Case study 6 — Stroke
Hospital costs and outcomes study for NSW Health

Other Industries
July 2010
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1 Introduction and executive summary

NSW Health is currently coordinating a project that ultimately aims to improve clinical practice and efficiency consistently across the NSW hospital system. The project involves 6 components, and is designed to enable development of a methodology that makes better use of available data to compare patient mix, costs, clinical practice and outcomes and which can then be applied across other hospitals to improve performance. (See Box 1.1 for more information.)

NSW Health asked the Independent Pricing and Regulatory Tribunal of NSW (IPART) to conduct a costs and outcomes study that encompasses 3 components of this larger project. The aim of the study was to provide information and analysis that can be used by clinical experts to better understand the variation in clinical practice in NSW hospitals, and the extent to which this variation can lead to differences in hospital costs and clinical outcomes.

IPART’s study involved comparing costs, configurations of care and outcomes in 5 selected NSW hospitals:

- Royal Prince Alfred Hospital (RPAH)
- Royal North Shore Hospital (RNSH)
- John Hunter Hospital (JHH)
- Bankstown-Lidcombe Hospital (BLH), and
- Gosford Hospital (GH).

To do this, we analysed management practices at the hospital-wide level, and did detailed case studies of 11 specific clinical areas. As costs, configurations of care and relevant indicators of outcome vary significantly depending on the condition of the patient and/or the procedure undertaken, these case studies allowed us to compare the hospitals on a more like-with-like basis. This document discusses our findings in one of these 11 clinical areas – stroke. (See Box 1.2 for the full list of clinical areas we examined, how they were selected, and how we conducted the case studies.)
Box 1.1 NSW Health project

IPART’s hospital costs and outcomes study is part of a larger, multi-stage project NSW Health is coordinating with the assistance of other organisations. The terms of reference for this project set out 6 components:

1. Audit the quality of current coding and costing data.
2. Analyse differences in costs between 3 principal tertiary referral hospitals and 2 other principal referral hospitals.
3. Describe the different configurations of care that underpin different cost profiles.
4. Analyse available data on differences in adjusted admission rates and clinical outcomes for the 5 selected hospitals.
5. Determine whether variations in configurations of care lead to different clinical outcomes.
6. Identify the extent to which clinical variation exists, with the aim of achieving clinical best practice and maximum efficiency.

The first component is being completed by Health Outcomes International (audit of costing) and Pavilion Health (audit of coding). The results will assist the NSW Department of Health in further developing episode funding, in line with the national agreement by the Council of Australian Governments (COAG) to move to a more nationally consistent approach to activity-based funding. IPART has completed the second, third and fourth components through our hospital costs and outcomes study. The results of this study will be used by clinical experts in completing the fifth and sixth components.

The NSW Health project is part of its response to the findings and recommendations made in the Report of the Special Commission of Inquiry into Acute Care Services by Commissioner Garling.

Flowing from the NSW Government’s response to the Garling Inquiry (Caring Together - The Health Action Plan for NSW (2009)), ‘four pillars’ of clinical improvement have been established – Clinical Excellence Commission (CEC), Agency for Clinical Innovation (ACI), Bureau of Health Information (BHI) and Clinical Education and Training Institute (CETI). IPART’s analysis on costs, clinical practice and outcomes is to be considered by the NSW Department of Health and clinical experts in these agencies to assess whether variations in configurations of care lead to different clinical outcomes and to identify the extent to which clinical variation exists, with the aim of achieving clinical best practice and maximum efficiency.
To compare costs, configurations of care and outcomes in the 5 study hospitals, we focused on 11 specific conditions or procedures in detail (as well as undertaking a broad, hospital-wide analysis). These conditions/procedures are:

- Hip joint replacement
- Major chest procedures
- Breast surgery
- Cholecystectomy
- Appendicectomy
- Stroke
- Cardiology – stents, pacemakers and defibrillators
- Tracheostomy, or ventilation for greater than 95 hours
- Cataract/lens procedures
- Hysterectomy, and
- Obstetric delivery.

In selecting these conditions/procedures, and the relevant indicators to compare for each, we were advised by a clinical consultant (Dr Paul Tridgell) and a clinical reference group (Professor Bruce Barraclough, Dr Anthony Burrell, Dr Patrick Cregan, Professor Phillip Harris, Professor Clifford Hughes, Professor Brian McCaughan, Professor Peter McClusky, Dr Michael Nicholl, Professor Ron Penny, Professor Carol Pollock and Dr Hunter Watt).

The case studies were selected to provide a range of surgical procedures and a range of medical conditions that met one or more of the following criteria:

- high volumes
- high reported costs
- high variability in reported costs
- apparent differences in clinical practice, or
- a range of models of care.

To conduct the case studies, we visited each of the hospitals and spoke with a range of staff, including clinical, nursing, management, finance, coding and administrative staff. We also collected a range of clinical and financial data from NSW Health, relevant area health services and hospitals. By analysing the data and speaking with clinical experts, we established the most suitable data available for comparing hospitals on a like-with-like basis.

For further information on our methodology and broad findings on costs, outcomes and configurations of care, see our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*. Our detailed findings on the other case study areas can be found in our reports on each area.
1.1 Why did we select stroke as one of the case studies?

Stroke was selected as one of the clinical areas for detailed study because:

- It is an example of a high volume, acute medical service.¹

- It is a good example of different ways to count the length of stay. Hospitals differ in how they count episodes and record ‘type changes’ between the acute and rehabilitation stages.

- Stroke patients have a significant impact on hospital occupancy (in terms of bed days more than admissions).

- The timeliness and way that stroke is assessed and treated are critical determinants of stroke outcomes.

