bureau of health information

The Insights Series

Exploring clinical variation in mortality and readmission

An overview

July 2012 – June 2015

BUREAU OF HEALTH INFORMATION

Level 11, 67 Albert Avenue
Chatswood NSW 2067
Australia
Telephone: +61 2 9464 4444
Email: BHI-enq@health.nsw.gov.au
bhi.nsw.gov.au

State Health Publication Number: (BHI) 170149
ISSN: 1839-1680 (print); 2204-5511 (online)

Suggested citation:
Bureau of Health Information. *The Insights Series – Exploring clinical variation in mortality and readmission, An overview, July 2012 – June 2015.* Sydney (NSW); BHI; 2017.

Please note there is the potential for minor revisions of data in this report.
Please check the online version at **bhi.nsw.gov.au** for any amendments.

Published April 2017

Table of contents

Foreword

Over the past three years, the Bureau of Health Information (BHI), in collaboration with other pillars of NSW Health, has been building capacity in the measurement and reporting of clinical variation. Our suite of metrics includes measures of mortality and readmission for people admitted to hospital for, to date, nine clinical conditions. These conditions span acute and chronic disease, medical and surgical specialties, and emergency and ongoing healthcare, and are therefore relevant measures to assess the care provided across New South Wales (NSW) hospitals.

This report is part of a suite of publications that explores clinical variation in NSW public hospitals – it summarises findings from two volumes of *The Insights Series* – one focused on mortality and the other on readmission. Both volumes are based on an internationally-validated method of reporting unwarranted clinical variation – one which develops risk-standardised ratios. These ratios allow fair assessment of hospital performance, taking into account differences in patient case mix.

The reports focus on patients admitted to NSW public hospitals during the period July 2012 – June 2015, and update previously released information, spanning back 15 years.

This temporal perspective allows us to highlight changes in performance. For mortality in particular, there has been significant improvement across all conditions at the NSW level, and markedly so in the latest time period for ischaemic stroke. More localised improvement has also been seen. Many hospitals that flagged as higher than expected in terms of mortality or readmission have actively sought to improve care in the time since the first public reports were released in 2013 for mortality, and 2015 for readmission.

Much of the improvement has occurred in the context of coordinated and collaborative efforts between pillar organisations, local health districts, hospitals and clinical groups. These concerted efforts highlight that data are essential, but not sufficient to achieve change. BHI reports provide detailed information – supplementing outcome measures with salient details about characteristics of patients, timing of patients' deaths within a 30-day period, the relationship between length of stay and readmission, and timing of and reasons for readmission.

The reports have direct relevance to clinical teams that treat the conditions featured. However, the results also have wider implications for hospital performance and can highlight more pervasive quality and safety issues that affect all patients – regardless of their principal diagnosis – and, if acted on, can improve care for all patients.

The benefits that accrue from performance reporting are considerable. The combined efforts of those of us dedicated to measuring, reporting, interpreting, guiding and acting upon healthcare performance information, have been met with considerable improvements in recent years in NSW. In real terms, this means better experiences of care and outcomes for patients, and better value for the people of NSW.

Dr Jean-Frédéric Lévesque
Chief Executive, Bureau of Health Information

About this report

Measures of mortality and unplanned readmission to hospital provide important insight into patient outcomes and the effectiveness of healthcare. When appropriately risk adjusted, they can point to unwarranted clinical variation. This overview is based on risk-standardised measures of mortality and readmission that assess outcomes for patients who were hospitalised during the period July 2012 – June 2015.

Background

In 2013, BHI published *30-day mortality following hospitalisation, five clinical conditions, NSW, July 2009 – June 2012*. That report represented an important watershed. For the first time, information about the performance of hospitals in terms of patient deaths following admission for acute myocardial infarction, ischaemic stroke, haemorrhagic stroke, pneumonia, and hip fracture surgery was made publicly available.

Subsequent to the mortality report, BHI released an edition of its *Insights Series* on readmission for the period July 2009 – June 2012 using a similar method. This focused on the same suite of conditions plus congestive (chronic) heart failure (CHF) and two elective surgical procedures – total hip replacement and total knee replacement. In 2016, mortality information for the July 2009 – June 2012 period was released for CHF and chronic obstructive pulmonary disease (COPD).

Exploring clinical variation in mortality and readmission provides an overview and synthesis of results for the subsequent three-year period, July 2012 – June 2015. It includes:

- A brief outline of the nine conditions covered in the analyses
- An overview of the data sources and methods used
- Key findings from two volumes – one focused on mortality and the other on readmission
- An integrated synthesis of findings from both volumes.

Altogether, risk-standardised results are reported for 79 NSW public hospitals. Those hospitals vary in size and in the types and complexity of clinical services they provide. Not all hospitals have results for all conditions. Some of the results are described in terms of a hospital's 'peer group'. These peer groups are based on a classification system that distinguishes between larger principal referral, major and district hospitals (peer groups A, B and C, respectively).

Why measure mortality and readmission?

Measures that assess how healthcare affects patient outcomes make a crucial contribution to performance evaluation. They provide accountability; help target and guide improvement efforts; and inform research and knowledge generation.

Using mortality and readmission to assess performance is not straightforward however. While variation in the types of care delivered to patients can influence outcomes, deaths and readmissions are not always avoidable.

Readmissions are particularly multi-factorial and can reflect performance across different healthcare settings and elements of care. Higher rates may be a result of issues ranging from suboptimal treatment, adverse events and complications of hospital care, and inadequate discharge planning, to problems with coordination and integration of care across hospital, primary care and community settings.

The *Exploring clinical variation* suite of reports includes: two volumes that describe variation in patient outcome measures across NSW public hospitals; tailored hospital profiles that provide detailed information about patient cohorts and outcomes; and method-based reports that describe the analytic approach and the sensitivity analyses that informed the development and validation of the measures.

Exploring clinical variation in mortality

A volume focused on mortality in the 30 days following hospitalisation. It reports hospital-level performance using risk-standardised mortality ratios (RSMRs) for seven conditions and features: funnel plots to display hospital results, descriptions of patient cohorts, distribution of higher and lower than expected performance across hospital peer groups, historical performance, and details about the effect of statistical modelling on hospital results.

Exploring clinical variation in readmission

A volume focused on readmission (or more precisely, on return to acute care) following discharge from an acute hospitalisation. It reports hospital-level performance using risk-standardised readmission ratios (RSRRs) for eight conditions and features: funnel plots to display hospital results, descriptions of patient cohorts, information about when, where and why readmissions occurred, distribution of higher and lower than expected performance across hospital peer groups, historical performance and details about the effect of statistical modelling on hospital results.

Hospital profiles

Individual hospital profiles for 79 public hospitals outline key characteristics of patients admitted for the nine conditions of interest. The profiles feature demographic details of patients, hospital case mix and how it differs from the NSW patient population, time series results, the effect of statistical modelling on results, and the distribution of higher than expected and lower than expected results across similar peer group hospitals.

Spotlight on Measurement

Two methods-based technical publications describe the development and validation processes that underpin the RSMR and RSRR measures. They feature cohort and outcome definitions, inclusions and exclusions, risk adjustment models, attribution protocols and sensitivity analyses that explore issues such as variation in palliative care coding.

All reports and profiles are available at **bhi.nsw.gov.au**

Mortality and readmission – Nine conditions

The conditions included in the two volumes of *Exploring clinical variation* range in terms of acuity, span chronic and acute care, and encompass different surgical and medical specialties.

Altogether the conditions account for about 10% of acute hospitalisations in NSW*; about 30% of all in-hospital deaths; and they are known to have relatively high readmission rates.

Acute myocardial infarction (AMI)

- Occurs when blood supply to part of the heart is interrupted
- In July 2012 – June 2015, 30,488 patients were hospitalised for AMI
- 65% of hospitalised patients were male
- Average patient age was 70 years (39% were aged 75+ years)
- 2,108 patients died within 30 days of hospitalisation (7 deaths per 100 patients)
- 6% of male patients died; 9% of female patients died
- There were 28,105 discharges from acute care
- There were 4,534 (16%) patient returns to acute care within 30 days of discharge.

Ischaemic stroke

- Occurs when a blood vessel is blocked, depriving the brain of oxygen
- In July 2012 – June 2015, 15,475 patients were hospitalised for ischaemic stroke
- 55% of hospitalised patients were male
- Average patient age was 74 years (55% were aged 75+ years)
- 1,861 patients died within 30 days of hospitalisation (12 deaths per 100 patients)
- 9% of male patients died; 15% of female patients died
- There were 14,471 discharges from acute care
- There were 1,539 (11%) patient returns to acute care within 30 days of discharge.

Haemorrhagic stroke

- Occurs when a blood vessel in the brain develops a leak or bursts
- In July 2012 – June 2015, 5,659 patients were hospitalised for haemorrhagic stroke
- 56% of hospitalised patients were male
- Average patient age was 74 years (58% were aged 75+ years)
- 1,855 patients died within 30 days of hospitalisation (33 deaths per 100 patients)
- 29% of male patients died; 37% of female patients died
- Haemorrhagic stroke was not included in the return to acute care analyses.

Congestive (chronic) heart failure (CHF)

- Occurs when the heart is unable to pump adequately
- In July 2012 – June 2015, 27,484 patients were hospitalised for CHF
- 51% of hospitalised patients were male
- Average patient age was 80 years (73% were aged 75+ years)
- 3,793 patients died within 30 days of hospitalisation (14 deaths per 100 patients)
- 14% of male patients died; 13% of female patients died
- There were 33,450 discharges from acute care
- There were 7,602 (23%) patient returns to acute care within 30 days of discharge.

* Of acute emergency hospitalisations for persons aged 15+ years.

Pneumonia

- Occurs when one or both lungs are inflamed, usually due to infection
- In July 2012 – June 2015, 47,133 patients were hospitalised for pneumonia
- 52% of hospitalised patients were male
- Average patient age was 71 years (50% were aged 75+ years)
- 5,037 patients died within 30 days of hospitalisation (11 deaths per 100 patients)
- 11% of male patients died; 10% of female patients died
- There were 46,422 discharges from acute care
- There were 6,543 (14%) patient returns to acute care within 30 days of discharge.

Chronic obstructive pulmonary disease (COPD)

- Occurs when the lungs are unable to provide adequate oxygenation
- In July 2012 – June 2015, 30,525 patients were hospitalised for COPD
- 50% of hospitalised patients were male
- Average patient age was 74 years (51% were aged 75+ years)
- 3,160 patients died within 30 days of hospitalisation (10 deaths per 100 patients)
- 11% of male patients died; 9% of female patients died
- There were 47,359 discharges from acute care
- There were 10,293 (22%) patient returns to acute care within 30 days of discharge.

Hip fracture surgery

- A fracture in the upper quarter of the thigh bone (femur), treated with surgery
- In July 2012 – June 2015, 16,193 patients were hospitalised for hip fracture and had surgery
- 28% of those patients were male
- Average patient age was 83 years (82% were aged 75+ years)
- 1,093 patients died within 30 days of hospitalisation (7 deaths per 100 patients)
- 9% of male patients died; 6% of female patients died
- There were 14,581 discharges from acute care
- There were 1,485 (10%) patient returns to acute care within 30 days of discharge.

