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Healthcare Infection Surveillance Western Australia

Annual Report 2013-2014

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Acknowledgments

The Healthcare Associated Infection Unit (HAIU) would like to acknowledge the dedication and commitment of all our HISWA contributors as well as the support provided by laboratory scientists, microbiologists, infectious disease physicians, and information technology and executive staff across the private and public sectors. All these staff continue to work collaboratively to improve the systems and processes that reduce infection risks to patients cared for in Western Australian hospitals.

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This publication has been produced by the Communicable Disease Control Directorate.

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The data presented was extracted from the HISWA database on 20 August 2014. As HISWA data is subject to ongoing validation, data from previously published HISWA reports should not be used as a current reference. All data in this report are de-identified.

Foreword

The *9th Annual Report of Healthcare Infection Surveillance Western Australian (HISWA)* evaluates healthcare-associated infection (HAI) data and summarises the impact these infections have on healthcare facilities (HCFs) in Western Australia (WA). Infections resulting from the provision of healthcare are among the most common causes of unintended harm suffered by healthcare consumers. HAIs can result in prolonged length of stay, increased antimicrobial resistance, greater healthcare costs, increased morbidity and mortality, and added physical and emotional costs to patients and their families. They are a major, yet often preventable, threat to patient safety.

Prevention of HAIs is at the heart of patient safety and is the responsibility not just of infection prevention and control professionals, but of all who are involved in the provision of care to patients or make decisions about our healthcare systems. It is this collaborative approach, both within our hospitals and across our health services that is required to further reduce the burden of HAIs for our patients and thus provide them with a safer patient journey.

The *HISWA Annual Report 2013-14* identifies areas where further infection prevention strategies are required to be initiated to reduce specific HAIs. In addition, it is important to remember that the 625 HAIs reported to HISWA in 2013-14 only represent a proportion of the HAIs occurring in our hospitals.

Encouragingly, the *HISWA Annual Report 2013-14* shows trends that reflect the ongoing efforts of clinicians, laboratory scientists, microbiologists, infectious disease physicians, information technology and executive staff across the private and public sectors who work diligently to reduce the burden of HAIs and improve patient outcomes. All these staff continue to work collaboratively to improve the systems and processes that reduce infection risks to patients cared for in Western Australian hospitals.

In acknowledging the dedication and commitment of all healthcare professionals, both within WA Health and the private sector, who participate in the surveillance and prevention of HAIs, we must remember that there are still areas where we can make considerable improvements, and we must all continue to work together to achieve further success.

Professor Bryant Stokes
A/DIRECTOR GENERAL

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Introduction

The *Healthcare Infection Surveillance Western Australian (HISWA) Annual Report 2013-14* provides a summary and analysis of data that was contributed to the HISWA program during the 2013-14 reporting period.

Although data is analysed and reported each quarter, the annual report provides an opportunity to analyse state-wide data in more depth. Where data is available from other Australian jurisdictions and international surveillance programs, HISWA data is adjusted to allow for meaningful comparison.

WA Health mandates the collection of data for key indicators through its *Operational Directive: Healthcare Associated Infection Surveillance in Western Australia,* while private sector support for the program is evidenced by the voluntary participation in HISWA by all private healthcare facilities (HCFs) in WA. This collaborative approach to jurisdictional surveillance enables comprehensive review of key patient safety and quality indicators across the full spectrum of acute healthcare.

With the introduction of public reporting of HAIs, as part of state and national performance measures, the need for valid, reliable and credible data is essential. The Healthcare Associated Infection Unit (HAIU) has introduced several validation processes to ensure HISWA data meet these criteria and can be reliably benchmarked against national and international performance.

Healthcare associated infections are a major, yet often preventable, threat to patient safety and the value of surveillance data produced by the HISWA program should not be understated. The HISWA 2013-14 Report highlights several areas where we have made significant improvements in reducing HAIs, but it also identifies areas of concern and these areas need to be a focus for quality improvement initiatives during 2015 and beyond.

The Healthcare Associated Infection Unit

Executive Summaries

Surgical Site Infection Following Hip and Knee Arthroplasty

Background

- Surgical site infection (SSI) following hip and knee arthroplasty is a good indicator of the quality of surgical care.
- Data collection commenced in July 2005 and has been mandatory for all public hospitals and private hospitals contracted to provide care for public patients since October 2007.
- Private hospitals have voluntarily submitted data since July 2005.
- All hospitals that perform these procedures in WA submit data to HISWA.
- A total of 20 healthcare facilities (10 private and 10 public) submitted data following hip and knee arthroplasty during this surveillance period.

Key results 2013 – 2014

- Between July 01 2013 and June 30 2014, 9,255 arthroplasty procedures were performed.
- Data included 3,667 hip procedures and 5,588 knee procedures.
- The majority (73%) of all procedures were performed at private hospitals.
- There were 41 hip and 36 knee SSIs reported during this surveillance period.
- The infection rate following hip arthroplasty decreased to 1.12 infections per 100 procedures, compared to 1.31 reported in 2012-13.
- The infection rate following knee arthroplasty decreased to 0.65 infections per 100 procedures, compared to 0.78 reported in 2012-13.
- Both the hip and knee SSI rates recorded in this reporting period are the lowest reported since data collection commenced in 2005.
- The majority of all hip (66%) and knee (59%) arthroplasty infections were caused by Gram-positive bacteria.

Impact

- The 77 SSIs reported in 2013-14 are estimated to have cost WA healthcare facilities $3,506,465 and contributed 2,079 additional bed-days.[1]

[1]Costing based on Victorian Infection Control Nosocomial Infection Surveillance System (VICNISS) economic costing[1] and adjusted using Australian Institute of Health and Welfare (AIHW) annual health inflation rates 2006-07 to 2012-13 [2]

Surgical Site Infection Following Caesarean Section

Background

- Surgical site infection (SSI) following caesarean section is considered a preventable complication and the consequences of mothers having to cope with a SSI following childbirth are not insignificant.
- Data collection commenced in April 2011 and includes both elective and emergency caesarean section procedures.
- This is a voluntary indicator, and both private and public HCFs contribute data.
- The majority of contributing hospitals do not perform post-discharge surveillance.
- HISWA data represents 79% of hospitals that perform caesarean sections in WA.
- A total of 28 healthcare facilities (6 private and 22 public) submitted data following caesarean section during this surveillance period.

Key results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 7,894 caesarean section procedures were performed at HISWA contributing sites.
- Public hospitals performed the majority (65%) of procedures reported to HISWA.
- Emergency procedures accounted for 4,006 (51%) of cases reported.
- A total of 70 SSIs following caesarean section were identified.
- The total infection rate following caesarean section increased to 0.89 infections per 100 procedures, compared to 0.84 reported in 2012-13.
- The SSI rate following an emergency procedure increased to 0.97 infections per 100 procedures compared to 0.68 reported in 2012-13.
- The SSI rate following elective procedures of 0.46 infections per 100 procedures was comparable to that reported in 2012-13.
- The majority (73%) of SSIs were classified as superficial infections.
- The majority (54%) of SSIs reported were identified when the patient required readmission to the HCF for management of the SSI.

Impact

- Currently there are no suitable economic costing studies for this indicator, however, a study conducted at one Australian hospital found an increased length of stay of 4 days for women who had an SSI diagnosed during their initial admission.[2]

[2] Length of stay (LOS) data from Henman et al. (2012) [3]

Methicillin-resistant *Staphylococcus aureus* Infection

Background

- Infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA) cause significant morbidity, with attributable mortality from an MRSA bloodstream infection (BSI) ranging from 10% to 50%. [4]
- Data collection commenced in July 2005 and has been mandatory for all public hospitals and private hospitals contracted to provide care for public patients since October 2007.
- Private hospitals have voluntarily submitted data since July 2005.
- A total of 46 healthcare facilities (14 private and 32 public) submitted MRSA healthcare associated infection (HAI) data during this surveillance period.
- All MRSA data submitted to HISWA is validated by cross-reference with the Australian Collaborating Centre for Enterococcus and Staphylococcus Species (ACCESS) Typing and Research database.

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 181 patients developed an MRSA infection related to the provision of healthcare.
- The total rate of MRSA HAI increased this reporting period to 0.95 infections per 10,000 bed-days. This is the second consecutive year the total MRSA HAI rate has increased.
- The majority of MRSA HAIs (93%) were associated with inpatient care, with 86% reported from non-ICU settings.
- The majority (67%) of MRSA HAIs were caused by local WA community clones, which is in keeping with historical trends.
- 34% of MRSA HAIs occurred in patients who were known to be colonised with MRSA prior to the onset of their infection.
- 20% of MRSA HAIs were bloodstream infections, which are associated with significant morbidity and mortality.

Impact

- There are no suitable economic costing studies to cost all types of MRSA HAIs. However, the 27 MRSA HAI BSIs reported in 2013-14 are estimated to have cost WA healthcare facilities $870,596 and contributed 243 additional bed-days.[3]

[3] Costing based on Cosgrove et al. (2005)[5] and adjusted using AIHW annual health inflation rates 2005-06 to 2012-13 Australian Institute of Health and Welfare Australian Institute of Health and Welfare [2]

Hospital-identified *Clostridium difficile* Infection

Background

- *Clostridium difficile* infection (CDI) can range from mild diarrhoea to life-threatening colitis. The incidence and severity of CDI is increasing worldwide, including in Australia. In addition to significant morbidity and mortality, CDI increases healthcare costs due to prolonged hospital length of stay and re-hospitalisations.
- The hospital-identified *Clostridium difficile* infection (HI-CDI) indicator provides data on the burden of CDI borne by our hospitals and includes both community associated and healthcare associated infections.
- Data collection commenced in January 2010 and has been mandatory for all public hospitals and private hospitals contracted to provide care for public patients since that time.
- Private hospitals have voluntarily submitted data since January 2010.
- A total of 45 healthcare facilities (13 private and 32 public) submitted hospital-identified CDI data during this surveillance period.
- All hospital-identified CDI data submitted to HISWA from public hospitals is validated by the Healthcare Associated Infection Unit (HAIU).

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 844 cases of HI-CDI were reported.
- The overall rate of HI-CDI for this reporting period was 3.40 infections per 10,000 bed-days. This was lower than the rate of 3.70 reported in 2012-13 ($p>0.05$).
- The majority (57%) of cases were reported by the three adult tertiary hospitals.
- The number of HI-CDI cases being identified at WA hospitals appears to have stabilised in this reporting period compared to the marked increase reported in 2011-12.
- The HAIU validation process identified 68 additional cases, 12 duplicates and 39 cases that did not meet the case criteria; the HISWA database was adjusted accordingly.

Impact

- The burden of CDI identified at WA hospitals has increased significantly since reporting commenced in 2010.
- This indicator is a surrogate marker for the incidence of CDI that is identified at a particular healthcare facility. It is not an indicator of CDI cases that can be prevented by an individual healthcare facility and therefore is not suitable for use as a performance indicator.

Vancomycin-resistant Enterococci Infection

Background

- Although not highly pathogenic, vancomycin-resistant enterococci (VRE) can cause severe infections in critically ill and immunocompromised patients.
- The increasing incidence of HAIs caused by VRE internationally and in Australia, is of concern due to the limited antimicrobial agents available to treat VRE infections.
- In addition, the vancomycin resistance gene has the potential to be transmitted to other more pathogenic organisms, such as *Staphylococcus aureus.*
- Data collection commenced in January 2012 and is mandatory for all public hospitals and private hospitals contracted to provide care for public patients.
- Private hospitals can voluntarily submit data.
- The HAIU obtains additional VRE infection data from the Australian Collaborating Centre for Enterococcus and Staphylococcus Species (ACCESS) Typing and Research database.
- The data contained in this report is data from both reporting streams and the HAIU validates all cases of VRE HAI from both sources.

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 735 VRE isolates were referred to the PathWest Gram Positive Typing Laboratory.
- Of these isolates 96% were screening samples and 4% were identified as clinical specimens.
- Of the 39 VRE clinical specimens, 30 (77%) were classified as clinical infections, with the remaining nine representing patient colonisation with no evidence of clinical infection.
- There were 29 HAIs identified from the 30 clinical infections, with seven HAIs being bloodstream infections.
- 50% of the clinical infections occurred in patients who were colonised with VRE prior to onset of infection

Impact

There are currently no costings available for the 29 VRE HAIs reported in 2013-14.

Staphylococcus aureus Bloodstream Infection

Background

- *Staphylococcus aureus* is the most common cause of healthcare associated bloodstream infection, and causes significant morbidity and mortality. The majority of episodes are associated with intravascular device usage and are considered to be preventable adverse events.
- Data collection commenced in October 2007 and has been a mandatory indicator since that time for all public hospitals and private hospitals contracted to provide care for public patients.
- Private hospitals have voluntarily submitted data since October 2007.
- A total of 45 healthcare facilities (13 private and 32 public) in WA submitted healthcare associated *Staphylococcus aureus* bloodstream infection (HA-SABSI) data during this surveillance period.
- All episodes of HA-SABSI identified in public hospitals are validated by the HAIU.

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 191 episodes of HA-SABSI were reported.
- The majority (86%) of these were attributed to inpatient care.
- The overall HA-SABSI rate increased for the second consecutive reporting period to 0.83 infections per 10,000 bed-days and is the highest rate reported since the 2009-10 reporting period.
- The majority (81%) of HA-SABSIs were caused by methicillin-sensitive *Staphylococcus aureus* (MSSA), which is in keeping with historical trends.
- The majority (44%) of HA-SABSIs were attributable to an intravascular device.
- The majority (67%) of all HA-SABSIs were reported by the three adult tertiary hospitals.

Impact

- The 191 HA-SABSIs reported in 2013-14 are estimated to have cost WA healthcare facilities $5,311,685 and contributed 2,197 additional bed-days.[4]

[4] Costing based on Wilkinson (2004)[6] and adjusted using AIHW annual health inflation rates 2004-05 to 2012-13 Australian Institute of Health and Welfare Australian Institute of Health and Welfare [2]

Central Line Associated Bloodstream Infection

Background

- The use of central venous catheters is crucial in the management of critically ill and immunocompromised patients. However, they are a common cause of healthcare associated bloodstream infection and are considered to be preventable adverse events.
- Data collection commenced in July 2005 and targets specific patient groups with similar risks for developing a central line-associated bloodstream infection (CLABSI).
- Reporting of events from adult intensive care units (ICUs) has been a mandatory indicator for all public hospitals and private hospitals contracted to provide care for public patients since October 2009.
- Private hospitals voluntarily submit data.
- A total of 11 adult ICUs submitted data to HISWA during this surveillance period and this represents 100% coverage of adult ICUs in WA.
- Four oncology and two haematology units and submitted CLABSI data during this surveillance period. One large private oncology unit commenced data submission for oncology CLABSI in this reporting period.

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 28 CLABSIs were reported: 15 events in ICUs, 11 events in haematology units and two events in oncology units.
- The adult ICU CLABSI rate increased to 0.72 infections per 1,000 central line days compared with 0.46 in 2012-13. This increase was not significant ($p>0.05$).
- The haematology CLABSI rate decreased to 0.76 infections per 1,000 central line days compared with 0.88 in 2012-13. This decrease was not significant ($p>0.05$).
- The oncology CLABSI rate decreased to 0.02 infections per 1,000 central line days compared with 0.08 in the 2012-13 period. This decrease was not significant ($p>0.05$).

Impact

- The economic impact of these 28 CLABSIs is difficult to establish as treatment costs and increased length of hospital stays vary markedly for the different clinical groups.

Haemodialysis Access-associated Bloodstream Infection

Background

- Sepsis and infection remain the second most common cause of death in patients requiring chronic haemodialysis.
- Data collection commenced in July 2005 and has been mandatory for all public hospitals and the private hospital and satellite units contracted to provide care for public patients since July 2009.
- Two new satellite haemodialysis units commenced surveillance in 2014 and data from these units is included in this report for the first time.
- 23 dialysis units in WA submitted haemodialysis access-associated bloodstream infection (HD-BSI) data during this surveillance period.
- HISWA data represents 100% coverage of haemodialysis services in WA.

Key Results 2013 – 2014

- Between July 01 2013 and June 30 2014, a total of 46 HD-BSIs were reported to HISWA.
- 42 (91%) of these were related to the presence of cuffed catheters.
- The cuffed catheter (CC) BSI rate increased to 1.79 infections per 100 patient-months compared to 1.53 reported in 2012-13.
- In keeping with historical trends, arteriovenous fistula (AVF) was the most common access type utilised, with 75.5% of patient-months attributed to these. AVFs are associated with the lowest risk of infection.
- The AVF HD-BSI rate was 0.03 infections per 100 patient-months, which is the same rate reported in 2012-13.

Impact

- The 46 HD-BSIs reported in 2013-14 are estimated to have cost WA healthcare facilities $1,440,843 and contributed 782 additional bed-days.[5]

[5] Costing based on Ramanathan et al. (2007)[7] and adjusted using AIHW annual health inflation rates 2007-08 to 2012-13 Australian Institute of Health and Welfare Australian Institute of Health and Welfare [2]

Occupational Exposures

Background

- There is currently no standardised national surveillance of occupational exposures in Australia. Available data indicates healthcare workers (HCWs) continue to have an unacceptable risk of blood borne virus exposure.
- Data collection commenced in January 2008 and has been mandatory for all public hospitals and private hospitals contracted to provide care for public patients since then.
- 14 private hospitals voluntarily submit data.
- A total of 47 healthcare facilities (14 private and 33 public) in WA submitted occupational exposure data during this surveillance period.
- Reported exposures included both parenteral (piercing of skin or mucous membranes with a contaminated sharp) and non-parenteral (mucous membrane or non-intact skin contact with blood or body fluid) events.

Key Results 2013 – 2014

- In the 2013-14 reporting period, 383 non-parenteral and 1,409 parenteral occupational exposures were reported by the 47 healthcare facilities.
- The majority of non-parenteral (63%) exposures were reported by nursing staff.
- Historically, nursing staff have reported the majority of parenteral exposures, however for the past two reporting periods the proportion of reported events between nursing and medical staff has been comparable.
- The parenteral occupational exposure rate increased to 4.01 exposures per 10,000 bed-days compared to 3.99 reported in 2012-13.
- The non- parenteral occupational exposure rate increased to 1.50 exposures per 10,000 bed-days compared to 1.31 reported in 2012-13.
- Metropolitan tertiary hospitals reported a significantly higher rate ($p<0.01$) of occupational exposures than all other hospital groups.

Impact

The 1,792 occupational exposures reported in 2013-14 are estimated to have cost WA healthcare facilities a minimum of $1,322,714 for initial testing, counselling, and post-exposure management for an uncomplicated exposure.[6]

[6] Costing based on Martland (2008)[8] and adjusted using AIHW annual health inflation rates 2008-09 to 2012-13 Australian Institute of Health and WelfareAustralian Institute of Health and Welfare [2]

National Hand Hygiene Initiative

Background

- Observational studies have repeatedly identified suboptimal hand hygiene practices by healthcare workers (HCWs) and it has been suggested that 60% of healthcare associated *Staphylococcus aureus* bloodstream infections in Australia are probably directly related to the poor hand hygiene compliance of Australian HCWs.[9]
- The National Hand Hygiene Initiative (NHHI), which incorporates the World Health Organization's '5 moments for hand hygiene' framework, includes tri-annual auditing of HCW hand hygiene practice using a national standardised observation tool.
- Participation in the NHHI by WA hospitals commenced in 2009 and became a mandatory requirement for WA public metropolitan, regional resource centres, integrated district hospitals and those private hospitals contracted to provide care to public patients in February 2010.
- All public hospital hand hygiene data and the majority of private hospitals in WA submit data to the National Health Performance Authority. This identifiable data can be viewed at http://www.myhospitals.gov.au/.
- WA Health hand hygiene data is publicly released and hospital performance since 2009 can be viewed at http://www.health.wa.gov.au/handhygiene/home/.

Key Results 2014

- A total of 81 hospitals submitted hand hygiene data in 2013-14. This included 5 tertiary, 5 metropolitan non- tertiary, 6 regional resource centres, 15 integrated district hospitals, 37 small country and 13 private health care facilities.
- Overall hand hygiene compliance results for 2013-14 for WA public hospitals was 78.1% and 76.8% for private hospitals.
- Hand hygiene compliance continues to be performed better amongst nursing staff than medical staff in both the public and private sectors, although there has been a noted increase in compliance by medical staff over time. This trend is also demonstrated in national data sets.
- Hand hygiene compliance in WA hospitals has improved significantly since the commencement of the program in 2009.

Surgical site infection following hip and knee arthroplasty

Surgical site infection following hip and knee arthroplasty

The development of a surgical site infection (SSI) following a joint replacement (arthroplasty) is the most significant complication associated with these procedures, and is an adverse event that can have serious consequences.[10] These infections often result in increased morbidity and mortality, prolonged hospital stay and long-term antibiotic treatment, with patients commonly requiring revision procedures. The associated increased healthcare costs are significant.[11-16]

Participating hospitals

For the 2013-14 surveillance period, 20 hospitals monitored and reported SSIs following hip and knee arthroplasty to HISWA. This represents 100% coverage of hospitals performing these procedures in Western Australia (WA). Hospital demographics included 14 metropolitan (eight private and six public) and six regional (two private and four public) hospitals. As in previous years, the majority of all hip and knee procedures (69% and 76% respectively) were performed in private hospitals.

Surveillance

Between July 01 2013 and June 30 2014, a total of 9,255 arthroplasty procedures were reported to HISWA. This represents a 9% increase in the number of procedures performed compared to the 2012-13 reporting period (n=8,512). This total figure comprised 3,667 hip and 5,588 knee arthroplasty procedures. There were 41 SSIs identified following hip arthroplasty and 36 SSIs following knee arthroplasty.

SSIs detected during the initial admission or on readmission to hospital are included in HISWA calculated SSI rates. As not all contributing hospitals routinely perform post-discharge surveillance (PDS) and there is no standardised PDS methodology, SSIs that are detected by PDS and treated in outpatient or primary care settings are not included in the calculated SSI rates. During the 2013-14 reporting period, there were three superficial knee SSIs reported that were detected by PDS.

SSI data submitted to HISWA is verified in regards to procedure and infection onset dates, information on the microbiological specimen and point of detection of the SSI. Data in HISWA is adjusted accordingly when non-congruent data is identified. Since January 2012, the HAIU commenced a formal validation process to ensure correct SSI classification and application of definitions by our contributors. HISWA data combines deep incisional and organ/space infections to allow for more meaningful statistical analysis. For the purpose of this report these combined infections are referred to as ‘deep’ SSIs.

When interpreting reported SSI rates per 100 procedures, the width of confidence intervals should be taken into account. Hospitals that perform few procedures and have wide confidence intervals may show greater variation in rates between reporting periods.

Data collection commenced in 2005, however in the following section, the results and analysis of SSIs following hip and knee arthroplasty procedures since the 2009-10 reporting period is used to demonstrate five year trends.

Table 1 SSI rates following hip and knee arthroplasty, 2009-10 to 2013-14

Procedure	Year	Number of SSI	Number of procedures	Aggregated infection rate per 100 procedures [95%CI]
Hip	**2009-10**	42	2,847	1.48 [1.09 – 2.00]
	2010-11	35	3,085	1.13 [0.81 - 1.58]
	2011-12	41	3,204	1.28 [0.94 - 1.74]
	2012-13	44	3,380	1.30 [0.97 - 1.75]
	2013-14	41	3,667	1.12 [0.82 - 1.52]
	Cumulative 2009-14	**203**	**16,183**	**1.25 [1.09 - 1.44]**
Knee	**2009-10**	61	4,015	1.52 [1.18 - 1.95]
	2010-11	77	4,630	1.66 [1.33 - 2.08]
	2011-12	51	4,976	1.02 [0.78 - 1.35]
	2012-13	40	5,132	0.78 [0.57 - 1.06]
	2013-14	36	5,588	0.64 [0.46 - 0.89]
	Cumulative 2009-14	**265**	**24,341**	**1.09 [0.97 - 1.23]**

Table 1 shows data for the number of infections, number of procedures and infection rates for all reporting periods since 2009. These infection data include both primary and revision procedures, superficial and deep SSIs, and those SSI detected during initial admission or at readmission.

The hip SSI rate has decreased from 1.48 per 100 procedures reported in 2009-10 to 1.12 in this reporting period, however this is not statistically significant ($p>0.05$). The 2013-14 rate is also lower than the five-year cumulative rate of 1.25 per 100 procedures.

The knee SSI rate has decreased from 1.52 per 100 procedures reported in 2009-10 to 0.64 in this reporting period and is statistically significant ($p< 0.01$). This rate is also lower than the five-year cumulative rate of 1.09 per 100 procedures.

A comparison of these data, showing performance since 2009-10, is presented in Figure 1.

Figure 1 SSI rates following hip and knee arthroplasty, 2009-10 to 2013-14

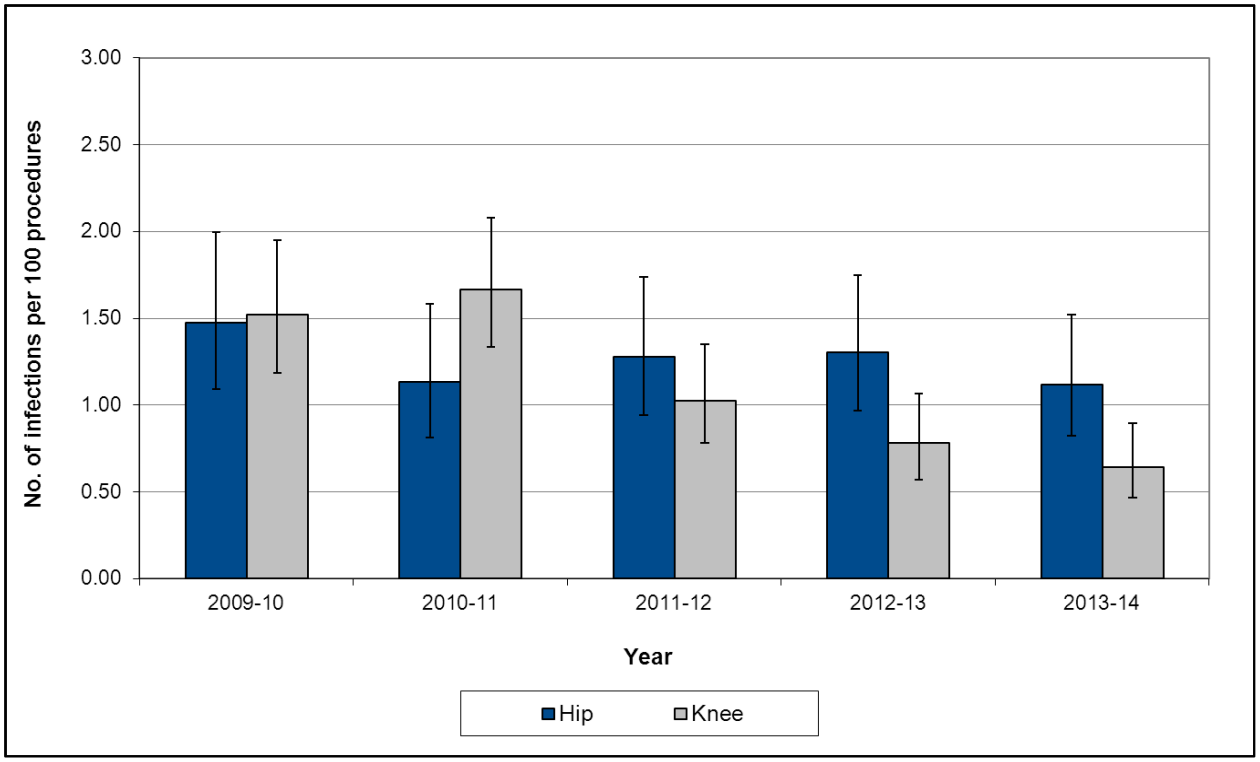


Figure 1 is a graphical representation of the data presented in Table 1. The aggregate infection rate following hip arthroplasty decreased in 2013-14 to 1.12 infections per 100 procedures, compared to the rate of 1.30 reported in 2012-13. This decrease was not statistically significant ($p>0.05$) however, the 2013-14 hip rate is the lowest reported in the five year period.

The aggregate infection rate following knee arthroplasty in 2013-14 decreased for the third consecutive year to 0.64 infections per 100 procedures compared to the rate of 0.78 reported in 2012-13. This decrease was not statistically significant ($p>0.05$), however the 2013-14 knee SSI rate of 0.64 is the lowest reported in the five year period.

Figure 2 Hip and Knee SSI rates by procedure type, 2009-10 to 2013-14

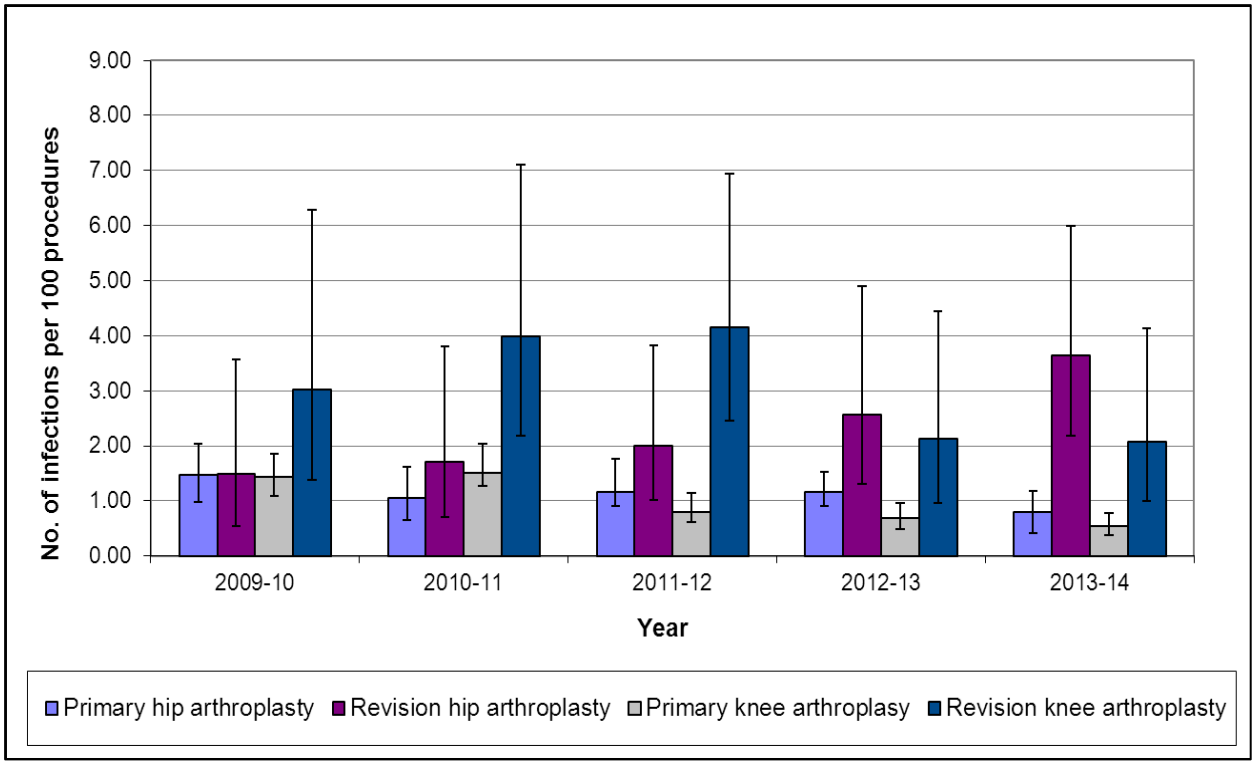


Figure 2 shows the rates of SSI following primary and revision procedures for both hip and knee arthroplasty since the 2009-10 reporting period. Primary arthroplasty accounted for 91% of all procedures in the five year period 2009-14. In 2013-14, the majority (89%) of hip procedures and the majority (93%) of knee procedures performed were primary arthroplasty. The SSI rate following primary hip arthroplasty was 0.80 per 100 procedures compared to 3.64 for revision hip arthroplasty. The SSI rate following primary knee arthroplasty was 0.54 per 100 procedures compared to 2.07 for revision knee arthroplasty. Fifteen (37%) of the 41 hip SSIs and eight (22%) of the 36 knee SSIs reported in 2013-14 were related to revision procedures.

The revision hip SSI rate was significantly higher ($p<0.01$) than the primary hip rate, and the revision knee SSI rate was significantly higher ($p<0.05$) than the primary knee SSI rate.

Although revision procedures consistently comprise a smaller proportion of all procedures, a higher rate of infection is reported in all reporting periods when compared to primary procedures. Possible reasons for this increased rate include an increased number of co-morbid conditions in this patient group, a prolonged operating time, an increased number of blood transfusions, and / or a higher frequency of post-operative wound complications.[17]

Figure 3 Hip SSI rate by risk category, 2009-10 to 2013-14

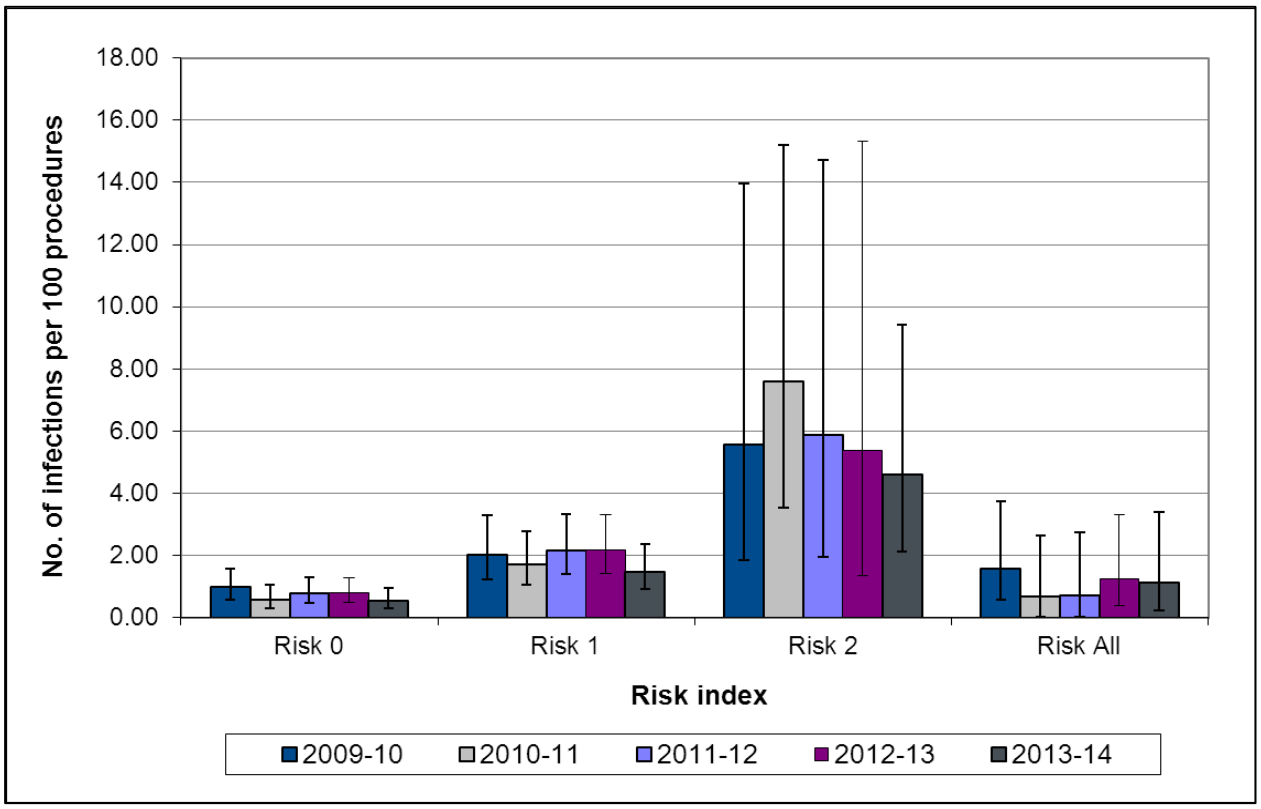


Figure 3 shows the aggregated SSI rate following hip arthroplasty (primary and revision combined) by risk index for each reporting period since 2009-10. For the five year period 2009-14, the majority (57%) of hip procedures were performed in the lowest risk index group (risk 0) and, as expected, this risk group has consistently lower infection rates than risk indices 1, 2 (or 3, not shown).

Risk index 3 data is not shown in Figure 3 due to the very low annual procedure numbers (three procedures were categorised as risk index 3 in 2013-14, with zero SSIs reported).

In the 2013-14 reporting period, the hip SSI rate decreased across risk index 0, 1, 2 and 'risk all' when compared to 2012-13, although none of these decreases were statistically significant ($p>0.05$).

Note: HISWA utilises a risk index score devised by the Centers for Disease Control and Prevention via the National Healthcare Safety Network (CDC-NHSN). The risk index assigns values between 0 and 3 points based on three independent variables: the patient's preoperative physical status based on their American Society of Anaesthesiology (ASA) score, surgical wound classification, and the length of operation. A higher risk index score indicates a greater risk of postoperative infection. Hospitals performing less than 100 procedures per annum are not required to stratify by risk index, and may classify all procedures as 'risk all'.

Figure 4 Knee SSI rate by risk category, 2009-10 to 2013-14

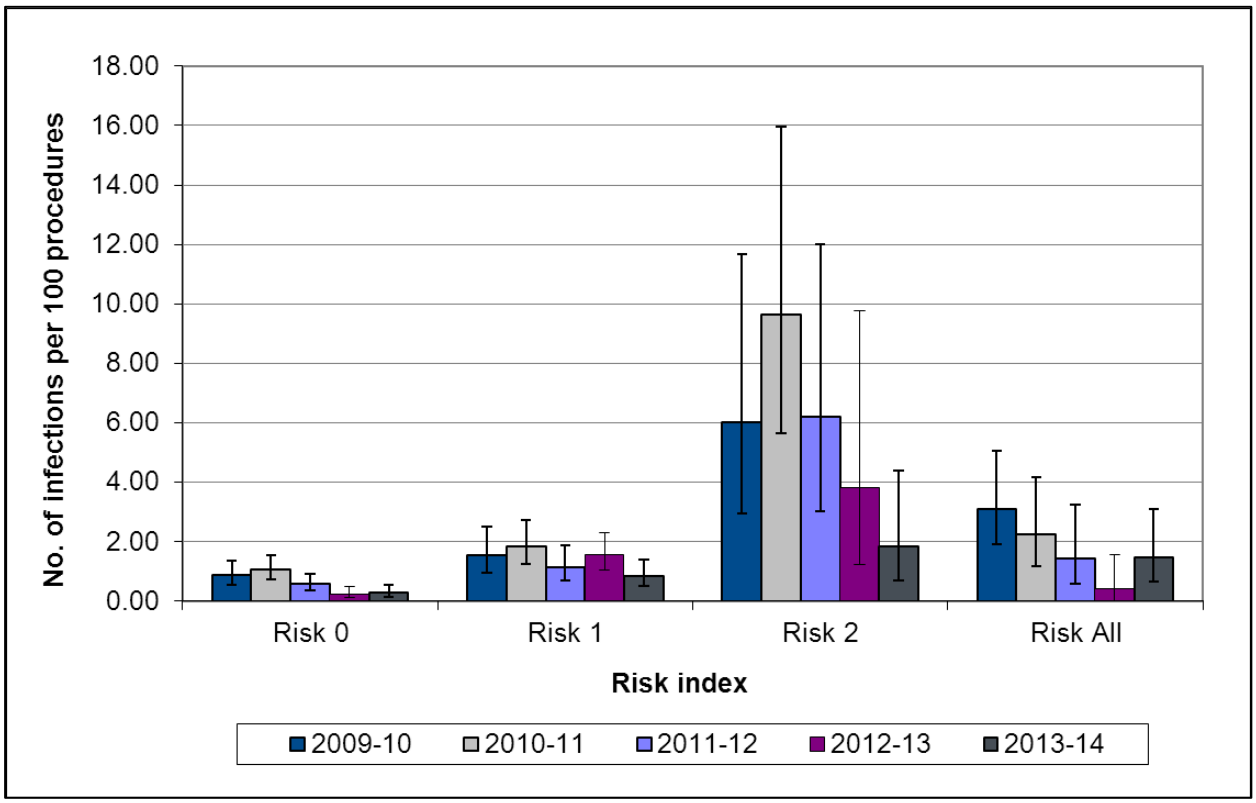


Figure 4 shows the SSI rate following knee arthroplasty (primary and revision combined) by risk index for each reporting period since 2009-10. For the five year period 2009-14, the majority (53%) of knee procedures were performed in the lowest risk index group (risk 0) and lower infection rates have consistently been reported for risk index 0 than risk indices 1, 2 or 3 (not shown).

Risk index 3 data is not shown in Figure 4 due to the very low annual procedure numbers (zero procedures were categorised as risk index 3 in 2013-14).

In the 2013-14 reporting period, the knee SSI rate increased for risk index 0 and 'risk all' but decreased for risk indices 1 and 2 when compared to 2012-13, however none of these changes were statistically significant ($p>0.05$).

