Bureau of Health Information

The Insights Series

30-day mortality following hospitalisation, five clinical conditions, NSW, July 2009 – June 2012

Acute myocardial infarction, ischaemic stroke, haemorrhagic stroke, pneumonia and hip fracture surgery

BUREAU OF HEALTH INFORMATION

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Foreword

Mortality is an easily measured outcome of healthcare. However, for mortality to be a meaningful and fair hospital-indicator, it needs to take account of differences in the case-mix of patients and system-related factors that might influence the likelihood of dying.

This report is based on a method that allows for such adjustments. Drawing on data going back 12 years and merging information from hospital records and death registries, it presents analyses of mortality in the 30 days following hospitalisation for five clinical conditions: acute myocardial infarction; ischaemic stroke; haemorrhagic stroke; pneumonia; and hip fracture surgery.

The principal indicator – the Risk-Standardised Mortality Ratio (RSMR) - compares deaths that occurred in the 30-days following admission to hospital, with the ***'expected'*** number of deaths, given the characteristics of hospitalised patients. We believe that this measure provides a strong assessment of mortality and has many advantages:

- It captures deaths that occur both within the hospital as well as following discharge, therefore potentially relates to both the short-term as well as the longer-term consequences of care
- It assesses mortality following initial admission to hospital, avoiding the biases related to multiple hospitalisations and transfers
- The measure attributes the outcomes to the first admission hospital, reflecting on the crucial role of emergency care and the first days of hospital care in determining survival of patients for these conditions
- It provides increased capacity to identify comorbidities in medical records, compared to measures using the comorbidities recorded at the time of a single hospitalisation
- It supports assessment of trends in time.

As with any statistics, caution should be taken in the interpretation of the measure that we have used. This measure is not designed to compare hospitals and cannot be used as a measure of the number of avoidable deaths. RSMRs do not distinguish deaths that are avoidable from those that are a reflection of the natural course of illness. They do not provide, by themselves, a diagnostic of quality and safety of care. Other measures, such as clinical audit and review panels, are designed to assess the avoidable nature of specific cases and the processes of care that might be at play.

The measure presented in this report is a fair and valid way to assess whether a hospital's 30-day mortality is higher than statistically expected, given its case-mix of patients and the volume of cases treated. It can act as a screening tool to guide further assessments and areas warranting improvement.

Dr Jean-Frédéric Lévesque
Chief Executive

Key messages

This report focuses on mortality in, or after discharge from, hospital in the 30 day period following admission. It shows:

- the NSW healthcare system performs well overall
- mortality in NSW for acute myocardial infarction, ischaemic stroke, haemorrhagic stroke, pneumonia, and hip fracture surgery has decreased over the past 12 years
- across the five conditions, the percentage of hospitals for which 30-day mortality was ***no different*** to, or ***lower than expected*** ranged from 86% for ischaemic stroke to 97% for haemorrhagic stroke
- most hospitals (72%) had no conditions for which 30-day mortality was ***higher*** than expected
- very few hospitals consistently recorded ***higher*** than expected 30-day mortality over 12 years
- hospitals with ***higher*** than expected 30-day mortality are found in rural and urban settings
- four hospitals had ***higher*** than expected 30-day mortality for two or more conditions
- the percentage of deaths that occurred on day one following admission ranged from < 1% (hip fracture surgery) to 20% (haemorrhagic stroke)
- the percentage of deaths that occurred after discharge ranged from 21% (haemorrhagic stroke) to 50% (hip fracture surgery).

These findings are based on an internationally accepted method. It:

- is based on '***observed***' deaths within 30 days of presentation to hospital (includes all causes of death, in or out of hospital)
- takes into account a range of patient-level factors that influence the likelihood of dying, to calculate ***'expected'*** mortality for each hospital, given its case mix. It does not, however, adjust for case severity.
- compares this ***'expected'*** mortality with the ***'observed'*** mortality to form a ratio, called the risk-standardised mortality ratio (RSMR).

A ratio less than 1.0 indicates ***lower-than-expected*** mortality, and a ratio more than 1.0 indicates ***higher-than-expected*** mortality. Small deviations from 1.0 are ***not*** meaningful. A funnel plot is used to determine whether the observed mortality is different from the expected. The report provides important information about the NSW healthcare system, however:

- mortality data are ***not*** standalone indicators of quality or performance
- RSMRs are screening tools - they provide an indication of where further assessment is required
- RSMRs ***do not*** reflect the number of avoidable deaths
- mortality ratios cannot be used to compare hospitals with each other
- 30-day mortality includes deaths in and outside hospital.

Overview

Monitoring and improving the quality of care in NSW hospitals is a complex and important task. Arguments for the routine measurement and reporting of mortality in pursuit of improved quality are compelling and international in scope.

Mortality reporting, done well, is able to make significant contributions to evaluating performance; providing accountability; targeting and guiding improvement efforts; and informing research and knowledge generation.

Mortality indicators have great potential value to act as a signal and catalyst for examination of other quality of care issues. They are not however, *'standalone'* measures of performance.

Several different hospital mortality indicators are in use internationally. Increasingly, disease-specific indicators; and those that can capture mortality occurring after discharge from hospital, are favoured.

This report provides detailed and multifaceted data on 30-day mortality in, or after discharge from, NSW hospitals. It reports at a state and hospital level for five clinical conditions: acute myocardial infarction (AMI), ischaemic stroke, haemorrhagic stroke, pneumonia, and hip fracture surgery. These five conditions encompass different aspects of healthcare delivery including acute emergency care, surgery, specialised care, rehabilitation and community-based services. They are grounded in a strong evidence base and established models of recommended clinical practice.

A range of different approaches has been considered and tested in developing the Bureau of Health Information's mortality indicator set. The data reported here have undergone extensive validation and sensitivity analyses to ensure that fair assessments and meaningful conclusions are drawn (for details, see the companion report *Spotlight on Measurement: 30-day mortality following hospitalisation, five clinical conditions, NSW, July 2009 – June 2012*).

Mortality in NSW

Altogether, the five conditions included in this report account for around 20% of hospital mortality. State-level performance in 30-day mortality for these five conditions has been steadily improving for more than a decade.

Hospitals result are presented in terms of whether the number of deaths recorded, or *'observed'*, were higher, lower or *no* different than expected. The *'expected'* number of deaths is generated by a statistical model that takes into account patient characteristics that affect the likelihood of dying (for details, see Appendix 1).

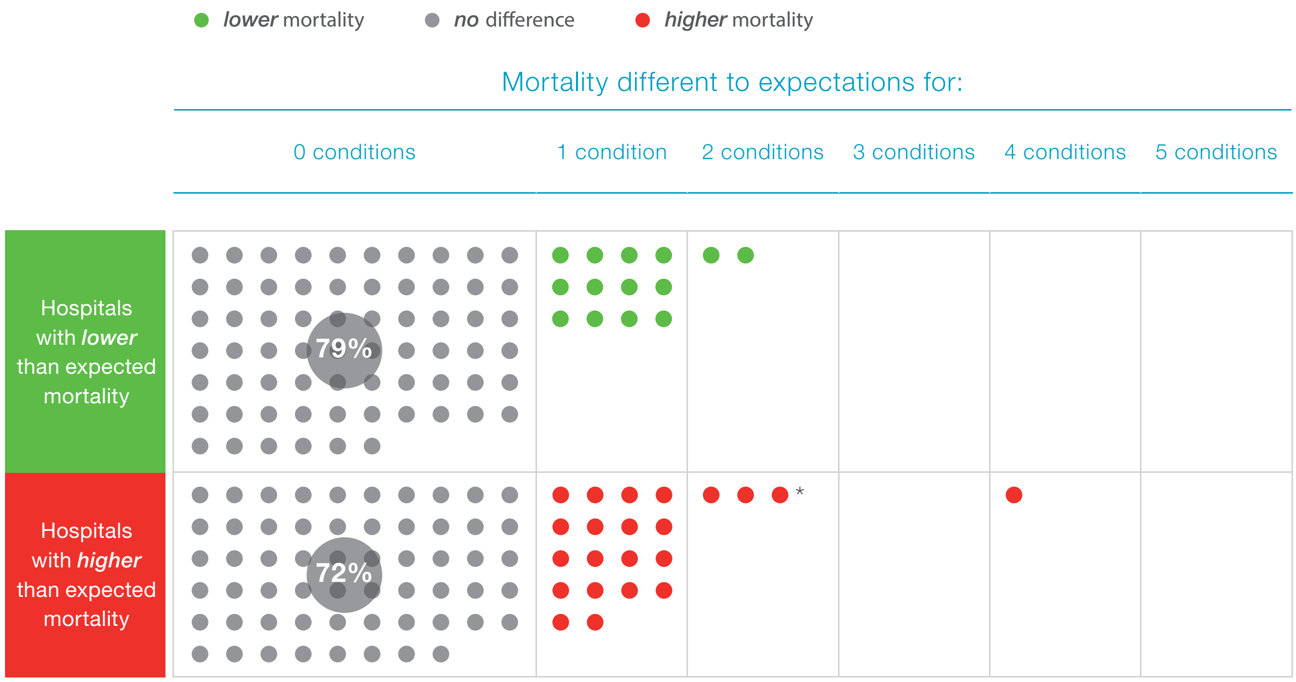
Hospitals in NSW are clustered into peer groups according to size (number of patients discharged each year), the spectrum of services provided and location (metropolitan or non-metropolitan) (see Peer group box, on page vi).

Figure 1 summarises the NSW results across all five conditions for referral, major and district hospitals (public hospitals, peer groups A – C2).

Among referral, major and district hospitals (peer groups A – C2), there were 28 results of *higher* than expected mortality. Mortality was *in line* with or *lower* than expected for all five conditions in the majority of hospitals (72%). Among hospitals recording any *higher* than expected mortality, most were limited to one condition only. Three hospitals had *higher* than expected mortality for two conditions and one hospital had *higher* than expected mortality for four conditions. Two hospitals (Prince of Wales and St Vincent's) had *lower* than expected mortality for two conditions (Figure 2).

Figure 1: 30-day mortality after hospitalisation, NSW, July 2009 – June 2012 Σ

Figure 2: Concentration of hospital results different from expected, NSW, July 2009 – June 2012 Σ



(*) Hospitals with < 50 patients are not reported publicly.
(Σ) Data are for risk-standardised mortality ratios. Table includes data for peer groups A – C2 only.
Source: SAPHaRI, *Centre for Epidemiology and Evidence, 2011*, NSW Ministry of Health.

Lower than expected mortality was recorded in major and district hospitals (peer groups B and C) but was concentrated in principal referral (peer group A) hospitals. *Higher* than expected mortality was distributed across peer groups A – C (Figure 3).

Referral, major and district hospitals, July 2009 – June 2012

For acute myocardial infarction, three hospitals (Royal Prince Alfred, Royal North Shore, Prince of Wales) recorded *lower* than expected mortality. Seven hospitals (Milton and Ulladulla, Cessnock, Bowral, Tamworth, Hornsby, St George, and one not reportable*) recorded *higher* than expected mortality.

For ischaemic stroke, four hospitals recorded *lower* than expected mortality (Concord, Prince of Wales, Belmont and Manly), and ten hospitals recorded *higher* than expected mortality (Moruya, Tamworth, Dubbo, Lismore, Nepean, Coffs Harbour, Westmead, Royal Prince Alfred, John Hunter, and one not reportable*).

For haemorrhagic stroke, two hospitals (Fairfield, and one not reportable*) had *lower* than expected mortality and two hospitals (Port Macquarie, and John Hunter) had *higher* than expected mortality.

For pneumonia, six hospitals (Canterbury, John Hunter, Bankstown, St Vincent's, Maitland, and Shellharbour) had *lower* than expected mortality and five hospitals (Inverell, Manning, Tamworth, Blacktown, and Wyong) had *higher* than expected mortality.

For hip fracture surgery, one hospital (St Vincent's) had *lower* than expected mortality and four hospitals (Tamworth, Orange, Gosford, and Coffs Harbour) had *higher* than expected mortality.

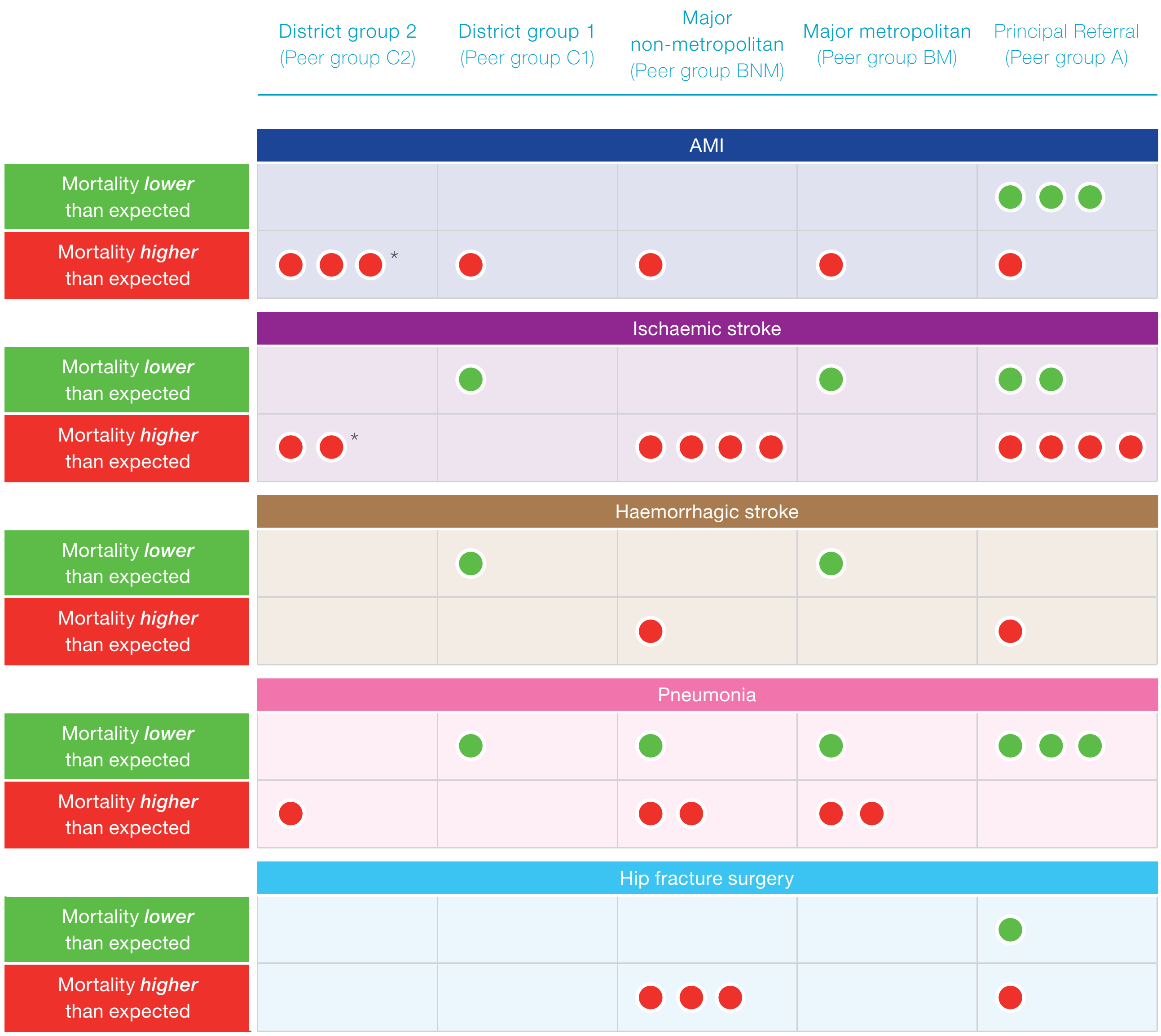
Peer groups

NSW hospitals vary in size and the types and complexity of clinical services that they provide. It is important to compare similar or like hospitals. To do this, the Bureau uses a NSW Health classification system called ***'peer group'***. The hospital peer groups included in this report are:

Group	Name	Description
A	Principal referral	Very large hospitals providing a broad range of services, including specialised units at a state or national level (for this report, ungrouped tertiary hospitals are included in this group).
BM / BNM	Major	Large metropolitan (BM) and non-metropolitan (BNM) hospitals.
C1	District group 1	Medium sized hospitals treating between 5,000–10,000 patients annually.
C2	District group 2	Smaller hospitals, typically in rural locations.

(*) Hospitals with fewer than 50 patients with a particular condition during the three year reporting period are not reported publicly to protect patient privacy and to ensure fairness.

Figure 3: Distribution of hospitals with ***higher*** or ***lower*** than expected mortality, by ***peer group***, NSW, July 2009 – June 2012



(*) Hospitals with < 50 patients are not reported publicly.
Source: SAPHaRI, *Centre for Epidemiology and Evidence, 2011*, NSW Ministry of Health.

Looking back to 2000

While the main focus of this report is the three year period July 2009 – June 2012, additional analyses on mortality since 2000 (in three-year time periods) are also presented to provide historical context.

Six hospitals recorded mortality lower than expected for three or more time periods. They were: Royal North Shore for AMI; Belmont and Manly for ischaemic stroke; St Vincent's, Maitland and Sydney / Sydney Eye for pneumonia; and St Vincent's for hip fracture surgery (Figure 4).

Seven hospitals recorded high mortality over three or more time periods. They were: Moruya, Coffs Harbour and Nepean for ischaemic stroke; Calvary Mater and Inverell for pneumonia, Gosford, and Bega for hip fracture surgery (Figure 4).

Analytic insights

A range of sub-analyses revealed important observations about patterns in 30-day mortality:

- The percentage of deaths that occurred on day one following admission ranged from < 1% for hip fracture surgery to 20% for haemorrhagic stroke.
- The percentage of deaths that occurred within seven days of hospitalisation ranged from 27% for hip fracture surgery to 75% for haemorrhagic stroke
- The percentage of deaths that occurred after discharge (within 30 days of admission) ranged from 21% for haemorrhagic stroke to 50% for hip fracture surgery.
- Hospitals with ***lower*** than expected mortality and ***higher*** than expected mortality were found in both rural and urban settings.
- Mortality in hospitals with specialist facilities such as cardiac catheterisation laboratories, varied across hospitals.
- As expected, survival curves differed across the five conditions. Haemorrhagic stroke had the steepest curve and the widest variation across sites.
- There was very little variation between hospitals and peer groups in depth of secondary diagnosis recording.

What's next?

For the healthcare system, a number of the results presented in this report should prompt further consideration and assessment.

For the Bureau of Health Information, this work introduces a new type of hospital measure that is complementary to the existing performance indicators we already publish.