1.2 What was the scope of the stroke case study?

The stroke case study compared the length of stay, costs, configurations of care and outcomes related to treating stroke patients. We used diagnostic related groups (DRGs) to define the procedures and identify the data included in the scope of the case study (see Table 1.1).

Table 1.1 DRGs included in the scope of the stroke case study

<table>
<thead>
<tr>
<th>DRG</th>
<th>Description</th>
<th>Number of cases in study hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>B70A</td>
<td>Stroke with catastrophic complication or comorbidity</td>
<td>466</td>
</tr>
<tr>
<td>B70B</td>
<td>Stroke with severe complication or comorbidity</td>
<td>523</td>
</tr>
<tr>
<td>B70C</td>
<td>Stroke without catastrophic or severe complication or comorbidity</td>
<td>472</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B70D</td>
<td>Stroke, died or transferred &lt; 5 days</td>
<td>282</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,743</td>
</tr>
</tbody>
</table>

¹ Excluding 34 patients with transient global amnesia.

We excluded some cases from our analysis. We found that there were a few patients who were coded into DRG B70C, but had principal diagnosis of a condition other than a ‘stroke’. One group with a very short average length of stay was patients with ‘transient global amnesia’ (ICD-10 code G45.4). We excluded these 34 amnesia patients from our analysis because they distort the length of stay and cost comparisons between the hospitals.

¹ In 2007/08 there were 31,627 hospital admissions for stroke in Australia. See Australian Institute of Health and Welfare, AR-DRG Data Cubes, Separation, patient day and average length of stay statistics by Australian Refined Diagnosis Related Group (AR-DRG) Version 5.0/5.1, Australia, 1998-99 to 2007-08 (http://d01.aihw.gov.au/cognos/cgi-bin/ppdscgi.exe?DC=Q&E=/AHS/drgv5_9899-0708_v2).
For most of our analysis we also excluded 282 patients who died or were transferred to another hospital in less than 5 days (DRG B70D). We did this because some hospitals count (as admissions) patients who die soon after arriving at hospital with a stroke, while others don’t. Excluding DRG B70D avoids this counting issue.

Unless specified otherwise in this case study, the data we analysed related to the 12-month period from 1 July 2008 to 30 June 2009.

### 1.3 What were the key findings of the stroke case study?

To compare the costs, configurations of care and outcomes of treatment for stroke at the study hospitals, we collected, analysed and compared data on:

- the type, number and mix of stroke patients at each hospital
- the average length of stay for these patients at each hospital
- selected costs, or major clinical resources used to provide acute inpatient care for these patients at each hospital
- the configurations of care used to provide and manage stroke patient care at each hospital
- indicators of outcome, safety and quality of care for stroke patients for each hospital.

Our key findings are summarised below.

#### 1.3.1 Type, number and mix of patients

A stroke occurs where a blood vessel in the brain becomes blocked or bursts. There are 2 main types of strokes, namely ischaemic strokes (a blood clot in blood vessel) and haemorrhagic (a burst blood vessel). The distinction between the 2 types of strokes is important because treatment options are different for the 2 types of strokes.

We were unable to separately analyse ischaemic and haemorrhage strokes because the cause of the stroke was unspecified for about 25% of patients. Instead, we used the DRG system to compare costs and outcomes. The DRG system classifies patients according to the degree of complication or comorbidity (catastrophic, severe or not catastrophic/severe). However, we note that hospitals have significantly different proportions of patients in the different DRGs and we do not know to what extent coding practices contribute to this difference in distribution.
In particular, we found that BLH had a significantly higher proportion of patients in the most complex DRG than any of the other hospitals. One possible reason for this is that stroke patients at BLH are on average older than at the other hospitals. Another possibility is that coding practices differ between the hospitals. A third possibility is that BLH uses less medication (tPA) or surgical intervention (ie, interventional radiology) to dissolve or remove clots than the other hospitals. We could not examine this possibility because tPA administration is not coded as a procedure in the hospital data set.

We found that the vast majority of stroke patients are admitted through the emergency department and between 4% and 15% of patients are transferred in from other hospitals. We also found that patients in the most complex DRG (B70A) were on average older than patients in the less complex categories.

### 1.3.2 Average length of stay

Our analysis indicates that the measure often used in the National Hospital Cost Data Collection (NHCDC) and DRG benchmarking – the average ‘acute episode length of stay’, which is the length of an acute episode – is not a consistent basis for comparing length of stay for stroke patients. This is because of differences in the way hospitals reclassify patients’ care from ‘acute’ to ‘rehabilitation’ care and because of differences in access to rehabilitation facilities. Our analysis indicates that for length of stay comparisons to be meaningful:

- the length of stay needs to include all consecutive episodes (acute, rehabilitation and other) at the study hospital, plus the length of related stays at other hospitals, and
- the main patient subgroups (ie, DRGs) need to be compared separately.

For our analysis, we have included three alternative measures of length of stay:

- LOS1 – acute episode length of stay in study hospital
- LOS2 – total stay in study hospital including acute episode and other consecutive episodes for stroke DRG
- LOS3 – total stay in study hospital (LOS2) plus length of stay for one prior hospital stay (transfer in) and one subsequent hospital stay (transfer out).

For each DRG, we found that there was significant variation in the acute episode length of stay (LOS1), but far less variation in the length of stay when total hospitalisation is measured (LOS3). This was mainly because LOS3 includes rehabilitation care and the hospitals differ in the way they arrange rehabilitation care.

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2 Only RNSH and RPAH remove clots surgically.
We found that differences in the average ‘acute episode length of stay’ (LOS1) across the study hospitals are largely due to differences in the way the hospitals reclassify patients from acute to rehabilitation care, rather than differences in clinical practice. In particular, we found that BLH has a long episode length of stay (LOS1) because a significant amount of rehabilitation occurs in the acute ward and the type change to “rehabilitation” occurs only when a patient physically moves to a rehabilitation ward. We also found that differences in the hospital length of stay (LOS2) are largely due to whether rehabilitation occurs on-site or at other rehabilitation facilities.