Figure 5 Hip and knee SSI rates by risk category, public and private hospitals, 2013-14

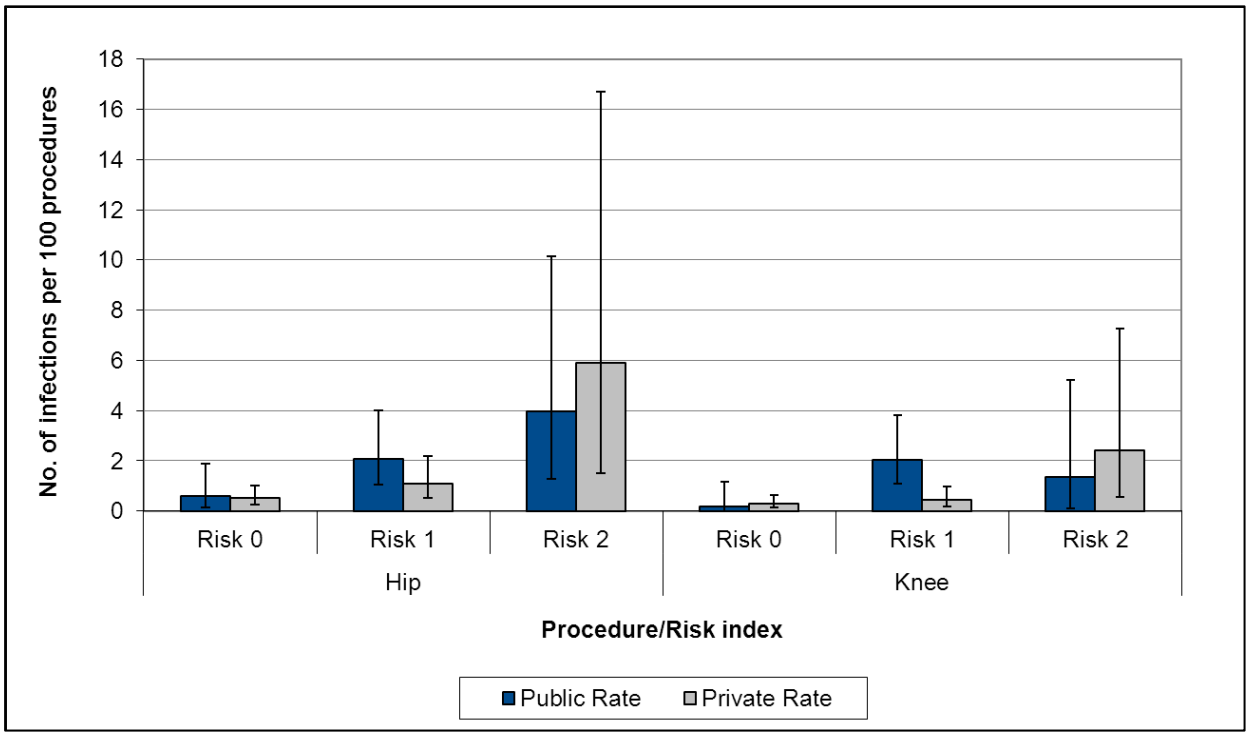


Figure 5 shows the SSI rates for hip and knee arthroplasty by risk index and by private or public provider for the 2013-14 reporting period.

The majority of all procedures (69% of hip arthroplasty [n=2,522] and 76% of knee arthroplasty [n=4,230]) were performed by private hospitals in the 2013-14 reporting period, with three private hospitals performing 46% of all hip and 54% of all knee arthroplasty procedures.

Private hospitals reported 21 of the 41 (51%) hip SSIs and 21 of the 36 (58%) knee SSIs, with overall rates of 0.83 and 0.50 infections per 100 procedures following hip and knee arthroplasty respectively.

Conversely, public hospitals reported 20 of the 41 (49%) hip SSIs and 15 of the 36 (42%) knee SSIs, with overall rates of 1.48 and 1.32 infections per 100 procedures following hip and knee arthroplasty respectively. The public hospital hip and knee SSI rates are significantly higher ($p<0.05$) than rates reported for private hospitals.

The SSI rate was higher for private hospitals for risk index 2 for hip arthroplasty and risk indices 0 and 2 for knee arthroplasty. The SSI rate was higher for public hospitals for risk indices 0 and 1 for hip arthroplasty and risk index 1 for knee arthroplasty. The public hospital risk index 1 knee rate of 2.05 per 100 procedures was significantly higher than the private hospital knee rate of 0.43 ($p>0.05$).

Table 2 Hip SSI rates, by hospital, 2013-14 compared to 2012-13

Hospital number	Hospital type	Number of infections	Number of procedures	2013-14 SSI rate [CI_{95}]	Δ Rate	2012-13 SSI rate
11	Public	1	33	3.03 [0.00 - 16.90]	↑	2.63
15	Private	1	36	2.78 [0.00 - 15.66]	↑	0.00
3	Public	7	256	2.73 [1.24 - 5.68]	↓	3.93
1	Public	8	299	2.68 [1.29 - 5.31]	↑	1.28
5	Public	2	111	1.80 [0.13 - 6.83]	↑	0.78
4	Public	1	80	1.25 [0.00 - 7.54]	↓	2.44
13	Private	1	99	1.01 [0.00 - 6.16]	↓	1.03
9	Private	7	699	1.00 [0.45 - 2.11]	↑	0.74
8	Private	5	558	0.90 [0.33 - 2.16]	↑	0.36
6	Private	2	251	0.80 [0.04 - 3.09]	↑	0.00
7	Private	3	442	0.68 [0.14 - 2.10]	↓	1.86
19	Private	1	161	0.62 [0.00 - 3.86]	↓	4.00
10	Private	1	178	0.56 [0.00 - 3.50]	↓	1.94
2	Public	1	244	0.41 [0.00 - 2.57]	↓	1.97
12	Public	0	23	0.00 [0.00 - 17.29]	↓	4.35
20	Public	0	50	0.00 [0.00 - 8.74]	↓	1.69
14	Public	0	49	0.00 [0.00 - 8.9]	↓	1.11
18	Private	0	33	0.00 [0.00 - 12.69]	-	0.00
16	Private	0	65	0.00 [0.00 - 6.86]	-	0.00
17	Public	0	0	No procedures performed	-	0.00
Total		**41**	**3667**	**1.12 [0.82 - 1.52]**		**1.30**

Figure 6 Hip SSI rates, by hospital 2012-13 compared to 2013-14

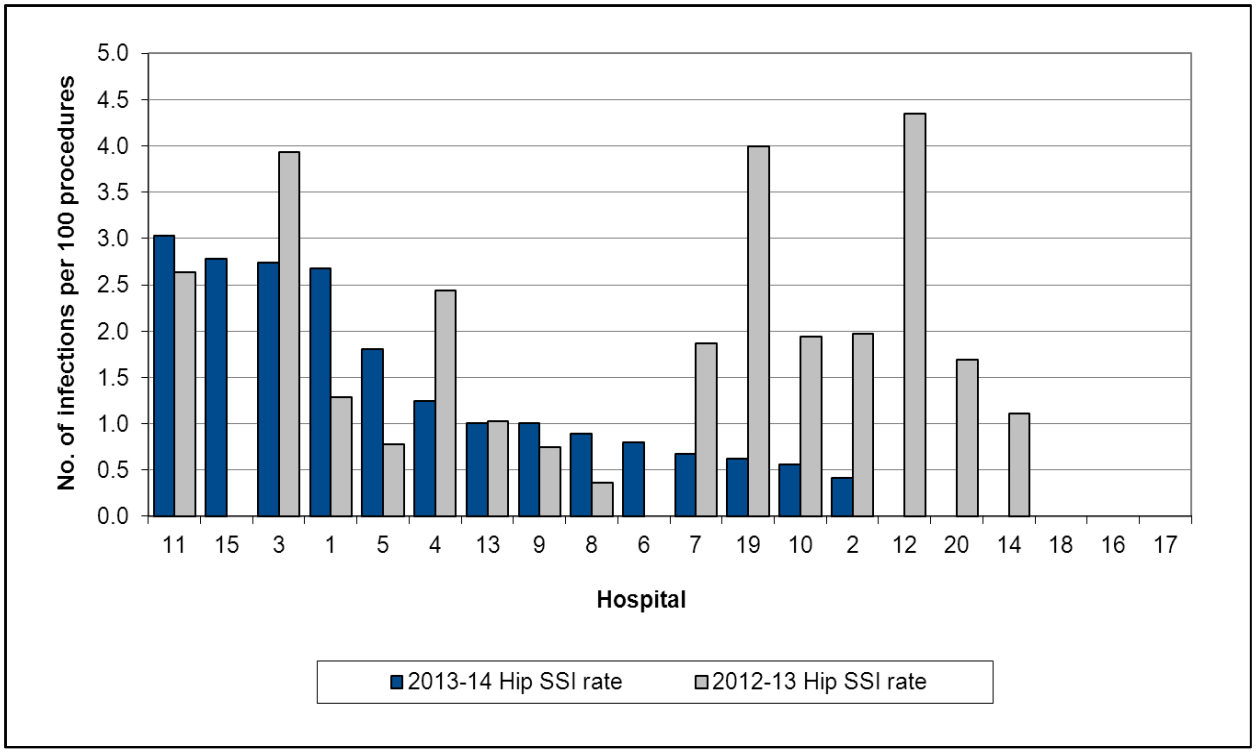


Table 2 shows individual hospital procedure / infection numbers and rates for hip arthroplasty procedures in 2013-14, compared with 2012-13 data from the same facility; and Figure 6 shows the comparative rates between the 20 hospitals. Hospitals are listed in order of descending infection rate for the current reporting period.

Although the overall hip SSI rate decreased in 2013-14, seven of the twenty hospitals reported an increased SSI rate following hip arthroplasty for this reporting period. Ten hospitals reported a decreased hip SSI rate and five hospitals reported zero hip SSIs (three hospitals decreased to zero SSI). One hospital did not perform any arthroplasty procedures during the 2013-14 surveillance period.

Table 3 Knee SSI rates, by hospital, 2013-14 compared to 2012-13

Hospital number	Hospital type	Number of infections	Number of procedures	2013-14 SSI rate [CI_{95}]	Δ Rate	2012-13 SSI rate
18	Private	2	62	3.23 [0.30 - 11.82]	↑	1.69
12	Public	1	31	3.23 [0 .00- 17.85]	↑	0.00
3	Public	7	253	2.77 [1.25 - 5.75]	↓	3.88
11	Public	1	47	2.13 [0.00 - 12.34]	↑	0.00
15	Private	2	96	2.08 [0.16 - 7.84]	↑	1.35
4	Public	3	148	2.03 [0.45 - 6.13]	↑	0.00
16	Private	2	112	1.79 [0.13 - 6.77]	↑	0.00
19	Private	4	262	1.53 [0.47 - 4.04]	↓	1.55
20	Public	1	112	0.89 [0.00 - 5.47]	↓	1.23
5	Public	1	148	0.68 [0.00 - 4.18]	↓	2.04
13	Private	1	162	0.62 [0.00 - 3.83]	↑	0.00
10	Private	1	230	0.43 [0.00 - 2.72]	↑	0.00
9	Private	6	1551	0.39 [0.16 - 0.87]	↓	0.90
7	Private	2	528	0.38 [0.02 - 1.49]	↓	0.72
1	Public	1	317	0.32 [0.00 - 1.99]	↓	0.91
8	Private	1	925	0.11 [0.00 - 0.69]	↓	0.12
2	Public	0	211	0.00 [0.00 - 2.21]	↓	0.44
6	Private	0	302	0.00 [0.00 - 1.56]	↓	0.69
14	Public	0	91	0.00 [0.00 - 4.99]	-	0.00
17	Public	0	0	No procedures performed	-	0.00
Total		36	5588	0.64 [0.46 - 0.89]	↓	0.78

Figure 7 Knee SSI rates, by hospital, 2012-13 compared to 2013-14

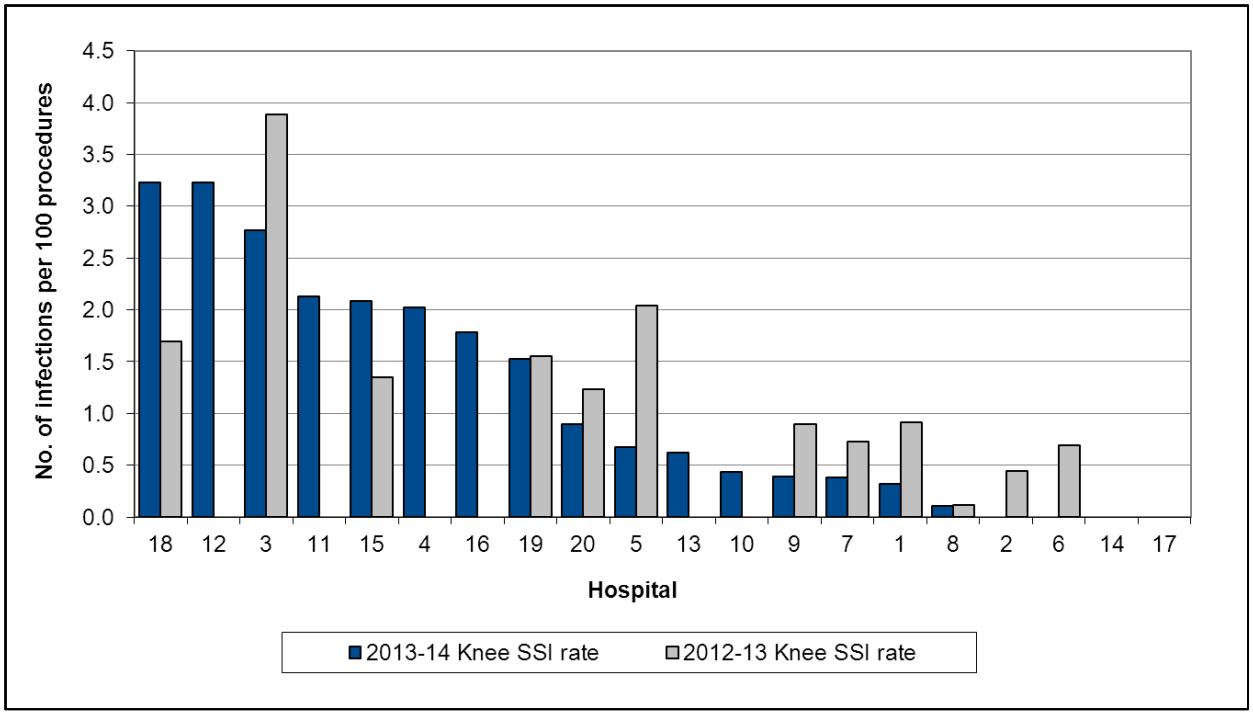


Table 3 shows individual hospital procedure / infection numbers and rates for knee arthroplasty procedures in 2013-14, compared with 2012-13 data from the same facility; and Figure 7 shows the comparative rates between the 20 hospitals. Hospitals are listed in order of descending infection rate for the current reporting period.

Although the overall knee SSI rate decreased in 2013-14, eight of the twenty hospitals reported an increased SSI rate following knee arthroplasty for this reporting period. Ten hospitals reported a decreased knee SSI rate and three reported zero knee SSIs (two hospitals decreased to zero SSI). One hospital did not perform any arthroplasty procedures during the 2013-14 surveillance period.

Figure 8 Proportion of hip SSIs classified as superficial or deep, 2009-10 to 2013-14

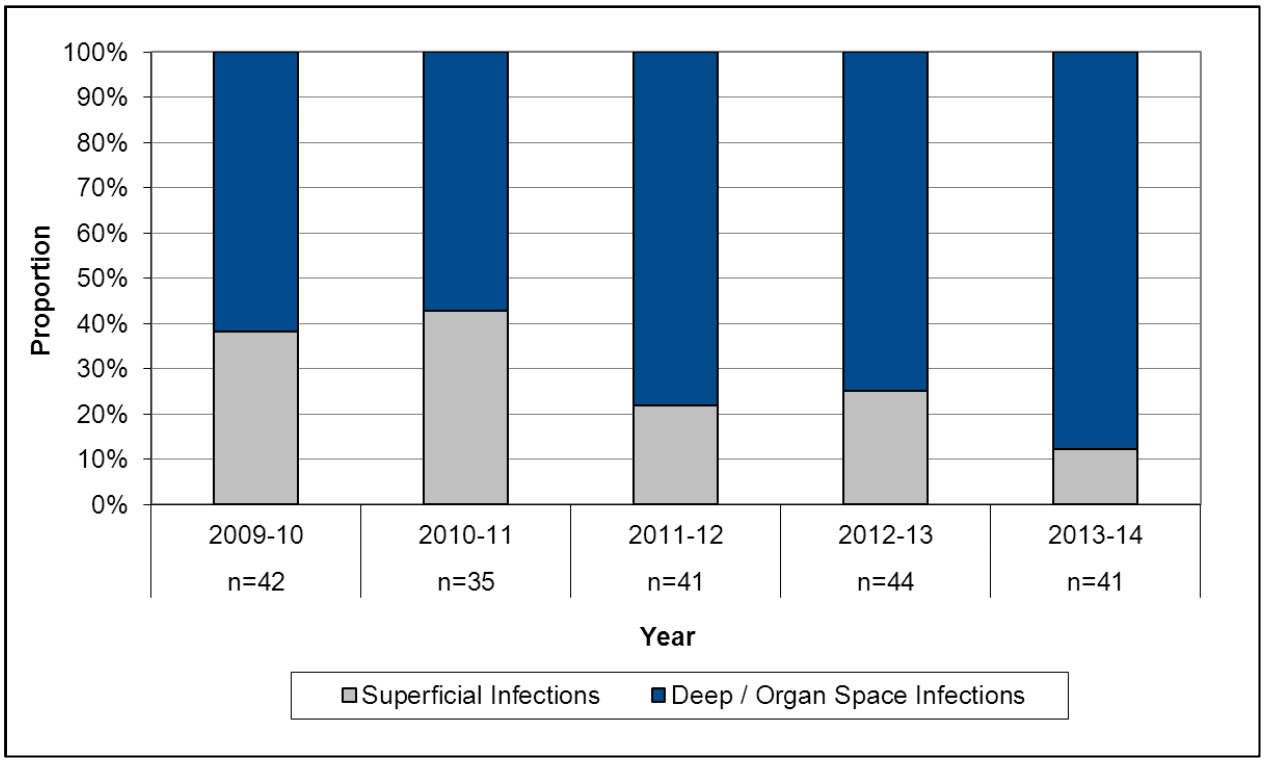


Figure 8 shows the proportion of hip SSIs that were classified as either superficial or deep since 2009-10. During this period the proportion of deep SSIs following hip arthroplasty has varied between 57% and 88%, with a mean of 72% (and, correspondingly, 28% superficial) hip infections. In 2013-14, the majority (88%, n=36/41) of hip SSIs were deep infections, which is higher than 2012-13 reporting period (75%, n=33/44) and the highest proportion reported for the five year period.

Patients with a deep SSI are at a greater risk of local and systemic complications and mortality.[17] Treatment of these infections is associated with significant increased costs and length of stay (LOS). Patients who develop superficial SSIs also require additional medical intervention, and are at a higher risk for developing subsequent deep SSIs.[17]

The Victorian Infection Control Nosocomial Infection Surveillance System (VICNISS) [1] found the average cost following hip SSI to be $34,138.65 per case. Using this figure, adjusted with Australian Institute of Health and Welfare annual health inflation rates, [2] the costs associated with the 41 hip infections reported to HISWA in 2013-14 are estimated to be $1,707,988. It is estimated that these SSIs contributed to an additional 1,107 bed-days based on the mean of 27 days excess length of stay reported by VICNISS.

Figure 9 Proportion of knee SSIs classified as superficial or deep, 2009-10 to 2013-14

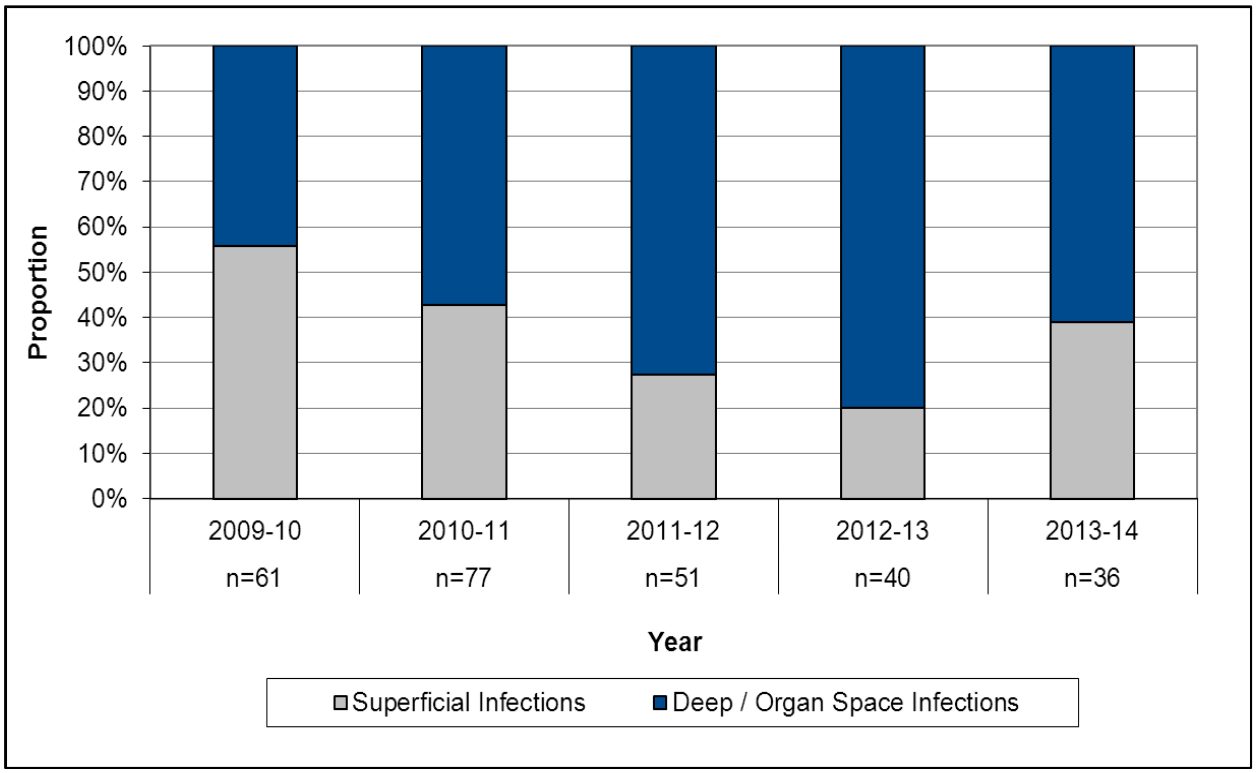
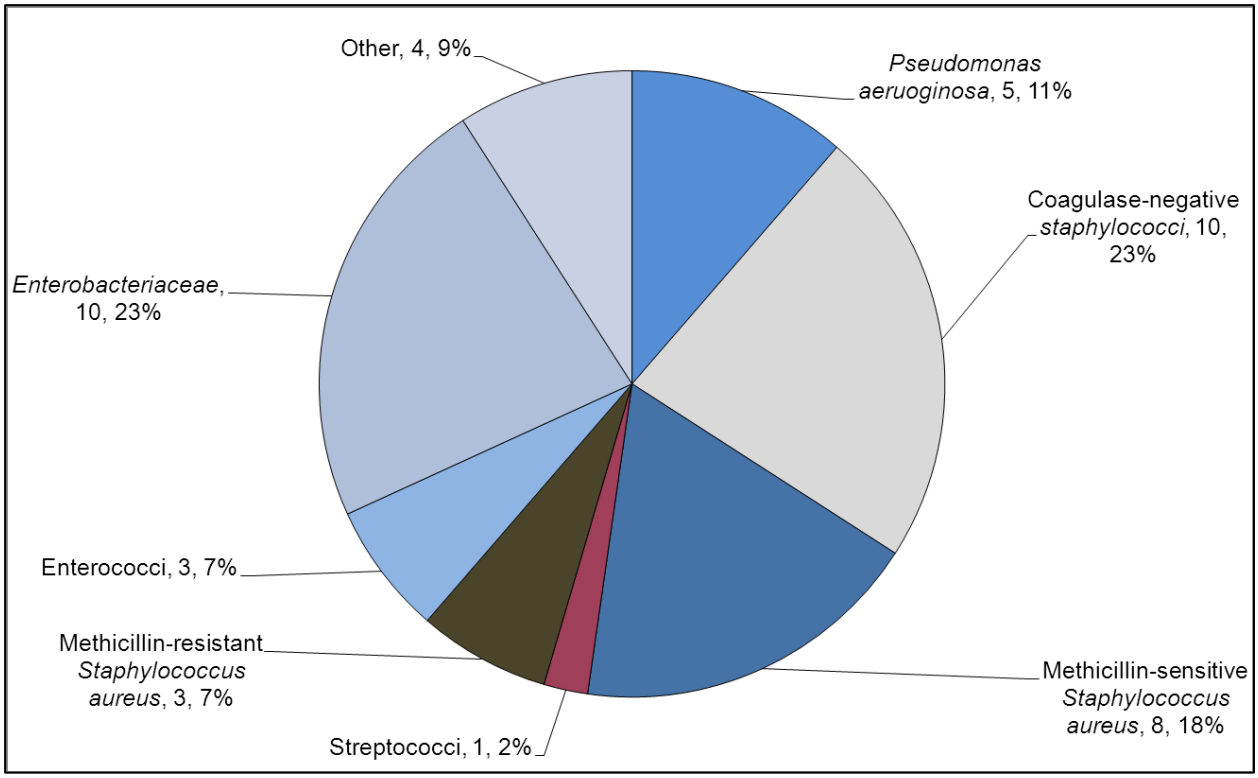


Figure 9 shows the proportion of knee SSIs that were classified as either superficial or deep since 2009-10. During this period the proportion of deep SSIs following knee arthroplasty has varied between 44% and 80%, with a mean of 63% (and, correspondingly, 37% superficial) knee infections. In the 2013-14 reporting period the majority (61%, n=22/36) of knee SSIs were deep infections, which is lower than the 80% reported in 2012-13.

In 2006, VICNISS found the average cost following knee SSI to be $40,940.00 per case. Using this figure, adjusted with AIHW annual health inflation rates,[2] the costs associated with the 36 knee infections reported to HISWA in 2013-14 are estimated to be $1,798,478. It is estimated that these SSIs contributed to an additional 972 bed-days based on the mean of 27 days excess length of stay reported by VICNISS.

Figure 10 Proportion of organisms isolated from hip SSIs, 2013-14



Other: Bacillus sp, Pseudomonas sp, *Candida parapsilosis* (2)

Figure 10 shows the proportion of microorganisms isolated from SSIs following hip arthroplasty in the 2013-14 reporting period. From the 41 hip SSIs reported and analysed, a specimen was not collected for microbiological culture on one (2%) occasion and no organism was cultured from specimens collected on three (7%) occasions.

A total of 44 organisms were isolated from the 37 hip SSIs with positive microbiology results:

- 59% (n=26) were Gram-positive bacteria: coagulase-negative staphylococci (n=10), methicillin-sensitive *Staphylococcus aureus* (n=8), methicillin-resistant *Staphylococcus aureus* (n=3), *Enterococcus faecalis* (n=3), Bacillus sp. (n=1), group B Streptococcus (n=1)
- 36% (n=16) were Gram-negative bacteria: *Pseudomonas aeruginosa* (n=5), *Enterobacter cloacae* (n=4), *Escherichia coli* (n=2), *Klebsiella pneumonia*e (n=3), Pseudomonas sp (n=1), *Serratia marcescens* (n=1)
- *Enterobacteriaceae* accounted for 63% (n=10) of Gram-negative bacteria
- 5% (n=2) were *Candida parapsilosis*.

The three methicillin-resistant *Staphylococcus aureus* (MRSA) isolated were all associated with deep hip SSIs.

Figure 11 Proportion of organisms isolated from hip SSIs, 2009-10 to 2013-14

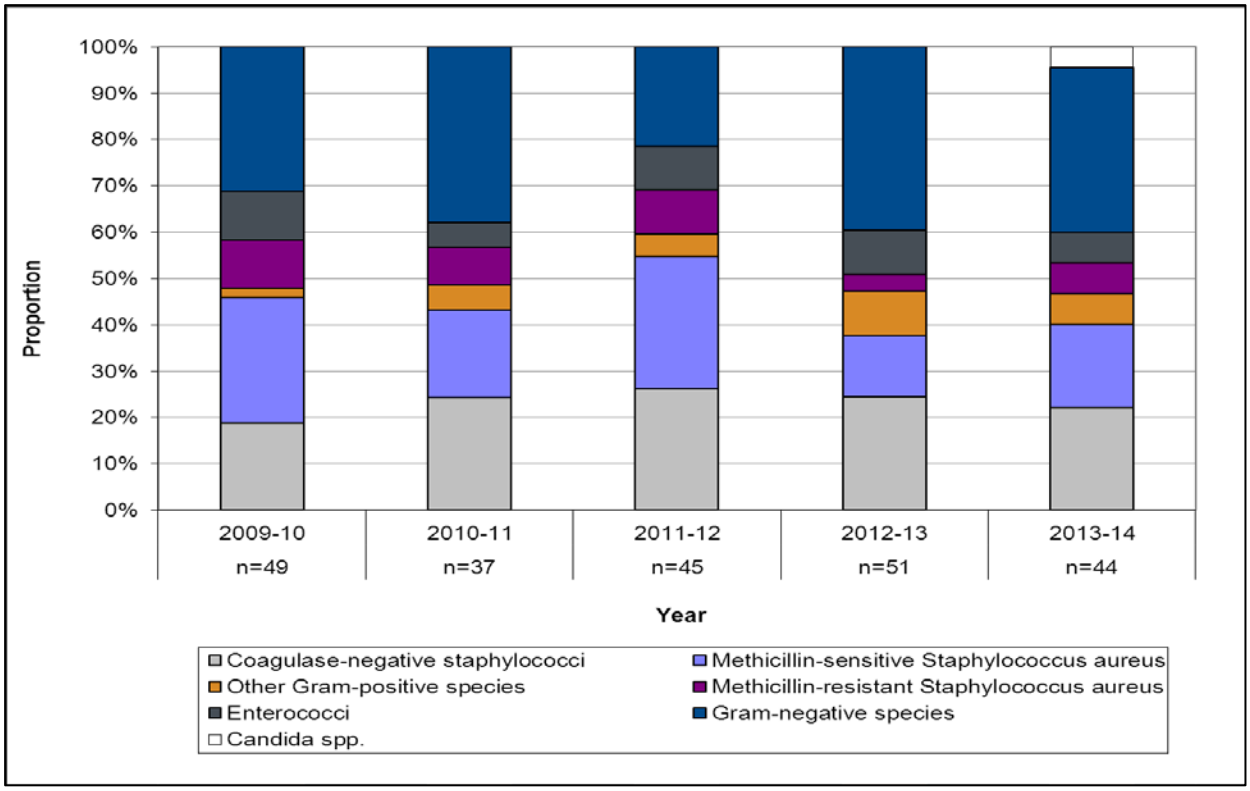


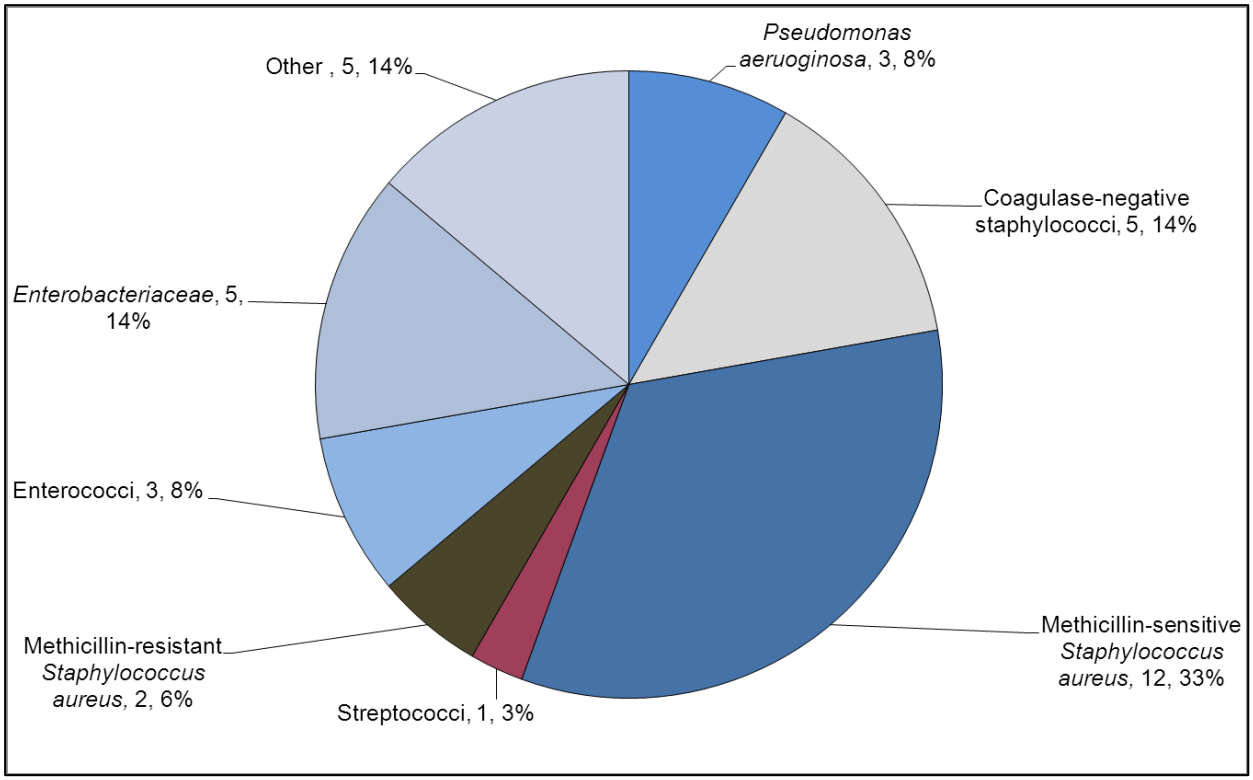
Figure 11 shows the proportion of microorganisms isolated from SSIs following hip arthroplasty since the 2009-10 reporting period. For the five year period 2009-14, the 226 organisms cultured from the 203 hip SSIs reported were:

- 66% (n=149) were Gram-positive bacteria: coagulase-negative staphylococci (n=52), MSSA (n=47), MRSA (n=17), Enterococci (n=19), other Gram-positive (n=14)
- 33% (n=75) were Gram-negative bacteria
- <1% (n=2) were fungi or other organisms.

The proportion of Gram-negative organisms isolated from infected hips decreased in the 2013-14 reporting period compared to 2012-13.

In 2013-14, MRSA represented seven percent of organisms isolated from hip SSIs, which is consistent with the five year reporting period.

Figure 12 Proportion of organisms isolated from knee SSIs, 2013-14



Other*: Peptostreptococcus magnus, Corynebacterium amycolatam, Corynebacterium tuberculostearicum, Acinetobacter baumannii, and Pseudomonas stutzeri*.

Figure 12 shows the proportion of microorganisms isolated from SSIs following knee arthroplasty in the 2013-14 reporting period. From the 36 knee SSIs reported and analysed, a specimen was not collected for microbiological culture on three (8%) occasions and no organism was cultured from specimens collected on five (14%) occasions.

A total of 36 organisms were isolated from the 28 knee SSIs with positive microbiology results:

- 59% (n=26) were Gram-positive bacteria: methicillin-sensitive *Staphylococcus aureus* (n=12), coagulase-negative staphylococci (n=5), methicillin-resistant *Staphylococcus aureus* (n=2), Enterococcus faecalis (n=2), Enterococcus species (n= 1), *Corynebacterium amycolatam* (n=1), *Corynebacterium tuberculostearicum* (n=1), Group G streptococcus (n=1) *Peptostreptococcus magnus* (n=1)
- 23% (n=10) were Gram-negative bacteria: *Pseudomonas aeruginosa* (n=3), *Acinetobacter baumannii* (n=1), *Enterobacter cloacae* (n=1), *Enterobacter aerogenes* (n=1), *Escherichia coli* (n=1), Proteus sp (n=1), *Proteus mirabilis* (n=1), *Pseudomonas stutzeri* (n=1).
- *Enterobacteriaceae* accounted for 50% (n=5) of all Gram-negative bacteria.

Figure 13 Proportion of organisms isolated from knee SSIs, 2009-10 to 2013-14

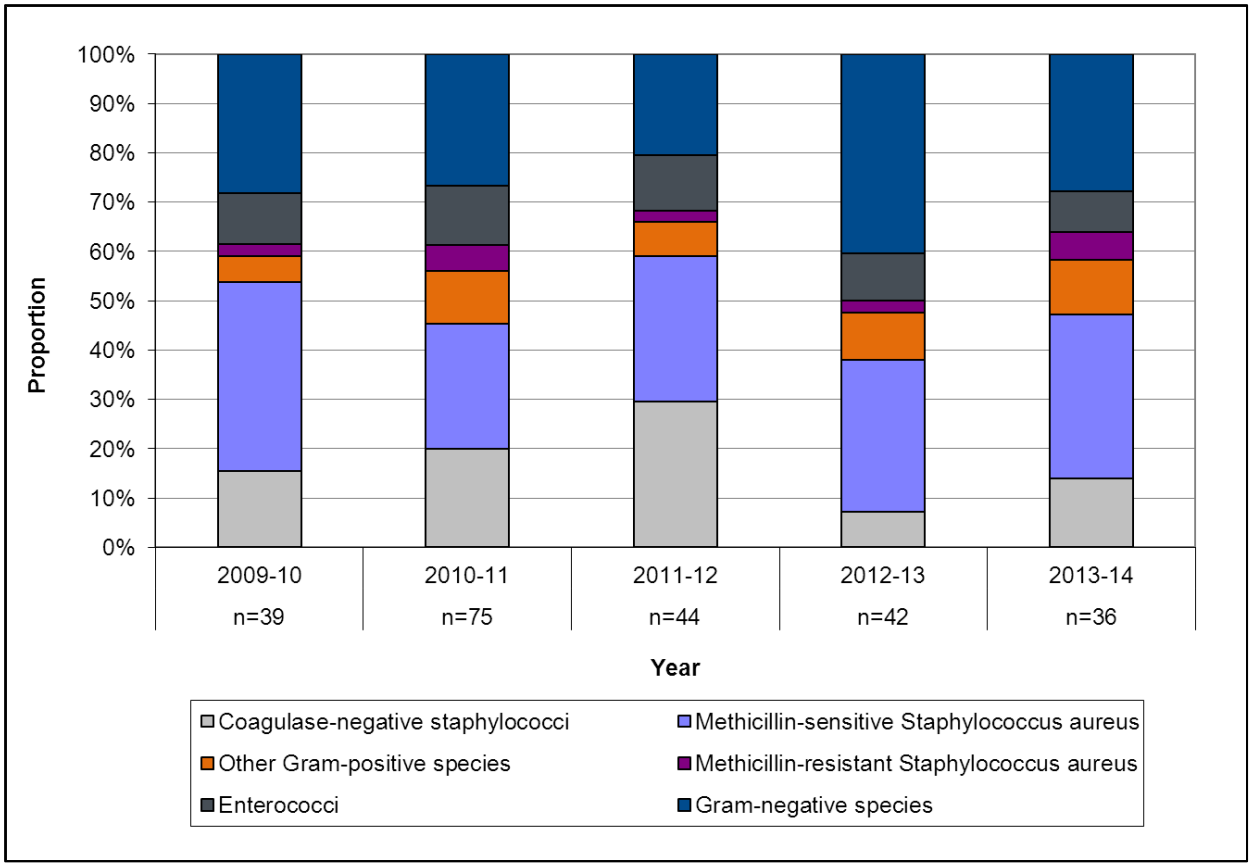


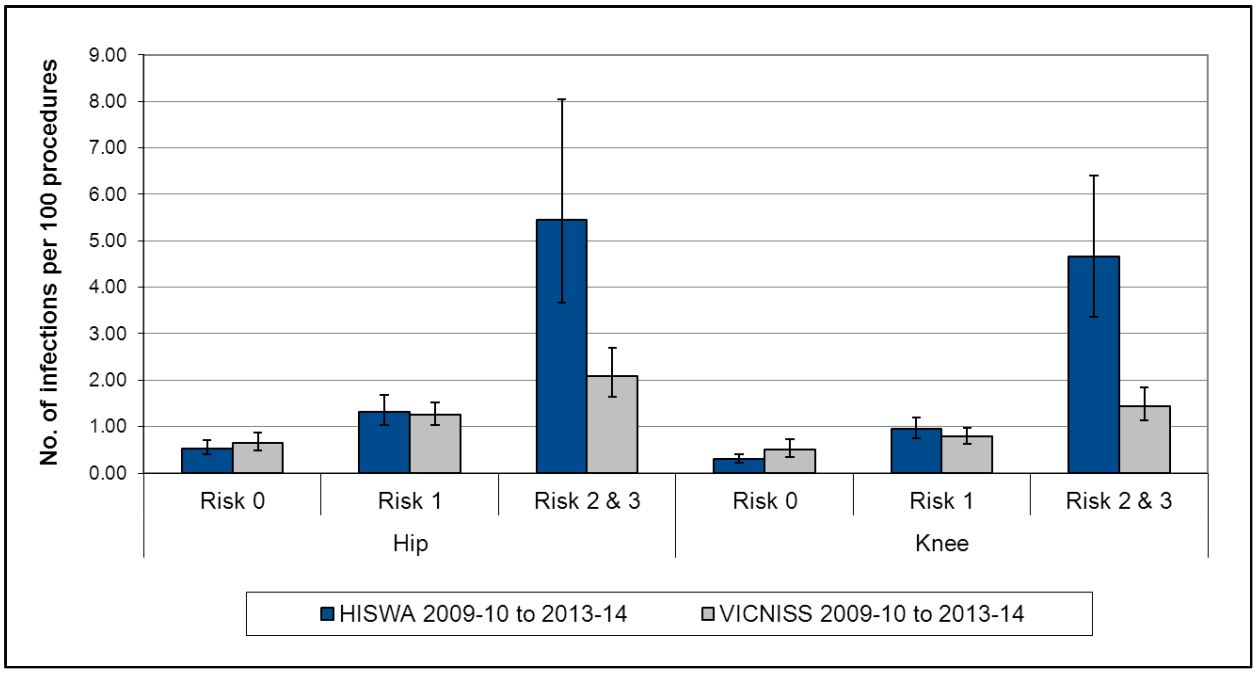
Figure 13 shows the proportion of microorganisms isolated from knee SSIs following knee arthroplasty since the 2009-10 reporting period. For the five year period 2009-14, the 236 organisms cultured from the 265 knee SSIs reported were:

- 72% (n=169) were Gram-positive bacteria: coagulase-negative staphylococci (n=42), MSSA (n=72), MRSA (n=9), Enterococci (n=25), other Gram-positives (n=21)
- 28% (n=67) were Gram-negative bacteria

There was a decrease in the proportion of Gram-negative organisms causing SSI in knee arthroplasty in the 2013-14 reporting period compared to 2012-13.