Future work will continue to strengthen the set of indicators we report on, including a broader set of diseases as well as continuing technical and methodological development.

Figure 4: ***Higher*** or ***lower*** than expected mortality over four time periods (hospital peer groups A – C) (July 2000 – June 2003; July 2003 – June 2006; July 2006 – June 2009; July 2009 – June 2012)

(∑) Data are for risk-standardised mortality ratios. Table includes data for peer groups A – C2 only.
Source: SAPHaRI, *Centre for Epidemiology and Evidence, 2011*, NSW Ministry of Health.

Notes about reporting conventions and terminology used in this report

Reporting conventions

- All patients are included in NSW-level data.
- While the modelling approach that underpins the RSMR is applicable to small hospitals, results for very small facilities can be disproportionately affected by a small number of deaths. To maintain fairness and to protect patient confidentiality, data for hospitals with fewer than 50 patients for each condition between July 2009 and June 2012 are not reported publicly. The data for these facilities do appear in the report's funnel plots.
- The modelling suffers from poor discrimination in facilities with less than one expected death in a three-year period. Data for these hospitals are suppressed and do not appear in the report's funnel plots.
- Given these conventions, each condition has a different number of hospitals included in the analysis.
- Some figures and exhibits are limited to a subset of hospital peer groups A – C. Hospitals in peer groups other than A – C are not named in the report (see **Peer group box** on **page vi** for description of peer groups).
- Hospital performance profiles for each of the five clinical conditions are available for peer group A-C hospitals that admitted 50+ patients with the relevant principal diagnosis and admission characterisitcs during the period July 2009 – June 2012.
- Private hospital results are not reported.

Significant results

- The significance of the RSMR results is determined using a funnel plot with control limits set at 90% and 95%. This means that if twenty hospitals were outside the 95% limit, one would be there by chance only.
- Hospitals positioned outside the 90% control limits are noted as having mortality ***higher*** or ***lower*** than expected.
- Hospitals with an RSMR of zero are not reported as ***'lower than expected'*** mortality.

Introduction

Monitoring and improving the quality of care in NSW hospitals are complex and important tasks.[1,2]

Hospital mortality is increasingly measured and reported internationally.[3,4] Arguments for the adoption of mortality indicators into routine reporting programs in pursuit of improved quality are compelling. Mortality reporting, done well, is able to make significant contributions to evaluating performance; providing accountability; targeting and guiding improvement efforts; and informing research and knowledge generation.[5,6,7,8]

Despite this potential power, it is important to note that no single indicator is able to fully capture the complexities of performance and drive these objectives. Mortality rates, on their own, cannot measure performance or quality of care. Rather, they can only act as a signal that other quality of care issues should be examined.[9,10,11]

The risk of death during or after hospitalisation is related to the nature and severity of a patient's underlying condition, the presence of comorbidity, and the effectiveness and safety of disease management during and after hospitalisation. Hence, use of mortality data to draw inferences about the relative performance of hospitals in general and the relative effectiveness and safety of hospitals in particular, has some limitations.[12,13]

While death is generally an adverse outcome when attributable to a disease, this is not always the case. Sometimes, the principal disease causing admission may represent the terminal phase of advanced and incurable disease. In this case death may be inevitable and hospital management may not seek to avert this outcome.

Therefore, 30-day mortality data do not provide unequivocal evidence of either poor or good performance. These data should be interpreted with some caution. Most useful as screening tools, mortality indicators help identify where further assessment is warranted.

Five conditions

This edition of *The Insights Series* provides NSW and hospital level 30-day mortality data for five conditions: acute myocardial infarction, ischaemic stroke, haemorrhagic stroke, pneumonia and hip fracture surgery.

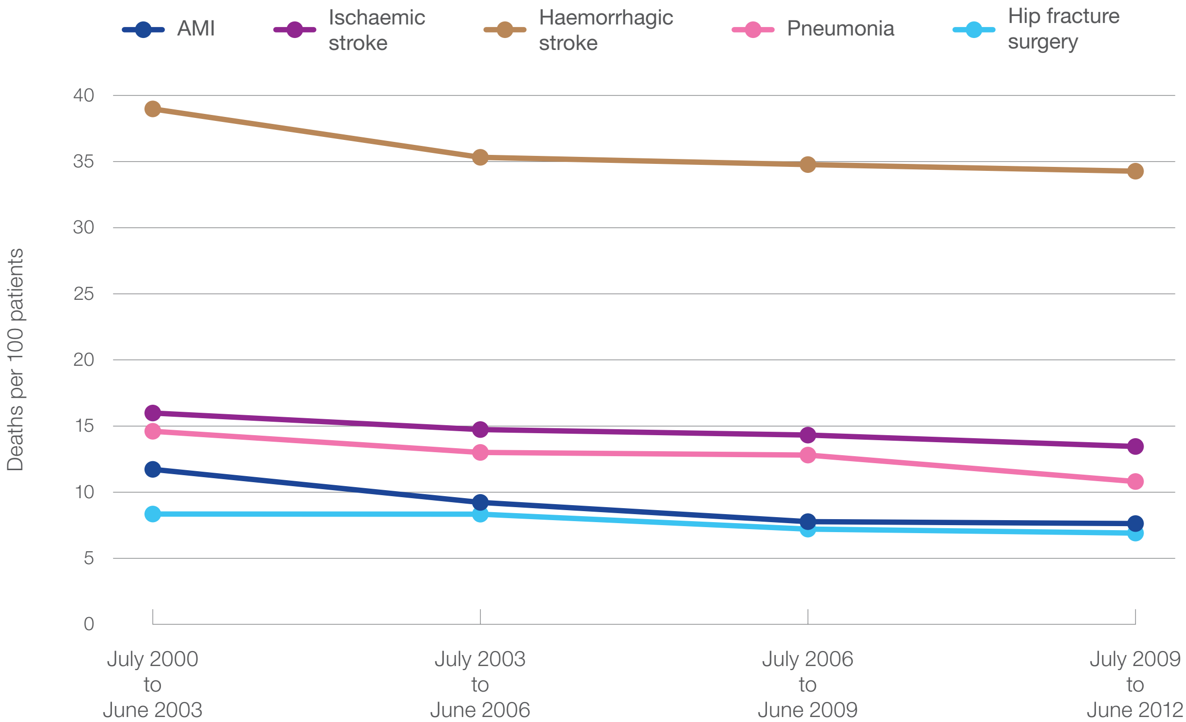
These five conditions were selected to provide insights into different aspects of healthcare including acute emergency care, surgery, specialised care delivery, rehabilitation and community-based services. The selection was also informed by international literature and experience in the measurement and reporting of risk standardised 30-day mortality.[14,15,16,17,18]

Together these five conditions account for around 20% of hospital mortality. Since 2000, state-level 30-day mortality for these five conditions has steadily decreased (Figure 5). However, NSW level data cannot provide specific information about the relative performance of individual hospitals – making it difficult to pinpoint areas for improvement.

The contribution of this report is to provide hospital-level information on 30-day mortality supplemented by additional information on patient characteristics, survival patterns, changes over time and associations with structural and organisational factors.

Accompanying the report are performance profiles for 75 NSW hospitals with tailored information about their patient populations, relative performance and changes over time.

Figure 5: 30-day mortality, age and sex standardised, NSW, July 2000 – June 2012 [ñ]



(ñ) Data are standardised to the NSW patient population, July 2009 – June 2012.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Methods

Development of the 30-day mortality measures has drawn on extensive research and international experience. Details of the development process and final indicator definitions are described in *Spotlight on measurement: 30 day mortality,* available at www.bhi.nsw.gov.au

Key features of the measure are:

- Principal diagnosis codes used to identify patients
- Patients and outcomes are attributed to the first admitting hospital
- The 30-day period starts at the time of initial admission to hospital
- Risk-standardised mortality ratios (RSMRs) are used to compare actual number of deaths to expected given the patients' characteristics
- Any hospitalisation that consisted of multiple contiguous episodes, a transfer to another hospital and / or a type-change separation was rolled up into a single *'period of care'*.
- For patients who have had multiple hospitalisations for the condition, only the last period of care is considered in the analysis
- Deaths from all causes, in or out of hospital, are included.

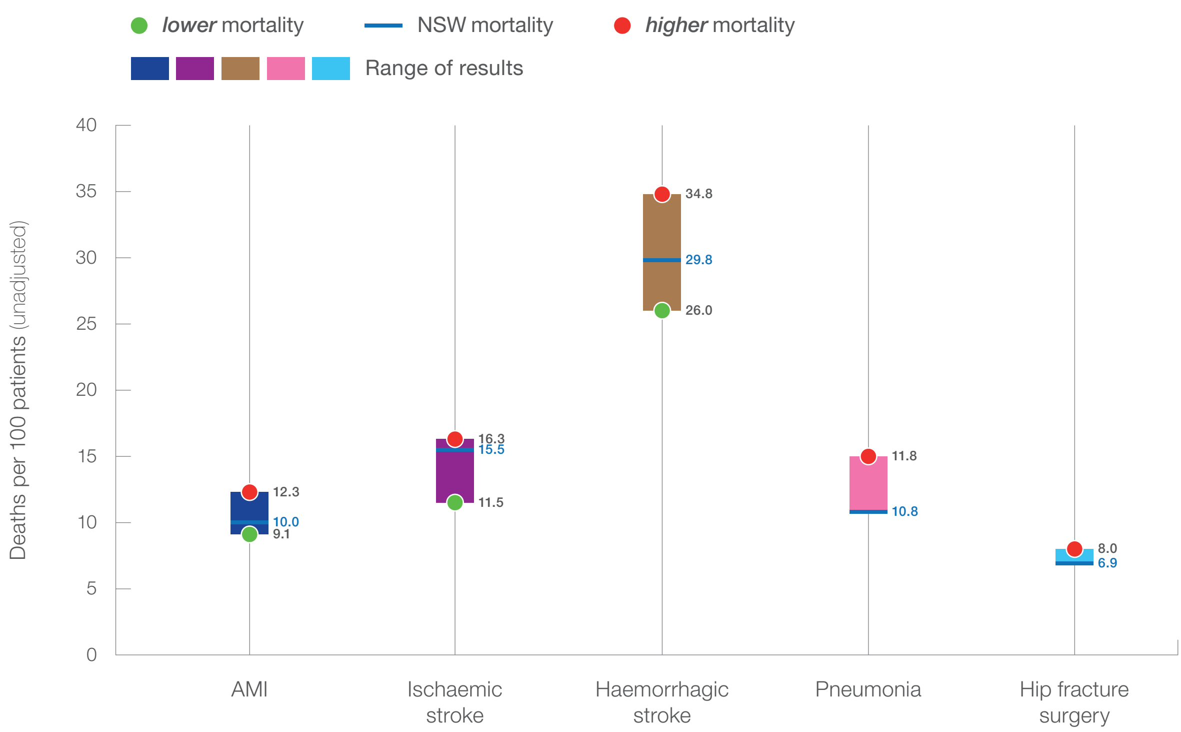
While the NSW average results are the benchmark for hospital level results, it is important to benchmark NSW in turn, with other healthcare systems. In 2012, the Bureau published international comparisons on 30-day mortality for AMI and for stroke.[2] For these conditions, NSW outcomes were within the range of international comparators (Figure 6). Published reports on 30-day mortality for hip fracture surgery and pneumonia likewise show that NSW performance is in line with international results.[19,20] This suggests good performance of NSW among a group of countries with comparable health systems.

Risk-standardised mortality ratios (RSMRs) - in context

This report is concerned with aspects of performance in NSW public hospitals. The measure it uses, the RSMR, is a condition-specific mortality indicator that draws on the NSW patient population characteristics and outcomes to assess the results for each hospital, given its case mix* (see How to interpret box on page 4).

RSMRs should not be used to compare performance between hospitals.

Figure 6: 30-day mortality, NSW in international context, ~ 2010 [Đ]



(Đ) Data are illustrative only, reported to contextualise NSW 30-day mortality. Unadjusted data are presented. Only one comparator country's data was available for pneumonia and hip fracture surgery.

Sources: OECD, *OECD Health Data 2011*, for *NSW Admitted Patient Data Collection*, SAPHaRI, Royal College of Physicians Hip Fracture Database, *Health Indicators Warehouse* (pneumonia).

(*) RSMRs rely on accuracy of clinical documentation, coding and classification in the medical record.

How to interpret? Risk-standardised mortality ratios (RSMRs)

Much of the hospital level data in this report is based on risk standardised mortality ratios (RSMRs). To make fair assessment an RSMR takes into account patient level factors that influence the likelihood of dying (see Appendix 1 on page 37).*

A hospital's RSMR compares the number of deaths that occurred (observed deaths) to the number of deaths expected to occur, given the characteristics of its patients and case mix (expected deaths). RSMRs are screening tools. They provide an indication of where further assessment is required.

A ratio of less than 1.0 indicates ***lower-than-expected*** mortality, and a ratio higher than 1.0 indicates ***higher-than-expected*** mortality. Small deviations from 1.0 are not considered to be meaningful. A mortality ratio of 1.25 indicates mortality is 25% ***higher*** than expected at that hospital. A mortality ratio of 0.75 indicates mortality is 25% ***lower*** than expected, through statistical modelling.

Mortality ratios should not be used to compare results between hospitals; they support comparison of each hospital with the NSW average. Because of how adjustments for patient characteristics are made, this is the only valid comparison for each hospital.

This report

This report provides:

- Data on NSW results for each of the five conditions.
- Hospital-level results from across the state, presented in a funnel plot identifying hospitals that have *higher* or *lower* mortality.
- Survival curves that illustrate, for each condition, variation in the pattern of deaths between hospitalisation and day 30.
- Comparison of the proportion of deaths that occurred on day one of the hospitalisation; and the proportion of deaths that occurred following discharge from hospital.
- RSMRs for hospitals in defined geographical areas and hospital peer groups.
- Analysis of the relationship between results and different organisational capacity (such as cardiac catheterisation laboratories in the care of AMI).

Alltogether the report aims to build a balanced picture of mortality in NSW hospitals. Drawing on international experience and sound science, it provides insights into clinical variation. It does so by first, statistically controlling for patient level factors and second, stratifying organisations according to volume and structural capacity. These processes together provide fair assessments of patient outcomes.

(*) While a comprehensive set of patient-level factors have been considered in the analysis, it is possible that unidentified confounders may exist.

Introduction

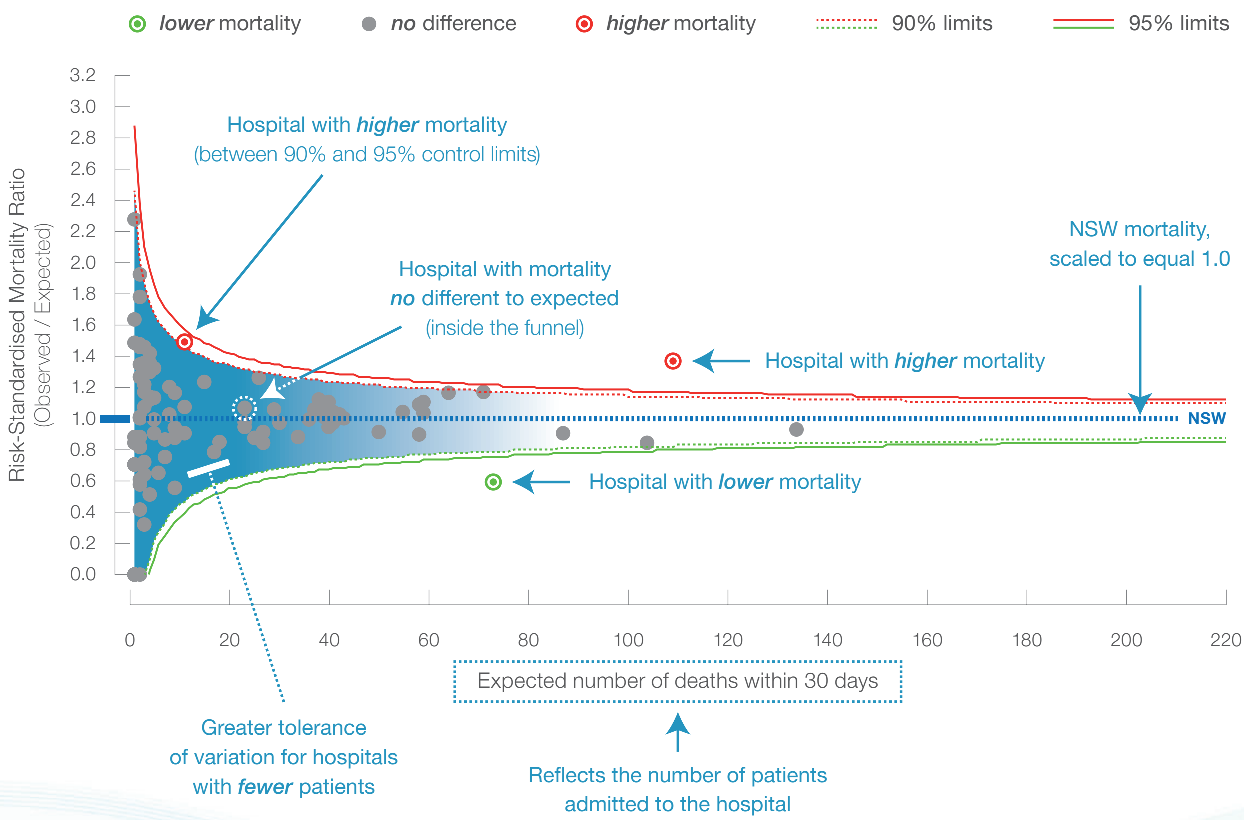
How to interpret? Funnel plots

Mortality is influenced by a wide range of factors that interact in complex ways, meaning there will always be some level of variation in patient outcomes.

The ***'funnel'*** shape that gives the funnel plot its name indicates the tolerance around this variability. Hospitals with fewer patients (those with *lower* expected number of deaths, and appearing towards the left hand side of the plot) will inevitably display greater variability and fair judgements about performance should take this into account. Therefore the funnel's 90% and 95% limits are wider for hospitals with fewer patients (see Example A, below).

Some hospitals, particularly those with relatively small numbers of patients with a condition may have high or low ratios simply by chance. Therefore funnel plots have been used to identify those hospitals that individually have a low probability of being high or low simply by chance. Hospitals ***above*** the 90% limits of the funnel are considered to have ***higher*** than expected mortality; those ***below*** the 90% control limits are considered to have ***lower*** than expected mortality. For hospitals outside 95% limits, there is greater confidence about their outlier status.