1.3.3 Costs of inpatient care

To compare the costs related to the case study areas at the study hospitals, we examined the use of a selection of clinical resources used directly for patient care in that area. For stroke, the main clinical resources we examined were nursing staff in wards, imaging and pathology. We had aimed to also estimate medical staff costs and pharmacy costs for this case study, but were unable to obtain consistent comparisons within the timeframe for this review. We did not include allied health costs in our data collection or analysis.

Cost of nursing staff in wards

We estimated nursing costs for the acute episode only. Therefore results need to be interpreted taking into account differences in LOS1 and LOS3 for each hospital. This is particularly important for stroke for patients that require rehabilitation (mainly those in DRGs B70A4 and B70B5).

We calculated and compared the nursing cost for DRGs B70B and B70C. We excluded DRG B70A because of the complexity introduced into the analysis by time spent in Intensive Care Units (ICU) and the different structures for ICU and high dependency units at the different hospitals. These differences mean that we could not calculate comparable costs across the study hospitals for this DRG. We also excluded DRG B70D, for the reasons discussed above.

We found that average length of stay and nursing hours per patient day (ie, the staff-to-patient ratio) are the main drivers for nursing costs at the study hospitals. Hospitals with shorter stays or lower staff-to-patient ratios had lower nursing costs. The proportions of Enrolled Nurses (ENs) and Assistants in Nursing (AINs) in their staffing mix had only a small impact on nursing costs. We found that JHH had the lowest staff-to-patient ratio and the lowest nursing cost per patient day, while RPAH had the highest staff-to-patient ratio and the highest nursing cost per patient day.

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3 Medical staff costs and pharmacy are discussed in Chapters 9 and 14 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*
4 Stroke with catastrophic complication or comorbidity.
5 Stroke with severe complication or comorbidity.
6 Stroke without catastrophic or severe complication or comorbidity. We excluded patients with a diagnosis of transient global amnesia.
7 Stroke patients died or were transferred within 5 days.
The hospitals use inpatient fractions (IFRACs) to allocate staff time to acute care and other staff responsibilities. We found that nursing costs are highly sensitive to the IFRAC the hospitals apply to them. When all nursing costs are attributed to inpatient care (i.e., IFRAC=1), RNSH’s costs increase the most because the IFRACs used at this hospital are the lowest.

**Imaging and pathology costs**

We found that imaging costs vary between the hospitals, with RNSH making the most use of imaging and BLH making the least use of imaging. We also found that imaging costs vary less than pathology costs by DRG because stroke patients all have CT scans or MRIs, regardless of their DRG classification.

We found that pathology costs are strongly related to the DRG of the patients, with expenditure significantly higher in the most complex DRG compared with the least complex DRG. However, we note that small coding differences between the hospitals could shift patients between the DRGs and change some of the measures of relative pathology use. We found that pathology costs are on average highest at BLH and lowest at JHH.

**National Hospital Cost Data Collection**

The NHCDC reports estimates of average hospital costs based on data it collects from hospitals around Australia. In this study, we had access to the study hospitals’ provisional de-identified patient-level data for 2008/09, as well as the overall averages publicly reported by the NHCDC for different hospital groupings in 2007/08. The final NHCDC estimates for study hospitals for 2008/09 became available towards the end of our study. We compared these to the provisional costs and found that some of the costs had changed substantially. Given the limited time available, we used the final costs only where these were substantially different from the provisional costs.

We were able to compare study hospitals’ NHCDC estimates with our estimates of nursing, pathology and imaging costs. For pathology we used the final NHCDC costs. We found that the direct nursing costs from the NHCDC are higher than our costs for all hospitals. The costs for GH and BLH are particularly high compared with our costs. We found a far higher degree of consistency in the hospitals’ use of pathology for diagnostic purposes than reflected in the NHCDC. In particular, the NHCDC pathology costs for RPAH and BLH are significantly higher than both our estimated pathology costs and the other hospitals’ NHCDC costs. We believe that

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8 BLH does not currently have MRI facilities on-site, and must transport patient to Liverpool Hospital if MRI scans are required for further diagnosis or treatment. However, we understand that there is a firm proposal for an MRI at BLH and planning is well underway.

9 In NSW, these cost estimates are often compiled by area health services, rather than individual hospitals.

our costs better reflect the different usage patterns of pathology because we have used a consistent methodology to calculate them, based on clinical information. The NHCDC imaging costs show less variation than our cost for the combined DRGs, but more variation between the DRGs.

1.3.4 Configurations of care

Strokes are medical emergencies. Two important objectives in stroke treatment are early diagnosis of the type of stroke as either an ischaemic stroke or a haemorrhagic stroke (often based on a CT scan) and early commencement of treatment. The treatment options and pathways for the 2 types of stroke are different.

We identified 5 major differences in the way the study hospitals managed and provided care for stroke patients, comprising differences in:

- Arrangements with the NSW Ambulance Service to minimise delays.
- How effectively the emergency departments worked to minimise delays.
- The administration of clot-dissolving medication (tPA).
- The use of surgery to remove clots.
- The way rehabilitation is organised.

All the study hospitals have had specialised stroke units for acute stroke patient care since about 2003. However, they differ in size, opening hours and the care they provide.

Rapid notification and bypass protocols with NSW Ambulance Service

We found that JHH and GH have bypass arrangements with NSW Ambulance Service to deliver some stroke patients to the stroke unit with minimum delay. As a consequence of these arrangements, as well as less traffic congestion, JHH and GH have higher rates of tPA administration than any of the other study hospitals. (We note however that the use of tPA for stroke is not universally accepted because it carries a risk of complications due to bleeding.)