Total hip replacement

- Elective surgery to remove a damaged hip joint and replace it with an artificial joint
- Not included in the 30-day mortality analyses
- In July 2012 – June 2015, there were 8,312 patient discharges from acute care
- 48% of discharged patients were male
- There were 764 (9%) patient returns to acute care within 60 days of discharge.

Total knee replacement

- Elective surgery to remove a damaged knee joint and replace it with an artificial joint
- Not included in the 30-day mortality analyses
- In July 2012 – June 2015, there 14,961 patient discharges from acute care
- 39% of discharged patients were male
- There were 1,727 (12%) patient returns to acute care within 60 days of discharge.

Data and methods

Data sources

Data for the mortality and readmission analyses were drawn from the NSW Admitted Patient Data Collection and NSW Registry of Births, Deaths and Marriages, and were probabilistically linked by the Centre for Health Record Linkage. Data access was via SAPHaRI, Centre for Epidemiology and Evidence and the NSW Ministry of Health. Linked data were used to measure:

- All deaths that occurred in the 30 days following hospitalisation, either in hospital and after discharge
- All readmissions or returns to acute care that occurred in the 30 days (or 60 days, in the case of elective surgery) following discharge.

The measures

A risk-standardised ratio is an indicator that describes, for each hospital's patient cohort, the 'observed' number of outcomes (deaths or readmissions) divided by the 'expected' number of outcomes. The 'expected' number of outcomes takes account of the hospital's case mix and is estimated using a statistical model built using the NSW patient population's characteristics, deaths and readmissions.

A ratio of less than 1.0 indicates lower than expected mortality or readmission while a ratio greater than 1.0 indicates higher than expected mortality or readmission. Small deviations from 1.0 are not considered to be meaningful.

Risk-standardised mortality ratio (RSMR)

- Measures as an outcome, deaths, from any cause
- For patients hospitalised multiple times during 2012–15 for the condition of interest, only the last hospitalisation is considered
- Attributes patient outcomes to the initial admitting hospital
- Patients with a service category of palliative care are excluded from the analysis but those for acute care that had a palliative care code applied during their hospitalisation were included
- Risk adjustment is based on a random intercept logistic regression model.

RSMR and RSRR cohort definitions, outcomes, risk adjustment models and attribution, are outlined in Figure 1 and described in new editions of *Spotlight on Measurement – Measuring 30-day mortality following hospitalisation* and *Measuring return to acute care following discharge from hospital (2nd editions, 2017)*.

Risk-standardised readmission ratio (RSRR)

- Measures as an outcome, any return to acute care, for any reason and to any hospital, within 30 days (or 60 days following joint replacement) of discharge
- Includes acute hospitalisations that end either with patient discharge home or discharge to non- or sub-acute care, with a subsequent return to an acute care setting
- Attributes patient outcomes to the discharging hospital
- Only acute emergency readmissions are considered (except for joint replacement where planned readmissions for orthopaedic complications are included)
- Risk adjustment is based on a Fine and Gray competing risk model.

Interpretation

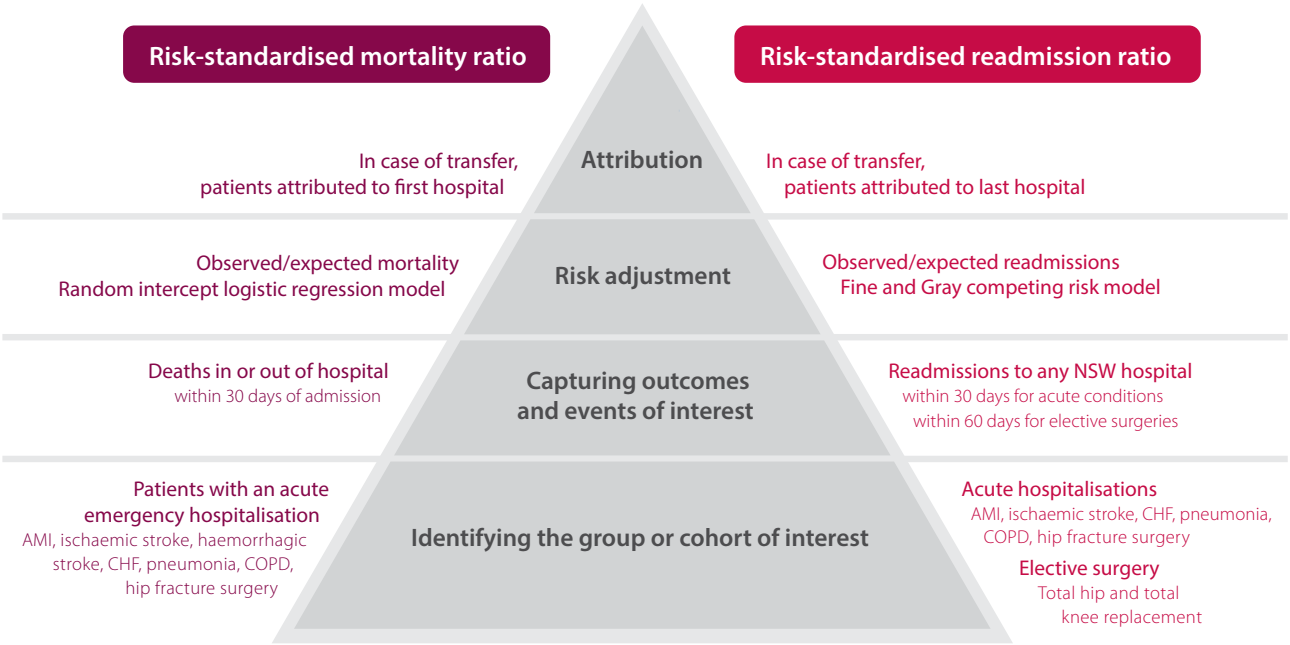
Funnel plots are used to identify outlier hospitals – those with 'special cause' variation that may warrant further investigation. Control limits are calculated based on a Poisson distribution. Hospital results that fall outside the 95% control limits are considered to be 'special cause' outliers and results are flagged. The probability that an 'in-control' hospital would fall outside the upper 95% control limit by chance alone is, at most, one in 40.

Results are reported, by condition or procedure, for principal referral, major and district hospitals with at least 50 index cases in the three-year period, July 2012 – June 2015. Not all hospitals have results for all conditions.

Risk-standardisation ratios help assess performance in light of patient characteristics and also take account of hospital size. As with all statisitics, there are methodological limitations to consider in interpretation. It is not possible to perfectly risk adjust for all permutations of patient characteristics and severity of disease. However, as long as this limitation is evenly distributed, it does not introduce a bias. The risk-standardised ratios do not identify specific deaths or readmissions that were avoidable.

Supplementary analyses across the two volumes explore patterns of patient transfers, place of death, length of stay, and reasons for and timing of any readmission.

Figure 1 Risk-standardised ratios for assessing performance in mortality and readmission



Mortality

- Acute myocardial infarction (AMI)
- Ischaemic stroke
- Haemorrhagic stroke
- Congestive (chronic) heart failure (CHF)
- Pneumonia
- Chronic obstructive pulmonary disease (COPD)
- Hip fracture surgery

Mortality – 10 key findings

1. **At a NSW level, 30-day mortality rates have fallen for all seven conditions** – over a 15-year period, decreases ranged from 15% for haemorrhagic stroke to 41% for acute myocardial infarction.

2. **Between 2009–12 and 2012–15, mortality fell most sharply for ischaemic stroke.**

3. **In 2012–15, NSW mortality rates were lowest for acute myocardial infarction (AMI) and hip fracture surgery (7%) and highest for haemorrhagic stroke (33%).** Placing the NSW results in an international context, mortality in 2013 was relatively low for AMI and relatively high for ischaemic stroke.

4. **The percentage of deaths that occurred after discharge ranged across conditions from 24% for haemorrhagic stroke to 53% for hip fracture surgery.**

5. **There were 75 public hospitals included in the analyses and for each of the conditions, only a small number of hospitals had higher than expected mortality** – ranging from one hospital for haemorrhagic stroke to 11 hospitals for chronic obstructive pulmonary disease.

6. **There were twice as many hospital results that were higher than expected than lower than expected in 2012–15** – with 45 'higher than expected' and 20 'lower than expected' mortality results.

7. **Higher and lower than expected mortality occurred in hospitals of various sizes and geographical remoteness** – however lower than expected mortality results were more prevalent in larger (principal referral) hospitals.

8. **For two conditions, there was a pronounced increase between 2009–12 and 2012–15 in the number of hospitals with higher than expected mortality** – for chronic obstructive pulmonary disease, the increase was from four to 11 hospitals and for pneumonia, from five to nine hospitals.

9. **Two hospitals had lower than expected mortality for multiple conditions and maintained that over two time periods** – St Vincent's and Prince of Wales hospitals were both flagged as low outliers for three conditions in the 2012–15 analyses; and for two conditions mortality was lower than expected both in 2009–12 and 2012–15.

10. **Four hospitals had higher than expected mortality for multiple conditions both in 2009–12 and 2012–15** – however each one – John Hunter, Manning, Port Macquarie and Tamworth – did improve for one or more conditions in 2012–15.

Mortality – NSW results

Between 2000 and 2015, NSW age-sex standardised mortality rates improved considerably – with decreases ranging from 15% for haemorrhagic stroke to 41% for AMI (Figure 2).

More recently, between 2009–12 and 2012–15, mortality rates generally continued to fall – most markedly for ischaemic stroke (from 13.5 to 11.9 deaths per 100 patients).

The seven conditions included in the 2012–15 mortality analyses differed in the percentage of deaths that occurred after discharge from hospital – ranging from 24% for haemorrhagic stroke to 53% for hip fracture surgery (Figure 3).

The conditions also differed in the rate and patterns of mortality over the 30-day period following hospitalisation. Unadjusted 30-day mortality rates at the NSW level ranged from seven per 100 hospitalisations for AMI and hip fracture surgery to 33 per 100 hospitalisations for haemorrhagic stroke. Mortality was particularly high in the first seven days following hospitalisation for haemorrhagic stroke (Figure 4).

