3 calendar days before and the 3 calendar days after.

2.6 New MRSA HAI

Only the first new MRSA HAI event for a single admission period is reported. The intention of this definition is to exclude ongoing episodes of infection that have been previously reported. However, if the admission period is prolonged e.g. greater than one month, count additional MRSA HAIs if a new infective event occurs and it is unrelated to a previously reported MRSA HAI event.

If a patient develops a non-sterile site infection and a sterile site infection during the same admission, then the sterile site HAI takes precedence and the non-sterile site HAI is not reported. If the non-sterile infection occurred in a previous admission, then it remains reported for that period. If a BSI and another sterile site HAI occur, report the BSI only.

> **Note:** the exception for repeat reporting is that the definition of a BSI requires that an additional MRSA BSI is reported if it has been more than 14 days since a previous positive MRSA BSI.

2.7 Community-associated MRSA infection

These events are when the infection manifests within 48 hours of admission and do not meet criterion A or B for classification as an HAI.

2.8 Maternally-acquired MRSA infection

Infections that arise in neonates less than 48 hours after delivery are not considered HAI unless there is compelling evidence that the infection was related to an intervention during passage through the birth canal e.g. wound secondary to vacuum extraction.

2.9 Specimen types

2.9.1 Sterile specimens

Sterile specimens: are those that are collected in a manner that prevents the introduction of microorganisms from surrounding tissues into the specimen being collected and therefore if organisms are isolated the site is considered infected e.g. intra-operative aspirates and biopsies, blood cultures.

2.9.2 Non-sterile specimens

Non-sterile specimens: are those obtained from superficial wounds/skin swabs, drain fluid, sputum and urine. The microorganisms present can represent colonisation or potentially be contaminated with skin organisms from surrounding tissue and therefore require investigation and clinical judgement to determine if an infection is present.

2.10 Specimen site of infection

MRSA HAIs are stratified by HISWA as sterile or non-sterile sites depending on which body site the specimen was obtained from and how it was collected.

2.10.1 Sterile site

Sterile sites are body sites that do not normally contain microorganisms. The HISWA categories for sterile sites are:

- aseptic tissue e.g. bone, muscle, fascia, joint fluid (synovial) or other tissue from internal body sites where the specimen is aseptically-obtained
- bloodstream
- cerebrospinal fluid
- peritoneum, pleural, pericardial (includes fluid from these sites)
- surgical wound when the tissue specimen is aseptically obtained.

2.10.2 Non-sterile site

Non-sterile sites are body sites that are exposed to microorganisms in the external environment and may contain normal flora. The HISWA categories for non-sterile sites are:

- sputum, including bronchial washings and endotracheal tube specimens
- wound swabs, drain fluid (Refer to 2.8.2)
- urine.

> **Note:** MRSA in urine is rarely a cause of primary urinary tract infection. If MRSA is isolated from urine it may reflect translocation of organisms from the bloodstream, contamination from perineal flora or colonisation of a catheter. Discussion with a clinician should occur to ascertain if the isolate represents an actual MRSA infection.

2.10.3 Wound specimens – non-sterile

Wound-surgical: MRSA HAIs related to surgery or invasive instrumentation and meets Criterion A or B (Refer to 2.4) and the specimen is obtained from a wound swab, drain site or another external surgical device e.g. external fixator, surgical wire. These should be entered as Specimen site: wound-surgical, Specimen: non-sterile.

> **Note:** this includes infections related to surgery that don't meet the criteria for an SSI but are HAIs e.g. an inpatient develops superficial MRSA infection of surgical incision >30 days post-procedure i.e. not an SSI by definition, but it is an HAI.

Wound-all other: MRSA HAIs in all other wound types including:

- all non-surgical wounds or skin and soft tissue infections e.g. decubitus ulcers
- device exit site infections e.g. intravenous cannulae, peritoneal dialysis catheter, suprapubic catheter
- infected burns and includes infections post-surgical debridement
- infections of the mucous membranes e.g. conjunctivitis, high vaginal swab
- infections of breast tissue due to mastitis i.e. MRSA isolated in breast milk.

2.11 Place of acquisition

MRSA HAIs are categorised according to where the infection was likely acquired i.e. inpatient or non-inpatient healthcare setting. It does not relate to where the patient was physically located when the infection was identified e.g. outpatient department. For non-inpatient settings, the MRSA HAIs are associated with healthcare received as an outpatient, and meet Criterion B.

2.11.1 ICU or non-ICU (inpatient)

- MRSA HAI acquired as inpatients are stratified as ICU or non-ICU (all other wards/units outside of the ICU)
- ICU MRSA HAIs are those detected more than 48 hours after ICU admission or within 48 hours of discharge from ICU
- non-ICU MRSA HAI are associated with healthcare during a multi-day admission to non-ICU wards or HITH or within 48 hours of discharge
- inpatient MRSA HAI also includes infections that meet Criterion B and are associated with a multi-day admission but are detected post-discharge e.g. a surgical patient develops an SSI caused by MRSA detected on readmission.

2.11.2 Non-inpatient higher-risk units – renal, haematology, oncology

- MRSA HAIs, in patients receiving care under these speciality units and who are not under the care of HITH, are acquired at home or following admission for day care at hospital outpatient settings or attendance at outpatient clinics e.g. haemodialysis, chemotherapy day-wards, day surgery.

2.11.3 Non-inpatient – other units

- MRSA HAIs acquired following admissions for day care in hospital outpatient settings or attendance at outpatient clinics who are not under the care of HITH or the higher-risk units e.g. an MRSA SSI in a general surgery patient following day surgery or an MRSA HAI following a facet joint injection at an outpatient clinic.

2.11.4 MRSA infections identified following care at another healthcare facility

- If an MRSA HAI is identified and is a result of care at another HCF or develops within 48 hours of a transfer, contact the IPPSU so that the infection can be attributed to the correct HCF.

2.12 Previous colonisation status

- Patients colonised with MRSA are at an increased risk of developing an MRSA HAI. The risk may be reduced if these patients receive decolonisation or suppression treatment.
- Report ‘Yes’ to previously colonised: if the patient has been previously identified to have colonisation or infection with any strain of MRSA prior to the HAI occurring.
- Report ‘No’ or ‘Unknown’ if it is the first time the patient has been identified with MRSA or their previous MRSA status is unknown.

3. HISWA dataset

3.1 Numerator data fields

Data described in Table 1 are required to be entered in the HISWA database.

3.1.1 Inclusions

- all strains of MRSA causing HAIs
- patients previously colonised with MRSA who develop a new MRSA HAI.

3.1.2 Exclusions

- community-associated MRSA infections
- maternally-acquired MRSA infections
- patients who are colonised only.

3.2 Denominator data fields

The denominator that is utilised is bed-days. Both multi-day and same-day bed-days are collected to allow for different rate calculations.

3.2.1 Inclusions

HISWA bed-day data for MRSA HAI includes:

- inpatient admissions to rehabilitation and aged care areas in an acute HCF
- HITH bed-days
- same-day admissions e.g. haemodialysis units, day-surgery, procedure units.

3.2.2 Exclusions

HISWA bed-day data for MRSA HAI excludes:

- psychiatric wards/units
- unqualified newborns i.e. newborn who is nine days of age or less and does not require admission to a neonatal ICU and whose mother is the admitted patient
- boarders i.e. a person who is receiving food and/or accommodation but not medical care including newborns ≥10 days of age
- residential Aged Care Reporting Establishments co-located with public hospitals within the WACHS.

Table 1: MRSA HAI data fields and descriptors for HISWA database

Data field	Descriptor
Patient ID	Unique patient identifier
Date of birth	Patient date of birth
Patient postcode	Postcode of patients home address
Laboratory specimen number	Laboratory number assigned to the specimen
Specimen date	Date the specimen was obtained
Organism	MRSA (MRSA strain data will be entered by the IPPSU)
Infection/colonisation	• new infection
Previously colonised	• yes (known to be colonised with any MRSA strain prior to infection) • no or unknown
Specimen site	• **sterile sites:** bloodstream, CSF, peritoneum, pleural, pericardial, aseptic tissue (includes – sterile surgical wound specimens) • **non-sterile sites:** sputum, urine, wound – surgical (non-sterile only), wound – all other • **Note:** faeces is to be used for *C.difficile* only.
Specimen type	Sterile or non-sterile specimen
Place of acquisition	• ICU • Non-ICU • Non-inpatient – renal • Non-inpatient – haematology/oncology • Non-inpatient – other/unknown

3.2.3 Outpatient clinic settings and emergency department

Patients who attend outpatient clinics or emergency departments without admission to hospital are not counted in bed-days. However, MRSA HAIs that occur as a result of healthcare in these settings will be included in numerator data if criterion B of the MRSA HAI definition is met e.g. a patient develops an MRSA HAI following a facet joint injection given at an outpatient clinic of a hospital.

4. Calculation of MRSA HAI rate

4.1 Inpatient MRSA HAI rate

The inpatient MRSA HAI rate is expressed as a rate per 10,000 multi-day bed-days.

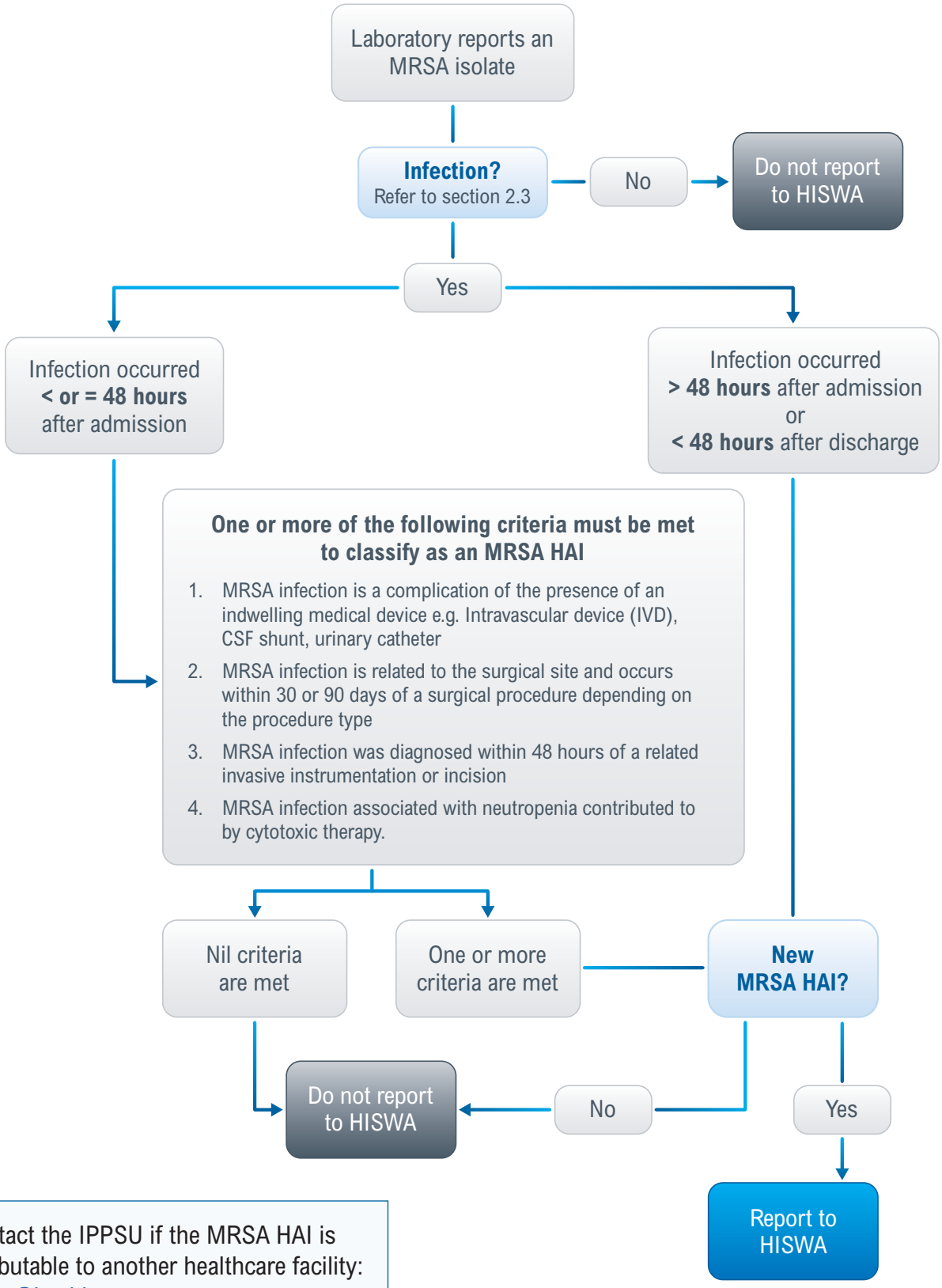
Rate calculation: $\frac{\text{Number of inpatient MRSA HAI}}{\text{Number of multi-day bed days}} \times 10{,}000$

4.2 Total MRSA HAI rate

This rate reflects the total number (inpatient and non-inpatient) of MRSA HAIs.

Rate calculation: $\frac{\text{Total number of MRSA HAI}}{\text{Number of multi-day and same-day bed days}} \times 10{,}000$

Appendix 1: Methodology to identify MRSA HAI



Contact the IPPSU if the MRSA HAI is attributable to another healthcare facility: ippsu@health.wa.gov.au

Note: Ensure MRSA HAIs are entered into other relevant modules e.g. the MRSA HAI is a BSI, therefore it must also be entered into the specific organism bloodstream infection module.

Appendix 2: MRSA SSI

An MRSA infection is considered an HAI related to the surgical site when criteria for classification as a SSI are met (Refer to SSI module).

- SSIs are followed for the following periods where day 1 = the date of the procedure:
- 30 day period for all superficial SSI and 30 or 90 day period for deep and organ/space infections depending on the procedure. Common procedures are listed in Table 2, however this is not an exhaustive list and MRSA infections associated with procedures not included here are to be reported.

Table 2: Procedures and surveillance periods for deep or organ/space SSI

30-day Surveillance	
Abdominal aortic aneurysm repair	Laminectomy
Limb amputation	Liver transplant
Appendix surgery	Neck surgery
Shunt for dialysis	Kidney surgery
Bile duct, liver or pancreatic surgery	Ovarian surgery
Carotid endarterectomy	Prostate surgery
Gallbladder surgery	Rectal surgery
Colon surgery	Small bowel surgery
Caesarean section	Spleen surgery
Caesarean section with tubal ligation	Thoracic surgery
Gastric surgery	Thyroid and/or parathyroid surgery
Heart transplant	Vaginal hysterectomy
Abdominal hysterectomy	Exploratory laparotomy
Kidney transplant	Other surgery not listed
90-day Surveillance	
Breast surgery	Cardiac surgery
Coronary artery bypass graft with both chest and donor site incisions	Coronary artery bypass graft with chest incision only
Craniotomy	Spinal fusion
Open reduction of fracture	Herniorrhaphy
Hip arthroplasty	Pacemaker surgery
Knee arthroplasty	Peripheral vascular bypass surgery
Refusion of spine	Ventricular shunt

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Module 4

Vancomycin-resistant enterococci (VRE) sterile site infection

Contents

Introduction

Enterococci are bacteria normally found in the gastrointestinal tract of animals and humans, and in the female genital tract and are inherently resistant to most antibiotics. They are opportunistic pathogens which can cause infections in patients who are vulnerable due to surgery, invasive devices, immunosuppression or extreme older age. Most enterococcal infections are caused by the person's own normal flora (endogenous), however cross-infection between hospitalised patients can occur either by direct contact with contaminated hands of HCWs or colonised patients, or indirectly via contaminated equipment or environmental surfaces. There are several different enterococci but those of importance in the context of vancomycin resistance are *Enterococcus faecium* and *Enterococcus faecalis*.

In Australia, national antimicrobial surveillance programs continue to show an increase in the number of clinical VRE isolates which is of concern due to the limited antimicrobial agents available and the potential for the vancomycin resistance gene to be transferred to other more pathogenic organisms i.e. *Staphylococcus aureus.*

Bloodstream and other sterile site infections caused by VRE have been associated with significant morbidity and mortality for critically ill or immunocompromised patients. Surveillance of sterile site infections allows evaluation of strategies to reduce the spread of VRE and colonisation of patients receiving care in higher-risk units. In Western Australia, VRE is listed as a Notifiable disease under the *Public Health Act 2016.*

1. Methodology

Currently, VRE sterile site infections are unable to be reported via the HISWA website.

HISWA surveillance is of both CAI and HAI VRE identified from sterile body sites (refer to 2.3). Surveillance personnel need to review all VRE positive laboratory reports, including those from emergency and outpatient departments. If the VRE sterile site infection is a HAI, identify the attributable HCF.

All clinical and screening samples where VRE is detected are required to be referred to the Gram-positive Reference Laboratory located at the Fiona Stanley Hospital PathWest laboratory. This laboratory works in collaboration with the Antimicrobial Resistance Infectious Diseases Research (AMR-ID) Laboratory, Murdoch University to undertake further molecular typing and characterisation of isolates.

Once a VRE sterile site isolate is confirmed from a hospitalised patient, the hospital IPC staff are to complete a REDCap multi-resistant organism (MRO) notification form (see Appendix 1), which is available via the IPPSU website under IPPSU tools and resources.

Please refer to Appendix 2 VRE Sterile Site Surveillance Methodology flow chart.