In 2013-14, MRSA represented six percent of organisms isolated from knee SSIs, which is consistent with the five year reporting period (mean = 4%).

Figure 14 HISWA and VICNISS, deep hip and knee SSI rates, by risk category, 2009-10 to 2013-14



Surveillance systems selected as suitable comparators for HISWA hip and knee SSI data were the VICNISS and the Public Health England (PHE) in the United Kingdom. [18] HISWA data has been adjusted to allow for comparison with these data sets.

Figure 14 benchmarks cumulative HISWA data with cumulative VICNISS data by risk index for deep SSIs. Deep (as opposed to superficial) SSIs are likely to be more reliably detected and classified by routine surveillance methods and are a more clinically valid measure to benchmark. Due to low procedure numbers for risk indices 2 and 3, both HISWA and VICNISS combine these categories.

HISWA reports lower rates than VICNISS for hip and knee arthroplasty, risk index 0, however only the knee SSI rate was significantly lower ($p>0.05$).

HISWA reports significantly higher rates ($p<0.05$) for combined risk index 2 and 3 following both hip and knee arthroplasty. HISWA rates were also higher for risk index 1 following knee arthroplasty, but this was not statistically significant ($p>0.05$).

Figure 15 HISWA and PHE superficial and deep hip and knee SSI rates, 2013-14

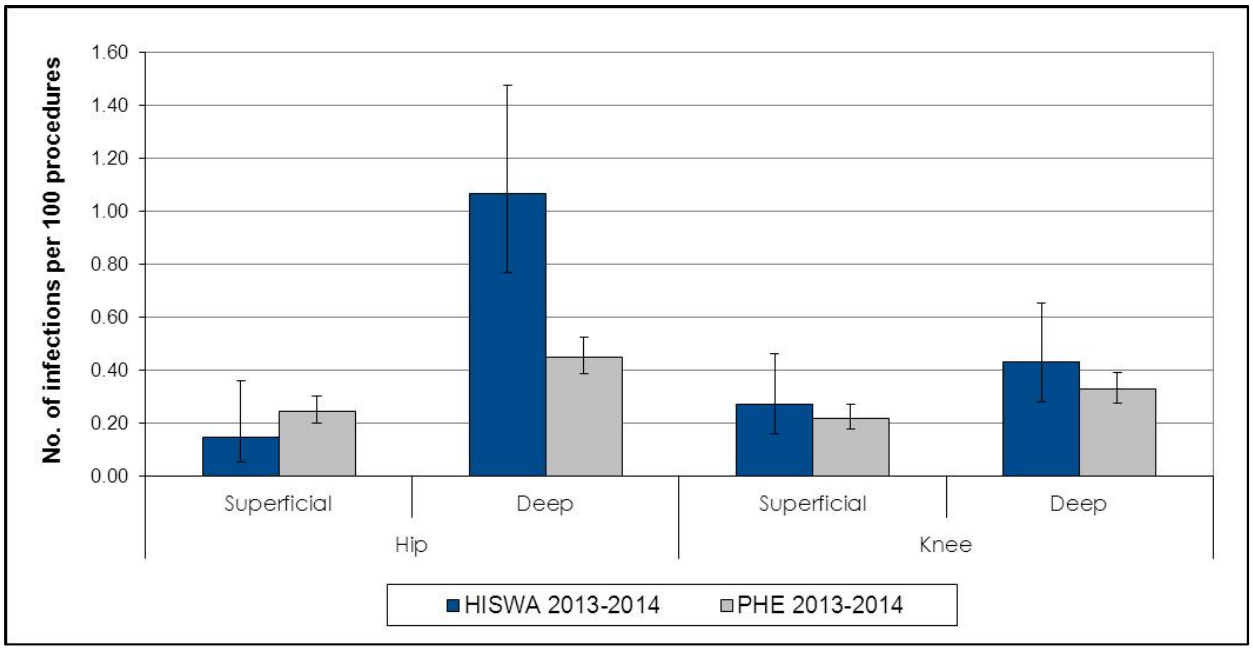


Figure 15 compares HISWA data with that from the United Kingdom's PHE for superficial and deep SSI rates (all risk indices combined) for both hip and knee procedures in the 2013-14 reporting period.

The HISWA SSI rates were higher for all categories and procedure types when compared with PHE data except for superficial hip SSI rates. The HISWA deep hip arthroplasty SSI rate was significantly higher ($p<0.05$) than the PHE rate.

The total PHE hip SSI rate was 0.69 per 100 procedures compared to the HISWA rate of 1.12 and the total knee SSI rate was 0.54 per 100 procedures compared to the HISWA rate of 0.64 per 100 procedures.

Surgical site infection following caesarean section

Surgical site infection following caesarean section

Caesarean section deliveries around the world have been increasing and in Australia have reached 30% of all births. Surgical site infections (SSIs) are a preventable complication of caesarean section at a time when women are trying to cope with a newborn child. Reducing the rate of SSI following caesarean section is therefore highly desirable.[19]

Participating hospitals

For the 2013-14 surveillance period, 28 hospitals monitored and reported SSIs following caesarean section to HISWA. Hospital demographics included 11 metropolitan (five private and six public) and 17 regional (one private and 16 public) hospitals. HISWA commenced voluntary reporting for this indicator in April 2011. One large private metropolitan hospital commenced reporting in the 2013-14 surveillance period.

Surveillance

Between July 01 2013 and June 30 2014, a total of 7,894 caesarean section procedures were reported to HISWA. A total of 4,006 (51%) were classified as emergency procedures. The 22 public hospitals submitting data to HISWA reported the majority (65%) of all procedures. A total of 70 SSIs following caesarean section were reported to HISWA.

It is well documented that many caesarean section SSIs are superficial and are diagnosed and treated post-discharge in outpatient or primary care settings.[3,20] As not all contributing hospitals routinely perform post discharge surveillance (PDS) the reported HISWA caesarean section SSI rates are likely an underestimation of true rates and should not be used for benchmarking.

SSI data submitted to HISWA has always been verified in regards to SSI classification, procedure and infection onset dates, information on the microbiological specimen and point of detection of the SSI. HISWA data is adjusted accordingly when non-congruent data is identified. Since January 2012, the HAIU has conducted a formal validation process for submitted SSI data to assist with identifying correct application of definitions by our contributors.

HISWA data combines deep and organ / space infections to allow for more meaningful statistical analysis. For the purpose of this report these combined infections are referred to as deep SSIs. Procedures are risk-stratified using the CDC-NHSN risk index (refer page 25). Evidence-informed caesarean section specific risk factors (e.g. body mass index of mother, ruptured membranes or blood loss) are currently not collected by HISWA, however if membranes are ruptured for greater than six hours, the risk index is increased by one score.

Data collection commenced in 2011 and in the following section, the results and analysis of caesarean section SSI surveillance data since that time are presented.

Table 4 SSI rates following caesarean section procedures, 2011-12 to 2013-14

Year	Total Number of SSI	Detected initial admission or re-admission	Detected outpatient / post discharge	Number of procedures	Total aggregated infection rate per 100 procedures [95%CI]	Initial / readmission infection rate per 100 procedures [95%CI]
2011-12	45	28	17	4,157	1.08 [0.80 - 1.45]	0.67 [0.46 - 0.97]
2012-13	57	39	18	6,826	0.83 [0.64 - 1.08]	0.57 [0.41 - 0.78]
2013-14	70	51	19	7,894	0.88 [0.70 - 1.12]	0.64 [0.49 - 0.85]
Cumulative 2011-14	**172**	**118**	**54**	**18,877**	**0.91 [0.78 - 1.05]**	**0.62 [0.52 - 0.74]**

Table 4 shows the data for the number of infections, number of procedures and infection rates for all reporting periods since data collection commenced. These infection data include both elective and emergency procedures, superficial and deep infections, those detected during the initial admission period of the procedure, readmission and outpatient / post discharge surveillance.

In the 2013-14 reporting period there were 70 caesarean section SSIs reported to HISWA. The majority were identified on readmission to hospital (n=38; 54%). A further 13 (19%) were identified during the initial admission period and the remaining SSIs (n=19; 27%) were identified and treated post-discharge in outpatient and primary care settings. These 19 SSIs are excluded from any further analysis in this report.

The combined infection rate (initial admission and readmission) of 0.64 infections per 100 procedures is higher than the rate of 0.57 reported in 2012-13, however this increase was not statistically significant ($p>0.05$).

Figure 16 Caesarean section SSI rates, by procedure type, 2011-12 to 2013-14

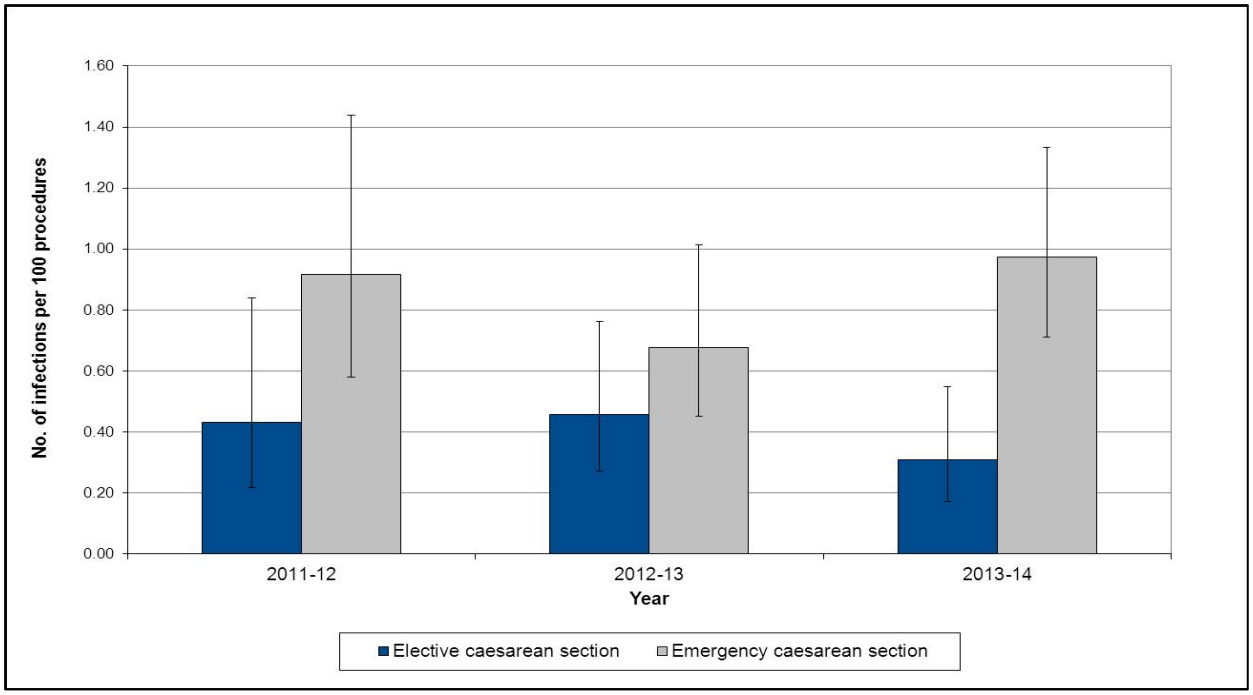


Figure 16 compares SSI rates by procedure type for the three reporting periods since 2011-12. In 2013-14, 7,894 caesarean section procedures were performed and of these, 51% (n=4,006) were classified as emergency procedures. This represents a 13% increase from the 3,545 emergency procedures reported in the 2012-13 reporting period.

Caesarean section SSI rates are higher following emergency procedures than elective procedures in all reporting periods. The SSI rate following emergency procedures increased to 0.97 per 100 procedures in 2013-14 from 0.68 reported in 2012-13. This increase was statistically significant ($p<0.05$). (During emergency caesarean section procedures, membranes are frequently ruptured, which can result in a higher infection rate due to a greater inoculum of bacteria in the amniotic fluid).[20]

The SSI rate of 0.31 per 100 procedures following elective caesarean section in 2013-14 is lower than the rate of 0.46 reported in 2012-13, however this decrease is not significant ($p>0.05$).

The majority of all reported caesarean section SSIs were classified as superficial and this is consistent with international caesarean section infection surveillance reports.[3,20] The majority (81%, n=30) of superficial SSIs were reported following emergency procedures, with 67% of these SSI identified due to the patient requiring readmission to hospital for management of the infection.

Of the 16 deep SSIs reported, nine (56%) were associated with emergency procedures with three detected during the initial admission period and five identified on readmission.

Figure 17 Caesarean section SSI rates, by risk index, 2011-12 to 2013-14

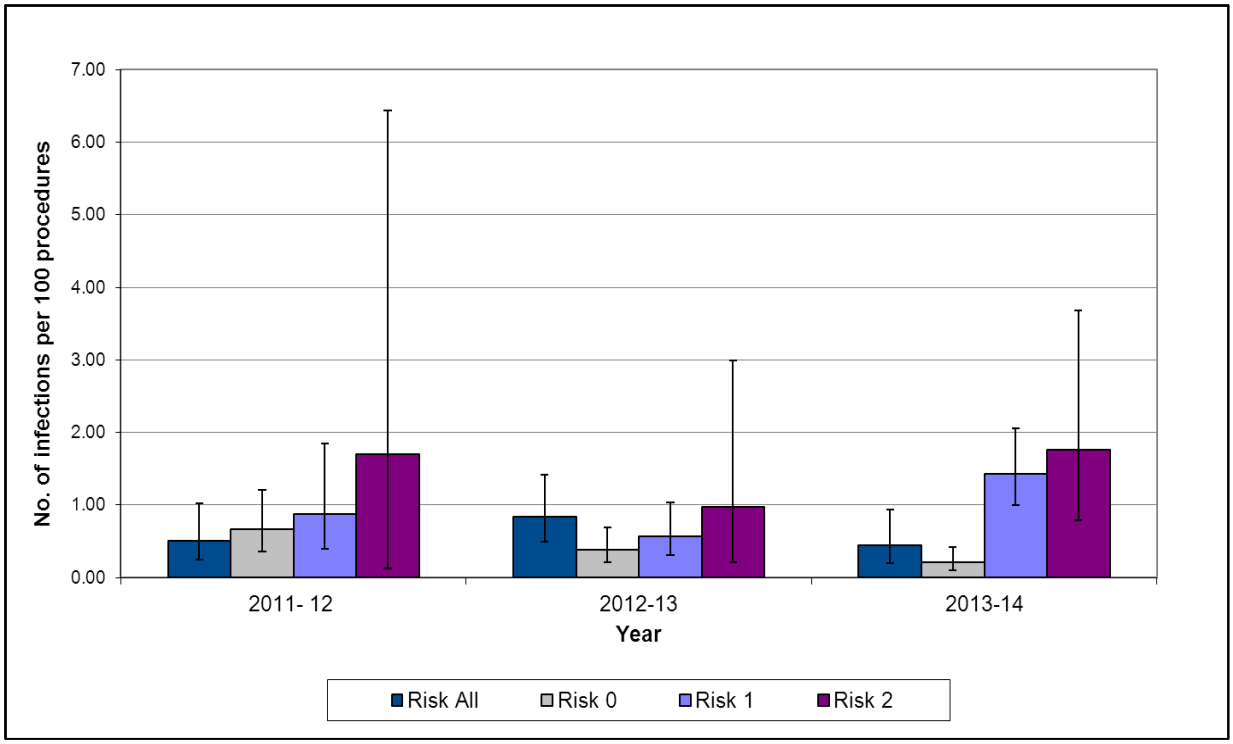


Figure 17 compares caesarean section SSI rates by risk index for the three reporting periods since 2011-12. Hospitals performing less than 100 procedures per annum are not required to stratify by risk index, and may classify procedures as 'risk all'. In 2013-14, fifteen hospitals (mainly regional/rural sites), utilised the 'risk all' category, which represents 20% of all procedures. For all other procedures classified according to risk, the majority (49%) were classified as risk index 0, 26% classified as risk index 1 and five percent as risk index 2.

In 2013-14 the SSI rates following caesarean section decreased for risk 0 and 'risk all' indices but increased for risk 1 and 2 indices when compared to the 2012-13 reporting period. The increase was statistically significant for risk index 1 ($p<0.05$).

Figure 18 Caesarean section SSI rates, by hospital type, 2011-12 to 2013-14

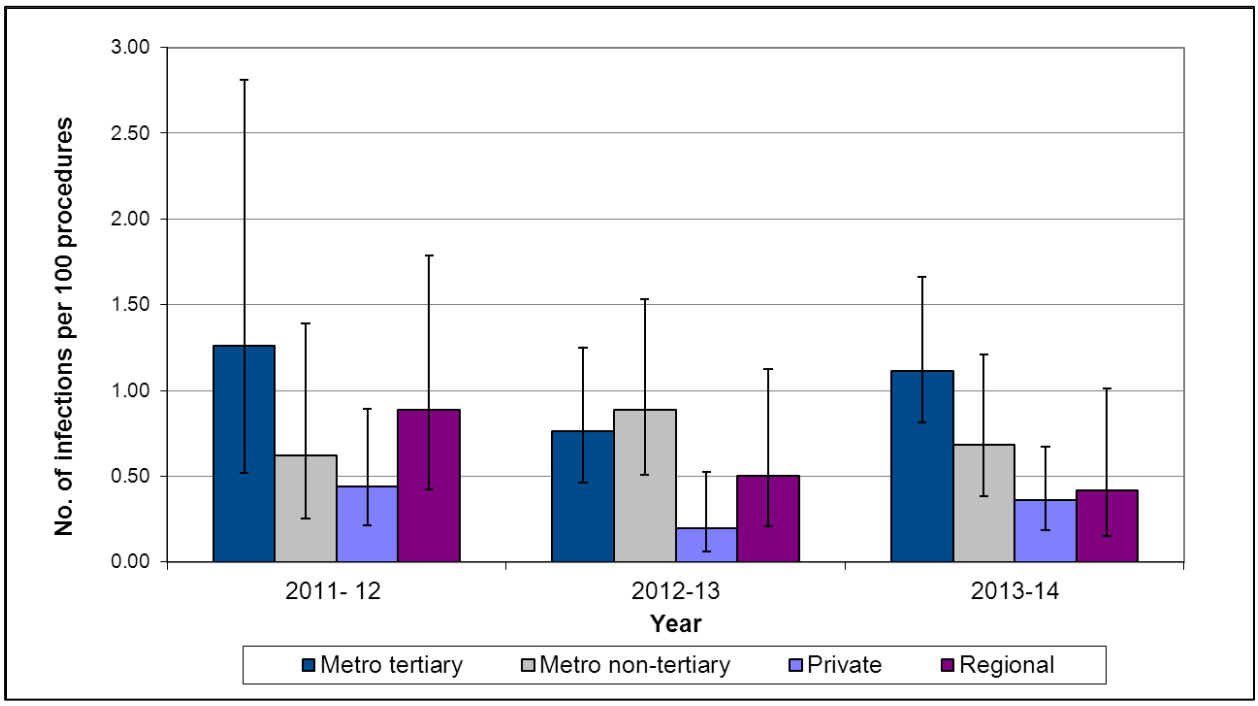


Figure 18 compares SSI rates by hospital groups for the three reporting periods and shows that SSI rates following caesarean section decreased in 2013-14 for metropolitan non-tertiary hospitals and regional hospitals, and increased in the tertiary hospital and private hospitals when compared to 2012-13. None of the rate variations were statistically significant (p>0.05).

The metropolitan tertiary hospital admits higher-risk patients with increased morbidity and in 2013-14 performed 27% (n=2,156) of all caesarean sections reported to HISWA. Of the procedures performed at this hospital, 64% were on patients identified with a risk index of 1, 2 or 3. In addition, 62% of the caesarean sections were emergency procedures. The caesarean section SSI rate at the tertiary metropolitan hospital increased to 1.11 per 100 procedures in 2013-14 from the rate of 0.76 reported in 2012-13, however this increase is not statistically significant (p>0.05).

In comparison, the private hospital group performed 35% (n=2,786) of all procedures, with the majority (72%) of patients identified with a risk index of 0 (and no patients with risk indices 2 and 3). The majority (62%) of procedures performed in the private hospital group were elective caesarean sections. It should be noted that one of the largest private hospitals performing caesarean procedures does not submit data to HISWA.

Figure 19 Proportion of organisms isolated from caesarean section SSIs, 2013-14

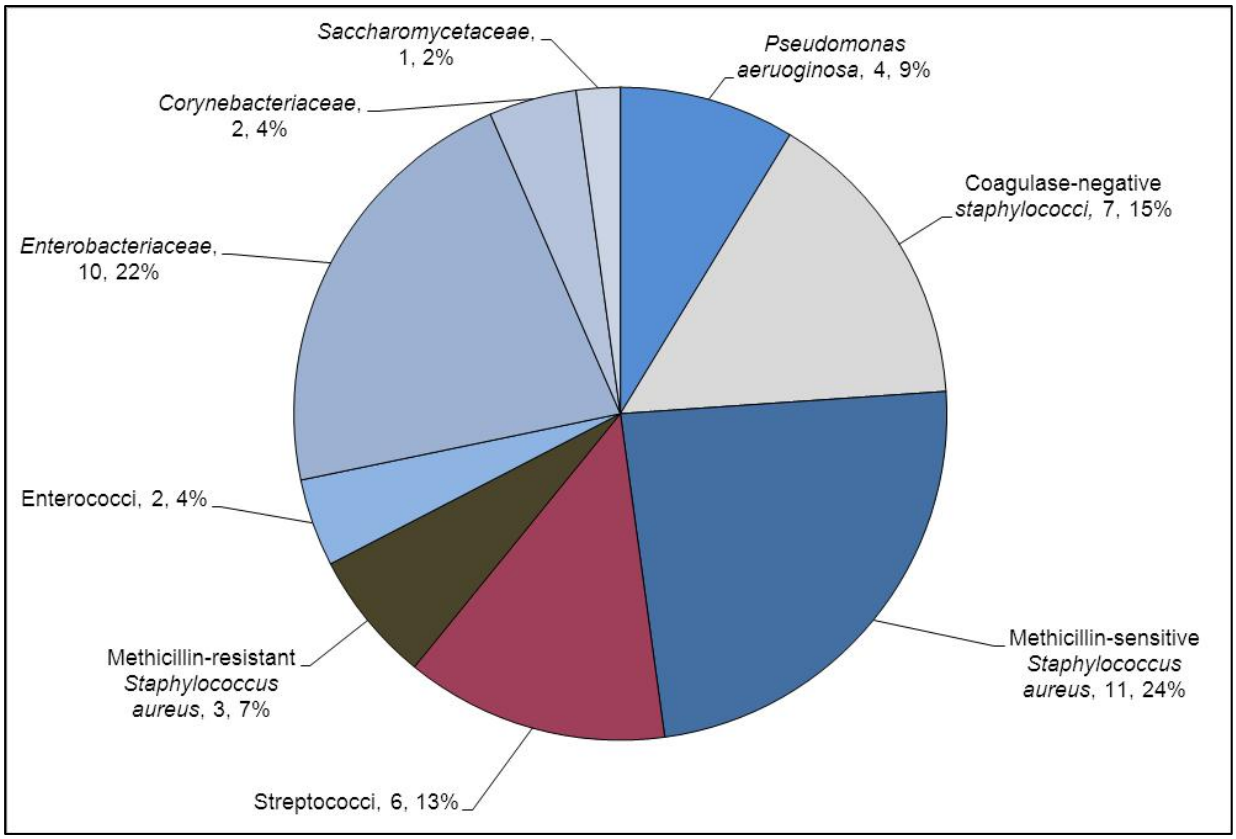


Figure 19 shows the proportion of microorganisms isolated from caesarean section SSI specimens in the 2013-14 reporting period. From the 51inpatient /readmission SSIs reported and analysed, a specimen was not collected for microbiological culture on six occasions (12%) and no organism was cultured from specimens collected on 8 (16%) occasions.

A total of 46 organisms were cultured from the 37 caesarean section SSIs to have positive microbiology:

- 67% (n=31) were Gram-positive bacteria: methicillin-sensitive *Staphylococcus aureus* (n=11), coagulase-negative staphylococci (n=7), Streptococci (n=6), methicillin-resistant *Staphylococcus aureus* (n=3), enterococci (n=2), *Corynebacteriaceae* (n=2)
- 31% (n=14) were Gram-negative bacteria: *Pseudomonas aeruginosa* (n=4), *Enterobacteriaceae* (n=10)
- 2% (n=1) *Saccharomycetaceae.*

Methicillin-sensitive *Staphylococcus aureus* was the causative organism for the majority (30%, n=11/37) of caesarean section SSIs, followed by *Enterobacteriaceae* (27%, n= 10/37). Methicillin-resistant *Staphylococcus aureus* (n=3), was the causative organism on three (8%) occasions and this proportion is comparable to the previous reporting periods.

Benchmarking

HISWA data has not been benchmarked with other jurisdictions as studies have shown that caesarean section surveillance data that includes only SSI diagnosed during the initial hospital admission period or on readmission are likely to be an underestimation of the true SSI rate, with some studies suggesting that the SSI rate increases by as much as 19-fold when post-discharge surveillance data is included, depending on the methodology.[3]

A study conducted by the Health Protection Agency in the UK that included post-discharge surveillance of caesarean section SSI, reported a SSI rate of 9.6 per 100 procedures. Of these, only 11% were detected during the initial admission or on readmission and 89% were detected by post-discharge surveillance methods.[20]

In the HISWA data, it is important to note the large proportion (54%, n= 38/70) of patients who required readmission to hospital for the management of their SSI post caesarean section, which adds significant healthcare costs to the system and more importantly adverse effect on the mother and baby.

The 70 SSIs reported to HISWA following caesarean section should be considered preventable adverse events and all hospitals need to ensure that evidence-informed infection prevention practices are implemented consistently, to prevent these infections occurring with a particular focus on emergency procedure infection prevention strategies.

Post discharge surveillance

There is no standardised post discharge surveillance methodology following caesarean section procedures conducted at the 28 hospitals in WA. Seven hospitals identified the 19 SSI that were treated as outpatients using a variety of methods and of these 11 were attributed to the metropolitan tertiary hospital.

Of the 19 SSI detected as outpatients, a total of 21 organisms were cultured from 18 SSIs with positive microbiology results:

- 62% (n=13) were Gram-positive bacteria: methicillin-sensitive *Staphylococcus aureus* (n=7), methicillin-resistant *Staphylococcus aureus* (n=6)
- 38% (n=8) were Gram-negative bacteria: *Pseudomonas aeruginosa* (n= 4*), Serratia marcescens* (n=1), *Enterobacter cloacae* (n=2), *Klebsiella sp* (n=1).

Methicillin-resistant *Staphylococcus aureus* healthcare associated infection

Methicillin-resistant *Staphylococcus aureus* healthcare associated infection

Healthcare associated infections (HAIs) caused by Methicillin-resistant* Staphylococcus aureus *(MRSA), such as SSIs, intravenous line-related BSIs, pneumonia and osteomyelitis, are a significant issue in hospitals worldwide. MRSA infections can present significant treatment challenges and can also result in significant morbidity, mortality and increased costs due to longer duration of hospital stay.[21,22]

Participating hospitals

For the 2013-14 surveillance period, 46 hospitals monitored and reported MRSA HAIs to HISWA. Hospital demographics included 23 metropolitan (12 private and 11 public) and 23 regional (2 private and 21 public) hospitals. One private metropolitan hospital submitted data for only one quarter of the reporting period.

Surveillance

Between July 01 2013 and June 30 2014, 181 MRSA HAIs were reported to HISWA.

HISWA categorises MRSA HAIs according to where the infection was likely to have been acquired, that is, inpatient or non-inpatient settings. The risk for infection in the intensive care unit (ICU) is higher due to severity of illness, multiple invasive devices, length of stay and immunosuppression in this patient population.[23,24] Therefore, inpatient events are also stratified by risk into ICU and non-ICU categories. For non-inpatient settings, the HAIs are associated with healthcare received as a non-inpatient e.g. haemodialysis or day surgery.

Invasive MRSA HAIs are isolated from normally sterile body sites, such as the bloodstream, and are associated with more severe disease and adverse patient outcomes, therefore, HISWA stratifies specimens by the site that the specimens were obtained from i.e. sterile and non-sterile.

There is no formal validation to ensure that all MRSA HAIs are captured in the surveillance data, however, data reported to HISWA are routinely verified to confirm they are HAI events and cross-checked with the Australian Collaborating Centre for Enterococcus and Staphylococcus Species (ACCESS) Typing and Research database in regards to strain classification, infection date and previous colonisation / infection status.

Data collection commenced in 2005, however in the following section, the results and analysis of MRSA HAIs since the 2009-10 reporting period is used to demonstrate five year trends.

Table 5 MRSA HAIs, by patient location and specimen type, 2013-14

Patient Location: Specimen Site	Number of MRSA HAIs	Number of bed-days	MRSA HAI rate per 10,000 bed-days [CI_{95}]
ICU: Sterile Site	2	71,387	0.28 [0.01 - 1.11]
ICU: Non-sterile Site	15	71,387	2.1 [1.25 - 3.51]
Non-ICU: Sterile Site	49	1,758,591	0.28 [0.21 - 0.37]
Non-ICU: Non-Sterile Site	107	1,758,591	0.61 [0.5 - 0.74]
Total Inpatient	**173**	**1,829,978**	**0.95 [0.81 - 1.1]**
Non-inpatient Nephrology	3	NA	NA
Non-inpatient Haematology/Oncology	0	NA	NA
Non-inpatient OPIV	0	NA	NA
Non-inpatient Other/Unknown	5	NA	NA
Total Non-inpatient	**8**	**NA**	**NA**
ICU	17	71,387	2.38 [1.46 - 3.86]
Non-ICU	156	1,758,591	0.89 [0.76 - 1.04]
Non-inpatient	8	NA	NA
Total MRSA HAI	**181**	**2,313,842***	**0.78 [0.68 - 0.91]**

*includes 483,864 same-day bed-days

In the 2013-14 surveillance period, a total of 181 MRSA HAIs were reported to HISWA, as shown in Table 5. The majority (96%) of these were related to inpatient care.

Overall, the majority (86%, n=156) of MRSA HAIs were reported from the non-ICU setting, which is consistent with previous reporting periods.

In the 2013-14 reporting period, the inpatient rate increased to 0.95 infections per 10,000 bed-days from 0.88 reported in 2012-13. The total MRSA HAI (inpatient and non-inpatient) rate increased to 0.78 infections per 10,000 bed-days from 0.75 reported in the 2012-13. These increases were not significant ($p>0.05$), however it is the second consecutive year both the inpatient and total MRSA HAI rates have increased.

Note: Same-day bed-days are added to overnight-stay bed-days to obtain a total MRSA HAI rate that includes inpatients and non-inpatients. A separate rate for non-inpatient MRSA HAI only cannot be calculated.

Figure 20 ICU and non-ICU and total MRSA HAI rates, 2009-10 to 2013-14

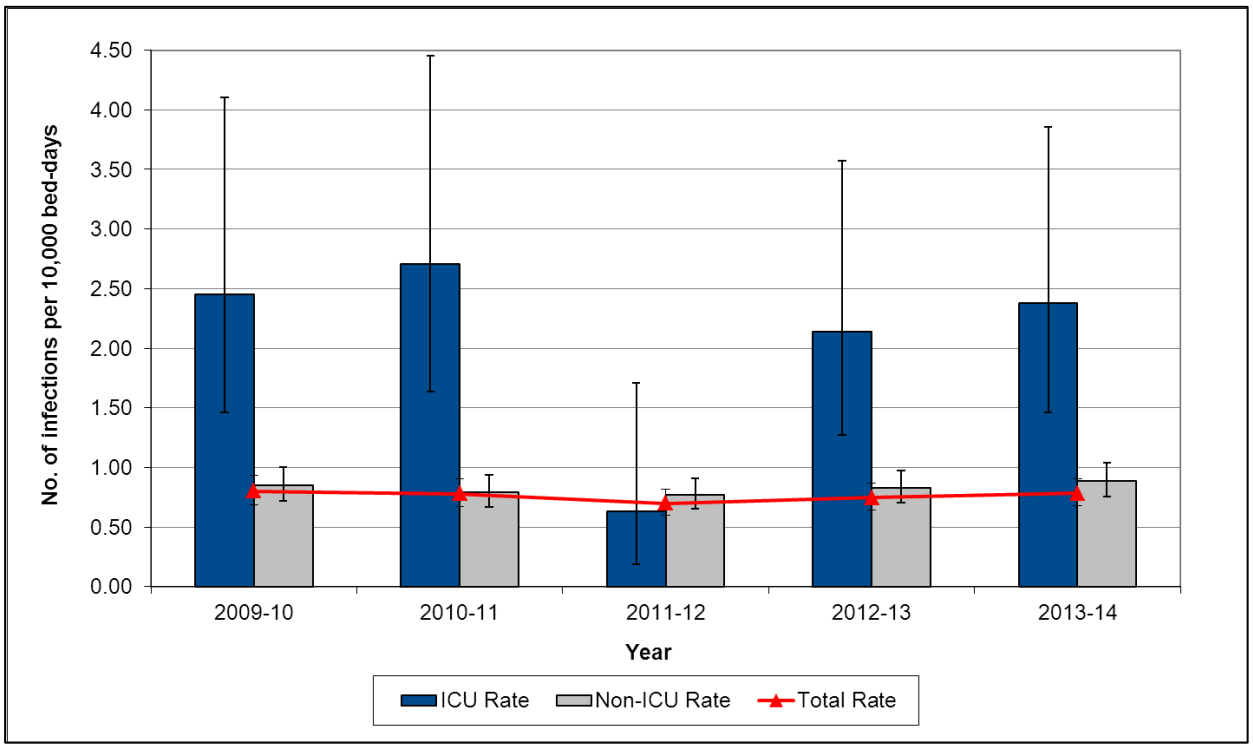


Figure 20 shows MRSA HAI rates by ICU, non-ICU and the total rate for each reporting period since 2009-10. With the exception of the 2011-12 reporting period, the rate of MRSA HAIs in the ICU is historically higher than both the non-ICU and the total MRSA HAI (inpatient and non-inpatient) rates and this pattern continues in 2013-14.

In the 2013-14 reporting period, 17 ICU MRSA HAIs were reported compared to 15 in 2012-13 and the ICU rate increased to 2.38 per 10,000 bed-days compared to 2.14 in 2012-13. This increase was not statistically significant ($p>0.05$).

Of the 13 hospitals that report ICU MRSA HAI data, three reported rate increases for the 2013-14 reporting period when compared with 2012-13; none of these hospitals had a rate increase that was statistically significant ($p>0.05$).

In the 2013-14 reporting period, the non-ICU MRSA HAI rate increased to 0.89 infections per 10,000 bed-days, compared to 0.83 reported in 2012-13. This increase was not statistically significant ($p>0.05$).

Both the ICU and non-ICU rates have increased for the second consecutive year.

Figure 21 MRSA HAI rates, by ACHS clinical indicator group, 2009-10 to 2013-14

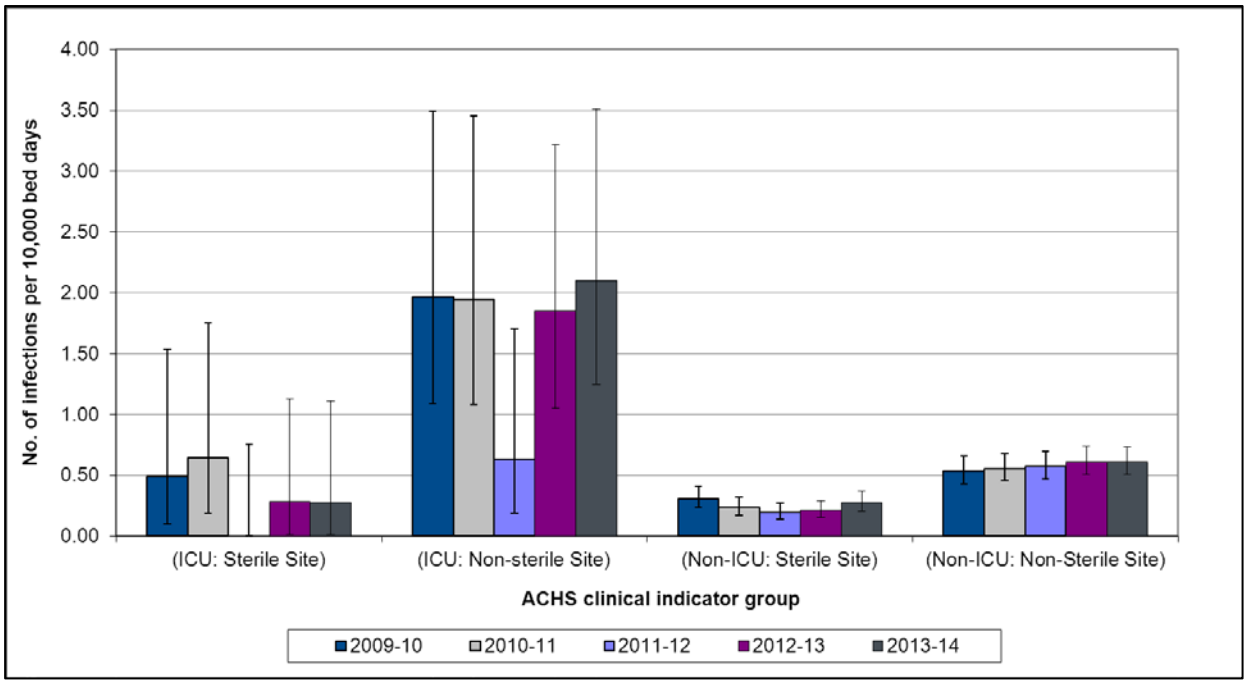


Figure 21 shows inpatient MRSA HAIs, categorised by the clinical indicator groups used by the Australian Council on Healthcare Standards (ACHS).

MRSA HAIs occurring in the ICU in non-sterile sites represent the highest rate in all reporting periods since 2009-10. In the 2013-14 reporting period, the rate increased to 2.10 infections per 10,000 bed-days from 1.85 in 2012-13. This increase was not significant ($p>0.05$).

The infection rate for non-ICU sterile site category also increased this reporting period, however this was not significant ($p>0.5$). The ICU: sterile site and non-ICU: non-sterile site categories remained similar to rates reported in previous reporting periods.