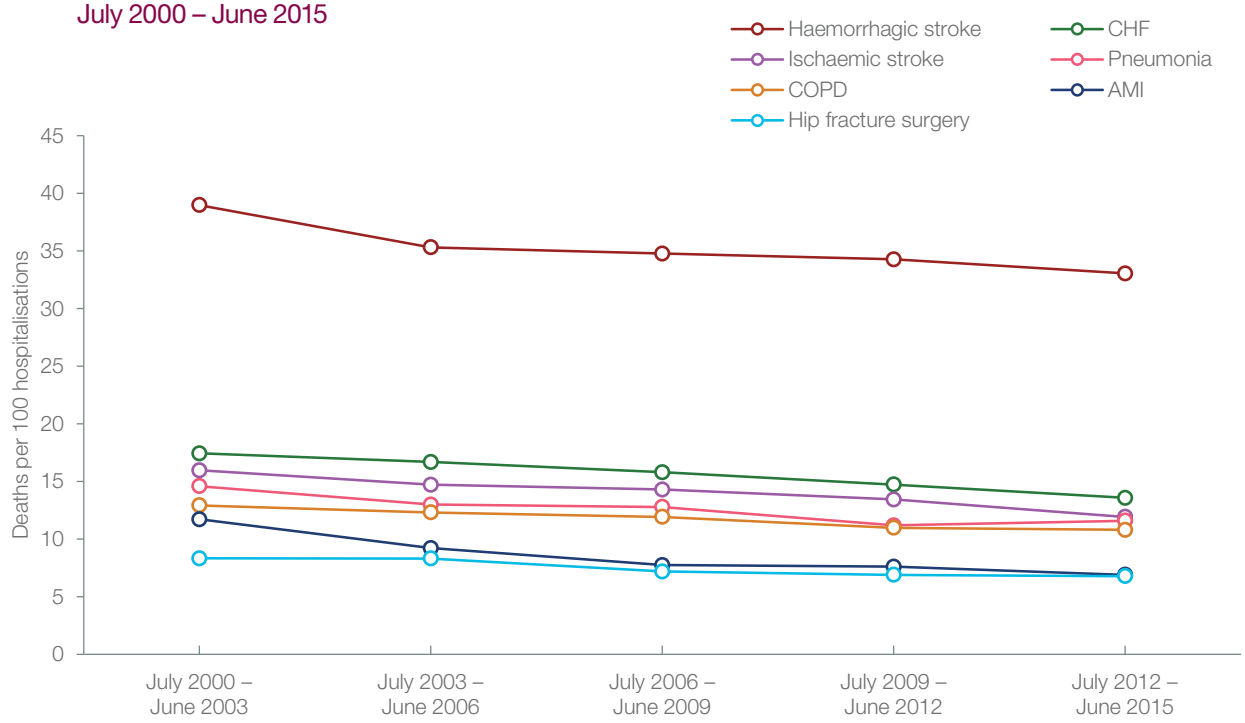
Limited data are available for benchmarking, however they suggest mortality in NSW is relatively low for AMI and relatively high for ischaemic stroke (Table 1).

Table 1 NSW mortality rates, international context

Conditions	NSW (July 2012 – June 2015)	Comparators
AMI	7%	7%, 8%, 8%, 8%, 9%, 9%, 14%
Ischaemic stroke	12%	8%, 8%, 10%, 10%, 10%, 11%
Haemorrhagic stroke	33%	NA
CHF	14%	7%, 12%
Pneumonia	11%	9%, 12%
COPD	10%	7%, 11%
Hip fracture surgery	7%	5%, 5%, 8%

For details see the BHI report, *Exploring clinical variation in mortality.*

Figure 2 30-day mortality, age-sex standardised rate per 100 hospitalisations, by condition, NSW, July 2000 – June 2015



Note: Indirectly standardised using July 2009 – June 2012 NSW condition-specific hospitalisation cohorts as the standard population.

Figure 3 Percentage of deaths that occurred in hospital and after discharge, by condition, NSW, July 2012 – June 2015

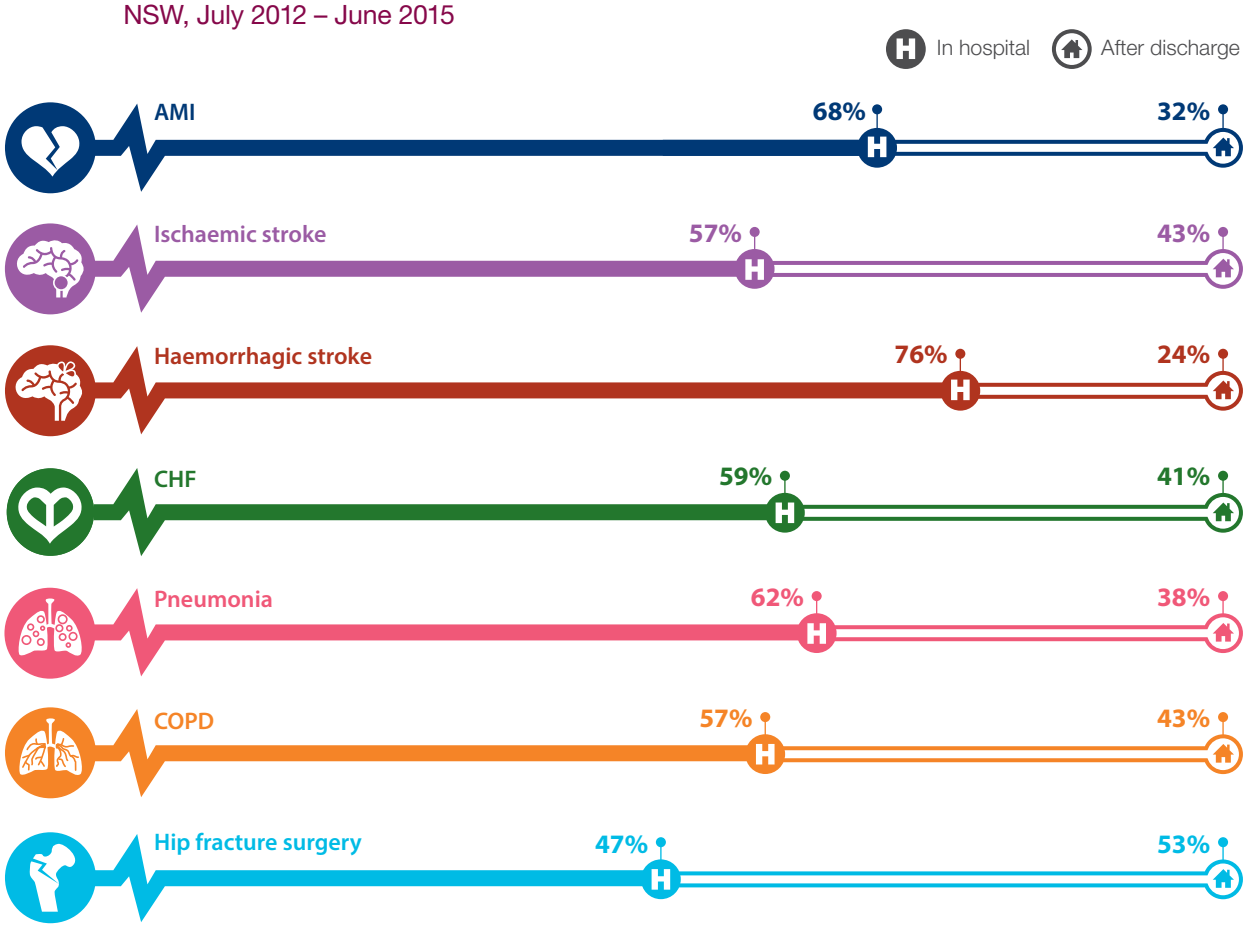
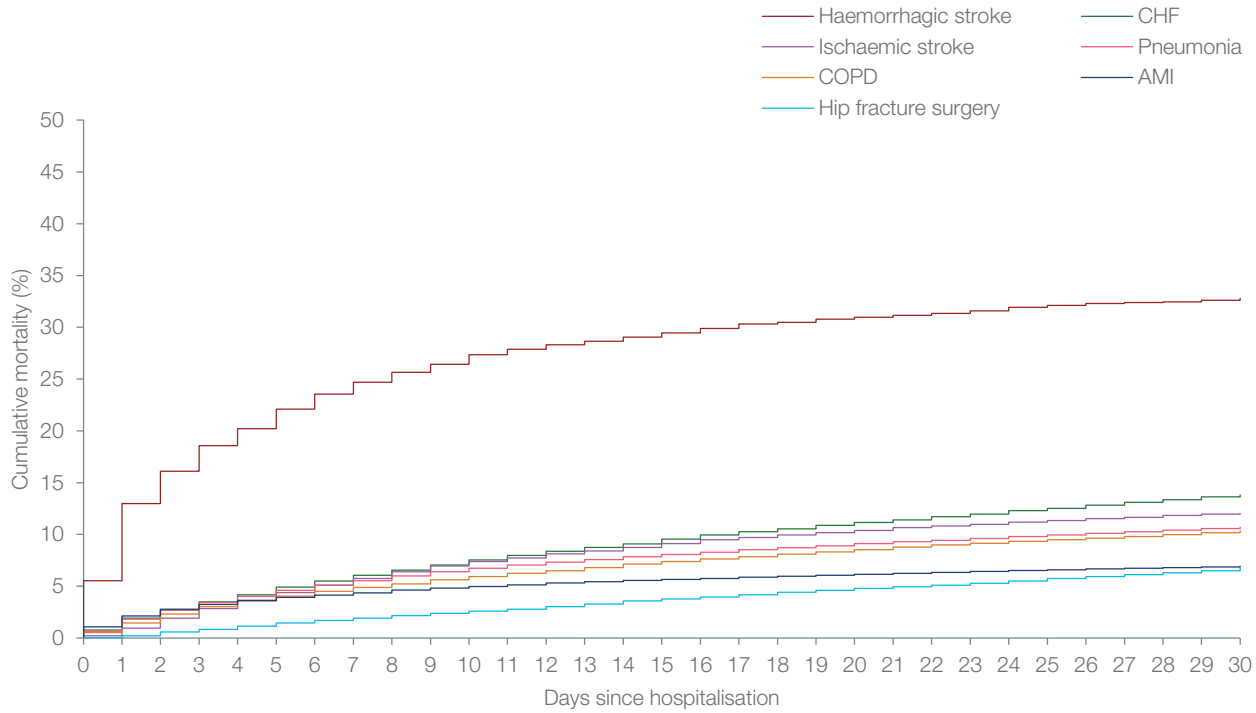


Figure 4 Cumulative mortality (%) in 30 days following hospitalisation, by condition, NSW, July 2012 – June 2015



Note: For hip fracture, data are for 30 days following surgery.

Mortality – Hospital-level results

Across the seven conditions in 2012–15, the number of hospitals* with lower than expected mortality ranged from none to six hospitals; and the number with higher than expected mortality ranged from one to 11 hospitals (Figure 5).

Within each set of analyses, the majority of hospitals had mortality results that were not significantly different than expected, once patient characteristics were taken into account – ranging from 54 hospitals (78%) for CHF to 29 hospitals (97%) for haemorrhagic stroke (Figure 6).

Across all the conditions there were 45 higher than expected and 20 lower than expected mortality results.

Between 2009–12 and 2012–15, the number of hospitals with higher than expected mortality did not change dramatically for most conditions. There were two exceptions however – for COPD, the number of hospitals with higher than expected mortality increased from four to 11 and for pneumonia, from five to nine (data not shown).

In the 2012–15 analyses, 47 hospitals had no conditions for which mortality was higher than expected. Two hospitals (Prince of Wales and St Vincent's) had lower than expected mortality for three conditions; and four hospitals (John Hunter, Manning, Port Macquarie and Tamworth) had higher than expected mortality for three conditions (Figure 7).

