Mortality following hospitalisation for seven clinical conditions

July 2015 – June 2018

bureau of health information

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State Health Publication Number: (BHI) 190550
ISSN: 2204-5511 (online)

Suggested citation:
Bureau of Health Information. Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018. Sydney (NSW): BHI; 2019.

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 or errata.

Published November 2019

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Setting the scene

Overview of key findings

Measures that assess how healthcare affects health outcomes make an important contribution to efforts to support transparency, strengthen accountability and inform local efforts to improve care for every patient in NSW.

This report provides the community and health professionals with information about the performance of 73 public hospitals in terms of patient deaths following admission for seven clinical conditions during the period July 2015 to June 2018. Altogether, these conditions account for about 11% of acute emergency hospitalisations for persons aged 15+ years in NSW, and about 28% of in-hospital deaths following acute emergency hospitalisation.

The main mortality indicator used in this report is the 30-day risk-standardised mortality ratio (RSMR) that takes into account the volume of patients treated and key patient risk factors beyond the control of the hospital. Three years of data are used to create stable, reliable estimates of performance.

As with any measure, care is needed in interpretation. Each hospital's ratio is based on its particular patient cohort so cannot be used in direct hospital comparisons. While the statistical models used to risk-standardise perform well, some risk factors are not captured in the available data, so standardisation is not perfect. RSMRs are best used as screening tools to indicate where further, locally-driven, assessment is needed. They should be looked at alongside other measures and used by clinicians as a tool to prompt discussion and inform the development of quality improvement initiatives.

Mortality rates across NSW

Age-sex standardised rates for 30-day mortality from 2015–2018 have fallen for all seven conditions when compared with 2012–2015. The largest decrease was for pneumonia (Table 1).

Rates for 2015–2018 were lowest for acute myocardial infarction (AMI) (6.7%) and hip fracture surgery (6.9%), and highest for congestive heart failure (CHF) (13.2%) and haemorrhagic stroke (32.6%).

Deaths that occurred in hospital or after discharge varied by condition. For example, of those patients who died within 30 days of admission for hip fracture surgery, 60% of deaths occurred after discharge. By comparison, of those patients who died within 30 days of admission for haemorrhagic stroke, two-thirds of deaths (67%) occurred in hospital and 33% occurred after discharge (Figure 3, page 13).

Seven conditions covered

- Acute myocardial infarction
- Ischaemic stroke
- Haemorrhagic stroke
- Congestive heart failure
- Pneumonia
- Chronic obstructive pulmonary disease
- Hip fracture surgery.

Table 1 30-day mortality, age-sex standardised rate per 100 hospitalisations, by condition, NSW

Condition	No. of patients hospitalised July 2015 – June 2018	Mortality rate		
		July 2015 – June 2018	July 2012 – June 2015	Change
AMI	30,560	6.7	7.3	-8.0%
Ischaemic stroke	17,415	13.0	13.5	-3.6%
Haemorrhagic stroke	5,264	32.6	33.3	-2.2%
CHF	28,514	13.2	13.7	-3.6%
Pneumonia	49,810	9.7	11.1	-12.3%
COPD	32,605	9.1	9.7	-5.9%
Hip fracture surgery	16,538	6.9	7.6	-8.8%

Mortality ratios across hospitals

Across all seven conditions, a large majority of hospitals had RSMRs that were not significantly different than expected.

The number of hospitals with lower than expected mortality ranged from zero (ischaemic stroke) to five (CHF and chronic obstructive pulmonary disease).

The number of hospitals with higher than expected mortality ranged from two (haemorrhagic stroke) to seven (CHF).

Six hospitals had lower than expected mortality for at least two conditions:

- **Blacktown**: AMI; and pneumonia
- **Prince of Wales**: AMI; haemorrhagic stroke; and chronic obstructive pulmonary disease (COPD)
- **Royal North Shore**: AMI; and COPD
- **Royal Prince Alfred**: CHF; and COPD
- **Ryde**: CHF; and hip fracture surgery
- **St Vincent's**: haemorrhagic stroke; CHF; pneumonia; and COPD.

Nine hospitals had higher than expected mortality for at least two conditions:

- **Blue Mountains**: AMI; CHF; and COPD
- **Bowral**: CHF*; and hip fracture surgery
- **Gosford**: pneumonia; and hip fracture surgery
- **Lithgow**: CHF; and COPD
- **Nepean**: AMI; and ischaemic stroke
- **Orange**: pneumonia; and COPD
- **Port Macquarie**: AMI; and COPD
- **Tamworth**: ischaemic stroke; and pneumonia
- **Wyong**: haemorrhagic stroke; and pneumonia.*

Mortality ratios across local health districts

There are some metropolitan local health districts (LHDs) such as Northern Sydney, South Eastern Sydney, Sydney, and St Vincent's Health Network, where one or more hospitals had RSMRs lower than expected. These LHDs had no hospitals where RSMRs were higher than expected.

At the same time, there were some LHDs such as Central Coast*, Nepean Blue Mountains and Hunter New England where two or more hospitals had RSMRs higher than expected. These LHDs had no hospitals where RSMRs were lower than expected.

Murrumbidgee was the only LHD with no hospital with 50 or more index admissions with an RSMR lower or higher than expected.

*The RSMRs for Bowral (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. Bowral (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

About this report

Introduction

This report aims to provide information that is useful for health professionals in understanding patterns of mortality across the seven clinical conditions in their hospitals and informs local efforts to improve care. The Australian Commission on Safety and Quality in Healthcare describes mortality indicators as 'crucial elements of a hospital patient safety monitoring program'. They should be looked at alongside other measures and used to prompt discussion and inform the development of quality improvement initiatives. This report also provides transparency for the community about patterns of mortality across the seven clinical conditions within 30 days of admission to a NSW public hospital.

This is the Bureau of Health Information (BHI's) third report exploring 30-day mortality following hospitalisation in NSW. It provides risk-standardised mortality ratios (RSMRs) for seven clinical conditions for 73 NSW public hospitals:

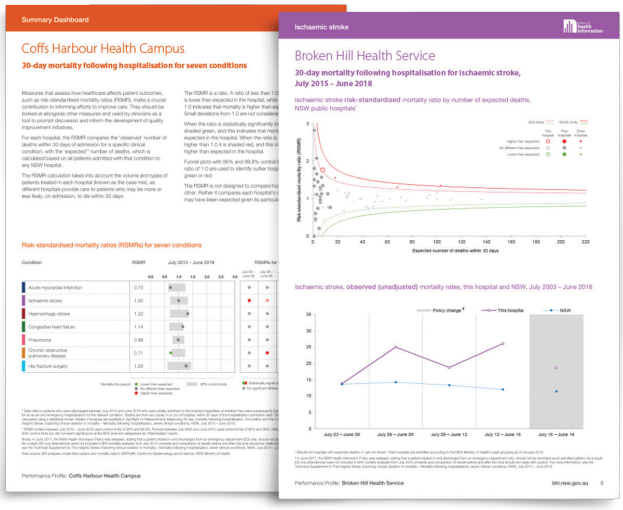
- Acute myocardial infarction
- Ischaemic stroke
- Haemorrhagic stroke
- Congestive heart failure
- Pneumonia
- Chronic obstructive pulmonary disease
- Hip fracture surgery.

The results were calculated for patients who were hospitalised during the period July 2015 to June 2018.

See Appendix 1 for a list of hospitals included in the analyses.

Hospital profiles

Individual hospital profiles for 73 public hospitals with more than 50 index hospitalisations accompany this report. Each profile provides the hospital's condition-specific RSMRs for July 2015 – June 2018 and information on previous three-year periods. It outlines key characteristics of patients admitted for each condition, including comorbidities and how they differ from the NSW patient population, information on where and when deaths occurred and the distribution of higher and lower than expected results across peer group and other hospitals. These profiles are available at **bhi.nsw.gov.au**



Measuring mortality

There are a range of mortality indicators in use within and outside Australia. In order to provide information on healthcare performance that is fair, meaningful and useful for informing improvement, BHI has calculated 30-day risk-standardised mortality ratios (RSMRs) that are specific to seven clinical conditions.

While hospital-level mortality indicators have their place, condition-specific indicators are more meaningful at clinical level and arguably more useful for informing improvement.

Focusing on deaths that occur within 30 days of admission, rather than just in-hospital deaths, provides a more complete picture of patient outcomes following discharge from acute care. By using linked data, BHI's analysis is also able to take into account patient transfers between any NSW hospital, including private hospitals. Three years of data are used to create stable, reliable estimates of performance.

Risk-standardised mortality ratios

Measuring mortality is not straightforward. While death is an unequivocal outcome, its occurrence reflects a combination of inherent patient risk factors, such as age and the complexity of a patient's condition, as well as quality and safety factors that may be amenable to change. Risk standardisation allows some of the impact of differences in patient characteristics to be taken into account, allowing fairer comparisons to be made.

RSMRs therefore make adjustments for the types of patients treated in each hospital (known as the case mix) as different hospitals provide care to patients who may be more or less likely, on admission, to die within 30 days. They also take into account the volume of patients treated at each hospital for that condition. This means that a hospital that treats older or sicker patients is not expected to have similar rates of mortality as a hospital that treats younger or less complex cases.

For each hospital, the RSMR compares the 'observed' number of deaths within 30 days of admission for a specific clinical condition, with the 'expected' number of deaths, which is calculated based on all patients admitted with that condition to any NSW hospital.

The RSMR is a ratio. A ratio of less than 1.0 indicates that mortality is lower than expected in the hospital, while a ratio of greater than 1.0 indicates that mortality is higher than expected in the hospital. Small deviations from 1.0 are not considered meaningful.

In this report and in accordance with international practice, the RSMR has been used to identify:

- hospitals with mortality ratios statistically significantly lower than expected based on the volume and types of patients
- hospitals with mortality ratios no higher or lower than expected based on the volume and types of patients
- hospitals with mortality ratios statistically significantly higher than expected based on the volume and types of patients.

As with any measure, care is needed in interpretation. Each hospital's ratio is based on its particular patient cohort so cannot be used in direct hospital comparisons or to create league tables. While the models perform well, some risk factors are not captured in the available data, and so adjustment is not perfect. RSMRs are best used as screening tools to indicate where further, locally-driven, assessment is needed.

Seven conditions

The conditions included in this report range in terms of acuity, span chronic and acute care, and encompass different surgical and medical specialties.

Altogether, these conditions account for about 11% of acute emergency hospitalisations for persons aged 15+ years in NSW, and about 28% of in-hospital deaths following acute emergency hospitalisation.

Acute myocardial infarction (AMI)

- Occurs when blood supply to part of the heart is interrupted
- Between July 2015 and June 2018, 30,560 patients were hospitalised for AMI
- 1,948 patients were hospitalised for AMI two or more times
- 65% of hospitalised patients were male
- Average patient age was 69 years (38% were aged 75+ years)
- 1,792 patients died within 30 days of hospitalisation (six deaths per 100 patients)†
- 5% of male patients died; 8% of female patients died

Ischaemic stroke

- Occurs when a blood vessel is blocked, depriving the brain of oxygen
- Between July 2015 and June 2018, 17,415 patients were hospitalised for ischaemic stroke
- 800 patients were hospitalised for ischaemic stroke two or more times
- 56% of hospitalised patients were male
- Average patient age was 74 years (55% were aged 75+ years)
- 1,996 patients died within 30 days of hospitalisation (11 deaths per 100 patients)†
- 9% of male patients died; 14% of female patients died

Haemorrhagic stroke

- Occurs when a blood vessel in the brain develops a leak or bursts
- Between July 2015 and June 2018, 5,264 patients were hospitalised for haemorrhagic stroke
- 246 patients were hospitalised for haemorrhagic stroke two or more times
- 56% of hospitalised patients were male
- Average patient age was 74 years (55% were aged 75+ years)
- 1,620 patients died within 30 days of hospitalisation (31 deaths per 100 patients)†
- 26% of male patients died; 36% of female patients died

Congestive heart failure (CHF)

- Occurs when the heart is unable to pump adequately
- Between July 2015 and June 2018, 28,514 patients were hospitalised for CHF
- 7,178 patients were hospitalised for CHF two or more times
- 52% of hospitalised patients were male
- Average patient age was 80 years (72% were aged 75+ years)
- 3,683 patients died within 30 days of hospitalisation (13 deaths per 100 patients)†
- 13% of male patients died; 13% of female patients died

There are clear differences in the patient populations and outcomes across the conditions. For example, patients hospitalised for acute myocardial infarction were, on average, younger than those hospitalised for hip fracture surgery (69 and 83 years, respectively). With the exception of hip fracture surgery and chronic obstructive pulmonary disease, more than half of patients were male for each condition.