Figure 22 Proportion of MRSA HAIs, by specimen site, 2009-10 to 2013-14

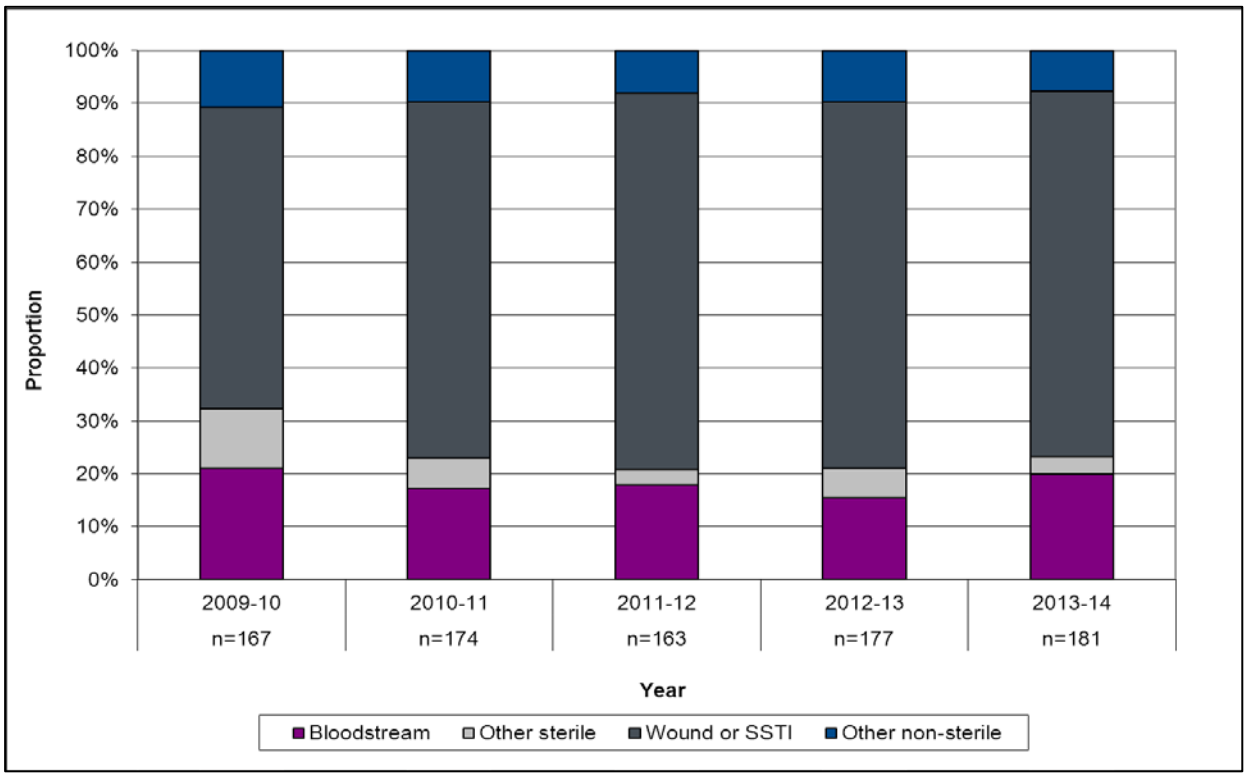


Figure 22 shows the proportion of MRSA HAIs by specimen site for each reporting period since 2009-10. Of the 181 MRSA HAIs reported in the 2013-14 reporting period, 139 (77%) were identified from specimens obtained from non-sterile sites that included:

- wounds (n=125)
- sputum (n=8)
- urine (n=6).

Of the eight MRSA respiratory HAIs diagnosed from sputum, six occurred in ICU patients. Of the 125 MRSA HAIs identified from wounds, 78 (62%) were associated with surgical procedures and represented 43% of all MRSA HAI reported in 2013-14. The remaining 42 (23%) MRSA HAIs were from sterile site specimens that included:

- bloodstream (n=36)
- pleural (n=2)
- aseptic tissue (n=4).

There have been zero MRSA HAIs diagnosed from peritoneal sites for the last three reporting periods. The 36 MRSA BSIs represent 20% of all MRSA HAIs reported in 2013-14. Of these, two occurred in ICU patients and three in haemodialysis non-inpatients and the remaining 31 were in non-ICU patients. With an estimated mortality rate of 25% [21], the 36 MRSA BSIs infections may have contributed to approximately nine deaths in WA hospitals.

Figure 23 Proportion of MRSA HAIs by clone groups, 2009-10 to 2013-14

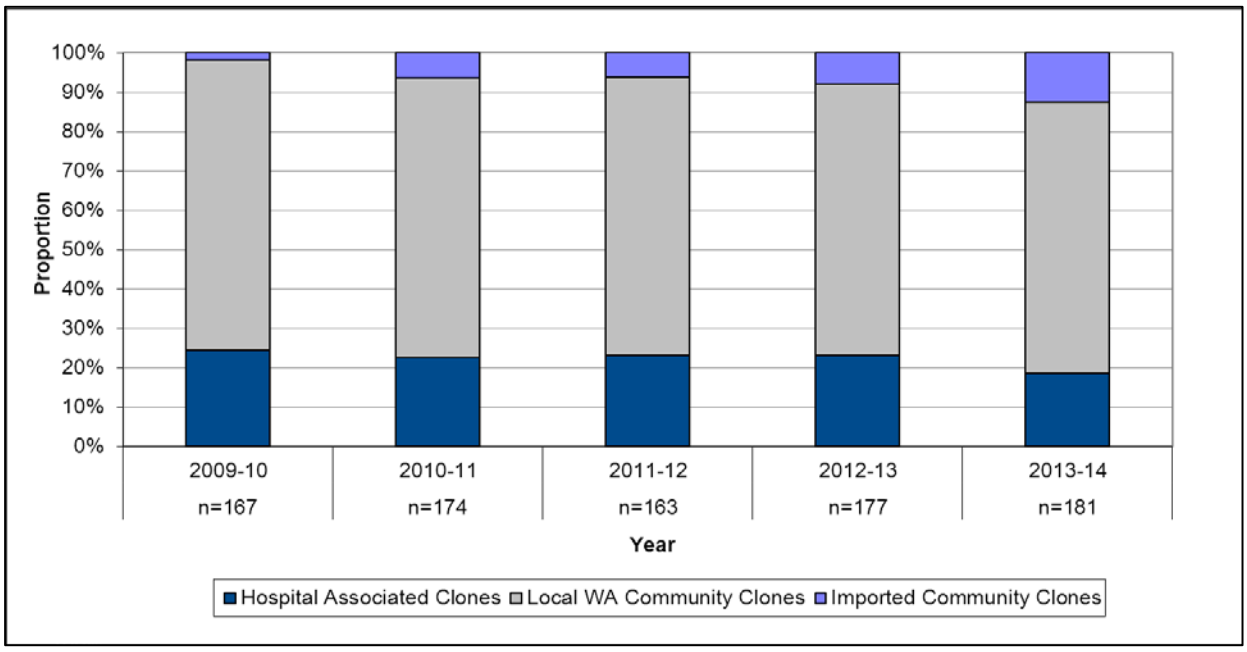


Figure 23 shows the proportions of MRSA HAIs by clone group since 2009-10.

MRSA clones are broadly grouped in this report into hospital-associated clones (HA-MRSA) and community-associated clones (CA-MRSA) based on molecular typing. HA-MRSA clones are often referred to internationally as 'healthcare-associated MRSA', and were known previously as 'epidemic MRSA'. These clones are known to be highly transmissible within and between hospitals and cause outbreaks in hospital settings. However, they do not appear to spread readily in the community and are uncommon in people who have had no contact with hospitals. CA-MRSA strains have adapted to survive and spread successfully in the community and are further classified as either local WA CA-MRSA or imported CA-MRSA.

The local WA CA-MRSA clones are the most prevalent in WA and in 2012-13 accounted for 52% of all MRSA isolated from people in both community and healthcare settings.[25] Figure 23 shows that the majority (67%) of all MRSA HAIs were caused by the local WA CA-MRSA clones, and this is consistent with previous reporting periods.

The proportion of HA-MRSA clones causing HAIs had remained stable for the past four reporting periods at around 24, however, this proportion decreased to 18% in 2013-14. The proportion of MRSA HAIs caused by imported CA-MRSA has increased each reporting period since 2009-10 and represents 12% of all MRSA HAIs compared with 8% in 2012-13.

Of the 22 HAIs caused by imported CA-MRSA clones, 17 (77%) were typed as the Queensland clone. This is the predominant imported CA-MRSA clone isolated in WA. The UK 15 clone is the most frequently isolated HA-MRSA clone associated with HAIs in WA, accounting for 30 (91%) of the MRSA HAIs caused by HA-MRSA clones.

Figure 24 Proportion of MRSA HAI by colonisation status and specimen sites, 2009-10 to 2013-14

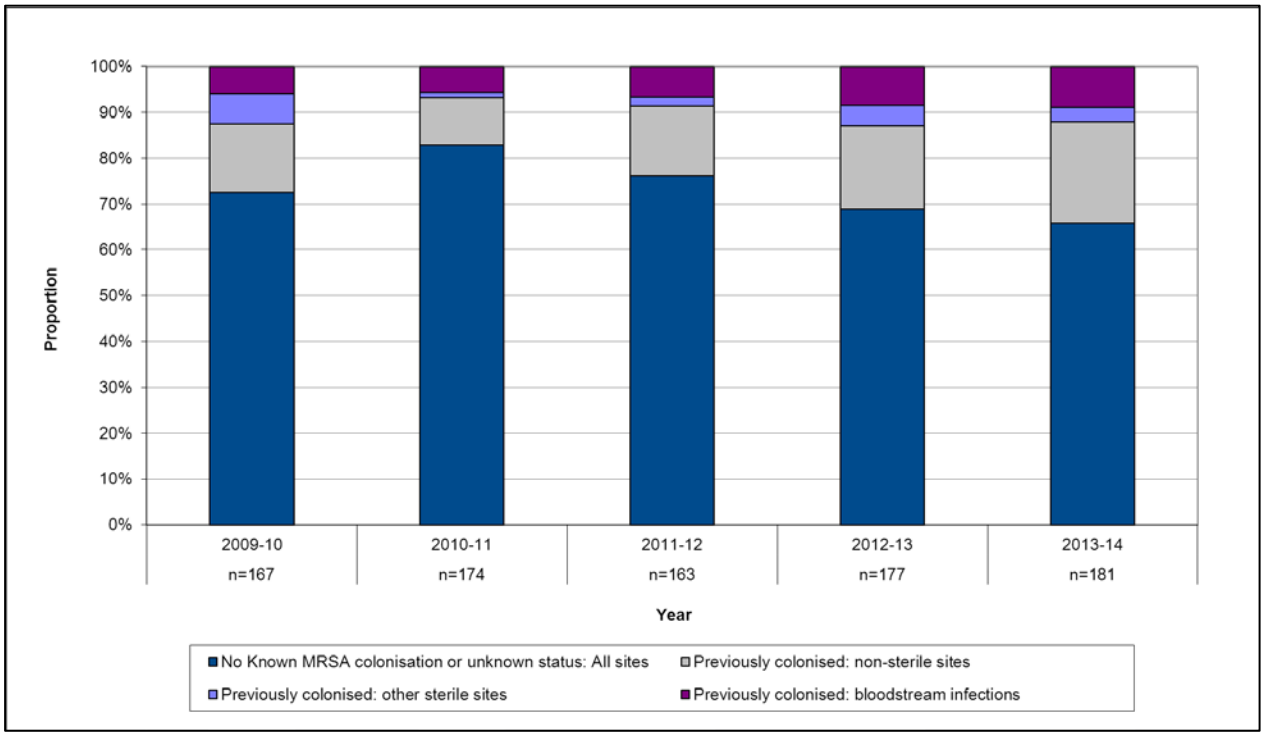


Figure 24 shows the proportion of MRSA HAI according to colonisation status and specimen sites (i.e. sterile or non-sterile) for each reporting period since 2009-10.

Of the 181 MRSA HAIs reported in the 2013-14 period, 62 (34%) were identified in patients who were known to be colonised with the same strain of MRSA prior to the onset of the HAI event occurring. This represents an increase in numbers and proportion compared to the 2012-13 period when 55 (31%) MRSA HAIs were identified in patients with known colonisation. This increase was not statistically significant ($p>0.05$). Of the 36 MRSA BSIs reported in 2013-14, 16 (44%) occurred in patients with known MRSA colonisation compared with 15 (56%) in 2012-13.

Cumulative data for the 2009-14 period, shows that of the 862 MRSA HAI reported, 232 (30%) occurred in previously colonised patients. Ninety-two (44%) of these were from sterile sites, indicating severe invasive infection, including 62 BSIs that potentially may have been prevented. Of the 62 BSIs in this subgroup, seven occurred in ICU patients and seven occurred in haemodialysis patients.

Patients who are colonised with MRSA have an increased risk for endogenous MRSA HAI.[26,27] These patients may benefit from interventions to eliminate or reduce their colonisation status, thus preventing the acquisition of an HAI.

Figure 25 HISWA, SA and ACHS MRSA HAI rates, 2009 to 2013

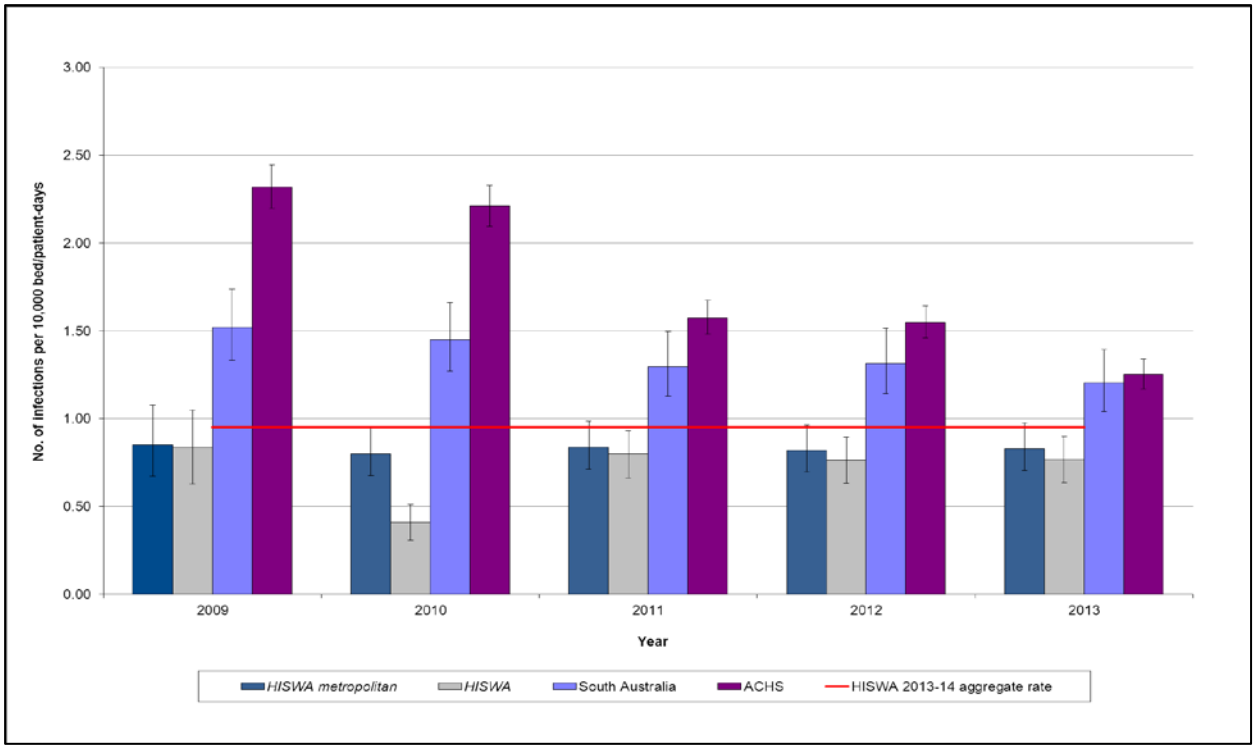


Figure 25 shows annual aggregate rates for HISWA, South Australia (SA) and the Australian Council on Healthcare Standards (ACHS) from 2009 to 2013. The HISWA 2013-14 aggregate inpatient rate of 0.95 per 10,000 bed-days is represented by the red line.

HISWA data has been adjusted to provide comparison with data collection in SA and ACHS. SA data does not include data from paediatric or neonatal ICUs, and reports cases from metropolitan hospitals only and does not include non-inpatient data. ACHS data includes inpatient data from metropolitan and non-metropolitan hospitals and is comparable with total inpatient HISWA data (*HISWA).*

HISWA metropolitan data is metropolitan inpatient data and is adjusted to compare with SA. *HISWA* data includes inpatient data from metropolitan and non-metropolitan hospitals and is adjusted to compare with ACHS.

In 2013 the *HISWA metropolitan* rate of 0.83 per 10,000 bed-days was significantly lower than the 2013 SA rate of 1.20 ($p<0.05$). For the five-year period 2009-13, the *HISWA metropolitan* rate of 0.85 infections per 10,000 bed-days was significantly lower ($p<0.05$) than the SA rate of 1.36 per 10,000 patient days.

In 2013 the *HISWA* rate of 0.77 per 10,000 bed-days was significantly lower than the ACHS rate of 1.25 ($p<0.05$). For the five-year period 2009-13 the *HISWA* cumulative rate of 0.70 infections per 10,000 bed-days was significantly lower ($p<0.05$) than the ACHS rate of 1.76 per 10,000 patient days.

Figure 26 HISWA, SA and ACHS MRSA HAI rates, by clinical indicator groups, 2009-2013

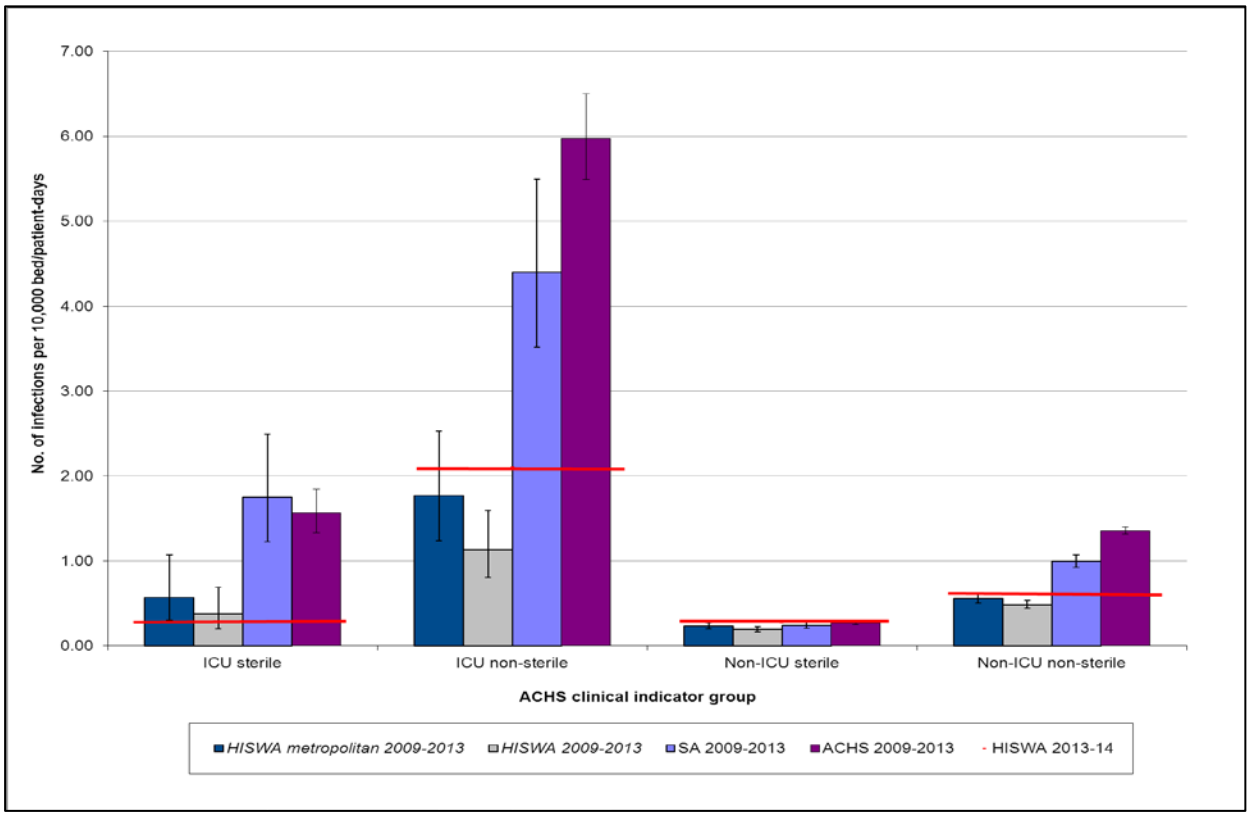


Figure 26 shows cumulative MRSA HAI rates compared with SA and ACHS by ACHS indicator groups for the period 2009-13.

The 2009-13 *HISWA metropolitan* MRSA HAI rates for ICU sterile site (0.57) infections per 10,000 bed-days), ICU non-sterile site (1.77) and non-ICU non-sterile site (0.56) are all significantly lower ($p<0.05$) than the SA comparator rates for these groups (1.75; 4.40; 1.00 respectively). The *HISWA metropolitan* MRSA HAI rate for non-ICU sterile site infections (0.23) is comparable to the SA rate of 0.24 infections per 10,000 patient-days.

The *HISWA* rate is significantly lower ($p<0.05$) than the ACHS rates for ICU sterile, ICU non-sterile and non-ICU non-sterile sites. The red lines represent the HISWA inpatient aggregate rate for 2013-14 and this rate is significantly lower than SA and ACHS for the same indicators ($p<0.05$).

Note: SA uses patient-days as a denominator for rate calculations rather than occupied bed-days as used by HISWA. The yearly variance between calculations of patient-days and occupied bed-days is minimal and is estimated to be less than 1%.

Hospital-identified *Clostridium difficile* infection

Hospital-identified *Clostridium difficile* infection

Clostridium difficile ***is a Gram-positive, anaerobic, spore forming bacterium that is the most common infectious cause of healthcare associated diarrhoea.[22] The impact of*** **Clostridium difficile** ***infection (CDI) has been felt across the entire spectrum of healthcare, and it is recognised as a pathogen capable of causing human suffering to a degree matching that of MRSA.[23]***

Participating hospitals

For the 2013-14 surveillance period, 45 hospitals monitored and reported hospital-identified *Clostridium difficile* infections (HI-CDI) to HISWA. Hospital demographics included 22 metropolitan (11 private and 11 public) and 23 regional (two private and 21 public) hospitals.

Surveillance

In the 2013-14 reporting period a total of 844 HI-CDIs were reported to HISWA.

HI-CDI cases are reported by the hospital at which the positive specimen was identified. These include both hospital-acquired *and* community-acquired cases, and represent the overall burden of CDI cases at a particular hospital. Case numbers are ascertained from specimens obtained from all parts of a facility, including inpatients, outpatients, emergency departments and mental health wards within the hospitals. This contrasts with the reporting of the other indicators in this report which are all healthcare associated infections.

The HAIU receives independent notification of all *Clostridium difficile* toxin-positive specimens from the state pathology service (PathWest), which performs state-wide testing for WA public hospitals. This allows for validation of all HI-CDI episodes reported to HISWA from the public sector. The validation process includes checking toxin-positive status, removal of duplicates reported by multiple hospitals, removal of cases that are reported within eight weeks of an existing report and addition of cases missed by internal hospital reporting.

Data from the private sector is not available to the HAIU for validation, however, duplicate reporting between private and public hospitals is checked.

Data collection for this indicator commenced in 2010 and in the following section, the results and analysis of HI-CDI surveillance are presented.

Table 6 Quarterly aggregate HI-CDI rates, 2010-2014

Year	Quarter	Number of HI-CDIs	Number of bed-days	CDI rate per 10,000 bed-days [CI_{95}]
2010	Jan - Mar	71	485,186	1.46 [1.16 - 1.85]
	Apr - Jun	72	514,121	1.40 [1.11 - 1.77]
	Jul - Sep	107	538,099	1.99 [1.65 - 2.41]
	Oct - Dec	139	525,996	2.64 [2.24 - 3.12]
2011	Jan - Mar	127	527,044	2.41 [2.03 - 2.87]
	Apr - Jun	135	544,515	2.48 [2.09 - 2.94]
	Jul - Sep	173	569,980	3.04 [2.62 - 3.53]
	Oct - Dec	258	559,481	4.61 [4.08 - 5.21]
2012	Jan - Mar	293	553,540	5.29 [4.72 - 5.94]
	Apr - Jun	209	583,523	3.58 [3.13 - 4.10]
	Jul - Sep	219	612,103	3.58 [3.13 - 4.09]
	Oct - Dec	257	602,073	4.27 [3.78 - 4.83]
2013	Jan - Mar	219	606,729	3.61 [3.16 - 4.12]
	Apr - Jun	215	639,071	3.36 [2.94 - 3.85]
	Jul - Sep	198	640,173	3.09 [2.69 - 3.56]
	Oct - Dec	184	620,958	2.96 [2.56 - 3.43]
2014	Jan - Mar	207	602,304	3.44 [3.00 - 3.94]
	Apr - Jun	255	615,366	4.14 [3.67 - 4.69]
Total		**3,338**	**10,340,262**	**3.23 [3.12 – 3.34]**

Table 6 shows the fluctuations in the number and rate of HI-CDI for each reporting quarter. There has been a general upward trend since mandatory reporting commenced in January 2010. The highest rate of 5.29 per 10,000 bed-days was reported in January to March 2012.

Figure 27 Quarterly aggregate HI-CDI rates, 2010-2014

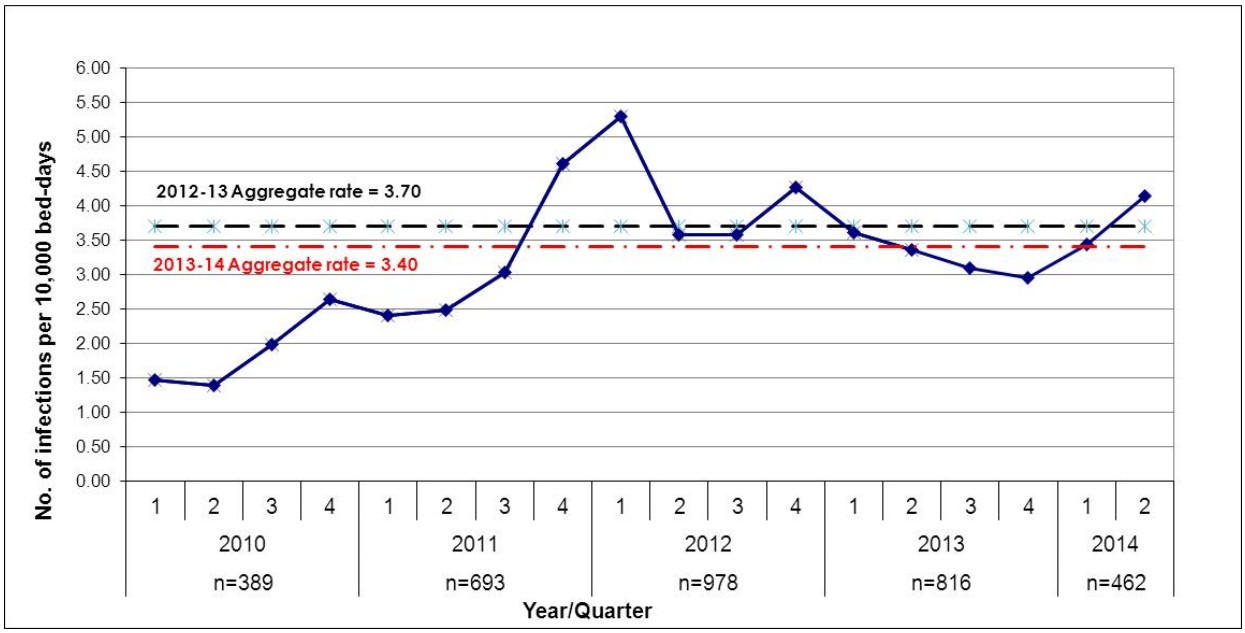


Figure 27 shows the quarterly HI-CDI rate since reporting commenced in 2010. The HISWA aggregate rate for 2012-13 and 2013-14 is also shown. The 2013-14 aggregate rate of 3.40 per 10,000 bed-days is lower than the rate of 3.70 reported for 2012-13 ($p>0.05$)

Table 7 CDI rates, by hospital group, 2013-2014

Hospital group	Number of HI-CDIs	Number of bed-days	HI-CDI rate per 10,000 bed-days [CI_{95}]	2012-13 rate
Tertiary	483	942,606	5.12 [4.68 - 5.60]	5.72
Metropolitan non-tertiary	105	327,110	3.20 [2.65 - 3.89]	3.23
Regional/rural	71	262,844	2.70 [2.14 - 3.41]	2.98
Private	185	946,241	1.96 [1.69 - 2.26]	1.59
Total	**844**	**2,478,805**	**3.40 [3.18 - 3.64]**	**4.10**

Tertiary hospitals consistently report the highest rates of HI-CDI and private hospitals the lowest, and this was observed in 2013-14 data as shown in Table 7.

Figure 28 HI- Quarterly HI-CDI rates, by hospital group, 2010-2014

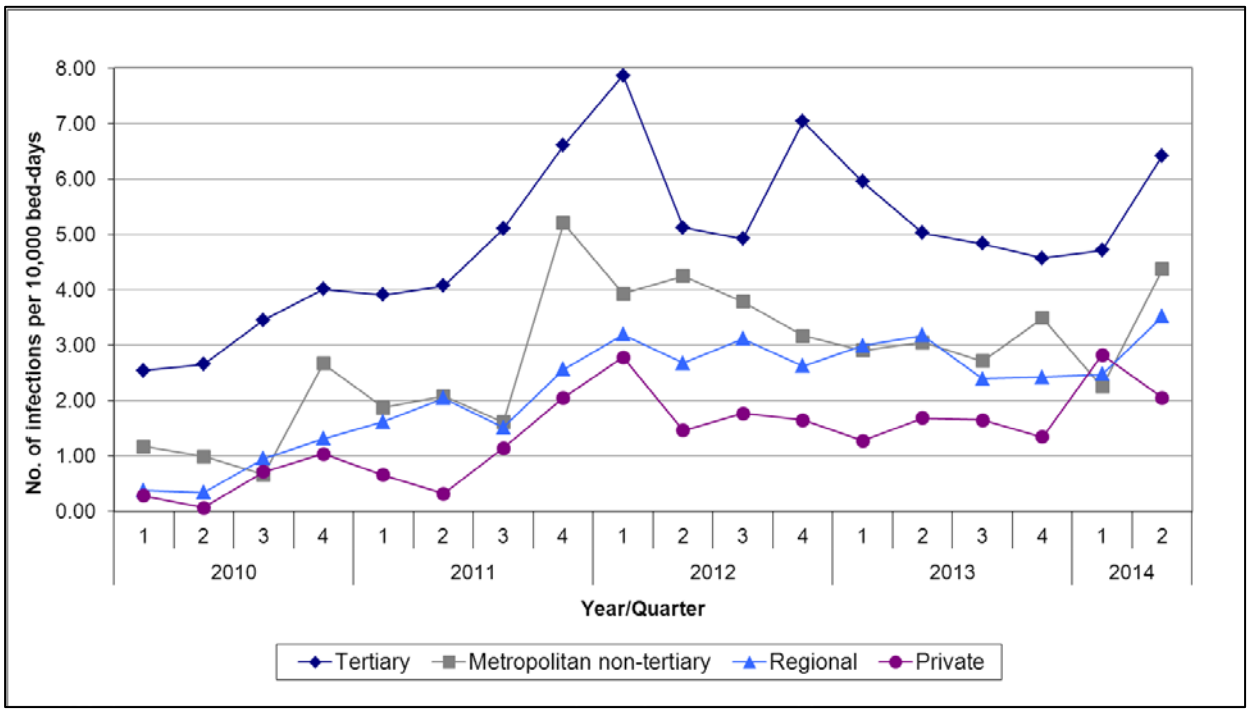


Figure 28 shows the quarterly rates of HI-CDI across all hospital groups since data collection commenced in 2010. All hospital groups have demonstrated an upward trend in HI-CDI rates since data collection commenced.

In quarter two of 2014, the HI-CDI rate increased for tertiary, metropolitan non-tertiary and regional hospital groups compared to quarter one 2014. This was a significant increase for tertiary and metropolitan non-tertiary groups ($p<0.05$).

Benchmarking

HI-CDI data is not suitable for benchmarking as it reflects overall burden of HI-CDI present in a particular hospital catchment area rather than hospital performance.

Vancomycin-resistant Enterococci infection

Vancomycin-resistant Enterococci Infection

The increasing incidence of healthcare associated infections (HAIs) caused by vancomycin-resistant enterococci (VRE), internationally and in Australia, is a concern due to the limited antimicrobial agents available to treat these infections. Although not highly pathogenic, VRE can cause severe infections in critically ill and immunocompromised patients. In addition, the vancomycin resistance gene can be transmitted to more pathogenic organisms, such as **Staphylococcus aureus.**[30]

Participating hospitals

For the 2013-14 surveillance period, 45 hospitals monitored and reported sterile site (e.g. bloodstream, aseptic tissue) VRE infections to HISWA. Reporting includes both HAIs and community associated infections (CAIs). Hospital demographics included 22 metropolitan (11 private and 11 public) and 23 regional (2 private and 21 public) hospitals.

Surveillance

In addition to the active hospital sterile site surveillance, the Healthcare Associated Infection Unit (HAIU) is notified of all VRE isolates reported to the PathWest Gram Positive Typing Laboratory from both public and private laboratories. For the 2013-14 reporting period, 735 VRE isolates were referred for typing and of these 708 (96%) were screening specimens and 27 (4%) were identified as clinical specimens.

Between July 1 2013 and June 30 2014, a total of 39 VRE clinical isolates were reviewed by the HAIU from both surveillance sources. Of these clinical isolates, 29 were HAIs. Additional information on VRE colonisation prior to the onset of infection and if the patient was classified as a higher-risk patient for the development of a VRE infection is also captured.

Note: The additional 12 clinical isolates notified to the HAIU were from patients that were known to be VRE positive from previous screening specimens prior to the clinical specimen. In these cases, there has been an assumption that the strain will be the same and therefore the clinical isolate was not referred to the Typing Laboratory or not typed on receipt. Data in this reporting period is based on this assumption, however all clinical isolates are now referred to the Typing Laboratory and typed irrespective of previous typing.

Formal data collection for this indicator commenced in the 2012-13 reporting period and in the following section, the results of VRE infection surveillance are presented.

Table 8 Number of VRE clinical isolates causing HAIs and CAIs, 2012-13 and 2013-14

Reporting period	Number of clinical isolates notified to HAIU	HAI	CAI	Total
2012-13	13	7	2	9
2013-14	39	29	1	30
Total	**52**	**36**	**3**	**39**

Table 8 shows a marked increase in the number of VRE clinical isolates and VRE HAIs notified in the 2013-14 reporting period compared to 2012-13. Of the 39 VRE clinical isolates, 30 (77%) were associated with clinical infection and the remaining nine 9 were VRE colonised with no evidence of clinical infection being diagnosed or treated. Of the 36 VRE HAI reported in 2013-14, the majority (83%) were reported from the three metropolitan general tertiary hospitals.

Table 9 VRE infections identified from clinical specimens, 2013-14

Specimen sample type	Infection site	HAI	CAI	Total
Sterile	Bloodstream	7	0	7
	Aseptic tissue	4	0	4
	Peritoneum	4	0	4
Non-sterile	Urine	10	1	11
	Wound	4	0	4
Total		**29**	**1**	**30**

Table 9 shows the sterile and non-sterile site infections identified from clinical isolates in the 2013-14 reporting period. The four wound infections were all related to surgical procedures and three of the four peritoneum infections, were associated with peritoneal dialysis.

Of the 30 VRE infections, 15 (50%) occurred in patients who were colonised with VRE prior to the onset of infection. Twenty nine were caused by vanB *Enterococcus faecium* and of these, 21 (72%) were caused by a single strain associated with a VRE outbreak at two metropolitan tertiary hospitals during this reporting period. The majority (n =16, 76%) of infections with the outbreak strain were associated with one hospital where the outbreak was prolonged.

Figure 29 VRE HAIs by site of clinical specimen 2012-13 to 2013-14

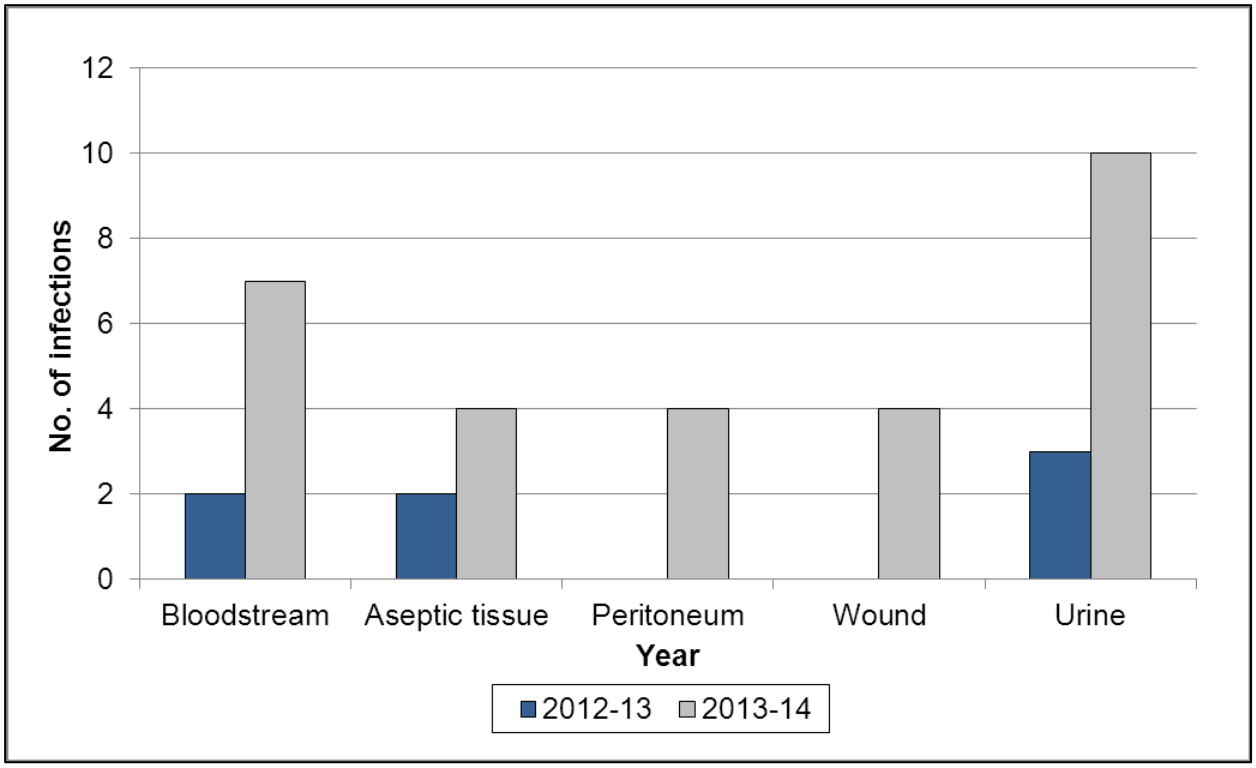


Figure 29 shows the VRE HAIs from all specimen sites in this reporting period compared with 2012-13. There was a marked increase in the number of VRE HAIs from all specimen sites in this reporting period.

In this reporting period, 15 (52%) of the 29 VRE HAIs were identified in higher-risk patient groups (haematology =2; ICU =3; dialysis/ renal =10). This represents a marked increase from the four VRE HAIs reported from higher-risk groups in 2012-13 (dialysis = 3, ICU =1). Higher-risk patients are those who are at increased risk of VRE infection and are identified as those patients admitted to higher-risk wards such as intensive care / high dependency unit, haemodialysis, haematology or oncology and solid organ transplant patients.

Of the seven bloodstream infections reported, six (86%) were reported from two metropolitan general tertiary hospitals and one from a private hospital. Four were associated with higher-risk patient groups (dialysis 3, ICU 1).

For the 2013-14 reporting period, the WA aggregated rate of healthcare associated VRE BSIs was 0.03 per 10,000 bed-days. The metropolitan tertiary inpatient hospital VRE BSI rate was 0.07 per 10,000 bed-days.

Data for benchmarking purposes is limited, however, comparable data was sourced from 20 major teaching hospitals in California from 2012. The pooled mean rate of hospital onset VRE BSI reported by this group was 0.98 per 10,000 patient days which is significantly higher ($p<0.05$) than the HISWA rate and the metropolitan tertiary inpatient hospital rate. [24]

Healthcare associated *Staphylococcus aureus* bloodstream infection

Healthcare associated *Staphylococcus aureus* bloodstream infection

Healthcare associated* Staphylococcus aureus *bloodstream infection (HA-SABSI) causes significant illness and serious complications, such as endocarditis, osteomyelitis and septic arthritis, which frequently result in prolonged hospital admission and consequent increased healthcare costs. Even with advanced medical care, mortality remains high, with a median attributable mortality rate of 25%. [25] ***These adverse events are an important measure of quality of care in our hospitals and are increasingly regarded as preventable healthcare associated infection.*** [26]

Participating hospitals

From July 01 2013 to June 30 2014, 45 hospitals monitored and reported HA-SABSI data to HISWA. Hospital demographics included 23 metropolitan (11 private and 11 public) and 23 regional (2 private and 21 public).

Surveillance

Between July 01 2013 and June 30 2014, 191 HA-SABSIs were reported to HISWA.

HISWA surveillance aligns with the national surveillance definitions for HA-SABSI developed by the Australian Commission on Safety and Quality in Health Care (ACSQHC). HISWA also stratify HA-SABSI according to the setting where the infection was likely to have been acquired (inpatient or non-inpatient) and according to the source of the HA-SABSI, which informs infection prevention strategies and quality improvement initiatives.