Figure 5 30-day mortality results, by condition, NSW public hospitals, July 2012 – June 2015

	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Higher than expected mortality	Calvary Mater Dubbo Nepean Parkes	Armidale Auburn John Hunter Shoalhaven Westmead	Gosford	Armidale Ballina Belmont Bowral Campbelltown Grafton Maclean Moruya Parkes Tamworth	Blue Mountains Gosford Inverell Manning Moruya Mudgee Port Macquarie Queanbeyan Wyong	Belmont Calvary Mater Campbelltown Casino Cowra John Hunter Manning Mudgee Port Macquarie Tamworth The Tweed	Dubbo John Hunter Manning Port Macquarie Tamworth
Lower than expected mortality	Kempsey Prince of Wales Queanbeyan	Belmont		Blacktown Concord Hornsby Prince of Wales St Vincent's	Blacktown Prince of Wales Royal North Shore Shellharbour St Vincent's Wollongong	Royal North Shore Wollongong	Concord Liverpool St Vincent's

* Hospital results are shown for principal referral, major and district hospitals (peer groups A – C only).

Figure 6 Number of public hospitals, by outlier status for 30-day mortality, by condition, NSW, July 2012 – June 2015

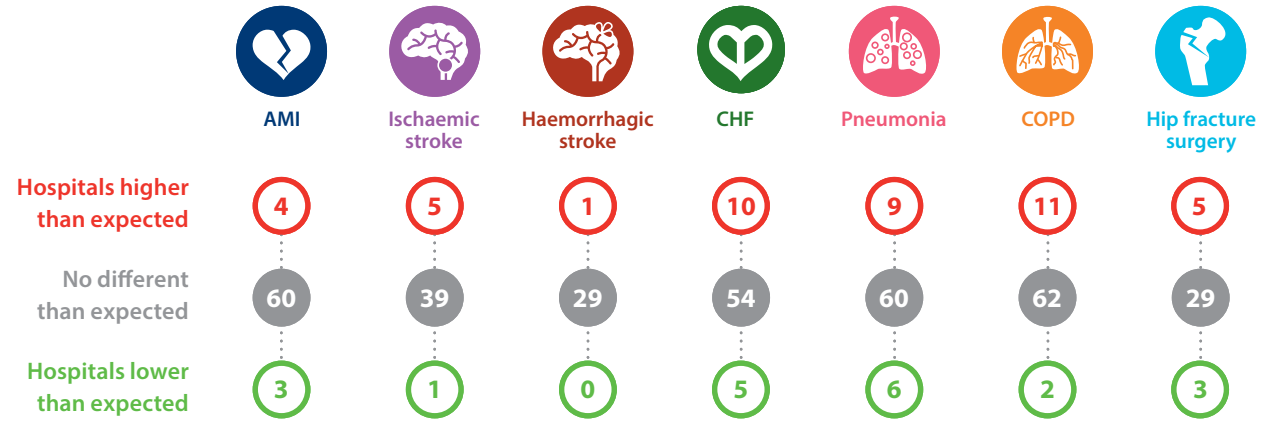
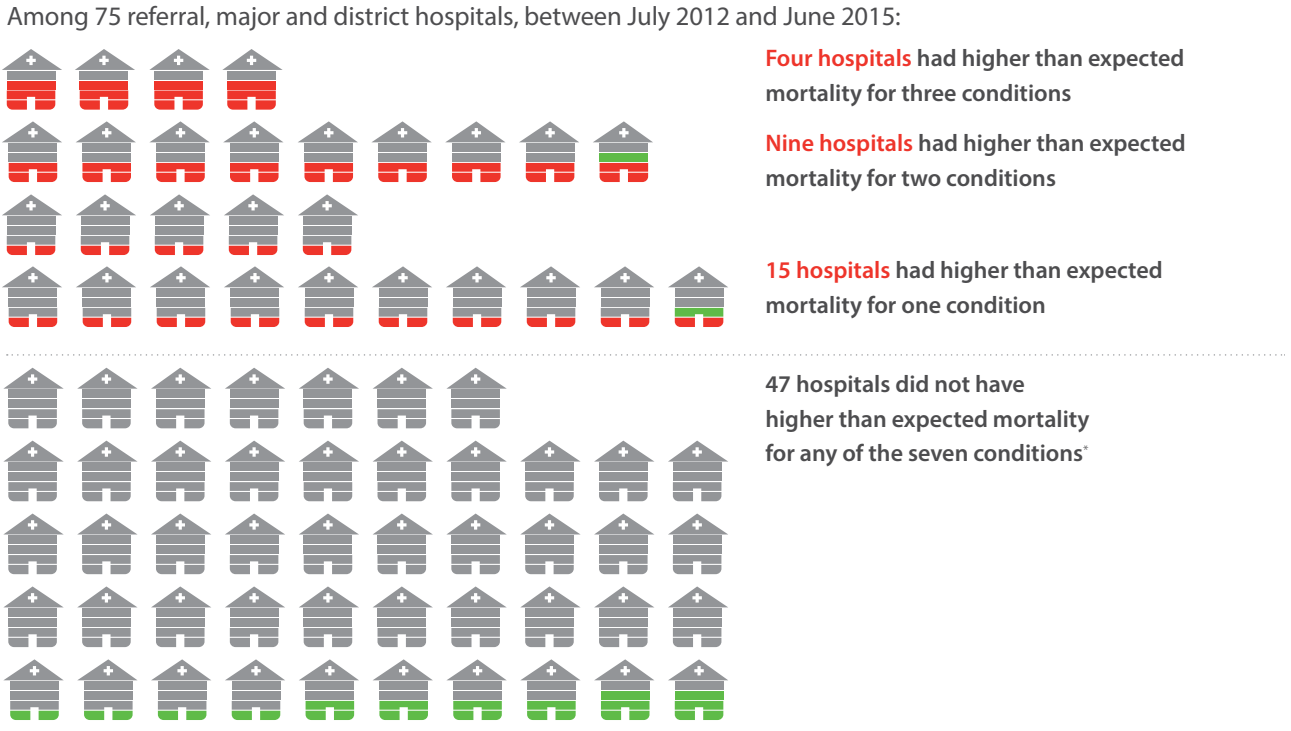


Figure 7 30-day mortality, concentration of outlier results across hospitals, NSW, July 2012 – June 2015



* Not all hospitals have results for all seven conditions.

Mortality – By peer group and changes over time

Hospital peer groups

Not every hospital had sufficient patients to be reported in the RSMR analyses (50 or more index hospitalisations). To summarise peer group findings, any RSMR reported for a hospital is considered to be a 'result'. In all peer groups, the majority of hospitals' 30-day mortality results were no different than expected – 78% of principal referral, 86% of major, and 86% of district hospitals (Figure 8).

Among principal referral hospitals, 13% of results showed lower than expected mortality and 9% higher than expected. For major hospitals, 2% of results showed lower than expected mortality and 12% higher than expected; and for district hospitals, 3% of results showed lower than expected mortality and 12% higher than expected (Figure 8).

Higher and lower than expected mortality results were found across all peer groups. There was however a greater concentration of lower than expected mortality results among principal referral hospitals (Figure 9).

Checking validity of measures

The mortality indicators have undergone extensive sensitivity testing to explore:

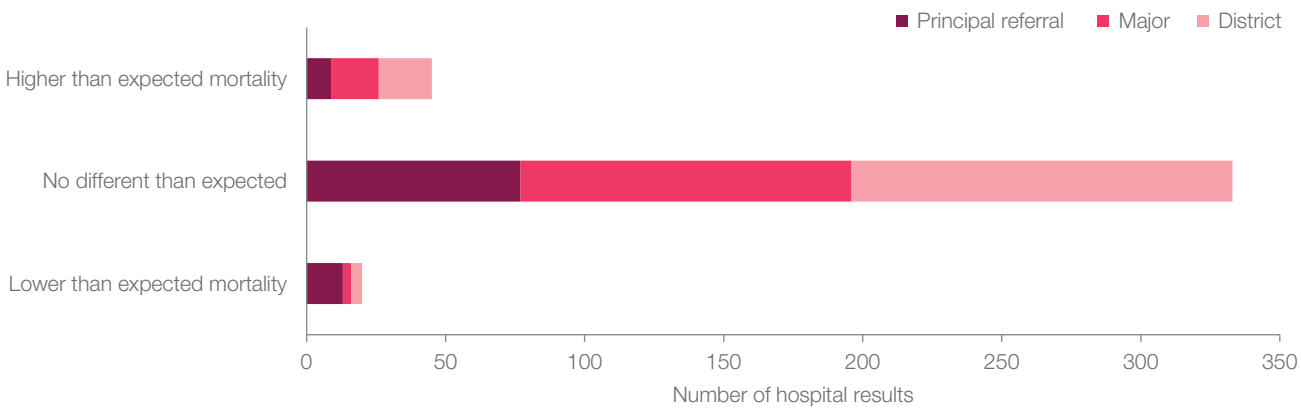
- The extent of change over time in coding of comorbidities in patients' records
- Whether palliative care codes are applied differently across the state's hospitals
- Prevalence and potential confounding of ED visits to a different hospital in the 24 hours before admission
- For hospitals that operate in partnerships, the effect of treating them as a single unit.

The results of these analyses did not identify any significant methodological limitation in the RSMR approach. For more detail, see *Spotlight on Measurement – Measuring 30-day mortality following hospitalisation, 2nd edition*.

Figure 8 30-day mortality, all conditions, number and percentage of peer group results, NSW, July 2012 – June 2015

Hospital peer group	Lower than expected mortality	No different than expected mortality	Higher than expected mortality
Principal referral	13 results (13%)	77 results (78%)	9 results (9%)
Major	3 results (2%)	119 results (86%)	17 results (12%)
District	4 results (3%)	137 results (86%)	19 results (12%)

Figure 9 30-day mortality, all conditions, by hospital peer group results, NSW, July 2012 – June 2015



Changes between 2009–12 and 2012–15

Three hospitals had consistently low mortality for the same condition in both 2009–12 and 2012–15 and two of them (Prince of Wales and St Vincent's) did so for two conditions. There were eight hospitals with higher than expected mortality for the same condition across both time periods, and one of these (Tamworth) did so for three conditions (Figure 10).

For 10 hospitals, mortality improved to lower than expected – and for four of them, improvement was for two conditions (Blacktown, Concord, Royal North Shore and Wollongong). One hospital changed from higher to lower than expected mortality – Blacktown for pneumonia.

For 18 hospitals, mortality improved to no different than expected for at least one condition; and for Tamworth and Port Macquarie, the improvement was for three and two conditions, respectively (Figure 10).

Figure 10 Hospitals with changed outlier status, 30-day mortality, NSW, 2009–12 and 2012–15

Higher than expected | No different than expected | Lower than expected

09–12	12–15	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Higher	Higher		John Hunter		Bowral Tamworth	Inverell Manning Wyong	Cowra Port Macquarie Tamworth	Tamworth
No different	Higher	Calvary Mater Dubbo Nepean Parkes	Armidale Auburn Shoalhaven Westmead	Gosford	Armidale Ballina Belmont Campbelltown Grafton Maclean Moruya Parkes*	Blue Mountains Gosford Moruya Mudgee Port Macquarie Queanbeyan	Belmont Calvary Mater Campbelltown Casino John Hunter Manning Mudgee The Tweed	Dubbo John Hunter Manning Port Macquarie
Higher	No different	Cessnock Hornsby Milton Tamworth	Dubbo Lismore Nepean Tamworth	John Hunter Port Macquarie	Batemans Bay Blue Mountains Cowra Manning Mudgee Port Macquarie Tumut	Tamworth	Mt Druitt	Gosford Orange
Higher	Lower					Blacktown		
No different	Lower	Kempsey Queanbeyan*	Belmont		Blacktown Concord Hornsby St Vincent's	Prince of Wales Royal North Shore Wollongong	Royal North Shore Wollongong	Concord Liverpool
Lower	Lower	Prince of Wales			Prince of Wales	Shellharbour St Vincent's		St Vincent's

Note: Using 90% control limits in 2009–12, eight hospitals had higher than expected mortality: Belmont (COPD), Blacktown (COPD), Bowral (AMI), Coffs Harbour (hip fracture surgery and ischaemic stroke), Royal Prince Alfred (ischaemic stroke), St George (AMI) and Westmead (ischaemic stroke). One hospital had lower than expected mortality: Belmont (ischaemic stroke).