Pneumonia

- Occurs when one or both lungs are inflamed, usually due to infection
- Between July 2015 and June 2018, 49,810 patients were hospitalised for pneumonia
- 4,690 patients were hospitalised for pneumonia two or more times
- 53% of hospitalised patients were male
- Average patient age was 71 years (50% were aged 75+ years)
- 4,538 patients died within 30 days of hospitalisation (nine deaths per 100 patients)†
- 10% of male patients died; 9% of female patients died

Chronic obstructive pulmonary disease (COPD)

- Occurs when the lungs are unable to provide adequate oxygenation
- Between July 2015 and June 2018, 32,605 patients were hospitalised for COPD
- 10,798 patients were hospitalised for COPD two or more times
- 49% of hospitalised patients were male
- Average patient age was 74 years (51% were aged 75+ years)
- 3,084 patients died within 30 days of hospitalisation (nine deaths per 100 patients)†
- 10% of male patients died; 9% of female patients died

Hip fracture surgery

- A fracture in the upper quarter of the thigh bone (femur), treated with surgery
- Between July 2015 and June 2018, 16,538 patients were hospitalised for hip fracture and had surgery
- 30% of those patients were male
- Average patient age was 83 years (80% were aged 75+ years)
- 1,055 patients died within 30 days of hospitalisation (six deaths per 100 patients)†
- 9% of male patients died; 5% of female patients died

† These rates are not standardised for age and sex.

Data and methods

The measure

The principal indicator used in the report is a risk-standardised mortality ratio (RSMR) (Figure 1).

The RSMR calculates, for each hospital, the 'observed' number of patient deaths in or out of hospital within 30 days of admission compared with the 'expected' number of deaths. The 'expected' number of deaths is generated by a statistical model that takes into account patient characteristics that affect the likelihood of dying following hospitalisation.

For each condition, principal diagnosis codes were used to identify patients hospitalised between 1 July 2015 and 30 June 2018. For hip fracture surgery, procedure codes and diagnosis-related group codes were also used to identify the index cohort.

Multiple acute, contiguous hospitalisations were considered as a single, acute period of care. Acute admissions on the same day of separation from another acute hospitalisation are included in the same acute period of care, regardless of the mode of separation recorded in the initial hospital. If an acute admission is coded as ending in a transfer, and there is another acute admission within one day of that transfer, the second admission is concatenated into the same period of care.

Data sources

Data were drawn from the Hospital Performance Dataset, NSW Ministry of Health Secure Analytics for Population Health Research and Intelligence.

Record linkage was carried out by the Centre for Health Record Linkage (www.cherel.org.au). Linked data were used to measure all patient deaths that occurred in the 30 days following hospitalisation, both in hospital and after discharge. SAS[1] was used for the analyses.

Prediction models

For each condition, NSW-level prediction models were developed using index admissions between 1 July 2015 and 30 June 2018 and using random intercept logistic regression models, taking into account patient-level risk factors (age, sex and comorbidities) and clustering within hospitals. C-statistics assess the prediction ability of the models and range from 0.67 for haemorrhagic stroke to 0.86 for acute myocardial infarction (see Appendix 2 for model variables and C-statistics). The stability of the coefficients was tested using different years of data.

Interpretation

Funnel plots are used to determine whether RSMRs reach statistical significance.

In line with international best practice and in order to enhance specificity and limit type I errors, this report presents RSMRs in funnel plots with 95% and 99.8% control limits.

Control limits are calculated based on a Poisson distribution. Hospital RSMRs that fall outside the 95% control limits are considered to be 'special cause' outliers and results are flagged. The probability that a hospital would fall outside the upper 95% control limit by chance alone is, at most, one in 40.[2]

In June 2017, the *NSW Health Admission Policy* was released, stating that a patient treated in and discharged from an emergency department (ED) only, should not be recorded as an admitted patient.[3] As a result, ED-only attendances in admitted patient data were not included in BHI mortality analyses for the July 2015 – June 2018 period, and comparison of results before and after this time should be made with caution (see Technical Supplement for more information).

Attribution and reporting

Outcomes were attributed to the first admitting hospital within the period of care.

NSW hospitals vary in size and in the types and complexity of clinical services they provide. For some analyses, data are stratified by peer group in terms of principal referral hospitals (peer group A), major hospitals (peer group B) and district hospitals (peer group C). Results for principal referral, major and district hospitals (peer groups A to C) with at least 50 hospitalisations for the condition of interest in the three-year study period are reported publicly. Not all hospitals have results for all conditions. Results for hospitals with <1.0 expected deaths are suppressed.

See Appendix 1 for a list of hospitals included in the analyses

Depth of coding

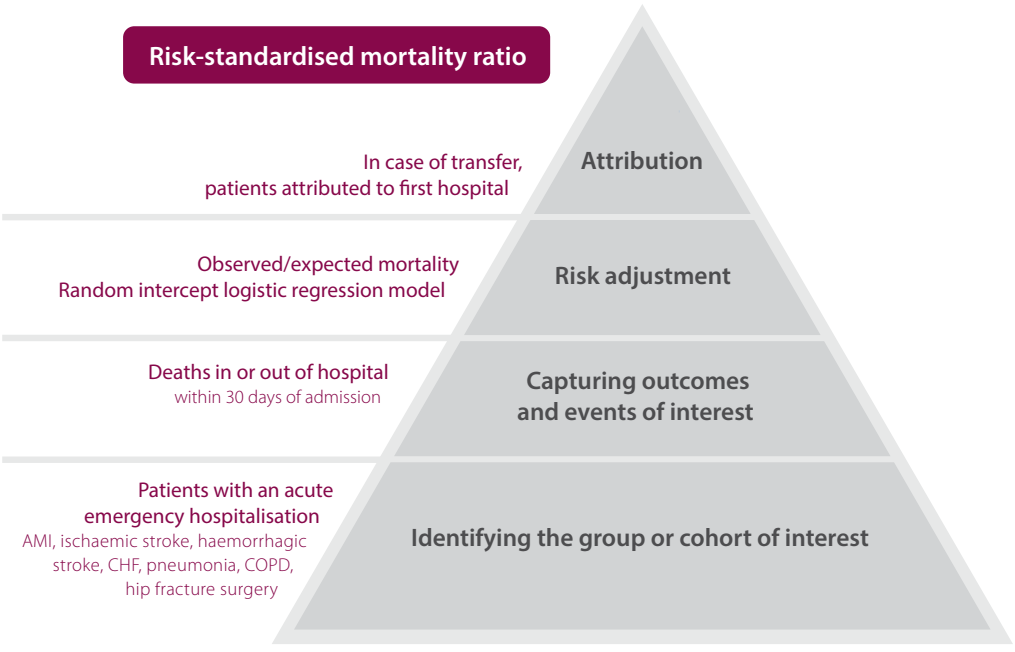
The RSMR relies on accurate coding of secondary diagnoses in patients' hospital records. Comorbidities are identified by a one-year lookback to capture all comorbidities listed in any hospitalisation in the preceding year. Depth of coding is monitored to assess differences over time and between hospitals (see Technical Supplement).[4]

Multiple periods of care

Among patients who had multiple hospitalisations for a condition, only the last period of care was considered in the analysis. Across the conditions, the proportion of patients who had a single period of care during July 2015 – June 2018 ranged from 67% among patients hospitalised for COPD to 97% for hip fracture surgery patients.

Details about cohort definitions, outcomes, risk adjustment models and attribution are described in the Technical Supplement and *Spotlight on Measurement: Measuring 30-day mortality following hospitalisation, NSW, July 2012 – June 2015, 2nd edition*.[5]

Figure 1 Risk-standardised ratios for assessing performance in mortality



Exploring mortality results

NSW results

Between 2003 and 2018, NSW age-sex standardised mortality rates improved considerably for six of the seven conditions – with decreases ranging from 16% for ischaemic stroke (from 15.5 to 13.0 deaths per 100 patients) to 25% for acute myocardial infarction (AMI) (from 9.0 to 6.7 deaths per 100 patients). The mortality rate for haemorrhagic stroke has not decreased but has remained stable at 33% (Figure 2).

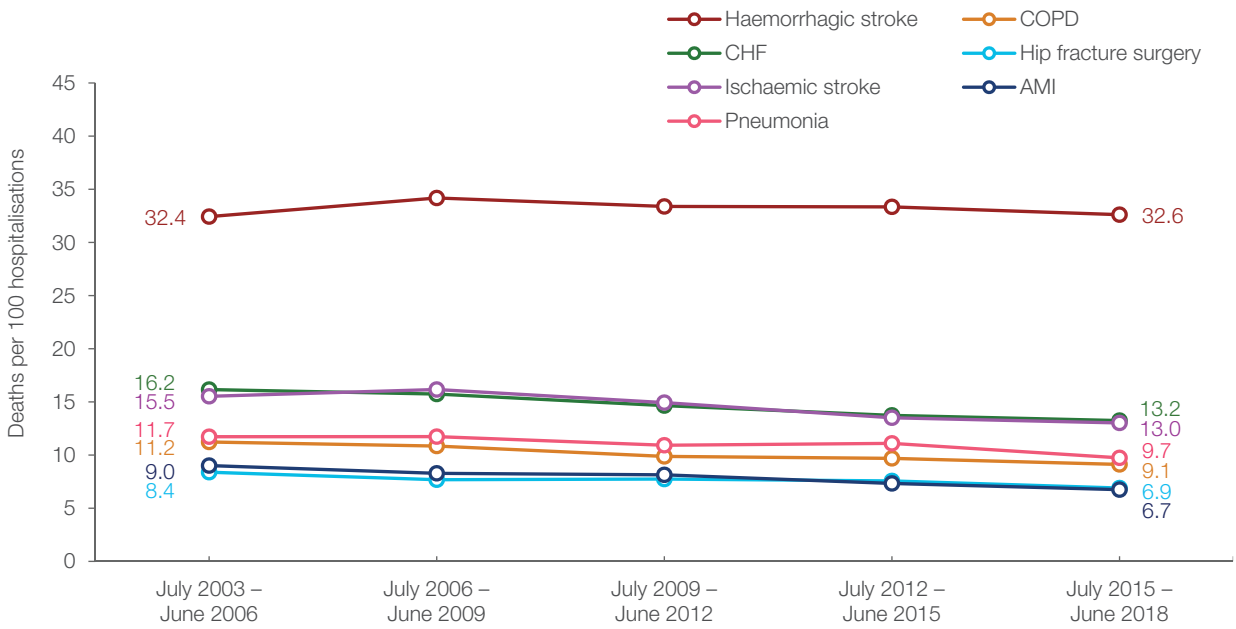
More recently, between 2012–2015 and 2015–2018, mortality rates continued to fall – most markedly for pneumonia (from 11.1 to 9.7 deaths per 100 patients) (Figure 2).

Altogether, these conditions account for about 11% of acute emergency hospitalisations for persons aged 15+ years in NSW, and about 28% of in-hospital deaths following acute emergency hospitalisation.

The seven conditions differed in the percentage of deaths that occurred after discharge from hospital – ranging from 33% for haemorrhagic stroke to 60% for hip fracture surgery (Figure 3).

The conditions also differed in the rate and patterns of mortality across the seven clinical conditions over the 30-day period following hospitalisation. Mortality was particularly high in the first seven days following hospitalisation for haemorrhagic stroke (Figure 4).

Figure 2 **30-day mortality, age-sex standardised rate per 100 hospitalisations, by condition, NSW, July 2003 – June 2018**



Note: Indirectly standardised using July 2015 – June 2018 NSW condition-specific hospitalisation cohorts as the standard population. Excludes patients who were treated in, and discharged from, an emergency department only.

