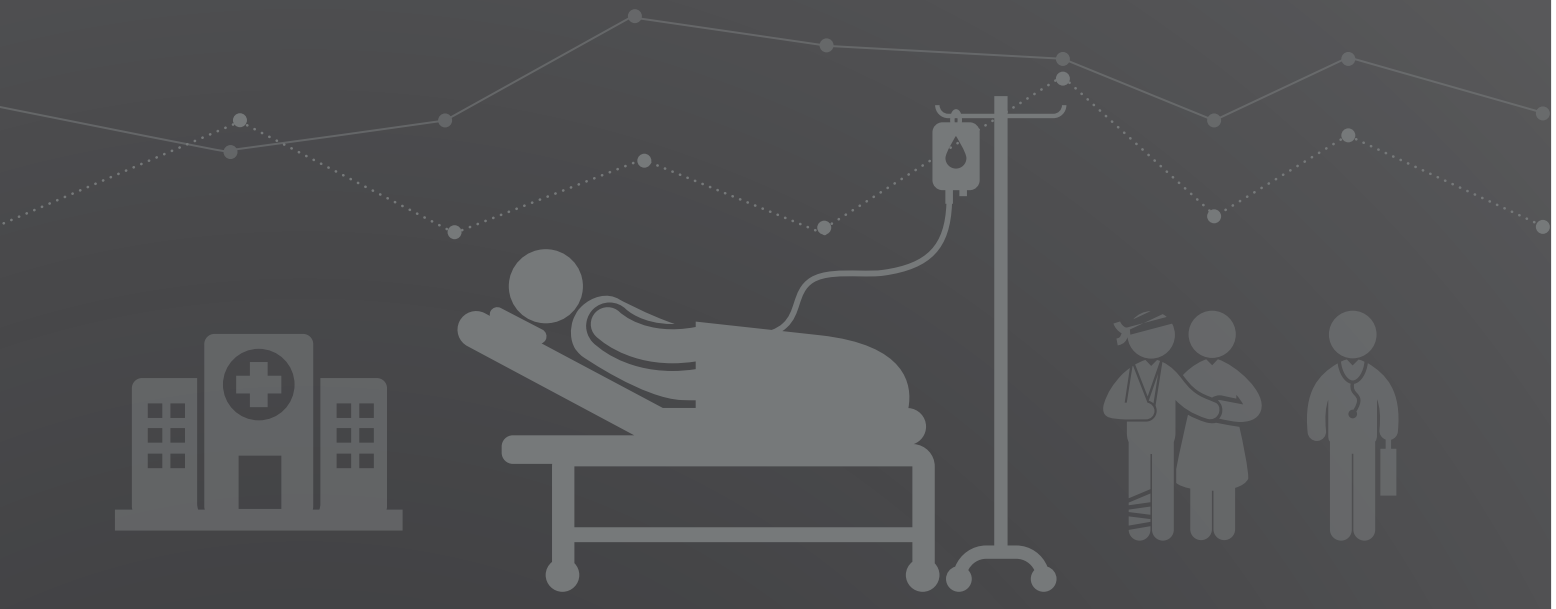
Measurement Matters

Reliability of selected indicators of hospital-acquired complications



bureau of health information

BUREAU OF HEALTH INFORMATION
Level 11, 67 Albert Avenue
Chatswood NSW 2067
Australia
Telephone: +61 2 9464 4444
bhi.nsw.gov.au

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Overview

Executive summary

In 2016, the Council of Australian Governments (CAOG) agreed to improve hospital pricing mechanisms to reflect the safety and quality of hospital services.

This was to be achieved by reducing funding for unnecessary or unsafe care through a decrease in hospital-acquired complications. In 2019, there is national interest in increasing public reporting of safety and quality across public and private hospitals.

Consumers and clinicians are recommending more transparency in relation to, for example, hospital-acquired infections, surgical mishaps and post-intervention or procedure outcomes.[1]

To contribute to and inform these efforts, this report explores a range of issues and options to support ongoing measurement, monitoring and reporting of patient safety in New South Wales (NSW).

Specifically, it focuses on four hospital-acquired complications and assesses and compares the reliability of different measurement approaches, particularly if they may be used for public reporting.

The measures selected for inclusion were identified by an advisory group established to support this project, and they represent a subset of measures identified as important nationally.

The assessment of each measure is informed by Bureau of Health Information (BHI) analyses of healthcare data and advice from the advisory group.

Executive summary

Hospital-acquired complications

Hospital-acquired complications can have serious impacts on patients and their families by affecting recovery and overall health outcomes, and resulting in lengthier hospital stays.

The resources required to treat these complications means they also have implications for health services and the wider system.

Clinical risk-mitigation strategies may reduce, but not eliminate, the risk of hospital-acquired complications.[1] Accordingly, information on variation between facilities in hospital-acquired complication rates can support the identification and management of patient risk, to support better value care.

This *Measurement Matters* report focuses on four hospital-acquired complications:

- stage three and four pressure injuries
- healthcare-associated infection
- medication complications
- third and fourth degree perineal laceration during delivery.

They have been selected from the Australian Commission on Safety and Quality in Health Care's (ACSQHC) list of 16 hospital-acquired complications to be prioritised for monitoring and prevention[1], and are among the most common hospital-acquired complications.

There are a variety of approaches to measuring hospital-acquired complications – in NSW, nationally and internationally. These include indicators defined by ACSQHC, the NSW Ministry of Health (MoH), Agency for Healthcare Research and Quality (AHRQ), Organisation for Economic Co-operation and Development (OECD), Canadian Institute for Healthcare Information (CIHI) and BHI.

The hospital-level indicators are derived from administrative, clinical and patient-reported data sources. It is important to note that clinical definitions of complications may not correspond with patients' own definitions.

It is likely therefore that the results of analyses of patient-reported complications will differ from those using administrative or clinical data. Nevertheless patients' reports of their own experiences provide a unique and important perspective on the prevalence and impact of hospital-acquired complications.

Assessing indicator reliability

In our analyses, the following four criteria have been used to assess reliability in measuring each complication at the hospital level:

- comparison across indicator specifications where calculations were carried out by BHI using administrative data
- comparison with patient-reported complications that rely on survey data collected and analysed by BHI
- comparison over time to assess the stability of estimates of performance
- comparison between unadjusted and risk-adjusted rates to recommend approaches for ongoing monitoring and reporting of patient safety (risk-adjustment was not conducted for medication complications).

Recommendations

The findings in this report support the following conclusions and recommendations – presented in further detail on pages 33–34 – in relation to internal reporting (within the health system), public reporting and improvements in the quality of existing datasets to better support the production and use of information on hospital-acquired complications.

Internal reporting

1. NSW should continue to support ACSQHC in further refining the medication complications indicator so that appropriate conditions and consequences are captured in the specifications.

2. The risk-adjusted post-operative sepsis within 30 days of surgery indicator should be supported by assessment of hospital-level concurrent validity using available surgical outcomes data (internal and public reporting).

Public reporting

3. There should be further consideration of risk-adjustment for public reporting of stage three and four pressure injury, along with further work to analyse concurrent validity of administrative data against patient-reported complications.

4. For third and fourth degree perineal laceration during delivery, BHI recommends the use of risk-adjusted rates to support fairer comparisons between hospitals. BHI also recommends the information is published in a way that is accessible to all consumers.

Quality of existing datasets

5. NSW would benefit from work to understand concordance between patient self-reported, and clinical information on, complications, enabled by linking of the Admitted Patient Data Collection (APDC) with data from the Adult Admitted Patient Survey (AAPS), Maternity Care Survey, and NSW's Electronic Medication Management.

6. To further support measurement, monitoring and reporting on patient safety, NSW would benefit from routine analyses of linked hospital, emergency department, pharmaceutical and patient self-reported data to follow patient journeys over time.

Overview of findings

Stage three and four pressure injuries

Pressure injuries are a localised form of skin damage caused by pressure, shear or friction.[2]

While indicators used AHRQ, ACSQHC and MoH produced different rates of pressure injuries in NSW hospitals, the indicators produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

Patient-reported pressure injury rates and those using the APDC – that is, AHRQ, ACSQHC and MoH – were substantially different at the hospital level. Patient-reported injury rates were typically higher even when the scopes of the two data sources were closely matched.