* <50 hospitalisations in 2009–12.

Readmission

- Acute myocardial infarction (AMI)
- Ischaemic stroke
- Congestive (chronic) heart failure (CHF)
- Pneumonia
- Chronic obstructive pulmonary disease (COPD)
- Hip fracture surgery
- Total hip replacement
- Total knee replacement

Readmission – 10 key findings

1. **At a NSW level, readmission rates have decreased over a 15 year period for four of the eight conditions** – changes ranged from an 8% increase for ischaemic stroke to an 11% decrease for acute myocardial infarction and total hip replacement.

2. **More recently, there has been an increase in readmissions following a pneumonia hospitalisation** – with the number of readmissions per 100 hospitalisations increasing from 13.0 to 14.1 between 2009–12 and 2012–15.

3. **In 2012–15, NSW readmission rates were lowest for total hip replacement (9 per 100 hospitalisations) and highest for congestive heart failure (23 per 100 hospitalisations)** – the limited number of international benchmarks available suggest NSW results are broadly in line with other systems – although recent studies suggest NSW readmissions are higher for joint replacements.

4. **For the non-surgical conditions, the majority of readmissions were either for the same or a similar condition, or were potentially related to hospital care received** – ranging from 54% of readmission for pneumonia to 73% for chronic obstructive pulmonary disease. For hip fracture surgery and joint replacements, about 40% of readmissions were for orthopaedic complications.

5. **Around four in 10 readmissions following acute myocardial infarction, ischaemic stroke and pneumonia hospitalisations occurred in the first week following discharge** – for the other conditions, around three in 10 readmissions occurred in the first week.

6. **There were 79 public hospitals included in the readmission analyses and for each condition, only a few hospitals were flagged as high outliers** – ranging from one hospital each for total hip and total knee replacement to seven hospitals for congestive heart failure.

7. **The number of high outlier hospital results in 2012–15 was similar to the number of low outlier hospital results** – with 31 higher than expected readmission results and 27 lower than expected readmission results.

8. **Higher and lower than expected readmission results occurred in hospitals of various sizes and geographical remoteness** – however higher than expected readmission results were more prevalent in larger (principal referral) hospitals.

9. **Five hospitals – Auburn, Bankstown/Lidcombe, Fairfield, Liverpool and Westmead – had higher than expected readmissions for multiple conditions in both 2009–12 and 2012–15** – however, the hospitals that had the most higher than expected readmission results in 2009–12 (Nepean and Wagga Wagga) saw improvements for several conditions in 2012–15.

10. **There has been an overall improvement in hospital results** – between 2009–12 and 2012–15, the number of lower than expected readmission results increased from 21 to 27; and the number of higher than expected hospital readmission results fell from 41 to 31.

Readmission – NSW results

Between 2000 and 2015, NSW age-sex standardised rates of unplanned readmission or 'returns to acute care' improved for four conditions, most notably for AMI and total hip replacement (both decreased by 11%). However, for two conditions, ischaemic stroke and pneumonia, readmissions increased (by 8% and 6%, respectively) (Figures 11 and 13).

The conditions included in the report differed in the percentage of returns to acute care that were to the discharging hospital – ranging from 55% for total hip replacement to 85% for COPD (Figure 12).

The conditions also differed in terms of patients' average length of stay for the index (initial) hospitalisation – ranging from 5.3 days for COPD to 10.7 for hip fracture surgery. Across the conditions generally, higher readmission rates were seen for patients with longer lengths of stay in the index hospitalisation. This was particularly marked for pneumonia and total knee replacement patients (data not shown).

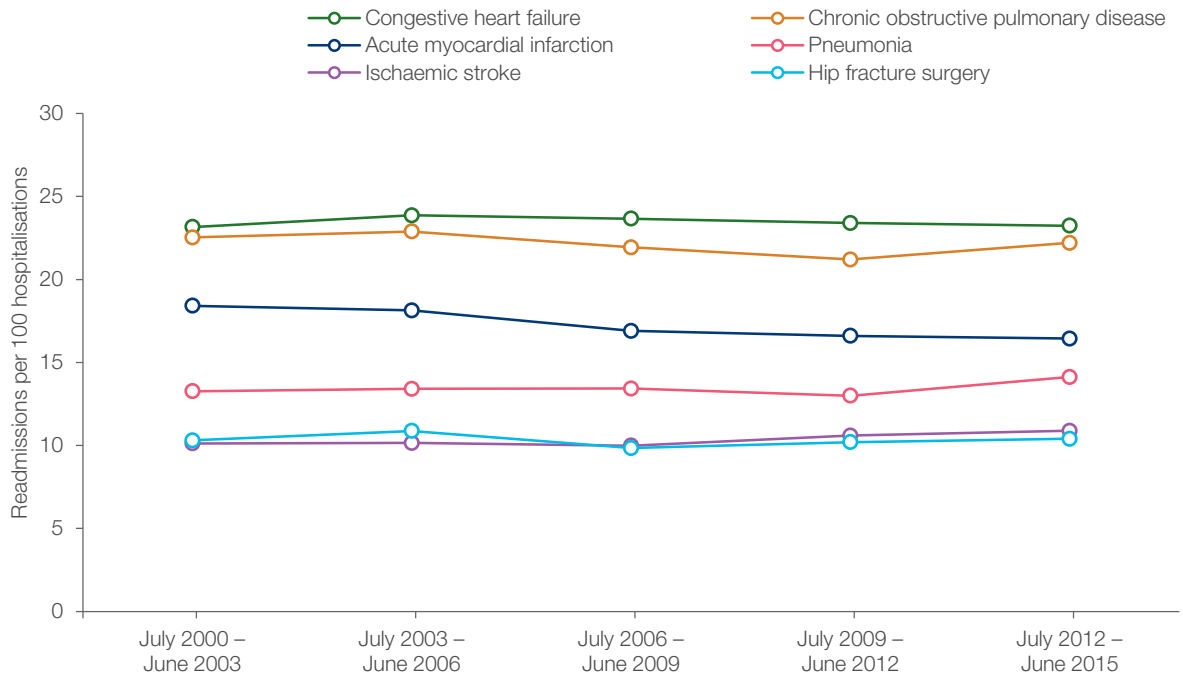
In terms of international comparisons, there are limited data for benchmarking NSW results. Available information suggests that NSW readmission rates are similar to those in other systems for most conditions (Table 2).

Table 2 NSW readmission rates, international context

Conditions	NSW (July 2012 – June 2015)	Comparators
AMI	16%	11%, 15%, 15%, 17%
Ischaemic stroke	11%	13%
CHF	23%	19%, 22%, 24%
Pneumonia	14%	14%, 16%, 17%
COPD	22%	20%
Hip fracture surgery	10%	9%, 15%
Total hip replacement	9%	8%*
Total knee replacement	12%	10%*

* Comparator data are pooled estimates for 90-day readmissions.
For details see the BHI report, *Exploring clinical variation in readmission.*

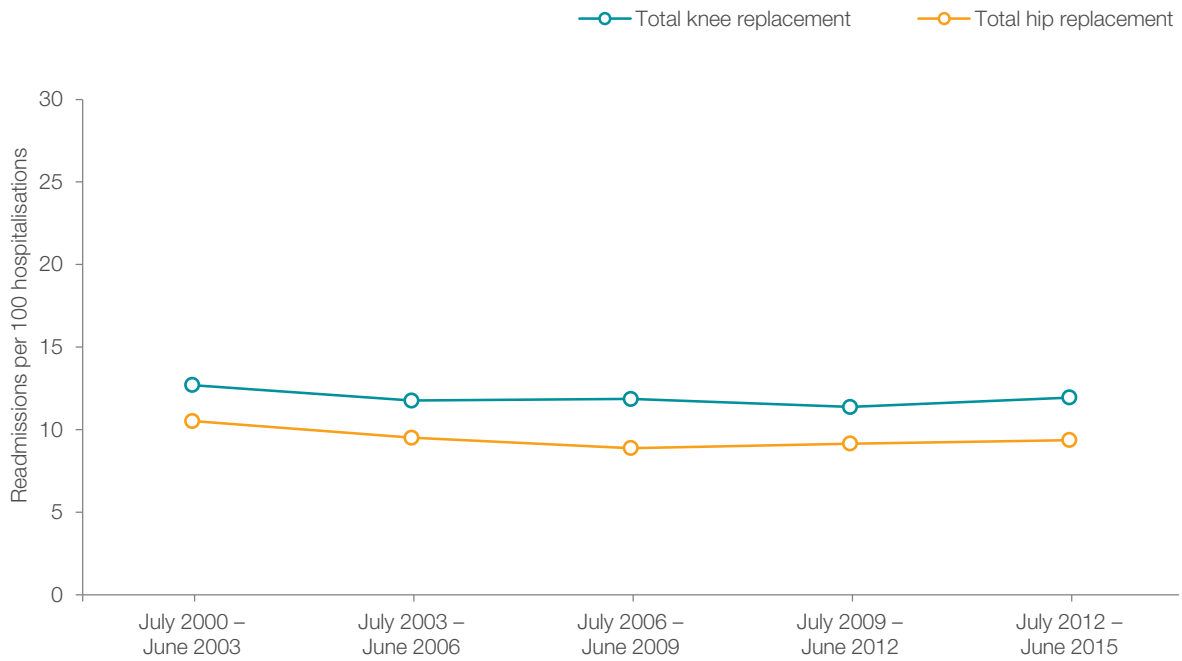
Figure 11 Readmission, age-sex standardised rate per 100 hospitalisations, by condition, NSW, July 2000 – June 2015



Note: Indirectly standardised using July 2009 – June 2012 NSW condition-specific hospitalisation cohorts as the standard population.

Figure 12 Percentage of readmissions for which patients returned to the same or different hospital, by condition, NSW, July 2012 – June 2015

Figure 13 Readmission, age-sex standardised rate per 100 hospitalisations, by elective surgery, NSW, July 2000 – June 2015



Note: Indirectly standardised using July 2009 – June 2012 NSW condition-specific hospitalisation cohorts as the standard population.

Readmission – Hospital-level results

Across the eight conditions, the number of hospitals* with lower than expected readmission ranged from one to six; and the number with higher than expected readmission ranged from one to seven (Figure 14).