Figure 3 Percentage of deaths within 30 days of admission that occurred in hospital and after discharge, by condition, NSW, July 2015 – June 2018

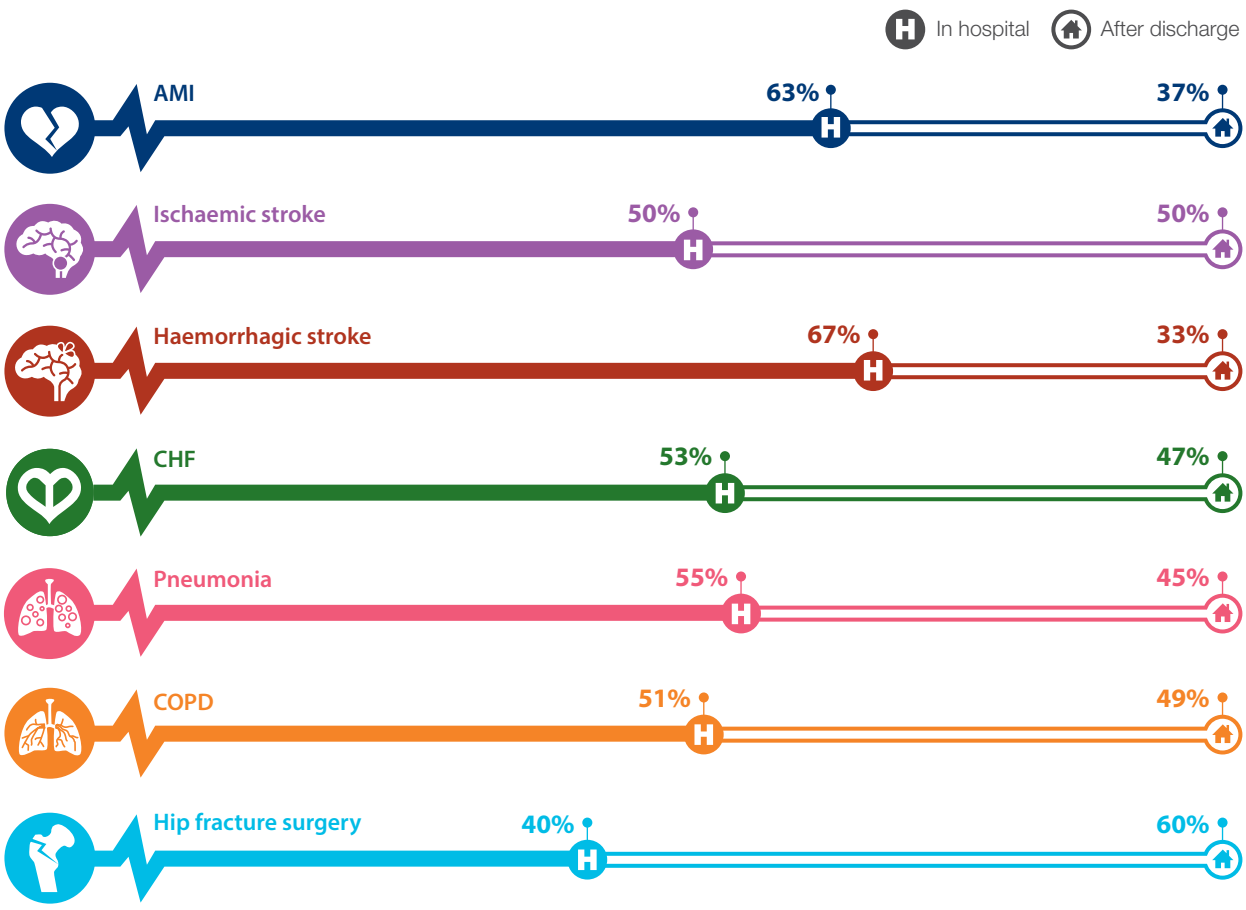
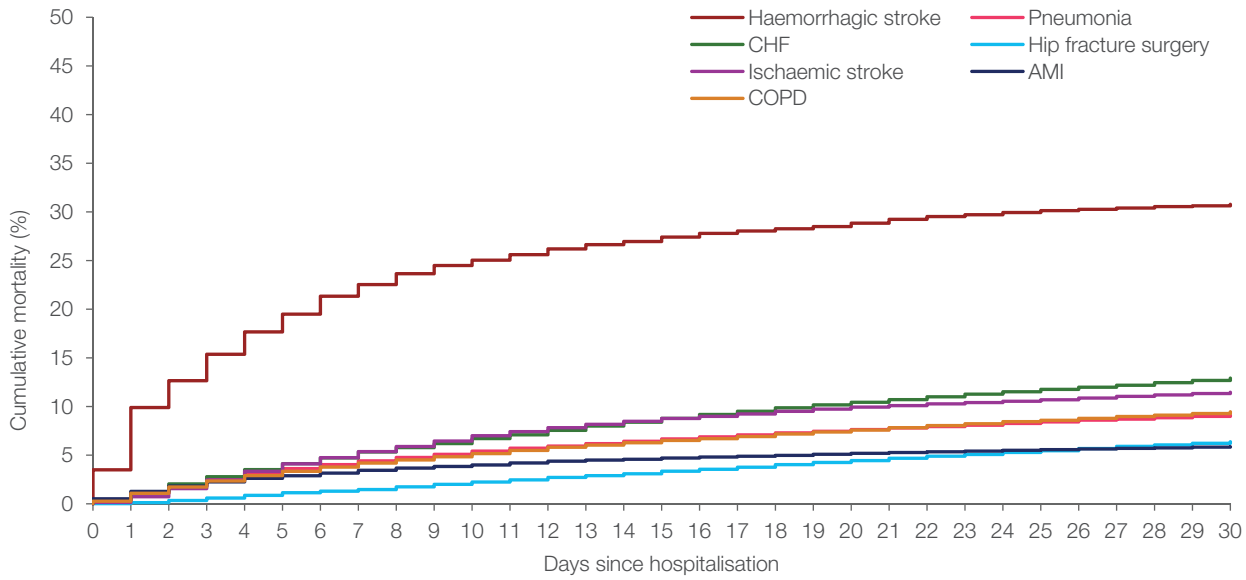


Figure 4 Cumulative mortality (%) in 30 days following admission to hospital, by condition, NSW, July 2015 – June 2018



Hospital results

Across the seven conditions in 2015–2018, the number of hospitals with lower than expected mortality ranged from zero hospitals for ischaemic stroke to five for CHF and COPD; and the number with higher than expected mortality ranged from two hospitals for haemorrhagic stroke to seven for CHF (Table 2).

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 49 hospitals (80%) for congestive heart failure (CHF) to 37 hospitals (90%) for ischaemic stroke (Figure 5 and Appendix 1).

In the 2015–2018 analyses, 54 hospitals had no conditions for which mortality was higher than expected. St Vincent's and Prince of Wales hospitals had lower than expected mortality for four and three conditions respectively, and Blue Mountains had higher than expected mortality for three conditions (Figure 6 and Appendix 1).

Table 2 **30-day mortality results, by condition, NSW public hospitals, July 2015 – June 2018**

	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Higher than expected mortality	Blue Mountains Nepean Port Macquarie	Broken Hill Nepean Tamworth Westmead	Campbelltown* Wyong*	Ballina Blue Mountains Bowral* Cessnock Cooma Lithgow Milton Ulladulla*	Gosford Orange Tamworth Wyong*	Blue Mountains Cowra Lithgow Manning Orange Port Macquarie	Bowral Gosford John Hunter
Lower than expected mortality	Blacktown Prince of Wales Royal North Shore		Prince of Wales St Vincent's	Concord Royal Prince Alfred Ryde St Vincent's Wollongong	Blacktown Shoalhaven St Vincent's Sydney & Sydney Eye	Coffs Harbour Prince of Wales Royal North Shore Royal Prince Alfred St Vincent's	Liverpool Ryde St George

*The RSMRs for Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Figure 5 Number of public hospitals, by outlier status for 30-day mortality, by condition, NSW, July 2015 – June 2018

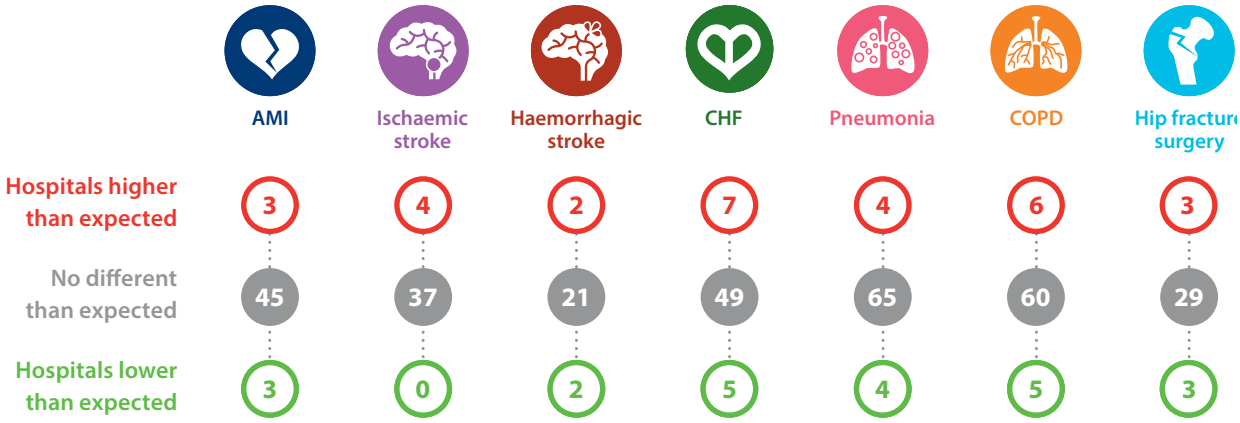
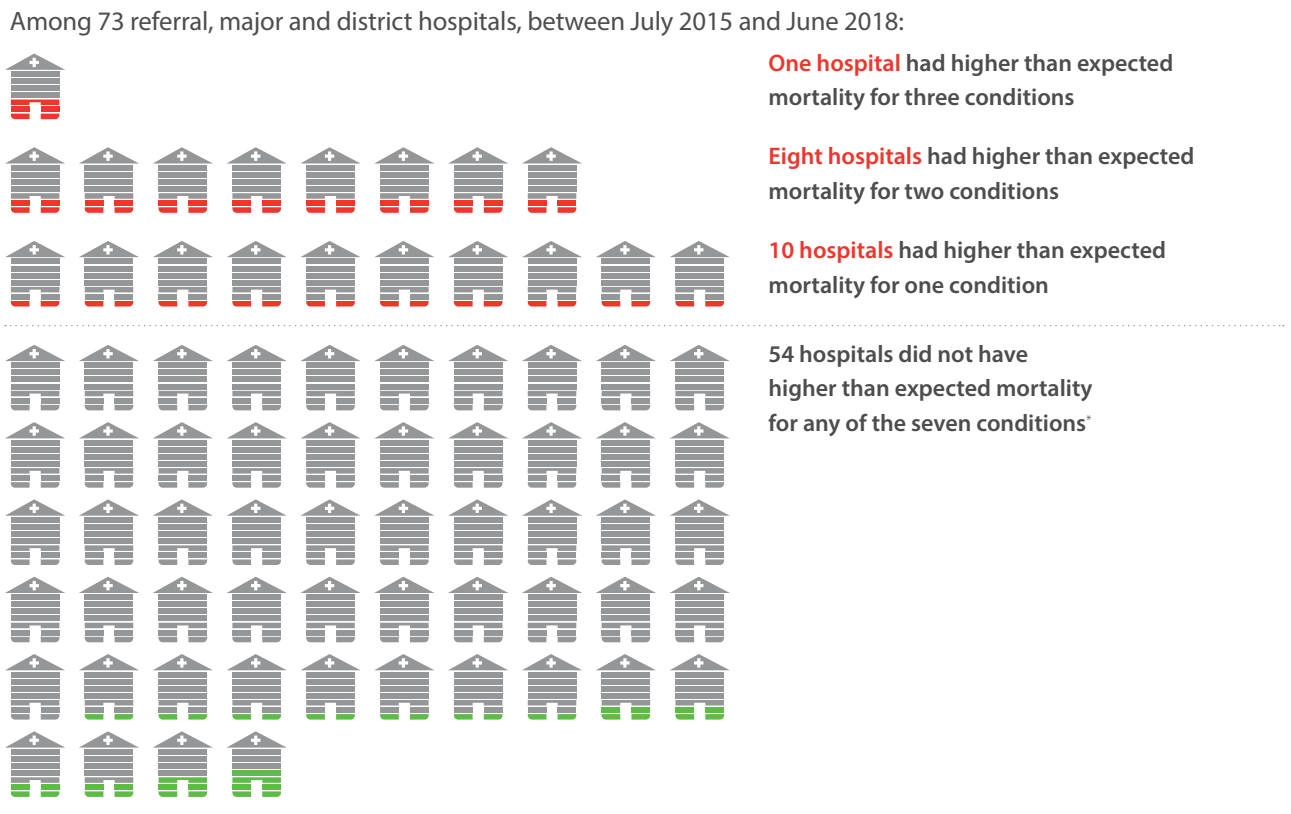


Figure 6 30-day mortality, concentration of outlier results across hospitals, NSW, July 2015 – June 2018



* Not all hospitals have results for all seven conditions. See Appendix 1 for more details

Local health district results

In NSW there are 16 local health districts (LHDs) responsible for the 73 public hospitals included in this report.