All SABSI events reported to HISWA from public hospitals are validated by the HAIU. This is enabled by the receipt of *Staphylococcus aureus* blood culture data from the PathWest Laboratory Medicine, which processes all microbiology for WA public hospitals. All *Staphylococcus aureus* blood cultures are reviewed to assess if they are healthcare or community associated events. This process helps to ensure the accuracy of HISWA data. Private hospitals are encouraged to engage in routine internal validation processes to assess data integrity and validity.

HA-SABSIs acquired as a result of healthcare procedures and invasive medical devices are largely preventable, and surveillance data should be used to drive patient safety initiatives to improve patient outcomes.

Data collection commenced in October 2007, however in the following section, the results and analysis of HA-SABSIs since the 2009-10 reporting period is used to demonstrate five year trends.

Figure 30 Inpatient and non-inpatient HA-SABSI rates, 2009-10 to 2013-14

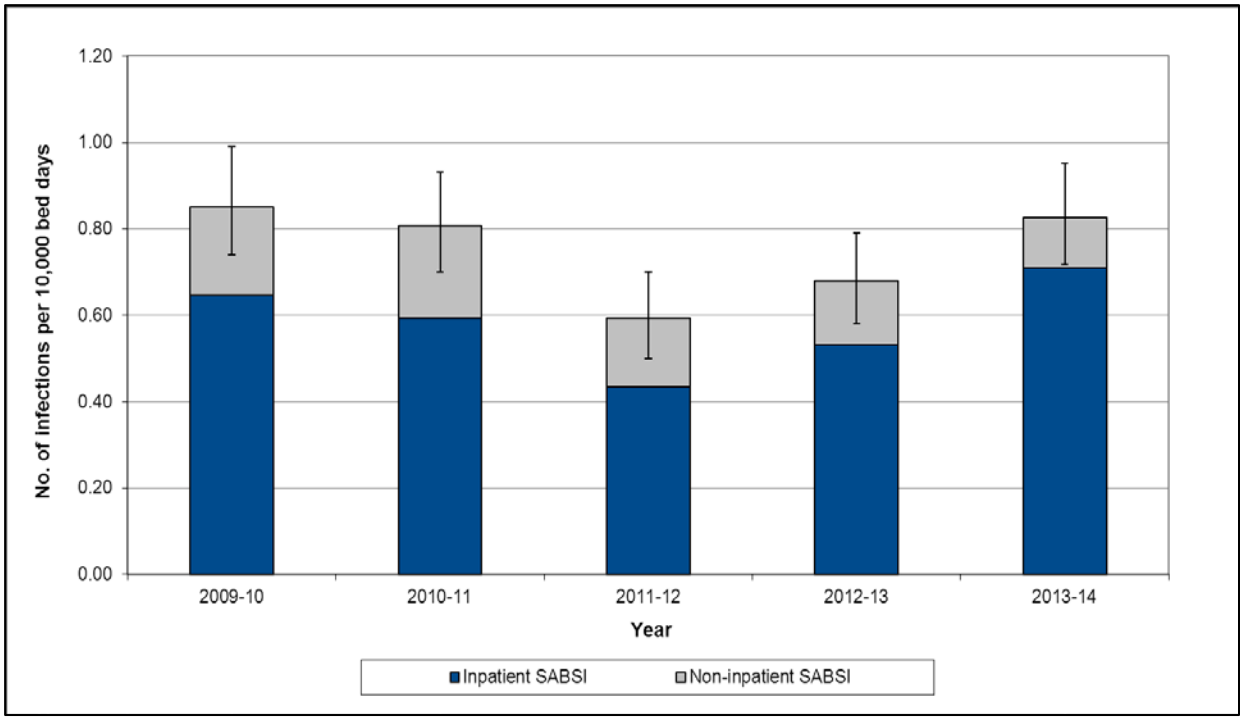


Figure 30 shows the annual HA-SABSI rates, stratified by inpatient and non-inpatient events. Inpatient SABSIs consistently represent the majority of HA-SABSIs reported from WA hospitals (mean=77%). The inpatient rate and total rate (inpatient and non-inpatient) of HA-SABSI have increased for the second consecutive year. The total HA-SABSI rate of 0.83 infections per 10,000 bed-days for 2013-14 is the highest rate reported since the 2009-10 reporting period.

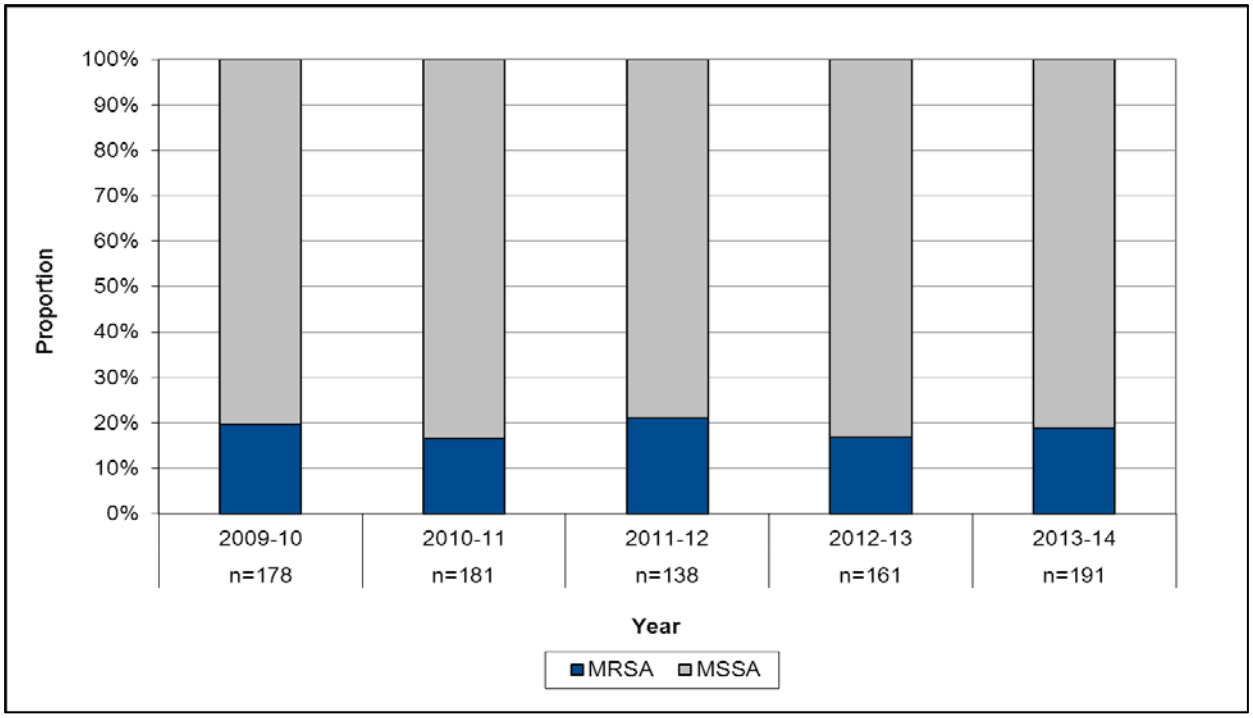
The non-inpatient HA-SABSI rate has remained stable for the past three reporting periods.

All WA public hospitals reporting to HISWA had rates below the national benchmark of 2.0 infections per 10,000 patient-days as set by the Australian Institute of Health and Welfare for the National Healthcare Agreement and MyHospitals reporting in 2009.

It should be noted that an additional five HA-SABSIs, all methicillin-sensitive *Staphylococcus aureus* (MSSA), were identified in this reporting period from the private purpose-built satellite haemodialysis units that are not attached to a hospital. These episodes are not included in hospital HA-SABSI rates as bed-day data is not collected from these units and the events cannot be attributed to a hospital.

However, if these five events are added to WA data, the total HA-SABSI rate for the 2013-14 reporting period increases to 0.85 infections per 10,000 bed-days. These five HA-SABSIs are not included in further analysis of HA-SABSI data.

Figure 31 Proportion of MSSA and MRSA HA-SABSI, 2009-10 to 2013-14

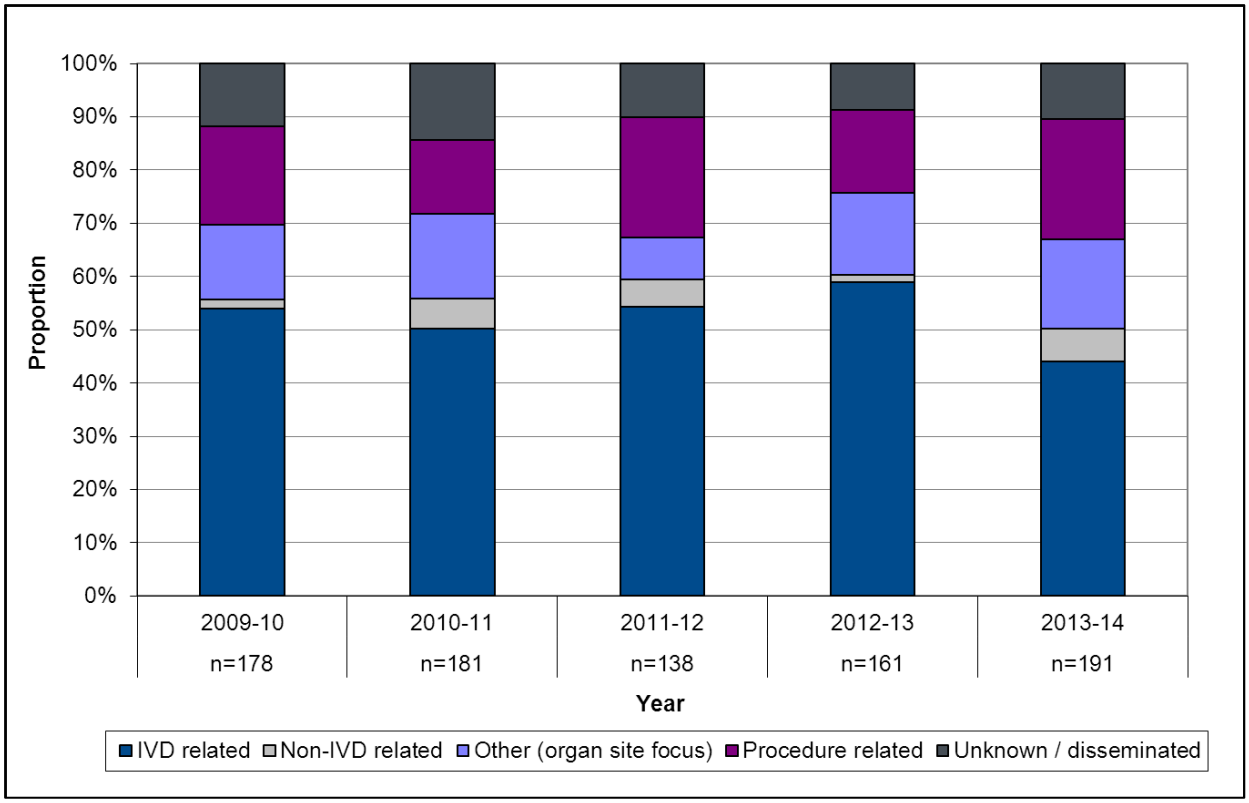


As Figure 31 shows, the majority of HA-SABSIs reported to HISWA since 2009-10 are caused by MSSA. In 2013-14, only 36 (19%) of the 191 HA-SABSIs reported were caused by MRSA. The proportion of MRSA HA-SABSI reported is consistent over all reporting periods, with a range of 17% to 21%.

The ACCESS Typing and Research Unit - PathWest Laboratory Medicine, performs molecular typing on MRSA isolates and therefore allows strain identification of MRSA HA-SABSIs. The community-associated MRSA (CA-MRSA) clones are the most prevalent in WA and accounted for 52% of all MRSA isolated from people in the community and healthcare settings in 2012-13.[26] The majority (83%) of MRSA HA-SABSIs in 2013-14 were caused by CA-MRSA strains, which is consistent with previous reporting periods.

Approximately 50% of healthy adults carry *S.aureus* in their nasal passages or on their skin and people are admitted to hospital with unknown carriage of MSSA or MRSA.[27] The incidence of HA-SABSI is therefore a useful indicator of the standard of infection prevention and control practices such as hand hygiene, aseptic technique, appropriate skin antisepsis and *S.aureus* screening and decolonisation of high-risk patients.[28] Despite the increasing prevalence of MRSA in the WA community, the number of MRSA HA-SABSIs reported in WA hospitals has remained fairly stable over time. This may be reflective of the stringent MRSA policies that have been in place in WA for many years.

Figure 32 Sources of HA-SABSI, 2009-10 to 2013-14



Of the 191 HA-SABSIs reported in the 2013-14 period, 171 (90%) were from an identifiable source, that included intravascular devices (IVDs) (n=84), invasive procedures (n=43), a specific organ site infection (n=32) and indwelling medical devices (n=12). The source was either unknown or disseminated on 20 occasions.

Figure 32 shows that since 2009-10, the most commonly identified source of HA-SABSIs are events related to the presence of an IVD (mean 52%, range 44% to 59%). In 2013-14 this trend continued, with 44% (n=84) of HA-SABSIs attributable to IVDs, although the proportion and number did decrease from the 59% (n=95) reported in 2012. The proportion and number of HA-SABSIs that were procedure-related increased to 23% (n=43), compared with the 16% (n=25) reported in 2012-13.

This data remains a concern for WA HCFs, as the majority of these events are considered preventable adverse events rather than inevitable complications of healthcare. If the attributable mortality rate of 25% is applied to the 2013-14 data, then an estimated 32 patients may have died as a result of intravascular device and procedural interventions alone. HCFs need to thoroughly review infection prevention strategies related to IVD insertion and management, and pre-procedural skin preparation. All HA-SABSIs should be subject to root cause analysis and findings should be fed back to relevant stakeholders in order to facilitate effective change management.

Figure 33 HA-SABSI reported by hospital group, 2009-10 to 2013-14

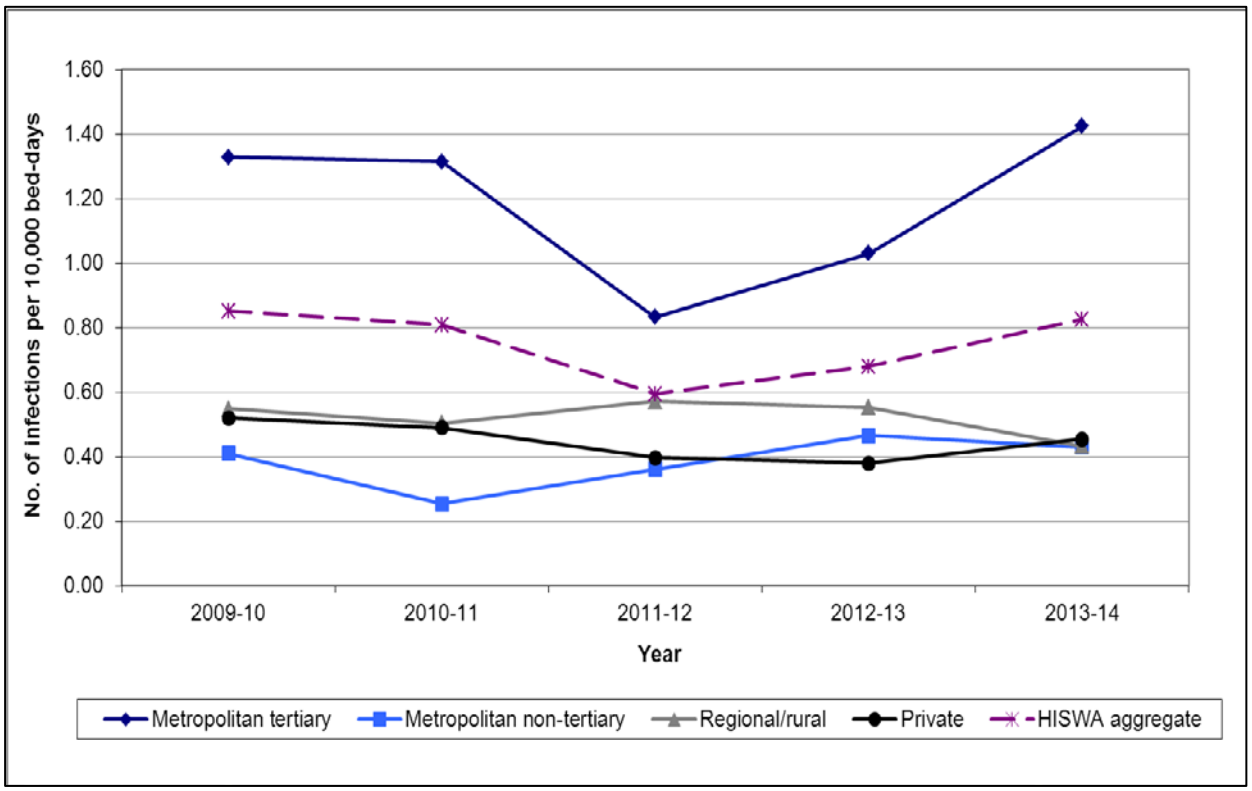


Figure 33 shows the HA-SABSI rates for the different hospital groups. Of the 191 HA-SABSI, reported in the 2013-14 period, the majority (67% n=128) were reported by tertiary hospitals. The tertiary hospital rate is higher than the HISWA aggregate and all other hospital groups, in all reporting periods. Tertiary hospitals tend to treat more complex medical cases and have a greater number of patients requiring complex procedural interventions and invasive devices.

The 2013-14 tertiary hospital HA-SABSI rate increased to 1.42 infections per 10,000 bed-days when compared to the rate of 1.03 reported in 2012-13. This increase was significant ($p<0.05$). The other three hospital groups all reported rates significantly lower than the tertiary hospital group ($p<0.05$) and also lower than the HISWA aggregate rate of 0.83 ($p<0.05$). The HA-SABSI rate for regional public hospitals decreased for the second consecutive reporting period.

Of the 128 HA-SABSI reported by the tertiary hospitals, 50 (39%) were attributable to an intravascular device and 26 (20%) were attributable to an invasive procedure. This would suggest there are areas within tertiary facilities where considerable improvements in infection prevention and patient safety outcomes could be made.

Figure 34 HA-SABSI rates for WA tertiary hospitals, 2009-10 to 2013-14

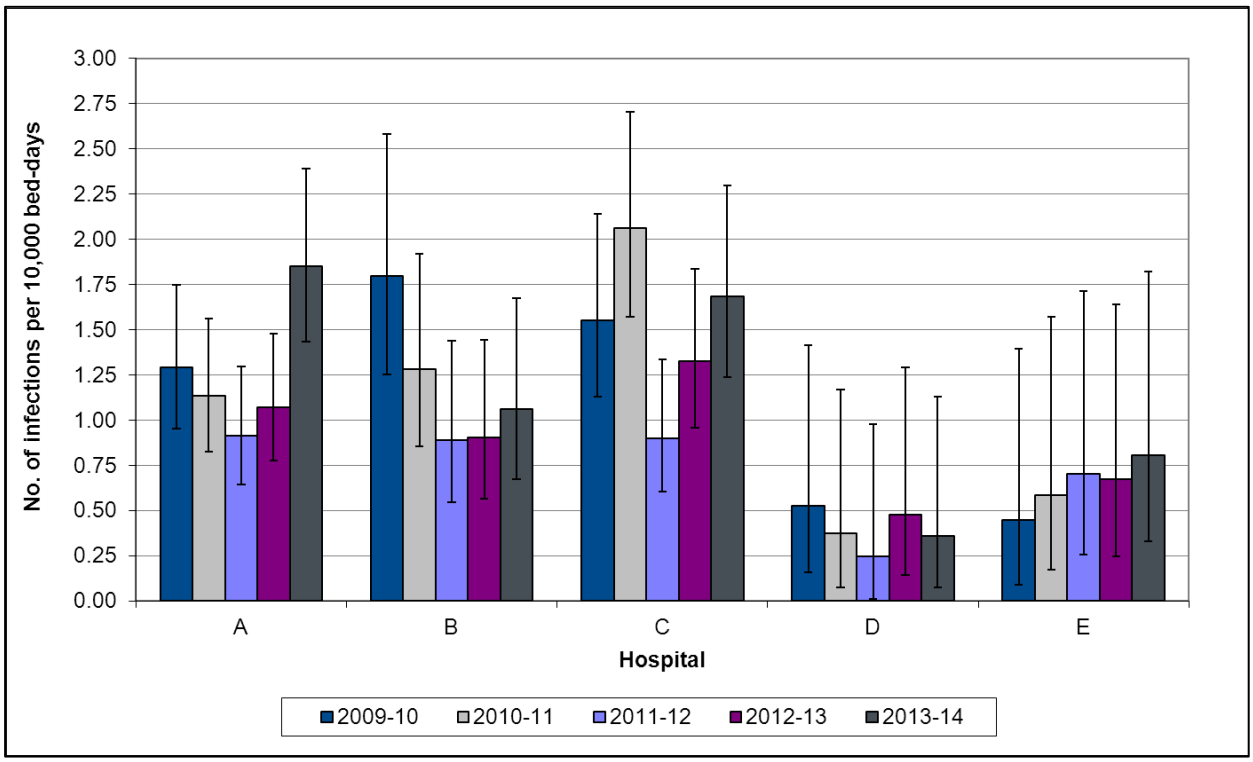


Figure 34 shows the HA-SABSI rates at the five tertiary hospitals since 2009-10. Hospital D was the only tertiary hospital not to report an increased rate in 2013-14 compared with 2012-13 and has reported lower rates than all other tertiary hospitals for the 4th consecutive reporting period. Hospital D and E (rates of 0.36 and 0.81 per 10,000 bed-days respectively) both report lower rates than the 2013-14 HISWA aggregate rate of 0.83.

In 2013-14, the majority (62%) of all HA-SABSIs were reported from the three general tertiary hospitals (A, B and C), all of whom reported rate increases for this reporting period. Of the three general tertiary hospitals, the rate of 1.06 per 10,000 bed-days reported by Hospital B was the lowest and Hospital A reported the highest rate of 1.85, which was significantly higher ($p<0.05$) than their rate of 1.07 reported in 2012-13.

Figure 35 IVD-related and procedure-related HA-SABSI rates, by hospital group, 2013-14

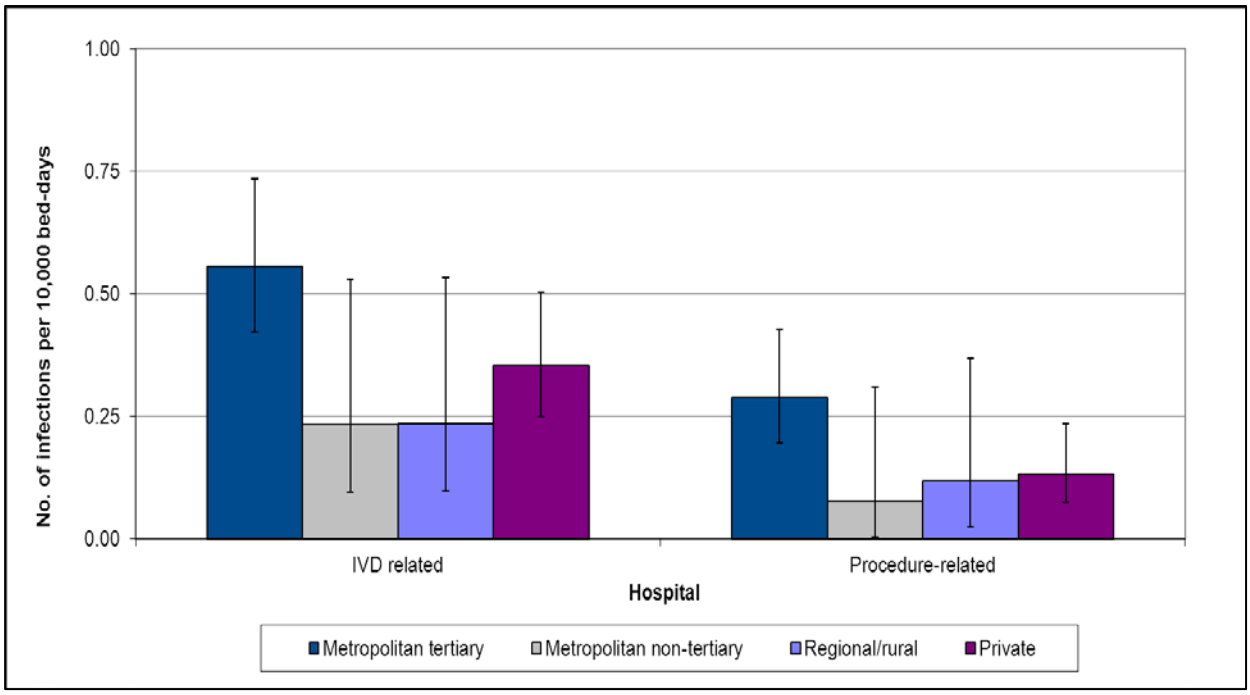


Figure 35 shows the rates of IVD-related and procedure-related HA-SABSI in each of the hospital groups in 2013-14.

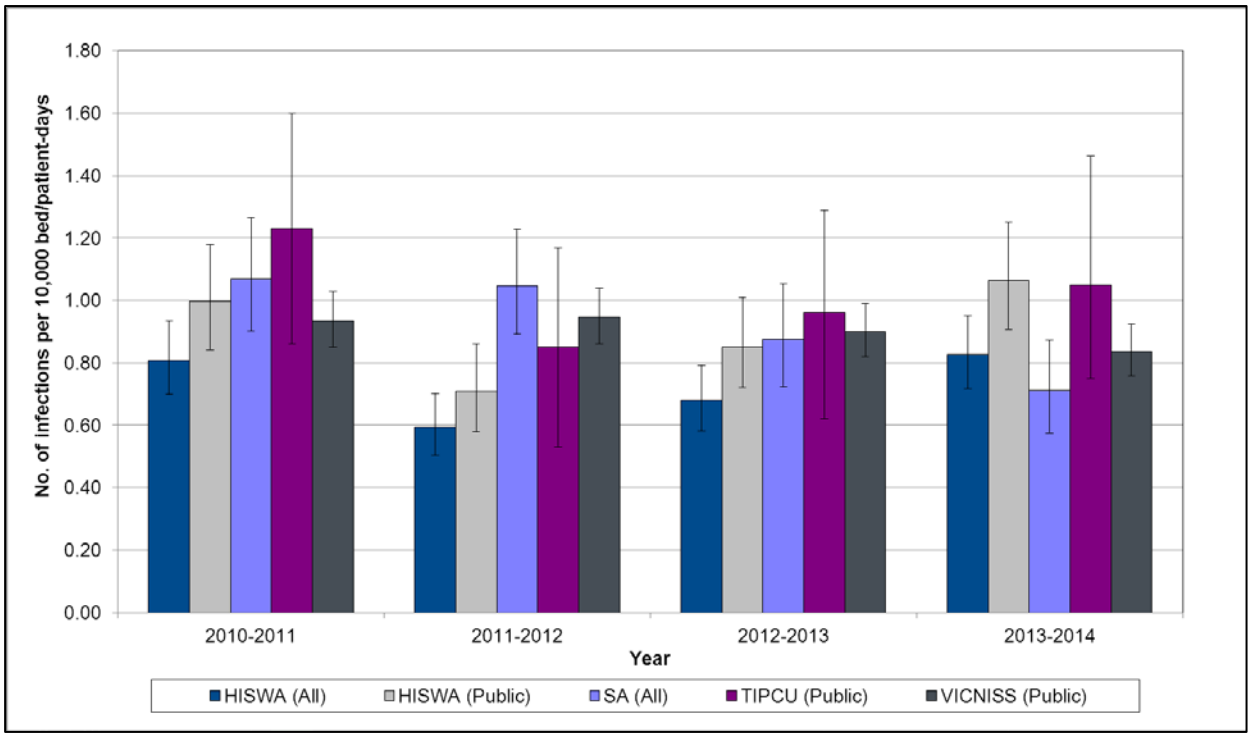
Of the 84 IVD-related HA-SABSIs reported in 2013-14, 45 (54%) were reported from the three general tertiary hospitals, 22 (26%) from the private hospital group, six (7%) from regional hospitals, six (7%) from metropolitan non-tertiary hospitals and five (6%) from the two specialist tertiary hospitals.

The rate of IVD-related HA-SABSI was highest in the tertiary hospital group at 0.56 infections per 10,000 bed-days and this was significantly higher ($p<0.05$) than the rate of 0.35 reported by private hospitals.

Of the 43 procedure-related HA-SABSIs reported in 2013-14, 24 (56%) were reported from the three general tertiary hospitals, 12 (28%) from the private hospital group, three (7%) from regional hospitals and two each from the metropolitan non-tertiary and specialist tertiary hospital.

The rate of procedure-related HA-SABSI was also highest in tertiary hospitals in 2013-14, with a rate of 0.26 infections per 10,000 bed-days. Again, this was significantly higher ($p<0.05$) than the rate of 0.13 reported for private hospitals.

Figure 36 HA-SABSI comparator rates for benchmarking, TIPCU 2010-14, VICNISS 2010-14, HISWA 2010-2014, and SA 2009-2013



Note: Data supplied by SA is reported by calendar year.

Figure 36 shows HISWA HA-SABSI data compared to comparators available from South Australia (SA), the Tasmanian Infection Prevention and Control Unit (TIPCU) and the Victorian Infection Control Nosocomial Infection Surveillance System (VICNISS). Data from SA includes public and private facilities, while TIPCU and VICNISS have provided data from acute public hospitals. HISWA data has been adjusted accordingly to allow for comparable benchmarking with all jurisdictions.

Over the four reporting periods HISWA has consistently reported lower rates of HA-SABSI than the other jurisdictions. In 2012-13 the HISWA (All) rate of 0.68 infections per 10,000 bed-days was significantly lower than the SA (All) rate of 0.82 ($p<0.01$). The HISWA (Public) rate of 0.85 infections per 10,000 bed-days is lower than both TIPCU (0.98) and VICNISS (0.90), however these are not significant ($p>0.05$).

In 2013-14, the national rate of HA-SABSI in public hospitals was reported as 0.87 cases per 10,000 patient days by the Australian Institute of Health and Welfare (AIHW).[29] This was significantly lower ($p<0.05$) than the HISWA public hospital rate of 1.06 infections per 10,000 bed-days for this reporting period.

Note: TIPCU, SA and AIHW use patient-days as a denominator for rate calculations rather than occupied bed-days as used by HISWA. The yearly variance between calculations of patient-days and occupied bed-days is minimal, and is estimated to be less than 1%.[30]

Central line-associated bloodstream infection

Central line-associated bloodstream infection

Central venous catheters (CVCs), also referred to as central lines, are crucial in the management of critically ill and immunocompromised patients. However, a central line-associated bloodstream infection (CLABSI) results in increased morbidity, mortality, length of hospital stay and healthcare costs. Risk factors for the acquisition of CLABSI can be intrinsic (patient characteristics) or extrinsic (modifiable factors associated with insertion technique, care and maintenance, or the environment in which the patient is receiving care). Recent studies have demonstrated a causal relationship between multi-faceted prevention strategies (bundles of evidence-based CVC care) and reduced CLABSI in intensive care units (ICU), further supporting the view that most CLABSI are preventable events. The Society of Healthcare Epidemiology of America (SHEA) has recently updated **Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals.** [25,31,32]

CLABSI risk adjustment

Patient groups with similar risks for developing a CLABSI are targeted by HISWA surveillance. These groups are: adult intensive care, haematology and oncology. The risk of developing a CLABSI varies according to the type of central line utilised and therefore HISWA stratifies by peripherally inserted (PI) and centrally inserted (CI) central lines.[32-35]

Data collection commenced in July 2005, however in the following section, the results and analysis of CLABSIs since the 2009-10 reporting period is used to demonstrate five year trends.

Adult ICU CLABSI – Participating hospitals

For the 2013-14 surveillance period, 11 adult intensive care units (ICUs) contributed data for this indicator. This represents 100% coverage of adult ICUs under surveillance in Western Australia (WA). Hospital demographics included 10 metropolitan (5 private and 5 public) ICUs and one regional ICU.

Adult ICU CLABSI – Surveillance

Between July 01 2013 and June 30 2014, there were 15 CLABSIs reported from the 11 participating units. The ICU central line utilisation ratio (CLUR) gives an indication of patient acuity, case mix and the risk of developing a CLABSI. In the 2013-14 reporting period, the aggregate CLUR for the 11 units was 59%. The aggregated CLUR for the three adult tertiary hospitals was 81%, reflecting the higher patient acuity in these hospitals. Infection data from PI and CI central lines are combined in the ICU setting, as it is frequently necessary for both types of central line to be used simultaneously.

Table 10 Adult ICU CLABSI line-days and rates, 2009-10 to 2013-14

Year	Number of ICUs	Number of CLABSI	Line-days	CLABSI rate per 1,000 line-days [CI_{95}]
2009-10	3	6	10,522	0.57 [0.23 - 1.29]
2010-11	8	11	14,940	0.74 [0.40 - 1.34]
2011-12	9	3	16,966	0.18 [0.04 - 0.55]
2012-13	11	9	19,644	0.46 [0.23 - 0.89]
2013-14	11	15	20,978	0.72 [0.43 - 1.20]
Total	11	44	83,050	0.53 [0.39 - 0.71]

Figure 37 Adult ICU CLABSI numbers and infection rates, 2009-10 to 2013-14

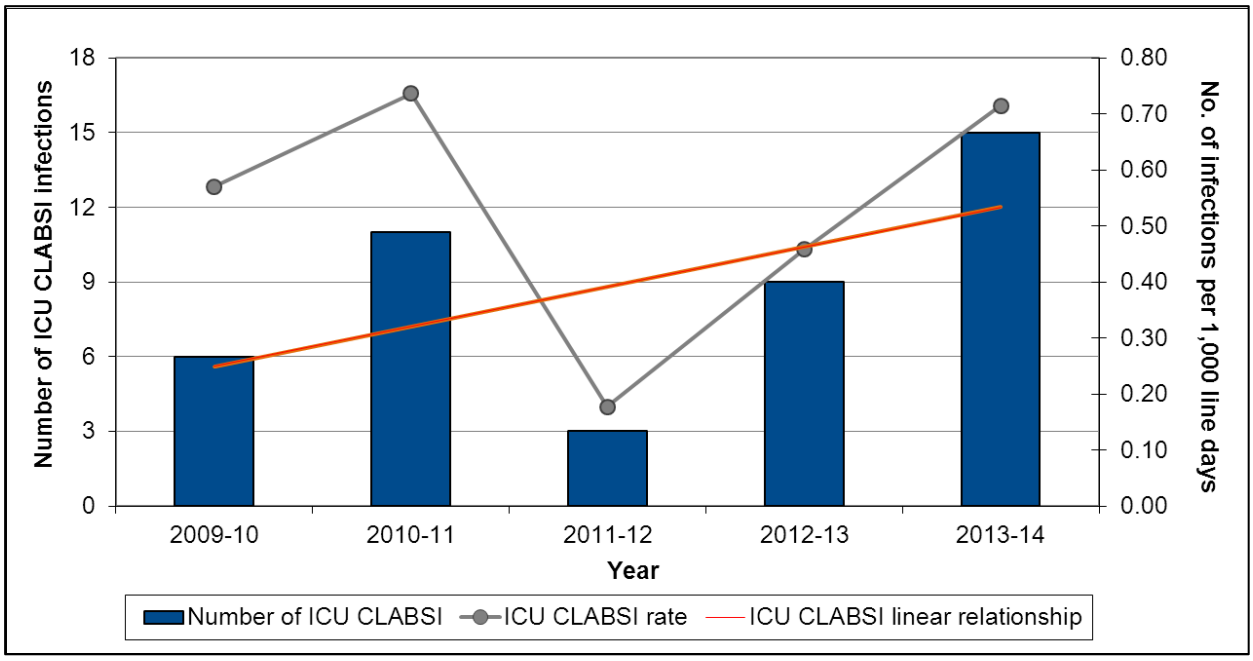
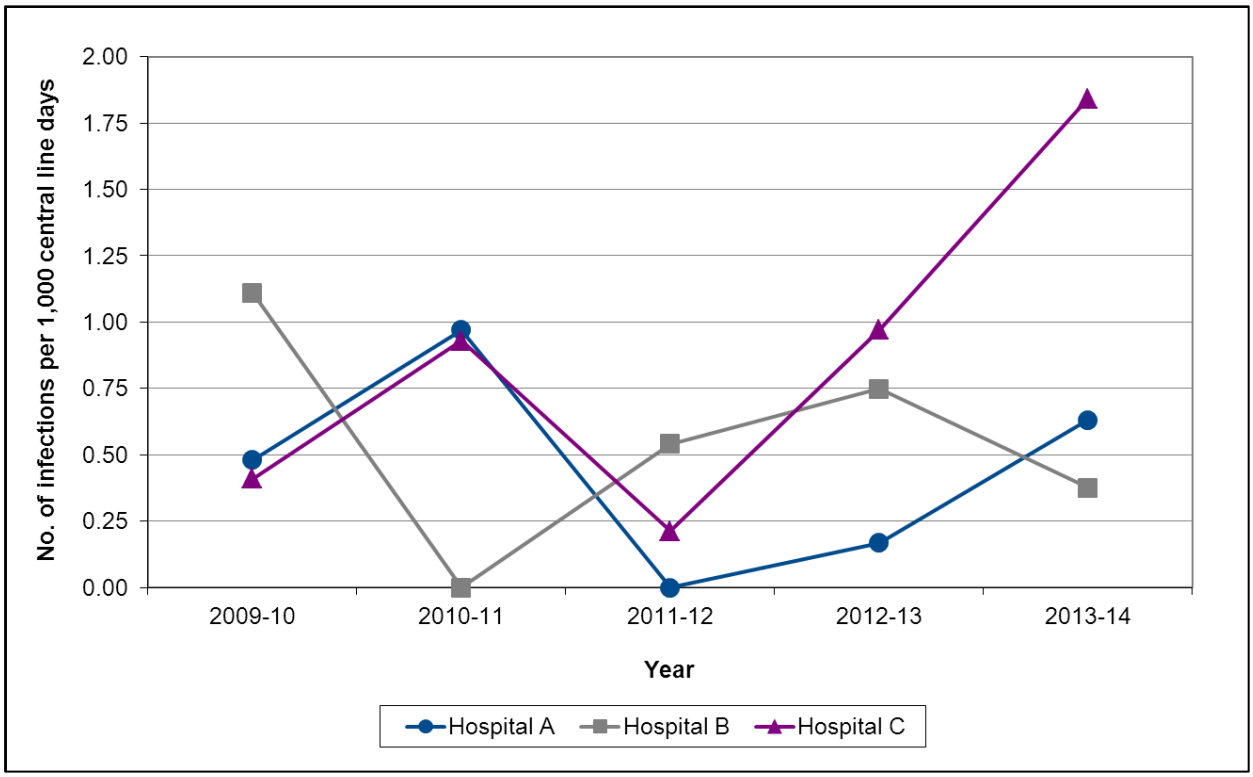


Table 10 and Figure 37 show aggregated data for each reporting period since 2009-10.

The adult ICU CLABSI rate increased to 0.72 infections per 1,000 central line-days in this reporting period compared to the rate of 0.46 reported in 2012-13. This increase was not statistically significant ($p>0.05$). There is however an upward trend evident over the past five years. The HISWA adult ICU CLABSI data set now includes data from all adult ICUs in WA, and therefore provides a valid reflection of adult ICU CLABSI rates in WA acute care hospitals.

Figure 38 Adult ICU CLABSI rates, general tertiary hospitals, 2009-10 to 2013-14



The 11 adult ICUs reporting this indicator have been assigned the identifiers of Hospital A through K. The three general tertiary hospitals (A, B and C) contribute 82% of the adult ICU CLABSI line-days and their rates are shown in Figure 38.

In the 2013-14 reporting period, hospitals A, B and C collectively reported 14 ICU CLABSI (4, 1 and 9 respectively) with rates of 0.63, 0.37 and 1.84 per 1,000 line-days respectively.

Two tertiary ICUs (A and C) reported an increased rate for the second consecutive year. The increase in rates in 2013-14, compared to the previous reporting period was not statistically significant. Hospital C reported its highest infection rate since it commenced reporting in 2009-10.

One CLABSI was reported from a private hospital (hospital E) with a rate 0.79 infections per 1,000 line-days (CI_{95} 0.00 – 5.04). Five Hospitals (D, H, I, J and K) have not reported any ICU CLABSI since they commenced data collection. Two Hospitals (F and G) have each reported only one ICU CLABSI (in the 2011-12 and 2012-13 period s respectively).

The HAIU submits adult ICU CLABSI data from eight ICUs to the Australian and New Zealand Intensive Care Society (ANZICS) Centre for Outcome and Resource Evaluation (CORE) as part of the ANZICS CLABSI Prevention Project. Reports and resources for central line insertion and maintenance are available here http://www.anzics.com.au/ on the ANZICS website.