Within each set of analyses, the majority of hospitals had readmission results that were not significantly different to expected, once patient characteristics were taken into account – ranging from 31 hospitals (74%) for ischaemic stroke to 37 hospitals (94%) for total hip replacement (Figure 15).

Across all the conditions there were 31 higher than expected and 27 lower than expected results.

There were 42 hospitals for which there were no readmission results or 'returns to acute care' that were significantly higher or lower than expected. Two hospitals (Gosford and Manning) had lower than expected readmission for three and four conditions respectively; and two hospitals (St George and Liverpool) had higher than expected readmission for three conditions (Figure 16).

Figure 14 Readmission results, by condition, NSW public hospitals, July 2012 – June 2015

	AMI	Ischaemic stroke	CHF	Pneumonia	COPD	Hip fracture surgery	Total hip replacement	Total knee replacement
Higher than expected readmission	Blacktown Liverpool	Bankstown/ Lidcombe Fairfield Liverpool Murwillumbah Royal Prince Alfred St George	Canterbury Cessnock Cowra Fairfield Lithgow Liverpool Nepean	Auburn St George Westmead	Auburn Campbelltown Mudgee Tamworth Young	Murwillumbah** The Tweed St George Goulburn Bankstown/ Lidcombe Westmead	Wagga Wagga	Prince of Wales
Lower than expected readmission	Gosford Prince of Wales	Gosford Hornsby Maitland Tamworth Wollongong	Armidale Hornsby Maclean Manning Royal North Shore Sutherland	Manning St Vincent's Sutherland	Manly Royal North Shore Singleton Wagga Wagga Queanbeyan	Dubbo Gosford Manning	Bathurst	Fairfield Manning

* Hospital results are shown for principal referral, major and district hospitals (peer groups A – C only).

** Hip fracture surgery was not conducted at Murwillumbah.

Figure 15 Number of public hospitals, by outlier status for readmission, by condition, NSW, July 2012 – June 2015

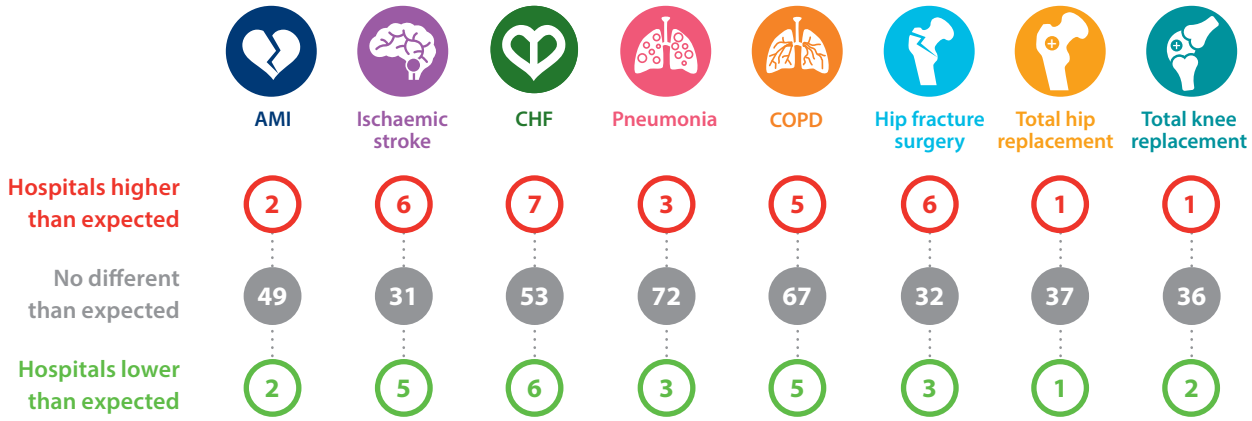
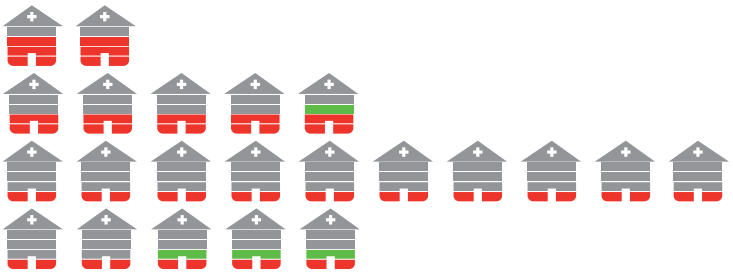


Figure 16 Readmission, concentration of outlier results across hospitals, NSW, July 2012 – June 2015

Among 79 referral, major and district hospitals, between July 2012 and June 2015:



Two hospitals had higher than expected readmission for three conditions

Five hospitals had higher than expected readmission for two conditions

15 hospitals had higher than expected readmission for one condition

57 hospitals did not have higher than expected readmission for any of the eight conditions*

* Not all hospitals have results for all eight conditions.

Readmission – By peer group and changes over time

Hospital peer groups

Not every hospital had sufficient patients to be reported in the RSRR analyses (50 or more index hospitalisations). To summarise peer group findings, any RSRR reported for a hospital is considered to be a 'result'. In all peer groups, the majority of hospital readmission results were no different than expected – 80% of principal referral, 85% of major, and 92% of district hospitals (Figure 17).

Among principal referral hospitals, 7% of results showed lower than expected readmission and 12% higher than expected. For major hospitals, 9% of results showed lower than expected readmission and 6% higher than expected; and for district hospitals, 3% of results showed lower than expected readmission and 5% higher than expected (Figure 17).

Higher and lower than expected readmission results were found across all peer groups. There was however a greater concentration of higher than expected results among principal referral hospitals (Figure 18).

Checking validity of measures

The readmission indicators have undergone extensive sensitivity testing to explore:

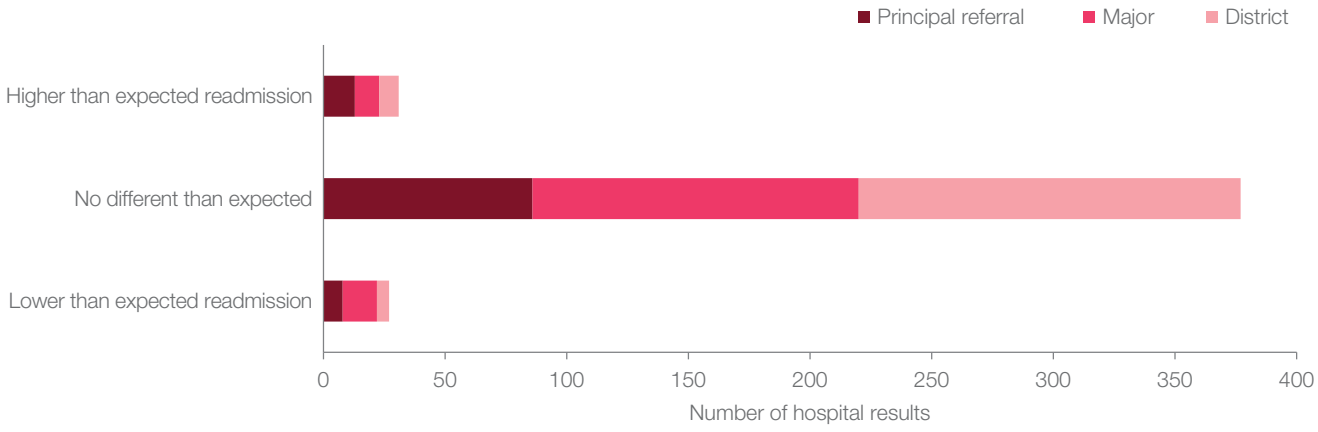
- Whether there were significant changes across NSW hospitals in coding of comorbidity in patients' records
- For hospitals that operate in partnerships, whether their results are affected when treated as a single unit
- The relative performance of hospitals for patients in different socioeconomic subgroups.

The results did not identify any significant methodological limitation in the risk-standardised ratio approach. For more detail, see *Spotlight on Measurement – Measuring return to acute care following discharge from hospital, 2nd edition*.

Figure 17 Readmission, all conditions, number and percentage of peer group results, NSW, July 2012 – June 2015

Hospital peer group	Lower than expected readmission	No different than expected readmission	Higher than expected readmission
Principal referral	8 results (7%)	86 results (80%)	13 results (12%)
Major	14 results (9%)	134 results (85%)	10 results (6%)
District	5 results (3%)	157 results (92%)	8 results (5%)

Figure 18 Readmission, all conditions, by hospital peer group, NSW, July 2012 – June 2015



Changes between 2009–12 and 2012–15

There were five hospitals that had lower than expected readmission results across both time periods and seven with higher than expected results across both time periods. Three hospitals (Auburn, Fairfield and Westmead) had higher than expected readmission results for two conditions in both time periods (Figure 19).

Sixteen hospitals improved their status to lower than expected readmission over the two time periods and one of these hospitals (Manning) did so for three conditions.

For 19 hospitals, there was an improvement in readmission results to no different than expected. For one hospital (Nepean) the improvement was for four conditions; for two hospitals (Wagga Wagga and Milton) the improvement was for three conditions; and for four hospitals (Auburn, Bankstown/Lidcombe, Kempsey and Tamworth) the improvement was for two conditions (Figure 19).

There has been an overall improvement in hospital results in risk-adjusted readmission. Between 2009–12 and 2012–15, the number of lower than expected hospital results increased from 21 to 27; and the number of higher than expected hospital results fell from 41 to 31 (data not shown).

Figure 19 Hospitals with changed outlier status, readmission, NSW, 2009–12 and 2012–15

Higher than expected | No different than expected | Lower than expected

09–12	12–15	AMI	Ischaemic stroke	CHF	Pneumonia	COPD	Hip fracture surgery	Total hip replacement	Total knee replacement
▮	▮		Fairfield Liverpool	Nepean Fairfield	Auburn Westmead	Auburn	St George Westmead	Wagga Wagga	
●	▮	Blacktown Liverpool	Bankstown/ Lidcombe Murwillumbah* Royal Prince Alfred St George	Canterbury Cessnock Cowra Lithgow Liverpool	St George	Campbelltown Mudgee Tamworth Young	Murwillumbah** The Tweed Goulburn Bankstown/ Lidcombe		Prince of Wales
▮	●	Auburn Bankstown/ Lidcombe Kempsey Manning Tamworth	Wagga Wagga	Auburn Kempsey Milton	Lithgow Liverpool Milton Mount Druitt Nepean Wagga Wagga	Bateman's Bay Milton Parkes	Grafton Nepean	Bankstown/ Lidcombe Nepean Wollongong Wyong	Armidale Coffs Harbour Nepean Shoalhaven Tamworth Wagga Wagga
●	▮	Gosford	Gosford Hornsby Maitland Tamworth Wollongong	Armidale Hornsby Maclean Royal North Shore Sutherland	Manning St Vincent's Sutherland	Manly Royal North Shore Singleton Queanbeyan	Manning Dubbo	Bathurst*	Manning
▮	▮	Prince of Wales		Manning		Wagga Wagga	Gosford		Fairfield

* <50 hospitalisations in 2009–12.

** Hip fracture surgery was not conducted at Murwillumbah.

Readmission – Reasons for returns to acute care

Variation in reasons for readmission, timing and length of stay

Readmission rates varied across the conditions. Across NSW public hospitals in 2012–15, unadjusted rates of readmission, or returns to acute care, ranged from nine per 100 discharges for total hip replacement to 23 per 100 discharges for CHF.