2. Definitions

2.1 Vancomycin-resistant enterococci

Enterococcus species resistant to vancomycin by standard susceptibility testing methods or a laboratory finding of VRE, includes but not limited to polymerase chain reaction (PCR) or other molecular based detection methods.

2.2 VRE colonisation

A positive culture of VRE from a non sterile site where there are no observable signs or symptoms of infection and patient did not need treatment; i.e. antimicrobial therapy. VRE colonisation is not reported.

2.3 VRE sterile site infection

A VRE sterile site infection is when VRE is isolated from a specimen obtained aseptically from a sterile site.

Sterile sites are body sites that do not normally contain microorganisms. Non-sterile sites are body sites that are exposed to microorganisms in the external environment and may also be colonised with normal flora.

The HISWA categories for sterile site specimen sites are:

- **Blood**
- **Peritoneal:** fluid and tissue from peritoneal space/peritoneum (includes abdominal fluid and ascites).
- **Bone and joint:** bone biopsy, bone marrow and synovial fluid and fluid aspirated or cultured from any specific joint including knee, ankle, elbow, hip, wrist synovial fluid.
- **Other Internal sites:** specimens from body sites that are normally sterile where a specimen has been obtained surgically or by aspirate e.g. deep soft tissue (muscle and fascia), pleura, liver, pancreas, kidney, spleen, vascular tissue, heart, brain, lymph node, ovary.

VRE isolated from blood, CSF and joint specimens are always considered significant thus are reported as infections regardless of whether an antibiotic was commenced. Isolates from other sites cannot always be attributed to infection and require clinical assessment to determine if an infection is present.

Do not report VRE isolated from a specimen obtained from a non-sterile site e.g. wound, urine, and sputum.

2.4 VRE sterile site HAI

The VRE infection is considered to be an HAI event if either criterion A or B is met.

Criterion A: an infection acquired >48 hours after hospital admission or <48 hours after discharge and the infection was not present or incubating on admission i.e. no signs or symptoms of the VRE infection were evident at that time.

Criterion B: an infection acquired 48 hours or less after admission and at least one of the following criteria is met:

1. Is a complication of the presence of an indwelling medical device e.g. intravascular line, CSF shunt, and no other focus of infection is identified.
2. VRE is isolated from aseptic tissue from the surgical site and occurs within 30 or 90 days of a surgical procedure depending on the procedure type refer to Appendix 3.
3. An invasive instrumentation or incision related to the infection was performed within 48 hours. If longer than 48 hours, there must be compelling evidence that the VRE infection was related to the procedure.

4. Is associated with neutropenia contributed to by cytotoxic therapy. Neutropenia is defined as at least 2 separate days with values of total white blood cell count (WBC) or ANC <500 cells/mm^3 (0.5 x 10^9/L) collected within a 7-day time period[4] which includes the date the VRE sterile site infection was identified.

Note: Patients being treated empirically for a suspected VRE infection, even if a known VRE carrier, must not be included in the surveillance. Only laboratory confirmed VRE infection taken from sterile sites is to be included.

2.5 Inpatient or non-inpatient HAI

A VRE infection that is classified as an HAI, is further categorised as:

2.5.1 Inpatient HAI

- VRE HAI is associated with the provision of healthcare during a multi-day admission to hospital or HITH
- ICU-associated VRE infections are detected >48 hours after admission to ICU or within 48 hours of discharge from ICU.

2.5.2 Non-inpatient HAI:

- VRE HAI meets **Criterion B** and is associated with healthcare received in hospital outpatient settings e.g. haemodialysis, peritoneal dialysis, chemotherapy day-wards, apheresis, day surgery and primary care providers.

2.6 VRE sterile site community-associated infection

- The VRE sterile site infection manifests within 48 hours of admission and does not meet either criterion A or B for classification as an HAI.
- VRE sterile site infections, identified at an acute care HCF that occur in a patient who has been admitted from a residential care facility (RCF) are reported as VRE CAIs.
- An RCF refers to all private and public facilities registered to provide 24-hour non-acute care to persons who are not able to live independently. This includes nursing homes, hostels, hospices, psychiatric and rehabilitation facilities.

2.7 New VRE sterile site infection

- Only the first new VRE infection for a single admission period is reported, however, if a BSI and another sterile site occur in a patient during an admission report the BSI only.
- If the admission period is prolonged, count additional VRE sterile site infections if it is evident that it is a new infection i.e. unrelated to a previous event.
- Exception: the definition of a BSI requires that an additional VRE BSI is reported if it has been more than 14 days since a previous positive VRE blood culture. This rule applies to both HAI and CAI events.

2.8 Place of acquisition

- Report all CAI and HAI VRE sterile site infections.
- Report VRE HAI sterile site from the below areas as higher risk units:
  - ICU (includes high-dependency units)
  - recipients of renal dialysis (haemodialysis and peritoneal dialysis)
  - medical oncology
  - haematology
  - transplant recipients (solid organ [e.g. liver, lung, kidney], bone marrow).

2.9 Attributable HCF

If the VRE sterile site infection may be a result of care at another HCF, or develops within 48 hours of transfer, contact the IPPSU at ippsu@health.wa.gov.au for advice regarding attributing to the correct HCF.

2.10 Previous colonisation status

- Patients colonised with VRE are at an increased risk of developing a VRE HAI.
- Report 'Yes' to previously colonised: if the patient has been previously identified to have colonisation or infection with any strain of VRE prior to the infection occurring.
- Report 'No' or 'Unknown' if it is the first time the patient has been identified with VRE or their previous VRE status is unknown.

3. HISWA dataset

3.1 Numerator data fields

Appendix 1 **HISWA REDCap Multi-resistant Organism Notification Form - VRE** describes the VRE sterile site infection data fields and descriptors describe the numerator data fields for VRE sterile site infection that are required to be provided.

3.1.1 Inclusions

- Patients previously colonised with VRE who develop a VRE sterile site infection.
- Both CAI and HAI VRE sterile site infections.

3.1.2 Exclusions

- VRE infections from non-sterile sites e.g wound, urine, sputum.
- Patients who are colonised with VRE and no VRE specific antimicrobial therapy is prescribed.

3.2 Denominator data fields

- Multi-day and same-day bed-day denominator data to calculate infection rates.

Appendix 1 HISWA REDCap Multi-resistant Organism Notification Form – VRE

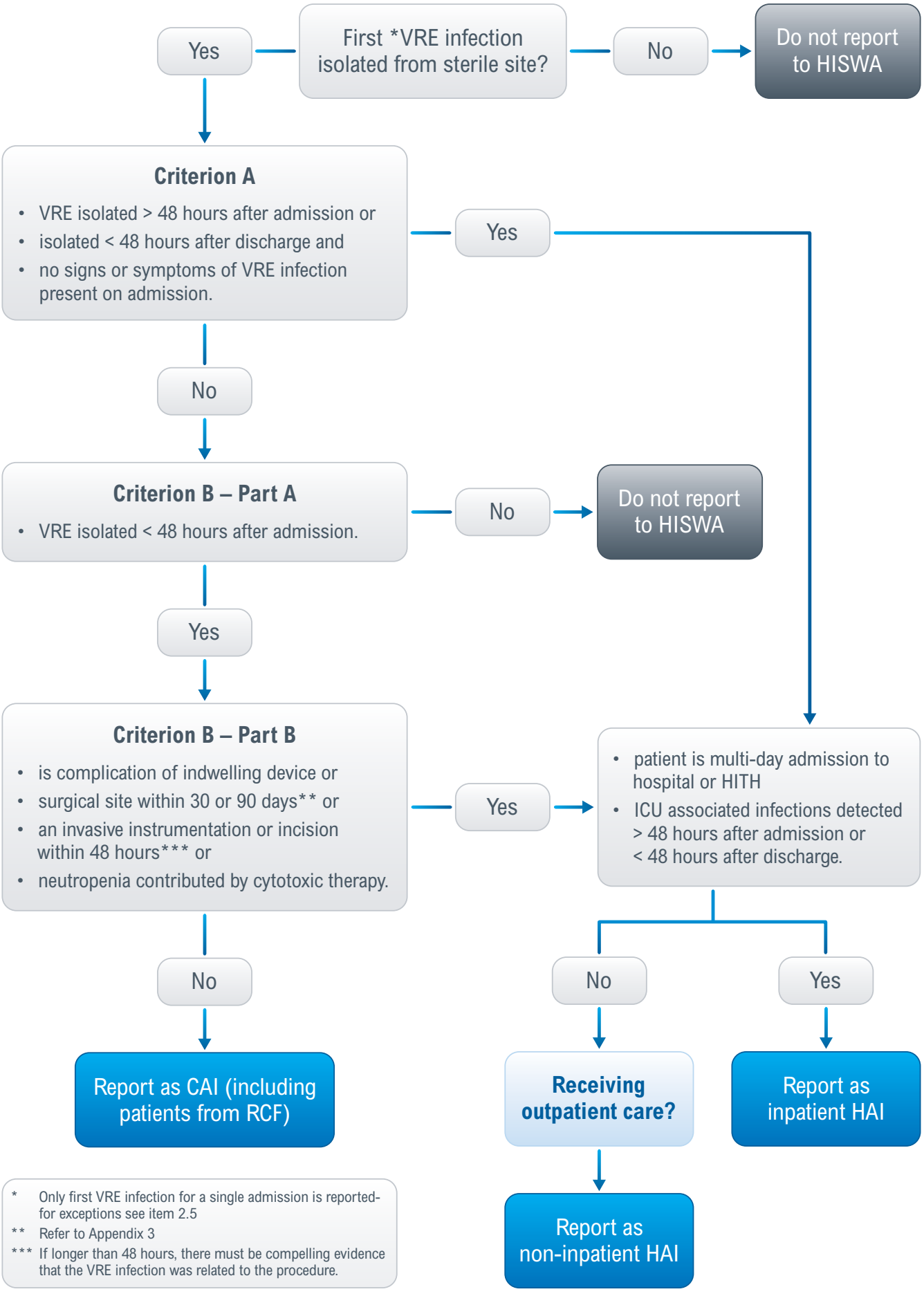
Data field	Descriptor
Case details	
Reporting hospital	Name of healthcare facility
UMRN	Unique patient identifier
First name	Block letters please
Surname	Block letters please
Date of birth	ddmmyyyy
Speciality	e.g. medical, surgical, oncology,
Admission diagnosis	Free text
Patient classification	Current inpatient Discharged Outpatient Emergency Department presentation only
Date of admission	ddmmyyyy
Date of discharge	ddmmyyyy
Date of death	ddmmyyyy
Patient presented from	Home Rehabilitation facility Residential care facility (RCF) Prison Psychiatric hospital Transfer from hospital within WA Transfer from hospital outside WA Transfer from hospital outside Australia
Current admission summary	Provide brief descriptor of patient journey
Select which notifiable MRO is being notified (if more than one MRO has been identified for this patient, a separate notification form is required for each organism)	Vancomycin-resistant enterococci (VRE)
How many contacts have been identified prior to notification of positive result?	
Does this patient undergo haemodialysis?	Yes No
Has the patient resided in a RCF in WA in the last 12 months?	Yes No
Has the patient been hospitalised or resided in a RCF overseas in the last 12 months?	Yes No
If Yes, specify where and when	Country hospitalised/month and year
Has the patient been hospitalised or resided in a RCF interstate in the last 12 months?	Yes No
If Yes, specify where and when	Australian state or territory / month and year
If hospitalised or resided in a RCF outside of WA in the last 12 months, was screening performed on admission?	Yes No
Did the patient have a prior micro alert F?	Private hospitals can check via ippsu@health.wa.gov.au
Did the patient have a prior micro alert V?	Private hospitals can check via ippsu@health.wa.gov.au

Appendix 1 HISWA REDCap Multi-resistant Organism Notification Form – VRE

(continued)

Data field	Descriptor
Did the patient have a prior vancomycin sensitive (VSE) isolate?	Private hospitals can check via ippsu@health.wa.gov.au
Did the patient receive vancomycin prior to identification of this isolate	Yes No
Did the patient receive a MRO letter and information sheet?	Yes No
If Yes, date provided	ddmmyyyy
What date was the micro alert placed for this organism?	ddmmyyyy
Specimen Details	
Date of specimen collection	ddmmyyyy
Laboratory service provider	PathWest Australian Clinical Laboratories Clinipath Western Diagnostics
Laboratory specimen number	Enter unique laboratory number
Organism	Enterococcus faecalis Enterococcus faecium
Van type	vanA vanB vanAB
Specimen type	e.g. blood culture, tissue sample, bone chip
Reason for specimen collection	Screening – policy requirement Screening – VRE contact Clinically indicated
Sterile site classification	Blood culture Bone/joint fluid CSF Pericardial Pleural Other stearile body site
Specimen site, if Other, specify	
Surveillance classification	Infection Colonisation
Infection acquisition	CAI HAI – acquired outside of Australia HAI – acquired outside WA but within Australia HAI – inpatient within WA HAI – non-inpatient within WA Maternally acquired
Notification Details	
Form completed by	Provide Full Name
Reporting Facility	Your healthcare facility
Contact Number	
Date notification submitted	ddmmyyyy

Appendix 2: VRE methodology flowchart



Appendix 3: VRE sterile site infection related to an SSI

VRE isolated from aseptic tissue obtained from a surgical site is considered a sterile site infection when criteria for classification as a SSI are met (Refer to SSI module).

SSIs are followed for the following periods where day one = the date of the procedure:

- 30 day period for all superficial SSI and 30 or 90 day period for deep and organ/space infections depending on the procedure. Common procedures are listed in Table 1. This is not an exhaustive list and VRE infections associated with procedures not included here are still to be reported.

Table 1 Surveillance period for deep or organ/space SSI following surgical procedures

30-day Surveillance	
Abdominal aortic aneurysm repair	Laminectomy
Limb amputation	Liver transplant
Appendix surgery	Neck surgery
Shunt for dialysis	Kidney surgery
Bile duct, liver or pancreatic surgery	Ovarian surgery
Carotid endarterectomy	Prostate surgery
Gallbladder surgery	Rectal surgery
Colon surgery	Small bowel surgery
Caesarean section	Spleen surgery
Gastric surgery	Thoracic surgery
Heart Transplant	Thyroid and/or parathyroid surgery
Abdominal hysterectomy	Vaginal hysterectomy
Kidney transplant	Exploratory laparotomy
	Other surgery not listed
90-day Surveillance	
Breast surgery	Cardiac surgery
Coronary artery bypass graft with both chest and donor site incisions	Coronary artery bypass graft with chest incision only
Craniotomy	Spinal fusion
Open reduction of fracture	Herniorrhaphy
Hip arthroplasty	Pacemaker surgery
Knee arthroplasty	Peripheral vascular bypass surgery
Refusion of spine	Ventricular shunt

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Module 5

Candida auris

Contents

Introduction

1. *Candida auris*

Candida auris (*C. auris*) is an emerging multi-resistant yeast that is commonly resistant to the "azole" antifungal medications, with some strains resistant to all antifungal agents. Unlike other fungal pathogens, *C. auris* can be readily transmitted between people and is associated with healthcare associated outbreaks internationally.

In Australia the risk factor for acquisition is primarily overseas hospitalisation, particularly when this admission has been prolonged or required intensive care.

Colonisation is asymptomatic and may be identified on many body sites including axilla, nose and throat, groin, rectum, urine, sputum, wounds or indwelling medical devices e.g. Percutaneous endoscopic gastrostomy (PEG) tubes, intravascular devices.

C. auris can cause blood stream infections or localised infections, most commonly of the urinary tract but many other sites have been reported. Mortality associated with invasive infection has been reported at between 30 per cent and 60 per cent.

The routes of transmission from patient to patient are either by direct contact via carriage of *C. auris* on the hands of HCWs or indirectly via contaminated environmental surfaces or shared patient equipment. *C. auris* can persist in the environment.

Currently the period of communicability is unknown, and all patients who are colonised or infected should be considered colonised indefinitely and must not be cleared.

In Western Australia, *C. auris* is listed as a Notifiable disease under the *Public Health Act 2016*.

2. Methodology

Currently, *C. auris* surveillance requirements are unable to be reported via the HISWA website. HISWA surveillance includes all confirmed *C. auris* isolates i.e. community and healthcare acquired infection and colonisation.

All clinical and screening samples where *C. auris* is detected are required to be reported by the identifying laboratory to the Communicable Disease Control Directorate, Department of Health. In addition, all isolates are to be referred to the Mycology Department, PathWest Laboratory Medicine Fiona Stanley Hospital site for further molecular testing and referral to the national critical antimicrobial resistance alert system (CARAlert).

If the isolate has been identified from a hospitalised patient, IPPSU will request the hospital IPC staff to complete an on-line REDCap enhanced surveillance form, which is available on the IPPSU website under IPPSU tools and resources.

Hospital IPC staff are to complete all case details including the enhanced surveillance information e.g. patient and family travel history for all confirmed *C. auris* cases.

The IPPSU is responsible for the surveillance and follow up of non-hospitalised patients.

Currently there are no standardised definitions for *C. auris* HAI however, in the interim, the criteria used to classify MRSA as CAI or HAI will be applied by IPPSU staff.

3. Definitions

C. auris: is a yeast which is part of the Candida species.

C. auris colonisation: laboratory confirmed *C. auris* isolated from a screening sample. People can be colonised with *C. auris* without having symptoms.

C. auris infection: laboratory confirmed *C. auris* isolated from a clinical specimen. Invasive *C. auris* infection can present as sepsis, urinary tract infections, wound infections, ear infections or intravascular device line infections.