Figure 39 Adult ICU CLABSI, microorganisms isolated, 2009-10 to 2013-14

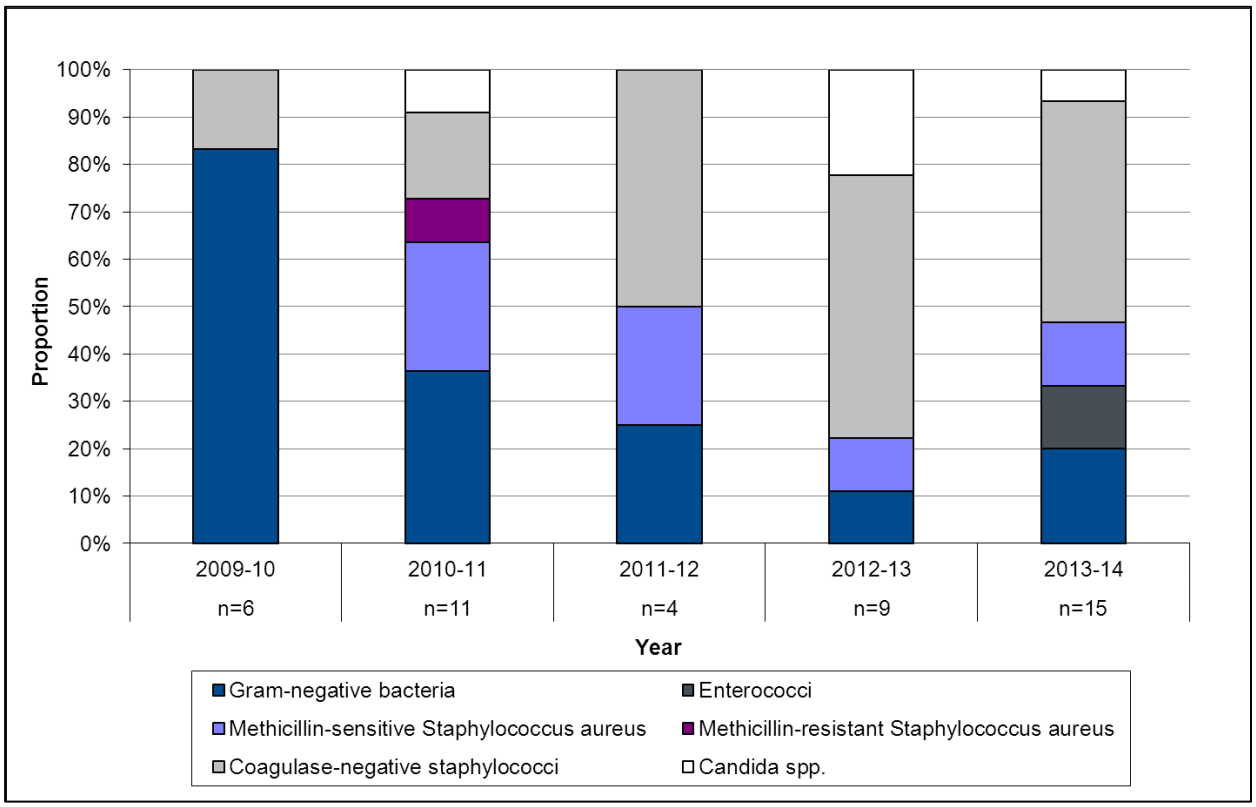


Figure 39 shows the microorganisms isolated from adult ICU CLABSI since 2009-10. In 2013-14, 15 organisms were cultured from the 15 reported ICU CLABSI and included:

- 73% (n=11) were Gram-positive bacteria: coagulase-negative staphylococci (n=7), methicillin-sensitive *Staphylococcus aureus* (n=2), *Enterococcus faecalis* (n=2)
- 20% (n=3) were Gram-negative bacteria : *Escherichia coli* (n=1), *Klebsiella pneumoniae (n=1), Bacteroides fragilis* (n=1)
- 7% (n=1) was a *Candida albicans*.

For the five year period 2009-14, 45 organisms were cultured from the 44 reported ICU CLABSI and included:

- 60% (n=27) were Gram-positive bacteria: coagulase-negative staphylococci (n=17), MSSA (n=7), MRSA (n=1), Enterococci (n=2)
- 31% (n=14) were Gram-negative bacteria
- 9% (n=4) were fungi or other organism.

It is important to note that since the 2009-10 reporting period there has been a noticeable reduction in the proportion of Gram-negative bacteria and a noticeable increase in the proportion of coagulase-negative staphylococci reported as the causative organisms for adult ICU CLABSI. There have been zero MRSA ICU CLABSI reported for three consecutive years.

Figure 40 HISWA and VICNISS ICU CLABSI rates, 2009-10 to 2013-14

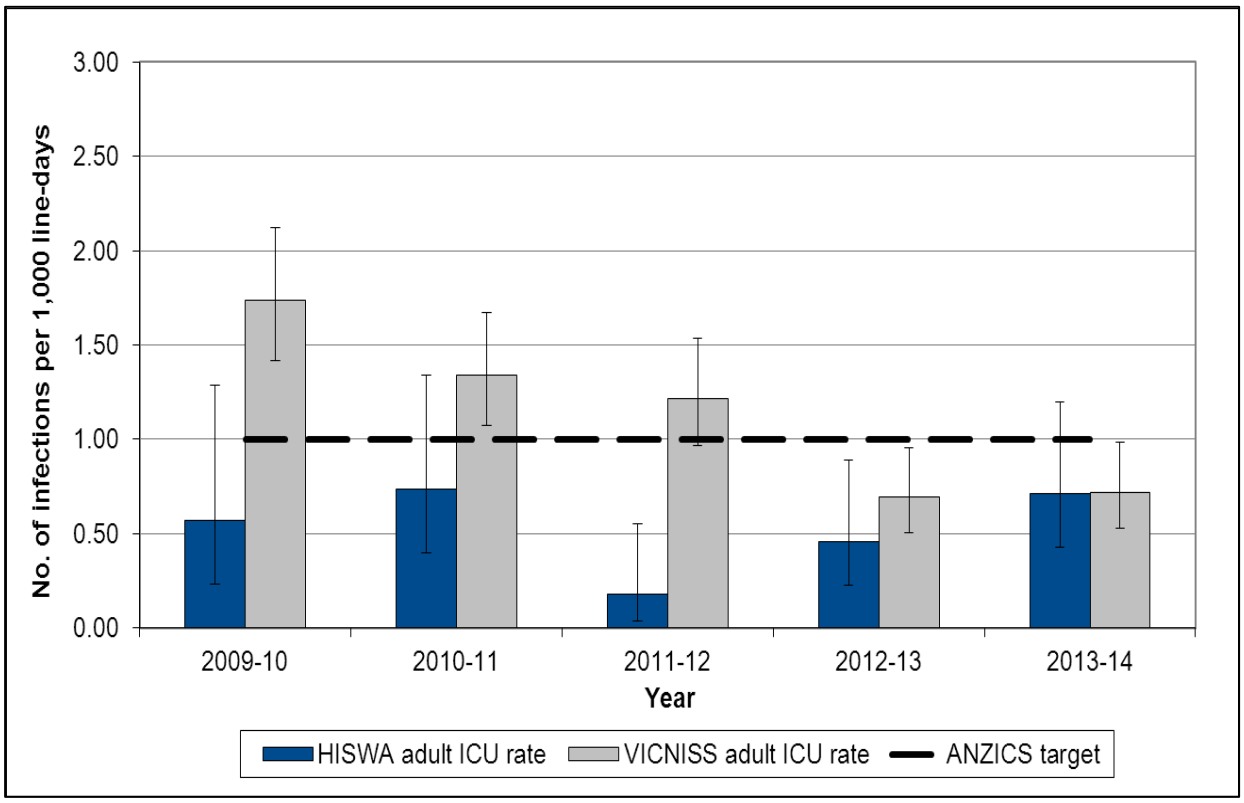


Figure 40 shows comparative data from HISWA and VICNISS for adult ICU CLABSI rates and the Australian and New Zealand Intensive Care Society (ANZICS) target.

For the five-year period 2009-10 to 2013-14, HISWA has consistently reported lower adult ICU CLABSI rates than VICNISS, however in 2013-14 the HISWA rate of 0.72 infections per 1000 line-days was the same as the VICNISS rate. The HISWA rate remains lower than the ANZICS national target of 1.0 infection per 1,000 line-days.

Haematology, Oncology CLABSI – Participating Hospitals

Oncology

For the 2013-14 surveillance period, four oncology units contributed data for this indicator. Two private facilities (1 metropolitan and 1 regional) and one public non-tertiary metropolitan contributed continuous data for the period. The other unit (1 private metropolitan) contributed nine months of data.

Haematology

For the 2013-14 surveillance period, two haematology units (one private and one metropolitan tertiary) contributed data for this indicator. One unit has submitted data continually since July 2005, and the other unit commenced in July 2012.

Oncology and Haematology Unit – Surveillance

For the 2013-14 reporting period:

- a total of two CLABSI were reported by the four oncology units
- a total of 11 CLABSI were reported by the two haematology units

Central lines are stratified by CI and PI lines in these units. Both inpatient and non-inpatient haematology and oncology CLABSI are included in the rate calculations, to reflect patient movement between these settings with a central line in-situ.

In the following section, the results of haematology and oncology CLABSI surveillance and analysis are reported.

Table 11 HISWA aggregate oncology CLABSI rates, 2009-10 to 2013-14

Year	Number of units	CLABSI	Line-days	CLABSI rate per 1,000 line-days [CI_{95}]
2009-10	1	0	2,256	0.00 [0.00 - 2.11]
2010-11	1	0	3,561	0.00 [0.00 - 1.34]
2011-12	2	4	11,142	0.36 [0.11 - 0.97]
2012-13	4	6	72,904	0.08 [0.03 - 0.19]
2013-14	4	2	106,628	0.02 [0.00 - 0.07]
Total		**12**	**196,491**	**0.11 [0.06 - 0.20]**

Table 11 shows reported data for oncology CLABSI since the 2009-10 reporting period. The marked increase in line-days reported this reporting period is because a large private hospital oncology unit commenced reporting in 2013-14. One tertiary metropolitan unit ceased reporting in December 2012.

For the 2013-14 reporting period, a total of 106,628 line-days (46,411PI and 60,217 CI) were available for analysis and there were two oncology CLABSIs reported. The aggregate oncology CLABSI rate decreased to 0.02 per 1,000 line-days in this reporting period compared to 0.08 reported in 2012-13 and was not statistically significant ($p<0.05$).

Two units reported one oncology CLABSI each. There was one PI and one CI associated CLABSI.

In 2013-14, three organisms were cultured from the two reported oncology CLABSIs

- 100% (n=3) were Gram-positive organisms: MSSA (n=1), *Streptococcus sanguinis* (n=1) and *Clostridium perfringens* (n=1).

For the period 2009-14, 14 organisms were cultured from the 12 oncology CLABSI.

- 65% (n=9) were Gram-positive organisms: MSSA (n=6), *Streptococcus sanguinis* (n=1), coagulase negative *Staphylococcus (*n=1), *Clostridium perfringens* (n=1)
- 21% (n=3) were Gram-negative organisms: *Enterobacteriaceae* (n=3)
- 14% (n=2) were Candida spp.

There has been zero MRSA oncology CLABSI reported during the 2009-14 surveillance period.

Table 12 HISWA aggregate haematology CLABSI rates, 2009-10 to 2013-14

Year	Number of units	CLABSI	Line-days	CLABSI rate per 1,000 line-days [CI_{95}]
2009-10	2	36	12,324	2.92 [2.10 – 4.06]
2010-11	2	15	14,983	1.00 [0.60 – 1.67]
2011-12	2	10	15,916	0.63 [0.33 – 1.18]
2012-13	3	18	20,559	0.88 [0.55 – 1.40]
2013-14	2	11	14,535	0.76 [0.41 – 1.38]
Total		**90**	**79,191**	**1.41 [0.92 – 1.40]**

Table 12 shows reported data for haematology CLABSI since the 2009-10 reporting period. One tertiary hospital ceased reporting haematology CLABSI in December 2012 which is reflected in the reduction of line days for the 2013-14 reporting period.

For the 2013-14 reporting period, a total of 14,535 haematology line-days (PI 10,047 and CI 4,488) were available for analysis and there were 11 haematology CLABSI events reported. The aggregate haematology CLABSI rate decreased to 0.76 infections per 1,000 line days compared to 0.88 reported in 2012-13. This decrease was not statistically significant ($p>0.05$).

Of the 11 haematology CLABSI events, the majority (n=6; 55%) were associated with PI central lines. The PI CLABSI rate of 0.60 per 1000 line-days was lower than the CI CLABSI rate of 1.11 per 1,000 line-days, however this difference was not significant ($p>0.05$).

The PI CLABSI rate decreased in this reporting period to 0.60 infections per 1,000 line days compared to 0.75 reported in 2012-13; however this decrease was not significant ($p> 0.05$).

The CI CLABSI rate decreased in this reporting period to 1.11 infections per 1,000 line days compared to 1.29 reported in 2012-13; however, this decrease was not significant ($p> 0.05$).

All 11 haematology CLABSI were reported from one metropolitan tertiary hospital.

Figure 41 Haematology CLABSI, microorganisms isolated, 2009-10 to 2013-14

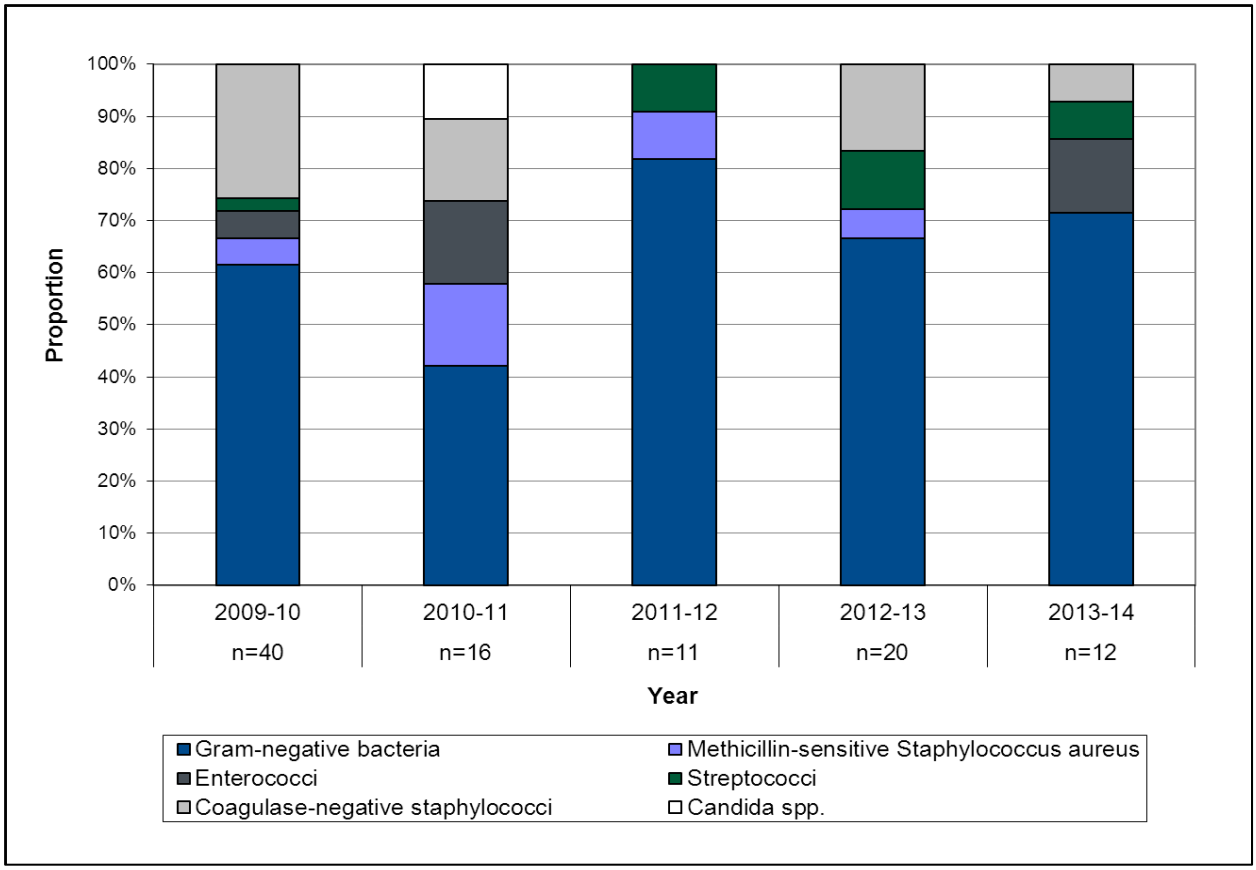


Figure 41 shows the microorganisms associated with haematology CLABSI for the past five reporting periods.

In 2013-14, 12 organisms were cultured from the 11 reported haematology CLABSIs:

- 83% (n=10) were Gram-negative bacteria: *Enterobacteriaceae* (n=6), *Pseudomonas aeruginosa (n=2), Achromobacter xylosoxidans* (n=1), *Ochorobactrum anthropi* (n=1)
- 17% (n=2) were Gram-positive bacteria: coagulase-negative staphylococci (n=1), *Streptococcus mitis* (n=1).

For the period 2009-14, 99 organisms have been cultured from the 90 haematology CLABSI.

- 64% (n=63) were Gram-negative bacteria: *Enterobacteriaceae (*n=41); *Pseudomonas aeruginosa* (n=11); *Stenotrophomonas maltophilia* (n=5)*,* Achromobacter spp (n=2), *Ochrobactrum anthropic* (n=1), *Acinetobacter baumannii* (n=1), *Sphingomobacterium multivorum* (n=1), and *Stenotrophomonas maltophilia* (n=1)
- 34% (n=34) were Gram-positive bacteria: coagulase-negative staphylococci (n=17), MSSA (n=7), Streptococci spp (n=5) and Enterococci spp(n=5)
- 2% (n=2) were Candida spp.

There were zero MRSA oncology CLABSI reported during the 2009-14 surveillance period.

Figure 42 Combined haematology and oncology CLABSI rates, HISWA, CDC-NHSN and ACHS, 2009-13

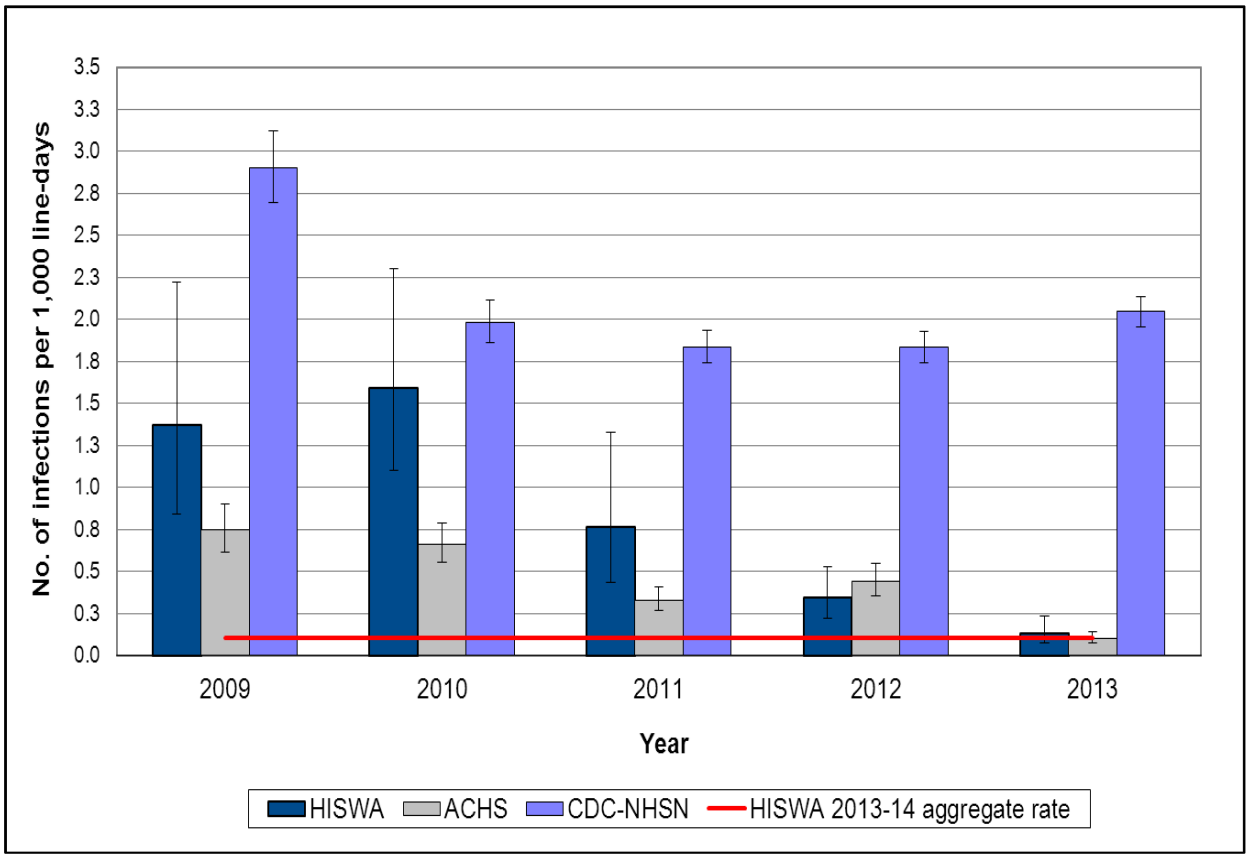


Figure 42 shows HISWA combined haematology and oncology unit CLABSI rates with ACHS and CDC-NHSN data as a comparator for the period 2009-13. These are the most current data sets available for benchmarking at an international level.[36-39]

The CDC-NHSN combines data for both haematology and oncology CLABSI associated with both CI and PI central lines; therefore HISWA and ACHS data have been adjusted to enable comparison. It should be noted, however, that differences in patient case mix, the type of central line utilised and variable inclusion of inpatient and outpatient data make valid comparison difficult. This should be taken into account when interpreting benchmark data for this indicator.

For the five-year period 2009-13 the combined haematology and oncology HISWA rate has been lower than the CDC-NHSN rate for all periods. Historically HISWA has reported higher rates than ACHS, with the exception of 2012. The 2013 HISWA combined haematology and oncology rates are significantly lower than the CDC-NHSN 2013 rates ($p<0.05$) and slightly higher than the ACHS rate, however this is not a significant difference ($p>0.05$).

Haemodialysis access-associated bloodstream infection

Haemodialysis access-associated bloodstream infection

In Australia, infections are the third leading cause of death in haemodialysis patients after cardiovascular disease and withdrawal of treatment.[40] Vascular access is crucial to the effective administration of haemodialysis, however access-related bloodstream infections contribute significantly to the excess mortality, morbidity and healthcare costs associated with haemodialysis.[41,42]

Participating facilities

In the 2013-14 surveillance period, 23 units that provide haemodialysis services in WA, monitored and reported haemodialysis access-associated bloodstream infections (HD-BSIs) to HISWA. The 23 units included three metropolitan public tertiary hospital in-centres, 18 satellite units (8 metropolitan and 10 regional) and two home haemodialysis units. Satellite units include those attached to non-tertiary public and private hospitals, and purpose-built haemodialysis facilities. The two home units oversee haemodialysis administered by the patients in their own homes or designated setting, and are categorised separately due to unique risk factors.

Surveillance

In the 2013-14 reporting period, a total of 46 HD-BSIs were reported to HISWA.

Haemodialysis access types are stratified for reporting and analysis and are listed in order of increasing risk of infection: arteriovenous fistula (AVF), arteriovenous graft (AVG), cuffed catheter (CC) and non-cuffed catheter (NCC). Haemodialysis service provider's worldwide aim to have as many patients as possible dialysing through an AVF, as this is the optimal form of access and is associated with the lowest risk of acquiring an access-associated BSI.

As HD-BSI are frequently identified following admission to an acute hospital, liaison between satellite and home haemodialysis units, in-centre units, hospital infection control personnel and the Healthcare Associated Infection Unit (HAIU) is actively promoted to ensure that HD-BSI events are captured in surveillance and attributed to the appropriate unit.

Data collection commenced in July 2005 and became mandatory for all units in January 2008. In the following section, the results and analysis of access-associated haemodialysis BSIs since the 2009-10 reporting period is used to demonstrate five year trends.

Table 13 HD-BSI rates and access utilisation ratio, by access type, 2013-14

Access type	Number of HD-BSIs	Number of patient-months	HD-BSI rate per 100 patient-months [CI_{95}]	Access utilisation ratio
AVF	3	8755	0.03 [0.01 - 0.11]	75.5%
AVG	1	417	0.24 [0.00 - 1.57]	3.0%
Cuffed catheter	42	2340	1.79 [1.33 - 2.43]	21.0%
Non-cuffed catheter	0	72	0.00 [0.00 - 7.28]	0.5%

Table 13 shows there were 46 HD-BSIs reported in the 2013-14 reporting period and the majority (91%) were associated with cuffed catheters. The most common type of access utilised were AVFs. The AVF access utilisation ratio was 75.5% and remains comparable to the 74.5% reported in 2012-13. The access utilisation ratio for cuffed catheters was 21% and this is comparable to the 22% reported in 2012-13. Non-cuffed catheters are short-term catheters with the highest-risk for developing a HD-BSI. This risk is minimised by ensuring they are in situ for the minimum time possible whilst another access type is placed and this is reflected in the low utilisation ratio.

Zero HD-BSI were reported for non-cuffed catheters and of the other three types of haemodialysis access, the AVF HD-BSI rate was the lowest and the cuffed catheter HD-BSI rate the highest in 2013-14. This is consistent with all other reporting periods.

Due to low utilisation of AVGs and non-cuffed catheters, these access devices are excluded from further analysis of rates and utilisation ratios.

Figure 43 AVF and cuffed catheter associated BSI rates, 2009-10 to 2013-14

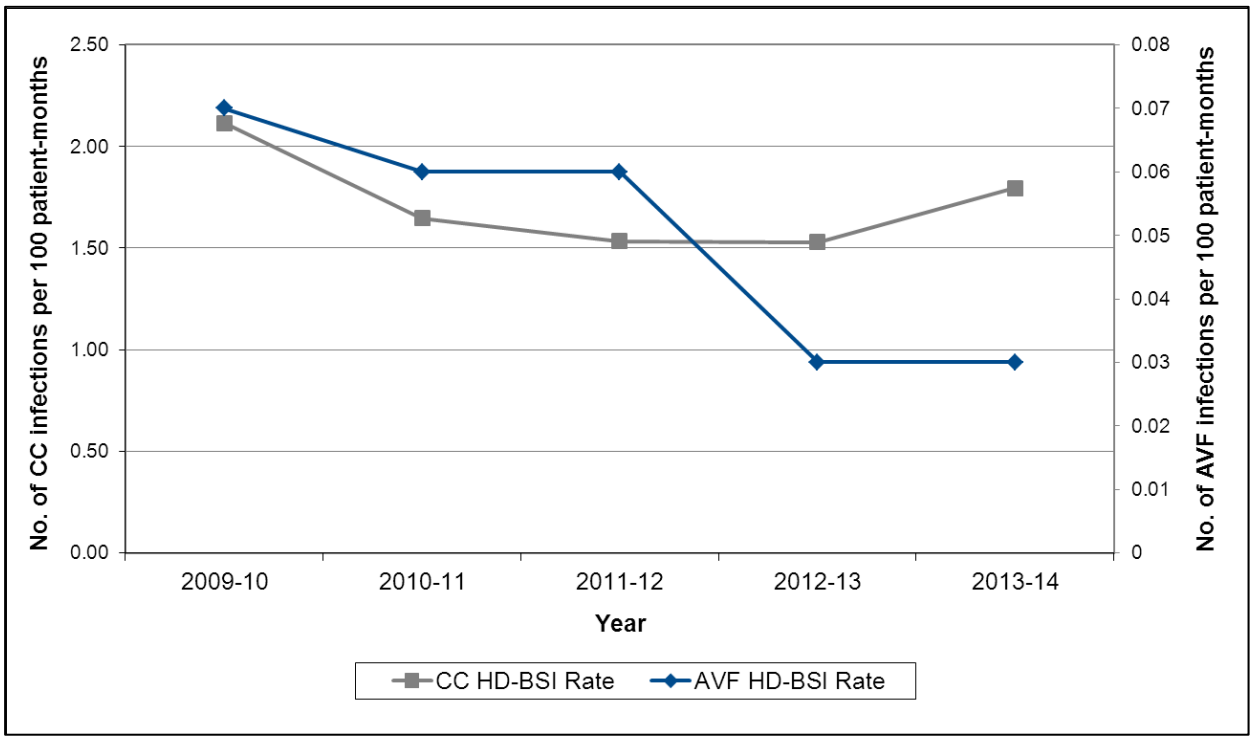


Figure 43 shows the HD-BSI rates for both CCs and AVFs since the 2009-10 reporting period. In 2013-14 the AVF HD-BSI rate remained at the lowest reported rate of 0.03 per 100 patient-months for the 2nd consecutive reporting period. The CC HD-BSI rate increased to 1.79 infections per 100 patient-months compared to the rate of 1.53 reported in 2012-13.

Table 14 AVF and CC HD-BSI rates and utilisation ratios, by unit type, 2013-14

Access type	Unit type	Number of units	Number of BSIs	Number of patient-months	HD-BSI rate per 100 patient-months [CI_{95}]	Access utilisation ratio
AVF	In-centre	3	0	959	0.00 [0.00 - 0.49]	50%
	Home dialysis	2	1	763	0.13 [0.00 - 0.83]	84%
	Satellite	18	2	7033	0.03 [0.00 - 0.11]	80%
	Satellite (metro)	8	0	5050	0.00 [0.00 - 0.09]	79%
	Satellite (regional)	10	2	1983	0.10 [0.00 - 0.40]	84%
Cuffed Catheter	In-centre	3	17	766	2.22 [1.37 - 3.56]	43%
	Home dialysis	2	4	138	2.90 [0.92 - 7.53]	14%
	Satellite	18	21	1436	1.46 [0.95 - 2.24]	13%
	Satellite (metro)	8	13	1123	1.16 [0.66 - 2.00]	18%
	Satellite (regional)	10	8	313	2.55 [1.23 - 5.08]	13%

Table 14 shows the number of infections, the infection rate and access utilisation ratio for AVF and CC access reported from the different unit types in the 2013-14 reporting period. There were 42 CC HD-BSIs and three AVF HD-BSIs reported from the 23 units. The CC utilisation ratio was highest at metropolitan tertiary hospital in-centre units and decreased to 43% this reporting period compared to 45% reported in 2012-13. Consistent with previous reporting periods the AVF utilisation ratio is the lowest in metropolitan tertiary hospital in-centre units, and increased to 50% this reporting period compared to 49% reported in 2012-13. The AVF utilisation ratio of 80% in satellite units is comparable with 2012-13 data.

The lowest CC HD-BSI rate of 1.16 per 100-patient months was reported from the metropolitan satellite dialysis units. The highest CC HD-BSI rate of 2.90 per 100 patient-months was reported from the two home dialysis units.

There were zero AVF HD-BSIs reported from the three tertiary in-centre units. The highest AVF HD-BSI rate of 0.13 per 100 patient-months was reported from the 2 home dialysis units. The differences in infection rates between in-centre and satellite units and between metropolitan and regional satellite units were not statistically significant ($p \geq 0.05$).

Table 15 AVF and CC HD-BSI rates, by unit, 2013-14

HD Unit	Number of AVF HD-BSIs	Number of AVF patient-months	AVF HD-BSI rate per 100 patient-months [CI_{95}]	Number of CC HD-BSIs	Number of CC patient-months	CC HD-BSI rate per 100 patient-months [CI_{95}]
TERTIARY IN-CENTRES						
Unit 1	0	251	0.00 [0.00 - 1.86]	8	336	2.38 [1.15 - 4.73]
Unit 2	0	263	0.00 [0.00 - 1.78]	5	193	2.59 [0.97 - 6.13]
Unit 3	0	445	0.00 [0.00 - 1.06]	4	237	1.68 [0.52 - 4.45]
SATELLITE METROPOLITAN						
Unit 4	0	518	0.00 [0.00 - 0.91]	0	57	0.00 [0.00 - 7.74]
Unit 5	0	404	0.00 [0.00 - 1.16]	1	78	1.28 [0.00 - 7.72]
Unit 6	0	376	0.00 [0.00 - 1.25]	4	64	6.25 [2.081 - 15.5]
Unit 7	0	806	0.00 [0.00 - 0.58]	1	241	0.41 [0.00 - 2.60]
Unit 8	0	937	0.00 [0.00 - 0.50]	5	210	2.38 [0.89 - 5.65]
Unit 9	0	380	0.00 [0.00 - 1.24]	0	74	0.00 [0.00 - 6.07]
Unit 10	0	562	0.00 [0.00 - 0.84]	1	128	0.78 [0.00 - 4.81]
Unit 11	0	1067	0.00 [0.00 - 0.44]	1	271	0.36 [0.00 - 2.31]
SATELLITE REGIONAL						
Unit 12	0	120	0.00 [0.00 - 3.83]	0	33	0.00 [0.00 - 12.6]
Unit 13	0	305	0.00 [0.00 - 1.54]	0	25	0.00 [0.00 - 16.1]
Unit 14	0	249	0.00 [0.00 - 1.88]	0	32	0.00 [0.00 - 13.0]
Unit 15	1	380	0.26 [0.00 - 1.66]	0	15	0.00 [0.00 - 24.3]
Unit16/17	1	576	0.17 [0.00 - 1.10]	6	90	6.67 [2.87 - 14.15]
Unit 18	0	231	0.00 [0.00 - 2.02]	0	74	0.00 [0.00 - 6.07]
Unit 19	0	64	0.00 [0.00 - 6.95]	2	50	4.00 [0.42 - 14.30]
Unit 20	0	22	0.00 [0.00 - 17.9]	0	0	0.00 [0.00 – 0.00]
Unit 21	0	36	0.00 [0.00 - 11.7]	0	0	0.00 [0.00 – 0.00]
HOME HAEMODIALYSIS						
Unit 22	0	375	0.00 [0.00 - 1.25]	4	80	5.00 [1.64 - 12.6]
Unit 23	1	388	0.25 [0.00 - 1.62]	0	58	0.00 [0.00 - 7.62]
TOTAL	**3**	**8755**	**0.03 [0.00 – 0.09]**	**42**	**2340**	**1.79 [1.33 - 2.42]**

Table 15 shows AVF and CC HD-BSI rates for all participating units for the 2013-14 reporting period. All haemodialysis units in WA submitted data to HISWA in 2013-14, allowing for comprehensive, state-wide analysis of access-associated BSIs. Unit 16/17 contains data from two satellite regional units that report combined data. The width of confidence intervals should be taken into account when interpreting rates for units that report low numbers of patient-months (denominator).

Table 15 also shows that in 2013-14, the 42 CC HD-BSIs were reported from 12 of the 23 dialysis units and the rate from these units ranged from 0.36 to 7.69 infections per 100 patient-months. The three AVF HD-BSIs were reported from three units and the rate from these units ranged from 0.17 to 0.26 per 100 patient-months. Eight units reported both zero CC and AVF HD-BSIs.

In the 2013-14 reporting period, nine units reported an increase and 10 units reported a decrease in CC HD-BSI rates compared with 2012-13. Three units (13, 19 and 20) have reported zero CC HD-BSI for the two consecutive reporting periods.

The rate variations between units may be a reflection of different practices, staff competency and/or compliance with evidence-based infection prevention protocols at the various units. Even where every effort is made to increase the number of patients dialysing via an AVF, it is inevitable that a proportion of patients will be dependent on cuffed catheters for dialysis. Therefore, the prevention of CC HD-BSIs must be a priority for all haemodialysis units, but particularly for those reporting higher rates.

The Centers for Disease Control and Prevention (CDC) Dialysis Prevention Collaborative has a range of audit tools, staff competencies, checklists and protocols intended to promote recommended practices for the prevention of both CC and AVF access-associated bloodstream infections. These can be found at http://www.cdc.gov/dialysis/prevention-tools/index.html) and adapted for use in WA haemodialysis units.

Figure 44 Microorganisms associated with HD-BSI, 2009-10 to 2013-14

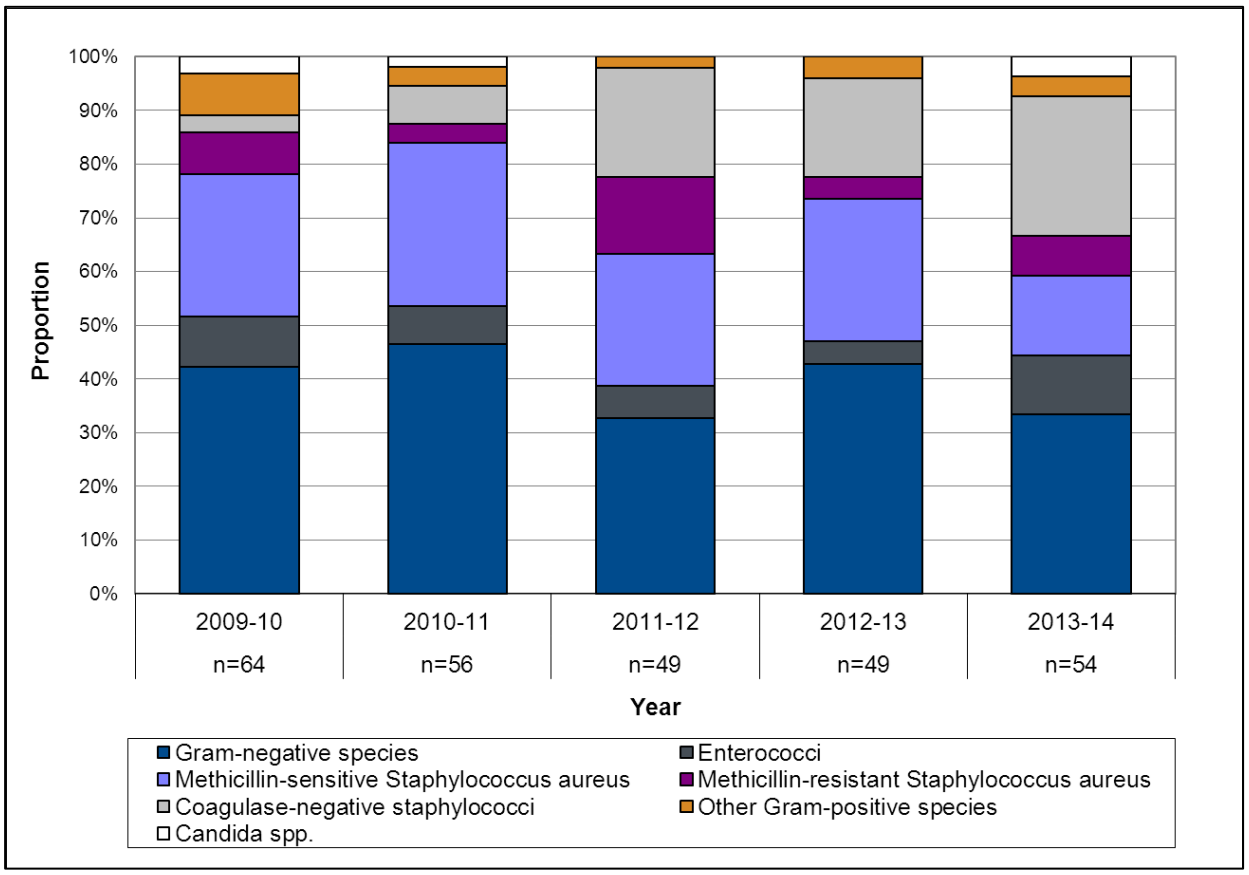


Figure 44 shows the organisms isolated from HD-BSIs since 2009-10. In 2013-14, there were 54 organisms isolated from 46 reported HD-BSIs and included:

- 63% (n=34) were Gram-positive bacteria: coagulase-negative staphylococci (n=14), methicillin-sensitive *Staphylococcus aureus* (n=8), methicillin-resistant *Staphylococcus aureus* (n=4), *Enterococcus faecalis* (n=4), *Enterococcus faecium* (n=2), *Bacillus cereus* (n=1), and gram positive coccus (n=1)
- 33% (n=18) were Gram-negative bacteria: *Klebsiella pneumonia*e (n=5*), Pseudomonas aeruginosa* (n= 3), *Stenotrophomonas maltophilia* (n=3), *Enterobacter cloacae* (n=2), *Serratia marcescens* (n=2), *Escherichia coli* (n=1), *Weeksella virosa* (n=1), and Brevundimonas species (n=1)
- 4% (n=2) were *Candida albicans*.

The number of MRSA HD-BSIs increased in this reporting period, while the number caused by MSSA decreased. Isolates of MSSA and MRSA represent 22% of all organisms identified in this reporting period compared to the 31% in 2012-13.