None of the other hospitals have rapid notification or emergency department bypass protocols with the NSW Ambulance Service, and delays occur in getting patients to the stroke units.
Emergency departments

We found that the emergency departments at GH and, particularly, JHH work well with the stroke unit to minimise delays (for those patients who are eligible for bypass arrangements). At RNSH the stroke unit is notified immediately if a suspected stroke patient arrives during standard working hours, and staff members then go to the emergency department to do the assessment. RPAH has a very busy emergency department, and this may cause delays for stroke patients who might be eligible for tPA treatment. These delays arise mainly because ambulances are sometimes redirected to other hospitals when RPAH’s emergency department is too busy.

Use of tPA and clot retrieval

We understand that senior clinicians at BLH have differences of opinion regarding the risks and benefits of using tPA for stroke, and that this may be a factor limiting the use of this treatment option. We found that only RPAH and RNSH remove blood clots surgically.

Rehabilitation

We found that there were differences in the way hospitals arrange rehabilitation services for patients that need it. At BLH, almost all rehabilitation occurs on-site, beginning in the acute ward. The other hospitals transfer most or all their patients to other facilities for rehabilitation. Shortages of places in these rehabilitation facilities can lead to longer than necessary stays in acute wards. One specialist raised the possibility that a significant component of rehabilitation could be provided in the home, if resources were shifted to this setting.

1.3.5 Outcome, safety and quality indicators

The terms of reference for this study required us to analyse available data on differences in clinical outcomes across the 5 study hospitals. However, while there are a number of safety and quality indicators being collected locally, at the state level and through clinical registries, there are few clinically agreed outcome indicators. As such, we found that data on only a few indicators of clinical outcomes are collected consistently across hospitals, or on a state-wide (or national) basis. Therefore, we worked with clinical experts to establish a set of outcome, safety and quality indicators that are clinically relevant, and for which we could feasibly obtain data in the timeframe for our study.

We approached the National Stroke Research Institute (NSRI) to help us collect the data for these indicators. The NSRI confirmed that they had most of the required data. However, we needed permission from the National Stroke Foundation and the hospitals to gain access to the data and were unable to obtain the information in time for our review. We recommend that NSW Health pursue the collection of this data. We also note that indicators for stroke should be nationally standardised.
We obtained one indicator from NSW Health, namely the 6-month survival rate for stroke patients adjusted for age, sex, comorbidity (using the Charlson index), and socio-economic status. In the 3-year period, 2005/06 to 2007/08, there were 5,408 hospital admissions for the 5 hospitals for stroke. The overall crude 6-month survival rate was 726.9 per 1,000. NSW Health calculated and provided risk-adjusted odds ratios for these rates. There were no statistically significant differences between the study hospitals’ risk-adjusted 6-month-survival rates.

1.4 What are the key implications of these findings?

Combining all stroke patients for comparison is misleading

Our analysis of patient data for the 4 DRGs indicates that there are wide variations in the severity of the stroke in the patient cohort, which impacts on costs and outcomes. Therefore, at a minimum, comparisons should be made at the individual DRG level.

Length of stay and cost analysis needs to include all episodes

This case study and some other case studies (eg, hips), demonstrate the need to link the episodes for each patient, so that the full patient journey is considered (including stays in other hospitals or facilities). The AIHW ‘linkage key’ can be used to consider the full journey of the patient from hospital to hospital. Ideally, a unique patient identifier could ultimately be used.

Improvements can be made to coding and classification practices

We identified three areas where improvements in diagnosis classification and coding practices could improve the quality of outcome information and the accuracy of episode-based cost comparisons and funding.

Firstly, we believe that it would be desirable for hospitals to reduce the proportion of stroke patients with a principal diagnosis of ‘stroke, not specified as haemorrhage or infarction’ (ICD-10 code I64). Reducing the proportion of unclassified cases would allow ischaemic and haemorrhage strokes to be separately analysed.

Secondly, we believe the tPA administration should be coded as a procedure. This would help to monitor and evaluate the outcomes associated with the use of this medication and treatment for ischaemic strokes.

Thirdly, we believe that a consistent approach to ‘type changes’ would significantly improve the comparability of episode costs between hospitals. This is particularly important for episode based funding for hospitals.
Improvements can be made to the configuration of care

We believe that there may be scope for the Sydney based hospitals to establish better protocols or arrangements with the NSW Ambulance Service to deliver suspected stroke patients to the most appropriate Stroke Unit with minimum delay. We also believe that it might be possible and useful to combine NSW Ambulance Service data on time of emergency call and response time with hospital patient data or imaging CT data. This could provide useful information on the time that has elapsed since an ischaemic stroke, which in some instances would influence the appropriate treatment for some patients (since some stroke treatment protocols depend on the time that has elapsed since a stroke occurred). It could also be used to monitor how the NSW Ambulance Service and hospitals are working together to minimise delays. It will also provide useful data for outcome indicators.

We also believe there may be scope for developing consistent guidelines for tPA use for stroke. We believe that the hospitals should code tPA administration as a procedure so that the rates of administration and the outcomes can be more accurately measured.

Given the shortage of rehabilitation places, we believe that NSW Health should investigate the costs and benefits of providing more rehabilitation care in the home setting.