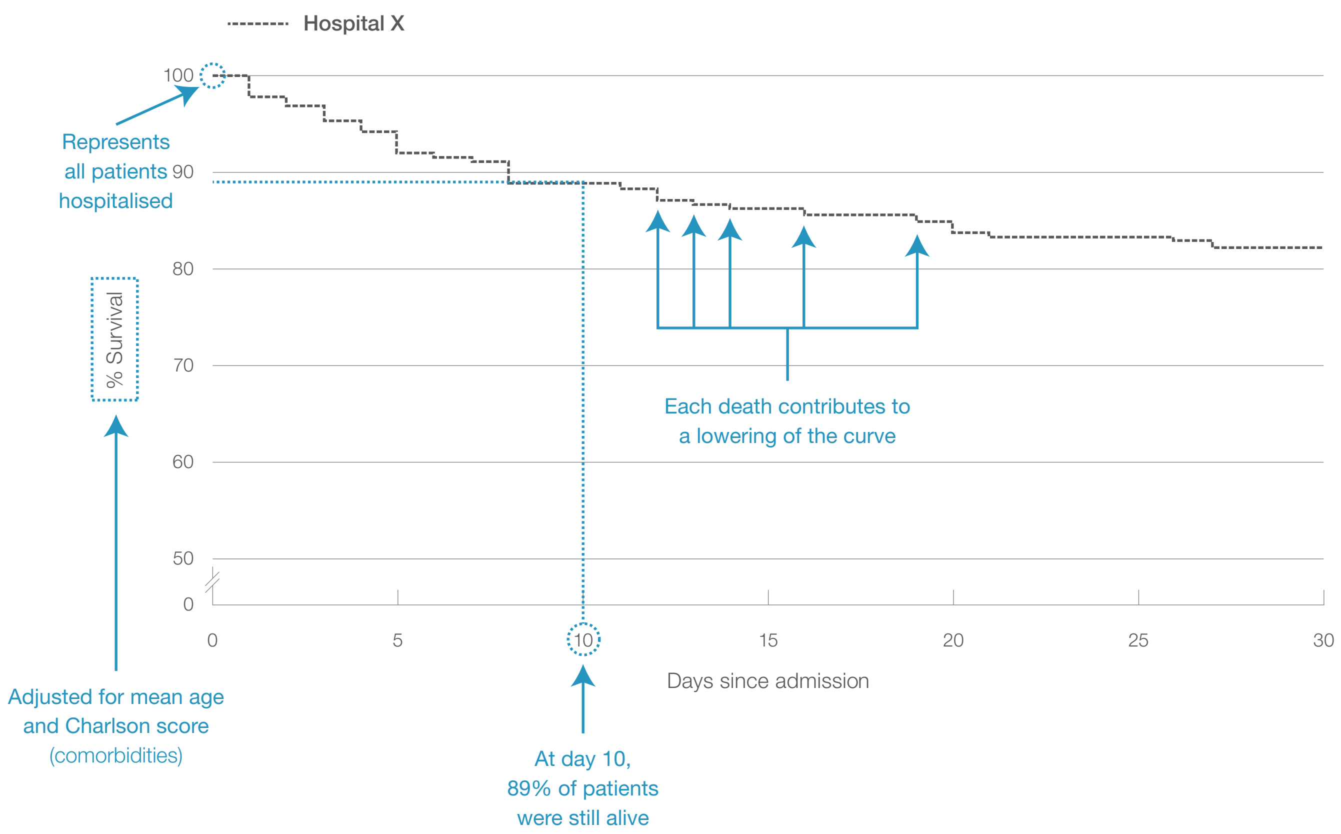
Example A: ***How to interpret:*** funnel plot



How to interpret? Survival curves

From a clinical and performance perspective, information about the way deaths are distributed over the 30-day period following hospitalisation may help point towards particular aspects of care requiring consideration and assessment. This information is shown as survival curves (a curve of the percentage of patients still surviving each day after admission). Each death contributes to lowering the curve. For example, a very early steep drop in the curve indicates a high number of day one deaths (see **Example B**, below).

Example B: ***How to interpret:*** survival curve



Acute Myocardial Infarction (AMI) in NSW

An AMI, or heart attack, occurs when the blood supply to part of the heart is interrupted, resulting in death of heart cells. If blood supply is not restored quickly, the heart muscle suffers permanent damage.

Figure 7 summarises the characteristics of people hospitalised for AMI between July 2009 – June 2012. For hospitals that admitted at least 50 patients, unadjusted mortality rates range from 3.0 to 12.9 deaths per 100 patients. Unadjusted rates cannot be used to make meaningful assessments of hospital performance. Statistical techniques, such as RSMRs, take into account a range of patient level factors (such as age and other illnesses recorded in the medical record) to assess hospital outcomes fairly.

Figure 8 shows the AMI 30-day RSMRs for each hospital in the state, using a funnel plot (see page 5 for how to interpret funnel plots). There were 91 hospitals (90%) with mortality ***no*** different to expected. Three hospitals (Royal Prince Alfred, Royal North Shore, Prince of Wales), had ***lower*** than expected mortality and seven hospitals (Milton and Ulladulla, Cessnock, Bowral, Tamworth, Hornsby, St George, and one not reportable*) had ***higher*** than expected mortality.

The distribution of results for unadjusted ratios, and age and sex adjusted ratios are compared with RSMRs in Figure 9. While RSMRs provide the fairest assessments of hospital outcomes, they do not necessarily reduce variability.

Figure 7: Acute myocardial infarction (AMI) 30-day mortality in NSW at a glance

In the period July 2009 – June 2012 ...
• There were **29,223** patients hospitalised with a principal diagnosis of AMI (ICD-10-AM code I21)
• Of these, **2,206** died within 30 days (any cause, in or out of hospital)
• This corresponds to an unadjusted mortality rate of **7.5** per 100 patients
Among the **2,206** deaths within 30 days:
• **1,401** (64%) occurred in the initial admitting hospital
• **129** (6%) occurred at another hospital, following patient transfer
• **676** (30%) occurred after discharge, outside hospital
• **313** (14% of total deaths) occurred on the first day of hospitalisation
• **1,351** (61% of total deaths) occurred within seven days of hospitalisation
People who survived for at least 31 days following hospitalisation for AMI:
• had an average age of **69** years (median 69)
• **65%** were male
People who died within 30 days of hospitalisation for AMI:
• had an average age of **80** years (median 83)
• **55%** were male
More male patients **(18,891)** were hospitalised than female patients **(10,332)**. Among males, **6.5%** died within 30 days, while among females, **9.5%** died within 30 days. Although females were more likely to die within 30 days, after adjusting for age and comorbidities, sex was no longer significantly associated with mortality.

(*) Hospitals with fewer than 50 patients with a particular condition during the three year reporting period are not reported publicly to protect patient privacy and to ensure fairness.

Figure 8: Acute myocardial infarction (AMI) 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012 Δμ

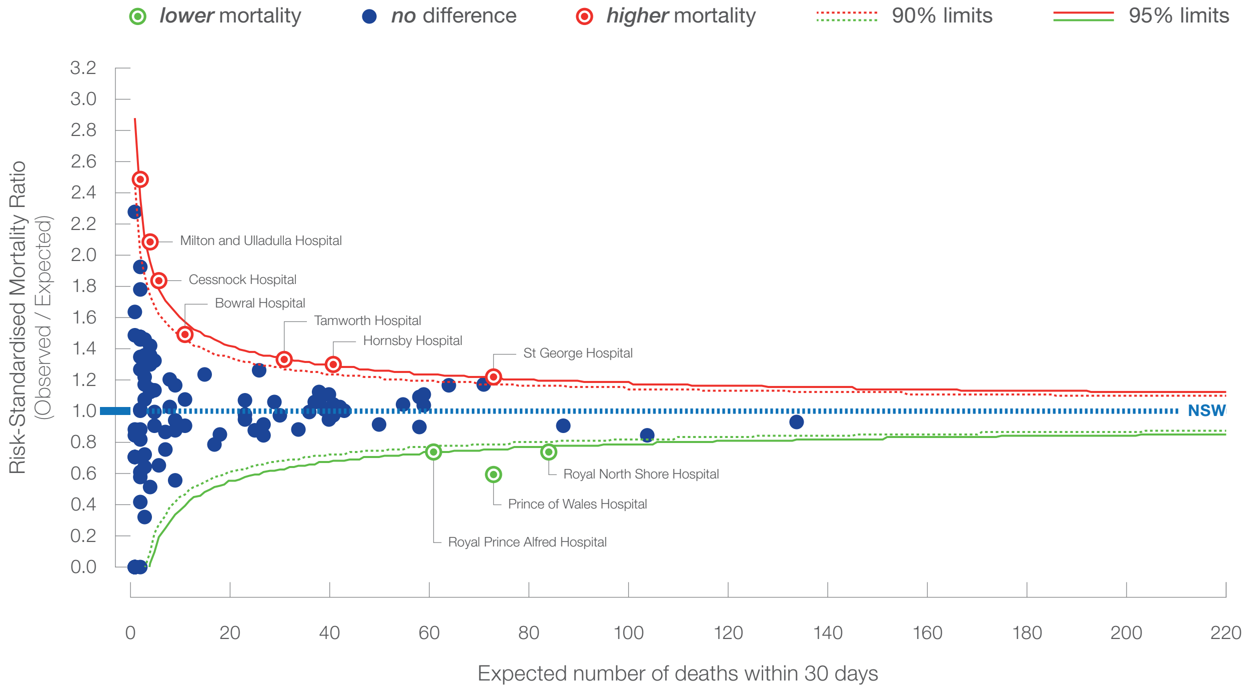


Figure 9: The effect of statistical adjustment on measures of acute myocardial infarction (AMI) 30-day mortality, NSW public hospitals, July 2009 – June 2012 Δμ

	Unadjusted	Age and sex standardised	RSMR
Range of hospital results	Unadjusted ratios ranged from: 0.38 to 2.65	Age and sex standardised ratios ranged from: 0.41 to 2.52	Risk standardised mortality ratios ranged from: 0.33 to 2.49

Increasing account taken of patient characteristics →

(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.

(μ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital. Data exclude AMI STEMI-not specified (ICD-10-AM I21.9).

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Acute Myocardial Infarction: patterns and trends

From a clinical and performance perspective, knowing when in the 30-day period deaths occurred may help point towards particular aspects of care for consideration.

To illustrate the variation seen in survival curves, Figure 10 compares two de-identified hospitals (X & Y). **Hospital X** has a flatter curve than **Hospital Y**, indicating fewer deaths, with differences appearing most marked in the first 10 days after hospitalisation.

Across peer groups, performance in principal referral and district hospitals (groups A and C) is distributed around the NSW average - with the smaller district hospitals displaying greater variability associated with low numbers of patients. Major hospitals (B group) tend towards ***higher*** than expected mortality (Figure 11).

Looking across the past 12 years, broken into four three-year periods, no hospitals had ***higher*** than expected mortality for three or more time periods. One hospital, Royal North Shore, had ***lower*** than expected mortality in all four time periods (Figure 12).

Figure 10: Acute myocardial infarction (AMI) patient survival, by day (1 – 30 days), ***high*** and ***low*** RSMR hospitals, and NSW, July 2009 – June 2012 ∅ ¶

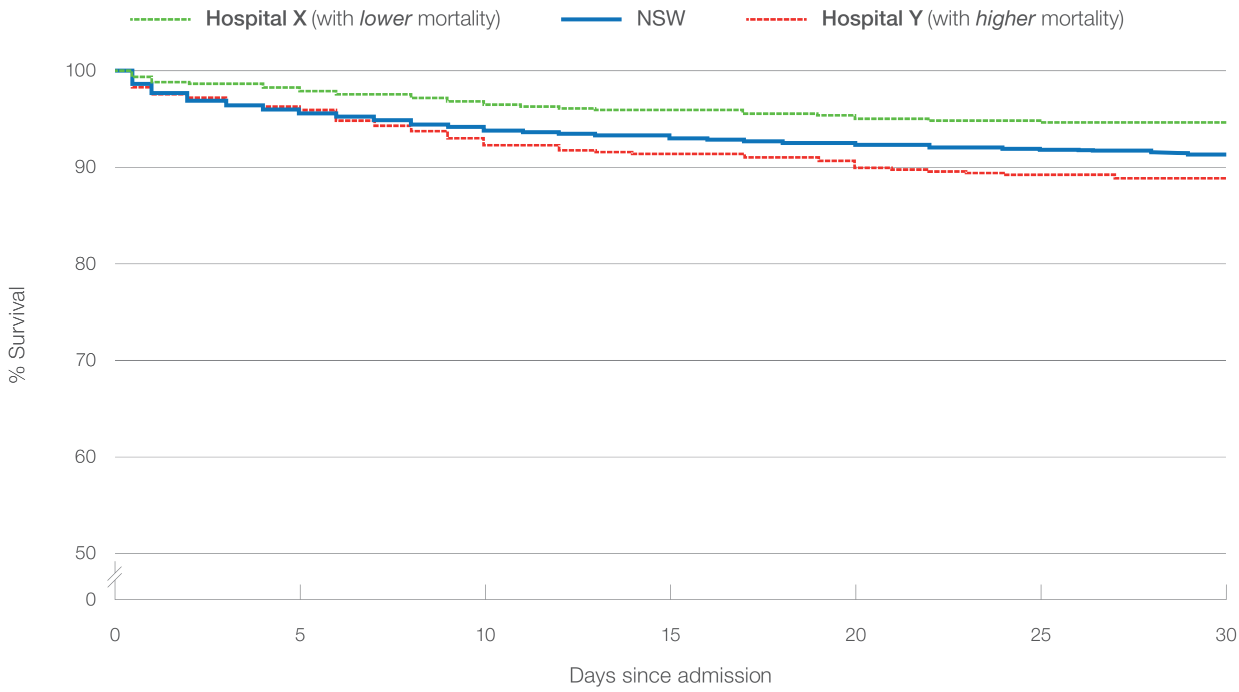
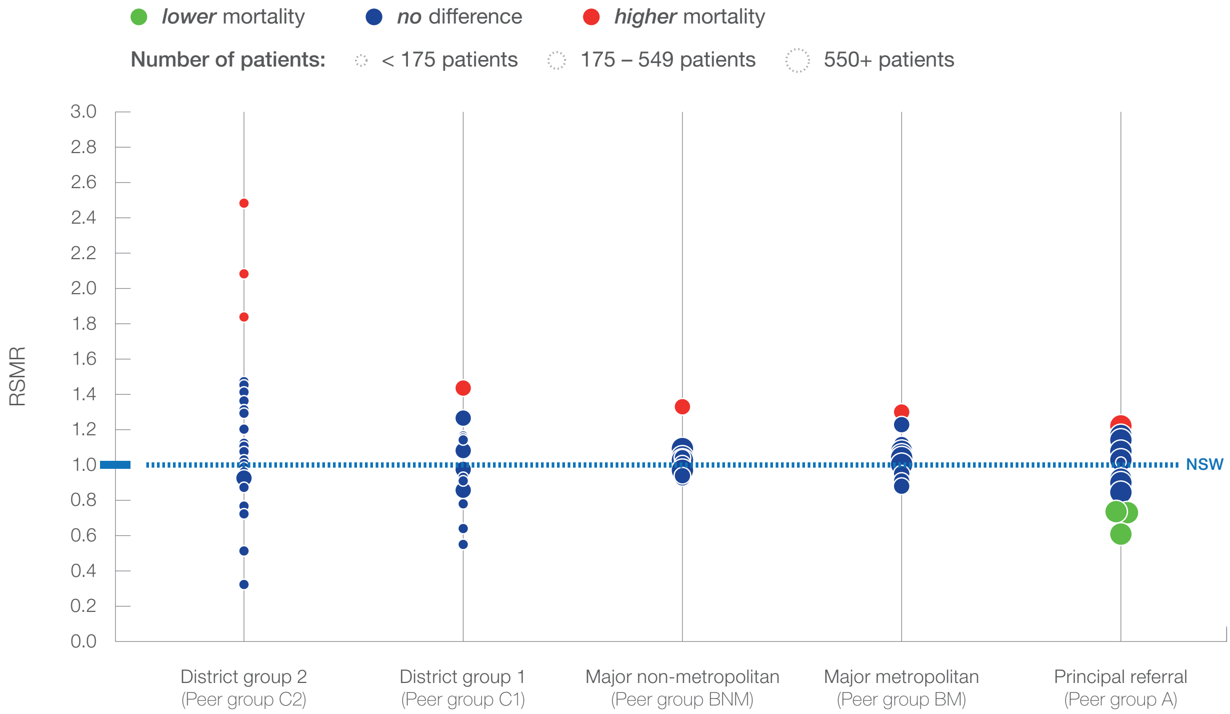
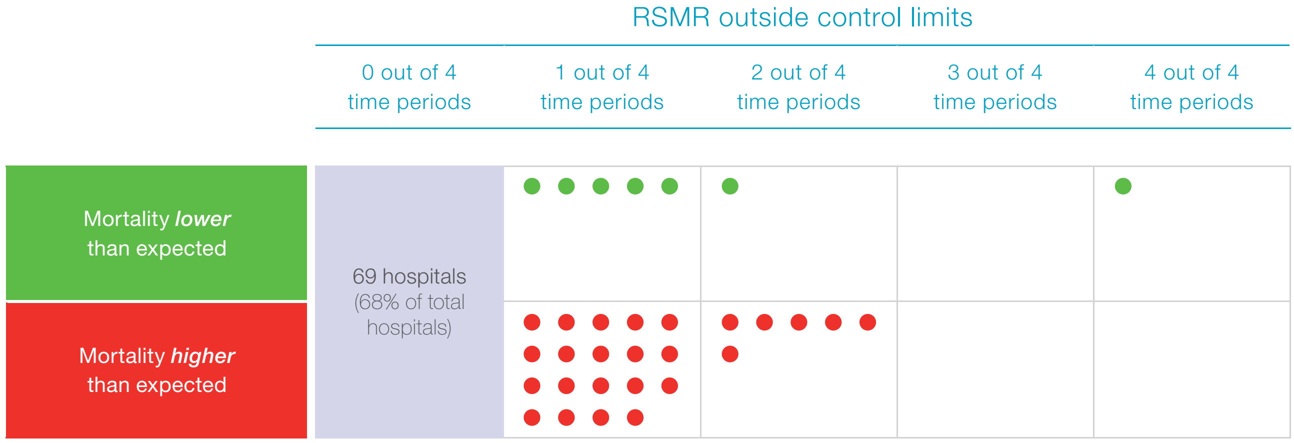


Figure 11: Acute myocardial infarction (AMI) 30-day risk-standardised mortality ratio, by ***peer group***, July 2009 – June 2012 ∅†



Number of patients	1,709	2,829	5,588	4,947	12,500

Figure 12: Acute myocardial infarction (AMI) 30-day risk-standardised mortality ratios over four time periods (three years each period), NSW public hospitals, July 2000 – June 2012 ∅Σ¥



(∅) RSMR methods are described on **page 4**.
(¶) Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score.
(†) Peer groups are described on **page vi**.
(Σ) Two hospitals recorded fluctuating results - both *lower* and *higher* mortality across the four time periods.
(¥) To make RSMRs comparable over time, a reference population is required. The time series RSMRs for each hospital are based on the reference years (July 2009 – June 2012). Control limits are based on the NSW average within each period.