4. C. auris reporting

All isolates of *C. auris*, from both screening and clinical samples are to be reported via the REDCap surveillance form. The data collection fields are described in Appendix 1.

Appendix 1 HISWA REDCap Multi-resistant Organism Notification Form *Candida auris*

Data field	Descriptor
Case details	
Reporting hospital	Name of healthcare facility
UMRN	Unique patient identifier
First name	Block letters please
Last name	Block letters please
Date of birth	ddmmyyyy
Speciality	e.g. medical, surgical, oncology,
Admission diagnosis	Free text
Patient classification	Current inpatient Discharged Outpatient Emergency department presentation only
Date of admission	ddmmyyyy
Date of discharge	ddmmyyyy
Date of death	ddmmyyyy
Patient presented from	Home Rehabilitation facility Residential care facility (RCF) Prison Psychiatric hospital Transfer from hospital within WA Transfer from hospital outside WA Transfer from hospital outside Australia
Current admission summary	Provide brief descriptor of patient journey
Select which notifiable MRO is being notified (if more than one MRO has been identified for this patient, a separate notification form is required for each organism)	*Candida auris*
Has the patient resided in a RCF in WA in the last 12 months?	Yes No
Has the patient been hospitalised or resided in a RCF overseas in the last 12 months?	Yes No
If Yes, specify where and when	Country hospitalised/month and year
Has the patient been hospitalised or resided in a RCF interstate in the last 12 months?	Yes No
If Yes, specify where and when	Australian state or territory/month and year

Data field	Descriptor
If hospitalised or resided in a RCF outside of WA in the last 12 months, was screening performed on admission?	Yes No
Did the patient have a prior micro-alert J?	Private hospitals can check via ippsu@health.wa.gov.au
Did the patient have a prior micro-alert K?	Private hospitals can check via ippsu@health.wa.gov.au
How many contacts have been identified prior to notification of positive result?	
Did the patient receive a MRO letter and information sheet?	Yes No
If Yes, date provided	ddmmyyyy
What date was the micro alert placed for this organism?	ddmmyyyy
Enhanced Surveillance	
Country of birth	
Has the patient been in an ICU, aged or long-term care facility or had an endoscopy performed within the last 12 months?	Yes No Unknown
If Yes, specify where and when	
Has the patient travelled overseas in the past 4 years?	Yes No Unknown
If Yes, specify where and when	
Has anyone else in the patient's household travelled overseas in the past 4 years?	Yes No Unknown
If Yes, specify where and when	
Is anyone in the patient household a known positive case for this organism?	Yes No Unknown
If Yes, specify their relationship to patient	

Data field	Descriptor
Specimen Details	
Date of specimen collection	ddmmyyyy
Laboratory service provider	PathWest Australian Clinical Laboratories Clinipath Western Diagnostics
Laboratory specimen number	Enter unique laboratory number
Reason for specimen collection	Screening – policy requirement Screening – contact Clinically indicated
Specimen type	Sterile Non-sterile
Specimen site	Blood culture Bone/joint fluid CSF Pericardial Respiratory/pleural Screen – axilla and groin Wound Other
Specimen site, if Other, specify	
Surveillance classification	Infection Colonisation
Infection acquisition	CAI HAI – acquired outside of Australia HAI- acquired outside WA but within Australia HAI – inpatient within WA HAI – non-inpatient within WA Maternally acquired
Notification Details	
Form completed by	Provide full name
Reporting Facility	Your healthcare facility
Contact Number	
Date notification submitted	ddmmyyyy

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Module 6

Carbapenemase-producing Organisms

Contents

Introduction

Carbapenemase-producing organisms (CPOs) are bacteria that have developed resistance to both first-line antibiotics and carbapenems, which are considered 'last resort' antibiotics for the treatment of serious infections. Carbapenemase genes encode enzymes that degrade carbapenem antibiotics.

CPOs most commonly include carbapenemase-producing *Enterobacterale*s (CPE), which comprise the largest group of Gram-negative bacteria causing human infection and includes common pathogens such as *Escherichia coli, Klebsiella* and *Enterobacter* species (see Appendix 1). These organisms are normal flora of the gastrointestinal tract but have the potential to cause infections such as bacteraemia, pneumonia, urinary tract, and wound infections; and disseminate antimicrobial resistance. CPOs also include other less common organisms such as CPPA and carbapenemase-producing *Acinetobacter baumanii* (CPAB) complex. See Appendix 1.

In WA, these described CPOs are listed as a Notifiable disease under the *Public Health Act 2016.*

1. Methodology

Currently, CPO surveillance requirements are unable to be reported via the HISWA website.

All clinical and screening samples where carbapenemase resistance is detected are required to be referred to the Gram-negative Reference Laboratory located at the QEII PathWest laboratory medicine for confirmatory testing.

Once a CPO case is confirmed, PathWest will advise the IPPSU and the referring laboratory. If the isolate has been identified from a hospitalised patient, IPPSU will request the hospital IPC staff to complete an on-line REDCap enhanced surveillance form, which is available on the IPPSU website under IPPSU tools and resources.

Hospital IPC staff are to complete all case details including the enhanced surveillance information e.g. patient and family travel history for all confirmed CPO cases.

The IPPSU is responsible for the surveillance and follow up of people identified with a CPO in the community.

Currently there are no standardised definitions for CPO healthcare associated infections however, in the interim, the criteria used to classify MRSA as community associated infection or healthcare associated infections will be applied by IPPSU staff.

2. Definitions

Carbapenem: a class of broad-spectrum antibiotic agents reserved for the treatment of resistant bacterial infections.

Carbapenemase-producing organism: a collective term that refers to any organisms of the order *Enterobacterales* and genera *Acinetobacter* and *Pseudomonas* that have been identified to carry an acquired carbapenemase gene.

Carbapenemase: a class of enzymes that inactivate carbapenem antibiotics (ertapenem, imipenem or meropenem) with those most identified as: *Klebsiella pneumoniae* carbapenemase (KPC); New Delhi metallo-ß-lactamase (NDM); Verona integron-encoded metallo-ß-lactamase (VIM); Oxacillinases (OXA); Imipenemase (IMP); and Guiana Extended Spectrum carbapenemase (GES).

Carbapenemase-producing *Acinetobacter baumannii* complex (CPAB): Gram-negative bacteria identified as belonging to the *Acinetobacter baumannii* species complex which have been shown to produce a carbapenemase enzyme.

Carbapenemase-producing *Enterobacterales* (CPE): *Enterobacterales* that are non-susceptible to carbapenem via production of a carbapenemase enzyme.

Carbapenemase-producing *Pseudomonas aeruginosa* (CPPA): Gram-negative bacteria identified as *Pseudomonas aeruginosa* which have been shown to produce a carbapenemase enzyme.

Colonisation: Colonisation refers to a CPO isolated from a body site without clinical signs or symptoms of infection and the person is not being treated for CPO infection.

Duplicate isolate: a patient's isolates are classed as duplicates if they identify the same organism and enzyme(s) as a previous isolate within the last 12 months. This is regardless of specimen type/site. The most significant specimen will be used for data analysis e.g. BC over screening swab.

Unique isolate: one record per patient with the same species and carbapenemase type isolated from the same patient within one year. If there are multiple isolates from one patient with a different organism/s and/or enzyme/s then this is counted as another unique isolate.

3. Carbapenemase-producing organism reporting

All isolates of a CPO, from both screening and clinical samples, are to be reported via the REDCap surveillance form. The data collection fields are described in Appendix 2.

Appendix 1: Carbapenemase-producing organisms

***Enterobacterales* include the following species**		
Citrobacter spp.	*Klebsiella* spp.	*Providencia* spp.
Cronobacter spp.	*Kluyvera* spp.	*Raoultella* spp
Edwardsiella spp.	*Leclercia* spp.	*Salmonella* spp.
Enterobacter spp.	*Morganella* spp	*Serratia* spp.
Escherichia spp.	*Pantoea* spp.	*Shigella* spp.
Ewingella spp.	*Plesiomonas* spp.	*Yersinia* spp.
Non-*Enterobacterales* CPO include		
• carbapenemase-producing *Pseudomonas* spp., typically *Pseudomonas aeruginosa* • carbapenemase-producing *Acinetobacter* spp., typically *Acinetobacter baumannii.*		

Appendix 2: HISWA REDCap Multi-resistant Organism Notification Form CPO

Data field	Descriptor
Case details	
Reporting hospital	Name of healthcare facility
UMRN	Unique patient identifier
First name	Block letters please
Last name	Block letters please
Date of birth	ddmmyyyy
Speciality	e.g. medical, surgical, oncology,
Admission diagnosis	Free text
Patient classification	Current inpatient Discharged Outpatient Emergency department presentation only
Date of admission	ddmmyyyy
Date of discharge	ddmmyyyy
Date of death	ddmmyyyy
Patient presented from	Home Rehabilitation facility Residential care facility (RCF) Prison Psychiatric hospital Transfer from hospital within WA Transfer from hospital outside WA Transfer from hospital outside Australia
Current admission summary	Provide brief descriptor of patient journey
Select which notifiable MRO is being notified (if more than one MRO has been identified for this patient, a separate notification form is required for each organism)	Carbapenemase-producing organism (CPO)
Has the patient resided in a RCF in WA in the last 12 months?	Yes No
Has the patient been hospitalised or resided in a RCF overseas in the last 12 months?	Yes No
If Yes, specify where and when	Country hospitalised/month and year
Has the patient been hospitalised or resided in a RCF interstate in the last 12 months?	Yes No
If Yes, specify where and when	Australian state or territory/month and year

Data field	Descriptor
If hospitalised or resided in a RCF outside of WA in the last 12 months, was screening performed on admission?	Yes No
Did the patient have a prior micro-alert G?	Private hospitals can check via ippsu@health.wa.gov.au
Did the patient have a prior micro-alert H?	Private hospitals can check via ippsu@health.wa.gov.au
How many contacts were identified?	
What date was the micro alert placed for this organism?	ddmmyyyy
Did the patient receive a MRO letter and information sheet	Yes No
If Yes, Date provided	ddmmyyyy
Enhanced Surveillance	
Country of birth	
Has the patient been in an ICU, aged or long-term care facility or had an endoscopy performed within the last 12 months?	Yes No Unknown
If Yes, specify where and when	Country or Australian jurisdiction / month and year
If 'Unknown', please explain why	
Has the patient travelled overseas in the past 4 years?	Yes No Unknown
If Yes, specify where and when	Country/year
Has anyone else in the patient's household travelled overseas in the past 4 years?	Yes No Unknown
If Yes, specify where and when	Country/year
Is anyone in the patient household a known positive case for CPO?	Yes No Unknown
If Yes, specify their relationship to patient	
If 'Unknown', please explain why	

Data field	Descriptor
Specimen Details	
Date of specimen collection	ddmmyyyy
Laboratory service provider	PathWest Western Diagnostics Clinipath Australian Clinical Laboratories Other
Carbapenem enzyme type/s (select all that apply)	GES IMP KPC NDM OXA VIM
Reason for specimen collection	Screening – policy requirement Screening – contact Clinically indicated
Specimen type	Sterile Non-sterile
Specimen site (if more than one specimen site, select the option for the most relevant sample e.g. if blood culture and screen both positive, select blood culture)	Blood culture Bone/joint fluid CSF Pericardial Respiratory/pleural Screen – rectal or stomal swab, faecal specimen. Wound Other
Specimen site, if Other, specify	
Surveillance classification	Infection Colonisation
Infection acquisition	CAI HAI – acquired outside of Australia HAI – acquired outside WA but within Australia HAI – inpatient within WA HAI – non-inpatient within WA Maternally acquired
Notification Details	
Form completed by	Provide full name and role
Contact number	
Reporting facility	
Date notification submitted	ddmmyyyy

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Module 7

Clostridioides difficile infection

Contents

Introduction

Clostridioides difficile infection (CDI) (renamed from *Clostridium difficile* [1]) is a common HAI in the developed world and is strongly connected to the use of antibiotics.[2,3] The severity of infection ranges from mild diarrhoea to pseudomembranous colitis, toxic megacolon and death[4,5]. Hyper virulent strains that are associated with epidemic spread and high rates of severe disease and death in other countries have now also been identified in Australia.[3-5] Patients who acquire CDI whilst in a hospital may have their length of stay increased by up to 3 times that of a patient without CDI.[6]

Identification of hospitalised patients with CDI using optimal surveillance systems and strict enforcement of infection prevention and control principles are the key to preventing transmission.[4,5] CDI can be linked to prolonged or inappropriate use of antimicrobial therapies.[7] Antimicrobial stewardship programs are an essential CDI prevention strategy to minimise the frequency and duration of antimicrobial use and to promote narrow-spectrum antibiotic prescribing.[4,5]

1. Methodology

Surveillance of hospital-identified CDI (HI-CDI) is the minimum requirement for both national[5] and HISWA surveillance. Classification of HI-CDI cases is intended to be derived from laboratory reports and does not require case review by surveillance personnel. HISWA definitions are those endorsed by the Australian Commission on Safety and Quality in Health Care (ACSQHC)[8]. Refer to Module 1 for an introduction to HAI surveillance. The methodology to assist with the classification of HI-CDI is described in Appendix 1: Methodology for determining a HI-CDI case.

Surveillance personnel are required to:

- Implement processes to ensure they receive all laboratory reports that detect *C.difficile* from specimens of stools that take the shape of a container, obtained at their HCF, including from the emergency department and all other outpatient settings.
- Apply the definition of a HI-CDI case consistently.
- Additional surveillance of severe CDI, and healthcare or community-associated CDI cases, is recommended, however, it is optional for HISWA hospitals (Refer to section 5).

Note: HISWA HI-CDI data is not designed to be used as a hospital performance indicator. The rate reported, measures the burden of CDI in the patient population, and includes both community acquired and healthcare acquired infections. The HISWA HI-CDI rate must not be used as a measure of performance or comparison between hospitals.

2. Definitions

2.1 Hospital-identified CDI

A HI-CDI is a case identified in a patient attending any area of a hospital i.e. admitted patients, emergency department, outpatient clinic, day surgery.

A HI-CDI case reflects the burden of CDI on a hospital and describes healthcare-associated infections, community-associated infections, as well as CDI of indeterminate or unknown origin (Refer to 5.2 Definitions of healthcare or community-associated CDI cases).

2.2 CDI case

A CDI case is defined as a case of diarrhoea i.e. an unformed stool that takes the shape of the container, in a person greater than 2 years of age at the date of specimen collection that meets the following criteria:

- the stool sample yields a positive result in a laboratory assay for *C.difficile* toxin A and/or B

or

- a toxin-producing *C.difficile* organism is detected in the stool sample by culture or other means.

and excludes

- cases where a known previous positive test has been obtained within the last 8 weeks i.e. only include cases once in an 8 week period.
- patients less than 2 years old at the date of specimen collection.

Note: An additional positive test obtained from a specimen collected from the same patient more than 8 weeks since the last positive test is regarded as a new case.

Note: If a specimen is PCR-positive but enzyme immunoassay (EIA)-negative, the infection does not need to be reported to HISWA. If your laboratory does not conduct EIA testing, then report based on PCR result.

See Appendix 1: Methodology for determining a HI-CDI case.

2.3 Specimen descriptors

Faecal samples that take the shape of the container are described in laboratory reports as semi-formed, watery, loose, liquid or fluid.

3. HISWA dataset

3.1 Numerator data fields

The numerator data fields for HI-CDI cases required to be entered into the HISWA database are described in Table 1.

3.1.1 Inclusions

- all events that meet the HI-CDI case definition.

3.1.2 Exclusions

- formed stools i.e. do not take the shape of the container, even if toxin positive
- recurrent cases in an 8 week period
- patients less than 2 years old at the date of specimen collection.

Table 1: CDI numerator data fields and descriptors for HISWA database

Data field	Descriptor
Patient ID	Unique patient identifier
Date of birth	Patient date of birth
Patient postcode	Postcode of patient's home address
Lab specimen number	Laboratory number assigned to the specimen
Specimen date	Date the specimen was obtained
Organism	*Clostridioides difficile*
Infection/colonisation	For every case enter: **new infection**
Previously colonised	For every case enter: **no / unknown**
Specimen site	For every case enter: **Faeces**
Specimen	For every case enter: **Non-sterile**
Place of acquisition	For every case enter: **Hospital-identified CDI**

3.2 Denominator data fields

The denominator that is utilised is bed-days and includes both multi-day and same-day bed-days.

3.2.1 Inclusions

HISWA bed-day data for HI-CDI includes:

- All inpatient wards or units within the HCF including psychiatric, rehabilitation and aged care. Do not include residential aged care facilities co-located on same site e.g. as per some WACHS sites
- HITH admissions
- Same-day admission wards or units e.g. haemodialysis units, day of surgery or procedure units.

3.2.2 Exclusions

- Boarders
- Patients less than 2 years of age
- Emergency and outpatient clinic attendance data is not included in bed-day counts provided to HISWA.

4. Calculation of hospital-identified CDI rate

The HI-CDI rate reflects the burden of CDI presenting to a HCF. CDI rates will be calculated and reported to HISWA using bed-days and expressed per 10,000 bed-days. Bed-days include both multi-day and same-day bed-days.

Rate calculation: $\frac{\text{Total number of HI-CDI cases}}{\text{Total number of bed-days at the hospital}} \times 10{,}000$

5. Enhanced surveillance (optional)

National surveillance does not require classification of healthcare and community-associated CDI cases or severe and non-severe CDI. Surveillance of these classifications is optional, however, it is recommended for HISWA hospitals.