1.5 List of recommendations

1 That NSW Health considers ways to reduce the proportion of stroke patients coded with a principal diagnosis of ‘stroke, not specified as haemorrhage or infarction’ (ICD10 code I64). 15

2 That NSW Health arranges for appropriate clinical expert groups to consider developing consistent guidelines for the administration of tPA. 47

3 That NSW Health considers including tPA administration as a procedure in coding standards. 47

4 That NSW Health considers ways to improve transfers of suspected stroke patients to stroke units with minimum delay, including consultation with the Ambulance Service and Emergency Departments. 47

5 That NSW Health investigates whether it is useful and possible to combine Ambulance Service data on response time with hospital patient data to monitor time from call to ambulance to arrival at an appropriate hospital. 47

6 That NSW Health arranges for appropriate clinical expert groups to consider the costs and benefits of providing more rehabilitation care in the home. 48
That NSW Health pursues the collection of the data on outcome indicators from the National Stroke Research Institute.

1.6 What does the rest of this report cover?

The rest of this report discusses the findings of the stroke case study in more detail:

- Chapters 2 and 3 discuss the main types of stroke patients the study identified, and compare the number and mix of these types of patients at the study hospitals.

- Chapter 4 compares the length of stay for the different types of stroke patients at the study hospitals, and describes the method we used to compare length of stay on a consistent basis.

- Chapter 5 describes how we analysed the costs of care for stroke patients by identifying the main clinical resources used to provide inpatient care, then estimating and comparing the level of each resource used at the study hospitals. It also compares our cost estimates with estimates based on the provisional or final data reported to NSW Health as part of the NHCDC.

- Chapter 6 compares the configurations of care for stroke patients at the study hospitals and highlights key differences.

- Chapter 7 discusses the indicators of outcome, safety and quality for stroke we identified as clinically meaningful. It then compares the available data on these indicators across the study hospitals.

- The appendices contain the complete list of recommendations for our hospital costs and outcomes study, more detailed information on the data sources for the risk-adjusted outcome indicators and a glossary.
Main types of stroke patient

To meaningfully compare data on the costs, configurations of care and outcomes for a particular condition or procedure, the patients to which the data relate must be reasonably similar – to allow ‘like with like’ comparisons. As Chapter 1 discussed, we used the 4 DRGs to identify clinical and financial data related to patients who had been treated for stroke at the study hospitals. We found that the DRG classifications adequately capture like-with-like patients, after excluding some short stay patients from DRG B70C\(^{11}\). We also excluded DRG B70D\(^{12}\) from much or our analysis to avoid different counting practices when patients die soon after arrival at hospital.

The sections below discuss the different types of stroke and explain why and how we have used the DRG classifications to make like-with-like comparisons. We also discuss the main approaches to treatment for stroke.

2.1 What is a stroke and how common is it?

Stroke is the second leading cause of disability in Australia and the third leading cause of death\(^{13}\). In 2007/08 there were 31,627 hospital admissions for stroke in Australia.\(^{14}\)

A stroke occurs where a blood vessel in the brain becomes blocked or bursts. Strokes mean that oxygen can no longer reach the brain cells in the damaged area. They can be fatal, but more commonly they are disabling. The effects of a stroke vary depending on which part of the brain is damaged. A stroke may cause weakness or numbness down one side of the body, difficulties in speaking and thinking clearly, emotional problems and partial loss of vision.

There are two main types of strokes:
1. Ischaemic – blood clot in blood vessel.
2. Haemorrhagic - burst blood vessel.

\(^{11}\) Stroke without catastrophic or severe complication or comorbidity.
\(^{12}\) Stroke patients died or were transferred within 5 days.
Stroke is a medical emergency. It is important for people who have had a stroke or who are suspected of having a stroke to get to a hospital as soon as possible. It is also important for clinicians to identify the type of stroke as soon as possible, because the immediate treatment options are different. Specifically, ischaemic stroke can be treated with medication to reduce clotting (e.g., tPA, aspirin) or by surgically removing the clot.

### 2.2 How have we categorised stroke patients for our analysis?

We wanted to separately analyse patients with ischaemic and haemorrhagic strokes. However, we found that 25% of the patients in the stroke DRGs had a principal diagnosis of ‘stroke, not specified as haemorrhage or infarction’ (ICD-10 code I64). This high percentage of unclassified cases means that we were unable to separately analyse ischaemic and haemorrhagic strokes.

Instead, we used the DRG system which classifies patients according to complication or comorbidity (catastrophic, severe or not catastrophic/severe). However, we note that hospitals have significantly different proportions of patients in the different DRGs and we do not know to what extent coding practices contribute to this difference in distribution.

We excluded some cases from our analysis. We found that there were a few patients who were coded into DRG B70C, but had principal diagnosis of a condition other than a ‘stroke’. One group with a very short average length of stay was patients with ‘transient global amnesia’ (ICD-10 code G45.4). We excluded these 34 amnesia patients from our analysis because they distorted the length of stay and cost comparisons between the hospitals.

For most of our analysis we also excluded 282 patients who died or were transferred to another hospital in less than 5 days (DRG B70D). We did this because some hospitals count (as admissions) patients who die soon after arriving at hospital with a stroke, while others don’t. If we had included this DRG we would have distorted the length of stay and cost comparisons between the hospitals, mainly because of the counting differences between the hospitals but also because of the short lengths of stay in this DRG.

**Recommendation**

1. That NSW Health considers ways to reduce the proportion of stroke patients coded with a principal diagnosis of ‘stroke, not specified as haemorrhage or infarction’ (ICD10 code I64).

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15 An infarction is the process of tissue death due to an interruption in the blood supply.
16 Stroke without catastrophic or severe complication or comorbidity.
17 The average length of stay for these patients varied between 1 day at RPAH and JHH and 3.4 days at GH. RNHS had the most cases (11) and BLH had the least (2).
2.3 What are the main approaches for treatment of stroke?

For the majority of patients with a stroke, treatment is supportive care to prevent complications like aspiration (food into the lungs) and pressure sores.