Across the seven clinical conditions, public hospitals with 30-day mortality results statistically significantly lower or higher than expected are summarised for each LHD in Table 3.

There were instances of both lower and higher than expected risk-standardised mortality ratios (RSMRs) across metropolitan, regional and rural LHDs.

There are some metropolitan LHDs such as Northern Sydney, South Eastern Sydney, Sydney, and St Vincent's Health Network, where one or more hospitals had RSMRs lower than expected. These LHDs had no hospitals where RSMRs were higher than expected.

At the same time, there were some LHDs such as Central Coast*, Nepean Blue Mountains and Hunter New England where two or more hospitals had RSMRs higher than expected. These LHDs had no hospitals where RSMRs were lower than expected.

Murrumbidgee was the only LHD with no hospital with 50 or more index admissions with an RSMR lower or higher than expected (Table 3).

Across LHDs, most public hospitals had RSMR results that were no different than expected. See Appendix 1 for a full list of hospitals included in the analyses.

Table 3 **Hospitals with statistically signifcant 30-day risk-standardised mortality ratios that are lower or higher than expected, by local health district and condition, NSW, July 2015 – June 2018**

● Higher than expected ● Lower than expected

	Local health district	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Metropolitan	Central Coast			Wyong*		Gosford Wyong*		Gosford
	Illawarra Shoalhaven				Milton Ulladulla* Wollongong	Shoalhaven		
	Nepean Blue Mountains	Blue Mountains Nepean	Nepean		Blue Mountains Lithgow		Blue Mountains Lithgow	
	Northern Sydney	Royal North Shore			Ryde		Royal North Shore	Ryde
	South Eastern Sydney	Prince of Wales		Prince of Wales		Sydney & Sydney Eye	Prince of Wales	St George
	South Western Sydney			Campbelltown*	Bowral*			Bowral Liverpool
	Sydney				Concord Royal Prince Alfred		Royal Prince Alfred	
	Western Sydney	Blacktown	Westmead			Blacktown		
	St Vincent's Health Network			St Vincent's	St Vincent's	St Vincent's	St Vincent's	
Rural and regional	Far West		Broken Hill					
	Hunter New England		Tamworth		Cessnock	Tamworth	Manning	John Hunter
	Mid North Coast	Port Macquarie					Coffs Harbour Port Macquarie	
	Murrumbidgee	Murrumbidgee LHD did not have any hospitals that were outliers in 2015–2018						
	Northern NSW				Ballina			
	Southern NSW				Cooma			
	Western NSW					Orange	Cowra Orange	

*The RSMRs for Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Condition-specific results

Acute myocardial infarction

An acute myocardial infarction (AMI), or heart attack, occurs when the blood supply to part of the heart is interrupted, resulting in death of heart cells. The heart muscle suffers permanent damage if blood supply is not restored quickly.

Key characteristics of people admitted to hospital for AMI between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 AMI patients, unadjusted mortality rates ranged from 2.2 to 12.9 deaths per 100 patients.

Figure 7 shows 30-day risk-standardised mortality ratios (RSMRs) for each hospital in the state. Of the 51 principal referral, major and district hospitals (peer groups A–C) that admitted 50 or more AMI patients in the three-year period, there were three (Blacktown, Prince of Wales and Royal North Shore) with lower than expected mortality and three (Blue Mountains, Port Macquarie and Nepean) with higher than expected mortality.

These outliers were found in both smaller district and larger principal referral hospitals (Figure 8).

For AMI patient factors and comorbidities, see Appendix 2.

Acute myocardial infarction 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 30,560 patients were hospitalised with a principal diagnosis of AMI (ICD-10-AM code I21, excluding I21.9). Of these patients, 1,948 were hospitalised for AMI two or more times. Only their last hospitalisation is considered.
- 1,792 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of six per 100 patients.

Among the 1,792 deaths within 30 days:

- 1,094 (61%) occurred in the initial admitting hospital
- 38 (2%) occurred in another hospital, following patient transfer
- 660 (37%) occurred after discharge, outside hospital
- 157 (9%) occurred on first day of hospitalisation
- 1,053 (59%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for AMI had an average age of 69 years (median 69); while patients who died within 30 days had an average age of 81 years (median 83)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.9
- More males (19,984) than females (10,576) were hospitalised for AMI
- Among males, 5% died within 30 days, while among females, 8% died within 30 days
- After adjusting for age and comorbidity, sex was not significantly associated with mortality.

Figure 7 Acute myocardial infarction 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

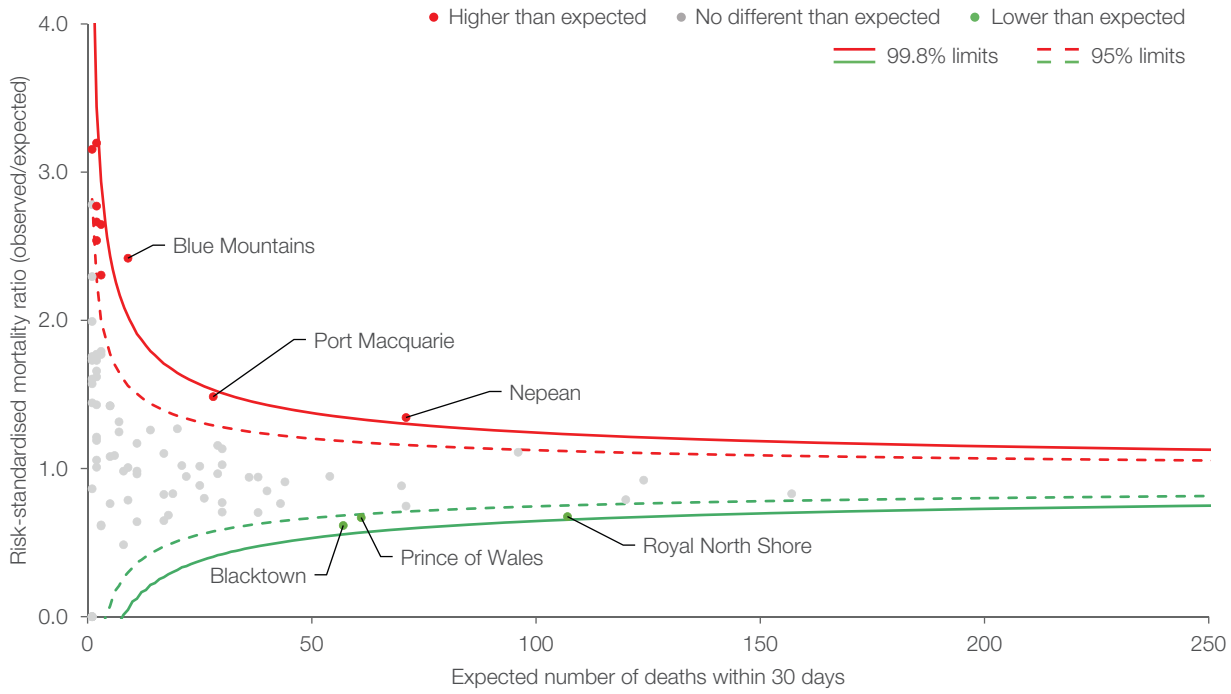
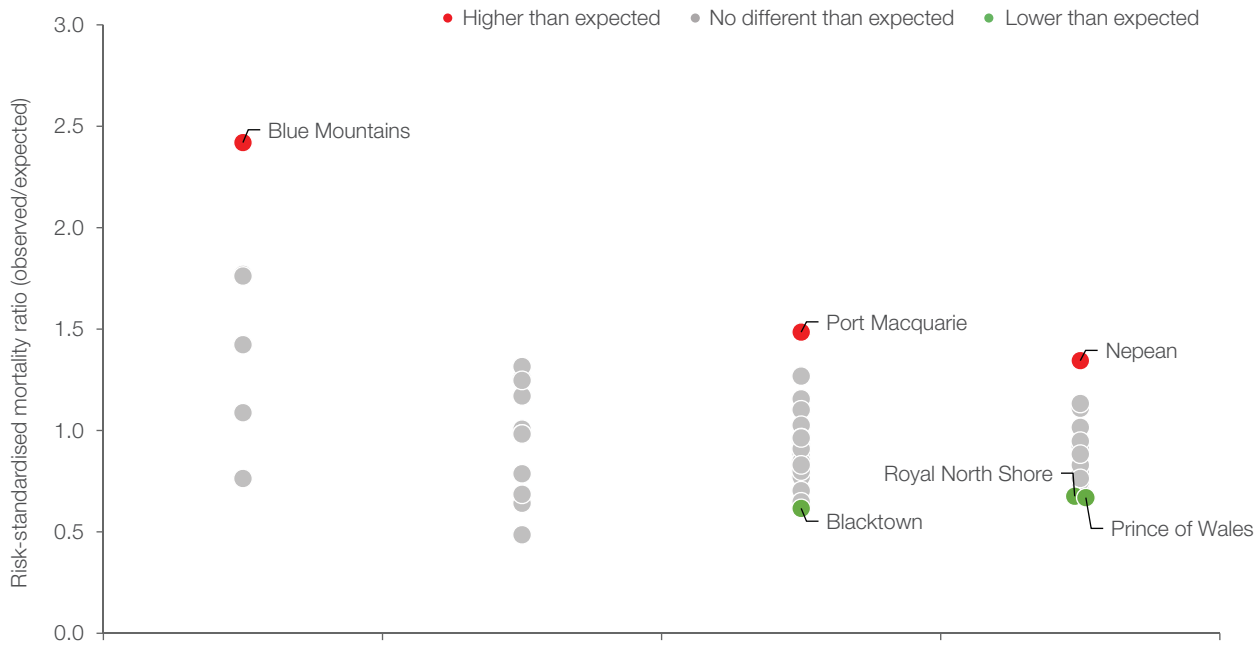


Figure 8 Acute myocardial infarction 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018



Number of patients	739	2,021	10,629	15,337

Ischaemic stroke

Ischaemic stroke occurs when a blood vessel is blocked, depriving the brain of oxygen and nutrients. As a result, the area of the brain supplied or drained by the blood vessel suffers damage. The severity and consequences of stroke can vary from complete recovery to severe disability or death.

Key characteristics of people admitted to hospital for ischaemic stroke between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 ischaemic stroke patients, unadjusted mortality rates ranged from 2.0 to 18.7 deaths per 100 patients.

Figure 9 shows 30-day RSMRs for each hospital. Of the 41 hospitals that admitted 50 or more ischaemic stroke patients in the three-year period, there were no hospitals with lower than expected mortality and four hospitals (Broken Hill, Tamworth, Nepean and Westmead) with higher than expected mortality.