Rates were also found to be variable over time, but within an expected range. Variation is expected on an annual basis. For the AHRQ indicator, most hospitals were in the same, or adjacent, quintile from one year to the next over three years and the correlation of hospital ranks was moderate across time. Correlation of hospital ranks was weak for patient-reported complications over time.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Healthcare-associated infection

Healthcare-associated infections are among the most common complications affecting hospital patients, greatly increasing patient morbidity, mortality and readmissions within 12 months.[1]

The ACSQHC and MoH indicators produced different rates of infections in NSW hospitals, though the two indicators mostly produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

BHI developed an indicator based on indicators used internationally which is different to the ACSQHC and MoH indicators, as it measures post-operative sepsis, which is a subset of healthcare-associated infection. It also uses linked data to identify patients that were re-admitted to any NSW hospital with post-operative sepsis within 30 days of their surgery.

Patient-reported infection rates and those using the APDC (i.e. the ACSQHC, MoH and BHI indicators) were substantially different at the hospital level, with patient-reported rates typically higher even when the scopes of the two data sources were closely matched.

Post-operative sepsis rates (i.e. the BHI indicator) were variable over time. While this might be expected on an annual basis, most hospitals were in the same or adjacent quintile from one three-year period to the next, and the correlation of hospital ranks was moderate. For the ACSQHC and MoH indicators, infection rates were reasonably stable over time, while they were not as stable for patient-reported complications.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Medication complications

Medication-related harm can occur at many points over the course of medical care. It encompasses preventable errors in prescribing, administering and managing medications, as well as non-preventable complications such as adverse drug reactions to accurate doses of correctly-prescribed medication.

CIHI, ACSQHC and MoH indicators produced different rates of medication complication in hospitals. Despite the differences, the indicators mostly produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

Patient-reported medication complication rates and rates using the APDC (i.e. the CIHI, ACSQHC and MoH indicators) were substantially different at the hospital level. Patient-reported medication complications were typically higher, even when the scopes of the two data sources were closely matched.

Medication complication rates were stable over time for the ACSQHC indicator. Correlation of hospital ranks was strong for the ACSQHC indicator and weak for patient-reported complications.

Third and fourth degree perineal laceration during delivery

A perineal tear can occur during childbirth as the baby stretches the vagina and surrounding tissues.

The OECD, ACSQHC and BHI indicators produced similar results in most cases in terms of hospital rank correlation, performance quintile and outlier status.

Patient-reported perineal/vaginal tear rates and rates using the APDC (i.e. the OECD, ACSQHC and BHI indicators) were substantially different at the hospital level. Patient-reported perineal tear rates were typically lower than those calculated using the APDC, even when the scopes of the two data sources were closely matched.

Third and fourth degree perineal laceration rates were reasonably stable over time.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Detailed findings for each of the four hospital-acquired complications can be found in the Findings and discussion section of this report. The Conclusion section outlines recommendations to support future efforts to measure, monitor and report on these hospital-acquired complications in NSW.

Setting the scene

Background

History

A range of initiatives have contributed to the advancement of measurement of hospital-acquired complications, though internal and public reporting is in its infancy in Australia.

In 2012, the Australian Commission on Safety and Quality in Health Care (ACSQHC) and the Independent Hospital Pricing Authority (IHPA) established a Joint Working Party to consider potential funding approaches to further support safety and quality in public hospital services. They also considered how existing data could be used to drive improvements in healthcare safety and quality. As part of this work, a list of 16 high priority hospital-acquired complications was developed through a clinician-led process, and a national algorithm for measuring hospital-acquired complications (counts and rates) was established by ACSQHC.

In 2016, the Council of Australian Governments (COAG) directed IHPA to develop risk adjustments for hospital-acquired complications to adjust Commonwealth Government financial contributions to local hospital districts nationally, which commenced in 2018–19.

The NSW Ministry of Health (MoH) has included 15 of the hospital-acquired complications as key performance indicators (KPIs) in service agreements with local health districts (LHDs) as of 2019–20.

Based on advice from the BHI Patient Safety Measurement Advisory Group, established to support the development of this *Measurement Matters*, the report focuses on the following four indicators:

- stage three and four pressure injuries
- healthcare-associated infection
- medication complications
- third and fourth degree perineal laceration during delivery.

Project questions

The project set out to answer the following questions for each of the four hospital-acquired complications:

- How do the rates, calculated using the NSW Admitted Patient Data Collection (APDC)* and indicators specified by peak bodies, compare to one another?
- How do the rates, calculated using the APDC, compare with patient-reported complications?
- How do the rates, calculated using the APDC*, and patient-reported complications compare over time? Do they vary in ways considered reasonable, since a hospital's performance is expected to shift over time?
- How do the unadjusted and risk-adjusted rates, calculated using the APDC*†, compare with one another?

Stakeholder engagement

The BHI Patient Safety Measurement Advisory Group was formed with the Clinical Excellence Commission to provide clinical advice on priority topics and measures for surveillance in this report, while giving consideration to data availability and quality. The advisory group was asked to consider:

- which surveillance measures are most relevant and of highest priority for public reporting
- analyses, risk-adjustment, validation, level of reporting and presentation of measures
- approaches to engagement and dissemination of information for the development and routine provision of surveillance measures.

Clinical and other subject matter experts were also engaged to inform measurement and reporting approaches and review emerging findings.

* For third and fourth degree perineal laceration, the NSW Perinatal Data Collection was also used for the BHI indicator.

† Risk-adjustment was not completed for medication complications.

Data and methods

Data sources

This report draws on a range of data sources, including:

- ADPC Hospital Performance Dataset, MoH Secure Analytics for Population Health Research and Intelligence (SAPHaRI)
- NSW Perinatal Data Collection (PDC), MoH Secure Analytics for Population Health Research and Intelligence
- Adult Admitted Patient Survey (AAPS), BHI's NSW Patient Survey Program
- Maternity Care Survey, BHI's NSW Patient Survey Program.

Condition onset flag

For every diagnosis coded in the APDC, there is an accompanying field known as the condition onset flag, to indicate whether the condition was present at the beginning of, or arose during, the episode of care.

Historically, in the APDC, the completion of the condition onset flag field was low. In 2007–08, 1% of diagnoses of acute episodes were assigned a condition onset value. However, there has been a substantial increase in recent years and in 2016–17, 98.7% of diagnoses had a condition onset value. For public hospitals in peer groups A–C, it was either 100% or 99.99% in 2016–17.

Overall in 2016–17, 6.3% of diagnoses were coded as arising during the episode of acute care. Across public hospitals in peer groups A–C, it ranged from 0.03% to 13.37%.

The IHPA has developed three rules to identify hospitals with low quality condition onset flag reporting.[3] Those three rules include hospitals with:

- fewer than 100 episodes, where it is not possible to determine the quality of condition onset flag reporting
- fewer than 1% of episodes containing conditions arising in the hospital, to remove hospitals with unusually few episodes with a condition arising during the episode
- more than 10% of episodes with no reported condition onset flag.

BHI used these rules to identify hospitals that would be excluded each year in the calculation of hospital-acquired complications because of low quality condition onset flag reporting. The number of public hospitals in peer groups A–C excluded each year ranged from 28 out of 73 in 2012–13 to three out of 74 in 2016–17 (Table 1).

Table 1 Hospitals with low quality condition onset flag reporting, NSW public hospitals, 2012–13 to 2016–17

Year	Number of hospitals
2012–13	28 out of 73
2013–14	18 out of 73
2014–15	7 out of 73
2015–16	6 out of 74
2016–17	3 out of 74

Source: BHI analysis of Hospital Performance Dataset (Admitted Patient Data), NSW Ministry of Health Secure Analytics for Population Health Research and Intelligence, data accessed 16 August 2018.

Statistical methods

Rank correlation

Hospital rank correlation refers to the extent to which hospitals have a similar rank under different indicators. Rank correlation can take values between -1 and 1. A value of 1 means hospitals are ranked in exactly the same order under different indicators. A value of -1 means hospitals are ranked in exactly the opposite order under different indicators. Values close to 1 mean hospitals are ranked in a very similar order under different indicators.

Performance quintile

Hospital results were categorised into five groups, from the 20% of hospitals with the lowest score up to the 20% of hospitals with the highest score. A 90% Winsorised z-score methodology was used, which reduced the impact of extremely low or extremely high results.