For patients who have had an ischaemic stroke (due to a blood clot), roughly 10% to 15% arrive in time to use a drug to dissolve the clot (tPA). Other patients are put on medications to reduce clotting (Heparin, aspirin). For a very small number of these patients it may be appropriate to try to remove the clot surgically, by passing a wire into the clot through the blood vessels and pulling it out.

For the vast majority of patients with a haemorrhagic stroke, treatment is supportive care. For a small number it may be appropriate to perform surgery to reduce the pressure on the brain.

Table 2.1 outline the major approaches to the treatment of stroke and which of our study hospitals offer the treatments.

**Table 2.1 Main types of strokes and their treatment**

<table>
<thead>
<tr>
<th>Clinical description</th>
<th>Lay description</th>
<th>Options for treatment</th>
<th>Available in the following hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic</td>
<td>Stroke from blood clot</td>
<td>Support</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tPA – dissolve clot</td>
<td>All – BLH working hours only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retrieve clot</td>
<td>RNSH, RPAH</td>
</tr>
<tr>
<td>Haemorrhagic</td>
<td>Stroke from burst blood vessel</td>
<td>Support</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surgery is rare</td>
<td>All</td>
</tr>
</tbody>
</table>
3 Number and mix of patients across study hospitals

Once we had established that we could use the DRG classifications to make meaningful comparison of the costs, configurations of care and outcomes across the study hospitals, we identified the total number of stroke cases at each hospital during the study period, and compared the proportions of cases that fell into each DRG. We also compared emergency department admissions, transfers in from other hospitals and transfers out to other hospitals. Finally, we compared average patient age in each DRG.

We found that BLH had a significantly higher proportion of patients in the most complex DRG than any of the other hospitals. This is significant, given other findings (discussed in Chapters 3 and 4) that patients in this DRG were associated with longer average length of stay, greater nursing intensity and higher diagnostic costs at all hospitals.

The sections below discuss our analysis of patient numbers and mix in more detail.

3.1 Number of stroke cases at each study hospital

Our data indicate that the 5 study hospitals had a total of 1,743 stroke cases during the study period.\(^{18}\) They also show that each hospital treated a fairly large number of cases (see Table 3.1).

---

\(^{18}\) The total excludes 34 cases of transient global amnesia. All are in DRG B70C.
### Table 3.1  Stroke cases at study hospitals (no.)

<table>
<thead>
<tr>
<th>DRG B70A</th>
<th>DRG B70B</th>
<th>DRG B70C*</th>
<th>DRG B70D</th>
<th>All DRGs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Died or transferred &lt;5 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>51</td>
<td>91</td>
<td>74</td>
<td>43</td>
</tr>
<tr>
<td>GH</td>
<td>133</td>
<td>143</td>
<td>119</td>
<td>63</td>
</tr>
<tr>
<td>RNSH</td>
<td>86</td>
<td>114</td>
<td>116</td>
<td>58</td>
</tr>
<tr>
<td>BLH</td>
<td>89</td>
<td>65</td>
<td>47</td>
<td>51</td>
</tr>
<tr>
<td>JHH</td>
<td>107</td>
<td>110</td>
<td>116</td>
<td>67</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>466</td>
<td>523</td>
<td>472</td>
<td>282</td>
</tr>
</tbody>
</table>

* Excluding 34 patients with transient global amnesia.

**Note:** See Box 3.1 for details on how we calculated the number of cases.

**Source:** HIE inpatient statistics, 2008/09 and IPART analysis.

Box 3.1 provides more detail on how we calculated the number of cases at each hospital.

### Box 3.1  How we calculated the number of stroke cases

To calculate the number of stroke cases in study hospitals, we:

- used patient episode data for 2008/09
- counted adjoining episodes as part of the same stay (ie, adjoining episodes counted as one case)
- only included patient data where the whole patient stay occurred within 2008/09 (ie, all episodes and adjoining episodes had to start on or after 1 July 2008 and end on or before 30 June 2009 to be counted)
- only included patient data where the first episode in the year in the study hospital was coded as a DRG for stroke (ie, episode sequence number had to be 1).

The approach prevented double counting. It excluded patients that may be admitted for a different condition and later be reclassified to a stroke DRG. This may occur, for example, if the patient was admitted for another condition and had a stroke in hospital, or where there is miscoding.

Note that our approach means that the number of cases we identified will be less than the number of separations in 2008/09.
3.2 Comparison of complexity of patient mix

Table 3.2 shows the percentage of cases coded in each stroke DRG for each hospital. BLH had a higher proportion of patients in the most complex DRG (B70A) than any of the other hospitals (35%). The reason for this is unknown. One possibility is that stroke patients at BLH are on average older than at the other hospitals, with an average age of 82 years in the most complex category DRG B70A (see Table 3.5 below). Another possibility is that coding practices differ, and BLH is more likely than the other hospitals to code stroke patients into the most complex DRG (see next section). A third possibility is that BLH uses less medication (tPA) or surgical intervention to dissolve or remove clots than the other hospitals (see Chapter 6). We could not examine the third possibility because tPA administration is not coded as a procedure in the hospital data set.

Table 3.2 Percentage of cases coded in each DRG category

<table>
<thead>
<tr>
<th>DRG</th>
<th>RPAH</th>
<th>GH</th>
<th>RNSH</th>
<th>BLH</th>
<th>JHH</th>
<th>All study hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>B70A</td>
<td>cataf</td>
<td>20</td>
<td>29</td>
<td>23</td>
<td>35</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>stic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B70B</td>
<td>severe</td>
<td>35</td>
<td>31</td>
<td>30</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>B70C*</td>
<td>not catastrophic or severe</td>
<td>29</td>
<td>26</td>
<td>31</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>B70D</td>
<td>Died or transferred &lt;5 days</td>
<td>17</td>
<td>14</td>
<td>16</td>
<td>20</td>
<td>16</td>
</tr>
</tbody>
</table>

* 34 cases of transient global amnesia excluded.