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Ischaemic stroke in NSW

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.

Figure 13 summarises the characteristics of people hospitalised for ischaemic stroke between July 2009 – June 2012. For hospitals with at least 50 ischaemic stroke patients, unadjusted mortality rates ranged from 9.3 to 20.0 deaths per 100 patients. Unadjusted rates cannot be used to make meaningful assessments of hospital performance. Statistical techniques, such as RSMRs, take into account a range of patient level factors (such as age and other illnesses) to assess hospital outcomes fairly.

Figure 14 shows ischaemic stroke 30-day RSMRs for each hospital in the state, using a funnel plot (see page 5 for how to interpret funnel plots). There were 57 hospitals (80%) with mortality no different from expected. Four hospitals (Concord, Prince of Wales, Belmont, and Manly) had ***lower*** than expected mortality and ten hospitals (Moruya, Tamworth, Dubbo, Lismore, Nepean, Coffs Harbour, Westmead, Royal Prince Alfred, John Hunter, and one not reportable*) had ***higher*** than expected mortality.

The distribution of results for unadjusted ratios, and for age and sex adjusted ratios are compared with RSMRs in Figure 15.

Figure 13: Ischaemic stroke 30-day mortality in NSW at a glance

In the period July 2009 – June 2012 ...

- There were **14,205** patients hospitalised with a principal diagnosis of ischaemic stroke (ICD-10-AM code I63)
- Of these, **1,896** died within **30** days (any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of **13.3** per 100 patients

Among the **1,896** deaths:

- **1,274** (67%) occurred in the initial admitting hospital
- **33** (2%) occurred at another hospital, following patient transfer
- **589** (31%) occurred after discharge, outside hospital
- **32** (2% of total deaths) occurred on the first day of hospitalisation
- **966** (51% of total deaths) occurred within seven days of hospitalisation

People who survived for at least 31 days following hospitalisation for ischaemic stroke:

- had an average age of **73** years (median 76)
- **55%** were male

People who died within 30 days of hospitalisation for ischaemic stroke:

- had an average age of **82** years (median 84)
- **41%** were male

More male patients **(7,593)** were hospitalised than female patients **(6,612)**. Among males, **10.3%** died within 30 days, while among females, **16.9%** died within 30 days. After adjusting for age and comorbidities, sex remained significantly associated with mortality, females were more likely to die.

(*) Hospitals with fewer than 50 patients with a particular condition during the three year reporting period are not reported publicly to protect patient privacy and to ensure fairness.

Figure 14: Ischaemic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012 Δμ

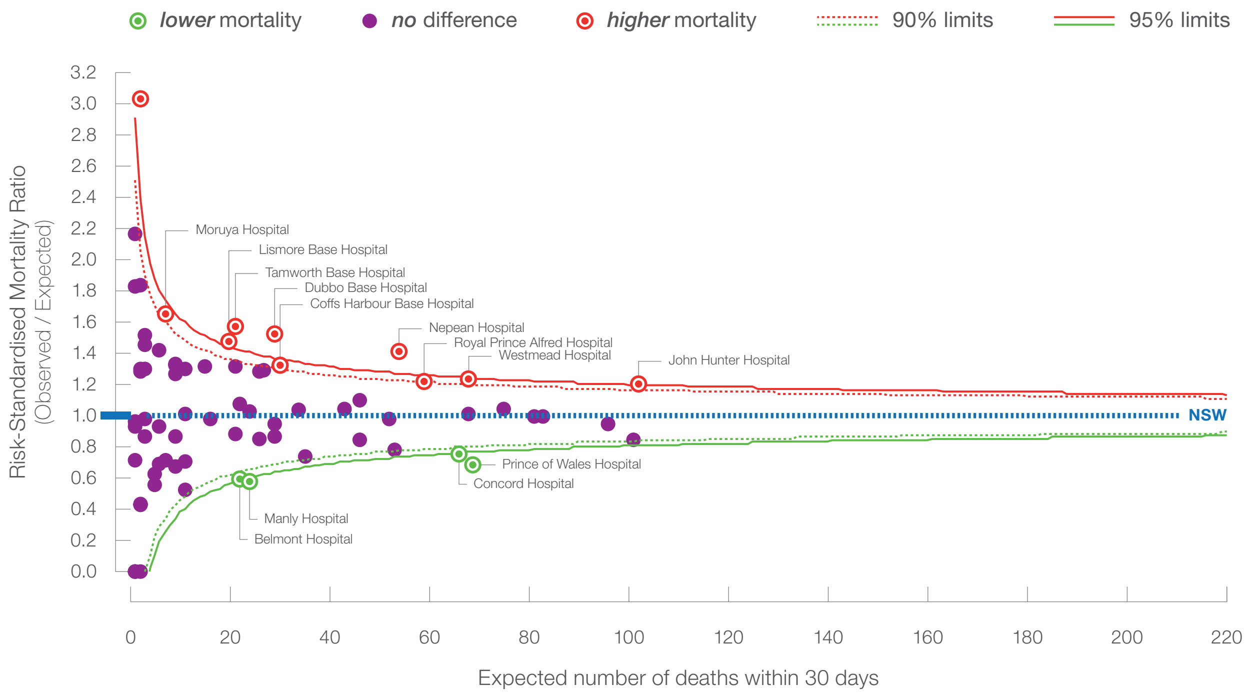


Figure 15: The effect of statistical adjustment on measures of ischaemic stroke 30-day mortality, NSW public hospitals, July 2009 – June 2012 Δμ

	Unadjusted	Age and sex standardised	RSMR
Range of hospital results	Unadjusted ratios ranged from: 0.5 to 3.21	Age and sex standardised ratios ranged from: 0.41 to 2.77	Risk standardised mortality ratios ranged from: 0.43 to 3.02

Increasing account taken of patient characteristics

(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.

(μ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital.

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Ischaemic stroke

Ischaemic stroke: patterns and trends

Identifying when in the 30-day period deaths occurred may point towards particular aspects of care for further investigation. For each hospital with 50 or more ischaemic stroke patients during the period July 2009 – June 2012, *Performance profiles* which include survival curves are available at www.bhi.nsw.gov.au

To illustrate the variation seen in survival curves, Figure 16 compares two de-identified hospitals (X & Y). Hospital X has a flatter curve than Hospital Y, indicating fewer deaths. Differences in survival are most marked between day five and day 11. Deaths in this time frame are often caused by pneumonia, pulmonary emboli and sepsis.[21] There may therefore be value in Hospital Y examining care processes relevant to preventing these complications.

Major non-metropolitan hospitals (peer group BNM) tend to have ***higher*** than expected mortality; while major metropolitan hospitals (peer group BM) tend toward ***lower*** than expected mortality (Figure 17).

Looking across the past 12 years, broken into four three-year periods, no hospital had ***lower*** than expected mortality in all four time periods. One hospital, Coffs Harbour, had ***higher*** than expected mortality for all four time periods (Figure 18).

Figure 16: Ischaemic stroke patient survival, by day (1 – 30 days), ***high*** and ***low*** RSMR hospitals, and NSW, July 2009 – June 2012 ∅¶

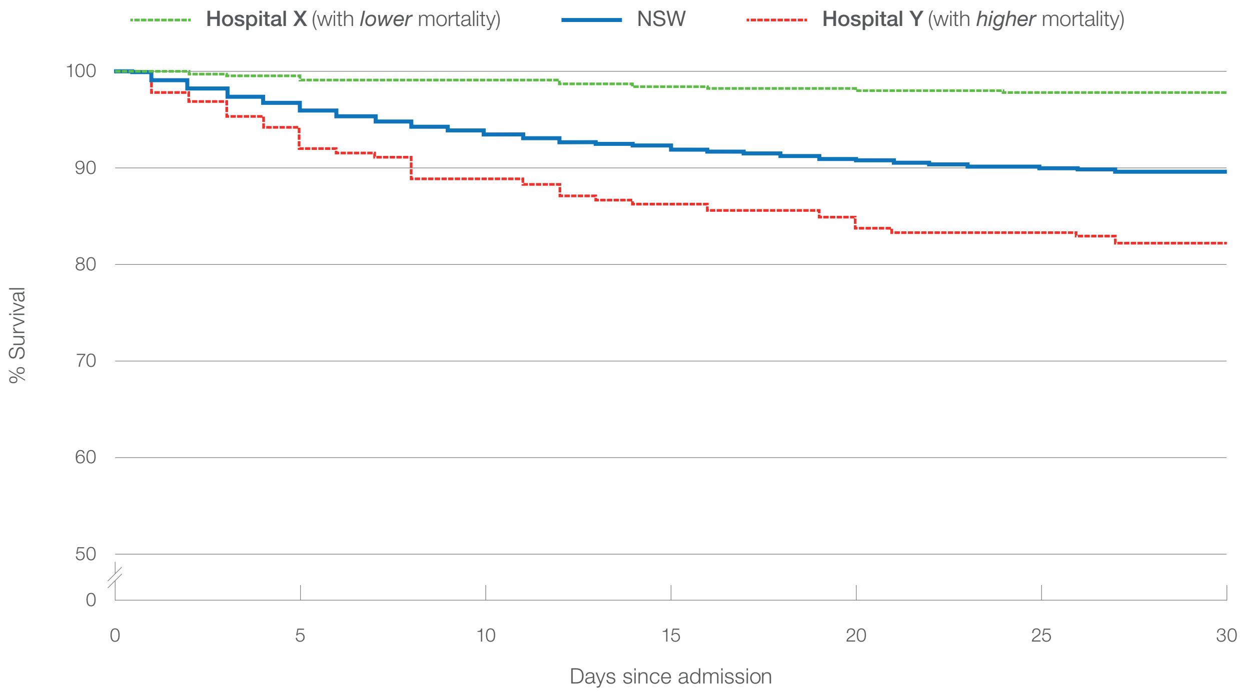
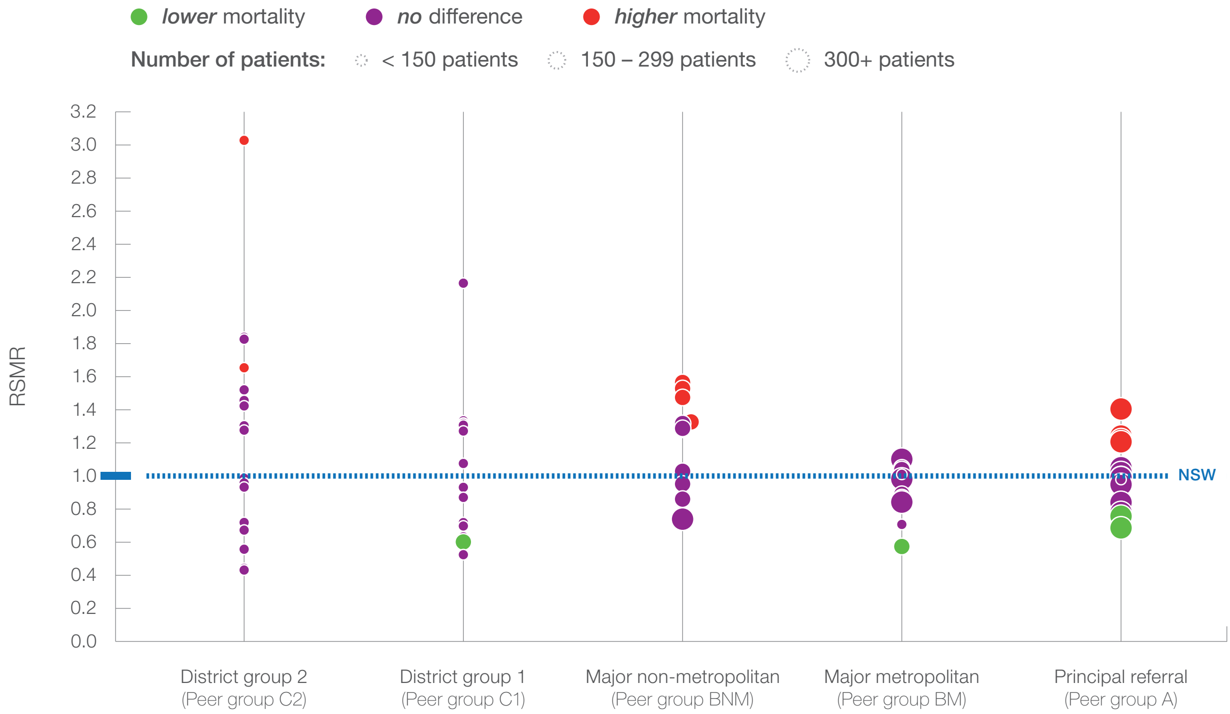
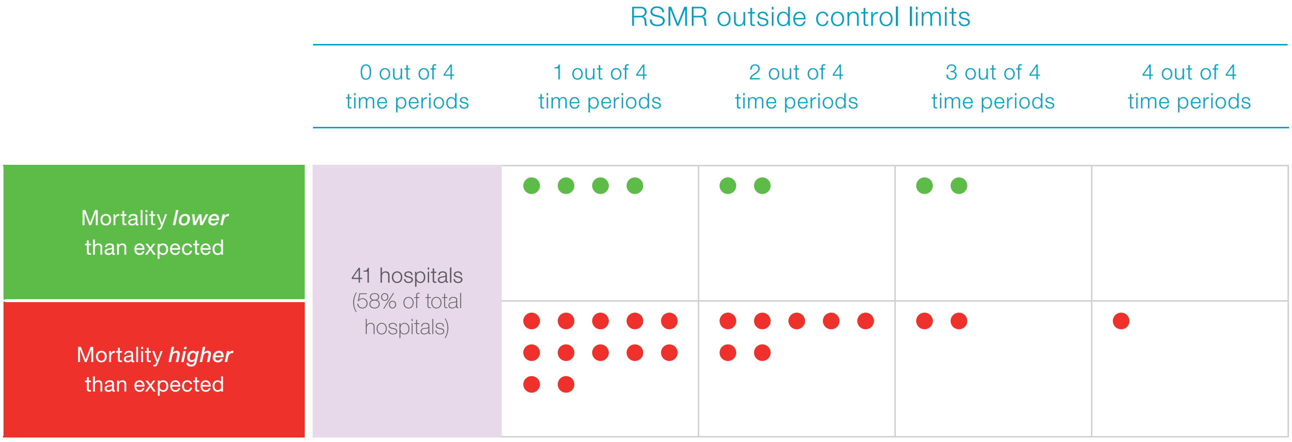


Figure 17: Ischaemic stroke 30-day risk-standardised mortality ratio, by ***peer group***, July 2009 – June 2012 Ø †



	District group 2	District group 1	Major non-metropolitan	Major metropolitan	Principal referral
Number of patients	430	1,023	2,307	2,277	7,580

Figure 18: Ischaemic stroke 30-day risk-standardised mortality ratios over four time periods (three years each period), NSW public hospitals, July 2000 – June 2012 Ø ¥



(Ø) RSMR methods are described on **page 4**.
(¶) Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score.
(†) Peer groups are described on **page vi**.
(¥) To make RSMRs comparable over time, a reference population is required. The time series RSMRs for each hospital are based on the reference years (July 2009 – June 2012). Control limits are based on the NSW average within each period.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Haemorrhagic stroke in NSW

A haemorrhagic stroke occurs when a blood vessel, usually an artery, develops a leak or bursts. As a result, the brain surrounding the vessel is damaged by blood or pressure. Severity and consequences of stroke vary from complete recovery, to severe disability or death.

Figure 19 summarises the characteristics of people hospitalised for haemorrhagic stroke between July 2009 – June 2012. For hospitals with at least 50 haemorrhagic stroke patients, unadjusted mortality rates ranged from 18.2 to 51.6 per 100 patients. Unadjusted rates cannot be used to make meaningful assessments of hospital performance. Statistical techniques, such as RSMRs, take into account a range of patient level factors (such as age and other illnesses) to assess hospital outcomes fairly.

Figure 20 depicts the haemorrhagic stroke 30-day RSMRs for each hospital in the state, using a funnel plot (see page 5 for how to interpret funnel plots). There were 82 hospitals (94%) within the expected range of results. Two hospitals (Fairfield, and one not reportable*) had *lower* than expected mortality and three hospitals (Port Macquarie, John Hunter, and one not reportable*) had *higher* than expected mortality.

The distribution of results for unadjusted ratios, and for age and sex adjusted ratios are compared with RSMRs in Figure 21. While RSMRs provide the fairest assessments of hospital outcomes, they do not necessarily reduce variability of results.

Figure 19: Haemorrhagic stroke 30-day mortality in NSW at a glance

In the period July 2009 – June 2012 ...

- There were **5,681** patients hospitalised with a principal diagnosis of haemorrhagic stroke (ICD-10-AM I61, I62)
- Of these, **1,923** died within 30 days (any cause, in or out of hospital)
- This corresponds to a state mortality rate of **34** per 100 patients

Among the **1,923** deaths:

- **1,457** (76%) occurred in the initial admitting hospital
- **56** (3%) occurred at another hospital, following patient transfer
- **410** (21%) occurred after discharge, outside hospital
- **386** (20% of total deaths) occurred on the first day of hospitalisation
- **1,443** (75% of total deaths) occurred within seven days of hospitalisation

People who survived for at least **31** days following hospitalisation for haemorrhagic stroke:

- had an average age of **72** years (median 75)
- **58%** were male

People who died within **30** days of hospitalisation for haemorrhagic stroke:

- had an average age of **79** years (median 82)
- **47%** were male

More male patients **(3,096)** were hospitalised than female patients **(2,585)**. Among males, **29%** died within 30 days, while among females, **39%** died within 30 days. After adjusting for age and comorbidities, sex remained significantly associated with mortality, females were more likely to die.

(*) Hospitals with fewer than 50 patients with a particular condition during the three year reporting period are not reported publicly to protect patient privacy and to ensure fairness.