Outlier status

Hospital outliers were identified based on whether the hospital result was significantly different from the NSW public hospital average at the 0.05 level. Hospitals were classified as having complications that were:

- lower than expected
- no different than expected
- higher than expected.

Criteria

Comparison across indicators

A summary of the specifications for each indicator is provided in Tables 5, 9, 13, and 16. Similarities and differences are noted for cohort inclusions, exclusions, units of analysis and other elements. In addition to the indicator-specific inclusion and exclusion criteria, hospital-level 'trimming' from IHPA was also applied.

BHI calculated rates for 2015–2017 according to the specifications of each indicator using the APDC.* Hospital rank correlation, performance quintile and outlier status were compared across the indicators and summarised for hospitals in peer groups A–C with at least one expected complication.† For each indicator, the specifications in place in 2018–19 were applied.

Comparison with patient-reported complications

BHI's patient surveys are developed with clinician input in order to ensure questions are clinically relevant.

AAPS 2017 asked patients: "Not including the reason you came to hospital, during your hospital stay, or soon afterwards, did you experience any of the following [nine] complications or problems?" Respondents could indicate if they had: an infection; a negative reaction to medication; a pressure wound or bed sore. The number of respondents was 21,026 with a response rate of 40%.

The Maternity Care Survey 2017 asked women: "During your hospital stay, or soon afterwards, did you experience any of the following [eight] complications or problems?" Women could indicate if they had a perineal/vaginal tear. The number of respondents was 4,787 with a response rate of 35%.

* For third and fourth degree perineal laceration, rates were calculated for 2014–2017, and the PDC was used for the BHI indicator.

† For third and fourth degree perineal laceration, results are summarised for maternity service level three to six hospitals with at least one expected complication.

Data and methods

Complications were identified in the APDC using the ACSQHC indicator diagnoses codes, and hospital-level 'trimming' from IHPA was applied. The other cohort inclusion and exclusion criteria used in the survey, for example patients aged 18 years and older, were also applied to the indicators using the APDC data. The survey's Technical Supplements provide further details and are available at:

bhi.nsw.gov.au/nsw_patient_survey_program/adult_admitted_patient_survey

bhi.nsw.gov.au/nsw_patient_survey_program/maternity_care_survey

Rates were calculated for 2017 using AAPS, the Maternity Care Survey and the APDC. Hospital rank correlation, performance quintile and outlier status were compared between the indicator and patient-reported complication and summarised for hospitals in peer groups A–C with at least one expected complication and at least 30 survey respondents.

Comparison over time

Rates were calculated for 2015–2017 for the Organisation for Economic Co-operation and Development (OECD), Canadian Institute for Health Information (CIHI), Agency for Healthcare Research and Quality (AHRQ), ACSQHC, MoH and BHI indicators. They were also calculated for the patient-reported complications.* Hospital rank correlation, performance quintile and outlier status were compared from one year to the next and summarised for hospitals in peer groups A–C with at least one expected complication and at least 30 survey respondents.

Comparison with risk-adjusted rates

Unadjusted rates are useful to support routine, local monitoring of performance and continuing improvement work at the local level.

Risk-adjusted rates are used to provide a fair comparison of hospital performance.

A statistical model was developed to calculate the expected number of complications at each hospital given their case mix. For each hospital, this number was compared with the actual number of complications to calculate a risk-standardised complication ratio (RSCR). An RSCR greater than one means there were more complications than expected. An RSCR less than one means there were fewer complications than expected. Risk-standardised complication rates were then calculated by multiplying the risk-adjusted ratios and the NSW crude (unadjusted) complication rates.

For the pressure injury and perineal laceration indicators, random intercept logistic regression models were used. These models adjusted for patient risk factors and accounted for clustering of patients in hospitals. Random intercept logistic regression, using hospital as the random intercept, accounts for correlation among patients within the same hospital.

* For the BHI post-operative sepsis indicator, rates were calculated for two three-year periods (January 2012 – December 2014 and January 2015 to December 2017) to produce more stable results. For third and fourth degree perineal laceration, rates were calculated for the years 2014 to 2017. The Maternity Care Survey question about experiencing a perineal/vaginal tear was only in 2017 so temporal patterns could not be investigated.

For the post-operative sepsis indicator, Fine and Gray competing risks regression models were used, adjusting for patient risk factors and taking into account the competing risk of death. The standard errors were adjusted for within hospital correlations.

The risk-adjustment models were developed using three years of data to produce more stable estimates.

Patient-level risk factors, which were considered non-modifiable by hospitals and were available in the data, were included in the development of the prediction models following literature review and consultation with clinical advisors.

A backward modelling approach was used to build the multivariable models. Variables significant at the 0.20 level in the univariate analyses were considered for inclusion in multivariable models. Only variables with a two-sided p-value of less than 0.05 in the multivariable models were retained in the final model and are presented in Tables 9 and 16. The stability of the coefficients in previous years was tested. The prediction ability of the models was also assessed using c-statistics in data from previous years.

The clinical relevance of the variables included in the final models and their direction of association with the outcomes were reviewed by clinicians.

Unadjusted and risk-adjusted rates were calculated for 2015–2017.[†] Hospital rank correlation, performance quintile and outlier status were compared between the unadjusted and risk-adjusted rates and summarised for hospitals in peer groups A–C with at least one expected complication.

Risk adjustment was not conducted for medication complications due to ongoing debate surrounding the appropriateness of the medication complication indicators.

[†] For third and fourth degree perineal laceration, rates were calculated for the years 2014 to 2016.

Findings and discussion

Stage three and four pressure injuries

Pressure injuries are a localised form of skin damage caused by pressure, shear or friction.

Healthcare-associated infection

Healthcare-associated infections are among the most common complications affecting hospital patients, greatly increasing patient morbidity, mortality and readmissions within 12 months.

Medication complications

Medication-related harm can occur at many points over the course of medical care. It encompasses preventable errors in prescribing, administering and managing medications, as well as non-preventable complications such as adverse drug reactions to accurate doses of correctly-prescribed medication.

Third and fourth degree perineal laceration during delivery

A perineal tear can occur during childbirth as the baby stretches the vagina and surrounding tissues.

Stage three and four pressure injuries

Pressure injuries are a localised form of skin damage caused by pressure, shear or friction.[2] They are a common form of harm that arises during the course of medical treatment, particularly in hospitals.[2, 4] A stage three pressure injury is characterised by full thickness tissue loss, and a stage four pressure injury defined as full thickness tissue loss with exposed bone, tendon or muscle. Most pressure injuries are preventable if appropriate measures are implemented. Stage three and four pressure injuries can be prevented by the timely diagnosis and treatment of stage one and two pressure wounds. The pain and discomfort caused by these injuries reduces the patient's quality of life. Patients also face additional medical treatment, extended hospital stays, additional use of medicines or medical services, and increased healthcare expenditure.[5, 6, 7, 8, 9]

BHI calculated and compared stage three and four hospital-acquired pressure injury rates between indicators using specifications developed by the Agency for Healthcare Research and Quality (AHRQ), Australian Commission on Safety and Quality in Health Care (ACSQHC) and NSW Ministry of Health (MoH). A summary of the specifications for each indicator is provided in Table 5. Using the ACSQHC indicator diagnoses codes, rates from the Admitted Patient Data Collection (APDC) were compared with patient-reported rates. The AHRQ, ACSQHC and MoH indicators and patient-reported pressure injuries were also compared over time.

The AHRQ indicator was used for risk adjustment.

Comparison across indicators

When pressure injury rates were compared using the AHRQ, ACSQHC and MoH indicators, it was found:

- Rank correlation – there was a very strong positive correlation in hospital rank across the three indicators within each year and over the 2015–2017 period (Table 2).
- Performance quintile – across all three indicators, 56 of the 78 hospitals (72%) were in the same quintile. The ACSQHC and MoH indicators allocated 61 hospitals (78%) to the same quintile.