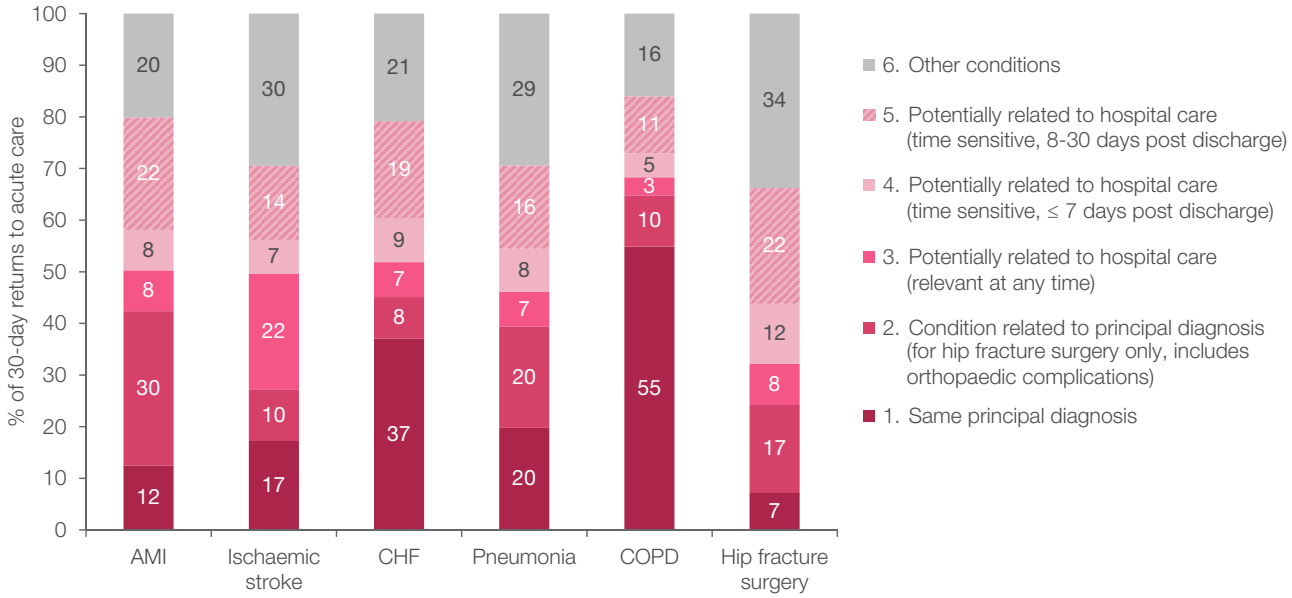
Reasons for readmission within 30 days also varied (Figures 20 and 21). The proportion that were for the same or a related condition ranged from 27% for ischaemic stroke to 65% for COPD while the proportion classified as 'potentially related to hospital care' (categories 3 and 4 in Figure 20) ranged from 8% for COPD to 29% for ischaemic stroke.

For the two elective surgeries, about 40% of readmission within 60 days were orthopaedic complications or were potentially related to hospital care (categories 1 and 3 in Figure 22).

The proportion of returns to acute care that occurred in the first three days following discharge ranged from about 15% for CHF, COPD, total knee replacement and hip fracture surgery, to 20% for AMI.

The average length of stay in acute care ranged from 5.3 days for COPD, to 10.7 days for hip fracture surgery. Variation at a hospital level was considerable. For example, the average length of stay for hip fracture surgery hospitalisations ranged from 7.0 to 16.7 days, and for CHF from 3.4 to 7.6 days (data not shown)*.

Figure 20 Reasons for readmission, six clinical conditions, NSW public hospitals, July 2012 – June 2015



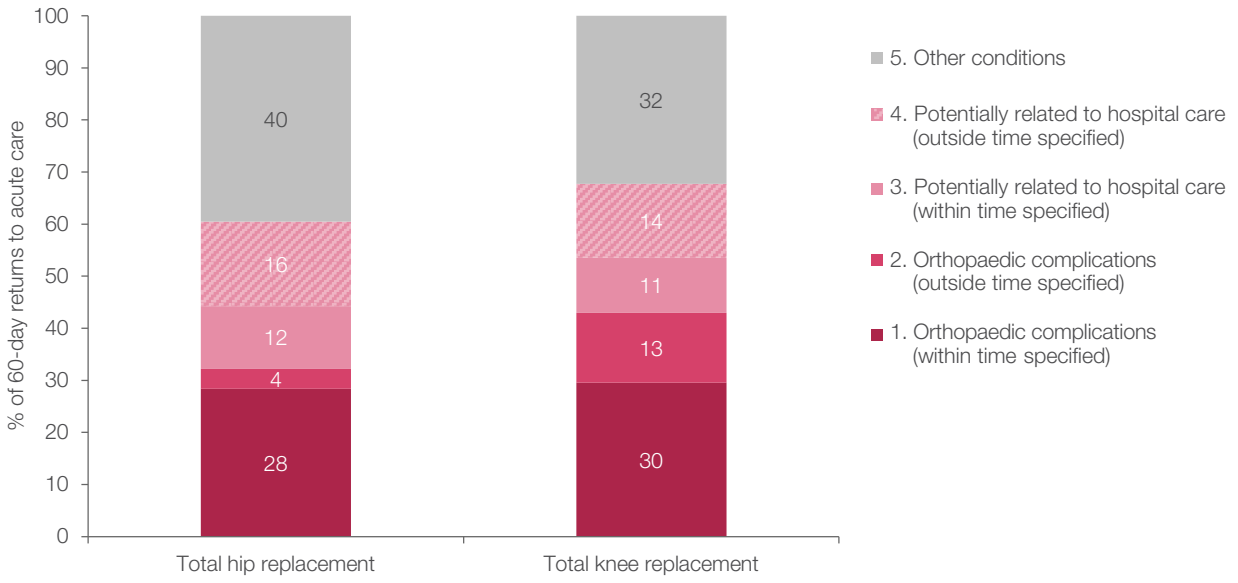
Note: Categories of reasons for readmission refer to: 1. The same principal diagnosis code as the index hospitalisation; 2. Condition related to principal diagnosis, in the same ICD-AM 10 chapter; 3. Potentially related to hospital care (not time sensitive) refer to complications such as pulmonary embolism; 4. Potentially related to hospital care if they occur in the first seven days following discharge e.g. urinary tract infection; 5. Same codes as category 4 but occurred beyond the seven day time period (less likely to be related to hospital care); 6. Other conditions.

* Includes peer group A-C hospitals with 50 or more index hospitalsiations.

Figure 21 Readmissions potentially related to hospital care, most frequent reasons, by condition

Condition	Reason for readmission was same as or related to index admission (*orthopaedic complication) Principal diagnosis (number of readmissions recorded)	Reason for readmission was potentially related to hospital care Principal diagnosis (number of readmissions recorded)
AMI	Acute subendocardial myocardial infarction (403) Congestive heart failure (330)	Pneumonia (48) Gastrointestinal haemorrhage (40)
Ischaemic stroke	Cerebral infarction (143) Transient cerebral ischaemic attack (52)	Pneumonitis due to food or vomit (70) Pneumonia (33)
CHF	Congestive heart failure (2,558) Left ventricular failure (224)	Acute kidney failure (130) Constipation (61)
Pneumonia	Pneumonia (1040) COPD (364)	Congestive heart failure (113) Pulmonary embolism (without cor pulmonale) (72)
COPD	COPD with acute lower respiratory infection (3,096) COPD with acute exacerbation (1,987)	Congestive heart failure (105) Constipation (71)
Hip fracture surgery	Wound infection following a procedure (41)* Pain in a joint, pelvic region and thigh (29)*	Urinary tract infection (67) Pneumonitis due to food and vomit (20)
Total hip replacement	Wound infection following a procedure (53)* Infection/inflammatory reaction to joint prosthesis (32)*	Phlebitis and thrombophlebitis of deep vessels (7) Urinary tract infection, site not specified (7)
Total knee replacement	Wound infection following a procedure (144)* Infection/inflammatory reaction to joint prosthesis (77)*	Phlebitis and thrombophlebitis of deep vessels (20) Cellulitis of lower limb (19)

Figure 22 Reasons for readmission, two elective surgeries, NSW public hospitals, July 2012 – June 2015



Note: Categories of reasons for readmission refer to: 1. Orthopaedic complications occurring within a time frame specified as likely to be related to hospital care e.g. other complications of anaesthesia within 7 days; 2. Orthopaedic complications outside time specified as likely to be related to hospital care which are the same codes as category 1; 3. Potentially related to hospital care (within time specified) e.g. pulmonary embolism; 4. Potentially related to hospital care (outside time specified) same codes as category 3; 5. Other conditions.

Mortality and readmission – A synthesis

Looking across mortality and readmission

Mortality and readmission are both indicators that reflect important patient outcomes. When appropriately risk adjusted, they can point to unwarranted clinical variation in healthcare.

The two types of measures are widely used internationally and are valued individually. However, when considered together, they can provide additional information and insight.

This is because hospital mortality and readmission, considered together for a particular condition, can reflect a range of scenarios. Potentially, mortality and readmission could have an inverse relationship – for example, a hospital with a low mortality rate could have high readmission rates because care processes and pathways that reduce mortality resulted in a higher-risk group being discharged and as a consequence, relatively high rates of readmission. In contrast, a hospital with a higher mortality rate could be discharging patients with relatively low risk who are less likely to be readmitted.

Between 2009–12 and 2012–15, the number of hospitals with multiple 'lower than expected' mortality results increased from three to six; and the number with multiple 'higher than expected' mortality results increased from five to 13.

There has been an overall improvement in hospital results in risk-adjusted readmissions. Between 2009–12 and 2012–15, the number of lower than expected hospital results increased from 21 to 27; and the number of higher than expected hospital results fell from 41 to 31.

Mortality and readmission: an integrated view

Over a 15-year period from 2000, rates of readmission decreased for four of the eight conditions analysed. The mortality analyses showed steeper and more widespread improvements with decreases seen for all conditions.

The 2012–15 mortality analyses showed there were more than twice as many high outlier results as low outliers (45 and 20). For readmissions however, the number of high and low outliers was similar (31 and 27).

Lower than expected mortality results were most prevalent among principal referral hospitals (peer group A). For readmissions however, higher than expected readmission results were most prevalent among principal referral hospitals.

At a hospital level, there was greater variation in the mortality results compared with the readmission results (65 outliers and 58 outliers respectively). In particular, the mortality analyses found more higher than expected results than the readmission analyses (45 and 31 respectively).

There is some evidence of greater influence of hospital-wide factors in the mortality outcomes. For example, hospitals with a concentration of multiple higher than expected results were more common in the mortality analyses than in the readmission analyses (13 and seven respectively).

Between 2009–12 and 2012–15 there was an increasing prevalence of hospitals with multiple higher than expected or multiple lower than expected results for mortality (higher than expected from five to 13; lower than expected from three to six). In contrast, for readmissions the number of hospitals with multiple higher than expected results decreased (from 10 to seven) while those with multiple lower than expected results remained stable (five in both periods).