Enhanced surveillance requires an individual case review in addition to the routine review of laboratory reports required for HI-CDI surveillance.

HCFs may be requested to undertake enhanced surveillance for target periods and also if the rate of HI-CDI is high or increasing significantly at their facility.

HISWA definitions for enhanced surveillance align with recommended international definitions and are described in sections 5.1 Severe CDI case and 5.2 Definitions of healthcare or community-associated CDI cases.

5.1 Severe CDI case

- A severe CDI case is defined as a CDI case that meets any of the following criteria within 30 days of symptom onset:
  - history of admission to an ICU for treatment of complication from CDI e.g. vasopressor therapy for shock
  - history of surgery for treatment of toxic megacolon, perforation or refractory colitis
  - death caused by CDI within 30 days of symptom onset[8].
- Clinical criteria that have been associated with severe CDI include[8]:
  - age >60 years of age
  - temperature >38.3°C
  - serum albumin <25g/L
  - peripheral white blood cell count >15,000cells/microL
  - deteriorating renal function
  - elevated serum lactate
  - endoscopic evidence of pseudomembranous colitis or treatment in the ICU
  - subtotal colectomy procedure or diagnosis of toxic megacolon.

5.1.1 Calculation of incidence of severe CDI

For HCFs monitoring severe disease, this should be expressed as the proportion of total HI-CDI cases in the reporting period that were severe. The raw number, as well as the proportion, should be reported to aid interpretation. The proportion should be calculated for the reporting period as follows[8]:

Proportion calculation: $\frac{\text{Total number of patients with severe HI-CDI}}{\text{Total hospital-identified CDI cases}}$

5.2 Definitions of healthcare or community-associated CDI cases

Each CDI case is classified according to the place of probable exposure described below[8] and in Figure 1: Timeline for healthcare or community-associated CDI definitions[7].

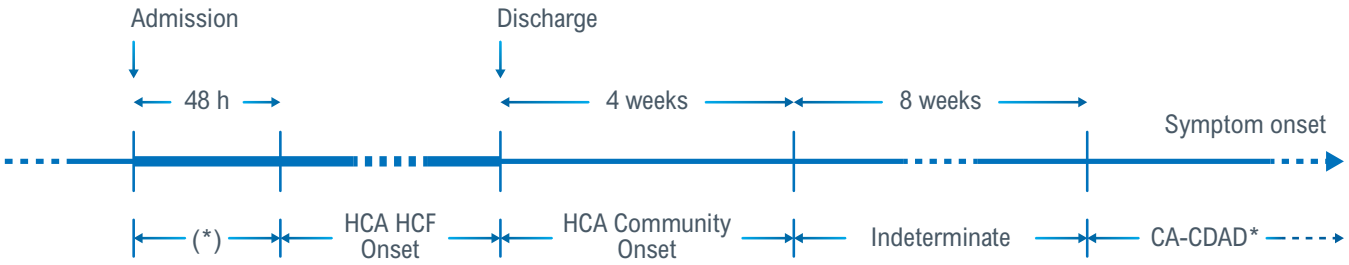
Healthcare-associated (HCA) CDI are classified as HCF onset or community-onset.

- **HCF onset:** when symptom onset or date and time of stool specimen collection is greater than 48 hours after admission to an HCF.
- **Community onset:** when symptom onset was in the community or within 48 hours of admission to an HCF, and symptom onset was less than 4 weeks after the last discharge from an HCF.

Cases can be further classified as:

- Community-associated CDI cases
  - symptom onset or date and time of stool specimen was in the community or within 48 hours of admission to an HCF provided the symptom onset was more than 12 weeks after the last discharge from an HCF
  - record if the CDI case was admitted to an HCF from a residential care facility.
- Indeterminate onset
  - criteria for community or healthcare-associated are not met e.g. CDI case with symptom onset in the community between 4 and 12 weeks of the last discharge from an HCF.
- Unknown
  - exposure setting cannot be determined because of a lack of data to classify.

Figure 1: Timeline for healthcare or community-associated CDI definitions[8]



*Community-associated *Clostridioides difficile*-associated diarrhoea

Calculation of rates:

Rates for healthcare-associated CDI cases are expressed per 10,000 bed-days (excluding same-day bed-days).

Rates for community-associated CDI cases are expressed per population rates.

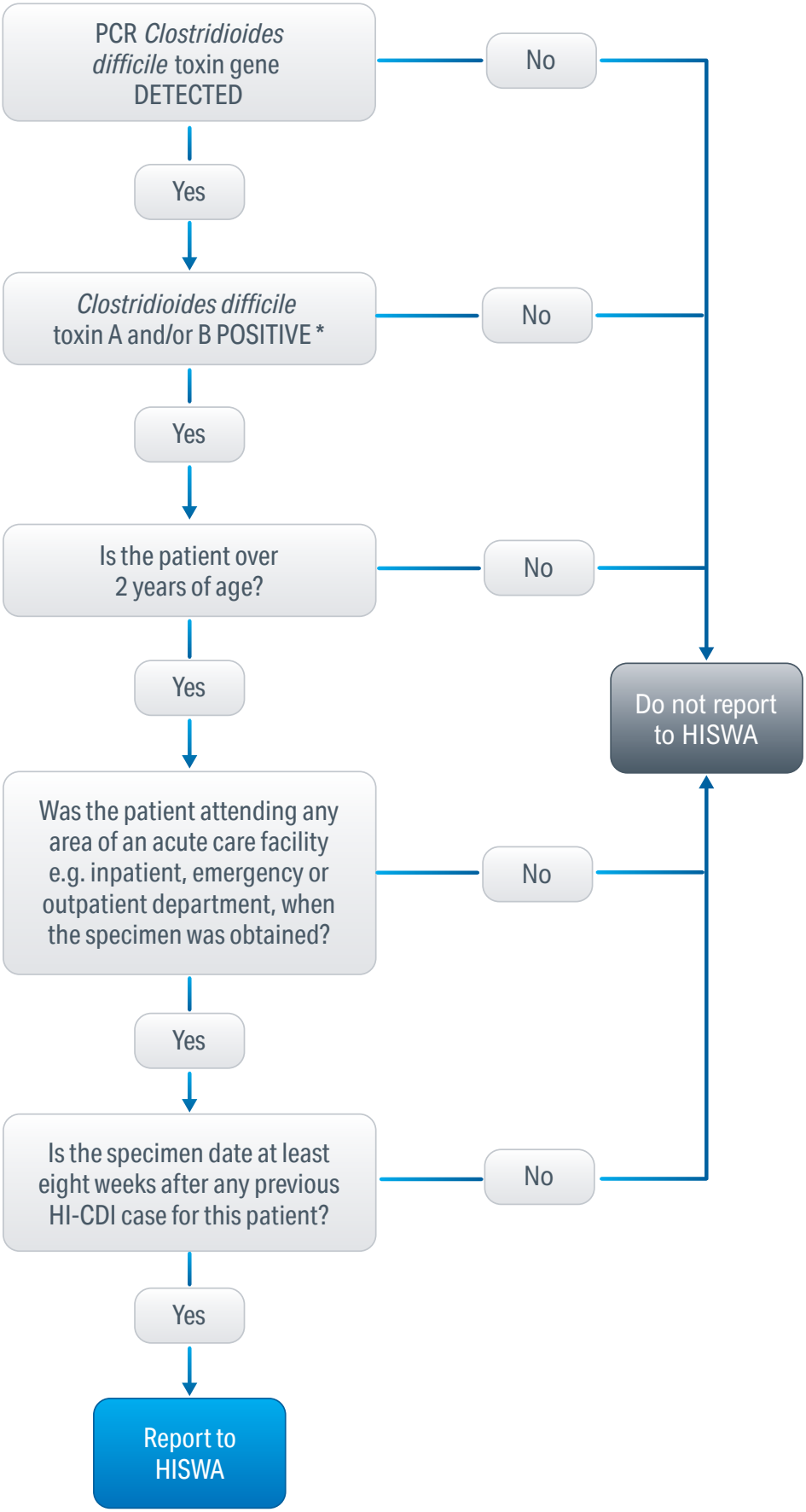
Note: Healthcare-associated community onset cases should be:

- Attributed to the reporting period during which the case was discharged from the HCF before CDI symptom onset e.g. if the case was discharged on the 28 May and readmitted with CDI on 5 June, the case should be assigned to May.
- Attributed to the HCF from which the case was discharged, providing they were an inpatient at the HCF from more than 48 hours.

5.3 Recurrent CDI cases

A recurrent CDI case is an episode that occurs within 8 weeks or less after the onset of a previous CDI episode, provided that CDI symptoms from the earlier episode have resolved with or without therapy. These cases are not included in the HI-CDI case definition and calculation, and monitoring is optional.

Appendix 1: Methodology for determining a HI-CDI case



*If your laboratory does not conduct EIA testing, then report based on PCR result.

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Module 8

Staphylococcus aureus bloodstream infection

Contents

Introduction

Bloodstream infections (BSI) can cause significant illness, serious complications and high mortality, with more than half of BSIs associated with the provision of healthcare.[2,3] *Staphylococcus aureus* (*S.aureus*) is the most common cause of healthcare-associated BSI.[3] The majority of healthcare-associated *S.aureus* BSIs (HA-SABSIs) are related to the presence of IVDs and these events are increasingly viewed as preventable adverse events.[4,5] Quality improvement programs that have involved surveillance and implementation of policies to promote preventative strategies, have resulted in sustained reductions in HA-SABSI.[2]

1. Methodology

For participating hospitals to make a valid comparison of their HA-SABSI rates, the methodology must be similar and definitions consistently applied. Surveillance personnel are required to:

- Implement processes to ensure that all positive laboratory reports are received.
- Investigate all blood culture laboratory reports positive for both methicillin-sensitive and methicillin-resistant *S.aureus*, including those from emergency and outpatient departments, to determine if the *S.aureus* BSI (SABSI) is healthcare-associated and identify the attributable HCF.
- Liaise with key stakeholders, clinical microbiologists/infectious diseases physicians to assist with the classification of SABSI episodes.
- The methodology to assist with the classification of HA-SABSI is outlined in Appendix 1. Refer to Module 1 for an introduction to HAI surveillance.
- HISWA HA-SABSI surveillance aligns with the Australian national definition developed by the ACSQHC.

Note: Surveillance personnel should take opportunities to promote best practice for blood culture collection to optimise BSI detection and classification as potential contaminants. Ideally blood culture specimens should be aseptically obtained from 2-4 blood draws from separate venepuncture sites, rather than through an intravascular device.[1]

Aseptic technique incorporating hand hygiene, the use of sterile gloves when required, and ensuring the skin or cannula hub and culture bottle tops are disinfected with an alcohol based disinfectant and allowed to dry prior to access is recommended.

2. Definitions

2.1 *Staphylococcus aureus* bloodstream infection

- A patient episode of SABSI is defined as a positive blood culture for *S.aureus*.[6]
- For surveillance purposes, only the first positive blood culture per patient within a 14 day period is counted. If the same patient has a further positive blood culture reported greater than 14 days after the last positive blood culture then an additional episode is counted (14-day rule).[6]
- The 14-day rule is to be applied to SABSI that occur in haemodialysis patients[6] (not the 21 days specified for haemodialysis access-associated bloodstream infection surveillance).

2.2 Intravascular devices

- Can be centrally or peripherally inserted
- Can include: PIVCs, arterial lines, central lines (centrally and peripherally inserted central venous catheters), Swan-Ganz catheters (pulmonary artery catheterisation), umbilical arterial catheters, and venous/arterial introducers.

2.3 Contaminants

- *S. aureus* is rarely a contaminant of blood cultures and therefore there are few false-positive isolates.[6]
- *S. aureus* positive blood culture will only be considered a contaminant, and not reported in the surveillance data if the clinical picture is unsupportive of infection and either a repeat blood culture is negative (within 2 days) and/or no antimicrobial treatment is given.
- It is recommended that attention is paid to aseptic technique, the volume of samples and that 2 or more samples of blood are collected (ideally from separate sites) on patients to reduce risk of contaminants and thus reduce false-positives.[1]

2.4 Healthcare-associated SABSI (HA-SABSI)

A patient episode of SABSI is considered to be healthcare-associated if either Criterion A or B are met:[6]

Criterion A: The patients first *Staphylococcus aureus* positive blood culture was collected:

1. More than 48 hours after admission, with no documented evidence that infection was present (including incubating) on admission.
2. Less than 48 hours after discharge.

> **Note:** incubating on admission means there were documented clinical signs or diagnostic evidence of staphylococcal infection on admission and provided there is no evidence of an association with a prior admission or medical procedure received in a HCF, then the episode was likely incubating on admission and is not counted as an HA-SABSI.

Criterion B: the patient's first positive blood culture is collected less than or equal to 48 hours after admission and one or more of the following clinical criteria was met:

1. The SABSI is a complication of the presence of an indwelling medical device e.g. IVD, haemodialysis vascular access, cerebrospinal fluid shunt, feeding tube.
2. The SABSI is related to a surgical site infection and occurs within 30 days of a surgical procedure or 90 days for deep incisional/organ space infections related to a surgically implanted device. Refer to Appendix 2.

> **Note:** include HA-SABSI related to SSI identified beyond the 30 or 90 day surveillance period, if first clinical signs of infection were identified within the surveillance period in a community or outpatient setting e.g. patient was being treated for SSI by general practitioner or during an emergency department visit.

3. The SABSI is related to invasive instrumentation or an incision performed within 48 hours. If greater than 48 hours, there must be compelling evidence that the infection is related to the invasive procedure.

4. The SABSI is associated with neutropenia contributed to by cytotoxic therapy and is unrelated to the presence of an indwelling medical device. Neutropenia is defined as at least 2 separate days with values of total WBC or ANC <500 cells/mm^3 (0.5 x 109/L) collected within a 7-day time period which includes the date of the BSI (Day 1), the 3 calendar days before and the 3 calendar days after.[7]

If none of these criteria is met, then the episode of SABSI is considered to be community-associated.

2.5 Maternally-acquired SABSI

SABSI that arise in neonates less than 48 hours after delivery are not considered HAIs unless there is compelling evidence that it is related to a procedure or intervention during the birth.

2.6 Focus of infection

HA-SABSI are categorised according to the likely source of the infection. The following section can be used to clarify the application of Criterion B.

2.6.1 Intravascular device (IVD) related (clarifies Criterion B1)

- For central venous catheters, refer to CLABSI definitions (Module 9). For all other IVD, if the IVD was present at some point within the 48 hours prior to the SABSI event, and there is no other identifiable focus of infection due to *S. aureus* at another body site then the IVD is considered the attributable source.[6] If the time period is greater than 48 hours there needs to be compelling evidence that the IVD is the cause of the infection e.g. pus at old IVD site.
- For haemodialysis patients, an HA-SABSI is haemodialysis access-associated if there is either clinical evidence of infection at the vascular access site or there is no other identifiable source of the SABSI.[6]
- An introducer used in intravascular procedures is considered an IVD, e.g. angiography, therefore, an HA-SABSI occurring within 48 hours of these procedures is IVD related unless there is an identifiable infection at another site related to the HA-SABSI.[6]

Note: if a patient is known or suspected to have accessed their own IVD and develops an HA-SABSI, and the infection meets the criteria, it is to be reported as an HA-SABSI.

2.6.2 Non intravascular device related (clarifies Criterion B1)

- The device was present at some point within the 48 hours prior to the SABSI event and there was clinical or microbiological evidence that the HA-SABSI was associated with the insertion site or an associated organ.[6] Examples of non-IVDs include shunts, suprapubic catheters, chest tubes, urinary catheters, peritoneal dialysis catheters, gastrostomy/jejunostomy feeding tubes.[6]

2.6.3 Procedure-related (clarifies Criterion B2 and B3)

- A SABSI is related to an SSI that fulfils the surveillance criteria of an SSI (Refer to Module 2) and occurs within 30[6] or 90 days of the procedure depending on the type of procedure (Refer to Appendix 2). Note the list of procedures are examples and does not include all surgical procedures that can be attributed to an HA-SABSI. The type of procedures in the 90-day list includes those where surgically implanted devices are permanently placed, such as joint prostheses, permanent pacemakers, transcatheter aortic valve implantation (TAVI), breast implants, stents, grafts, surgical mesh, pins or wire.

- There is invasive instrumentation or incision performed within the previous 48 hours e.g. cardiac catheterisation, pacing wires (not implanted), endoscopic retrograde cholangiopancreatography (ERCP).[6] If the time interval was longer, there must be compelling evidence that the HA-SABSI was related to the procedure.
- If there have been multiple incisions or instrumentation, then the HA-SABSI should be allocated to the most recent procedure.

2.6.4 Organ site focus

- There is clinical or bacteriological evidence that the HA-SABSI is a result of infection at a specific organ site e.g. skin and soft tissue, respiratory tract, urinary tract, gastrointestinal tract, and is not related to a procedure or an indwelling medical device.[6]
- To diagnose infection at a specific body site, refer to the CDC/NHSN *Surveillance Definitions for Specific Types of Infection*[7].

2.6.5 Neutropenia

The SABSI is associated with neutropenia contributed to by cytotoxic therapy. Neutropenia is defined as at least 2 separate days with values of total WBC or ANC <500 cells/mm^3 (0.5 x10^9/L) collected within a 7-day time period which includes the date of the BSI (Day 1), the 3 calendar days before and the 3 calendar days after (Refer to Appendix 4 in Module 9).[7]

2.6.6 Unknown/disseminated focus

- The source of the HA-SABSI cannot be determined or there are multiple organ site foci of *S. aureus* infection i.e. disseminated infection.