Table 2 Hospital rank correlation between stage three and four pressure injury rates using different indicators, NSW public hospitals, 2015–2017

	AHRQ and ACSQHC	AHRQ and MoH	ACSQHC and MoH
2015			
Number of hospitals	68	67	70
Rank correlation	0.90996	0.98119	0.91511
2016			
Number of hospitals	69	69	73
Rank correlation	0.93995	0.97365	0.94508
2017			
Number of hospitals	72	72	75
Rank correlation	0.93956	0.96278	0.96851
2015–2017			
Number of hospitals	76	76	78
Rank correlation	0.85071	0.88684	0.94842

- Outlier status – the indicators mostly agreed about the classification of hospitals. All three indicators classified 66 hospitals (85%) in a similar way. All three indicators classified 11 (14%) as having higher than expected pressure injury rates and 22 (28%) were classified as having lower than expected pressure rates.
- The ACSQHC and MoH indicators classified 71 hospitals (91%) similarly. Of these, 12 (15%) were classified as having higher than expected pressure injury rates and 25 (32%) were classified as having lower than expected rates.

The AHRQ, ACSQHC and MoH indicators produced different rates of pressure injuries in NSW hospitals. The differences are mostly a result of the denominators used by state, national and international specifications for each indicator. Despite the differences, the indicators mostly produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

Comparison with patient-reported complications

When rates were compared using the APDC and patient-reported complications, the following was found:

- Rank correlation – patient-reported pressure injury rates were not correlated with rates using the APDC. There was only a marginally weak correlation in 2017 (Table 3).
- When the analyses were restricted to hospitals with more than 100 respondents, only one hospital was excluded (with 66 respondents). This exclusion did not change the correlation co-efficients to any meaningful degree. The correlations among patient-reported pressure injuries and the APDC were therefore robust to changes in the number of respondents between 30 and 100 patients.
- Performance quintile – the two data sources allocated 56 of the 76 hospitals (74%) to different quintiles.
- Outlier status – more than half of the hospitals (56%) had a different significance result between the two data sources. The difference is in part due to the fact that the patient-reported data is based on a sample, whereas the APDC is a census. This means there is greater power to detect statistically significant differences in the APDC.

To ensure comparability with the survey data, the ACSQHC specifications for pressure injuries were used for the APDC data and included all stages of pressure injury (stages one to four) for adults aged 18+. Patient-reported pressure injury rates and rates using the APDC were substantially different at the hospital level. Patient-reported rates were typically higher, even when the scopes of the two data sources were matched as closely as possible. The rates arising from the two sources were also poorly correlated, resulting in hospitals being allocated to different quintiles, and different hospitals being identified as having higher or lower than expected pressure injuries. Only one of 76 hospitals was identified as having higher than expected pressure injuries by both data sources.

Table 3 Hospital rank correlation between stage three and four pressure injury rates using the APDC and patient-reported data, NSW public hospitals, 2015–2017

Year(s)	Number of hospitals	Rank correlation	P-value
2015	69	0.075	0.539
2016	72	0.037	0.756
2017	73	0.228	0.052

Stage three and four pressure injuries

A significant proportion of pressure injuries are never documented.[10] In particular, minor pressure injuries tend to be underreported in administrative data[10], and are more likely to be reported by patients. Patient-reported pressure injuries also capture those injuries that occurred soon after the patient's hospital stay. Therefore, patient experience surveys can serve to capture hospital-acquired pressure injuries that would otherwise be missed.

Comparison over time

When rates were compared over time using the AHRQ, ACSQHC and MoH indicators, and patient-reported pressure injuries, the following was found:

- Rank correlation – for the AHRQ, ACSQHC and MoH indicators, there was a moderate correlation in hospital ranks among adjacent years, ranging from 0.44 to 0.54.
- For patient-reported pressure injuries, there was no correlation in hospital rank between 2015 and 2016 and a weak correlation between 2016 and 2017 (Table 4).
- Performance quintile – for the AHRQ indicator, 47 of the 78 hospitals (89%) were in the same or adjacent quintile from one year to the next over three years.
- Outlier status – for the AHRQ indicator, of the 33 hospitals that were significantly different in at least one year, 16 (48%) were significantly different in the subsequent year.

Pressure injury rates were variable over time. While this might be expected on an annual basis, for the AHRQ indicator, most hospitals were in the same or adjacent quintile from one year to the next over three years. The correlation of hospital ranks was moderate. Correlation of hospital ranks was weak for patient-reported complications.

Comparison with risk-adjusted rates

When unadjusted and risk-adjusted rates were compared with three years of data using the AHRQ indicator, the following was found:

- Rank correlation – there was strong positive correlation in hospital rank between unadjusted and risk-adjusted rates ($n=72$, $rs=0.91$, $p<0.0001$).
- Performance quintile – for both rates, 50 of the 72 hospitals (69%) were in the same quintile.
- Outlier status – for both rates, 59 hospitals (82%) had the same significance result. In the unadjusted analysis, 12 hospitals (17%) had higher than expected pressure injuries. Following risk-adjustment, two of these hospitals were no longer higher than expected. One hospital's status changed to higher than expected.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Table 4 Hospital rank correlation between stage three and four pressure injury rates over time, NSW public hospitals, 2015–2017

	AHRQ	ACSQHC	MoH	Patient-reported
2015 and 2016				
Number of hospitals	68	71	72	75
Rank correlation	0.443	0.540	0.423	0.181
P-value	0.0001	<0.0001	0.0002	0.1196
2016 and 2017				
Number of hospitals	67	72	73	76
Rank correlation	0.505	0.513	0.481	0.238
P-value	<0.0001	<0.0001	<0.0001	0.0381

Table 5 Hospital-acquired pressure injuries indicator, AHRQ, ACSQHC and MoH specifications

Agency	AHRQ[11]	ACSQHC[1]	MoH 2018–19*[12]
Measure	Pressure Ulcer Rate	Pressure Injury	Hospital Acquired Pressure Injuries (Rate)
Reported as	Rate per 100 discharges	Rate per 100 episodes	Rate per 1000 bed days
Numerator	Stage III or IV pressure ulcers or unstageable (secondary diagnosis), and a condition onset flag of 1	Stage III or IV pressure ulcers or unspecified decubitus and pressure area (secondary diagnosis), and a condition onset flag of 1	Stage III or IV pressure ulcers or unspecified decubitus and pressure area (secondary diagnosis), and a condition onset flag of 1
Denominator		Hospitalisation episodes	Bed days
Episode type	Acute	Acute	Acute and neonatal
Cohort inclusions	Surgical or medical patients aged 18 years and older	All patients	All patients
Cohort exclusions	Principal diagnosis for stage III or VI or unstageable pressure injury Length of stay (LOS) < 3 days All secondary diagnoses of pressure ulcer (III, IV, UN) where the ulcer was present on admission Burns >= 20% body surface Skin conditions > 20% body surface Non-surgical or non-medical episodes Episodes with missing data for sex, age, date or principal diagnosis Hospitals with a poor quality of condition onset flag reporting based on IHPA specifications	Same-day chemotherapy Same-day haemodialysis (also IHPA) Newborn (care type = 5) Hospital boarder (care type = 0) Organ procurement (care type = 9) Non-acute episodes Long-stay patients (LOS > 200) Episodes where the patient died Age > 95 Same-day radiotherapy Error or unclassifiable diagnosis-related group Hospitals with a poor quality of condition onset flag reporting based on IHPA specifications	Principal diagnosis of stage III, IV or unstageable pressure injury (numerator exclusion) Sub-acute admitted patients Same-day chemotherapy Same-day haemodialysis Hospital boarder (care type = 0) Organ procurement (care type = 9) Hospitals with a poor quality of condition onset flag reporting based on IHPA specifications
Unit of analysis	Episodes	Episodes	Episodes
Risk adjustment	Age, sex, history of pressure injury, surgery, length of stay, transfer from other facility, major diagnostic category and comorbidity		
Data source	Admitted patient data	Admitted patient data	Admitted patient data

* The NSW Ministry of Health specification has been changed for 2019–20 and is now reported as a rate per 10,000 episodes of care.

Healthcare-associated infection

Healthcare-associated infections are among the most common complications affecting hospital patients, greatly increasing patient morbidity, mortality and readmissions within 12 months. They may occur with or without an invasive procedure or device. Depending on the location of the infection, patients may experience a range of symptoms, including fevers, chills, pain, hypotension and dizziness, tachycardia, collapse, delirium, cough, shortness of breath, urinary frequency, diarrhoea, purulent discharges, wound breakdown and even death.[1]

BHI calculated and compared rates of healthcare-associated infection between indicators using specifications developed by ACSQHC and MoH. A post-operative sepsis indicator developed by BHI was also explored. A summary of the specifications for each indicator is provided in Table 9. Using the ACSQHC indicator diagnoses codes, rates from the APDC were compared with patient-reported rates. The ACSQHC, MoH and BHI indicators and patient-reported infections were also compared over time.