Higher than expected mortality occurred across all peer groups (Figure 10).

For ischaemic stroke patient factors and comorbidities, see Appendix 2.

Ischaemic stroke 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 17,415 patients were hospitalised with a principal diagnosis of ischaemic stroke (ICD-10-AM code I63). Of these patients, 800 were hospitalised for ischaemic stroke two or more times. Only their last hospitalisation is considered.
- 1,996 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of 11 per 100 patients.

Among the 1,996 deaths within 30 days:

- 980 (49%) occurred in the initial admitting hospital
- 26 (1%) occurred in another hospital, following patient transfer
- 990 (50%) occurred after discharge, outside hospital
- 25 (1%) occurred on the first day of hospitalisation
- 935 (47%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for ischaemic stroke had an average age of 73 years (median 75); while patients who died within 30 days had an average age of 83 years (median 85)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.2
- More males (9,687) than females (7,728) were hospitalised for ischaemic stroke
- Among males, 9% died within 30 days, while among females, 14% died within 30 days
- After adjusting for age and comorbidity, sex was significantly associated with mortality; males had a lower risk of death.

Figure 9 Ischaemic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

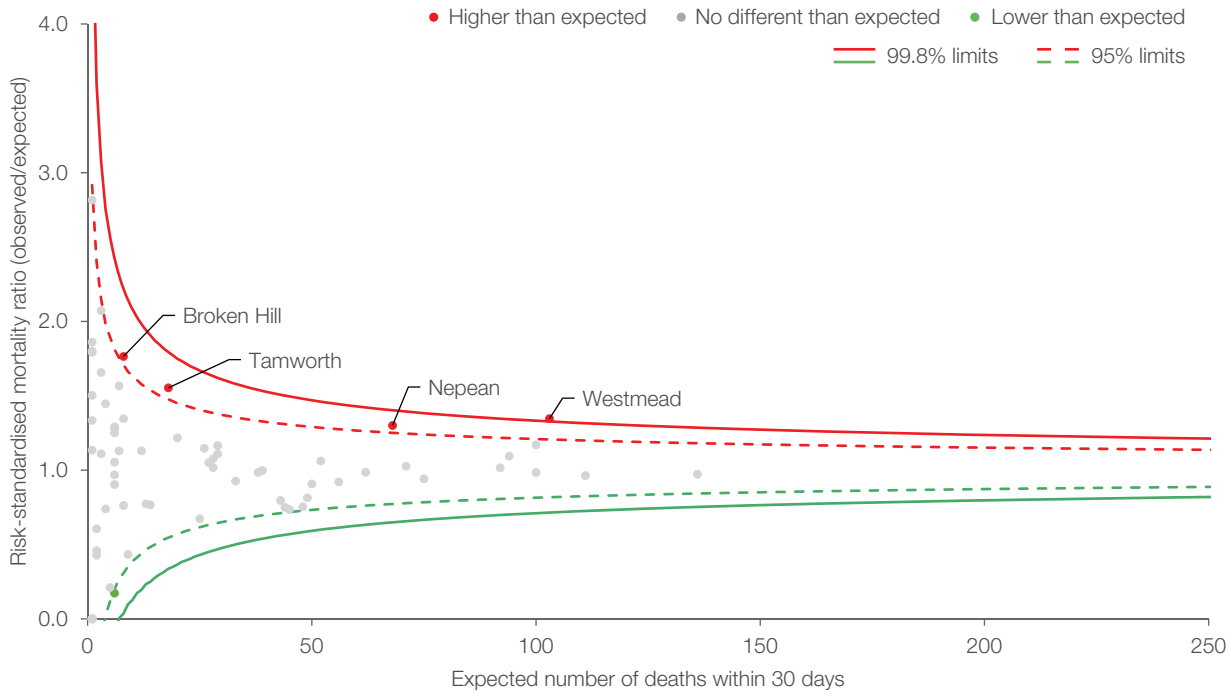
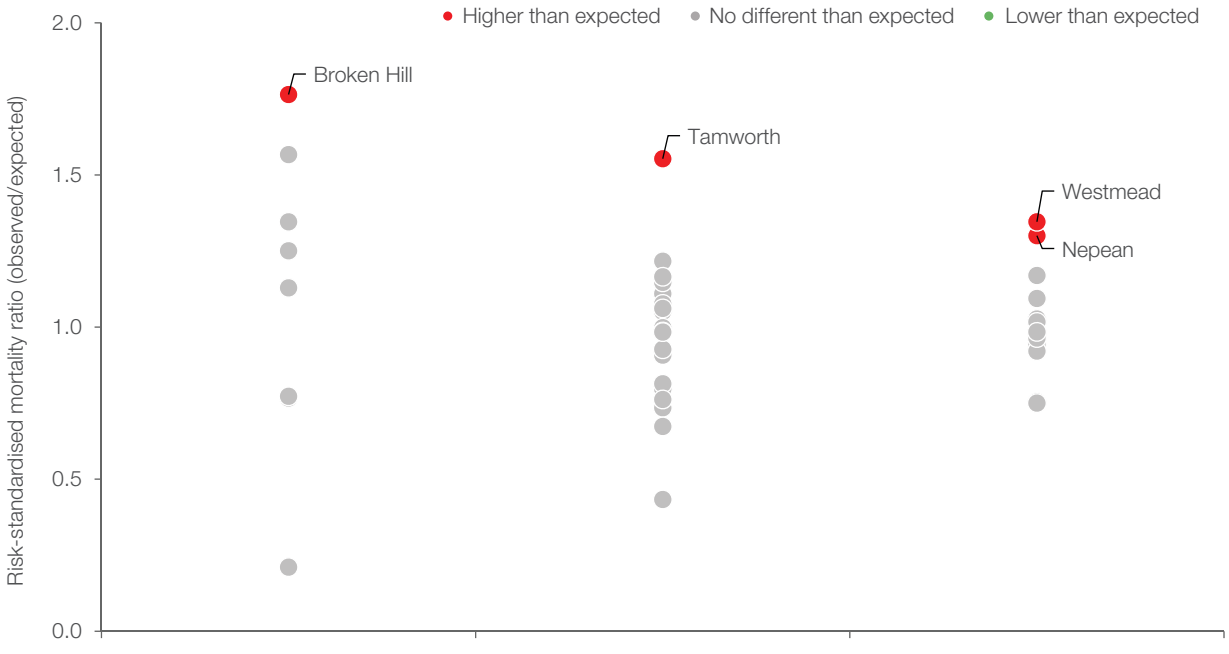


Figure 10 Ischaemic stroke 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018



Number of patients	734	5,747	9,899

Haemorrhagic stroke

Haemorrhagic stroke occurs when a blood vessel, usually an artery, develops a leak or bursts. Consequently, the brain surrounding the vessel is damaged by blood or pressure. The severity and consequences of stroke vary from complete recovery, to severe disability or death.

Key characteristics of people admitted to hospital for haemorrhagic stroke between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 haemorrhagic stroke patients, unadjusted mortality rates ranged from 17.4 to 50.0 deaths per 100 patients.

Figure 11 shows 30-day RSMRs for each hospital. Of the 25 hospitals that admitted 50 or more haemorrhagic stroke patients in the three-year period, there were two hospitals (St Vincent's and Prince of Wales) with lower than expected mortality and two hospitals (Wyong and Campbelltown)* with higher than expected mortality.

Across peer groups, there were instances of hospitals with lower than expected mortality in principal referral hospitals while the instances of higher than expected mortality occurred in major hospitals (Figure 12).

For haemorrhagic stroke patient factors and comorbidities, see Appendix 2.

Haemorrhagic stroke 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 5,264 patients were hospitalised with a principal diagnosis of haemorrhagic stroke (ICD-10-AM codes I61, I62). Of these patients, 246 were hospitalised for haemorrhagic stroke two or more times. Only their last hospitalisation is considered.
- 1,620 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of 31 per 100 patients.

Among the 1,620 deaths within 30 days:

- 1,082 (67%) occurred in the initial admitting hospital
- 9 (1%) occurred in another hospital, following patient transfer
- 529 (33%) occurred after discharge, outside hospital
- 184 (11%) occurred on the first day of hospitalisation
- 1,186 (73%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for haemorrhagic stroke had an average age of 72 years (median 74); while patients who died within 30 days had an average age of 79 years (median 82)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.1
- More males (2,933) than females (2,331) were hospitalised for haemorrhagic stroke
- Among males, 26% died within 30 days, while among females, 36% died within 30 days
- After adjusting for age and comorbidity, sex was significantly associated with mortality; males had a lower risk of death.

*The RSMRs for haemorrhagic stroke for Campbelltown and Wyong hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. For haemorrhagic stroke, these hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Figure 11 Haemorrhagic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

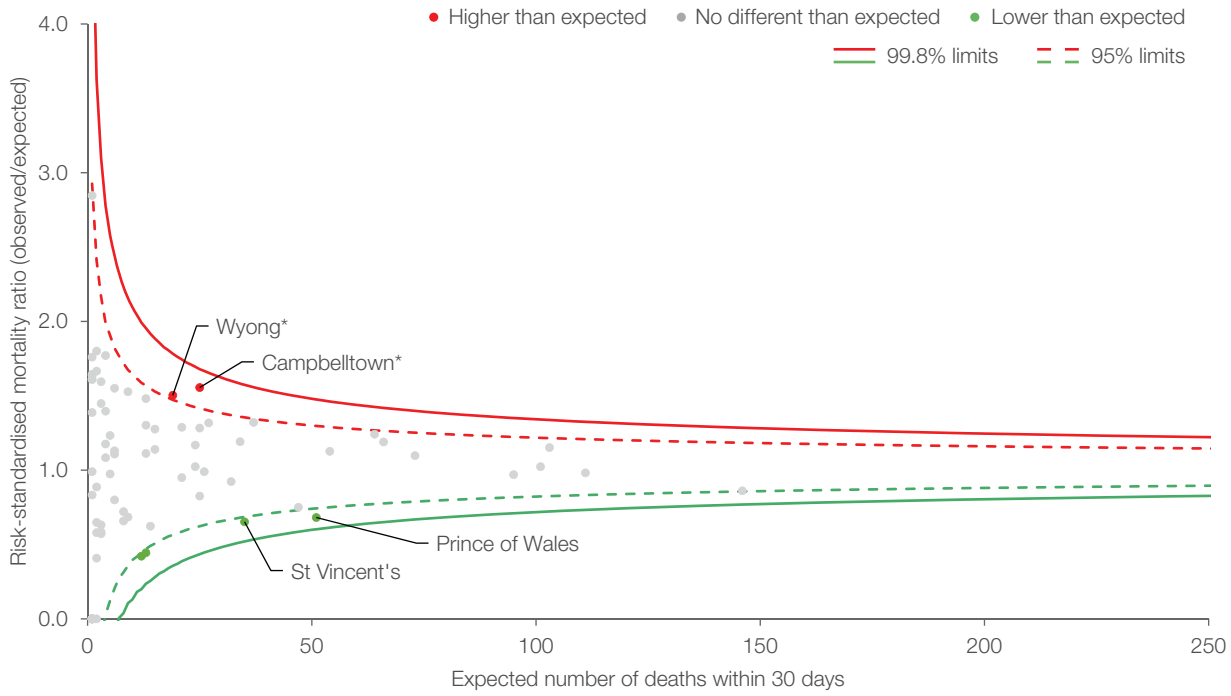


Figure 12 Haemorrhagic stroke 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018

Number of patients	891	3,495

Congestive heart failure

Congestive heart failure (CHF) occurs when the heart is unable to keep up with the demands of, or provide adequate blood flow to, other organs. It often develops as a result of hypertension, diabetes or other coronary diseases.

Key characteristics of people admitted to hospital for CHF between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 CHF patients, unadjusted mortality rates ranged from 6.1 to 25.7 deaths per 100 patients.

Figure 13 shows 30-day RSMRs for each hospital. Of the 61 hospitals that admitted 50 or more CHF patients in the three-year period, there were five (Ryde, St Vincent's, Concord, Royal Prince Alfred and Wollongong) with lower than expected mortality and seven (Cessnock, Cooma, Lithgow, Blue Mountains, Bowral*, Milton Ulladulla* and Ballina) with higher than expected mortality.