Figure 20 : Haemorrhagic stroke 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012 $^{\Delta\mu}$

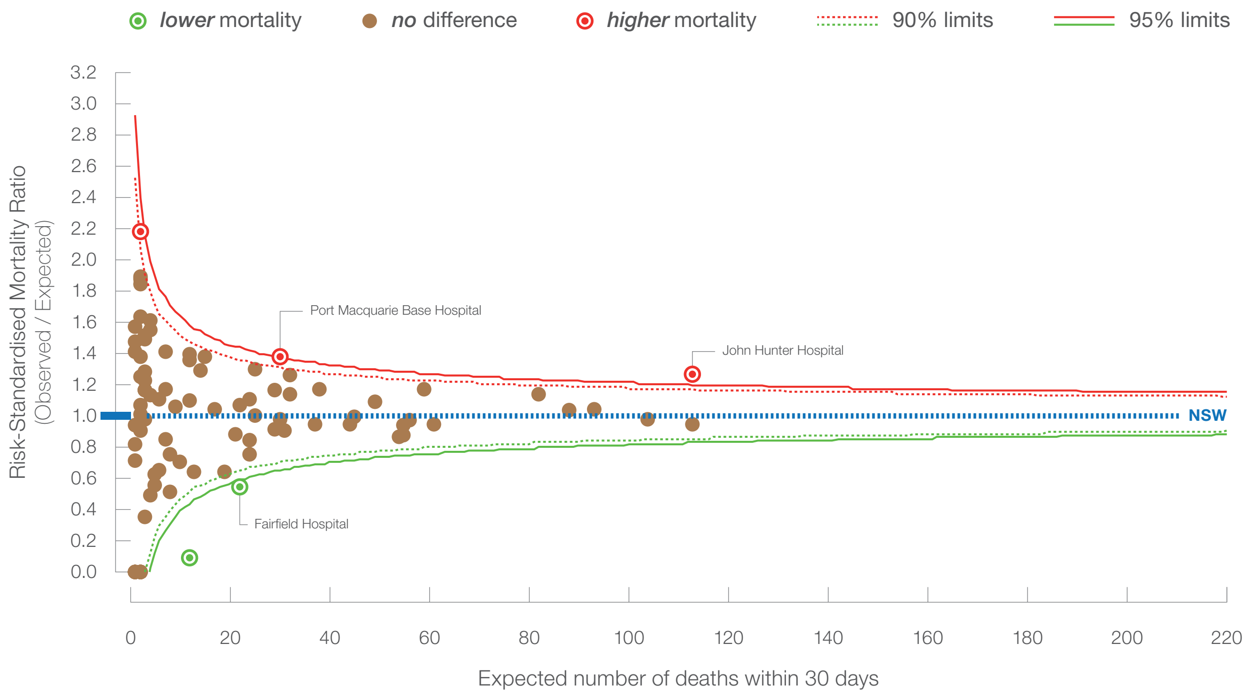


Figure 21 : The effect of statistical adjustment on measures of haemorrhagic stroke 30-day mortality, NSW public hospitals, July 2009 – June 2012 $^{\Delta\mu}$

	Unadjusted	Age and sex standardised	RSMR
Range of hospital results	Unadjusted ratios ranged from: 0.08 to 2.95	Age and sex standardised ratios ranged from: 0.08 to 2.41	Risk standardised mortality ratios ranged from: 0.08 to 2.17

Increasing account taken of patient characteristics →

(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.
(μ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Haemorrhagic stroke: patterns and trends

Identifying when in the 30-day period deaths occurred may point towards particular aspects of care for further investigation. For each hospital with 50 or more haemorrhagic stroke patients during the period July 2009 – June 2012, *Performance profiles* which include survival curves are available at www.bhi.nsw.gov.au

To illustrate the variation seen in survival curves, Figure 22 compares two de-identified hospitals (X & Y). Hospital Y has a much steeper curve than Hospital X, indicating more deaths. There is a marked difference between the two hospitals in survival patterns on day one, with Hospital X recording a lower proportion of deaths. In contrast to Hospital Y which has a steep curve until day 20, Hospital X's curve starts to flatten out around day four.

Across principal referral, major and district hospitals (peer groups A - C2), results are distributed around the NSW average (Figure 23).

Looking across the past 12 years, broken into four three-year periods, *no* hospital consistently had higher or lower than expected mortality (Figure 24).

Figure 22: Haemorrhagic stroke patient survival, by day (1 – 30 days), ***high*** and ***low*** RSMR hospitals, and NSW, July 2009 – June 2012 Ø ¶

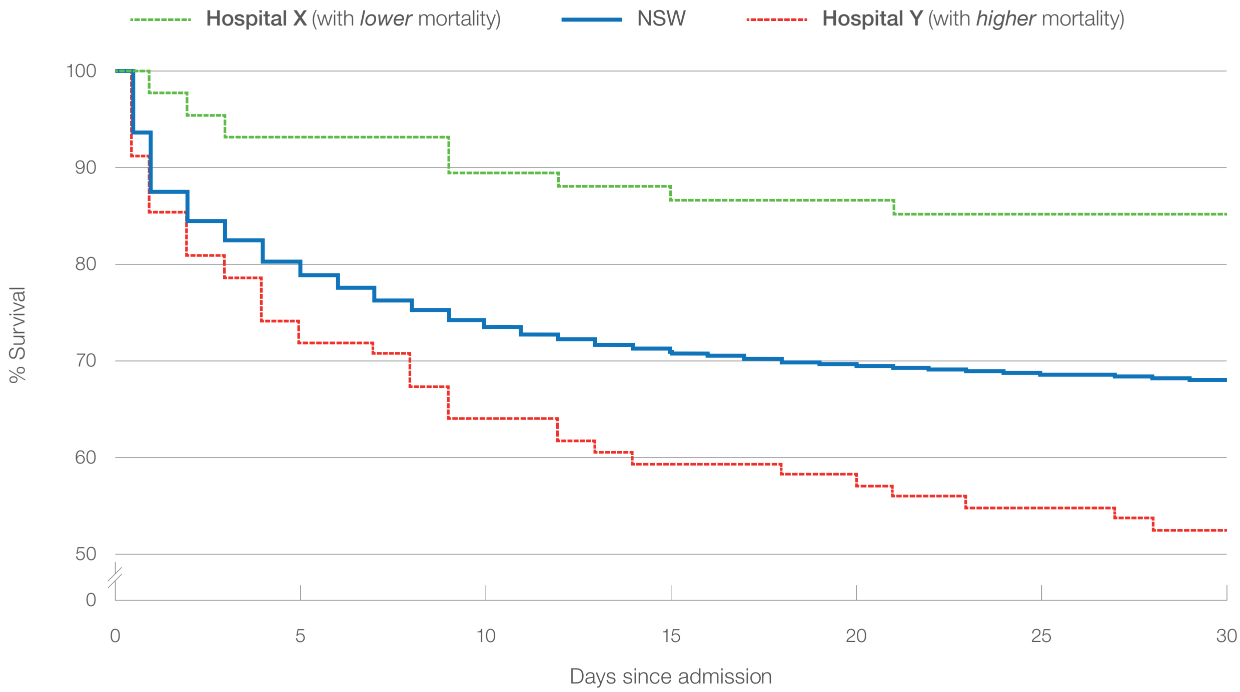
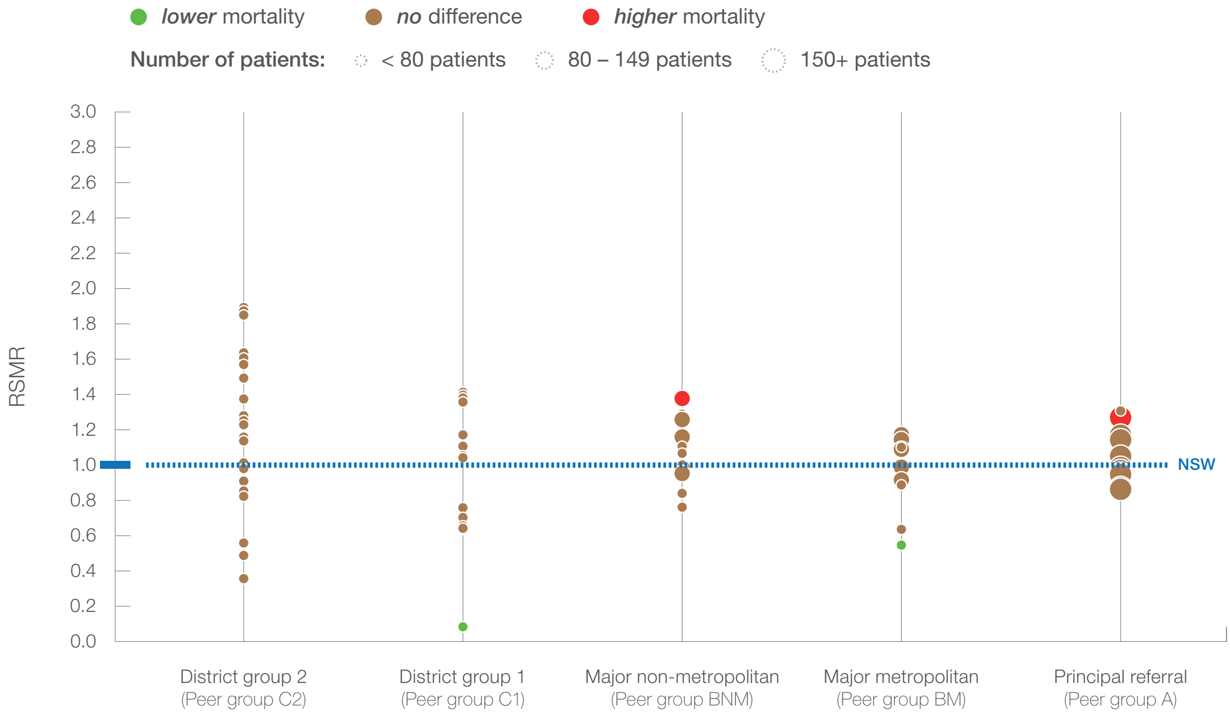
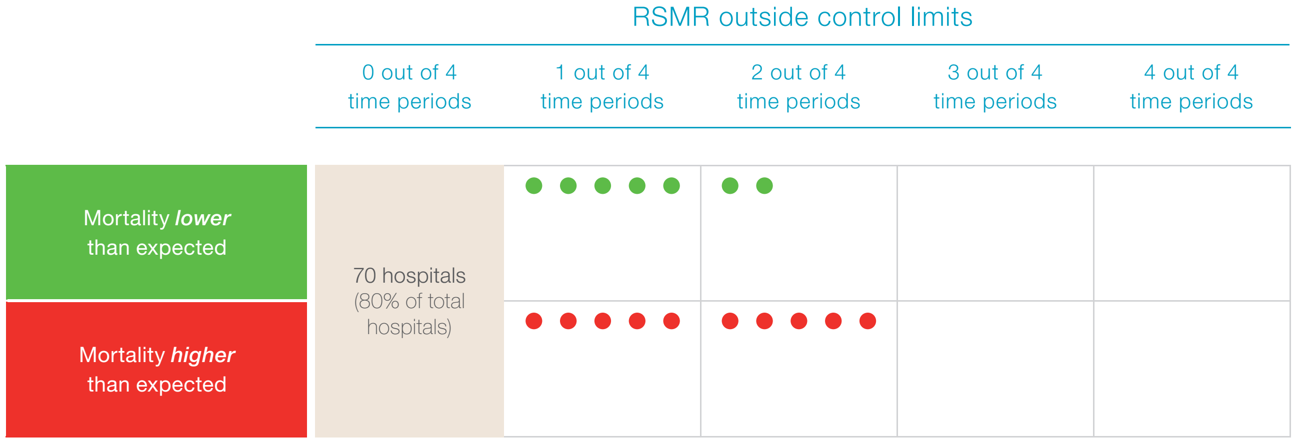


Figure 23: Haemorrhagic stroke 30-day risk-standardised mortality ratio, by ***peer group***, July 2009 – June 2012 ∅ †



Number of patients	213	432	860	834	3,086

Figure 24: Haemorrhagic stroke 30-day risk-standardised mortality ratios over four time periods (three years each period), NSW public hospitals, July 2000 – June 2012 ∅ ¥



(∅) RSMR methods are described on **page 4**.
(¶) Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score.
(†) Peer groups are described on **page vi**.
(¥) To make RSMRs comparable over time, a reference population is required. The time series RSMRs for each hospital are based on the reference years (July 2009 – June 2012). Control limits are based on the NSW average within each period.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Pneumonia in NSW

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

Figure 25 summarises the characteristics of people hospitalised for pneumonia between July 2009 – June 2012. Patients who died were, on average, older than those who survived for 30 days following hospitalisation.

Across hospitals that admitted at least 50 pneumonia patients, unadjusted mortality rates ranged from 1.4 to 16.9 deaths per 100 patients. Unadjusted rates cannot be used to make fair assessments of performance. Statistical techniques, such as RSMRs, take into account patient factors (such as age and other illnesses).

Figure 26 depicts the pneumonia 30-day RSMRs for each hospital in the state, using a funnel plot (see page 5 for how to interpret funnel plots). There were 126 hospitals (89%) within the expected range. Seven hospitals (Canterbury, John Hunter, Bankstown, St Vincent's, Maitland, Shellharbour, one not reportable) had *lower* than expected mortality and nine hospitals (Inverell, Manning, Tamworth, Blacktown, Wyong and four not reportable*) had *higher* than expected mortality.

The distribution of results for unadjusted ratios, and for age and sex adjusted ratios are compared with RSMRs in Figure 27. While RSMRs provide the fairest assessments of hospital outcomes, they do not necessarily reduce variability of results.

Figure 25: Pneumonia 30-day mortality in NSW at a glance

In the period July 2009 – June 2012 ...

- There were **44,059** patients hospitalised with a principal diagnosis of pneumonia (ICD-10 codes J13, J14, J15, J16, J18)
- Of these, **4,743** died within **30** days (any cause, in or out of hospital)
- This corresponds to an unadjusted mortality rate of **10.8** per 100 patients

Among the **4,743** deaths within 30 days:

- **3,133** (66%) occurred in the initial admitting hospital
- **142** (3%) occurred at another hospital, following patient transfer
- **1,468** (31%) occurred after discharge, outside hospital
- **294** (6% of total deaths) occurred on the first day of hospitalisation
- **2,568** (54% of total deaths) occurred within seven days of hospitalisation

People who survived for at least 31 days following hospitalisation for pneumonia:

- had an average age of **67.3** years (median 71.6)
- **52%** were male

People who died within 30 days of hospitalisation for pneumonia:

- had an average age of **81.1** years (median 83.6)
- **54%** were male

More male patients **(23,027)** were hospitalised than female patients **(21,032).** Among males, **11%** died within 30 days, while among females, **10%** died within 30 days. After adjusting for age and comorbidities, sex was not significantly associated with mortality.

(*) Hospitals with fewer than 50 patients with a particular condition during the three year reporting period are not reported publicly to protect patient privacy and to ensure fairness.

Figure 26: Pneumonia 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012 Δμ

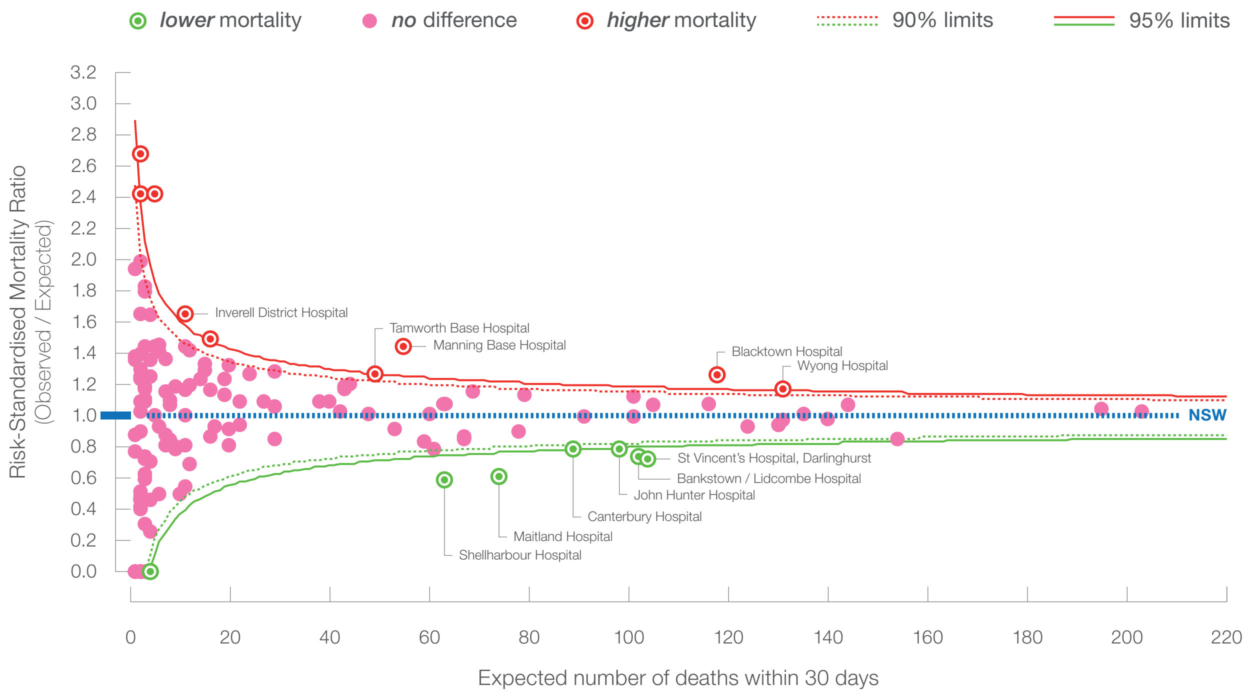


Figure 27: The effect of statistical adjustment on measures of pneumonia 30-day mortality, NSW public hospitals, July 2009 – June 2012 Δμ

	Unadjusted	Age and sex standardised	RSMR
Range of hospital results	Unadjusted ratios ranged from: 0.13 to 2.53	Age and sex standardised ratios ranged from: 0.17 to 2.34	Risk standardised mortality ratios ranged from: 0.26 to 2.68

Increasing account taken of patient characteristics

Pneumonia

(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.

(μ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital.

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Pneumonia: patterns and trends

Identifying when in the 30-day period deaths occurred may point towards particular aspects of care for further consideration. For each hospital with 50 or more pneumonia patients during the period July 2009 – June 2012, *Performance profiles* which include survival curves are available at www.bhi.nsw.gov.au

To illustrate the variation seen in survival curves, Figure 28 compares two de-identified hospitals (X & Y). Hospital Y has a much steeper curve than Hospital X, indicating more deaths. Hospital Y's survival curve falls more steeply in the first few days but continues to drop steadily over the 30-day period.

Principal referral hospitals (peer group A) tend towards ***lower*** than expected mortality while major metropolitan hospitals (peer group BM) results tend towards ***higher*** than expected mortality (Figure 29).