Figure 45 AVF HD-BSI rates, HISWA, VICNISS and ACHS, 2009-10 to 2013-14

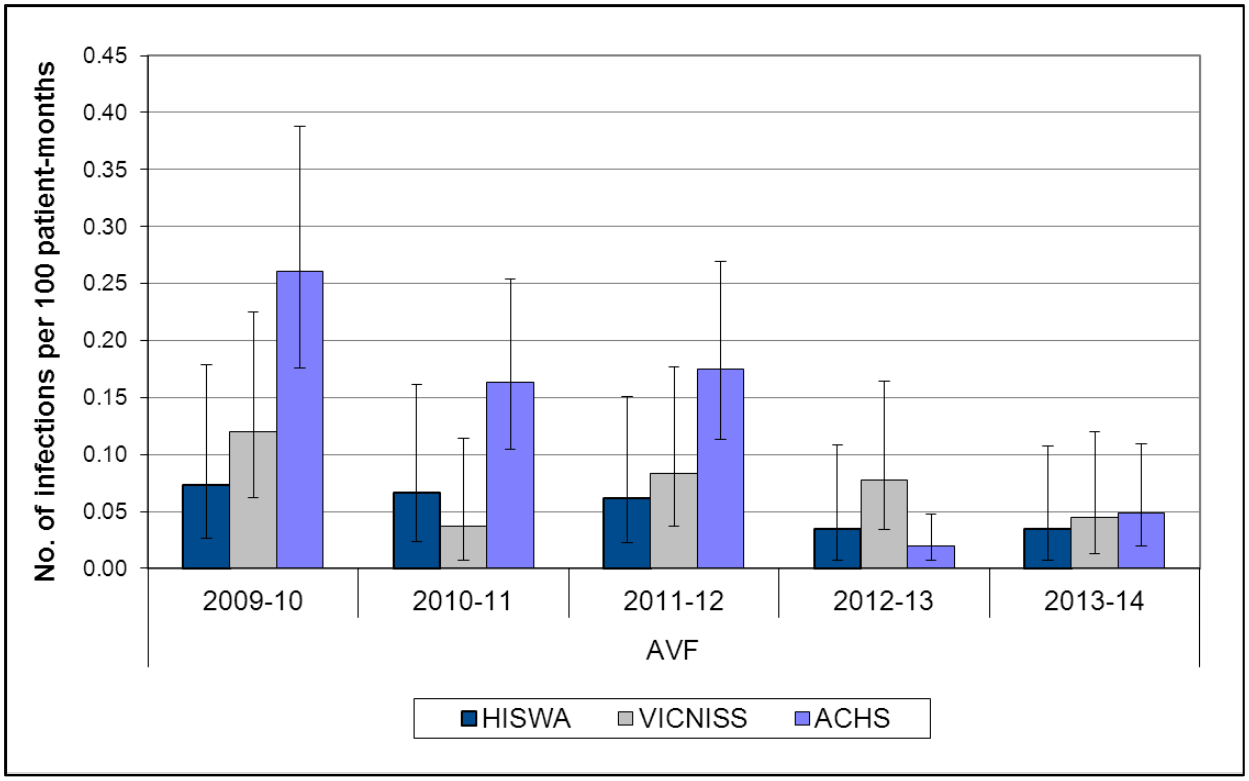
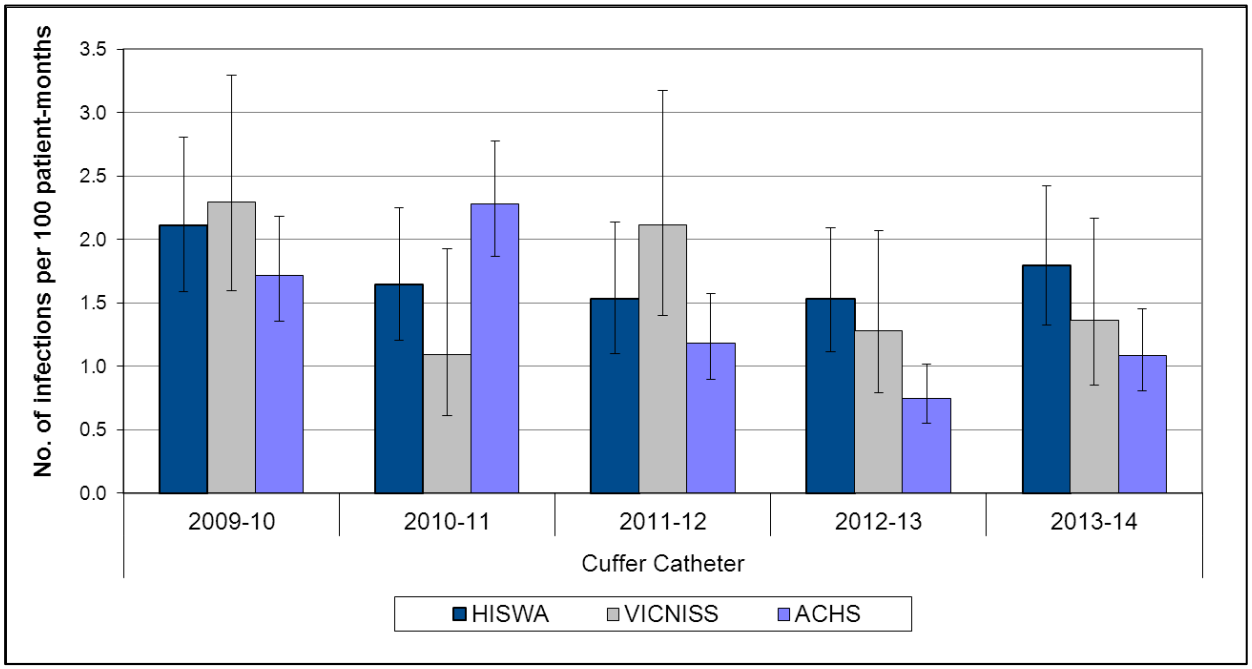


Figure 46 CC HD-BSI rates, HISWA, VICNISS and ACHS, 2009-10 to 2013-14



Note: Only BSIs associated with CC and AVF HD-BSIs are used for benchmarking due to the low utilisation of AVGs and non-cuffed catheters in WA. Comparator data from VICNISS and ACHS are utilised. [43,44]

Figure 45 shows HISWA data benchmarked against data from both VICNISS and ACHS since 2009-10. The 2013-14 HISWA AVF HD-BSI rate of 0.03 per 100 patient-months was lower than both the VICNISS rate of 0.04 and the ACHS rate of 0.05, however none of the rate variations are statistically significant ($p>0.05$).

Figure 46 shows the CC HD-BSI rates for HISWA data benchmarked against data from both VICNISS and ACHS since 2009-10. The HISWA 2013-14 CC HD-BSI rate of 1.79 per 100 patient-months is higher than the VICNISS rate of 1.36 and the ACHS rate of 1.08, the latter being statistically significant ($p<0.05$).

There is a small variation in the VICNISS methodology in that VICNISS do not count access-associated BSIs that develop in chronic haemodialysis patients more than 24 hours after a hospital admission. This may account for some of the differences between HISWA and VICNISS rates.

In previous years, cumulative data from the CDC-NHSN (USA) has also been used as a comparator and HISWA rates have been consistently lower than these rates in all reporting periods. However, there has been no updated report since 2006.

In 2009 CDC commenced a dialysis BSI prevention collaboration program and preliminary data from 17 participating units was published in 2013 for the first 15-month intervention period.[45] The data suggested that facilities participating in the collaboration had successfully decreased their CVC BSI rates and maintained a reduction over the time period reported on, however no further data analysis has been published.

Occupational exposures

Occupational exposures

An occupational exposure occurs when a healthcare worker (HCW) is at risk of acquiring a blood borne viral disease through exposure to a patient's blood or other body fluids.[46] Occupational exposures are increasingly regarded as preventable. In addition to the traditional approaches of education and incident reporting, adoption of safety engineered medical devices (SEMDs) is an effective measure in reducing the risk of exposures.[47]

Participating hospitals

Between July 01 2013 and June 30 2014, 47 hospitals monitored and reported occupational exposures to HISWA. Hospital demographics included 23 metropolitan (13 private and 10 public) and 23 regional (2 private and 21 public) and one psychiatric hospital. One private hospital submitted data for a three month period only (October to November).

Surveillance

In the 2013-14 surveillance period, a total of 1,409 occupational exposures were reported, of which 1,026 (73%) were parenteral (piercing of skin or mucous membranes with a contaminated sharp) and 383 (27%) were non-parenteral (exposure of mucous membrane or non-intact skin with blood or body fluid).

Reporting of occupational exposures by healthcare workers (HCWs) in WA healthcare facilities is voluntary, and the incidence of under-reporting is not known.

Occupational exposure data is not routinely validated, however data on classification of staff described as 'other' who are reported as sustaining a parenteral exposure are routinely checked with the submitting facility. HCWs included in this category are HCWs who would not normally be the primary user of a sharp device, such as volunteers, administrative and pastoral care workers.

Data collection commenced in 2005, however in the following section, the results and analysis of occupational exposures since the 2009-10 reporting period is used to demonstrate five year trends.

Figure 47 Parenteral and non-parenteral occupational exposure rates, 2009-10 to 2013-14

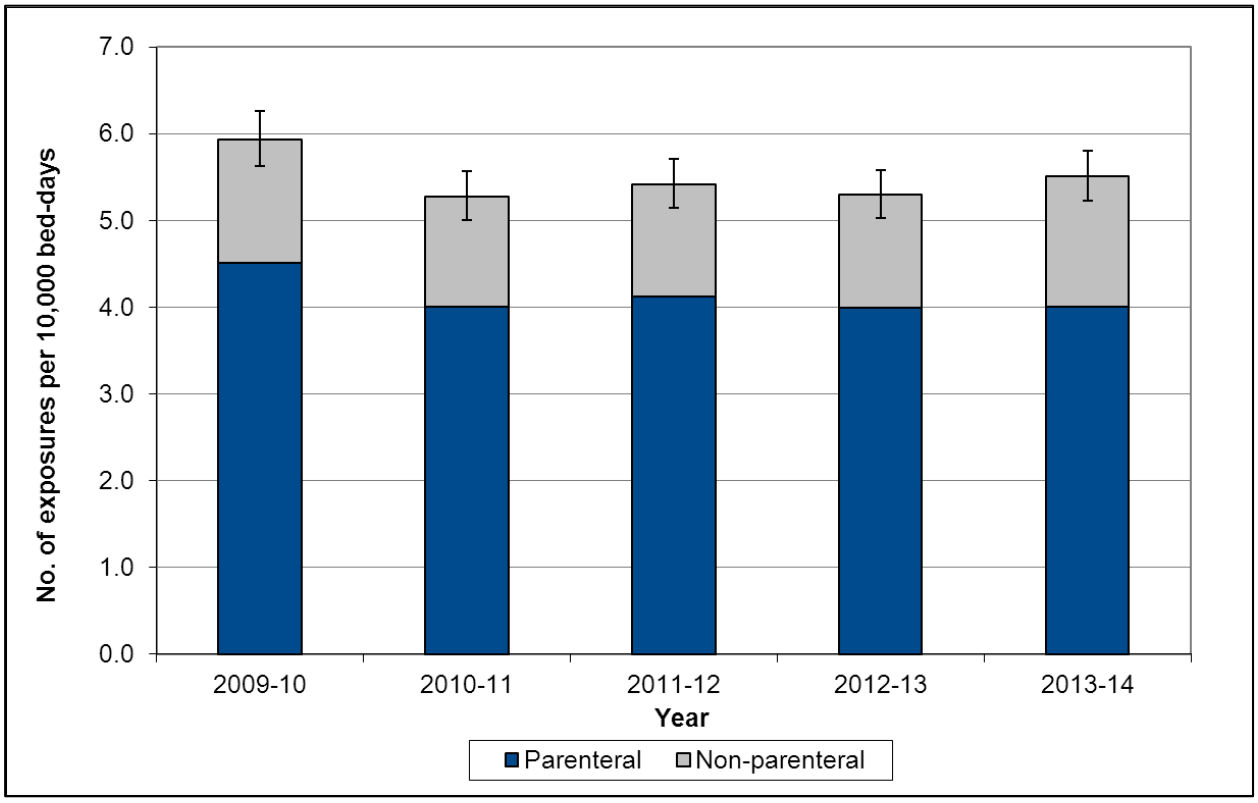


Figure 47 shows the total occupational exposure rates, stratified by the type of exposure that has occurred, i.e. parenteral or non-parenteral exposure, since 2009-10.

In the 2013-14 reporting period, the rate for parenteral occupational exposures increased to 4.01 exposures per 10,000 bed-days, compared to 3.99 reported in 2012-13, although this increase was not significant ($p \geq 0.05$).

In the 2013-14 reporting period, the rate for non-parenteral occupational exposures increased to1.50 exposures per 10,000 bed-days compared to 1.31 in 2012-13, although this increase was not significant ($p \geq 0.05$).

Figure 48 Parenteral occupational exposures, by HCW category, 2009-10 to 2013-14

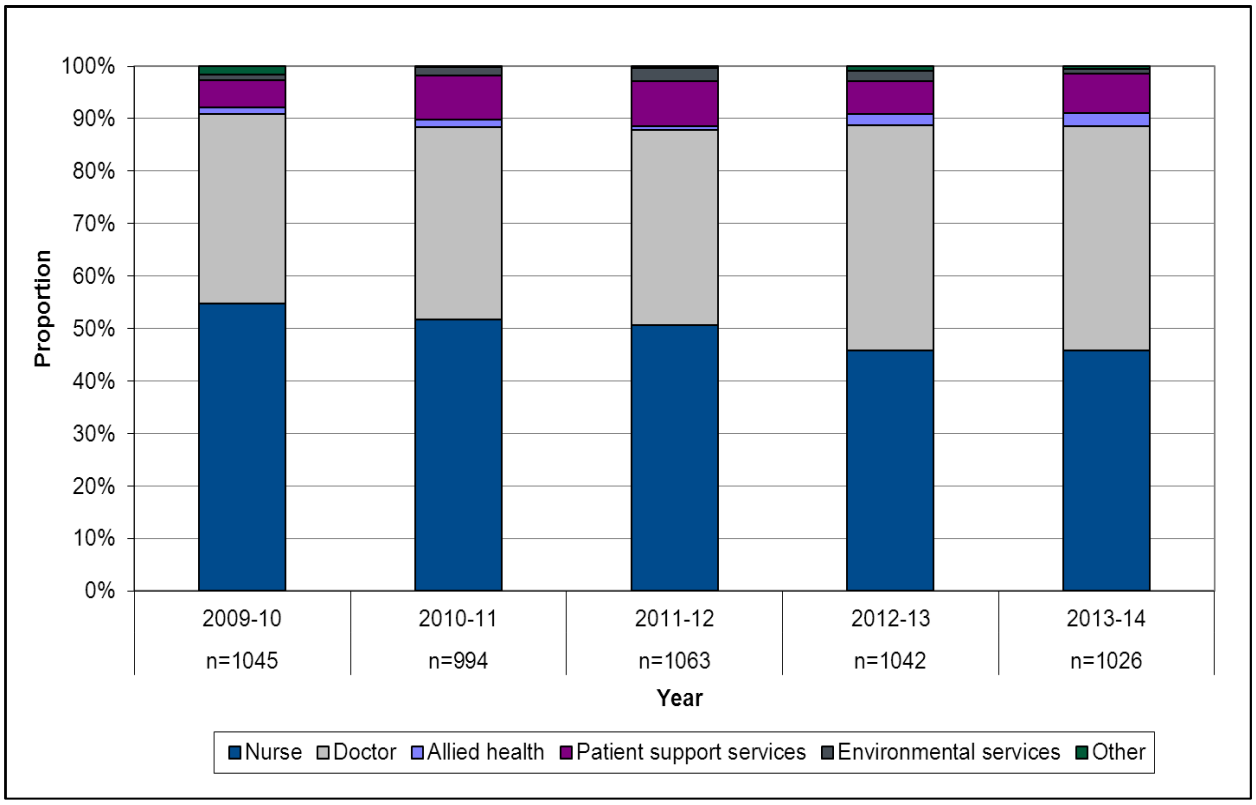


Figure 48 shows the proportion of parenteral occupational exposures reported by the various healthcare worker classifications.

For the 2013-14 reporting period the proportion of parenteral exposures reported by nurses (46%) was comparable with that reported by medical staff (43%). This trend was similar for the 2012-13 reporting period.

Parenteral exposures for environmental services, patient support services, allied health and 'other' workers who are not traditional users of sharps may be a result of inappropriate disposal of the sharp by the original user, and such exposures warrant further investigation. Parenteral exposures for these HCW groups represented 11% (n=117) of all parenteral exposures in this reporting period.

Figure 49 Non-parenteral occupational exposures, by HCW category, 2009-10 to 2013-14

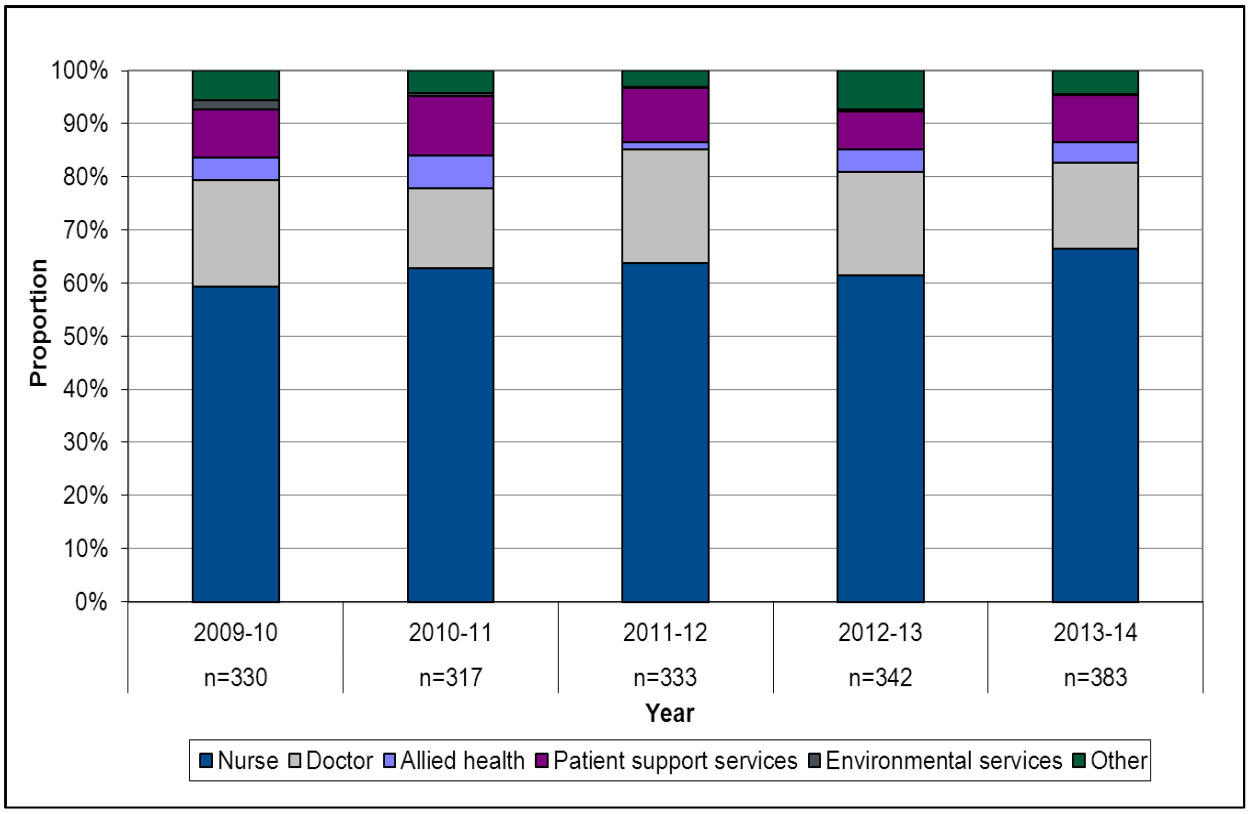


Figure 49 shows the proportion of non-parenteral occupational exposures reported by the various healthcare worker classifications.

In 2013-14 the majority (63%) of non-parenteral occupational exposures were reported by nurses. This is in keeping with historical trends (mean = 62%, range 57% to 65%).

Figure 50 Total occupational exposures, by hospital group, 2009-10 to 2013-14

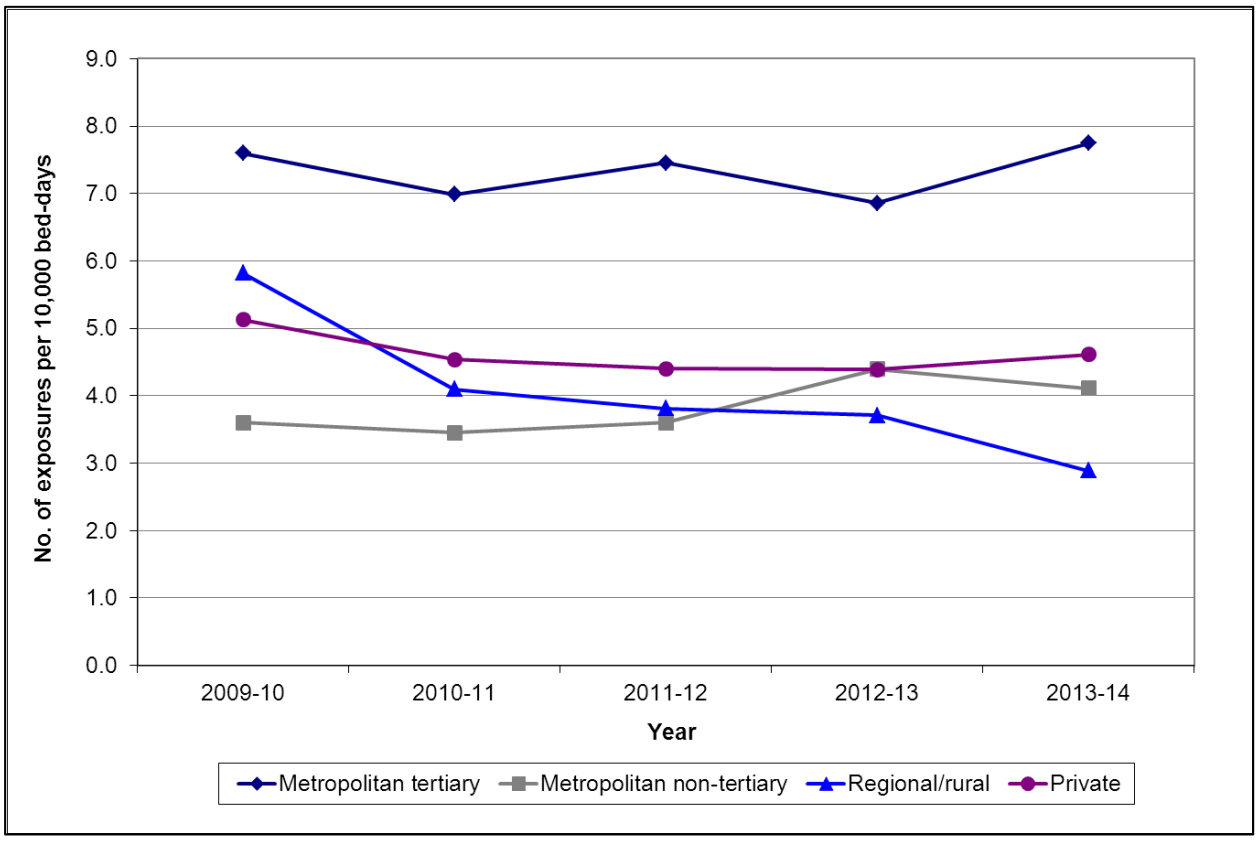


Figure 50 shows the total (parenteral and non-parenteral) occupational exposure rates for the various hospital groups.

In the 2013-14 reporting period, the metropolitan tertiary hospital rate is significantly higher ($p<0.01$) than the reported rates for all other hospital groups, and this is consistent with all previous reporting periods.

The total occupational exposure rate in the tertiary hospital group increased to 7.74 exposures per 10,000 bed-days from 6.86 in 2012-13, however this increase was not statistically significant.

In the 2013-14 reporting period, there was an increase in the total occupational exposure rate reported from the private hospital group, and a decrease in the total occupational exposure rate reported from the metropolitan non-tertiary hospital group when compared to 2012-13. Neither of these changes was significant ($p\geq0.05$). Regional hospitals reported a decrease in occupational exposures for the fourth consecutive reporting period and this decrease since 2009-10 is significant ($p<0.01$).

Figure 51 Parenteral and non-parenteral occupational exposures, tertiary hospitals, 2013-14

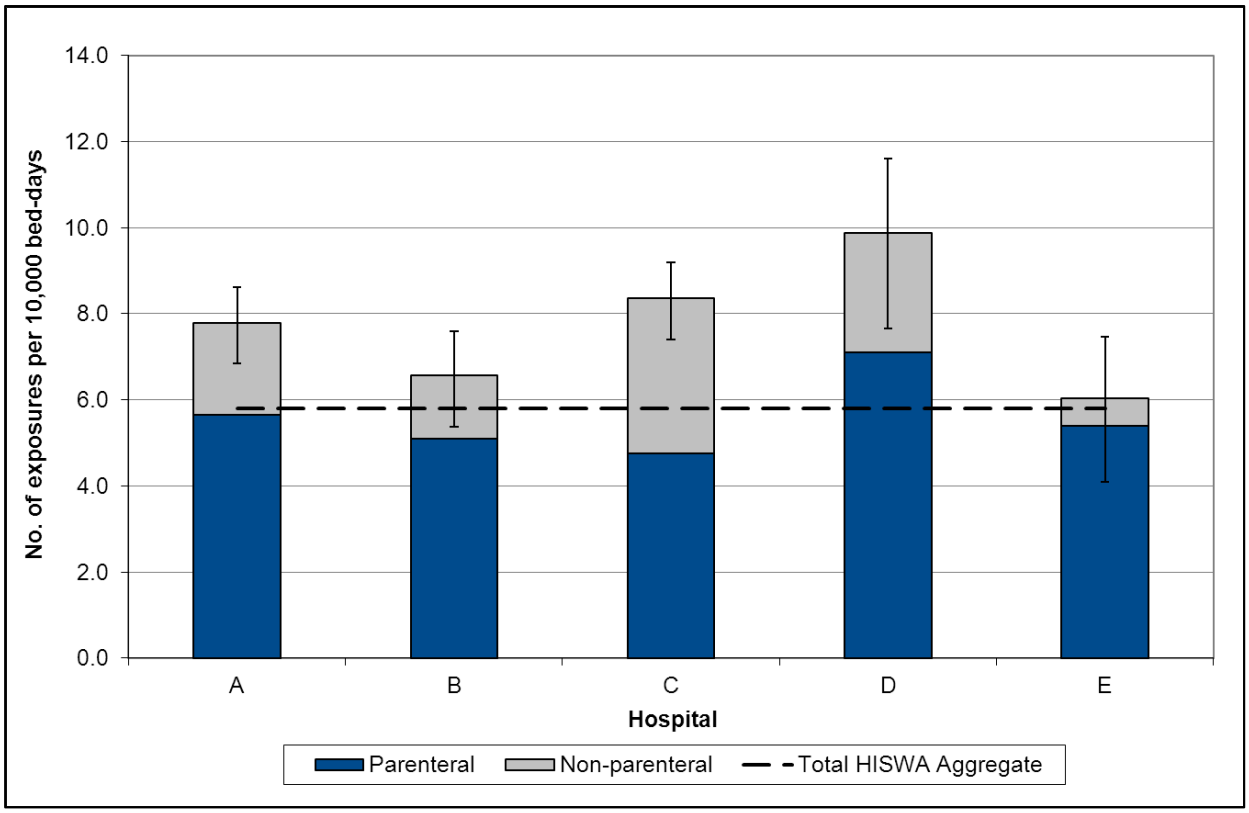


Figure 51 shows comparative data for parenteral and non-parenteral exposures for the five metropolitan tertiary hospitals. The three general tertiary hospitals are identified as A, B and C and the two specialist tertiary hospitals as D and E.

The majority of exposures in this reporting period, 50% of parenteral and 57% of non-parenteral, occurred at these five tertiary hospitals and the rate ranged from 6.04 to 9.87 exposures per 10,000 bed-days.

The total occupational exposure rate at hospital D of 9.87 exposures per 10,000 bed-days was significantly higher than the rates reported by hospital B (6.25) and hospital E (6.04) ($p<0.05$).

Figure 52 Parenteral occupational exposures, tertiary hospitals, 2009-10 to 2013-14

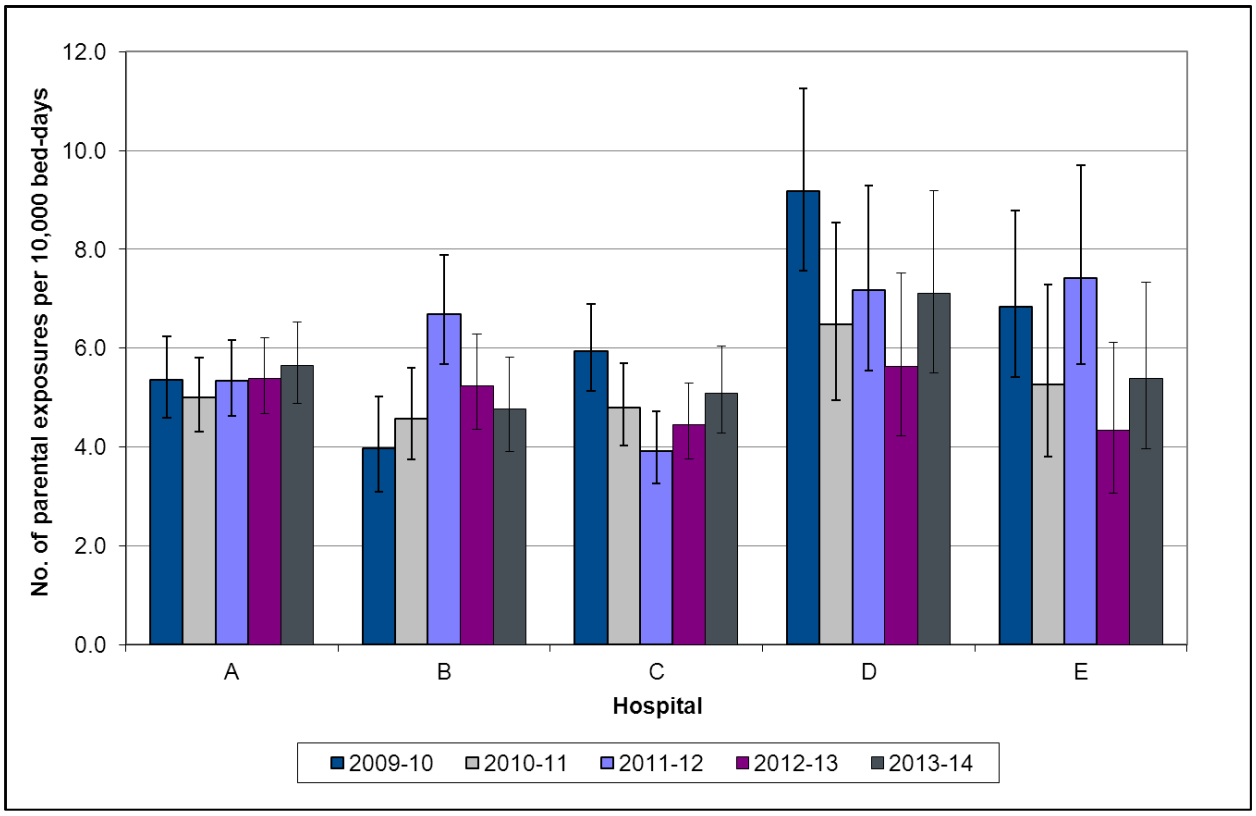


Figure 52 shows the parenteral exposure rates at the five metropolitan tertiary hospitals since 2009-10.

In August 2009, Hospital C implemented a safety engineered medical device (SEMD) program in response to unacceptably high parenteral exposure rates. The effectiveness of this program at Hospital C was evident in the decreased rates for each reporting period from 2008-09 to 2011-12 when they reported a rate that was significantly lower ($p<0.01$) than the parenteral exposure rate at all other tertiary hospitals. However, the rate has increased for the last two reporting periods and the 2013-14 increase is significant when compared to 2011-12 ($p<0.01$). The reason for this increase is unknown.

In 2013-14, hospitals A, D and E reported increases in parenteral exposure rates compared to the previous reporting period, however these were not significant ($p\geq0.05$).

Figure 53 Non-parenteral occupational exposures, tertiary hospitals, 2009-10 to 2013-14

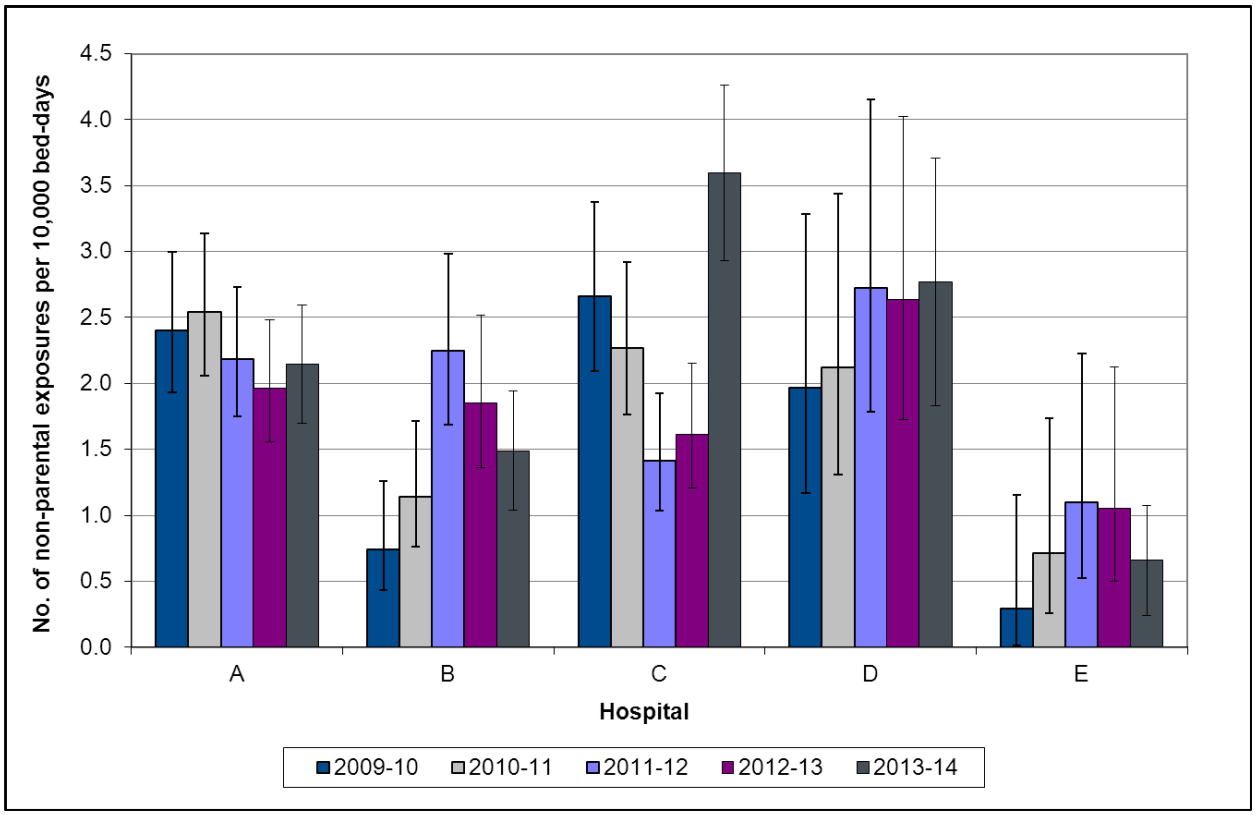
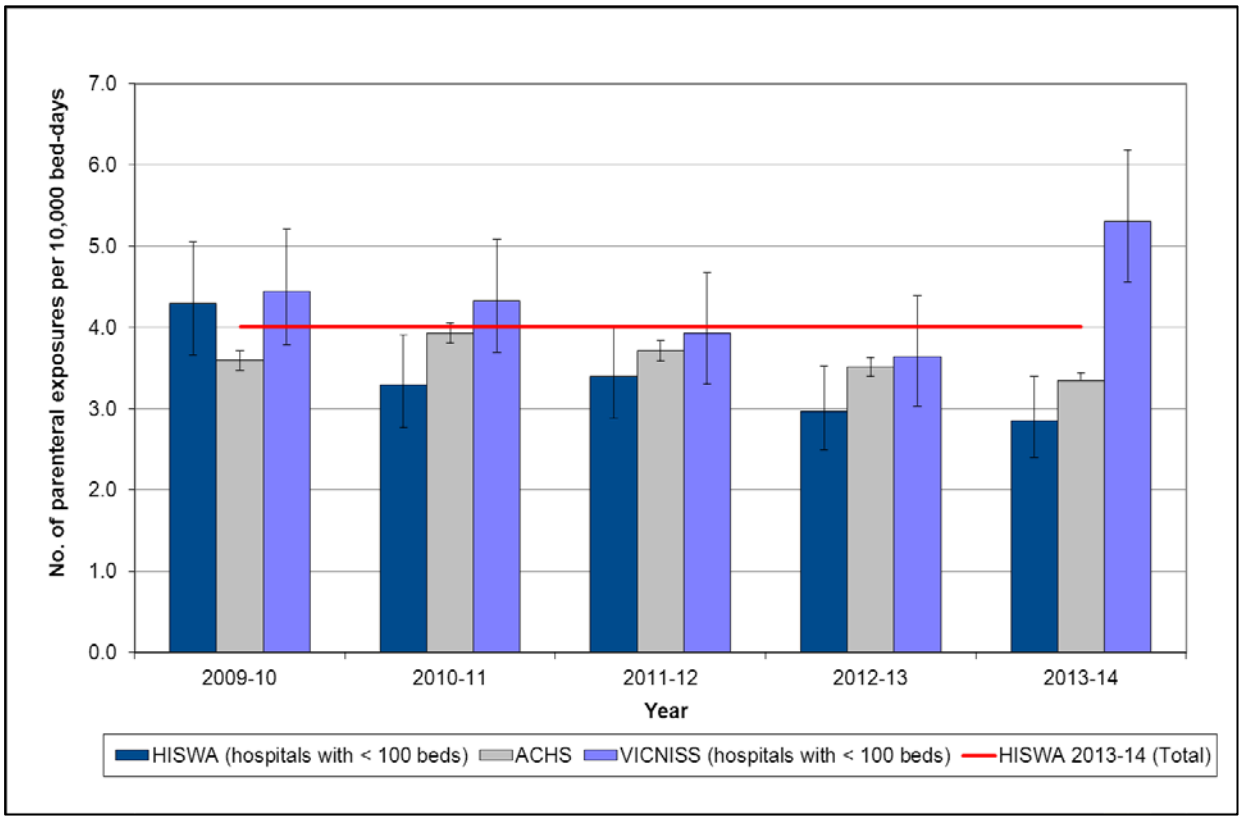


Figure 53 shows the non-parenteral occupational exposure data from the five metropolitan tertiary hospitals since 2009-10.

For Hospital C, the reduction in non-parenteral exposures shown from 2009 to 2012 and the subsequent increase over the past two reporting periods is reflective of the pattern reported for parenteral exposures. The rate of 3.6 exposures per 10,000 bed-days reported in 2013-14 at Hospital C is significantly higher ($p<0.01$) than the rate of 1.61 reported in 2012-13.

Hospitals B and E reported a reduction in non-parenteral occupational exposure rates in 2013-14 compared to the previous reporting period, while Hospitals A and D both reported increases, however these were not significant ($p>0.5$).

Figure 54 Parenteral occupational exposure rates, HISWA, ACHS and VICNISS, 2009-10 to 2013-14



Data available for benchmarking were from the VICNISS and the ACHS. VICNISS only includes data from hospitals with less than 100 beds and is a good comparator for WA hospitals of a similar size. HISWA data has been adjusted to make comparison with these data sets.

Figure 54 shows HISWA parenteral occupational exposure rates against the available comparators for the last five reporting periods. For the 2013-14 reporting period the HISWA rate for hospitals < 100 beds is significantly lower than the VICNISS rate. The total 2013-14 HISWA rate of 4.01 per 10,000 bed-days is significantly higher than the ACHS rate ($p<0.05$).