Across peer groups, most of the instances of lower than expected mortality occurred in principal referral hospitals while most of the instances of higher than expected mortality occurred in district hospitals. There were no outliers among major hospitals (Figure 14).

For CHF patient factors and comorbidities, see Appendix 2.

Congestive heart failure 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 28,514 patients were hospitalised with a principal diagnosis of CHF (ICD-10-AM codes I11.0, I13.0, I13.2, I50.0, 150.1, 150.9). Of these patients, 7,178 were hospitalised for CHF two or more times. Only their last hospitalisation is considered in the mortality analysis (however the number of previous hospitalisations is used as an adjustment variable).
- 3,683 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of 13 per 100 patients.

Among the 3,683 deaths within 30 days:

- 1,907 (52%) occurred in the initial admitting hospital
- 30 (1%) occurred in another hospital, following patient transfer
- 1,746 (47%) occurred after discharge, outside hospital
- 94 (3%) occurred on the first day of hospitalisation
- 1,519 (41%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for CHF had an average age of 80 years (median 81); while patients who died within 30 days had an average age of 84 years (median 86)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 1.8
- More males (14,797) than females (13,717) were hospitalised for CHF
- Among males, 13% died within 30 days, while among females, 13% died within 30 days
- After adjusting for age and comorbidities, sex was not significantly associated with mortality.

*The RSMRs for CHF for Bowral and Milton Ulladulla hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. For CHF, these hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Figure 13 Congestive heart failure 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

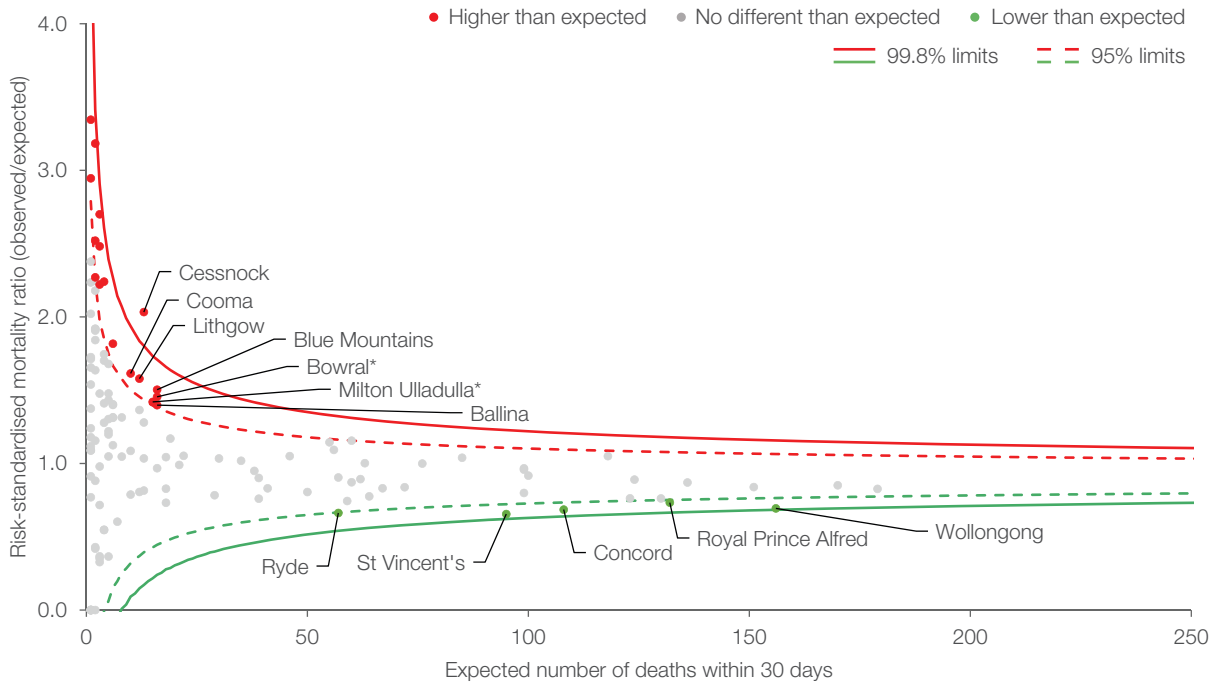
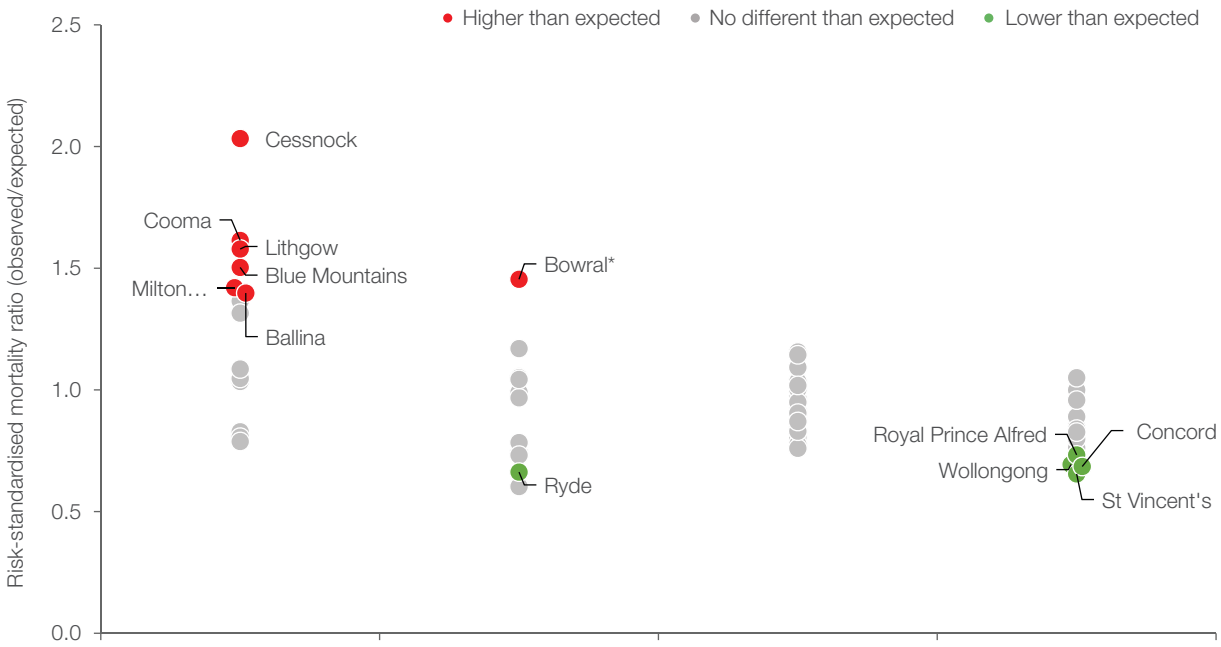


Figure 14 Congestive heart failure 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018



Number of patients	1,529	2,342	9,388	11,946

Pneumonia

Pneumonia is an inflammatory condition of one or both lungs, usually due to infection. Symptoms include fever, chills, cough with sputum production, chest pain and shortness of breath.

Key characteristics of people admitted to hospital for pneumonia between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 pneumonia patients, unadjusted mortality rates ranged from 1.8 to 14.1 deaths per 100 patients.

Figure 15 shows 30-day RSMRs for each hospital. Of the 73 hospitals that admitted 50 or more pneumonia patients in the three-year period, there were four (Sydney and Sydney Eye, Shoalhaven, St Vincent's and Blacktown) with lower than expected mortality and four (Orange, Tamworth, Wyong* and Gosford) with higher than expected mortality.

Across peer groups, there were instances of both higher and lower than expected mortality in principal referral and major hospitals. There were no outliers among district hospitals (Figure 16).

For pneumonia patient factors and comorbidities, see Appendix 2.

Pneumonia 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 49,810 patients were hospitalised with a principal diagnosis of pneumonia (ICD-10-AM codes J13-J16, J18). Of these patients, 4,690 were hospitalised for pneumonia two or more times. Only their last hospitalisation is considered.
- 4,538 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of nine per 100 patients.

Among the 4,538 deaths within 30 days:

- 2,446 (54%) occurred in the initial admitting hospital
- 26 (1%) occurred in another hospital, following patient transfer
- 2,066 (46%) occurred after discharge, outside hospital
- 132 (3%) occurred on the first day of hospitalisation
- 2,198 (48%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for pneumonia had an average age of 70 years (median 74); while patients who died within 30 days had an average age of 82 years (median 85)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.9
- More males (26,207) than females (23,603) were hospitalised for pneumonia
- Among males, 10% died within 30 days, while among females, 9% died within 30 days
- After adjusting for age and comorbidity, sex was not significantly associated with mortality.

*The RSMR for pneumonia for Wyong Hospital should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. For pneumonia, this hospital had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Figure 15 Pneumonia 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

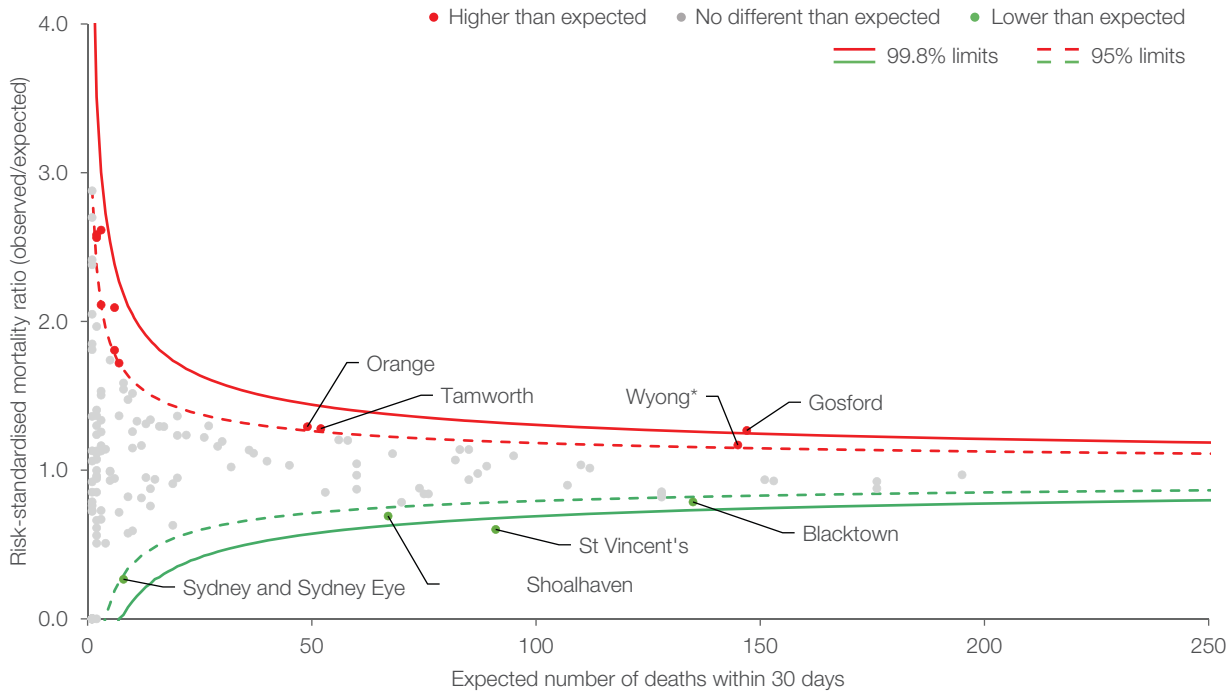
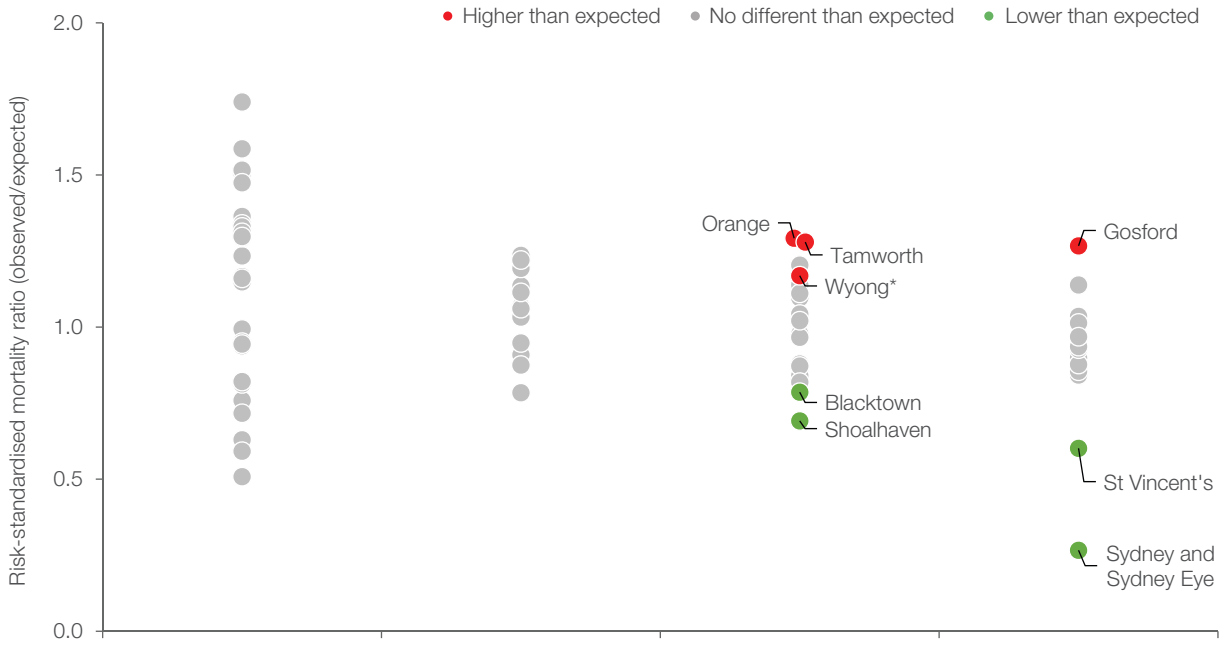