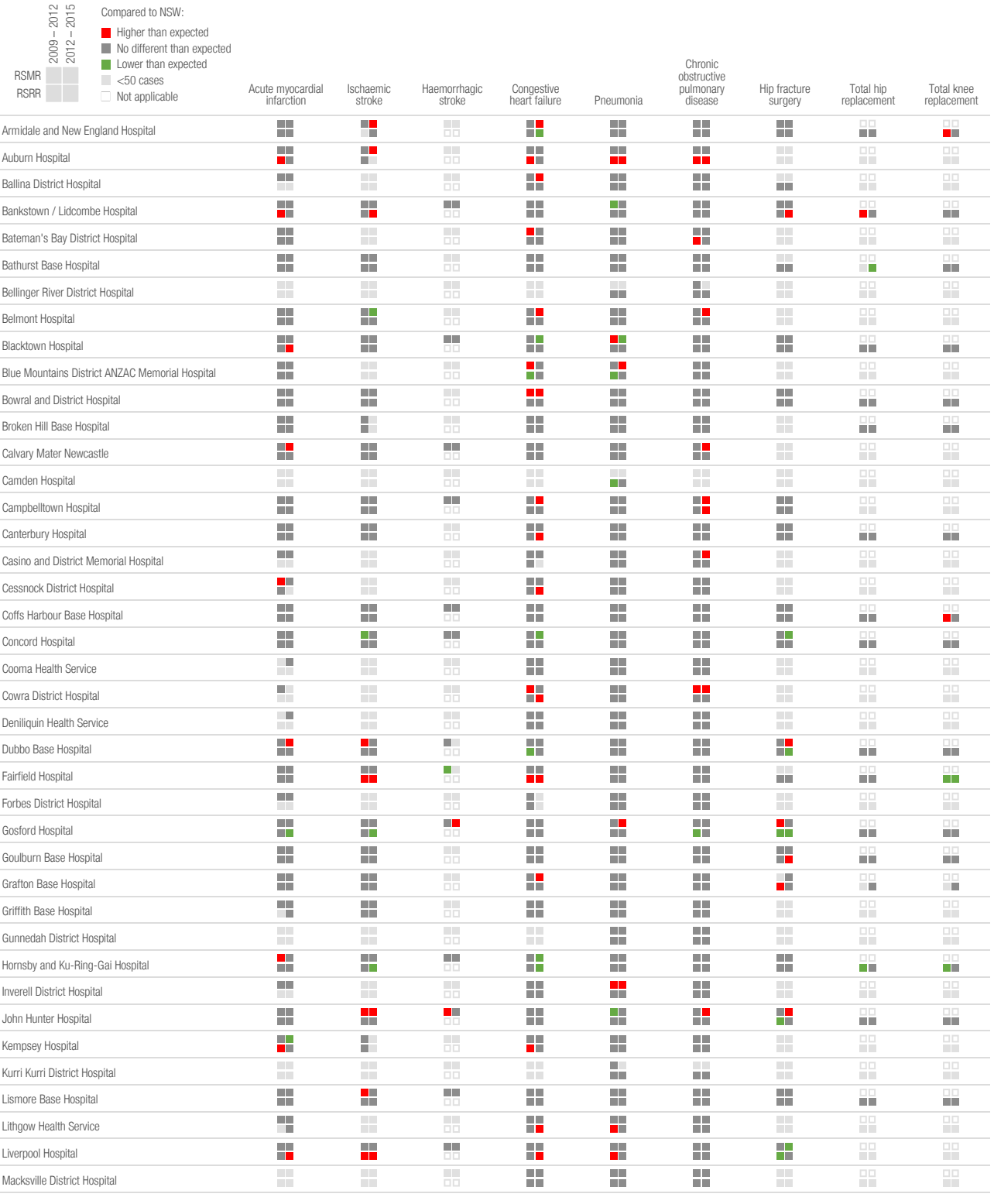
Out of the 79 hospitals included in the analyses, 25 hospitals had no outlier results for either mortality or readmission. There were a range of combinations, including:

- Four hospitals outperformed expected outcomes for both mortality and readmissions in a single condition – suggesting excellent performance. Mostly principal referral hospitals, they were St Vincent's for pneumonia; Hornsby for CHF; Royal North Shore for COPD and Prince of Wales for AMI.
- Three hospitals had both higher than expected mortality and higher than expected readmissions for a single condition – suggesting opportunities for improvement. All of these cases occurred among COPD patients. The hospitals were Campbelltown, Mudgee and Tamworth.
- There were four hospitals with a combination of higher than expected mortality but lower than expected readmissions for one or more conditions. Dominated by regional major and district hospitals, this pattern of results was seen in Maclean for CHF, Armidale for CHF, Manning for both pneumonia and hip fracture surgery and Dubbo for hip fracture surgery.
- No hospital had lower than expected mortality and higher than expected readmissions for a single condition.

Overview of hospital results

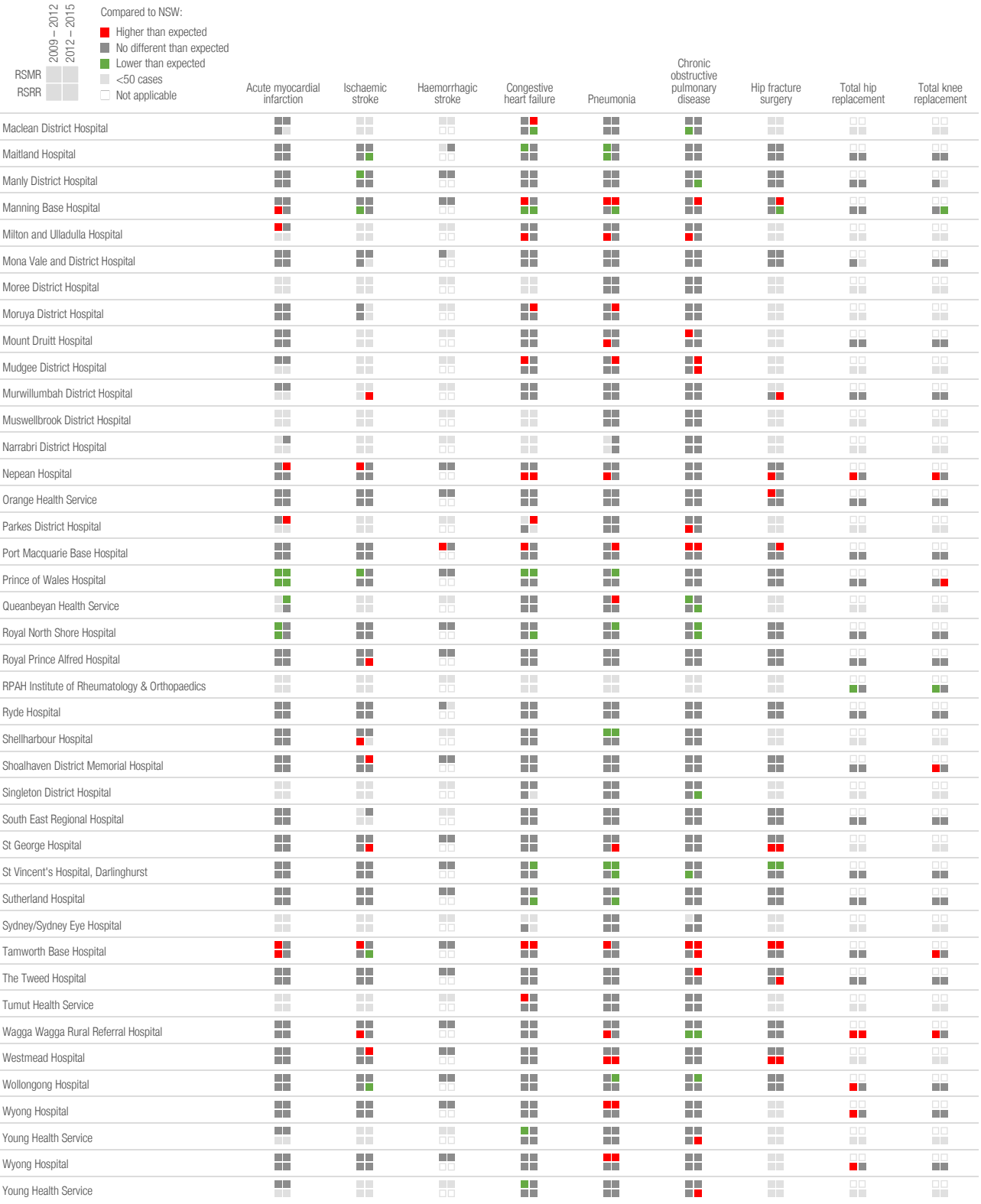
Providing an overview of hospital-level results across mortality and readmission analyses for two time periods helps to identify patterns of performance over time.

The overwhelming majority of hospital results were no different than expected (coloured grey).



For the mortality analyses, there were 398 individual hospital results, and of those 45 were higher than expected (coloured red) and 20 were lower than expected (coloured green).

For the readmission analyses, there were 435 individual hospital results, and of those 31 were higher than expected and 27 were lower than expected.



Acknowledgements

The Bureau of Health Information (BHI) is the main source of information for the people of NSW about the performance of their public healthcare system. A NSW board-governed organisation, BHI is led by Chairperson Professor Carol Pollock MBBS, PhD and Chief Executive Jean-Frédéric Lévesque MD, PhD.

We would like to thank our expert advisors, colleagues at the Ministry of Health, reviewers and staff who contributed to the report.

External Advisors and Reviewers

Ian Brownwood, Organization for Economic Cooperation and Development

Jacqui Close, Neuroscience Australia

Jason Fine, University North Carolina

Yana Gurevich, Kira Leeb, Kathleen Morris, Canadian Institute of Health Information

Isuru Ranasinghe, University of Adelaide

David Spiegelhalter, University of Cambridge

Bureau of Health Information Project Team

Analytics

Huei-Yang (Tom) Chen

Julia Chessman

Bradley Drayton

Sadaf Marashi-Pour (Lead)

Research

Diana Arachi

Ariana Dobrovic

Kim Sutherland

Design

Ed Bury

Adam Myatt

Efren Sampaga

Mark Williams

Communications and Stakeholder Engagement

Rohan Lindeman

Karen Perini

Stephanie Watson

bureau of health information

About the Bureau of Health Information

The Bureau of Health Information (BHI) is a board-governed organisation that provides independent information about the performance of the NSW public healthcare system.

BHI was established in 2009 to provide system-wide support through transparent reporting.

BHI supports the accountability of the healthcare system by providing regular and detailed information to the community, government and healthcare professionals. This in turn supports quality improvement by highlighting how well the healthcare system is functioning and where there are opportunities to improve.

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

BHI publishes a range of reports and tools that provide relevant, accurate and impartial information about how the health system is measuring up in terms of:

- Accessibility – healthcare when and where needed
- Appropriateness – the right healthcare, the right way
- Effectiveness – making a difference for patients
- Efficiency – value for money
- Equity – health for all, healthcare that's fair
- Sustainability – caring for the future

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 report 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.

bhi.nsw.gov.au

0149_UCV_IAO