2.7 Place of acquisition

- HA-SABSI are categorised according to healthcare settings where the infection was likely to have been acquired.

2.7.1 Inpatient

- An inpatient HA-SABSI event is associated with healthcare provided during a multi-day admission (overnight stay) to an HCF and meets either Criterion A or B of the HA-SABSI definition. These include HITH patients.
- These events may occur during the multi-day admission or are detected on readmission following a multi-day admission e.g. HA-SABSI caused by an SSI detected on readmission.

2.7.2 Non-inpatient

- A non-inpatient HA-SABSI event is associated with healthcare received as an outpatient and meets Criterion B of the HA-SABSI definition.
- Non-inpatient HA-SABSI are related to the presence of indwelling medical devices, procedures, day surgery or treatments such as haemodialysis, apheresis, chemotherapy and IV therapy provided in an outpatient setting.
- Outpatient settings include day wards, day of surgery units, outpatient clinics, hospital home healthcare services (not HITH) or emergency departments.

2.8 Healthcare facility attribution

- If the HA-SABSI event develops 48 hours or less after transfer from one HCF to another, it is attributed to the transferring HCF.
- When a patient is transferred between HCFs with a peripheral intravenous (IV) line in situ and subsequently develops an HA-SABSI, it is attributed:
  - to the transferring HCF if either the SABSI or an IV site infection occurs within 48 hours of the transfer unless there is other compelling evidence
  - to the receiving hospital if the SABSI or an IV site infection occurs greater than 48 hours after the transfer unless there is other compelling evidence.
- An HA-SABSI associated with a central venous catheter or haemodialysis access device is attributed to the HCF or haemodialysis unit where the device was accessed prior to developing signs and symptoms of infection.
- If a surgical procedure or invasive instrumentation is the source of the HA-SABSI, it will be attributed to the hospital where the initial procedure was performed. If there have been recurrent procedures, the HA-SABSI will be attributed to the HCF where the most recent procedure occurred.

2.9 Classification of *Staphylococcus aureus*

- *S.aureus* infections are commonly treated with beta-lactam antibiotics that include penicillins, cephalosporins, carbapenems and monobactams.
- Beta-lactam resistance is due to the production of a beta-lactamase enzyme by some strains of *S.aureus* and is detected in the laboratory using methicillin or oxacillin.
- *S.aureus* isolates are classified according to methicillin sensitivity:
  - methicillin-sensitive *S.aureus* (MSSA). *S.aureus* isolates that are sensitive to methicillin and therefore sensitive to flucloxacillin
    - **methicillin-sensitive = flucloxacillin sensitive**
  - methicillin-resistant *S.aureus* (MRSA). *S.aureus* isolates that are resistant to methicillin and therefore resistant to flucloxacillin
    - **methicillin-resistant = flucloxacillin resistant.**

3. HISWA dataset

3.1 Numerator data fields

The numerator data fields and information required to be entered into the HISWA database are described in Table 1.

Table 1: HA-SABSI numerator data fields and descriptors for HISWA database

Data field	Descriptor	
Patient ID	Unique patient identifier	
Date of birth	Patient date of birth	
Patient postcode	Postcode of patients home address	
Laboratory specimen number	Laboratory number	
Specimen date	Date the specimen was obtained	
Organism	MSSA or MRSA MRSA and MSSA when both isolated from same pecimen	
Acquisition	Inpatient Non-inpatient	
Focus of infection	IV line related Non-IV device related Procedure related Neutropenia Other – Organ site focus Unknown/disseminated	Select the type of IVD or Non-IVD from the drop-down list If IVD is a PIVC – enter time insitu in hours or unknown If Procedure enter procedure name and date of the procedure
CIMS* event raised	Yes No	If Yes, enter SAC** details and CIMS number or equivalent for private sector

* Clinical Incident Management System
** Severity assessment code

3.2 Denominator data fields

The denominator that is utilised is bed-days. Both multi-day and same-day bed-days are collected to allow for different rate calculations.

3.2.1 Inclusions

HISWA bed-day data for HA-SABSI includes:

- All inpatients including those admitted to HITH, rehabilitation, aged care areas and psychiatric units/wards within an acute HCF.
- All same-day patients e.g. haemodialysis units, day surgery or procedure units.
- Psychiatric units/wards associated with acute psychiatric hospitals.
- Qualified newborns.

3.2.2 Exclusions

HISWA bed-day data for HA-SABSI excludes:

- Boarders i.e. a person who is receiving food and/or accommodation but for whom the hospital does not accept responsibility for treatment (Refer to Module 12, section 2.4)
- Unqualified newborns (Refer to Module 12, section 2.3.1)
- Residential Aged Care Reporting Establishments that are co-located with public hospitals within the WACHS.

3.2.3 Outpatient clinic settings and emergency department

Patients who attend outpatient clinics or emergency departments without admission to hospital are not counted in bed-days. However, HA-SABSI events that occur as a result of healthcare received in these settings will be included in numerator data if criterion B of the HA-SABSI definition is met e.g. a patient develops a SABSI following a facet joint injection given at an outpatient clinic of a hospital and there was *S.aureus* infection at the injection site.

4. Calculation of HA-SABSI rates

4.1 Calculation of total HA-SABSI

- The HA-SABSI rate is expressed per 10,000 bed-days

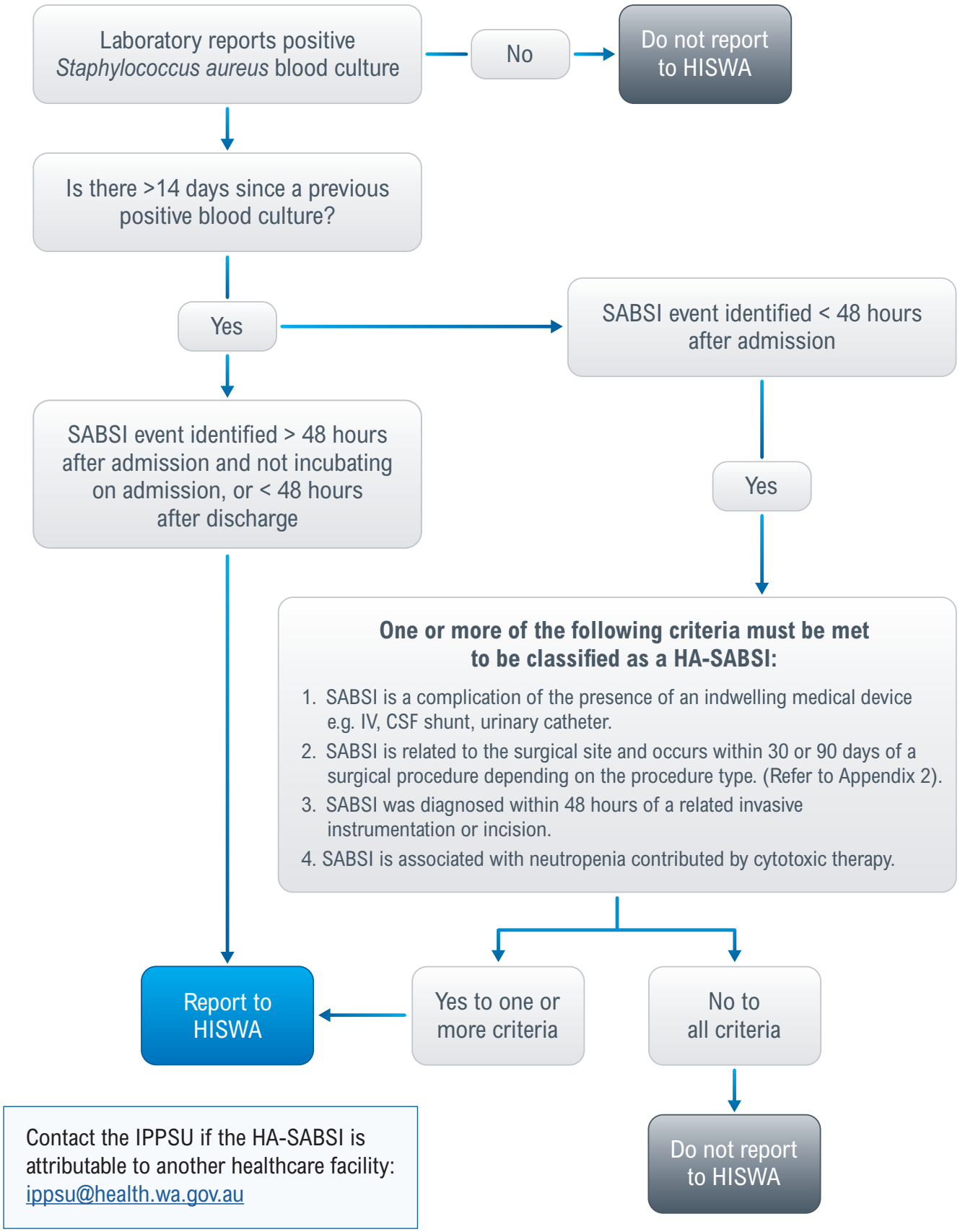
$$\textbf{HA-SABSI rate} = \frac{\text{Inpatient and non-inpatient SABSI}}{\text{Number of bed-days (multi-day and same-day)}} \times 10{,}000$$

4.2 Calculation of inpatient-only HA-SABSI

- The inpatient HA-SABSI rate is expressed per 10,000 bed-days (multi-day only)

$$\textbf{Inpatient SABSI rate} = \frac{\text{Number of inpatient SABSI}}{\text{Number of multi-day bed-days}} \times 10{,}000$$

Appendix 1: Methodology for classification of HA-SABSI



Contact the IPPSU if the HA-SABSI is attributable to another healthcare facility: ippsu@health.wa.gov.au

Note: If the HA-SABSI is an MRSA HAI, please add to the Significant Organism Module. If relevant, also add to the Haemodialysis/CLABSI modules.

Appendix 2: HA-SABSI related to a SSI

An HA-SABSI is considered to be related to a surgical site when criteria for classification as an SSI are met (Refer to Module 2). SSIs are followed for the following periods where day one = the date of the procedure:

- 30 day period for superficial SSI for all procedures and 30 or 90 day period for deep and organ/space infections depending on the procedure. Common procedures are listed in Table 2. This is not an exhaustive list and HA-SABSI associated with procedures not included here are still to be reported.

Table 2: Surveillance period for deep or organ/space SSI following surgical procedures

30-day Surveillance	
Abdominal aortic aneurysm repair	Laminectomy
Limb amputation	Liver transplant
Appendix surgery	Neck surgery
Shunt for dialysis	Kidney surgery
Bile duct, liver or pancreatic surgery	Ovarian surgery
Carotid endarterectomy	Prostate surgery
Gallbladder surgery	Rectal surgery
Colon surgery	Small bowel surgery
Caesarean section	Spleen surgery
Gastric surgery	Thoracic surgery
Heart transplant	Thyroid and/or parathyroid surgery
Abdominal hysterectomy	Vaginal hysterectomy
Kidney transplant	Exploratory laparotomy
	Other surgery not listed
90-day Surveillance	
Breast surgery	Cardiac surgery
Coronary artery bypass graft with both chest and donor site incisions	Coronary artery bypass graft with chest incision only
Craniotomy	Spinal fusion
Open reduction of fracture	Herniorrhaphy
Hip arthroplasty	Pacemaker surgery
Knee arthroplasty	Peripheral vascular bypass surgery
Refusion of spine	Ventricular shunt

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Module 9

Central line-associated bloodstream infection

Contents

Introduction

Central venous catheters (CVC), also referred to as central lines, serve a vital role in the management of critically ill patients, however, these predispose patients to preventable[2] CLABSI.[3,4] CLABSI are serious infections that significantly increase morbidity, mortality and contribute to increased healthcare costs. CLABSI are viewed as preventable adverse events if evidence-based infection prevention practices are followed and integrated with monitoring and feedback of rates to key stakeholders.[5] This approach should be taken by every HCF to achieve and maintain a zero CLABSI rate.[4]

1. Methodology

HISWA definitions are based on the CDC/NHSN CLABSI definitions[6]. For participating hospitals to make a valid comparison of their CLABSI rates the methodology must be similar and definitions consistently applied. Surveillance personnel are required to:

- Implement processes to ensure that all positive blood culture reports are received.
- Investigate all reported BSIs to determine if definition criteria for a CLABSI are met and the attributable facility.
- Liaise with key stakeholders, clinical microbiologist/infectious diseases physicians to assist with the classification of CLABSI events.
- The methodology to assist with classification of CLABSI is described in Appendix 1. Refer to Module 1 for an introduction to surveillance of HAIs.
- HISWA CLABSI surveillance aligns with the Australian national definition developed by the ACSQHC.

Note: Surveillance personnel should take opportunities to promote best practice for blood culture collection to optimise BSI detection and classification as potential contaminants ie. blood specimens drawn for culture should be obtained from 2 to 4 blood draws from separate venepuncture sites, within a few hours of each other and not through an intravascular catheter.[1]

Aseptic technique incorporating the use of sterile gloves where appropriate, and disinfecting culture bottle tops and the patient's skin using an alcohol based disinfectant is recommended.

2. Definitions

2.1 Central lines

- A central line is defined as an intravascular catheter where the tip of the catheter terminates at or close to the heart or in one of the great vessels which is used for infusion, blood withdrawal or haemodynamic monitoring.[6] The site of insertion or the type of catheter does not determine if a line qualifies as a central line for HISWA reporting purposes.
- The following are considered great vessels for CLABSI surveillance: aorta, pulmonary artery, superior/inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external and common iliac veins, femoral veins and, in neonates, the umbilical artery/vein.[6]

2.2 Types of central line

The main types of central lines are:

- **non-tunnelled CVCs:** these are central lines, with one or more lumens, placed directly in either the internal jugular or subclavian vein with the distal tip lying in the superior vena cava. They are suitable for shorter-term use.
- **tunnelled CVCs:** the central line is tunnelled subcutaneously between the skin insertion site and the point where the catheter enters the blood vessel. Some have a cuff which sits in the subcutaneous tunnel and are referred to as cuffed catheters. These catheters are suitable for long term use e.g Broviac, Hickman, Groshong catheters.
- **peripherally-inserted central catheters (PICCs):** these are central lines that are inserted percutaneously into peripheral veins e.g. basilic, brachial, cephalic. They are suitable for short, intermediate, and long term use.
- **implanted ports:** these central lines are surgically inserted, placed under the skin and accessed with specific port needles. They are for long term intermittent use.

An introducer is considered an intravascular catheter; however, if the location of its tip is in a great vessel, it may be considered a central line[6]. Central lines are sometimes described as permanent or temporary, however, HISWA do not stratify CLABSI by these terms.

2.3 Intravascular devices not included

The following are not considered central lines:

- pacemaker wires and other non-lumened devices inserted into central blood vessels or the heart, because fluids are not infused, pushed, nor withdrawn.[6]
- femoral arterial catheters, extracorporeal membrane oxygenation (ECMO), haemodialysis reliable outflow (HeRO) dialysis catheters and intra-aortic balloon pump (IABP) devices.[6]

2.4 Stratification by insertion site

Central lines are stratified by the insertion site for reporting and analysis as higher risk of infection with centrally-inserted (CI) lines is reported in some patient settings.[3]

- **centrally-inserted (CI):** the skin entry point is on the trunk of the patient
- **peripherally-inserted (PI):** the line is inserted through a limb vein

A higher risk of infection with CI lines is reported in some patient settings.[3]

2.5 Criteria for a central-line associated bloodstream infection

- First, the criteria for classification as a laboratory-confirmed BSI event must be met (Refer to Appendix 2).
- The date of the CLABSI event is the date the first positive blood culture was collected. For 'same' potential contaminants this is the date the first of two blood culture sets was collected.[6]
- A CLABSI is defined as a BSI, which is not related to an infection at another site, and on the date of the BSI event the central line had been in place for a period of less than 48 hours AND was in place on the date of the BSI event or within the previous 24 hours.[7]
- If a central line was in place for less than 48 hours and then removed, the CLABSI criteria must be fully met on the day the line was removed or within 24 hours of removal.[7]

- CLABSI may occur as inpatients or non-inpatients and both are included in surveillance. Non-inpatient CLABSI are present on admission or develop less than 48 hours after admission and are related to the receipt of health care.

2.6 Focus of infection

- The BSI definition requires that the organism cultured from the blood is not related to an infection at another site. A clinical assessment is required to determine if a focus of infection is present that is the likely cause of the BSI. This includes a review of medical records, laboratory, diagnostic and imaging reports. If an infection at another site is identified it must fulfil the infection criteria outlined in The NHSN Surveillance Definitions for Specific Types of Infection[6] found online at NHSN Patient Safety Component Manual.
- If a patient with both peripheral and central lines develops a BSI that can clearly be attributed to the peripheral line e.g. pus at the peripheral line insertion site and the same pathogen from pus and BSI, it should not be reported as a CLABSI.
- Patients suspected or known to have accessed their own central lines that may have contributed to the CLABSI are not excluded from CLABSI surveillance. A facility must implement education and prevention efforts to protect the line.

2.7 CLABSI recurring within 14 days

- If the CLABSI criteria are met again within 14 days and the same organism(s) is identified, a clinical review should be undertaken to determine if the CLABSI is the same event or a new event. The clinical review should include consultation with a clinical microbiologist or infectious diseases physician and consider the following: completion of antimicrobial therapy, resolution of signs and symptoms with negative blood cultures, and central line change.
- If the original infection has resolved, and a new central line has been inserted and the CLABSI criteria are met again, a new CLABSI event should be reported.
- If the new CLABSI event occurs more than 14 days after the previous event then it is always classified as a new event.