Figure 16 Pneumonia 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018



Number of patients	4,555	4,900	17,209	18,530

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is a long-term lung disease, associated with prolonged exposure to tobacco smoke. While no existing treatment can cure COPD, it can be effectively managed.

Key characteristics of people admitted to hospital for COPD between July 2015 and June 2018 are summarised below.

Among hospitals that admitted at least 50 COPD patients, unadjusted mortality rates ranged from 3.7 to 20.7 deaths per 100 patients.

Figure 17 shows 30-day RSMRs for each hospital. Of the 71 hospitals that admitted 50 or more COPD patients, there were five (St Vincent's, Coffs Harbour, Royal North Shore, Prince of Wales and Royal Prince Alfred) with lower than expected mortality and six (Cowra, Lithgow, Blue Mountains, Orange, Port Macquarie and Manning) with higher than expected mortality.

Across peer groups, there were instances of lower than expected mortality in principal referral and major hospitals while the instances of higher than expected mortality occurred in major and district hospitals (Figure 18).

For COPD patient factors and comorbidities, see Appendix 2.

Chronic obstructive pulmonary disease 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 32,605 patients were hospitalised with a principal diagnosis of chronic obstructive pulmonary disease (ICD-10-AM codes J20, J40-J44, J47). Of these patients, 10,798 were hospitalised for COPD two or more times. Only their last hospitalisation is considered.
- 3,084 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of nine per 100 patients.

Among the 3,084 deaths within 30 days:

- 1,541 (50%) occurred in the initial admitting hospital
- 17 (1%) occurred in another hospital, following patient transfer
- 1,526 (50%) occurred after discharge, outside hospital
- 89 (3%) occurred on the first day of hospitalisation
- 1,367 (44%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for COPD had an average age of 74 years (median 75); while patients who died within 30 days had an average age of 78 years (median 79)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.9
- Similar numbers of males (15,966) and females (16,639) were hospitalised for COPD
- Among males, 10% died within 30 days, while among females, 9% died within 30 days
- After adjusting for age and comorbidity, sex was significantly associated with mortality; males had a higher risk of death.

Figure 17 Chronic obstructive pulmonary disease 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

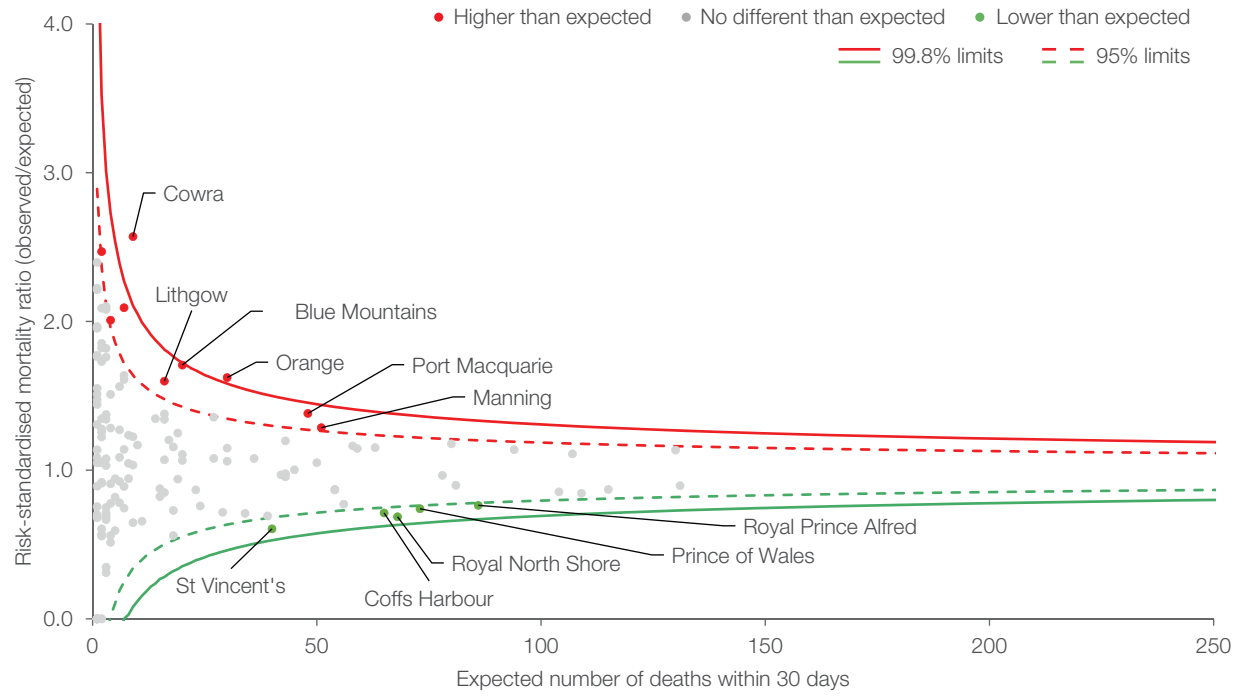


Figure 18 Chronic obstructive pulmonary disease 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018

Number of patients	3,619	3,193	11,346	10,865

Hip fracture surgery

Hip fracture refers to fractures of the femur (thigh bone) within five centimetres of the distal (lower) part of the lesser trochanter. Hip fractures can occur at any age but are most common in elderly people. There are two main risk factors, both associated with ageing: increased risk of falling, and loss of skeletal strength from osteoporosis.

This analysis includes patients aged 50+ years and their outcomes in the 30 days following admission to the hospital that performed surgery for their hip fracture. Not all patients admitted with a hip fracture undergo surgery. Between July 2015 and June 2018, of the 19,048 patients hospitalised with a hip fracture, 87% underwent surgery.

Key characteristics of people admitted to NSW public hospitals for hip fracture surgery between July 2015 and June 2018 are summarised below.

Figure 19 shows 30-day RSMRs for each hospital. Of the 35 hospitals that performed surgery on 50 or more hip fracture patients in the three year period, three (Ryde, St George and Liverpool) had lower than expected mortality and three hospitals (Bowral, Gosford and John Hunter) had higher than expected mortality.

Across peer groups, the instances of higher and lower than expected mortality occurred in principal referral and district hospitals. There were no outliers among major hospitals (Figure 20).

For hip fracture surgery patient factors and comorbidities, see Appendix 2.

Hip fracture surgery 30-day mortality

Key characteristics, NSW, July 2015 – June 2018

In the three-year period, July 2015 – June 2018:

- 16,538 patients were hospitalised for hip fracture surgery (ICD-10-AM codes S72.0, S72.1, S72.2 accompanied with a fall code W00-W19 and R29.6 and treated with a surgical procedure). There were an additional 2,510 patients who were admitted with a hip fracture but did not undergo surgery.
- 1,055 patients died within 30 days (from any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of six per 100 patients.

Among the 1,055 deaths within 30 days:

- 420 (40%) occurred in the initial admitting hospital
- 1 (0.1%) occurred in another hospital, following patient transfer
- 634 (60%) occurred after discharge, outside hospital
- 3 (0.3%) occurred on the first day of hospitalisation
- 243 (23%) occurred within seven days of hospitalisation.

Age, sex and comorbidity

- Patients who survived for at least 31 days following hospitalisation for hip fracture surgery had an average age of 82 years (median 84); while patients who died within 30 days had an average age of 88 years (median 89)
- The average number of recorded comorbidities that were predictors in the model (without one-year lookback) was 0.6
- Fewer males (5,024) than females (11,514) were hospitalised for hip fracture surgery
- Among males, 9% died within 30 days while among females 5% died within 30 days
- After adjusting for age and comorbidities, sex was significantly associated with mortality; males had a higher risk of death.

Figure 19 Hip fracture surgery 30-day risk-standardised mortality ratio, NSW public hospitals, July 2015 – June 2018