The BHI post-operative sepsis indicator was used for risk-adjustment.

Comparison across indicators

When healthcare-associated infection rates were compared using the ACSQHC and MoH indicators, and BHI's post-operative sepsis indicator was examined, it was found:

- Rank correlation – there was a very strong positive correlation in hospital rank between the ACSQHC and MoH indicators within each year and during the 2015–2017 period. The BHI post-operative sepsis indicator was also moderately correlated with the ACSQHC and MoH indicators over the 2015–2017 period (Table 6).
- Performance quintile – across the ACSQHC and MoH indicators, 60 of the 78 hospitals (77%) were in the same quintile. When the BHI indicator was included, 20 of the 51 hospitals (39%) were in the same quintile across the three indicators.

Table 6 Hospital rank correlation between healthcare-associated infection rates using different indicators, NSW public hospitals, 2015 to 2017

	ACSQHC and MoH	ACSQHC and BHI	MoH and BHI
2015			
Number of hospitals	72	40	40
Rank correlation	0.965	0.434	0.423
2016			
Number of hospitals	75	44	44
Rank correlation	0.966	0.625	0.519
2017			
Number of hospitals	76	45	45
Rank correlation	0.974	0.385	0.332
2015–2017			
Number of hospitals	78	51	51
Rank correlation	0.974	0.575	0.518

- Outlier status – the ACSQHC and MoH indicators mostly classified hospitals in similar ways. Both indicators similarly classified 67 hospitals (86%) during the 2015–2017 period – 14 (18%) were classified as having higher than expected infections and 49 (63%) were classified as having lower than expected infections. Across all three indicators, four hospitals (8%) were similarly classified as having higher than expected complications and three (6%) were classified as having lower than expected complications.

The ACSQHC and MoH indicators produced a different rate of infections in NSW hospitals. The difference is mostly due to the denominators used by state and national specifications for each indicator. Despite the differences, the indicators mostly produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

The BHI indicator is different to the ACSQHC and MoH indicators, as it measures post-operative sepsis, which is a subset of healthcare-associated infections. It also uses linked data to identify patients that were re-admitted to any hospital with post-operative sepsis within 30 days of their surgery. These findings suggest that selected conditions should be monitored, and consideration must be given to relevant follow-up intervals.

Comparison with patient-reported complications

When rates were compared using the APDC and patient-reported complications, it was found:

- Rank correlation – patient-reported infection rates were moderately correlated with rates using the APDC in 2017 (Table 7). No hospitals were excluded when the analyses were restricted to hospitals with more than 100 respondents.
- Performance quintile – the two data sources allocated 49 of the 73 hospitals (67%) to different quintiles.
- Outlier status – between the two data sources, 57 hospitals (78%) had a different significance result. The difference is partly due to the fact the patient-reported data is based on a sample, whereas the APDC is a census. This means there is greater power to detect statistically significant differences in the APDC.

To ensure comparability with the survey data, the ACSQHC diagnosis codes for hospital-acquired infections were used for the APDC data. Cohort inclusion and exclusion criteria used in the survey, for example patients aged 18+, were also applied to the hospital administrative data to ensure comparability with the survey results.

Patient-reported infection rates and rates using the APDC were substantially different at the hospital level. Patient-reported rates were typically higher, even when the scopes of the two data sources were matched as closely as possible. The rates arising from the two sources were also moderately correlated, resulting in hospitals being allocated to different quintiles, and different hospitals being identified as having higher or lower than expected infections. Only two hospitals (3%) were identified as having lower than expected infection rates by both data sources.

Table 7 Hospital rank correlation between healthcare-associated infection rates using the APDC and patient-reported data, NSW public hospitals, 2015–2017

Year(s)	Number of hospitals	Rank correlation	P-value
2015	69	0.343	0.004
2016	72	0.453	<0.0001
2017	73	0.442	<0.0001

Healthcare-associated infection

Patient-reported infections capture those that occurred during the hospital stay or soon after. Analyses showed that 33% of post-operative sepsis occurred after the surgical episode. Therefore, patient experience surveys can serve to capture hospital-acquired infections that would otherwise be missed.

Comparison over time

When rates were compared over time using the ACSQHC and MoH indicators, it was found:

- Rank correlation – for the ACSQHC and MoH indicators, there was a very strong correlation in hospital ranks among adjacent years, ranging from 0.82 to 0.89. The correlation was moderate for the BHI indicator. For patient-reported infections the correlation in hospital rank was weak between 2015 and 2016, and moderate between 2016 and 2017 (Table 8).
- Performance quintile – for the BHI indicator, 33 of the 41 hospitals (80%) were in the same or adjacent quintiles from one three-year period to the next.
- Outlier status – for the BHI indicator, of the hospitals that were significantly different in at least one three-year period, four (27%) were significantly different in the subsequent three-year period.

Post-operative sepsis rates were variable over time. While this might be expected on an annual basis, most hospitals were in the same or adjacent quintile from one three-year period to the next and the correlation of hospital ranks was moderate. For the ACSQHC and MoH indicators, infection rates were reasonably stable over time, while they were less stable for patient-reported complications.

Comparison with risk-adjusted rates

When rates were compared using the unadjusted and risk-adjusted BHI post-operative sepsis indicator with three years of data, it was found:

- Rank correlation – there was a strong positive correlation in hospital rank between unadjusted and risk-adjusted rates (n=48, rs=0.750, p<0.0001).
- Performance quintile – for both rates, 26 of the 48 hospitals (54%) were in the same quintile.
- Outlier status – for both rates, 38 hospitals (79%) had the same significance result. In the unadjusted analysis, seven hospitals (15%) had higher than expected post-operative sepsis. Following risk-adjustment, four out of seven hospitals were no longer higher than expected. One hospital's status changed to higher than expected.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Table 8 Hospital rank correlation between healthcare-associated infection and post-operative sepsis rates over time, NSW public hospitals, 2015–2017

Healthcare-associated infection	ACSQHC	MoH	Patient-reported	Post-operative sepsis
2015 and 2016				
Number of hospitals	72	72	69	40
Rank correlation	0.890	0.863	0.375	0.431
P-value	<0.0001	<0.0001	0.001	0.005
2016 and 2017				
Number of hospitals	73	73	70	44
Rank correlation	0.869	0.817	0.555	0.498
P-value	<0.0001	<0.0001	<0.0001	<0.001

Table 9 Healthcare-associated infection indicator, ACSQHC, MoH and BHI specifications

Agency	ACSQHC[1]	MoH 2018–19*[12]	BHI (built on OECD[13] and AHRQ[11] definitions)
Measure	Healthcare Associated Infections	Healthcare Associated Infections	Post-operative sepsis
Reported as	Rate per 100 episodes	Rate per 1000 bed days	Rate per 100 periods of care
Numerator	Urinary tract infection, surgical site infection, pneumonia, blood stream infection, central line and peripheral line associated blood stream infection, multi-resistant organism, infection associated with prosthetics/implantable devices or gastrointestinal infections (secondary diagnosis), and a condition onset flag of 1	Urinary tract infection, surgical site infection, pneumonia, blood stream infection, central line and peripheral line associated blood stream infection, multi-resistant organism, infection associated with prosthetics/implantable devices or gastrointestinal infections (secondary diagnosis), and a condition onset flag of 1	Secondary diagnosis of sepsis whose onset had occurred during the first index surgery hospitalisation, or primary diagnosis/secondary diagnosis present on admission of sepsis within 30 days following the index surgery hospitalisation, diagnosed in any NSW hospital (public or private, same or different hospital)
Denominator	Hospitalisation episodes	Bed days	Hospitalisation periods of care
Episode type	Acute	Acute and neonatal	Acute
Cohort inclusions	All patients	All patients	Elective surgical patients aged 18 and older
Cohort exclusions	Same-day chemotherapy – DRG V8: R63Z and admission date = separation date Same-day haemodialysis – DRG V8: L61Z and admission date = separation date Care type is 'Newborn – unqualified days only ' – Care type = 7.3 Care type is 'Hospital boarder' - Care type = 10 Care type is 'Organ procurement-posthumous' - Care type = 9. Private hospitals Extra exclusions based on IHPA[3] specifications: Non-acute episodes Patients with a length of stay greater than 200 days Patients over 95 years old Episodes where the patient died Hospitals with a poor quality of condition onset flag reporting in each year based on IHPA6 specifications	Sub-acute admitted patients Same-day chemotherapy – DRG V8: R63Z and admission date = separation date Same-day haemodialysis - DRG V8: L61Z and admission date = separation date Care type is 'Hospital boarder' – Care type = 0 Care type is 'Organ procurement-posthumous' – Care type = 9 Private hospitals Hospitals with a poor quality of condition onset flag reporting in each year based on IHPA[3] specifications	length of stay of less than three days Index surgeries with a diagnosis of sepsis that were assumed to have had the sepsis prior to the surgery With infection With immune-compromised state or cancer Pregnancy, childbirth, and puerperium Private hospitals Without at least 30 days of information until the end of the study period Hospitals with a poor quality of condition onset flag reporting in each year based on IHPA[3] specifications
Unit of analysis	Episodes	Episodes	Periods of care
Period of care			Two or more contiguous episodes with a separation and admission on the same day, or, episodes ending in a transfer with an admission on the next day
Risk adjustment			Comorbidity, ICU use and major diagnostic category
Data source	Admitted patient data	Admitted patient data	Linked admitted patient and mortality data