2.8 Mucosal barrier injury

- Oral and gastrointestinal mucosal barriers may break down as a result of chemotherapy and radiation treatment regimens. This mucosal barrier injury (MBI) can range from inflammation to ulceration and enables translocation of bacteria from the oral cavity or intestinal tract into the bloodstream and may cause a bloodstream infection.
- MBI-related BSI may occur in patients who are either:
  - Severely neutropenic*, or
  - A recipient of allogeneic haemopoietic stem cell transplant with either GI GVHD or diarrhoea.
- Refer to Appendix 2 for the definition of MBI-related BSI. A list of MBI organisms can be located in the NHSN Patient Safety Component Manual[8].

* Neutropenia is defined as at least 2 separate days with values of total WBC or ANC < 500 cells/mm^3 (<0.5 × 10^9/L) within a 7 day time period which includes the date of the BSI (day one), the 3 calendar days before and the 3 calendar days after[8]. For examples refer to Appendix 3.

Note: In a neutropenic or allogeneic haemopoietic stem cell transplant patient with GI GVHD, who has a BSI caused by a MBI organism (with no other organism isolated, and the BSI is not related to infection at another site), the likely source of the BSI is MBI and not the central line.

Report MBI-related BSI to HISWA stratified by unit for monitoring, however, MBI-related BSI will **not** be included in CLABSI rate calculations.

2.9 Stratification by unit

HISWA CLABSI events are stratified according to specific higher-risk specialty units.

2.9.1 Adult haematology or oncology

Patients managed by these units often have central lines in situ following discharge from hospital. Therefore all CLABSI events that occur either during a hospital admission or as an outpatient are reported.

2.9.2 Adult ICU

- A CLABSI event that occurs more than 48 hours after admission to an adult ICU or within 48 hours of discharge from ICU are reported as ICU-associated.[9]
- High dependency unit, or step down unit patients should only be included if they are co-located within the ICU and managed by the same medical and nursing staff. They are to be included in the ICU surveillance and data.[9]
- When paediatric patients are admitted to an adult ICU on an ad-hoc basis, they should be included in the adult ICU surveillance.[9]

2.10 Healthcare facility attribution

- The CLABSI is attributable to the location where the patient was assigned on the date of the CLABSI event, unless the **transfer rule** (see below) is applicable.
- If all elements of a CLABSI are present within 48 hours of transfer from one location to another in the same facility or new facility, the CLABSI is attributed to the transferring location. This is called the **transfer rule**.[9]
- If a patient is transferred into a facility, with one central line in place, the date and time of the first access as an inpatient is considered when applying the transfer rule (not the date and time of transfer). “Access” is defined as line placement, infusion or withdrawal through the line.
- If a CLABSI develops in a non-inpatient setting, it will be attributed to the facility where the device was last accessed prior to the event.

3. HISWA dataset

3.1 Numerator data fields

The numerator data fields and information required to be entered into the HISWA database are described in Table 1.

3.1.1 Inclusions

- CLABSI occurring as inpatient and non-inpatients in ICU, Haematology and Oncology Units.

3.1.2 Exclusions

- MBI-related BSIs in patients who are neutropenic or a recipient of allogeneic haemopoietic stem cell transplant with either GI GVHD or diarrhoea. MBI-related BSIs are reported to HISWA but not included in CLABSI counts.

Table 1: CLABSI numerator data fields and descriptors for HISWA database

Data field	Descriptor
Patient ID	Unique patient identifier
Date of birth	Patient date of birth
Lab specimen number	Lab number assigned to the specimen
Specimen date	Date the specimen was obtained
Type of central line	The type of central line that was inserted in the patient: • centrally-inserted (CI) central line • peripherally-inserted (PI) central line
Place acquired	Unit associated with the CLABSI and Unit associated with the MBI-related BSI: • ICU • Haematology unit • Oncology unit • MBI – BSI ICU • MBI – BSI haematology • MBI – BSI oncology
Organism 1	The pathogenic organism isolated from a blood culture
Organism 2	The second pathogenic organism isolated from a blood culture
Organism 3	The third pathogenic organism isolated from a blood culture

3.2 Denominator data fields

The denominator that is utilised is central line-days and these are calculated either by tracking or tally methodologies.[9]

3.2.1 Calculating central line days in haematology/oncology units

- A tracking method that counts central line days from the insertion date to the removal date, or to the end of the reporting period, whichever comes first i.e. count central line days during hospital admissions and as outpatients.
- If a line remains in situ at the end of a reporting period, start counting the same line anew from the first day of the next reporting period.

3.2.2 Calculating central line days in ICU

- A tally method that counts the number of patients in ICU that have a CI line or PI central line in situ at approximately the same time each day. Totals are tallied at the end of the month.
- Patients with 2 or more CI central lines in situ are counted as one CI central line.
- Patients with 2 or more PI central lines in situ are counted as one PI central line.
- If there is a PI and CI line in situ, count the CI line only.
- Central line data obtained from electronic databases may be used if it is validated for a minimum three months and the difference is not greater of less than 5 per cent from manual counts.
- A central line tally tool template is available on the IPPSU website.

3.2.3 Sampling of central line days in ICU

- Sample-based estimates of central line days using the tally method have been shown to yield results that are valid for surveillance of CLABSI.
- Central line days must be counted on a minimum of 3 non-consecutive days per week and a monthly calculation is extrapolated from the sample count (Refer to Appendix 5).
- A central line day sampling tool and an excel format template which calculates line days from sampled data are available at IPPSU tools and resources.

4. Calculation of rates

4.1 CLABSI rate

The CLABSI rate is expressed per 1,000 central line days:

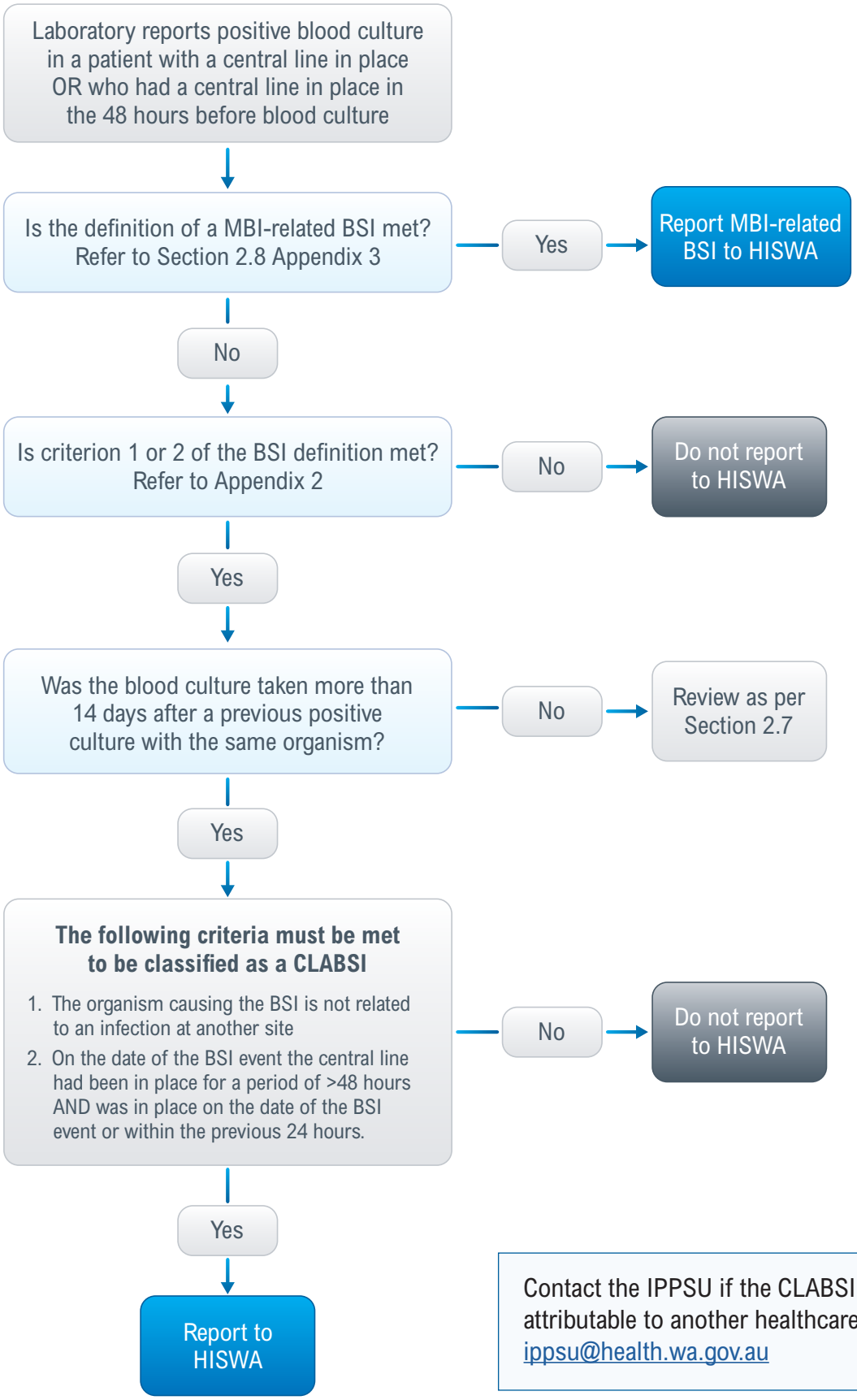
$$\textbf{CLABSI rate} = \frac{\text{Number of CLABSI}}{\text{Number of central line days}} \times 1{,}000$$

4.2 Adult ICU central line utilisation ratio

- The central line utilisation ratio (CLUR) provides an indication of the degree to which ICU patients are exposed to the risk of CLABSI.
- It enables ICUs to determine whether their unit is comparable to other similar units in terms of CI and PI central line utilisation.
- The CLUR is expressed as a percentage:

$$\textbf{CLUR} = \frac{\text{Number of line days}}{\text{Number of bed days (multi and same day bed days)}} \times 100$$

Appendix 1: Methodology for surveillance of CLABSI



Contact the IPPSU if the CLABSI is attributable to another healthcare facility: ippsu@health.wa.gov.au

Note: Ensure CLABSI are entered into other relevant modules e.g. if a MRSA CLABSI, please add to Significant Organsim and Specific Organism Bloodstream Infection Modules.

Appendix 2: Definition of a laboratory-confirmed BSI

A laboratory-confirmed BSI must meet either Criterion 1 or 2:

Criterion 1: recognised pathogen

- The patient has a recognised pathogen isolated from one or more positive blood cultures and is not related to an infection at another site.[7,8]

Comments for Criterion 1

- A recognised pathogen includes any organism that is not considered a potential contaminant.[8]
- Examples of recognised pathogens include: *Staphylococcus aureus, Escherichia coli, Klebsiella* spp, *Pseudomonas aeruginosa, Proteus* spp, *Candida* spp[8] *Streptococcus* Spp (excluding viridans *Streptococcus*), *Enterococcus* Spp, *Enterobacter* Spp and *Providencia* Spp[9].
- No signs or symptoms of infection are required to meet Criterion 1.[8]

Criterion 2: potential contaminant organisms

- The same (matching) potential contaminant organism is cultured from **2** or more blood cultures drawn on separate occasions within 24 hours.[7,8] (Refer to Determining "same" potential contaminant organisms)

AND

- The patient has at least one of the following signs and symptoms: fever (>38°C); chills; or hypotension[7,8] (within 24 hours of the date of the BSI event – see comments)

Comments for Criterion 2

- Organisms that can be considered as potential contaminants of blood cultures include those species that are part of the normal skin flora, such as diphtheroids [*Corynebacterium* spp.], *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group streptococci, *Aerococcus* spp., *Micrococcus* spp. Potential contaminants may also include other bacteria that can be found transiently on the skin such as *Bacillus* [not *B. anthracis*] spp., *Pseudomonas* spp. [other than *P.aeruginosa*], *Xanthomonas* spp., *Raltsonia* spp.[8]
- CDC/NHSN uses the term: "common commensals" and the NHSN list of common commensals is to be used. This can be accessed in the NHSN Organisms List located in the NHSN Patient Safety Component Manual.[8] Any organism that is considered a potential contaminant and is not on this list should be reviewed in liaison with a microbiologist/infectious diseases physician.
- An element refers to a specific component of infection and includes: positive blood culture(s); fever (>38°C), chills and hypotension.[7,8] Criterion elements must occur within a timeframe that does not exceed a gap of 24 hours between any 2 elements e.g. positive blood cultures and fever.[7,8] The same (matching) potential contaminant blood cultures represent a single element.
  The collection date of the first potential contaminant should be used to determine the date of the BSI event.[7,8]

Determining "same" potential contaminant organisms:

- If a potential contaminant organism is identified to the species level from one culture and a companion culture is identified with only a descriptive name (e.g. to the genus level), then it is assumed that the organisms are the "same" (matching).[9]
- Only genus and species identification are required to determine the sameness of organisms. If additional comparative methods are available at your facility (e.g. susceptibility profiles), they should be used in consultation with a clinical microbiologist or infectious disease physician.[9]
- The table below shows examples of "same" (matching) potential contaminant organisms and these should be reported to the species level.[9]

Culture (species level)	Companion culture	Report "same" organisms as
Staphylococcus epidermidis	Coagulase-negative staphylococci	*Staphylococcus epidermidis*
Bacillus cereus	*Bacillus* spp	*Bacillus cereus*
Micrococcus luteus	*Micrococcus* spp	*Micrococcus luteus*
Streptococcus salivarus	Viridans group streptococci	*Streptococcus salivarus*

The phrase "2 or more blood culture sets drawn on separate occasions" means that:

- blood from at least 2 blood draws must be collected on the same day or consecutive calendar days (e.g. blood draws on Monday and Tuesday would be acceptable but blood draws on Monday and Wednesday would be too far apart in time to meet this criterion).[9]
- preparation and decontamination of 2 separate sites for drawing blood aseptically is recommended, e.g. different venepuncture sites, a combination of venepuncture and lumen withdrawal.[9]
- a set of blood cultures includes one aerobic and one anaerobic bottle.
- at least one bottle from each blood draw is reported by the laboratory as having grown the same (matching) potential contaminant (i.e. is a positive blood culture).[9]

Note: For paediatric patients: a blood culture may consist of a single bottle due to volume constraints. Therefore to meet criterion 2, each bottle from 2 single bottle blood draws would have to be culture positive for the same potential contaminant.

Reporting instructions

- Catheter tip cultures are not a substitute for blood cultures in the determination of a BSI. The presence or absence of a positive tip culture does not affect the surveillance definition. Catheters can become colonised by an organism that originates from a different body site. Catheters may have luminal colonisation which may not be detected by usual laboratory culture procedures. In addition, catheters may be contaminated at the time of removal.[9]
- Purulent phlebitis confirmed with a positive semi-quantitative culture of a catheter tip, but with either negative blood culture or no blood culture taken is not a BSI.[9]
- Although blood cultures drawn through central lines can have a higher rate of contamination than blood cultures collected through peripheral venepuncture, all positive blood cultures regardless of the sites from which they are collected must be reported.

Appendix 3: Definition of a MBI-related BSI

MBI-related BSI^ Criterion 1	Patient meets criterion 1 for laboratory-confirmed BSI^, with at least one blood culture growing any of the following intestinal organisms with **no other organisms isolated**: *Bacteriodes* spp., *Candida* spp., *Clostridioides* spp., *Enterococcus* spp., *Fusobacterium* spp., *Peptostreptococcus* spp., *Prevotella* spp., *Veillonella* spp., or *Enterobacteriaceae*. Refer to complete list of MBI organisms at: http://www.cdc.gov/nhsn/PS-Analysis-resources/ **and** patient meets at least one of the following: 1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalisation as positive blood culture: a. Grade III or IV GI GVHD. b. ≥1 litre diarrhoea in a 24-hour period (or ≥20mL/kg in a 24-hour period for patients <18 years or age) with onset on or within 7 calendar days before the date the positive blood culture was collected. 2. Is neutropenic (see Definition Appendix 4).
MBI-related BSI^ Criterion 2	Patient meets criterion 2 for laboratory-confirmed BSI when the blood cultures are growing only viridans group streptococci with **no other organisms isolated** **and** patient meets as least one of the following: 1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalisation as positive blood culture: a. Grade III or IV GI GVHD. b. ≥1 litre diarrhoea in a 24-hour period (or ≥20mL/kg in a 24-hour period for patients <18 years or age) with onset on or within 7 calendar days before the date the positive blood culture was collected. 2. Is neutropenic (see Definition Appendix 4).
Comments	1. MBI-related BSI Criterion 1 and 2 apply to patients of any age including those < one year of age 2. In MBI-related BSI Criterion 1 and 2, "No other organism isolated" means there is no isolation in a blood culture of another recognised pathogen (e.g. *S. aureus*) or 2 matching potential contaminants (e.g. coagulase negative *staphylococci*), other than listed in MBI-related BSI criterion 1 and 2, that would otherwise meet the CLABSI criteria. If this occurs, the infection should not be classified as MBI-related BSI. 3. Grade III/IV GI GVHD is defined as follows: - In adults: ≥1L diarrhoea/day or ileus with abdominal pain - In paediatric patients: ≥20ml/kg/day of diarrhoea.