Note: Totals may not add to 100% due to rounding.

Source: HIE inpatient statistics, 2008/09 and IPART analysis.

3.2.1 Assessment of coding practice

In order to help assess if the coders in each hospital were coding patients similarly, we compared the average number of diagnosis codes per stroke patient in the 5 hospitals. This provides a rough guide to help assess whether there is a significant difference in coding practice between hospitals. For example, if one hospital is coding cases in higher complexity categories, we would expect to find that it uses more diagnosis codes on average. Conversely, if a hospital is paying little attention to coding complexity, we would expect to find that it uses few diagnosis codes.

19 Only RNSH and RPAH remove clots surgically.
20 A diagnosis code is recorded for each medical condition. For example, a stroke patient may also have high blood pressure, diabetes and dementia.
The number of diagnosis codes in the inpatient data was fairly similar across the hospitals – ranging from 6.4 diagnosis codes per patient at RNSH to 7.6 at BLH. However, the slightly higher number at BLH could indicate differences in coding practice and/or stroke patients with more medical conditions, both of which might help to explain the higher proportion of patients in the most complex DRG.

### Table 3.3 Average number of diagnosis codes per patient in study hospitals

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Average number of diagnosis codes per patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPAH</td>
<td>6.7</td>
</tr>
<tr>
<td>GH</td>
<td>7.0</td>
</tr>
<tr>
<td>RNSH</td>
<td>6.4</td>
</tr>
<tr>
<td>BLH</td>
<td>7.6</td>
</tr>
<tr>
<td>JHH</td>
<td>6.9</td>
</tr>
</tbody>
</table>

*Source:* HIE inpatient statistics, 2008/09 and IPART analysis.

#### 3.2.2 Admissions and transfers

Our analysis shows that the vast majority of stroke patients are admitted through the emergency department, and between 4% and 15% of patients are transferred in from other hospitals. The high proportion of transfers in to GH (15%) reflects its role in providing a referral service for the central coast. RNSH had an equally high proportion of transfers in as it provides a state-wide service for very sick patients (Table 3.4).

### Table 3.4 Admissions and transfers

<table>
<thead>
<tr>
<th></th>
<th>Emergency admissions</th>
<th>Transferred in from another hospital</th>
<th>Transferred out to another hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>RPAH</td>
<td>93</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>GH</td>
<td>84</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>RNSH</td>
<td>90</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>BLH</td>
<td>96</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>JHH</td>
<td>90</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>90</td>
<td>11</td>
<td>20</td>
</tr>
</tbody>
</table>

*a* These include direct admissions to the stroke unit at GH and JHH.

*Note:* See Box 3.2 for details on how we calculated the number of cases, and identified emergency admissions and transfers.

*Source:* HIE inpatient statistics, 2008/09 and IPART analysis.

---

21 Some patients who are transferred from other hospitals are recorded as emergency admissions, and others are recorded as planned admissions. The hospitals are not always consistent in how they record transfers from other hospitals.
The proportion of stroke patients transferred out to other hospitals for rehabilitation ranges from 14% at BLH and JHH to 27% at RPAH. Transfers out at RNSH, RPAH and GH are high because their rehabilitation facilities are located elsewhere. JHH and BLH do more on-site rehabilitation (discussed further in Chapter 4 and Chapter 6).

Box 3.2 describes the method we used to identify emergency admissions and transfers.

**Box 3.2 How we identified emergency admissions and transfers**

Emergency admissions were identified by linking emergency department attendance data with admitted patient data where the time of arrival and departure in the emergency department matched with the admission time. Note that some of the patients that are transferred in are not included in the emergency figures.

Due to data quality issues with the transfer in and transfer out fields in the admitted patient data, transfers were calculated using a linkage key developed by the Australian Institute of Health and Welfare.

### 3.2.3 Age of patients

The average age of stroke patients in all hospitals was 73 years, ranging from an average of 70 years at JHH to 76 years at BLH. Patients in the most complex category (B70A) were on average older than patients in the less complex categories. Patients in the least complex category (B70C) were on average 11 years younger than those in the most complex category (Table 3.5).
### Table 3.5 Average age of patients in stroke DRGs

<table>
<thead>
<tr>
<th></th>
<th>DRG B70A</th>
<th>DRG B70B</th>
<th>DRG B70C&lt;sup&gt;a&lt;/sup&gt;</th>
<th>DRG B70D Died or transferred &lt;5 days</th>
<th>All stroke DRGs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>years</td>
<td>years</td>
<td>years</td>
<td>years</td>
<td>years</td>
</tr>
<tr>
<td>RPAH</td>
<td>76</td>
<td>72</td>
<td>66</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td>GH</td>
<td>79</td>
<td>74</td>
<td>74</td>
<td>72</td>
<td>75</td>
</tr>
<tr>
<td>RNSH</td>
<td>80</td>
<td>75</td>
<td>67</td>
<td>74</td>
<td>73</td>
</tr>
<tr>
<td>BLH</td>
<td>82</td>
<td>74</td>
<td>74</td>
<td>71</td>
<td>76</td>
</tr>
<tr>
<td>JHH</td>
<td>75</td>
<td>72</td>
<td>63</td>
<td>73</td>
<td>70</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>79</td>
<td>73</td>
<td>68</td>
<td>73</td>
<td>73</td>
</tr>
</tbody>
</table>

<sup>a</sup> Excluding 34 patients with transient global amnesia.