* The NSW Ministry of Health specification has been changed for 2019–20 and is now reported as a rate per 10,000 episodes of care.

Medication complications

Medication-related harm can occur at many points over the course of medical care. It encompasses preventable errors in prescribing, administering and managing medications, as well as non-preventable complications such as adverse drug reactions to accurate doses of correctly-prescribed medication.

Depending on the type of medication error, patients may experience a range of symptoms. These include drowsiness, confusion, myoclonic jerking, hallucinations, hypoxic brain injury, excessive bruising, catastrophic bleeding, circulatory collapse, shock, anxiety, dizziness, nausea, vomiting, seizures, coma and even death.[1]

BHI calculated and compared hospital-acquired medication complication rates between indicators using specifications developed by the Canadian Institute for Health Information (CIHI), ACSQHC and MoH. A summary of the specifications for each indicator is provided in Table 13. Using the ACSQHC indicator diagnoses codes, rates from the APDC were compared with patient-reported rates. The ACSQHC indicator and patient-reported medication complications were also compared over time.

Comparison across indicators

When medication complication rates were compared using the CIHI, ACSQHC and MoH indicators, it was found:

- Rank correlation – there was a very strong positive correlation in hospital rank across the three indicators within each year and over the 2015–2017 period (Table 10).
- Performance quintile – across all three indicators, 43 of the 78 hospitals (55%) were in the same quintile. The ACSQHC and MoH indicators allocated 69 hospitals (88%) to the same quintile.
- Outlier status – the indicators mostly classified hospitals in similar ways. All three indicators similarly classified 52 hospitals (67%) while 13 (17%) were classified by all three as having higher than expected medication complications and 37 (47%) were classified as having lower than expected medication complications.

Table 10 Hospital rank correlation between medication complication rates using different indicators, NSW public hospitals, 2015–2017

	ACSQHC and CIHI	MoH and CIHI	ACSQHC and MoH
2015			
Number of hospitals	72	72	72
Rank correlation	0.837	0.805	0.976
2016			
Number of hospitals	75	75	75
Rank correlation	0.817	0.785	0.975
2017			
Number of hospitals	76	76	76
Rank correlation	0.872	0.858	0.984
2015–2017			
Number of hospitals	78	78	78
Rank correlation	0.874	0.852	0.983

The ACSQHC and MoH indicators similarly classified 67 hospitals (86%) while 18 (23%) were classified as having higher than expected medication complications and 45 (58%) were classified as having lower than expected medication complications.

The CIHI, ACSQHC and MoH indicators produced a different rate of medication complications in NSW hospitals. The differences are mostly a result of the denominators used by state, national and international specifications for each indicator. Differences in administrative data mean that the international specifications assessed in this report cannot be used in Australia. Despite the differences, the indicators mostly produced similar results in terms of hospital rank correlation, performance quintile and outlier status.

Comparison with patient-reported complications

When rates were compared using the APDC and patient-reported complications, it was found:

- Rank correlation – patient-reported medication complication rates were not correlated with rates using the APDC (Table 11).
- When the analyses were restricted to hospitals with more than 100 respondents, no hospitals were excluded.
- Performance quintile – the two data sources allocated 52 of the 73 hospitals (71%) to different quintiles.
- Outlier status – between the two data sources, 51 hospitals (70%) had a different significance result. The difference is partly due to the fact the patient-reported data is based on a sample, whereas the APDC is a census. This means there is greater power to detect statistically significant differences in the APDC.

To ensure comparability with the survey data, the ACSQHC diagnosis codes for hospital-acquired medication complications were used for the APDC data and included patients aged 18+.

Patient-reported medication complication rates and those using the APDC were substantially different at the hospital level. Patient-reported medication complications were typically higher, even when the scopes of the two data sources were matched as closely as possible.

The rates arising from the two sources were also poorly correlated, resulting in hospitals being allocated to different quintiles, and different hospitals being identified as having higher or lower than expected medication complications. No hospitals were identified as having higher than expected medication complications by both data sources.

Table 11 Hospital rank correlation between medication complication rates using the APDC and patient-reported data, NSW public hospitals, 2015–2017

Year(s)	Number of hospitals	Rank correlation	P-value
2015	69	0.156	0.202
2016	72	0.230	0.052
2017	73	0.188	0.111

Medication complications

The under-reporting of adverse drug events in administrative data[14], combined with the limited clinical conditions included in the specifications, results in some medication complications being missed by the APDC.

Patient-reported medication complications also capture complications that occurred soon after the patient's hospital stay, which is important, given that medications are often prescribed upon discharge. Therefore, patient experience surveys can capture hospital-acquired medication complications that would otherwise be missed.

However, the survey asked patients if they experienced a "negative reaction to medication", which may also result in incorrect identification of medication complications. For example, normal side effects may be misconstrued as a negative reaction to medication if the patient has not been sufficiently informed about the side effects of a medication they have been prescribed.

Comparison over time

When rates were compared over time using the CIHI, ACSQHC and MoH indicators, and patient-reported medication complications, the following was found:

- Rank correlation – for the ACSQHC, MoH and CIHI indicators, there was a strong correlation in hospital ranks among adjacent years, ranging from 0.83 to 0.91. For patient-reported medication complications, there was no correlation in hospital rank between 2015 and 2016, or between 2016 and 2017 (Table 12).
- Performance quintile – for the ACSQHC indicator, 63 of the 78 hospitals (81%) were in the same or adjacent quintile from one year to the next over three years.
- Outlier status – for the ACSQHC indicator, of the 68 hospitals that were significantly different in at least one year, 48 (71%) were significantly different in the subsequent year.

Medication complication rates were stable over time for the ACSQHC indicator. Correlation of hospital ranks was strong for the ACSQHC indicator and weak for patient-reported complications.

Comparison with risk-adjusted rates

Risk-adjustment was not conducted for this indicator due to ongoing debate surrounding the appropriateness of the medication complication indicators.