Figure 55 Non-parental occupational exposure rates, HISWA, ACHS and VICNISS, 2009-10 to 2013-14

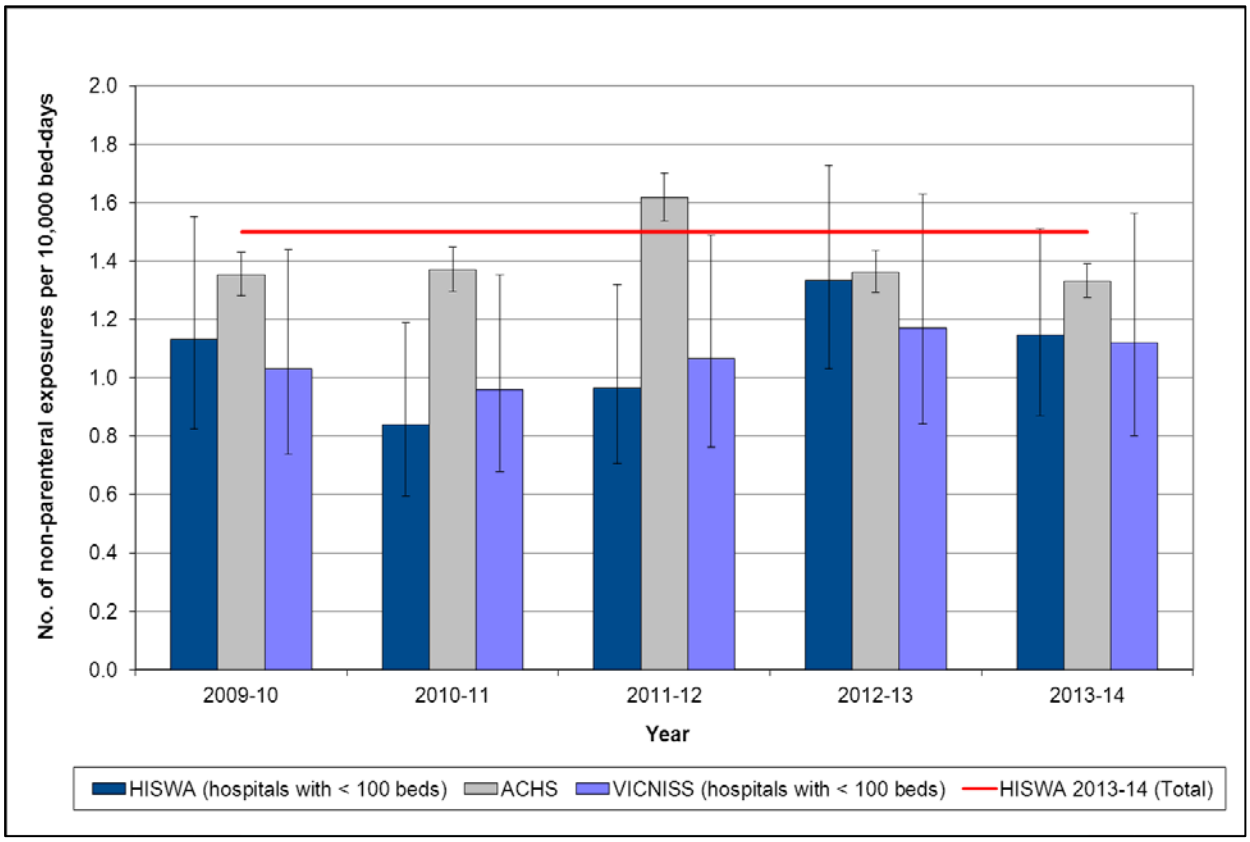


Figure 55 shows HISWA non-parenteral occupational exposure rates against the available comparators for the last five reporting periods. For the 2013-14 reporting period the HISWA rate of 1.15 per 10,000 bed-days for hospitals < 100 beds is comparable to the VICNISS rate. The total 2013-14 HISWA rate of 1.50 per 10,000 bed-days is significantly higher ($p<0.05$) than the ACHS comparator rate of 1.33.

National hand hygiene initiative

National hand hygiene initiative

The National Hand Hygiene Initiative (NHHI) is a multimodal program designed to increase healthcare worker (HCW) hand hygiene compliance. Included in the NHHI are a number of interventions that have been demonstrated to improve hand hygiene behaviour and reduce healthcare associated infection rates.[48-50]

Participating Hospitals

Data collection commenced in 2009 and is mandatory for all metropolitan public hospitals, WA Country Health Service (WACHS) regional resource centres, integrated district hospitals and those private hospitals contracted to provide care to public patients. Small hospitals and private hospitals submit compliance data on an opt-in basis.

In audit period 2 2014 (the last hand hygiene audit in the 2013-14 surveillance period), 81 WA hospitals (10 metropolitan public, 58 regional/rural, and 13 private hospitals) submitted data. In 2012, public reporting of hand hygiene compliance in WA public hospitals commenced via www.health.wa.gov.au/handhygiene.

Surveillance

The 2013-14 surveillance period includes data collected during the following NHHI audits:

- audit period 3 2013 (September – November)
- audit period 1 2014 (February – March)
- audit period 2 2014 (June – July).

The aggregated hand hygiene compliance in WA hospitals in 2013-14 improved with a mean compliance rate across the three periods of 78% compared to 75% in 2012-13. The national benchmark introduced in audit period 3 2011 by the Australian Institute of Health and Welfare (AIHW) is 70.0%, and the state aggregate data exceeded this benchmark for all of the three audit periods in 2013-14.

Figure 56 WA aggregate hand hygiene compliance, 2009-10 to 2013-14

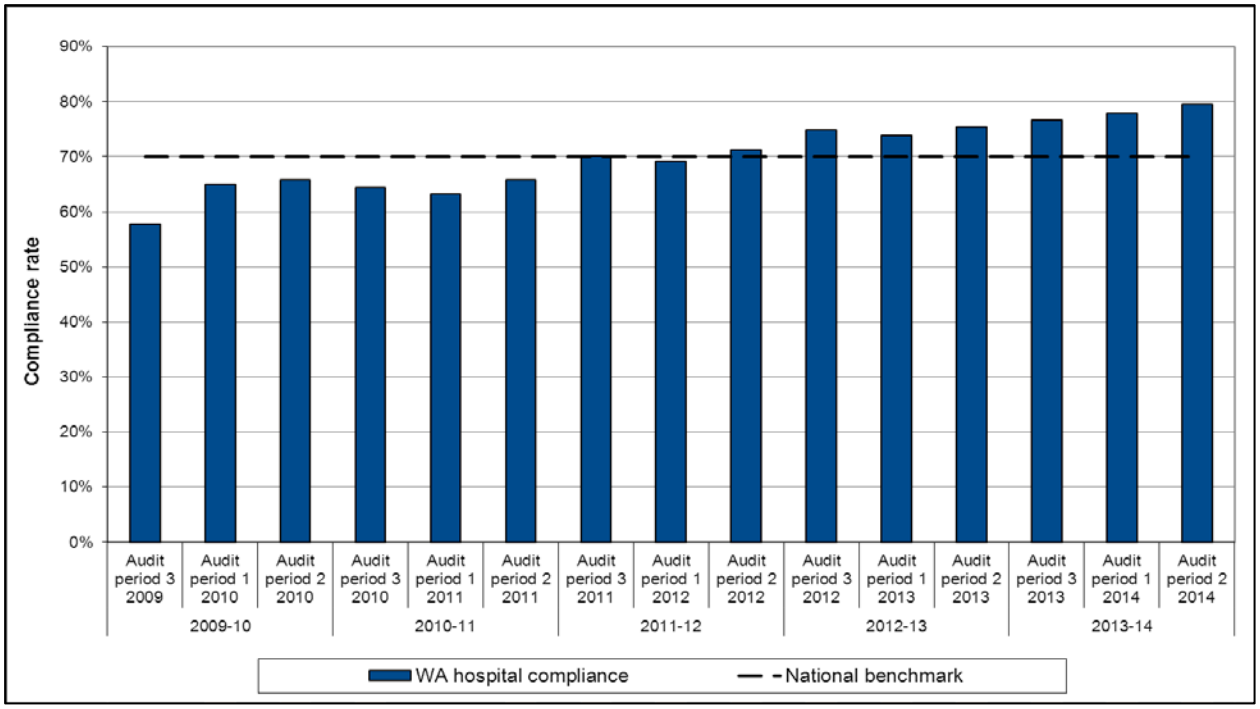


Figure 56 shows hand hygiene compliance data for each audit period since the 2009-10 reporting period. The 2013-14 surveillance period includes data from audit period 3 2013 and audit periods 1 and 2 2014. During this time, the WA aggregate hand hygiene compliance increased slightly from 77% in audit period 3 2013 to 80% in audit period 2 2014, placing WA well above the national benchmark of 70% set by the Australian Institute of Health and Welfare.

There continue to be variations in the compliance rates between hospital groups and healthcare worker groups that are detailed in subsequent figures. These variations highlight areas for targeted improvement initiatives aimed at increasing the aggregate compliance rate.

Figure 57 WA hand hygiene compliance, by hospital type, 2013-14

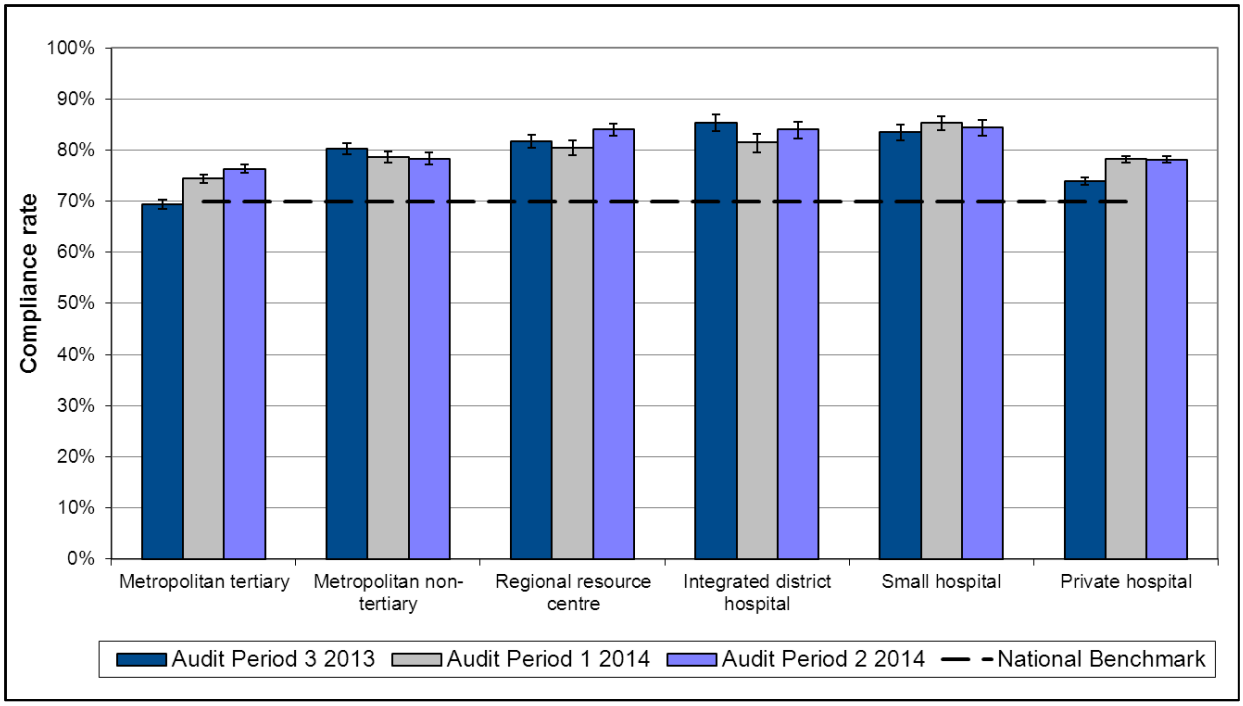
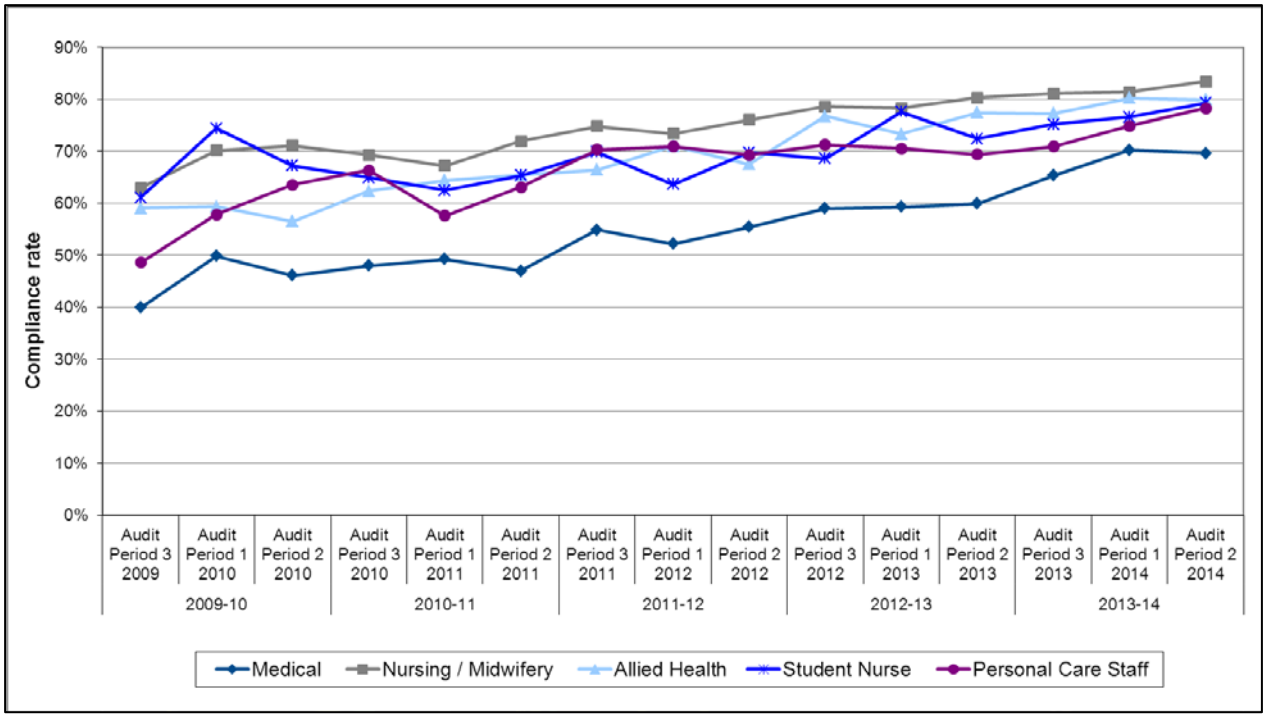


Figure 57 shows hand hygiene compliance rates by hospital groups. The compliance rate for all public hospitals was above the 70% benchmark for all audit periods during 2013-14, with the exception of tertiary hospitals for audit period 3 2013 (69%). There was a significant increase ($p<0.01$) in metropolitan tertiary and private hospital compliance between audit period 3 2013 (69% and 74% respectively) and audit period 2 2014 (76% and 78% respectively). The highest rate of compliance for the reporting year was by the small hospital group (84%).

Figure 58 WA hand hygiene compliance, by HCW category, 2009-10 to 2013-14

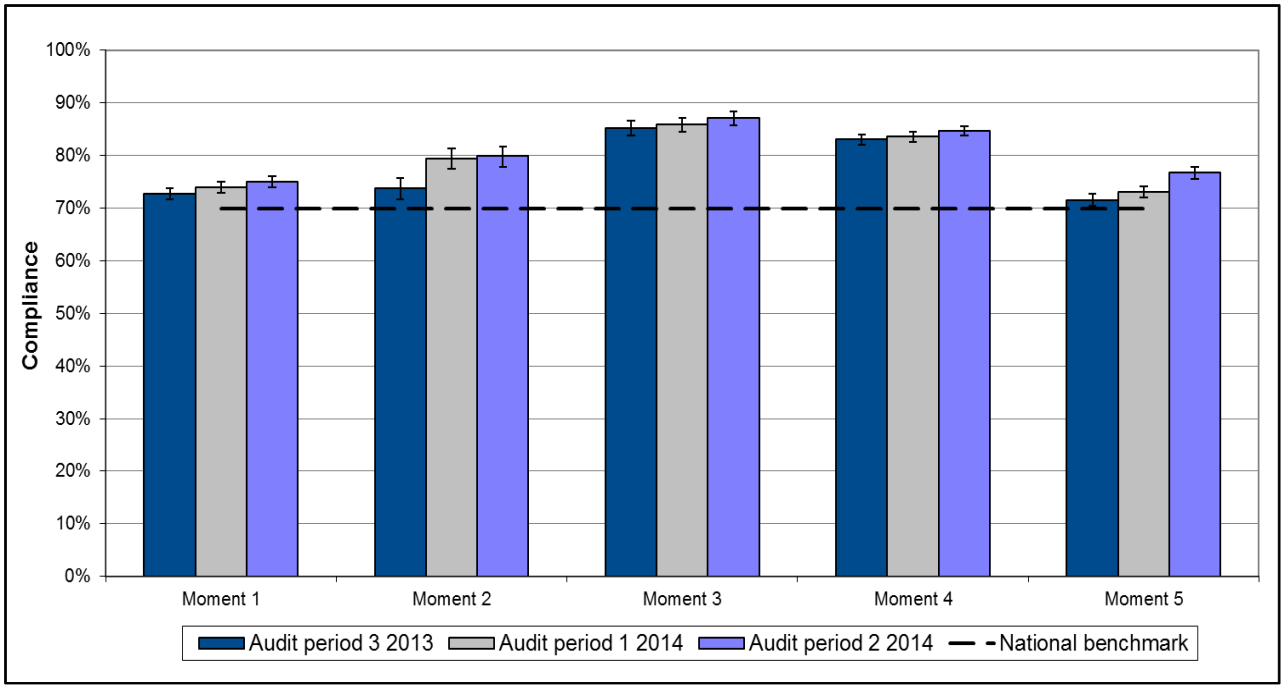


The NHHI audit data records the vocational status of observed HCWs, thus permitting the comparison of hand hygiene compliance across HCW categories. The majority (76%) of all observations in the 2013-14 period were recorded for medical and nursing/midwifery HCWs. The five professions shown in Figure 58 comprise 93% of all moments observed in WA hospitals in this period.

As Figure 58 shows, hand hygiene compliance is demonstrating an upward trend in all HCW categories since reporting commenced in 2009. The nursing/midwifery group has consistently demonstrated compliance rates over 70% for the last four audit periods. Allied health, personal care and student nursing staff are all within 3% of the national benchmark at the most recent audit.

Medical personnel have consistently demonstrated the lowest rate of hand hygiene compliance, however, hand hygiene compliance by medical HCWs has improved substantially from the 30% first recorded in audit 1 2009. It is hoped that this upward trend by medical personnel will continue. Two initiatives by Hand Hygiene Australia (HHA) to increase medical personnel compliance were the development of an online hand hygiene learning module aimed specifically at medical staff, and an initiative undertaken by the Royal Australasian College of Surgeons (RACS). Since the end of 2012, all applicants for entry into the Surgical Education Training program have been required to complete an online hand hygiene education program developed by HHA as part of the application process. It is hoped that other medical colleges will also endorse this approach in the future.

Figure 59 WA hand hygiene compliance, by moment, 2013-2014



The NHHI audit tool categorises patient and HCW interaction into five 'moments'. These moments are:

- Moment 1 – Before touching a patient
- Moment 2 – Before a procedure
- Moment 3 – After a procedure or body fluid exposure risk
- Moment 4 – After touching a patient
- Moment 5 – After touching a patient's immediate surroundings

Audit results for 2013-14 in Figure 59 show that HCWs correctly performed hand hygiene more frequently after touching a patient (moments 3 and 4) than before touching a patient (moments 1 and 2). This is in keeping with historical data. There were improvements in compliance for all moments across the 2013-14 period.

Figure 60 Hand hygiene compliance, by HCW category, WA and national data, audit period 2 2014

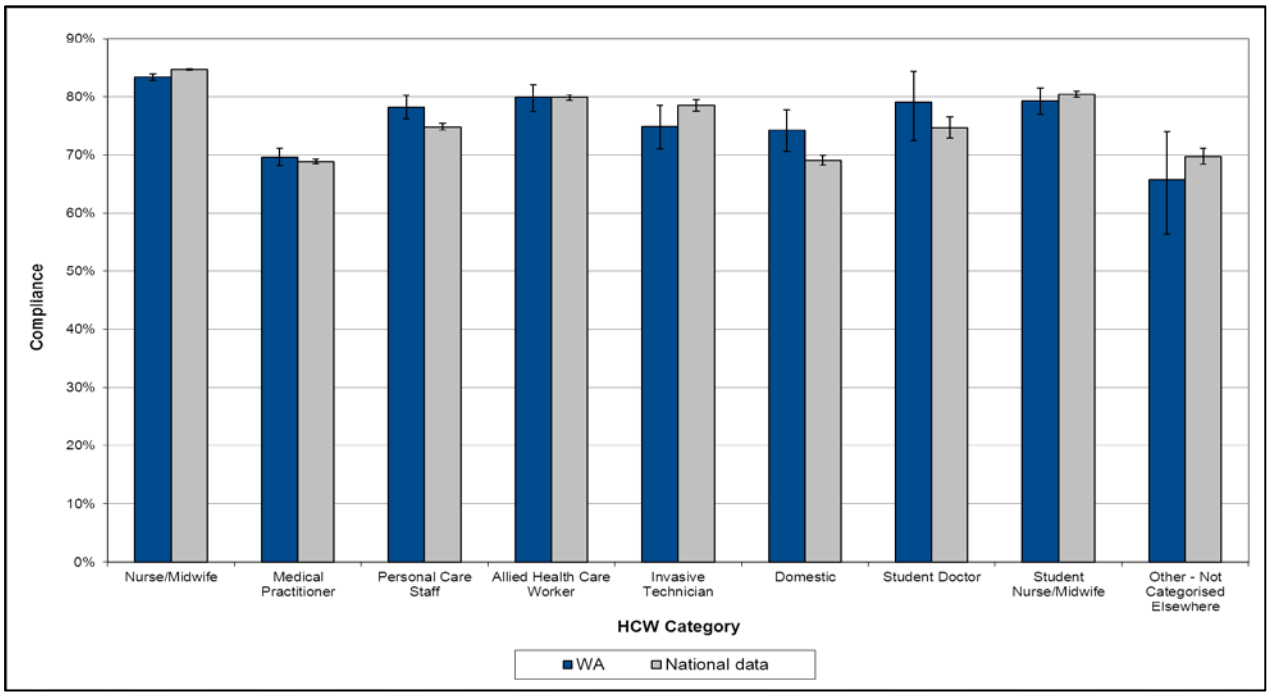


Figure 60 shows compliance rates by HCWs for the last audit period of 2013-14 (audit period 2 2014), and highlights areas for potential improvement in WA compliance compared to national compliance rates. The lower rates of compliance in WA by medical personnel are reflected in the national rates, as are the higher rates for nursing/midwifery HCWs.

Figure 61 Hand hygiene compliance, by moment, WA and national data, audit period 2 2014

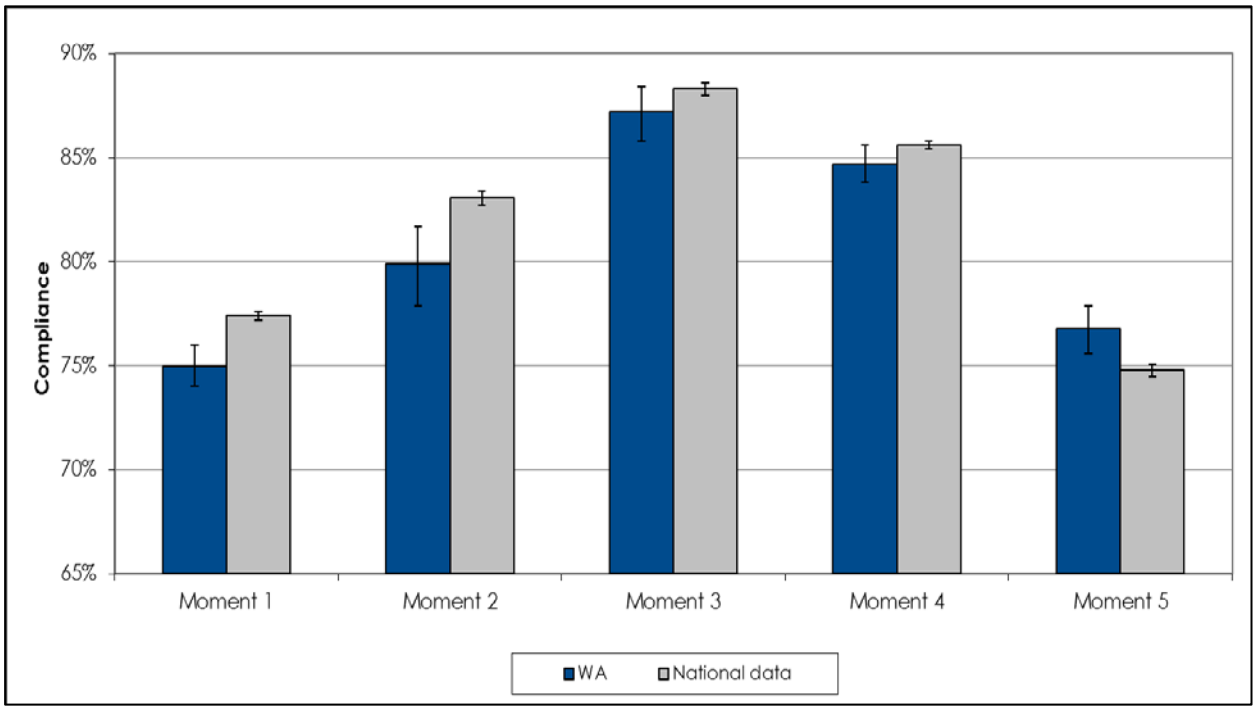


Figure 61 shows compliance rates by moment for the last audit period of 2013-14 (audit period 2 2014) compared to national data from the same audit period. National data reflects WA compliance rates in which compliance after touching a patient (moments 3 and 4) is higher than before touching a patient (moments 1 and 2).

Appendices

Appendix 1 Participating facilities for reporting period 2013-14

Hospital	* Size	* Group	SSI	MRSA	CDI	CLABSI	HD-BSI	HA-SABSI	OCC EXP	NHHI
Albany	D	RRC	Ar Cs	√	√		√	√	√	√
Armadale/Kelmscott	C	MNT	Ar	√	√	√	√	√	√	√
Attadale	E	P	Cs	√	√			√	√	√
Bentley	D	MNT	Cs	√	√			√	√	√
Bethesda	D	P	Ar	√	√			√	√	√
Beverley	F	SH								√
Boddington	F	SH								√
Bridgetown	E	SH								√
Broome	E	RRC	Cs	√	√			√	√	√
Bruce Rock	F	SH								√
Bunbury	D	RRC	Ar Cs	√	√	√		√	√	√
Busselton	E	IDH	Cs	√	√			√	√	√
Carnarvon	E	IDH	Cs	√	√			√	√	√
Collie	E	IDH	Cs	√	√			√	√	√
Corrigin	D	SH								√
Dalwallinu	D	SH								√
Denmark	D	SH								√
Derby	E	IDH	Cs	√	√			√	√	√
Diaverum: Cannington	NA	P					√			
Diaverum: Rockingham	NA	P					√			
Diaverum: Stirling	NA	P					√			
Esperance	E	IDH	Cs	√	√			√	√	√
Fitzroy Crossing	F	SH								√
Fremantle	A	MT	Ar	√	√	√	√	√	√	√
Fresenius: Coolbellup	NA	P					√			
Fresenius: Midland	NA	P					√			
Fresenius: Spearwood	NA	P					√			
Fresenius: Warwick	NA	P					√			
Geraldton	D	RRC	Ar Cs	√	√		√	√	√	√
Glengarry	C	P		√	√			√	√	√
Graylands	B	Psych							√	√
Hollywood	A	P	Ar	√	√	√		√	√	√
Joondalup	A	P	Ar Cs	√	√	√	√	√	√	√
KAMSC Derby	NA	P					√			
KAMSC Fitzroy	NA	P					√			
KAMSC Kununurra	NA	P					√			
Kalgoorlie	D	RRC	Ar Cs	√	√		√	√	√	√
Katanning	E	IDH		√	√			√	√	√
Kellerberrin	F	SH								√
Kimberley Satellite Dialysis Centre Broome		P				√				

Hospital	* Size	* Group	SSI	MRSA	CDI	CLABSI	HD-BSI	HA-SABSI	OCC EXP	NHHI
King Edward	**B**	MT	Cs	√	√			√	√	√
Kojonup	F	SH								√
Kondinin	F	SH								√
Kununoppin	F	SH								√
Kununurra	E	IDH	Cs	√	√			√	√	√
Lake Grace	F	SH								√
Margaret River	E	IDH		√	√			√	√	√
Merredin	E	IDH		√	√			√	√	√
Moora	F	IDH		√	√			√	√	√
Mount	B	P	Ar	√	√	√		√	√	√
Mount Lawley Private	P	P		√					√	
Murray District	E	MNT		√	√			√	√	√
Narembeen	F	SH								√
Narrogin	E	IDH	Cs	√	√			√	√	√
Newman	F	IDH		√	√			√	√	√
Nickol Bay	E	IDH	Cs	√	√			√	√	√
Northam	E	IDH	Cs	√	√			√	√	√
Osborne Park	C	MNT	Ar Cs	√	√			√	√	√
Peel	C	P	Ar Cs	√	√		√	√	√	√
Pemberton	F	SH								√
Port Hedland	E	RRC	Cs	√	√		√	√	√	√
Princess Margaret	B	MT		√	√			√	√	√
Quairading	F	SH								√
Rockingham	D	MNT	Ar Cs	√	√	√		√	√	√
Royal Perth	A	MT	Ar	√	√	√	√	√	√	√
SJOG Bunbury	B	P	Ar	√	√		√	√	√	√
SJOG Busselton	F	P					√			
SJOG Geraldton	D	P	Ar Cs	√	√			√	√	√
SJOG Mt Lawley	B	P	Ar Cs	√	√			√	√	√
SJOG Murdoch	A	P	Ar Cs	√	√	√		√	√	√
SJOG Subiaco	A	P	Ar	√	√	√		√	√	√
Sir Charles Gairdner	A	MT	Ar	√	√	√	√	√	√	√
South Perth	D	P		√	√			√	√	√
Southern Cross	F	SH								√
Swan Districts	C	MNT	Cs	√	√			√	√	√
Wagin	F	SH								√
Warren	F	IDH	Cs	√	√			√	√	√

*** Number of beds: A=300+, B=150-299, C=100-149, D=50-99, E=20-49, F=0-19**

 # MT = metropolitan tertiary hospital **MNT = metropolitan non-tertiary hospital**

RRC = regional resource centre **IDH = integrated district hospital**

SH = small hospital **P = private hospital**

SSI Ar = Arthroplasty **Cs= Caesarean section**

Appendix 2 Abbreviations

ACCESS	Australian Collaborating Centre for Enterococcus and Staphylococcus Species
ACSQHC	Australian Commission on Safety and Quality in Health Care
ACHS	Australian Council on Healthcare Standards
AIHW	Australian Institute of Health and Welfare
ANZDATA	Australia and New Zealand Dialysis and Transplant Registry
ANZICS	Australian and New Zealand Intensive Care Society
AV	arteriovenous
AVF	arteriovenous fistula
AVG	arteriovenous graft
BSI	bloodstream infection
CA	community associated
CAI	community associated infection
CA-MRSA	community associated methicillin-resistant *Staphylococcus aureus*
CDC	Centers for Disease Control and Prevention
CI	centrally inserted
CI_{95}	95% confidence interval
CLABSI	central line associated bloodstream infection
CLUR	central line utilisation ratio
CVC	central venous catheter
HA	healthcare associated
HAI	healthcare associated infection
HA-SABSI	healthcare associated *Staphylococcus aureus* bloodstream infection
HAIU	Healthcare Associated Infection Unit
HCF	healthcare facility
HCW	healthcare worker
HISWA	Healthcare Infection Surveillance Western Australia
ICU	intensive care unit
IVD	intravascular device
MRSA	methicillin-resistant *Staphylococcus aureus*
NA	Not available
NHHI	National Hand Hygiene Initiative
NHSN	National Healthcare Safety Network (formerly NNIS)
NSW	New South Wales
PDS	post-discharge surveillance
PI	peripherally inserted
PHE	Public Health England
SA	South Australia
SABSI	*Staphylococcus aureus* bloodstream infection
SEMDs	safety engineered medical devices
SSI	surgical site infection
SSTI	skin and soft tissue infection
SQuIRe	Safety and Quality Investment for Reform
TIPCU	Tasmanian Infection Prevention and Control Unit
VICNISS	Victorian Nosocomial Infection Surveillance System
VRE	Vancomycin-resistant enterococci
WA	Western Australia

Appendix 3 Explanatory notes

1. Surveillance Methodology

Surveillance methodology for each indicator is described in the HISWA Surveillance Manual Version 6, available from:
http://www.public.health.wa.gov.au/3/277/2/healthcare_infection_surveillance_wa.pm

2. Surgical Site Infection

Data Validation: Various data validation processes have been performed to investigate variation in SSI rates, case finding and infection classification across the participating hospitals since 2006. A formal SSI validation study was completed in October 2008.

3. Methicillin-resistant Staphylococcus aureus (MRSA) Infection

Within the MRSA HAI definition, each patient is only recorded as having one infection during a single admission, even if MRSA is isolated from multiple sites. If infection occurs at multiple sites, only the most significant infection site is recorded (e.g. if wound infection and bloodstream infection, recorded as bloodstream only).

Data Validation: MRSA is a notifiable disease in WA and all new isolates are sent by laboratories to the PathWest Gram-Positive Typing laboratory for molecular typing. MRSA data submitted to HISWA is cross-checked with the Gram-Positive Typing laboratory database to ensure that only MRSA isolates are included in the surveillance program and allows for the HAIU to identify the specific MRSA clone causing the MRSA HAI.

4. Hospital-Identified Clostridium difficile Infection

Data Validation: All public hospital-identified *Clostridium difficile* data is validated by the HAIU.

5. Vancomycin-resistant Enterococci Infection

Data Validation: All VRE clinical isolates referred to the PathWest Gram-Positive Typing Laboratory are reviewed by the HAIU to establish if they are colonisation or clinical infection and if VRE HAI.

6. *Staphylococcus aureus* Bloodstream Infection (SABSI)

Data Validation: All public hospital SABSI data is validated by the HAIU.

7. Central Line Associated Bloodstream Infection (CLABSI)

Risk Stratification: The risk of developing a CLABSI differs according to the type of catheter and patient population. CLABSI rates in various clinical units are therefore reported separately. HISWA data is stratified by ICU, haematology and oncology. Rates can be further stratified by central or peripheral line insertion if required.

The ICU central line utilisation ratio (CLUR) is the average proportion of patients in the ICU with a central line each day. This measure gives an indication of patient acuity and the risk of developing a CLABSI.

Data Validation: No formal validation of HISWA CLABSI data has been undertaken.

8. Haemodialysis Access-associated Bloodstream Infection

The ACHS clinical indicator rates are used as a comparator for HISWA, with rates stratified by device type. HISWA combines native and synthetic vessel graft data (indicators 3.2 and 3.3 – refer HISWA Surveillance Manual v6) for rate calculation.

Patient Inclusion/Exclusion Criteria: All patients with chronic renal failure receiving haemodialysis are included. Patients requiring haemodialysis for acute renal failure are

excluded as they have different infection risk factors, and often receive care outside of a dialysis unit (e.g. ICU).

Stratification: Access-associated infection rates are stratified according to the type of vascular device used i.e. arteriovenous (AV) fistulae, arteriovenous (AV) grafts (synthetic and native combined), cuffed/permanent catheters and non-cuffed/temporary catheters. The risk of acquiring a BSI is known to vary with the type of vascular access used.

Data Validation: In 2006 the dialysis units were audited for data collection methods and infection classification. This involved a review of the processes in place at each site to detect and classify haemodialysis access-associated BSI and record denominator data. Minor inconsistencies were detected and some practices were altered. Ongoing data validation has occurred since then with review of all quarterly haemodialysis BSI data.

9. Occupational Exposures

ACHS definitions of an occupational exposure to blood or body fluids are utilised and classified as either parenteral (piercing of skin or mucous membranes with a contaminated sharp, usually higher risk) or non-parenteral (mucous membrane, such as eyes, nose, mouth, or non-intact skin contact with blood or body fluid). Descriptors utilised to classify HCWs into the major occupational groups are shown in Appendix 4.

10. National Hand Hygiene Initiative

A nationally endorsed audit tool is utilised to assess compliance of HCWs with hand hygiene requirements. Auditors receive training to ensure high inter-rater reliability.

Hospital auditing requirements are stipulated in the Hand Hygiene Australia (HHA) manual (accessed at http://www.hha.org.au). Descriptors utilised to classify HCWs into the major occupational groups are shown in Appendix 4.

Appendix 4 Healthcare Worker Classification

HISWA Classification	Descriptor for Occupational Exposures
Dr	All medical officers, specialist clinicians, dentists, visiting and student doctors
Nurse	All nurses (registered, enrolled, midwives), nursing assistants and student nurses
Allied Health	Clinical healthcare professions distinct from medicine, dentistry and nursing, e.g. social work, physiotherapy, dietetics, occupational therapy, pharmacy, radiography, podiatry, psychology, speech pathology, orthotics and prosthetics, audiology
Patient Support Services	Other HCWs who provide services that support clinical patient care, e.g. patient care assistants, ward orderlies, phlebotomists, CSSD/TSSU staff, all technicians (lab, theatre, respiratory, orthopaedic, pathology, anaesthetic)
Environmental Services	HCWs mainly involved in maintaining equipment and the environment, e.g. housekeeping, catering and cleaning staff, laundry workers, waste management and maintenance personnel, plumbers, engineers, carpenters
Other	Utilise only if the above classifications are not suitable e.g. Administrative; clerical, information technology, chaplains, drivers, volunteers.

NHHI Classification	Descriptor for NHHI
Medical	Any qualified medical practitioner
Nursing/Midwifery	A HCW registered with the Nurses and Midwives Board of WA
Allied Health	e.g. physiotherapist, occupational therapist, dietician
Invasive Technician	e.g. phlebotomist, dialysis technician
PSA/PCA/AIN/NA	e.g. patient service/care assistant, nursing assistant
Other	Any person not otherwise categorised
Student Doctor	Student doctor
Student Nurse	Student nurse/midwife
Student Allied Health	Student allied health
Domestic	HCW engaged in housekeeping, cleaning, meal delivery
Administrative Clerical	Ward clerk, coding clerk, admissions officer
Student Personal Carer	Student personal carer
Personal Care Staff	Personal care staff

Appendix 5 Rate calculations

Surgical site infection

SSI rate = Number of SSI x 100 / Number of procedures

MRSA HAIs

Inpatient HAI MRSA rate = Number of inpatient infections x 10,000 / Number of multi-day bed-days

Total MRSA HAI rate = Number of inpatient and non-inpatient infections x10, 000 / Number of bed-days (including same day bed-days)

CLABSI

CLABSI rate = Number of CLABSI x 1,000 / Number of central line days

Central line utilisation ratio = Number of line-days x 100 / Number of bed-days (including same day bed-days)

Haemodialysis BSI

Access-associated BSI rate = Number of access-associated BSI x 100 / Number of patient-months

HA-SABSI

Total HA-SABSI rate = Number of inpatient and non-inpatient infections x 10,000 / Number of bed-days (including same day bed-days)

Occupational exposures

Exposure rate = Number of occupational exposures x 100 / Number of bed-days (including same day bed-days)

National Hand Hygiene Initiative

Compliance rate = Number of HH moments performed correctly x 100 / Total number of HH moments observed

Appendix 6 Resources

Surgical Site Infection

- Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA): The Healthcare Associated Infection Prevention Compendium; Strategies to prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update.

MRSA

- Society for Healthcare Epidemiology of America (SHEA): Strategies to Prevent Transmission of Methicillin-Resistant *Staphylococcus aureus* in Acute Care Hospitals: 2014 Update. This document reinforces the WA approach to MRSA and the additional strategies some WA hospitals have in place to enhance MRSA control.
- Association for Professionals in Infection Control and Epidemiology (APIC) Elimination Guide: Guide to the elimination of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission in hospital settings, 2nd Edition, 2010.

CLABSI

- Society for Healthcare Epidemiology of America (SHEA) and the Infectious Disease Society of America (IDSA): Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update.
- APIC: Guide to the elimination of catheter-related bloodstream infections 2009.
- Centre for Healthcare Related Infection Surveillance and Prevention (CHRISP) I-Care program. Available from: www.health.qld.gov.au/chrisp/icare/about.asp
- Reports and resources for central line insertion and maintenance are available here http://www.anzics.com.au/ on the ANZICS website.

Haemodialysis

- National Kidney Foundation's Kidney Disease Outcomes and Quality Initiative (KDOQI). Available from: www.kidney.org/professionals/kdoqi/guidelines_updates/doqi_uptoc.html#va
- Renal Health Network Department of Health Western Australia: Model of Care – Chronic Kidney Disease. Available from: www.healthnetworks.health.wa.gov.au/modelsofcare/docs/CKD_Model_of_Care.pdf
- British Renal Association Clinical Practice Guidelines for Vascular Access. Available from: www.renal.org/Clinical/GuidelinesSection/VascularAccess.aspx
- European Renal Best Practice. http://ndtplus.oxfordjournals.org/content/3/3/234.full
- The Centers for Disease Control and Prevention (CDC) Dialysis Prevention Collaborative http://www.cdc.gov/dialysis/prevention-tools/index.html)

Occupational Exposures

- The Centre for Disease Control and Prevention Sharps Safety Program: Workbook for designing, implementing, and evaluating a sharps injury prevention program. Available from: www.cdc.gov/sharpssafety

National Hand Hygiene Initiative

- Hand Hygiene Australia. Available from: http://www.hha.org.au
- WA Operational Directive 0236/10 *Hand Hygiene in Western Australia Hospitals.* Available from: http://www.health.wa.gov.au/CircularsNew/circular.cfm?Circ_ID=12609
- World Health Organization: Clean Care is Safer Care. Available from: http://www.who.int/gpsc/5may/en/index.html
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