Looking across the past 12 years, broken into four three-year periods shows ***no*** hospital consistently had higher or lower than expected mortality (Figure 30).

Figure 28: Pneumonia patient survival, by day of death (1 – 30 days), ***high*** and ***low*** RSMR hospitals, and NSW, July 2009 – June 2012 ∅ ¶

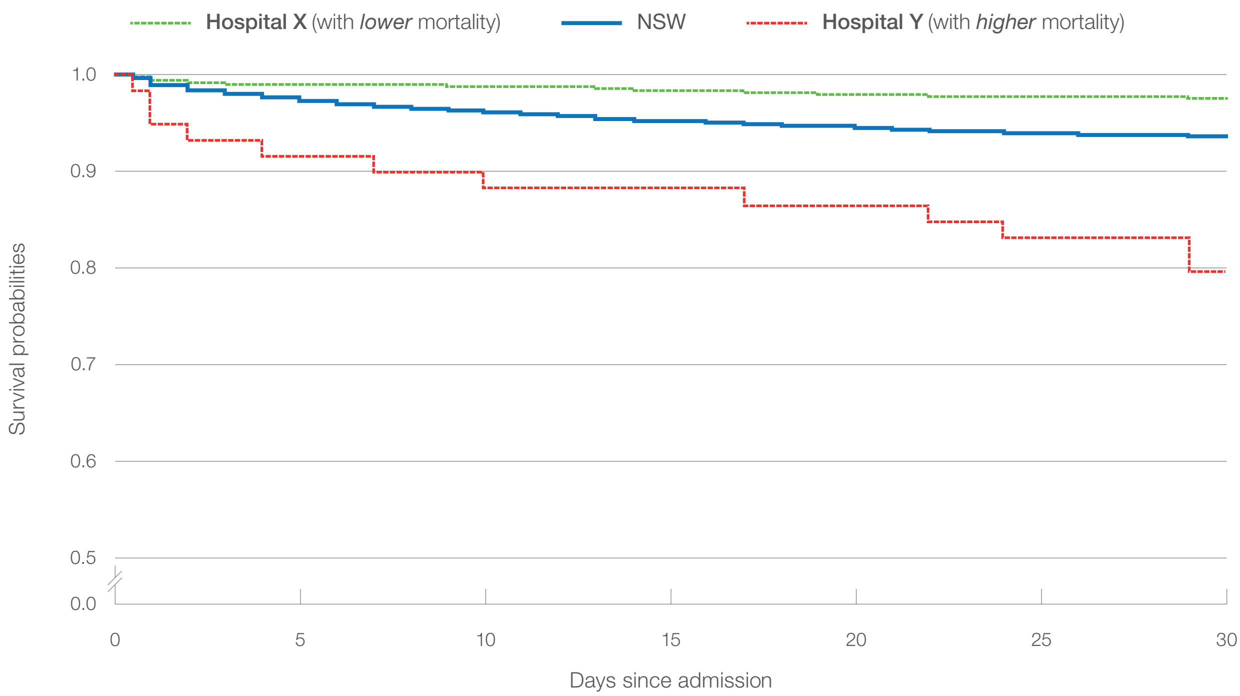
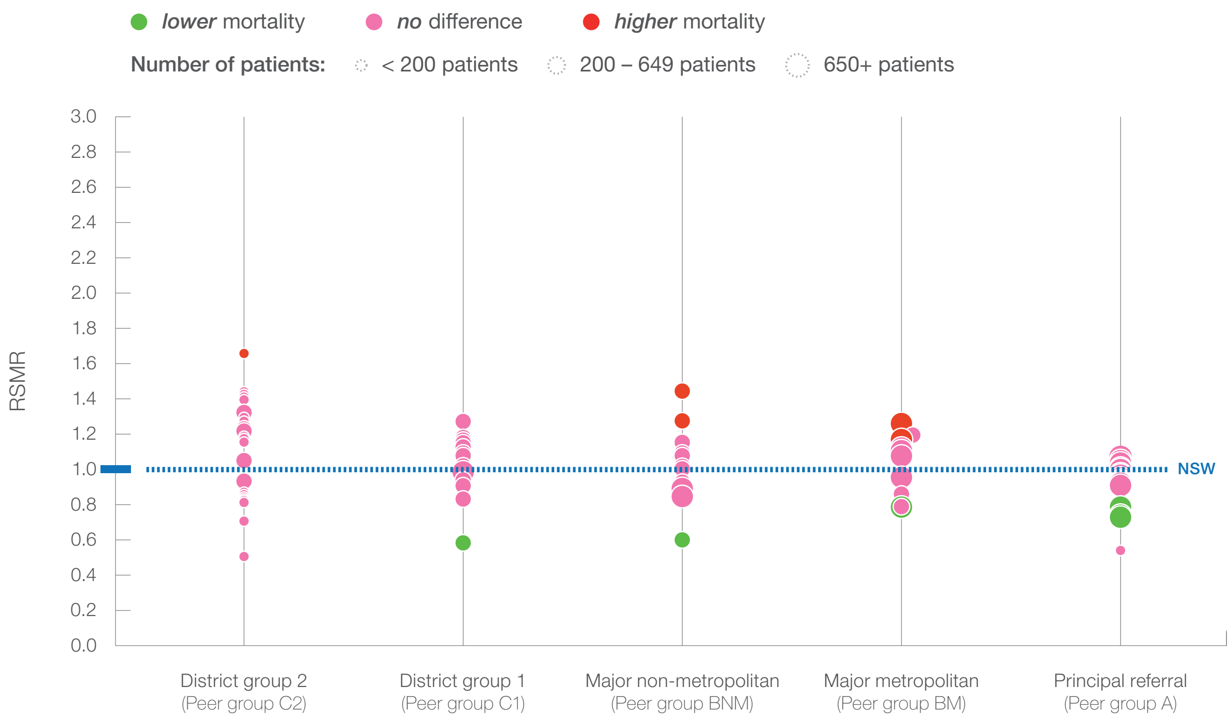
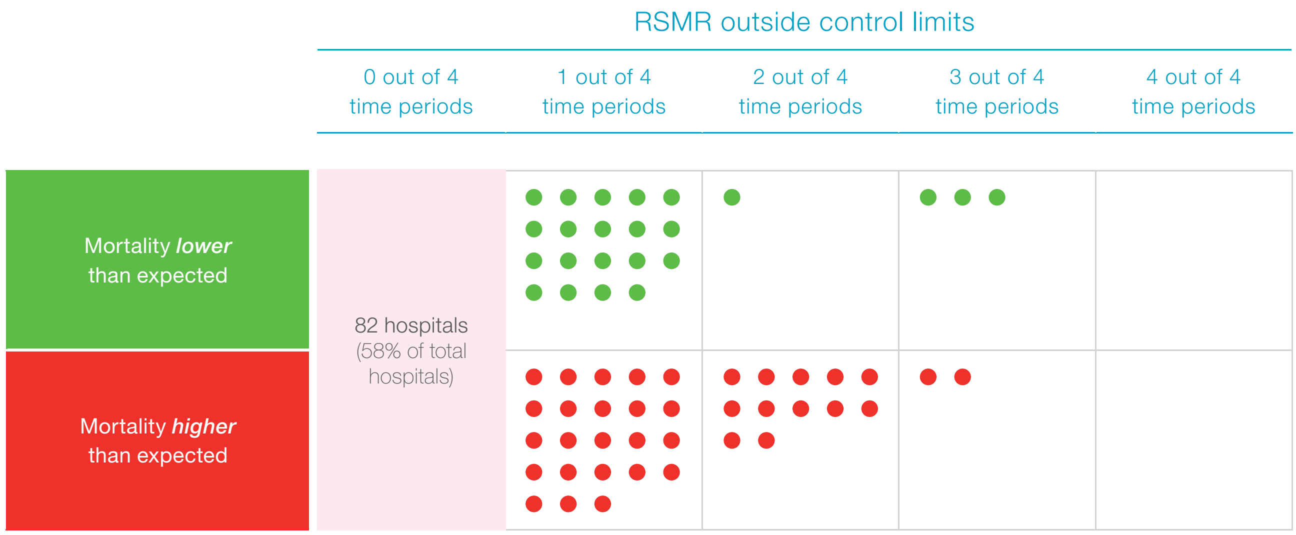


Figure 29: Pneumonia 30-day risk-standardised mortality ratio, by ***peer group***, July 2009 – June 2012 Ø†



	District group 2 (Peer group C2)	District group 1 (Peer group C1)	Major non-metropolitan (Peer group BNM)	Major metropolitan (Peer group BM)	Principal referral (Peer group A)
Number of patients	4,136	5,506	6,394	8,439	15,630

Figure 30: Pneumonia 30-day risk-standardised mortality ratios over four time periods (three years each period), NSW public hospitals, July 2000 – June 2012 Ø¥



(Ø) RSMR methods are described on **page 4**.
(¶) Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score.
(†) Peer groups are described on **page vi**.
(¥) To make RSMRs comparable over time, a reference population is required. The time series RSMRs for each hospital are based on the reference years (July 2009 – June 2012). Control limits are based on the NSW average within each period.

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Hip fracture surgery in NSW

Hip fracture refers to fractures of the femur (thigh bone) within 5 cm 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 indicator includes patients aged 50 years or older who died within 30 days of admission to the NSW hospital that performed surgery for their hip fracture.

Figure 31 summarises the characteristics of these patients. Patients who died had an average age of 87.1 years, compared to 82.6 years for those who survived at least 30 days. There were 85 hip fracture surgeries performed on people over 100 years old. For hospitals that performed hip fracture surgery on at least 50 patients, unadjusted mortality rates ranged from 4 to 11 deaths per 100 patients. Unadjusted rates cannot be used to make meaningful assessments of performance. Statistical techniques, such as RSMRs, take into account a range of patient-level factors (such as age and other illnesses) to assess hospital outcomes fairly.

Figure 32 depicts the hip fracture surgery 30-day RSMRs for each hospital in the state, using a funnel plot (see page 5 for how to interpret funnel plots). Results for 33 hospitals (87%) were within the expected range of mortality. One hospital (St Vincent's) had *lower* than expected mortality and four hospitals (Tamworth, Orange, Gosford, and Coffs Harbour) had *higher* than expected mortality.

The distribution of results for unadjusted ratios, and age and sex adjusted ratios are compared with RSMRs in Figure 33.

Figure 31: Hip fracture surgery 30-day mortality in NSW at a glance

In the period July 2009 – June 2012 ...

There were 15,836 patients who received surgery for hip fracture[∞]

- Of these, **1,086** died within 30 days of their hip fracture surgery (any cause, in or out of hospital)
- This corresponds to a state mortality rate of **6.9** per 100 patients

Among the **1,086** deaths within 30 days:

- **545** (50%) occurred in the initial admitting hospital
- **541** (50%) occurred after discharge, outside hospital
- **0** occurred at another hospital, following patient transfer
- **< 5** (< 1% of total deaths) occurred on the first day of hospitalisation
- **297** (27% of total deaths) occurred within seven days of hospitalisation

People who survived for 30 days following surgery for hip fracture:

- had an average age of **82.6** years (median 84.3)
- **27%** were male

People who died within 30 days following surgery for hip fracture:

- had an average age of **87.1** years (median 88.0)
- **40%** were male

More female patients **(11,459)** were hospitalised than male patients **(4,377)**. Among males, **9.9%** died within 30 days, while among females **5.7%** died within 30 days. After adjusting for age and comorbidities, sex remained significantly associated with mortality, males were more likely to die.

Figure 32: Hip fracture surgery 30-day risk-standardised mortality ratio, NSW public hospitals, July 2009 – June 2012 Δμ

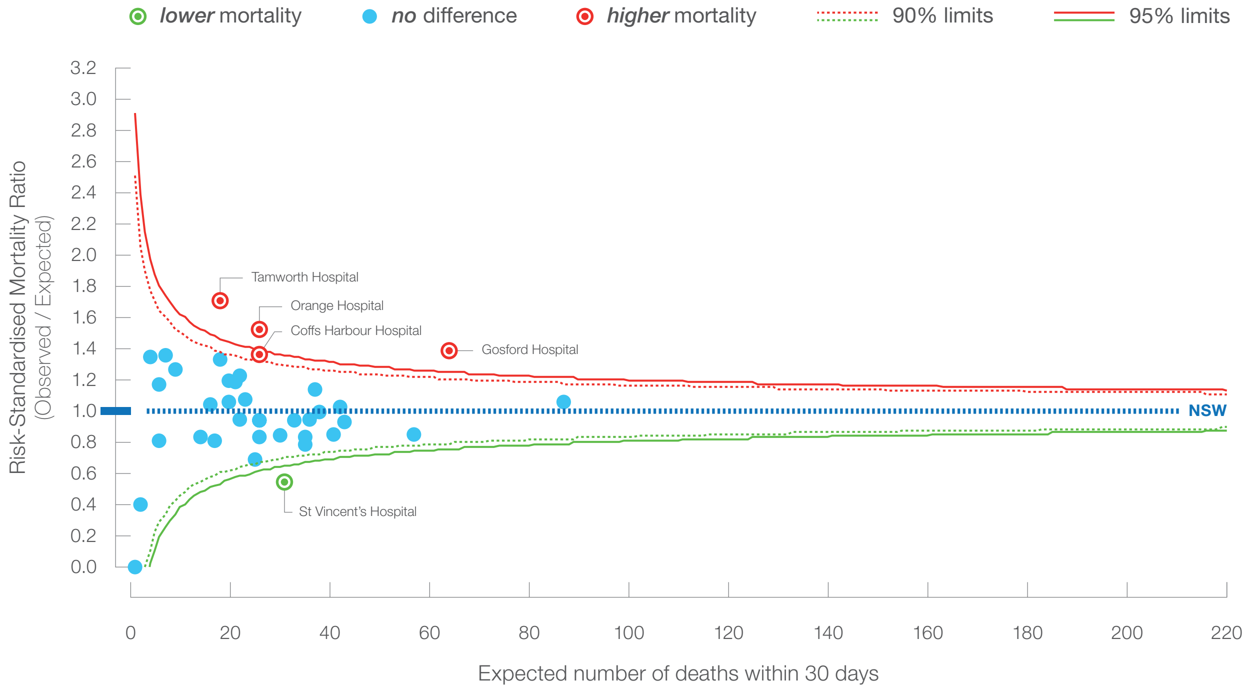


Figure 33: The effect of statistical adjustment on measures of hip fracture surgery 30-day mortality, NSW public hospitals, July 2009 – June 2012 Δμ

	Unadjusted	Age and sex standardised	RSMR
Range of hospital results	Unadjusted ratios ranged from: 0.32 to 1.60	Age and sex standardised ratios ranged from: 0.34 to 1.62	Risk standardised mortality ratios ranged from: 0.40 to 1.71

Increasing account taken of patient characteristics

(∞) ICD-10-AM codes (S72.0, S72.10, S72.11 and Procedure codes 47519-00 [1479] , 47522-00 [1489], 47528-01 [1486], 47531-00 [1486], 49315-00 [1489]) AND External cause 31 code of Falls (W00.x – W19.x) OR secondary diagnosis code 32 of Tendency to fall not elsewhere classified (R29.6).
(*) 50 years was the lower age limit set for the analysis.
(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.
(μ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Hip fracture surgery: patterns and trends

Identifying when in the 30-day period deaths occurred may point towards particular aspects of care for further investigation. For each hospital with 50 or more patients during the period July 2009 – June 2012, *Performance profiles* which include survival curves are available at www.bhi.nsw.gov.au

To illustrate the variation seen in survival curves, Figure 34 compares two de-identified hospitals (X & Y). **Hospital Y** has a steeper curve than **Hospital X**, indicating more deaths. **Hospital Y's** survival curve falls more steeply between days five and 10.

Major non-metropolitan hospitals (peer group BNM) (B non-metropolitan) tend to have ***higher*** than expected mortality while major metropolitan (peer group BM) tend towards ***lower*** than expected mortality (Figure 35).

Looking across the past 12 years, broken into four three-year periods, one hospital, St Vincent's, had ***lower*** than expected mortality in all four time periods. No hospital had ***higher*** than expected mortality for all four time periods (Figure 36).