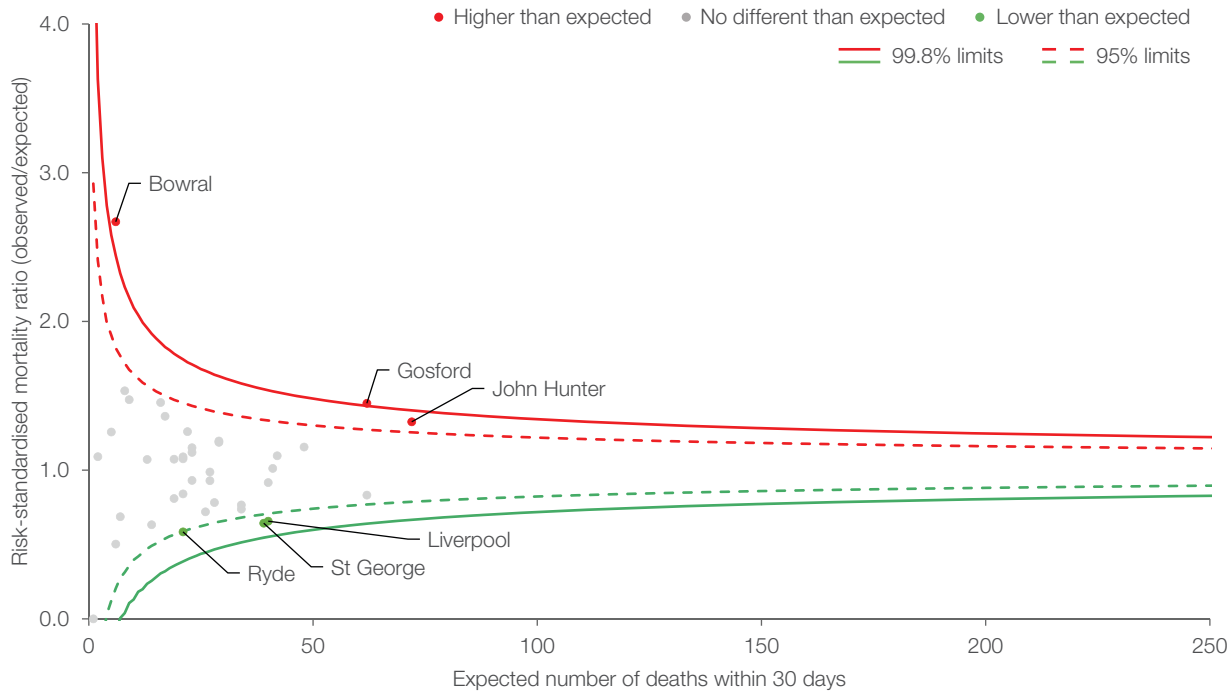
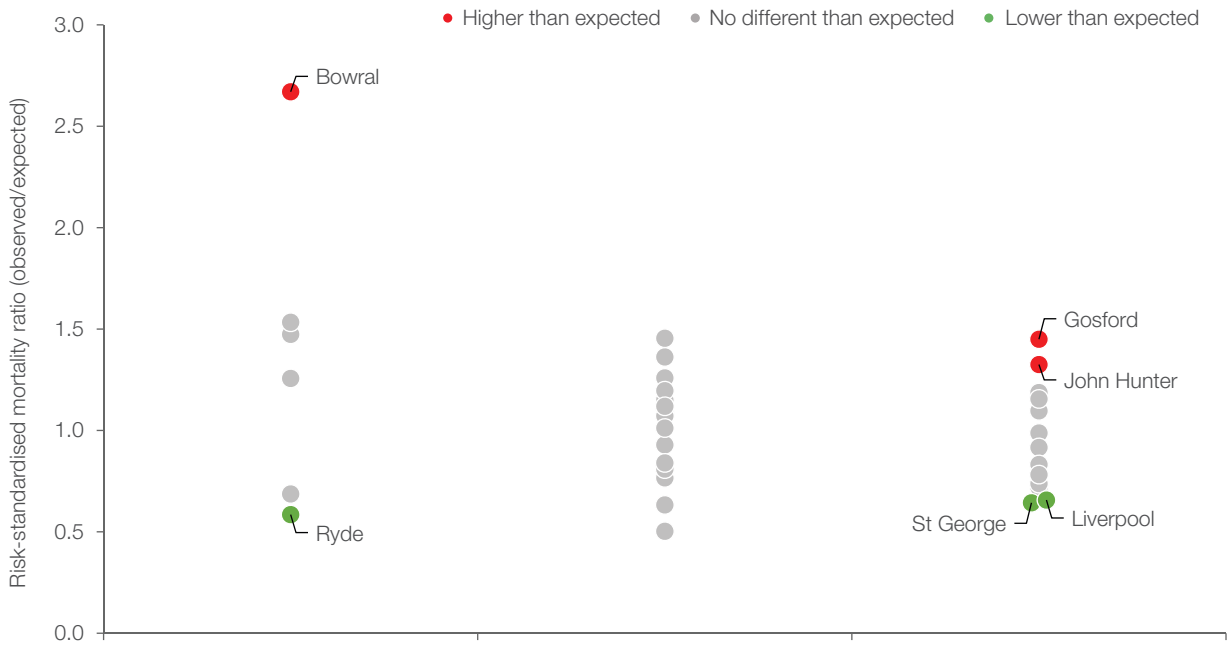


Figure 20 Hip fracture 30-day risk-standardised mortality ratio, NSW public hospitals with ≥ 50 patients, by peer group, July 2015 – June 2018



Number of patients	District group 1 (Peer group C1)	Major (Peer group B)	Principal referral (Peer group A)
	951	6,149	8,831

Appendix 1

Table 4 30-day mortality results, by local health district and condition, metropolitan NSW public hospitals, July 2015 – June 2018

● Higher than expected ● No different than expected ● Lower than expected

Local health district	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Central Coast	Gosford Wyong	Gosford Wyong	Gosford Wyong*	Gosford Wyong	Gosford Wyong*	Gosford Wyong	Gosford
Illawarra Shoalhaven	Shellharbour Shoalhaven Wollongong	Shoalhaven Wollongong	Wollongong	Milton Ulladulla* Shellharbour Shoalhaven Wollongong	Milton Ulladulla Shellharbour Shoalhaven Wollongong	Milton Ulladulla Shellharbour Shoalhaven Wollongong	Shoalhaven Wollongong
Nepean Blue Mountains	Blue Mountains Lithgow Nepean	Nepean	Nepean	Blue Mountains Lithgow Nepean	Blue Mountains Lithgow Nepean	Blue Mountains Lithgow Nepean	Nepean
Northern Sydney	Hornsby Royal North Shore Ryde	Hornsby Royal North Shore Ryde	Royal North Shore	Hornsby Royal North Shore Ryde	Hornsby Royal North Shore Ryde	Hornsby Royal North Shore Ryde	Hornsby Royal North Shore Ryde
South Eastern Sydney	Prince of Wales St George Sutherland	Prince of Wales St George Sutherland	Prince of Wales St George Sutherland	Prince of Wales St George Sutherland	Prince of Wales St George Sutherland Sydney & Sydney Eye	Prince of Wales St George Sutherland	Prince of Wales St George Sutherland
South Western Sydney	Bankstown Bowral Campbelltown Fairfield Liverpool	Bankstown Bowral Campbelltown Fairfield Liverpool	Bankstown Campbelltown* Liverpool	Bankstown Bowral* Campbelltown Fairfield Liverpool	Bankstown Bowral Campbelltown Fairfield Liverpool	Bankstown Bowral Campbelltown Fairfield Liverpool	Bankstown Bowral Campbelltown Liverpool
Sydney	Canterbury Concord Royal Prince Alfred	Canterbury Concord Royal Prince Alfred	Concord Royal Prince Alfred	Canterbury Concord Royal Prince Alfred	Canterbury Concord Royal Prince Alfred	Canterbury Concord Royal Prince Alfred	Canterbury Concord Royal Prince Alfred
Western Sydney	Auburn Blacktown Westmead	Blacktown Westmead	Blacktown Westmead	Auburn Blacktown Westmead	Auburn Blacktown Westmead	Auburn Blacktown Westmead	Blacktown Westmead
St Vincent's Health Network	St Vincent's	St Vincent's	St Vincent's	St Vincent's	St Vincent's	St Vincent's	St Vincent's

*The RSMRs for Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals should be interpreted with caution. BHI's mortality analyses rely on accurate coding in patients' hospital records. They exclude hospitalisations with an episode care type of palliative care, but include acute hospitalisations with palliative care as a secondary diagnosis. Bowral (CHF), Campbelltown (haemorrhagic stroke), Milton Ulladulla (CHF) and Wyong (haemorrhagic stroke and pneumonia) hospitals had a high proportion of acute hospitalisations with palliative care as a secondary diagnosis. For more information, see the Technical Supplement to *Mortality following hospitalisation for seven clinical conditions, July 2015 – June 2018*.

Table 5 30-day mortality results, by local health district and condition, rural and regional NSW public hospitals, July 2015 – June 2018

● Higher than expected ● No different than expected ● Lower than expected

Local health district	AMI	Ischaemic stroke	Haemorrhagic stroke	CHF	Pneumonia	COPD	Hip fracture surgery
Far West	Broken Hill	Broken Hill		Broken Hill	Broken Hill	Broken Hill	
Hunter New England	Armidale Belmont Calvary Mater Cessnock John Hunter Maitland Manning Tamworth	Armidale Belmont Calvary Mater John Hunter Maitland Manning Tamworth	Calvary Mater John Hunter Manning Tamworth	Armidale Belmont Calvary Mater Cessnock John Hunter Maitland Manning Singleton Tamworth	Armidale Belmont Calvary Mater Cessnock Gunnedah Inverell John Hunter Maitland Manning Moree Muswellbrook Narrabri Singleton Tamworth	Armidale Belmont Calvary Mater Cessnock Gunnedah Inverell John Hunter Maitland Manning Moree Muswellbrook Singleton Tamworth	Armidale John Hunter Maitland Manning Tamworth
Mid North Coast	Coffs Harbour Kempsey Port Macquarie	Coffs Harbour Port Macquarie	Coffs Harbour Port Macquarie	Coffs Harbour Kempsey Macksville Port Macquarie	Coffs Harbour Kempsey Macksville Port Macquarie	Coffs Harbour Kempsey Macksville Port Macquarie	Coffs Harbour Port Macquarie
Murrumbidgee	Griffith Wagga Wagga	Griffith Wagga Wagga	Wagga Wagga	Deniliquin Griffith Wagga Wagga	Deniliquin Griffith Tumut Wagga Wagga Young	Deniliquin Griffith Tumut Wagga Wagga Young	Wagga Wagga
Northern NSW	Grafton Lismore Tweed	Grafton Lismore Tweed	Lismore Tweed	Ballina Casino Grafton Lismore Maclean Murwillumbah Tweed	Ballina Byron Casino Grafton Lismore Maclean Murwillumbah Tweed	Ballina Byron Casino Grafton Lismore Maclean Murwillumbah Tweed	Grafton Lismore Tweed
Southern NSW	Batemans Bay Goulburn Moruya Queanbeyan South East Regional	South East Regional		Batemans Bay Cooma Goulburn Moruya Queanbeyan South East Regional	Batemans Bay Cooma Goulburn Moruya Queanbeyan South East Regional	Batemans Bay Cooma Goulburn Moruya Queanbeyan South East Regional	Goulburn South East Regional
Western NSW	Bathurst Dubbo Orange	Bathurst Dubbo Orange		Bathurst Cowra Dubbo Orange	Bathurst Cowra Dubbo Forbes Parkes Mudgee Orange	Bathurst Cowra Dubbo Forbes Parkes Mudgee Orange	Dubbo Orange

Appendix 2

Prediction models

For each condition included in the report, NSW-level prediction models were developed using index admissions between 1 July 2015 and 30 June 2018. Random intercept logistic regression models were built, taking into account patient-level risk factors (age, sex and comorbidities) and clustering within hospitals.

The variables that were found to be significantly associated with mortality were retained in the final models and are listed in Table 6.

C-statistics, that describe the prediction capacity of the models, are also shown.

Table 6 Final prediction models, patient factors and comorbidities, and C-statistics

Condition	Patient factors and comorbidities	C-statistic
Acute myocardial infarction*	Age, STEMI/non-STEMI status, dementia, hypotension, shock, renal failure, heart failure, dysrhythmia, malignancy, hypertension, cerebrovascular disease	0.86
Ischaemic stroke*	Age, sex, renal failure, heart failure, malignancy	0.75
Haemorrhagic stroke*	Age, sex, heart failure, malignancy, history of previous haemorrhagic stroke	0.67
Congestive heart failure	Age, valvular disease, pulmonary circulation disorders, hypertension, other neurological disorders, chronic pulmonary disease, diabetes – complicated, diabetes – uncomplicated, renal failure, liver disease, peptic ulcer disease excluding bleeding, metastatic cancer, coagulopathy, weight loss, fluid and electrolyte disorders, deficiency anaemia, dementia, number of previous acute admissions for CHF	0.73
Pneumonia*	Age, dementia, hypotension, shock, renal failure, other chronic obstructive pulmonary disease, heart failure, dysrhythmia, malignancy, liver disease, cerebrovascular disease, Parkinson's disease	0.81
Chronic obstructive pulmonary disease	Age, sex, congestive heart failure, cardiac arrhythmia, pulmonary circulation disorders, other neurological disorders, diabetes – complicated, metastatic cancer, solid tumour without metastasis, coagulopathy, weight loss, fluid and electrolyte disorders, dementia, number of previous acute admissions for COPD	0.75
Hip fracture surgery*	Age, sex, ischaemic heart disease, dysrhythmia, respiratory infection, renal failure, heart failure, malignancy, dementia	0.76

* Comorbidity based on Australian commission ICD codes and definitions used, dementia was added for hip fracture surgery and STEMI was added for acute myocardial infarction. The ICD-10-AM code for renal failure was used.

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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 board-governed organisation, BHI is led by Chairperson, Professor Carol Pollock, and Chief Executive, Dr Diane Watson.

We would also like to thank members of the BHI Mortality and Returns to Acute Care Advisory Group and the NSW Ministry of Health.

We acknowledge BHI's dedicated teams of analytics, research, corporate, design and communications professionals whose expertise made this report possible.

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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 healthcare system.

BHI was established in 2009 and 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 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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