Table 12 Hospital rank correlation between medication complication rates over time, NSW public hospitals, 2015–2017

	CIHI	ACSQHC	MoH	Patient-reported
2015 and 2016				
Number of hospitals	72	72	72	75
Rank correlation	0.906	0.853	0.831	0.136
P-value	<0.0001	<0.0001	<0.0001	0.247
2016 and 2017				
Number of hospitals	73	73	73	76
Rank correlation	0.885	0.885	0.853	0.219
P-value	<0.0001	<0.0001	<0.0001	0.058

Table 13 Hospital-acquired medication complications indicator, CIHI, ACSQHC and MoH specifications

Agency	CIHI[15]	ACSQHC[1]	MoH 2018–19*[12]
Measure	Anemia – Haemorrhage; Hypoglycaemia	Medication Complications	Hospital Acquired Medication Complications
Reported as	Rate per 100 episodes	Rate per 100 episodes	Rate per 1000 bed days
Numerator	Anemia – haemorrhage (with external cause codes) or hypoglycaemia (secondary diagnosis), and a condition onset flag of 1	Drug related respiratory complications/ depression (with external cause codes), haemorrhagic disorder due to circulating anticoagulants, or hypoglycaemia (secondary diagnosis), and a condition onset flag of 1	Drug related respiratory complications/ depression (with external cause codes), haemorrhagic disorder due to circulating anticoagulants, or hypoglycaemia (secondary diagnosis), and a condition onset flag of 1
Denominator	Hospitalisation episodes	Hospitalisation episodes	Bed days
Episode type	Acute	Acute	Acute and neonatal
Cohort inclusions	All patients	All patients	All patients
Cohort exclusions	Stillbirths and cadaveric donors Episodes with unknown age Episodes with sex not recorded as male or female Episodes with selected mental health diagnoses Episodes with invalid admission or discharge dates Private hospitals	Same-day chemotherapy Same-day haemodialysis (also IHPA) Newborn (care type = 5) Hospital boarder (care type = 0) Organ procurement (care type = 9) Non-acute episodes Long-stay patients (LOS > 200) Episodes where the patient died Age > 95 Same-day radiotherapy Error or unclassifiable diagnosis-related group Hospitals with a poor quality of condition onset flag reporting based on IHPA specifications Private hospitals	Sub-acute admitted patients Same-day chemotherapy Same-day haemodialysis Hospital boarder (care type = 0) Organ procurement (care type = 9) Hospitals with a poor quality of condition onset flag reporting based on IHPA specifications Private hospitals
Unit of analysis	Episodes	Episodes	Episodes
Data source	Admitted patient data	Admitted patient data	Admitted patient data

* The NSW Ministry of Health specification has been changed for 2019–20 and is now reported as a rate per 10,000 episodes of care.

Third and fourth degree perineal laceration during delivery

A perineal tear can occur during childbirth as the baby stretches the vagina and surrounding tissues. A first degree tear is a small, skin-deep tear of the perineum. A second degree tear affects the perineal muscle. A severe perineal tear occurs when the tear extends to include the anal sphincter (third degree) or also the lining of the anus or rectum (fourth degree).[16] Severe perineal tears can have serious consequences such as pain, urinary and faecal incontinence, depression and social isolation.[17] While not all severe tears are preventable, there are some clinical practices that may reduce the risk and severity.[18]

BHI calculated and compared rates of third and fourth degree perineal laceration during birth between indicators using specifications developed by the Organisation for Economic Cooperation and Development (OECD), ACSQHC, MoH and BHI.

A summary of the specifications for each indicator is provided in Table 16. Using diagnoses codes for all tears (first to fourth degree and unspecified), rates from the APDC were compared with patient-reported rates. The OECD, ACSQHC, MoH and BHI indicators were also compared over time.

The BHI indicator was used for risk-adjustment.

Comparison across indicators

When third and fourth degree perineal laceration rates were compared using the OECD, ACSQHC, MoH and BHI indicators, it was found:

- Rank correlation – there was a very strong positive correlation in hospital rank across the OECD, ACSQHC and BHI indicators within each year. The MoH indicator was not as strongly correlated with each indicator (Table 14).
- Performance quintile – across all four indicators in 2016, 30 of the 59 hospitals (51%) were in the same quintile. The OECD, ACSQHC and BHI indicators allocated 46 hospitals (78%) to the same quintile.
- Outlier status – the OECD, ACSQHC and BHI indicators mostly classified hospitals in similar ways. The three indicators classified 52 hospitals (88%) in a similar way. Across all four indicators, 39 hospitals (66%) were similarly classified.

The OECD, ACSQHC and BHI indicators produced similar results in most cases in terms of hospital rank correlation, performance quintile and outlier status. Results produced by the MoH indicator were not as similar, mainly because it is expressed as a rate per 1,000 bed days and includes all acute and neonatal episodes. The OECD, ACSQHC and BHI indicators report a rate per 100 vaginal births.

Table 14 Hospital rank correlation between third and fourth degree perineal laceration rates using different indicators, NSW public hospitals, 2013–2017

Year(s)	Number of hospitals	OECD and ACSQHC	OECD and MoH	OECD and BHI	ACSQHC and MoH	ACSQHC and BHI	MoH and BHI
2014	60	0.989	0.757	0.982	0.773	0.991	0.773
2015	60	0.970	0.743	0.961	0.797	0.994	0.776
2016	59	0.964	0.833	0.978	0.857	0.986	0.847
2017	59	0.972	0.851	NA	0.875	NA	NA

Comparison with patient-reported complications

When self-reported perineal laceration rates were compared to first, second, third and fourth degree perineal laceration rates using the APDC, the following was found:

- Rank correlation – self-reported perineal/vaginal tear rates (any degree) were not correlated with rates using the APDC (any degree) in 2017 (n=46, rs=0.07, p=0.65). When the analyses were restricted to hospitals with a higher number of survey respondents, there was still no correlation.
- Performance quintile – based on rates derived from the two data sources, 39 of the 46 hospitals (76%) were allocated to different quintiles.
- Outlier status – between the two data sources, 20 hospitals (43%) had a different significance result. The difference is partly due to the fact the self-reported data is based on a sample, whereas the APDC is a census. This means there is greater power to detect statistically significant differences in the APDC.

To ensure comparability with the survey data, the ACSQHC diagnosis codes for perineal tears were used for the APDC data and included all tears (first to fourth degree and unspecified), women aged 18+ and vaginal births only.

Self-reported perineal/vaginal tear rates and those using the APDC were substantially different at the hospital level. Self-reported perineal tears were typically lower than the rates (any degree) calculated using the APDC, even when the scopes of the two data sources were matched as closely as possible.

The rates arising from the two sources were also not correlated, resulting in hospitals being allocated to different quintiles, and different hospitals being identified as having higher or lower than expected perineal tears. Only one of the 46 hospitals was identified as having lower than expected perineal tears by both data sources.

Clinical definitions of complications may not correspond with women's self-reported experiences, leading to different results using the APDC and survey data.

It is important to note the large difference between self-reported perineal/vaginal tear rates and rates using the APDC. This difference suggests that development of definitions of maternity complications should include both clinicians and mothers. It also suggest that work can be done to assist mothers in understanding what is a complication and what may be normal consequences of labour and birth.

Comparison over time

When rates were compared using the OECD, ACSQHC, MoH and BHI indicators, the following was found:

- Rank correlation – there was moderate and strong correlation in hospital ranks among adjacent years, ranging from 0.57 to 0.78 (Table 15).
- Performance quintile – for the BHI indicator, most hospitals (61%) were in the same or adjacent quintile from one year to the next over four years.
- Outlier status – for the BHI indicator, of the hospitals that were significantly different in at least one year, 37% were significantly different in the subsequent year.

Third and fourth degree perineal laceration rates were reasonably stable over time.

Third and fourth degree perineal laceration during delivery

Comparison with risk-adjusted rates

When unadjusted and risk-adjusted BHI indicator rates were compared using three years of data, it was found:

- Rank correlation – there was a very strong positive correlation in hospital ranks between unadjusted and risk-adjusted rates for both vaginal births with instrument (n=57, rs=0.97, p=<0.0001) and without instrument (n=61, rs=0.89, p=<0.0001).
- Performance quintile – for vaginal births with instrument, 42 of the 57 hospitals (74%) were in the same quintile for both rates. For vaginal births without instrument, 42 of the 61 hospitals (69%) were in the same quintile for both rates.
- Outlier status – for vaginal births with instrument, 50 of the 57 hospitals (88%) had the same significance result for both rates. In the unadjusted analysis, eight hospitals (14%) had higher than expected perineal tears. Following risk-adjustment, the status of three hospitals changed to higher than expected.

  For vaginal births without instrument, 44 of the 61 hospitals (72%) had the same significance result for both rates. In the unadjusted analysis, 11 hospitals had higher than expected perineal tears. Following risk-adjustment, three of these hospitals no longer had higher than expected perineal tears, and the status of five hospitals changed to higher than expected.

The majority of hospitals had the same quintile and outlier status for unadjusted and risk-adjusted rates but risk-adjustment made a difference for some hospitals.