Adapted from NHSN Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-Central Line-Bloodstream Infection) (2019)

^ HISWA use the term "MBI-related BSI" instead of "mucosal barrier injury laboratory-confirmed bloodstream infections" (MBI LCBI) used by CDC/NHSN

Appendix 4: Examples illustrating the MBI-related BSI definition of neutropenia

		Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day 1*	Day 2	Day 3	Day 4
Pt. A	WBC	100	800	400	300	ND	ND	320	400 +BC* w/ *Candida* spp. x1	ND	550	600
Pt. B	ANC	ND	410	130	ND	ND	120	110	ND + BC* w/ viridians strep x 2 and fever > 38°C	110	300	320
Pt. C	WBC	100	800	400	300	ND	ND	ND	600 +BC* w/ *Candida* spp. x 1	230	ND	400

ND = not done

*Blood culture. Day the blood specimen that was positive was collected.

Definition of Neutropenia

At least 2 separate days with values of ANC or total WBC <500 cells/mm^3 (0.5 x 10^9/L) on or within a 7-day time period which includes the date the positive blood culture was collected (Day 1), the 3 calendar days before and the 3 calendar days after.

Examples

Patient A meets MBI-related BSI criterion 1, sub-criterion 2: Positive blood culture with intestinal organism (*Candida* spp) and neutropenia (2 separate days of WBC <0.5 x 10^9/L occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date). In this case, the Day 1 value = 400, and Day -1 value = 320.

Patient B meets MBI-related BSI criterion 2, sub-criterion 2: At least 2 positive blood cultures with viridians group streptococci (in this case, 2 positive), and fever >38°C and neutropenia (2 separate days of ANC <0.5 x 10^9/L < occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date). In this case, the Day -1 value = 110 and Day -2 value = 120.
Note: any 2 of Days -2, -1, 2, 3 and 4 could be used to meet this requirement since WBC or ANC <500 cells/mm^3 (0.5 x 10^9/L) were present on those days.

Patient C meets MBI-related BSI criterion 1, sub-criterion 2: Positive blood culture with intestinal organism (*Candida* spp) and neutropenia (2 separate days of WBC < 0.5 x 10^9/L occurring on the date the positive blood culture was collected [Day 1] or during the 3 days before or the 3 days after that date).

Appendix 5: CLABSI sampling of ICU central line days – worked example

Central line sampling tool		
Year: 2019 **Month:** August	No. of patients with one or more	
Day of month	**CI central lines**	**PI central lines**
1	20	5
2		
3	22	5
4		
5	15	4
6		
7		
8	24	3
9		
10	25	3
11		
12	24	4
13		
14		
15	20	4
16		
17	22	4
18		
19	18	4
20		
21		
22	25	3
23		
24	22	3
25		
26	25	3
27		
28	22	3
29	24	3
30		
31	20	3
Total line day counts	**328**	**54**

Instructions for line day data collection

- Patients with one or more central lines in situ on a day are counted only once as per these rules:
  - if there are 2 or more CI central lines in situ count one CI central line
  - if there are 2 or more PI central lines in situ count one PI central line
  - if there is a PI and a CI central line in situ, count one CI central line only.
- Counts of central line days will cease on patient discharge from ICU even if the lines remain in situ.
- Count lines at approximately the same time each day.
- Counts of central lines can be performed daily or by sampling, preferably on three or more non-consecutive days per week.

Calculations

Total number of central lines days **(a)**	328	54
Number of days when counts performed **(b)**	15	15
Average number of central lines per day **(c) = a/b**	21.9	3.6
Number of days in the month **(d)**	31	31
Total central line days for month (e) = c x d	**678**	**112**

References

1. Clinical Practice Guideline: Prevention of Blood Culture Contamination. Journal of Emergency Nursing. 2018;44(3).
2. Wise ME, Scott RD, Baggs JM, Edwards JR, Ellingson KD, Fridkin SK, et al. National Estimates of Central Line-Associated Bloodstream Infections in Critical Care Patients. Infection Control & Hospital Epidemiology. 2013;34(6):547-54.
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Module 10

Haemodialysis access-associated bloodstream infection

Contents

Introduction

Haemodialysis places patients at high risk for healthcare-associated infection due to the immunocompromised state intrinsic to end-stage renal disease[2], the high prevalence of diabetes, and numerous human, environmental and procedural factors. The invasiveness of the haemodialysis procedure, which requires vascular access, is an established risk factor for BSI. Haemodialysis access-associated BSI is a serious complication that can result in significant morbidity and mortality.

1. Methodology

For haemodialysis (HD) units to make a valid comparison of access-associated BSI rates the methodology must be similar and definitions consistently applied. It is essential that communication occurs between hospital and satellite HD service providers to ensure that access-associated BSIs are identified and attributed to the correct unit.

Hospital surveillance personnel are required to:

- implement processes to ensure all positive blood culture reports from HD patients are received and investigated to determine if the BSI is access-associated and the attributable HD unit.

Satellite HD personnel are required to:

- contact the IPPSU ippsu@health.wa.gov.au if a patient is transferred to a hospital directly from dialysis for investigation of infection and report if blood cultures or access site specimens were obtained prior to transfer.

Methodology to assist with classification of HD access-associated BSI is described in Appendix 1. Refer to Module 1 for an introduction to HAI surveillance.

Note: Surveillance personnel should take opportunities to promote best practice for blood culture collection to optimise BSI detection and classification as potential contaminants. Ideally blood culture specimens should be aseptically obtained from two to four blood draws from separate venepuncture sites, rather than through an intravascular device.[1]

Aseptic technique incorporating hand hygiene, the use of sterile gloves where appropriate, and ensuring the skin or cannula hub and culture bottle tops are disinfected with an alcohol based disinfectant and allowed to dry prior to access is recommended.

2. Definitions

2.1 Haemodialysis vascular access

- Refers to any intravascular access utilised for the purpose of haemodialysis e.g. cuffed or non-cuffed CVCs, arteriovenous grafts (AVGs) or arteriovenous fistulae (AVFs).

2.2 Haemodialysis access site infection

- An access site infection is defined as the presence of one or more of the following symptoms at the access site: purulent discharge, increased swelling or redness.[4]

2.3 Haemodialysis access-associated BSI

- Firstly, the criteria for classification as a BSI must be met (Refer to Appendix 2: Definition of a laboratory-confirmed BSI).
- An HD access-associated BSI is defined as a BSI in a patient where the source of the BSI is an access site infection or is unknown.[4]
  - if an access site infection is present the BSI is classified as access-associated.
  - where there is no access site infection, active investigation must be taken to determine the presence or absence of a focus of infection at another site. This includes a review of the medical record, laboratory, diagnostic and imaging reports.
  - If a focus of infection at another site other than the access device is considered the likely source of the BSI the infection must fulfil the infection criteria for that site outlined in the CDC NHSN *Surveillance Definitions for Specific Types of Infection*.[5]

Note: Haemodialyis patients often have chronic vascular wounds e.g. leg ulcers, which are colonised with micro-organisms and are not clinically infected. If the same organism is identified in a BSI, it is unlikely that the colonised wound is the source of the BSI.

Rather, it is probable that these organisms have been transmitted to the access site resulting in a BSI or access site infection. Therefore, if there are no other sources of infection, these cases are classified as a HD-BSI.

2.4 New access-associated BSI events

- There must be 21 days or more between positive blood cultures with the same organism for an HD access-associated BSI to be counted as a new event i.e. BSIs that occur less than 21 days apart and with the same organism are considered ongoing infection and are not counted as a new event. The exception to this rule is when a *Staphylococcus aureus* BSI occurs in an HD patient and then a 14-day rule is applied between infection episodes. Refer to Module 6.

2.5 Attribution of BSI to an HD unit

- An access-associated BSI will be attributed to the HD unit where the access device was last accessed prior to developing signs and symptoms of the BSI unless there is compelling evidence to the contrary.

2.6 Stratification by haemodialysis access type

- Haemodialysis access types are stratified for reporting and analysis and are listed in order of increasing risk of infection:
  - **AVF** – the connection of an artery and a vein using the patient's own blood vessels
  - **AVG** – the connection of an artery and a vein using synthetic or native grafts (graft types are combined for reporting)
  - **cuffed catheters** – permanent or semi-permanent, tunnelled central lines e.g. Hickman
  - **non-cuffed catheters** – temporary, non-tunnelled central lines.[4]

3. HISWA dataset

3.1 Numerator data fields

The numerator data fields for HD access-associated BSI required to be entered into the HISWA database are described in Table 1.

Table 1: Haemodialysis access-associated BSI numerator data fields and descriptors for HISWA database

Data field	Descriptor
Patient ID	Unique patient identifier
Date of birth	Patient date of birth
Laboratory specimen number	Laboratory number assigned to the specimen
Specimen date	Date the specimen was obtained
Type of access	Type of access: • AVF • AVG (native and synthetic) • Non-cuffed catheter • Cuffed catheter
Organism 1	The pathogenic organism isolated from a blood culture
Organism 2	The 2nd pathogenic organism isolated from a blood culture
Organism 3	The 3rd pathogenic organism isolated from a blood culture

3.2 Denominator data fields

- The denominator used is the number of patient-months, stratified by the type of vascular access type.
- The data fields required to be entered into the HISWA database each month are described in Table 2.

Table 2: Haemodialysis access-associated BSI denominator data fields for HISWA database

Access type	Number of patient-months
AVF	
AVG (synthetic and native combined)	
Cuffed catheter	
Non-cuffed catheter	

3.2.1 Denominator data collection

- The number of patients who received HD on the first 2 working days of each month, stratified by access type, are counted.
- Links to denominator data collection tools for satellite and in-centre dialysis units is available in Appendix 3. These links are also available on the IPPSU website in IPPSU tools and resources.
  - Each HD patient is only counted once each month on the specified collection date.[4]
  - If the patient has multiple vascular access types, count only the access type with the highest risk of infection,[4] e.g. catheters have a higher risk than AVF or AVG. Refer to section 2.6. Stratification by haemodialysis access type.
  - Non-cuffed catheters are not included in counts from Satellite HD units, as utilisation in this setting is rare.

3.2.2 Inclusions

The following patients are included in the surveillance:

- Chronic adult HD patients.
- Patients receiving HD as "visitors" to another HD unit within WA.

3.2.3 Exclusions

The following patients are excluded in the surveillance:

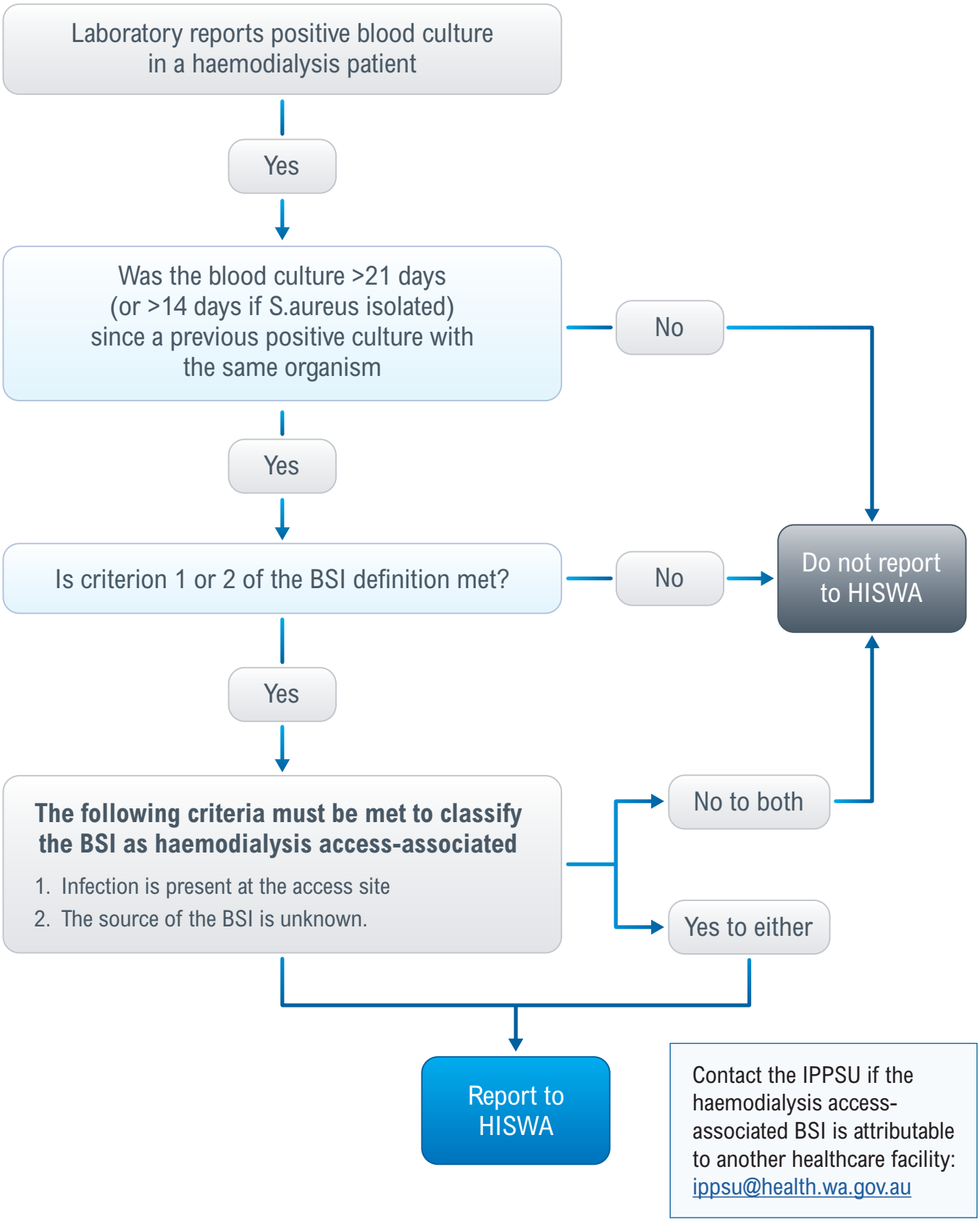
- Patients with acute renal failure requiring HD.
- HD patients who are short term visitors from outside WA, i.e. less than one week.

4. Calculation of rates

- The haemodialysis access-associated BSI rate is expressed per 100 patient-months, stratified by access type, and can be interpreted as the proportion of patients with each access type who develop a BSI each month.

$$\textbf{BSI rate} = \frac{\text{Number of access-associated BSI}}{\text{Number of patient-months}} \times 100$$

Appendix 1: Methodology for determining HD-BSI



Note: Ensure haemodialysis access-associated BSIs are entered into other relevant modules e.g. if the BSI is a MRSA, ensure it is entered into the Specific Organism Module.

Appendix 2: Definition of a laboratory-confirmed BSI

A laboratory-confirmed BSI must meet either Criterion 1 or 2:

Criterion 1: recognised pathogen

- The patient has a recognised pathogen isolated from one or more positive blood cultures.

Comments for Criterion 1

- a 'recognised pathogen' includes any organism that is not considered a potential contaminant.
- examples of recognised pathogens include: *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus* spp, *Candida* spp.

Criterion 2: potential contaminant organisms

- The **same (matching)** potential contaminant organism is cultured from **2** or more blood cultures drawn on separate occasions. (Refer to "Interpreting 'same" potential contaminants)

AND

- the patient has at least one of the following signs and symptoms: fever (>38°C); chills; or hypotension (within 24 hours of the date of the BSI event – see comments)

Note: Other specific signs and symptoms for patients aged one year or less are not listed as paediatric patients are not included in HISWA surveillance. Refer to CDC/NHSN module[3]

Comments for Criterion 2

- Organisms that can be considered as potential contaminants of blood cultures include those species that are part of the normal skin flora, such as diphtheroids [*Corynebacterium* spp.], *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group streptococci, *Aerococcus* spp., *Micrococcus* spp. Potential contaminants may also include other bacteria that can be found transiently on the skin such as *Bacillus* [not *B. anthracis*] spp., *Pseudomonas* spp. [other than *P.aeruginosa*], *Xanthomonas* spp., *Raltsonia* spp.
- CDC/NHSN uses the term: "common commensals" and the NHSN list of common commensals is to be used. This can be accessed at: www.cdc.gov/nhsn/psc/bsi/index.html.
  Any organism that is considered a potential contaminant and is not on this list should be reviewed in liaison with a microbiologist/infectious diseases physician.
- An element refers to a specific component of infection and includes: positive blood culture(s); fever (>38°C), chills and hypotension. Criterion elements must occur within a timeframe that does not exceed a gap of 24 hours between any two elements e.g. positive blood cultures and fever. The same (matching) potential contaminant blood cultures represent a single element. The collection date of the first potential contaminant should be used to determine the date of the BSI event.

Determining "same" potential contaminant organisms

- If potential contaminant organisms are identified to the species level from one culture and a companion culture is identified with only a descriptive name e.g. to the genus level, then it is assumed that the organisms are the "same" (matching).
- Only genus and species identification are required to determine the sameness of organisms. If additional comparative methods are available at your facility e.g. susceptibility profiles, they should be used in consultation with a clinical microbiologist or infectious disease physician.
- Table 3 below shows examples of "same" potential contaminant organisms and these should be reported to the species level.