Figure 34: Hip fracture surgery patient survival, by day (1 – 30 days), ***high*** and ***low*** RSMR hospitals, and NSW, July 2009 – June 2012 ∅ ¶

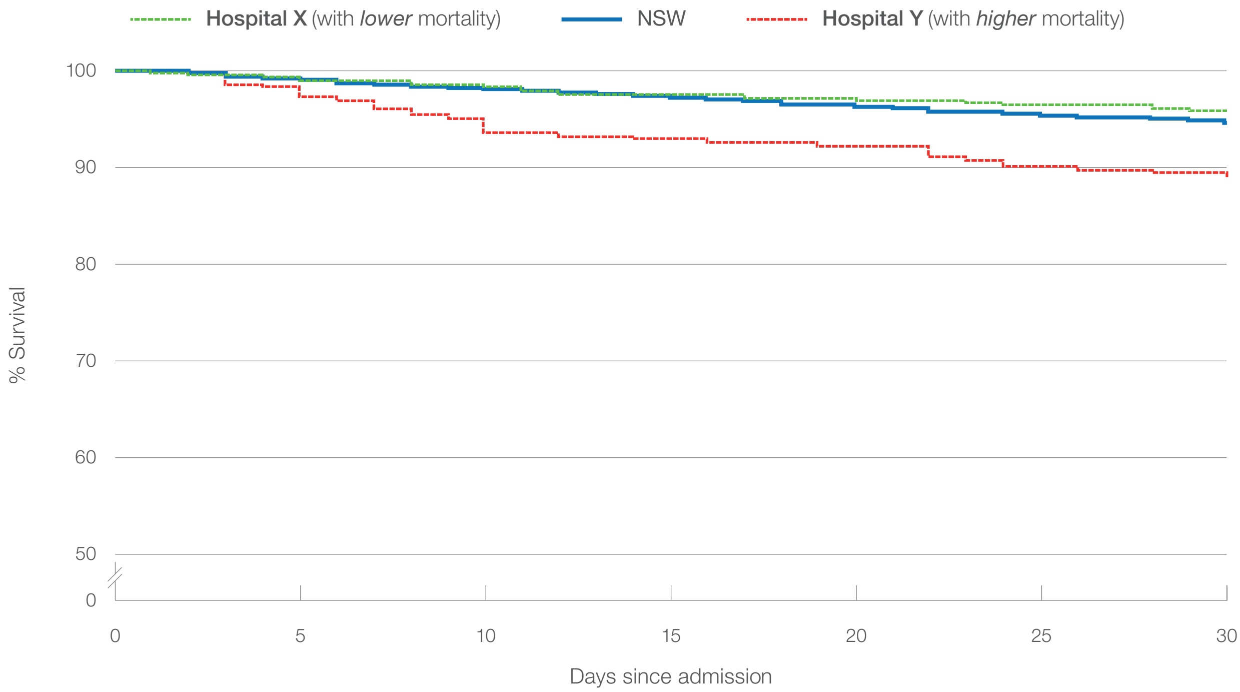
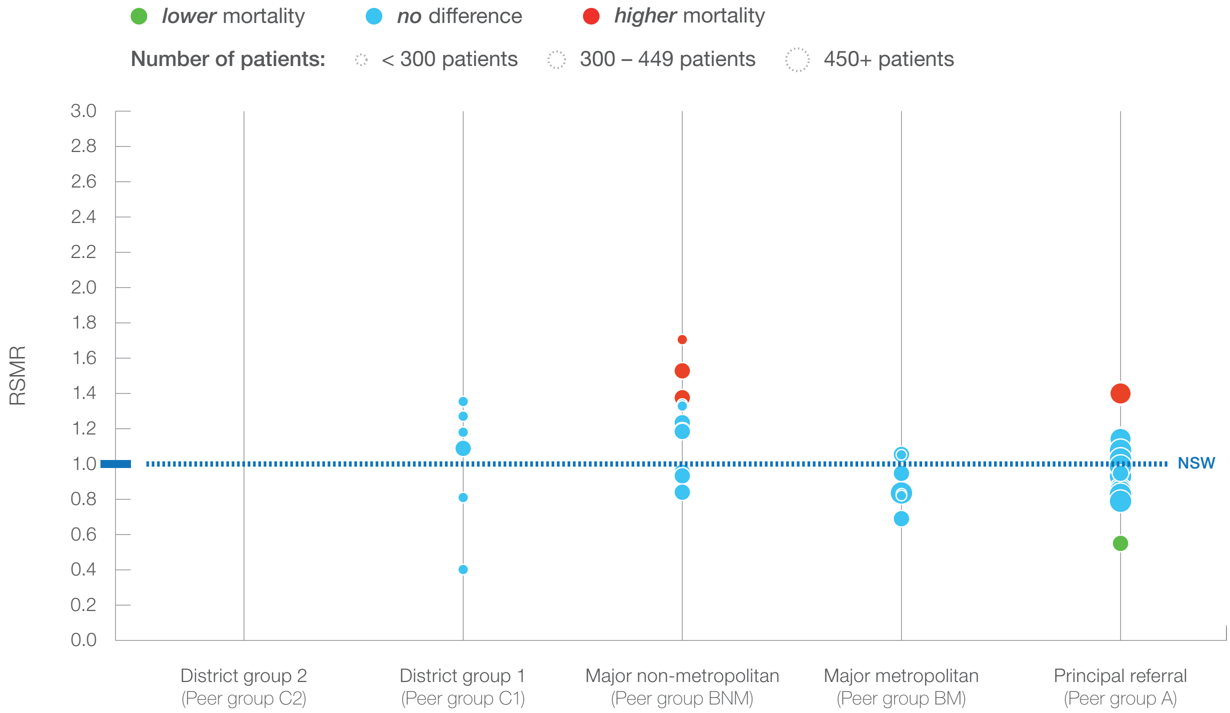
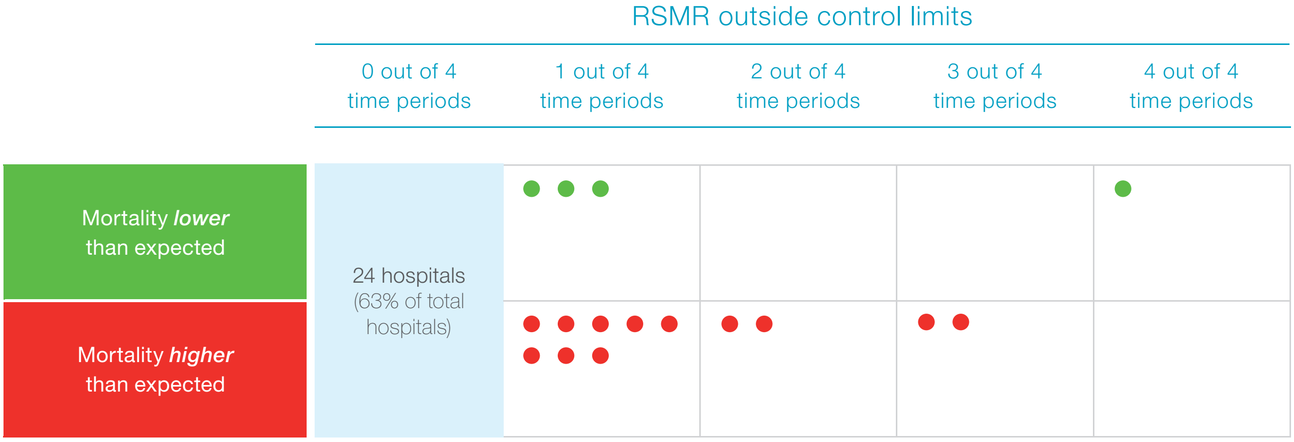


Figure 35: Hip fracture surgery 30-day risk-standardised mortality ratio, by ***peer group***, July 2009 – June 2012 Ø †



Number of patients	District group 2 (Peer group C2)	District group 1 (Peer group C1)	Major non-metropolitan (Peer group BNM)	Major metropolitan (Peer group BM)	Principal referral (Peer group A)
Number of patients	–	837	3,491	2,278	8,144

Figure 36: Hip fracture surgery 30-day risk-standardised mortality ratios over four time periods (three years each period), NSW public hospitals, July 2000 – June 2012 Ø ¥



(Ø) RSMR methods are described on **page 4**.
(¶) Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score.
(†) Peer groups are described on **page vi**.
(¥) To make RSMRs comparable over time, a reference population is required. The time series RSMRs for each hospital are based on the reference years (July 2009 – June 2012). Control limits are based on the NSW average within each period.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Geographical perspective

Geography, particularly differences between urban and rural services, is an important contextual element in system performance. This is particularly true for a jurisdiction as large and as unevenly populated as NSW. For acute conditions that require complex treatment and specialised facilities, appropriate care in rural areas often involves patient stabilisation and transport to larger, better equipped facilities.

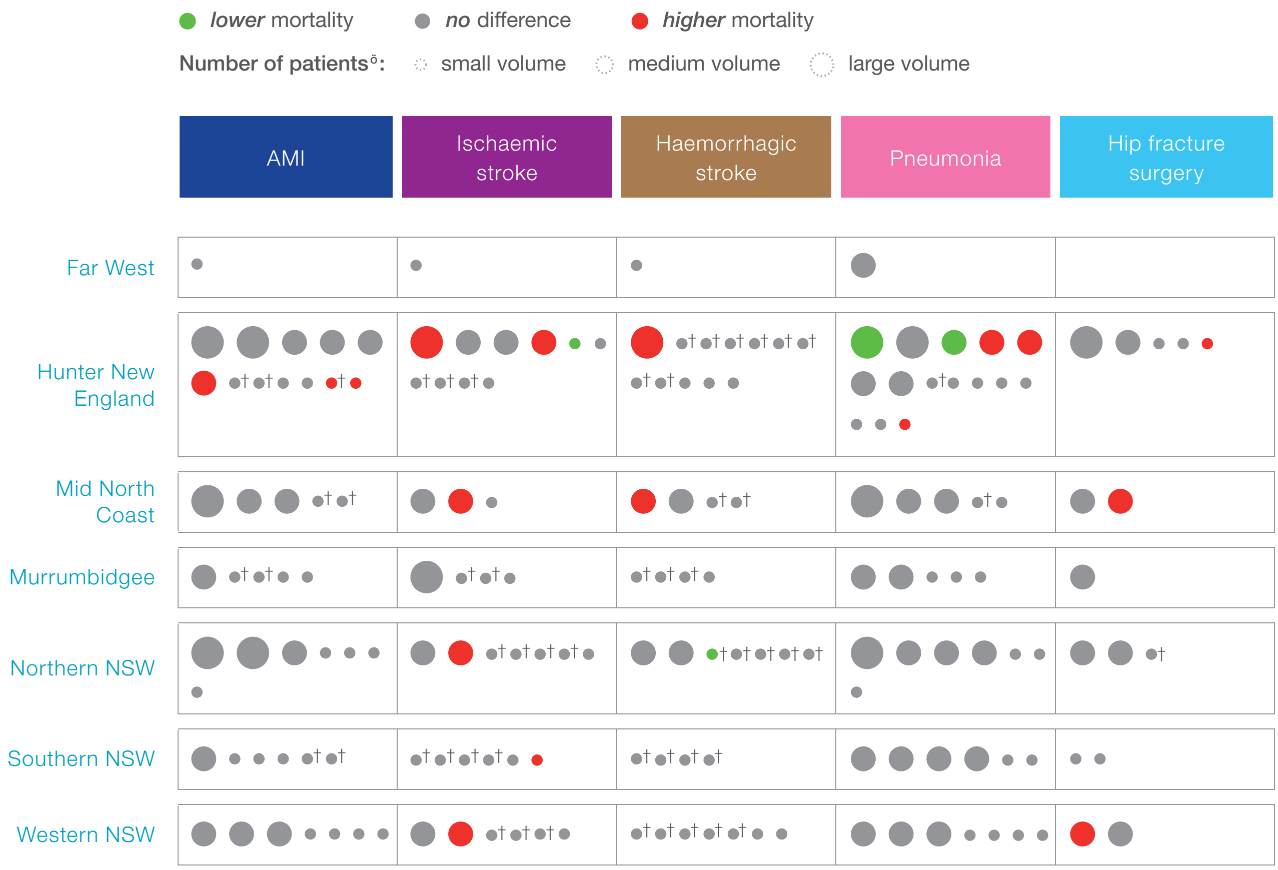
Hospitals that have *higher* than expected mortality are dispersed across the rural and urban spectrum. Results that are *lower* than expected are concentrated in urban areas (Figure 37).

Within the NSW health system, Local Health Districts (LHDs) have responsibility and accountability for managing hospital and health service delivery for their local district. LHDs are therefore an important level of analysis for performance reporting.

Hospitals with *higher* than expected mortality are distributed across the state's LHDs (Figures 37 and 38).

Figure 37: Distribution of hospitals that have ***higher*** than expected and ***lower*** than expected RSMRs, ***urban LHDs***, July 2009 – June 2012 ¤∆

Figure 38: Distribution of hospitals that have ***higher*** than expected and ***lower*** than expected RSMRs, ***rural LHDs***, July 2009 – June 2012 ¤Δ



(¤) For each condition, hospitals are grouped into tertiles according to the number of patients they admitted in the three year period. The size of the dots indicate whether the hospital had a small, medium or large number of patients. Because the conditions differ in prevalence, the tertile ranges differ across the conditions. The size of the dots signify:

For AMI, small < 175; medium 175 – 549; large 550+
For ischaemic stroke, small < 150; medium 150 – 299; large 300+
For haemorrhagic stroke, small < 80; medium 80 – 149; large 150+
For pneumonia, small < 200; medium 200 – 649; large 650+
For hip fracture surgery, small < 300; medium 300 – 449; large 450+.

(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for facilities smaller than district level hospitals (C2), or hospitals with < 1 *'expected'* death are supressed.

(†) A hospital with < 50 patients.

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Comparing the five conditions: patterns in survival

From a clinical and performance perspective, information about the way deaths are distributed over the 30-day period following admission may help point towards particular aspects of care requiring investigation. This information is shown as survival curves (a curve of the percentage of patients still surviving each day after admission). Each death contributes to lowering the curve (see page 6 for how to interpret survival curves).

The five conditions included in this report are known to differ in prognosis and, as expected, survival curves varied considerably. Haemorrhagic stroke had the steepest curve (Figure 39).

Looking at the percentage of deaths that occurred on day one of admission, NSW results ranged from < 1% for hip fracture surgery to 20% for haemorrhagic stroke. The percentage of deaths that occurred within seven days ranged from 27% for hip fracture surgery to 75% for haemorrhagic stroke (Figure 40).

The percentage of deaths that occurred post-discharge (but still within the 30 day period) ranged from 29% for pneumonia to 50% for hip fracture surgery (Figure 41).

Hospital-level survival curves, for each of the five conditions, are presented for referral, major and district hospitals in the *Performance Profiles* available at www.bhi.nsw.gov.au

Figure 39: Survival curves for five conditions, NSW, July 2009 – June 2012 ∂

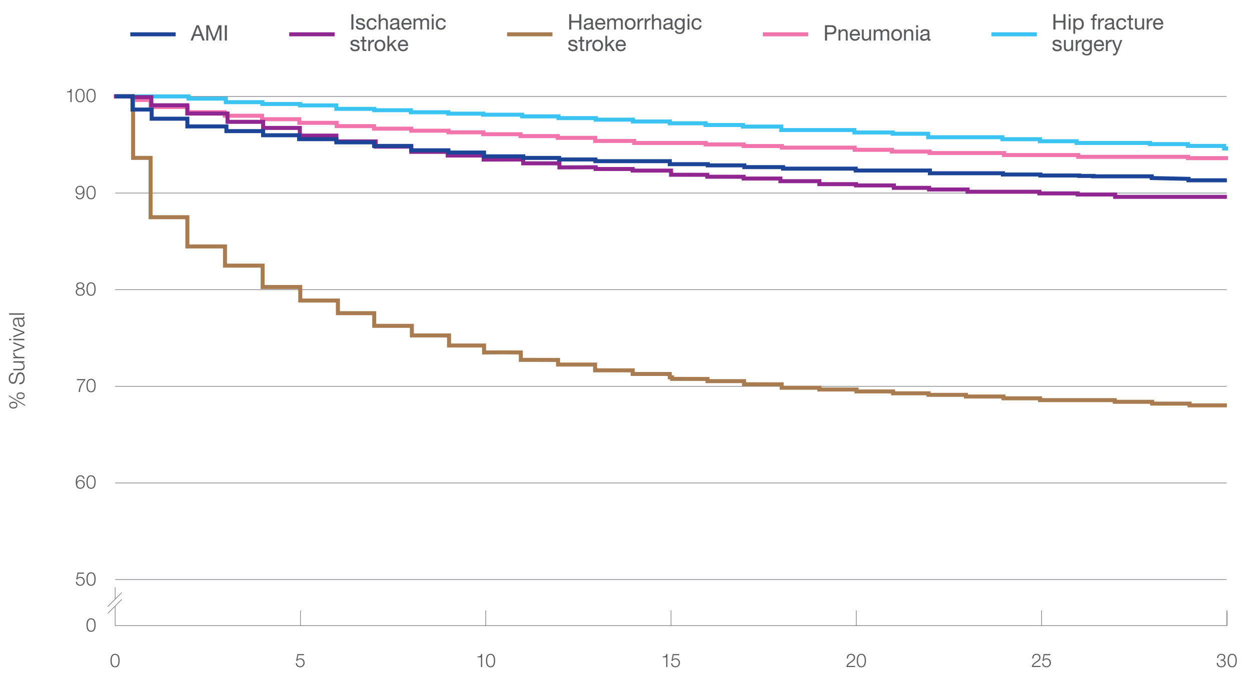


Figure 40: Percentage of 30-day mortality on day 1, day 2 – 7, day 8 – 30, by condition, NSW, July 2009 – June 2012

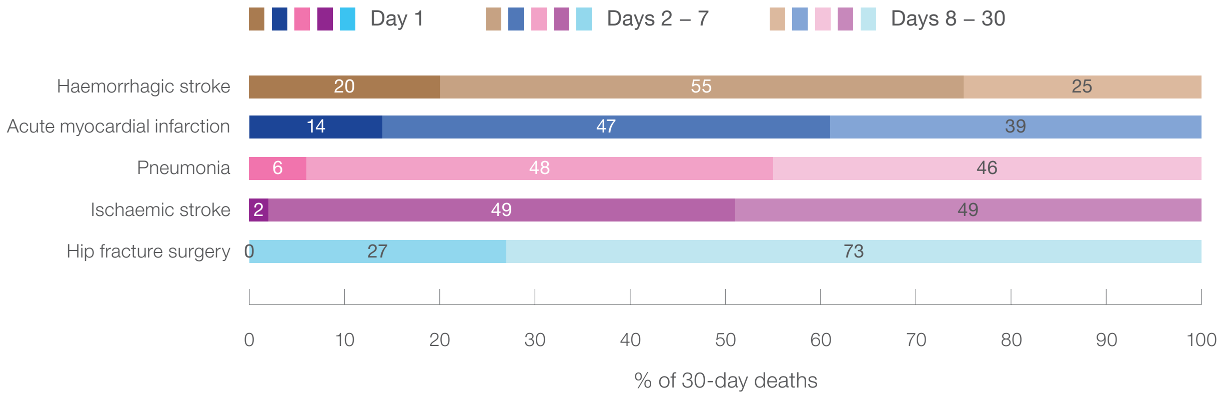
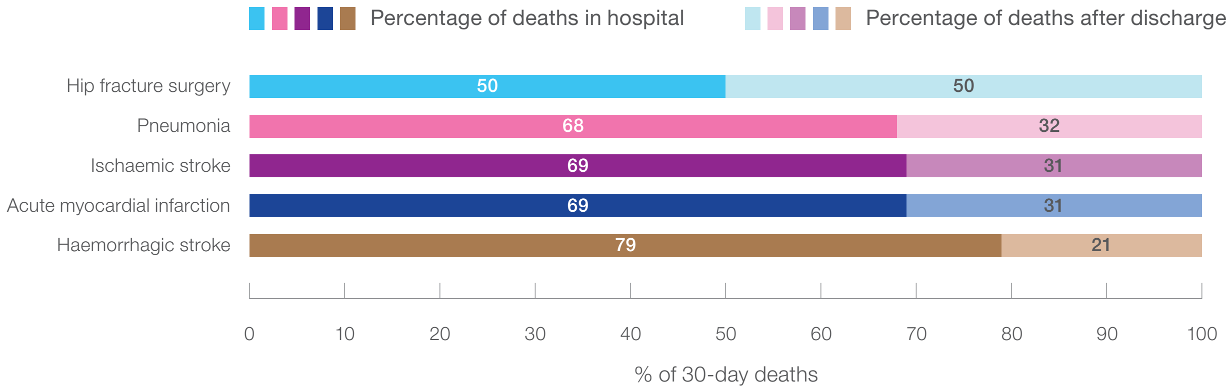


Figure 41: Percentage of 30-day mortality that occurred after discharge, by condition, NSW, July 2009 – June 2012



(∂) Deaths are from all causes. Kaplan-Meier survival curve for 30-day mortality following admission, adjusted for average age and average Charlson score. Transfers are defined based on separation mode (code 5).

Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Specialised facilities and AMI 30-day mortality

A cardiac catheterisation-laboratory (cath lab) is a specialised unit with equipment to locate blockages in the arteries of the heart and deliver rapid treatment to clear those blockages. The speed with which circulation is restored following an AMI is critically important to outcomes. Therefore access to a 24 hour cath lab is advantageous.

Figure 44 profiles three different hospital groups: those with no cath lab; those with a cath lab on site; and those with a cath lab on site with *'open all hours'* availability. Hospitals with cath labs are the first admitting hospital for over one-third of AMI patients. Cath lab hospitals also receive patients requiring urgent care from smaller facilities. Those transferred patients are attributed to the first, smaller hospital. This is so that outcomes, which are affected by timely transfer to appropriate facilities, reflect the smaller hospital's role in providing appropriate care.

Figure 45 presents the results for patients with acute myocardial infarction in NSW peer group A-C hospitals, according to the presence or absence of a cath lab and its opening hours.

Three hospitals in the state recorded *lower* than expected mortality. All three of these hospitals had access to an *'open all hours'* cath lab.

Hospitals with access to an *'open all hours'* cath lab tend to have RSMRs < 1.0. However, there are some NSW hospitals that have access to an *'open all hours'* cath lab that have *higher* than expected mortality.

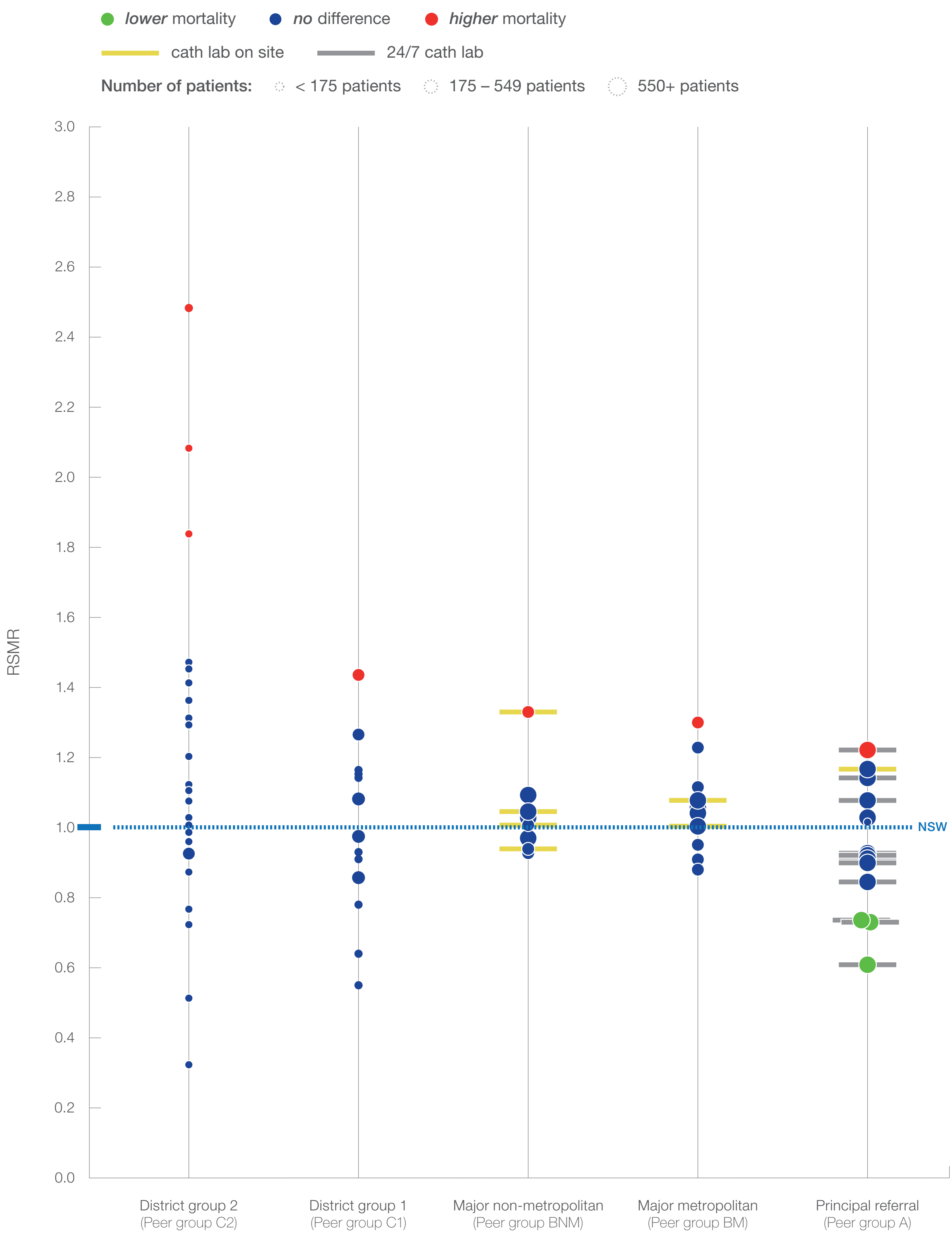
This suggests that while the presence of an *'open all hours'* cath lab can contribute to good outcomes, it does not guarantee them.

Figure 44: Profiling hospitals by availability of specialist cath labs, NSW, July 2009 – June 2012 [ž, Δ, µ]

	Hospitals with no cath lab	Hospitals with cath lab on site	Hospitals with *'open all hours'* cath lab
Number of patients hospitalised	14,211	3,929	10,354
Number of deaths among hospitalised patients	1,079	322	766
Deaths on day one	155	44	104
% deaths that occurred on day one	14.4%	13.7%	13.6%
Deaths within seven days	649	213	465
Percentage of deaths that occurred within seven days	60%	66%	61%

(ž) Distribution of cath lab facilities used for this analysis is shown in Appendix 2. Table excludes private hospital patients.
(Δ) Patients are assigned to the first admitting hospital in their last period of care. Data for hospitals with an expected mortality of < 1 are supressed.
(µ) Hospitals with < 50 patients are not reported publicly. Deaths are from all causes, in or out of hospital. Data exclude AMI STEMI-not specified (ICD-10-AM I21.9).
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

Figure 45: Acute myocardial infarction 30-day RSMR, by ***peer group*** (cath lab availability), July 2009 – June 2012 ž Ø †



(ž) Distribution of cath lab facilities used for this analysis is shown in Appendix 2.
(Ø) RSMR methods are described on page 4.
(†) Peer groups are described on page vi.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

rt-PA* and ischaemic stroke 30-day mortality

Stroke unit care refers to dedicated, coordinated care for stroke patients in hospital under a multidisciplinary team specialising in stroke management. Stroke unit care is strongly associated with better patient outcome.[22] Across NSW, stroke units differ in terms of physical capacity, specialist staff and facilities. The most advanced stroke units offer *'around the clock'* thrombolysis services (24/7 rt-PA*). There is strong evidence to suggest that hospitals with systems in place to deliver 24/7 rt-PA provide improved care for all stroke patients, regardless of whether they are suitable for thrombolytic treatment.[23]

Figure 46 compares NSW hospitals, according to whether or not they have a stroke unit with *'around the clock'* specialist thrombolysis services (24/7 rt-PA).

Hospitals with 24/7 rt-PA were the first admitting hospital for over one-half of ischaemic stroke patients in the period July 2009 – June 2012.

Thrombolysis given within six hours of ischaemic stroke increases the risk of intracranial haemorrhage and death within seven days. However, it is associated with an increase in survival and less disability in the long term.[24]

Altogether, 24/7 rt-PA hospitals had a *lower* proportion of deaths that occurred on day one and a slightly *higher* proportion of deaths occurring by day 7 of hospitalisation (Figure 47).

Looking at the capacity for 24/7 rt-PA alongside risk-standardised mortality ratios, there is no clear relationship between mortality and the presence of a stroke unit with 24/7 thrombolysis. There are hospitals with full stroke units with *higher* than expected as well as *lower* than expected mortality. Importantly, these results are for the presence of a stroke unit in a hospital, not the proportion of time that stroke patients benefited from their services, nor the extent to which individual units comply with practice guidelines.

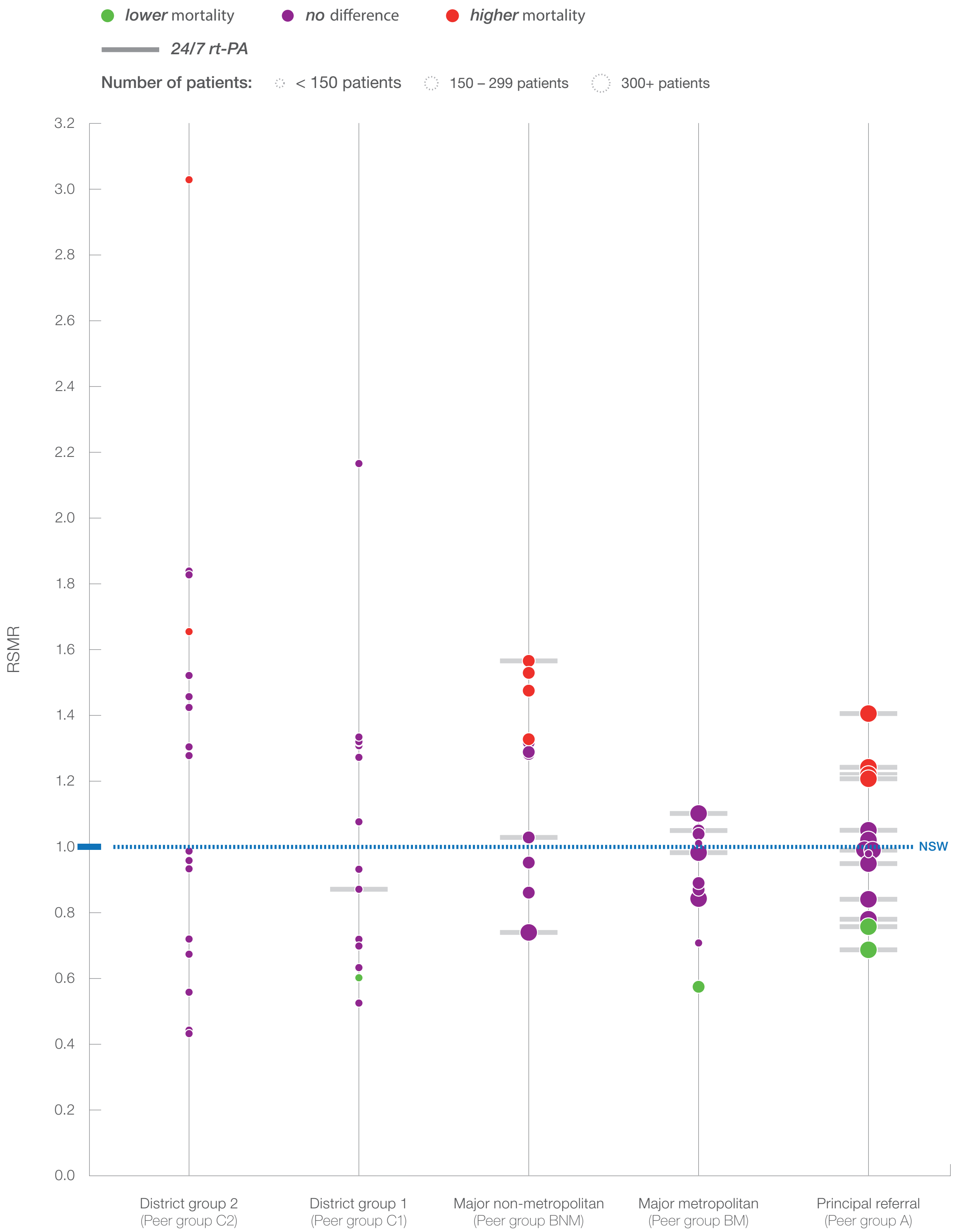
Figure 46: Profiling hospitals by availability of ***'around-the-clock'*** rt-PA, NSW, July 2009 – June 2012 [Δμ]

	Hospitals without *'around the clock'* rt-PA	Hospitals with *'around the clock'* rt-PA
Number of patients hospitalised	5,664	8,130
Number of deaths among hospitalised patients	798	1,067
Deaths on day one	14	18
% deaths that occurred on day one	1.8%	0.7%
Deaths within seven days	394	559
% of deaths that occurred within seven days	49.4%	52.4%

(Δ) Patients are assigned to the first admitting hospital in their last period of care.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

(*) rt-PA refers to recombinant tissue plasminogen activator, a powerful thrombolytic (clot-buster) that increases survival in stroke patients when administered within four hours of the stroke. It requires specialist facilities for safe administration.

Figure 47: Ischaemic stroke 30-day risk-standardised mortality ratio, by ***peer group*** (and stroke unit), July 2009 – June 2012 [Š Ø †]



(Š) Distribution of 24/7 rt-PA facilities used for this analysis is shown in Appendix 3.
(Ø) RSMR methods are described on page 4.
(†) Peer groups are described on page vi.
Source: SAPHaRI, *Centre for Epidemiology and Evidence*, NSW Ministry of Health.

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Appendix 1: risk adjustment for RSMRs

Appendix 1 table 1: For each of the five conditions included in this report, the following comorbidities were considered in exploratory analyses.

Congestive Heart Failure	Fluid and Electrolyte Disorders	Paralysis
Cardiac Arrhythmia	Metastatic Cancer	Lymphoma
Valvular Disease	Solid Tumor without Metastasis	Obesity
Pulmonary Circulation Disorders	Rheumatoid Arthritis / collagen	Blood Loss Anaemia
Renal Failure	Coagulopathy	Deficiency Anaemia
Liver Disease	Drug Abuse	Other Neurological Disorders
Peptic Ulcer Disease (excluding bleeding)	Psychoses	Chronic Pulmonary Disease
AIDS / HIV	Depression	Diabetes Uncomplicated
Dementia	Alcohol Abuse	Diabetes Complicated
Peripheral Vascular Disorders	Hypothyroidism	Weight Loss
Hypertension		

Appendix 1 table 2: Additional patient-level factors such as age and sex were also evaluated. Only those factors that were shown to have a significant impact on mortality ($P<0.05$) were retained in the final model. The clinical relevance of the variables in the final model and their direction of association with the outcome were reviewed by clinicians.

Condition	Patient factors and comorbidities included in the final model
Acute myocardial infarction	Age, STEMI* / non-STEMI status, dementia, Alzheimer's disease, hypotension, shock, renal failure, heart failure, dysrhythmia, malignancy, hypertension and cerebrovascular disease.
Ischaemic stroke	Age, sex, renal failure, heart failure, and malignancy.
Haemorrhagic stroke	Age, sex, history of haemorrhagic stroke, heart failure, and malignancy.
Pneumonia	Age, dementia, hypotension, shock, renal failure, other chronic obstructive pulmonary disease, heart failure, dysrhythmia, malignancy, liver disease, hypertension, cerebrovascular disease and Parkinson's disease.
Hip fracture surgery	Age, sex, ischaemic heart disease, dysrhythmia, congestive heart failure, acute respiratory tract infection, renal failure, dementia, malignancy.

(*) ST-elevated myocardial infarction.

Appendix 2: cardiac catherisation laboratories facilities, NSW hospitals

Appendix 2 table 1: The following cardiac catherisation laboratories are depicted in the analysis on **page 32**. The Bureau of Health Information has not independently verified the accuracy of this list.

Hospital name	Description
Royal Prince Alfred Hospital	24/7
St Vincent's Hospital, Darlinghurst	24/7
Concord Hospital	24/7
Gosford Hospital	24/7
Royal North Shore Hospital	24/7
Prince of Wales Hospital	24/7
St George Hospital	24/7
Liverpool Hospital	24/7
Nepean Hospital	24/7
Westmead Hospital (all units)	24/7
John Hunter Hospital	24/7
Sutherland Hospital	Cath lab
Blacktown Hospital	Cath lab
Coffs Harbour Base Hospital	Cath lab
Tamworth Base Hospital	Cath lab
Orange Base Hospital	Cath lab
Wollongong Hospital	Cath lab
Wagga Wagga Base Hospital	Cath lab

Appendix 3: hospitals with 24/7 rt-PA* stroke unit

Appendix 3 table 1: The following stroke units with ***'around-the-clock'*** rt-PA capability are depicted in the analysis on **page 34**. The Bureau of Health Information has not independently verified the accuracy of this list.

Hospital name
Bathurst Base Hospital
Blacktown Hospital
Campbelltown Hospital
Concord Hospital
Gosford Hospital
John Hunter Hospital
Hornsby Hospital
Liverpool Hospital
Nepean Hospital
Orange Base Hospital
Prince of Wales Hospital
Royal North Shore Hospital
Royal Prince Alfred Hospital
Tamworth Base Hospital
St George Hospital
St Vincent's Hospital
Wagga Wagga Base Hospital
Westmead Hospital

(*) rt-PA refers to recombinant tissue plasminogen activator, a powerful thrombolytic (clot-buster) that increases survival in stroke patients when administered within four hours of the stroke. It requires specialist facilities for safe administration.

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The Bureau of Health Information (the Bureau) has been established to be the main source of information for NSW people about the performance of their public system. A NSW-based board-governed organisation, the Bureau is led by Chairperson Professor Bruce Armstrong AM and Chief Executive Dr Jean-Frédéric Lévesque MD, PhD.

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The report, *The Insights Series: 30-day mortality for five clinical conditions, NSW hospitals, July 2009 - June 2012*, and related materials are available at www.bhi.nsw.gov.au

The suite of products includes:

- *The Insights Series: 30-day mortality for five clinical conditions, NSW hospitals, July 2009 - June 2012*. The main report presents detailed multifaceted data on 30-day mortality in or after discharge from NSW hospitals.
- *Spotlight on measurement: 30-day mortality for five clinical conditions, NSW hospitals, July 2009 - June 2012* presents technical information on the 30-day mortality indicator development process and final indicator specifications.
- *Performance Profiles* for 75 hospitals.

About the Bureau

The Bureau of Health Information provides the community, healthcare professionals and the NSW Parliament with timely, accurate and comparable information on the performance of the NSW public health system in ways that enhance the system's accountability and inform efforts to increase its beneficial impact on the health and wellbeing of the people of NSW.

The Bureau is an independent, board-governed statutory health corporation. The conclusions in this report are those of the Bureau and no official endorsement by the NSW Minister for Health, the NSW Ministry of Health or any other NSW statutory health corporation is intended or should be inferred.

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