Table 15 Hospital rank correlation between third and fourth degree perineal laceration rates over time, NSW public hospitals, 2013–2017

Year(s)	Number of hospitals	OECD	ACSQHC	MoH	BHI
2014 and 2015	60	0.650	0.613	0.706	0.570
2015 and 2016	59	0.607	0.577	0.641	0.613
2016 and 2017	59	0.620	0.683	0.776	NA

Table 16 Third and fourth degree perineal laceration indicator, OECD, ACSQHC, MoH, and BHI specifications

Agency	OECD[13]	ACSQHC[1]	MoH 2018–19*[12]	BHI (in consultation with the Kolling Institute)
Measure	Obstetric trauma during vaginal delivery with and without instrument for all vaginal births	Third and fourth degree perineal laceration during delivery for all vaginal births	Third and fourth degree perineal lacerations	Third and fourth degree perineal laceration during vaginal delivery with and without instrument for all singleton live vaginal births
Reported as	Rate per 100 episodes	Rate per 100 episodes	Rate per 1000 bed days	Rate per 100 episodes
Numerator	Third and fourth degree perineal laceration (any diagnosis) or suture of bladder/urethra laceration, rectum/sphincter laceration, or third or fourth degree perineum tear (any procedure)	Third and fourth degree perineal laceration (secondary diagnosis)	Third and fourth degree perineal laceration (secondary diagnosis) during vaginal delivery and source of referral is not another hospital Excluding episodes where code for third and fourth degree perineal laceration recorded as a principal diagnosis	Third and fourth degree perineal laceration (any diagnosis) or suture of third or fourth degree perineum tear (any procedure)
Denominator	Vaginal delivery episodes	Vaginal birth episodes	Bed days	Singleton live vaginal births
Episode type	Acute or neonatal	Acute	Acute or neonatal	
Cohort inclusions	Patients aged 15 and over	All patients	All patients	Patients aged 15 and over
Cohort exclusions	Private hospitals	Admission mode is 'Admitted patient transferred from another hospital' Care type is 'Newborn unqualified days only', 'Hospital boarder', or 'Organ procurement-posthumous' Private hospitals	Care type is 'Sub-acute', 'Hospital boarder', or 'Organ procurement-posthumous' Same-day chemotherapy Same-day haemodialysis Private hospitals	Births by independent midwife (so that only hospitals are compared) Births that occur before the mother arrives at hospital Births where the mother was transferred from another hospital PDC birth record with no matching APDC hospital record Private hospitals
Unit of analysis	Episodes	Episodes	Episodes	Births
Period of care				Two or more contiguous episodes with a separation and admission on the same day, or, episodes ending in a transfer with an admission on the next day
Risk adjustment				Age, parity, Asian ethnicity, birth weight and previous history of third or fourth degree tear (without instrument)†
Data source	Admitted patient data	Admitted patient data	Admitted patient data	Linked admitted patient and perinatal data

* The NSW Ministry of Health specification has been changed for 2019–20 and is now reported as a rate per 10,000 episodes of care.
† For third and fourth degree perineal laceration with instrument, history of tear was not a risk factor.

Conclusion

Recommendations

BHI provides the community, healthcare professionals and policy makers with information that enhances transparency of the performance of the healthcare system in NSW, in order to inform actions to improve healthcare and strengthen accountability. To support this work and reporting by other NSW Health entities, one of BHI's functions is to "advise the NSW Ministry of Health on the quality of existing data sets and the development of enhanced information analysis and reporting to support reporting to clinicians, the community and Parliament".

The findings in this report support the following conclusions and recommendations in relation to internal reporting (within the health system), public reporting and improvements in the quality of existing datasets to better support the production and use of information on hospital-acquired complications.

Internal reporting

In relation to stage three and four pressure injuries, healthcare-associated infection and third and fourth degree perineal laceration during delivery, the hospital performance outcome was similar when using both state and national definitions.

1. BHI welcomes the NSW Ministry of Health's decision to adopt a rate per episodes of care for its 2019–20 key performance indicators, which is more aligned with the indicator definition used nationally. NSW should continue to support the Australian Commission on Safety and Quality in Health Care (ACSQHC) in further refining the medication complications indicator so that appropriate conditions and consequences are captured in the specifications. This is important as, due to differences in the content of administrative data, the international specifications assessed in this report cannot be used in Australia.
2. Risk-adjusted post-operative sepsis within 30 days of surgery is an indicator that supports fairer comparison between hospitals and is a candidate for internal reporting, and potentially public reporting. However, this work should be supported by an assessment of hospital-level concurrent validity using new surgical outcomes data now available in NSW. This recommendation applies to both internal and public reporting.

Public reporting

3. Estimates of variation in the prevalence of stage three and four pressure injuries, healthcare-associated infection, and third and fourth degree perineal laceration during delivery are consistent across the different approaches to measurement. This suggests these measures can be prioritised for public reporting following clinical engagement.

   These measures are consistent with some of the priorities for public reporting recently identified by consumers and clinicians.[1] For public reporting of stage three and four pressure injuries, BHI recommends further consideration of risk-adjustment. This work should include further clinical engagement to determine the preventability of stage three and four pressure injuries, and whether risk-adjustment should be conducted at all.

   BHI also recommends further work to analyse concurrent validity of administrative data against patient-reported complications.

Recommendations

4. Rates of third and fourth degree perineal laceration during delivery are publicly reported in the NSW Health Annual Report. BHI recommends that this information is produced in a way that is accessible to all consumers. BHI would also recommend the use of risk-adjusted rates to support fairer comparisons between hospitals. The indicator definition should include vaginal births only and be separately reported for vaginal births with instrument and without instrument, which is in accordance with internal reporting practices. This work should be informed by completion of analyses regarding concurrent validity of administrative data against patient-reported complications.

Quality of existing datasets

5. In response to a policy priority to better distinguish between conditions acquired before or during admission, the completeness of the condition-onset flag across public hospitals now supports reporting on complications. To further support measurement, monitoring and reporting on patient safety, NSW would now benefit from work to understand concordance between patient self-reported and clinical information on complications.

   More specifically, the Admitted Patient Data Collection (APDC) and Adult Admitted Patient Survey (AAPS) data should be linked to better understand the differences between clinician-recorded and patient-reported complications. This work is important to determine the concurrent validity of administrative data against patient-reported complications.

   The APDC and Maternity Care Survey data should also be linked for the same reasons.

   Consideration should be given to linking the APDC with NSW's Electronic Medication Management to assess the risk factors associated with medication complications such as polypharmacy.

6. To further support measurement, monitoring and reporting on patient safety, NSW would benefit from routine analyses of linked hospital, emergency department, pharmaceutical and patient self-reported data to follow patient journeys across time. This would support efforts to monitor and report on hospital-acquired complications that occur after discharge. This type of information would also help improved patient outcomes.

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BHI Patient Safety Measurement Advisory Group

Lynne Bickerstaff	Central Coast Local Health District
Robyn Clay-Williams	Australian Institute of Health Innovation
Joanne Edwards	(formerly) Western Sydney Local Health District
Catherine Katz	Australian Commission on Safety and Quality in Health Care
Sean Kelly	Agency for Clinical Innovation
Carrie Marr (Co-Chair)	Clinical Excellence Commission
Dr Katherine Moore	Sydney Local Health District
Nhi Nguyen	Agency for Clinical Innovation
Melissa O'Brien	Hunter New England Local Health District

Clinical Advisors

Kirstin Berry	Hunter New England Local Health District
Rachel Brooks	Sydney Local Health District
Dr Deborah Browne	Clinical Excellence Commission
Professor Nicholas Buckley	University of Sydney
Maree Connolly	Clinical Excellence Commission
Kathy Dempsey	Clinical Excellence Commission
Malcolm Green	Clinical Excellence Commission
Dr Harvey Lander	Clinical Excellence Commission
Nina Muscillo	Clinical Excellence Commission
Dr Jay Ramanathan	Western Sydney University School of Medicine and Liverpool Hospital
Professor Ramon Shaban	University of Sydney and Western Sydney Local Health District
Dr Poppy Sindhusake	Clinical Excellence Commission

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BHI manages the NSW Patient Survey Program, gathering information from patients about their experiences and outcomes of care in public hospitals and other healthcare facilities.

BHI publishes a range of reports and information products, including interactive tools, that provide objective, accurate and meaningful information about how the health system is performing.

BHI's work relies on the efforts of a wide range of healthcare, data and policy experts. All of our assessment efforts leverage the work of hospital coders, analysts, technicians and healthcare providers who gather, codify and supply data. Our public reporting of performance information is enabled and enhanced by the infrastructure, expertise and stewardship provided by colleagues from NSW Health and its pillar organisations.

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