Table 3

Culture (species level)	Companion culture	Report "same" organisms as
Staphylococcus epidermidis	Coagulase-negative staphylococci	*Staphylococcus epidermidis*
Bacillus cereus	*Bacillus* spp	*Bacillus cereus*
Micrococcus luteus	*Micrococcus* spp	*Micrococcus luteus*
Streptococcus salivarus	Viridans group streptococci	*Streptococcus salivarus*

- The phrase "2 or more blood cultures drawn on separate occasions" means that:
  - Blood from at least 2 blood draws must be collected on the same day or consecutive calendar days (e.g. blood draws on Monday and Tuesday would be acceptable but blood draws on Monday and Wednesday would be too far apart in time to meet this criterion).[6]
  - Preparation and decontamination of 2 separate sites for drawing blood using an aseptic non-touch technique is recommended (e.g. different venepuncture sites, a combination of venepuncture and lumen withdrawal).
  - At least one bottle from each blood draw is reported by the laboratory as having grown the same (matching) potential contaminant (i.e. is a positive blood culture).

Reporting instructions

- Catheter tip cultures are not a substitute for blood cultures in the determination of a BSI. The presence or absence of a positive tip culture does not affect the surveillance definition. Catheters can become colonised by an organism that originates from a different body site. Catheters may have luminal colonisation which may not be detected by usual laboratory culture procedures. In addition, catheters may be contaminated at the time of removal.
- Purulent phlebitis confirmed with a positive semi-quantitative culture of a catheter tip, but with either negative blood culture or no blood culture taken is not a BSI.
- Although blood cultures drawn through central lines can have a higher rate of contamination than blood cultures collected through peripheral venepuncture, all positive blood cultures regardless of the sites from which they are collected must be reported.

Appendix 3: Haemodialysis collection tools

The tools to assist haemodialysis units collect denominator data can be found on the IPPSU tools and resources webpage.

Staff need to refer to the correct methodology for their unit type i.e. incentre or satellite.

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Module 11

Occupational exposure

Contents

Introduction

An occupational exposure occurs when a HCW is put at risk of acquiring a blood-borne viral (BBV) disease, such as hepatitis B virus (HBV), hepatitis C virus (HCV) or human immunodeficiency virus (HIV), through exposure to an infected patient's blood or body fluids.[1-3] Occupational exposures are increasingly regarded as preventable. In addition to education and adherence to standard precautions, the use of safety-engineered medical devices (SEMDs) is an effective measure in eliminating the risk of some exposures.[3]

1. Methodology

- All HCFs should have incident monitoring systems in place for the reporting and management of occupational exposures.
- All occupational exposures to BBVs where a risk assessment has been performed and follow-up is deemed necessary are to be reported to HISWA.
- The minimal data on each occupational exposure is reported to HISWA. Hospitals should collect additional information to ensure a risk management approach is undertaken to prevent occupational exposures.

2. Definitions

2.1 Occupational exposure

- An occupational exposure is an incident that occurs during the course of a person's paid or unpaid work where there is a risk of acquiring a BBV following exposure, typically via broken skin, eyes, mucous membranes or parenteral contact, to another person's blood, tissue, or body fluids that are potentially infected with a BBV.[4]
- Contact between blood or body fluids and intact skin is not considered occupational exposure.

2.2 Parenteral exposure

- Parenteral (or percutaneous) exposures include:
  - any incident where there is a penetration of the skin or mucous membranes with a sharp object including but not limited to needles, scalpels, broken glass, broken capillary tubes, surgical instruments, wires, spicules of bone and teeth, that may be contaminated with blood, tissue or other potentially infectious body fluids.[1]
  - penetration of skin through a dirty/contaminated glove with a clean sharp object.
  - human bites if the HCW skin is broken.

2.3 Non-parenteral exposure

- Non-parenteral (or non-percutaneous) exposures include:
  - any incident where a HCW's mucous membranes e.g. eyes, nose, mouth, or where non-intact skin e.g. skin abrasions, open wounds or skin that is damaged with dermatitis, is exposed to blood, tissue or other potentially infectious body fluids.[4]

2.4 Blood and body fluids

- The following body fluids are considered a potential risk for BBV transmission:
  - blood, serum, plasma and all tissue or body fluids visibly contaminated with blood
  - pleural, amniotic, pericardial, peritoneal, synovial and cerebrospinal fluids, uterine/vaginal secretions or semen
  - laboratory specimens containing concentrated BBV.[5,6]
- Faeces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomitus carry a minimal risk of BBV infection unless they are visibly contaminated with blood or where there is no obvious blood but there is potential for blood contamination.[6,7]

2.5 Classification of healthcare workers

All HCWs, students, contractors and volunteers are included in the surveillance and classified according to Table 1.

Table 1: Classification of HCW occupations and descriptors

HISWA Classification	Descriptor
Doctor (include student)	All medical officers, specialist clinicians, dentists, visiting and student doctors.
Nurse (include student)	All nurses – registered, enrolled; student; midwife; nursing assistant, dental nurses.
Allied health (include student)	Clinical healthcare professionals distinct from medicine, dentistry and nursing e.g. social work, dietetics, podiatry, pharmacy, audiology occupational therapy, physiotherapy, radiography, psychology, speech pathology and prosthetics and student allied health.
Patient support services	Other HCWs providing services that support clinical patient care e.g. patient care assistants, ward orderlies, all technicians (laboratory, theatre, respiratory, orthopaedic, pathology and anaesthetic) and CSSD/TSSU* staff.
Environmental services	HCWs mainly involved in maintaining equipment and the environment e.g. housekeeping, catering, cleaning, laundry workers, waste management, plumbers, engineers, carpenters, maintenance, visiting contractors.
Security	Non-HCWs involved in assisting HCWs in directing patients and visitors as required. May be required to use physical restraint on patients or visitors if there is a risk to safety.
Other	Other employees/workers who do not fit into the above classifications e.g. administrative, clerical, information technology, chaplains, volunteers, transport.

* Central Sterile Supply Department (CSSD) /Theatre Sterile Supply Unit (TSSU)

3. HISWA dataset

3.1 Numerator data fields

The numerator data fields required to be entered into the HISWA database are described in Table 2.

Table 2: Occupational exposure data fields and descriptors for HISWA database

Data field	Descriptor
Identifier	HCW identifier – a unique identifier e.g. initials and DOB, or staff number (but not HE or employee number for confidentiality reasons)
Exposure date	The date of the occupational exposure incident
Occupation	The classification of the HCW reporting the occupational exposure as per Table 1
Type of exposure	• parenteral • non-parenteral

3.1.2 Inclusions

- Report all occupational exposures where a risk assessment has been performed and follow-up is required.
- Report occupational exposures from staff working in all inpatient and outpatient departments of a hospital, including:
  - emergency and outpatient departments, day wards and units e.g. dialysis
  - psychiatric hospitals, and psychiatric units within hospitals
  - HITH
  - rehabilitation wards within hospitals.

3.1.3 Exclusions

- Do not report exposure to faeces, nasal secretions, saliva, sputum, sweat, tears, urine and vomitus to non-intact skin or mucous membranes unless visibly contaminated with blood or there is the potential for blood contamination.
- Do not report occupational exposures sustained by staff from contracted services e.g. PathWest phlebotomy staff, paramedics should not be included in hospital data as their occupational exposures should be recorded by their employer.
- Do not report occupational exposures from visitors who are not employees or contractors e.g. patient visitors.
- Do not report occupational exposures that are not officially reported and documented e.g. anecdotal reports.

3.2 Denominator data fields

The denominator used is the total number of bed-days for the HCF (multi-day and same-day bed-days). Emergency department and outpatient clinic presentations are not included in bed-day data.

4. Calculation of rates

The occupational exposure rate is expressed per 10,000 bed-days.

$$\textbf{Occupational exposure rate} = \frac{\text{Number of exposure}}{\text{Total number of multi and same-day bed-days}} \times 10{,}000$$

References

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Module 12

Bed-day and separation data

Contents

Introduction

All HCFs and haemodialysis units (both privately operated and public units) are required to submit data for a suite of mandatory surveillance indicators to HISWA[1]. Collection of accurate bed-day and separation data is essential to calculate infection rates for these indicators.

1. Roles and responsibilities

- Administrators responsible for the management of patient information data are required to provide monthly bed-day and separation data to surveillance personnel as outlined in this module.
- Surveillance personnel are required to check bed-day and separation data and submit to HISWA within 30 days from the end of the reporting month.
- Surveillance personnel are to regularly liaise with administrators providing the data to ensure HISWA requirements are being met.
- The mandatory indicators and reporting requirements are outlined in MP0108/19 *Healthcare Associated Infection Surveillance in Western Australia Policy*.[2]

2. Definitions

2.1 Bed-days

- Bed-days are defined and calculated as multi-day and same-day. Bed days are a calculation of the number of days of stay for all patients that occurred over a specific period.[3]
- HITH patients are considered admitted patients to a virtual non-ICU ward and are included in all bed-day data.

2.1.1 Multi-day bed-days

A count of beds that are occupied by overnight patients admitted to the hospital for a minimum of one night.[3]

2.1.2 Same-day bed-days

A count of beds/chairs that are occupied by patients that are admitted as same-day patients i.e. the patient is admitted to and separated from the HCF on the same date.[3]

2.2 Separations

- Separations are defined as formal and statistical.[3]
- Separations submitted to HISWA include both formal and statistical separations.
- HITH patients are included in all separation data.

2.2.1 Formal separations

This is the administrative process by which an HCF records the cessation of inpatient treatment and/or care and/or accommodation of a patient.[3]

2.2.2 Statistical separations

This is the administrative process by which an HCF records the cessation of an episode of care for a patient within the one hospital stay i.e. there is a change of care type category (not a change of ward, treatment or client status).[3]

2.3 Newborns

A newborn is a child who is aged 9 days or less.[3]

2.3.1 Unqualified newborns

A newborn who meets at least one of the following criteria:

- is a single live birth or the first live-born infant in a multiple birth, whose mother is currently an admitted patient
- is not admitted to an intensive care facility in a hospital for the provision of special care.[3]

If the unqualified newborn remains in hospital after day 9, then the newborn becomes a boarder.[3]

2.3.2 Qualified newborns

A newborn who meets at least one of the following criteria:

- is the second or subsequent live born infant of a multiple birth whose mother is an admitted patient
- is admitted to a level 2 neonatal intensive care unit (NICU) for the provision of special care
- remains in a hospital without the mother
- is admitted to the hospital without the mother.[3]

2.4 Boarders

A boarder is a person who is receiving food and/or accommodation but for whom the hospital does not accept responsibility for treatment and/or care including:

- family members of an admitted child who are provided with accommodation
- healthy newborns more than nine days of age who do not require acute care and belong to a mother who is admitted to the hospital or transferred to another hospital.[3]

2.5 Contracted services

An episode of care for an admitted patient who's treatment and care is provided under an arrangement between a hospital that purchases the care (funding establishment) and a provider of the admitted service (contracted service provider).[3]

- For the purposes of HISWA surveillance, the denominator bed-day/separation data for an admitted episode of care should be counted for the contracted service provider and not the funding hospital.

2.6 Maintenance care

Maintenance (or non-acute care and sometimes referred to as 'nursing home type patients') is care in which the primary purpose or treatment goal is support for a patient with impairment, activity limitation or participation restriction due to a health condition. Following assessment or treatment the patient does not require further complex assessment or stabilisation. Patients with care type of maintenance care often require care over an indefinite period. Maintenance care excludes care which meets the definition of mental health care. Refer to Hospital Morbidity Data Collection Data Dictionary.

Examples:

1. Hospitals (funding hospital) purchase care for public dialysis patients (contracted patients) at private dialysis units (contracted service provider). Admissions to the private dialysis units for treatment should not be counted in the bed-day/separation data of the funding hospitals.
2. Public hospitals (funding hospital) purchase care for public patients (contracted patients) in private hospitals (contracted service provider). Admissions to private hospitals contracted to provide care to public patients should be counted in the bed-day/separation data of the private hospital.

Note: contracted patients (activity funded by other service providers) will be counted in the denominator data of the contracted service provider only.

3. HISWA data fields

Data fields required to be entered into the HISWA database are outlined in Table 1 and HISWA data field definitions are described in Table 2 and Table 3.

Table 1: Monthly bed-day data required for HISWA

Month	ICU (all ages)	Non-ICU (all ages)	Psychiatric (all ages)	Unqualified Newborns	Patients < 2 years of age*
Multi-day bed-days					
Same-day bed-days					
Multi-day separations (formal and statistical)					
Same-day separations (formal and statistical)					

* Patients < 2 years of age on the date of their admission

4. HISWA data field definitions

Table 2: HISWA bed-day data fields

Definitions	ICU (all ages)	Non-ICU wards/ units (all ages)	Psychiatric wards/units (all ages)	Unqualified Newborns	Patients < 2 years of age*
Multi-day bed-days	admitted patients with an overnight stay in ICU***	admitted patients with overnight stay in non-ICU wards/units i.e. excluding ICU and psychiatric units***	admitted patients with overnight stay in a psychiatric ward/unit***	unqualified newborns where the mother is admitted with an overnight stay in ICU, non-ICU and psychiatric units***	patients < 2 years of age admitted with an overnight stay in ICU, non-ICU or psychiatric units***
Inclusions	qualified newborns	HITH, qualified newborns	HITH, qualified newborns	HITH	HITH, qualified newborns
Exclusions	same-day admissions, unqualified newborns, universal exclusions**	same-day admissions, unqualified newborns, universal exclusions**	same-day admissions, unqualified newborns, universal exclusions**	same-day admissions qualified newborns, universal exclusions**	same-day admissions, unqualified newborns, universal exclusions**
Same-day bed-days	patients separated from the HCF directly from ICU on the same-day of admission. This does not include transfers from the ICU to wards***	patients separated from non-ICU wards/units i.e. excluding ICU and psychiatric units, on the same day of admission***	patients separated from psychiatric wards/units on the same day of admission***	unqualified newborns where the mother is separated on the same-day of admission from ICU, non-ICU and psychiatric units***	patients < 2 years of age separated from the ICU, non-ICU and psychiatric units on the same-day of admission***
Inclusions	qualified newborns	HITH, qualified newborns	HITH, qualified newborns	HITH	HITH, qualified newborns
Exclusions	multi-day admissions, unqualified newborns, universal exclusions**	multi-day admissions, unqualified newborns, universal exclusions**	multi-day admissions, unqualified newborns, universal exclusions**	multi-day admissions qualified newborns, universal exclusions**	multi-day admissions, unqualified newborns, universal exclusions**

* Patients < 2 years of age on the date of their admission

** **Universal exclusions** are exclusions from all HISWA data and include: boarders, contracted patients, Rehabilitation in the Home (RITH), organ procurement, small WACHS hospitals and residents of Residential Aged Care Reporting Establishments within WACHS.

*** Maintenance type care patients should be included in same day AND multi day bed days and separations for non-ICU wards/units.

Table 3: HISWA separation data fields

Month	ICU (all ages)	Non-ICU wards/ units (all ages)	Psychiatric wards/units (all ages)	Unqualified Newborns	Patients < 2 years of age*
Multi-day separations (formal and statistical)	patients discharged or separated from ICU following an episode of care that includes an overnight stay***	patients discharged from non-ICU wards i.e. excluding ICU and psychiatric units, following an episode of care that includes an overnight stay***	patients discharged from psychiatric units following an episode of care that includes an overnight stay***	unqualified newborns where the mother is separated following an episode of care that involves overnight stay in ICU, non-ICU and psychiatric units***	Patients < 2 years of age separated from the HCF following an episode of care that includes an overnight stay***
Inclusions	qualified newborns	HITH, qualified newborns	qualified newborns	HITH	qualified newborns
Exclusions	same-day separations, unqualified newborns, universal exclusions**	same-day separations, unqualified newborns, universal exclusions**	same-day separations, unqualified newborns, universal exclusions**	same-day separations qualified newborns, universal exclusions**	same-day separations, unqualified newborns, universal exclusions**
Same-day separations (includes formal and statistical)	patients separated from the HCF directly from ICU on the same-day of admission. This does not include transfers from the ICU to wards***	patients separated from the non-ICU wards/units i.e. excluding ICU and psychiatric units, on the same day of admission***	patients separated from psychiatric units on the same day of admission***	unqualified newborns where the mother is separated on the same day of admission from ICU, non-ICU and psychiatric units***	patients < 2 years of age separated from the ICU, non-ICU and psychiatric on the same-day of admission***
Inclusions	qualified newborns	HITH, qualified newborns	HITH, qualified newborns	HITH	qualified newborns
Exclusions	multi-day separations, unqualified newborns, universal exclusions**	multi-day separations, unqualified newborns, universal exclusions**	multi-day separations, unqualified newborns, universal exclusions**	multi-day separations, qualified newborns, universal exclusions**	multi-day separations, unqualified newborns, universal exclusions**

* Patients < 2 years of age on the date of their admission

** **Universal exclusions** are exclusions from all HISWA data and include: boarders, contracted patients, Rehabilitation in the Home (RITH), organ procurement, small WACHS hospitals and residents of Residential Aged Care Reporting Establishments within WACHS.

*** Maintenance type care patients should be included in same day AND multi day bed days and separations for non-ICU wards/units.

5. National surveillance data

Patient-days are the standard denominator used for national reporting of HAI surveillance data. Patient-day denominator data for public HCFs in WA will be obtained from the state information management systems for national reporting as required.[4]

Patient-days are calculated by counting the total patient-days of those patients separated during the specified period, including those admitted before the specified period. Patient-days of those patients admitted during the specified period who did not separate until another reporting period are not counted until the period of separation.[4]

5.1 Variations between HISWA and national data

- HISWA uses bed-days to calculate rates. The yearly variance between calculations of patient-days and bed-days is reported to be less than one percent, however, the monthly variation can be quite significant for smaller hospitals.[4]

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