**Note:** Age at date of admission.

**Source:** HIE inpatient statistics, 2008/09 and IPART analysis.
4 Length of stay across study hospitals

We examined the average length of stay of stroke patients because it is one of the factors that influence the cost of an individual’s hospital care. This is because a large component of this cost is nursing care (and this cost increases with the length of stay). In addition, differences in length of stay can point to differences in casemix or clinical practice between hospitals.

We calculated the average length of stay across all study hospitals for stroke cases using 3 different measures:

- episode length of stay in study hospital (LOS1)
- total length of stay in study hospital (LOS2)
- total length of stay in study hospital and 2 other hospitals – one transfer in and one transfer out (LOS3).

Box 4.1 provides more detail on these measures. The sections below set out our analysis of length of stay for all stroke cases, as well as for each stroke DRG.

We found that there was significant variation in the acute episode length of stay (LOS1) across the study hospitals, but that much of this difference was due to differences in the way the hospitals reclassify patients from acute to rehabilitation care, rather than differences in clinical practice. We also found that there is far less variation in the length of stay when total hospitalisation is measured (LOS3), mainly because LOS3 takes into account different arrangements for rehabilitation.
Box 4.1 The 3 measures of length of stay we used for stroke patients

1. **Episode length of stay in study hospital (LOS1)**

   This is the average number of days a patient stayed in the study hospital for a single acute episode. This measure is often used in NHCDC and DRG benchmarking analyses. We used this measure to enable comparisons to be made between our cost estimates and those included in the NHCDC (discussed in Chapter 5).

2. **Total length of stay in study hospital (LOS2)**

   This is the total number of days a patient stayed in the study hospital from admission to discharge. It includes all consecutive episodes including acute, rehabilitation and any other types of care. However, for some conditions/procedures, patients can be:
   - transferred to the study hospital from another hospital, and/or
   - transferred from the study hospital to another.

   LOS2 does not include the length of stay in such other hospitals, so does not provide a consistent basis for comparing average length of stay required to care for certain conditions/procedures.

3. **Total length of stay in study hospital plus up to 2 other hospitals – one transfer in and one transfer out (LOS3)**

   The third measure is the total length of stay in the study hospital (ie, LOS2), plus the total length of stay at 2 other hospitals – one ‘transfer in’, and one ‘transfer out’. Ideally all related hospital stays would be linked, but we have only added up to one additional hospital stay at either end of the stay in the study hospital. We used the linkage key developed by the Australian Institute of Health and Welfare (AIHW) for use between all public and private hospitals. This step is not routinely done in hospital comparisons.

   We consider that LOS3 is a more consistent basis for comparing average length of stay for certain conditions/procedures because it takes account of differences in hospital:
   - administrative practices for reclassifying patients between their acute care and other phases of care (type changes)
   - access to rehabilitation facilities (transfers out)
   - patterns of referral from other hospitals (transfers in).

4.1 Comparing lengths of stay for stroke patients

We calculated lengths of stay both including and excluding patients in DRG B70D (ie, who died or were transferred to another hospital in less than 5 days) and those with a diagnosis of transient global amnesia. A few of these patients can significantly reduce the length of stay and distort comparisons of average lengths of stay.
4.1.1 Impact of exclusions on average length of stay for combined DRGs

Table 4.1 shows the average length of stay for all stroke patients, and the average length of stay for stroke patients, excluding DRG B70D patients and patients with a diagnosis of transient global amnesia. Removing these patients increased the length of stay by an average of about 2 days for all the hospitals.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Cases</th>
<th>LOS1</th>
<th>LOS2</th>
<th>LOS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>All DRGs (B70A, B70B, B70C and B70D, including patients with transient global amnesia)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>266</td>
<td>8.1</td>
<td>8.1</td>
<td>15.7</td>
</tr>
<tr>
<td>GH</td>
<td>468</td>
<td>10.9</td>
<td>11.2</td>
<td>16.1</td>
</tr>
<tr>
<td>RNSH</td>
<td>385</td>
<td>8.0</td>
<td>8.8</td>
<td>14.9</td>
</tr>
<tr>
<td>BLH</td>
<td>254</td>
<td>13.6</td>
<td>17.3</td>
<td>20.0</td>
</tr>
<tr>
<td>JHH</td>
<td>404</td>
<td>8.6</td>
<td>13.7</td>
<td>18.8</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>1,777</td>
<td>9.7</td>
<td>11.7</td>
<td>16.9</td>
</tr>
<tr>
<td>DRGs B70A, B70B and B70C (excluding patients with transient global amnesia)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>216</td>
<td>9.5</td>
<td>9.5</td>
<td>17.0</td>
</tr>
<tr>
<td>GH</td>
<td>395</td>
<td>12.7</td>
<td>12.9</td>
<td>17.8</td>
</tr>
<tr>
<td>RNSH</td>
<td>316</td>
<td>9.3</td>
<td>10.3</td>
<td>17.2</td>
</tr>
<tr>
<td>BLH</td>
<td>201</td>
<td>17.0</td>
<td>21.6</td>
<td>22.7</td>
</tr>
<tr>
<td>JHH</td>
<td>333</td>
<td>10.1</td>
<td>16.2</td>
<td>21.6</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>1,461</td>
<td>11.5</td>
<td>13.8</td>
<td>19.1</td>
</tr>
</tbody>
</table>

Source: HIE inpatient statistics, 2008/09 and IPART analysis.

We discuss difference in length of stay between the hospitals separately for each DRG, in the sections that follow.

4.1.2 Length of stay for stroke patients in DRG B70A

Table 4.2 includes average length of stay comparisons for stroke patients in the most complex category DRG B70A\(^\text{22}\).

\(^{22}\) Stroke with catastrophic complication or comorbidity.
Table 4.2  Average length of stay for stroke DRG B70A

<table>
<thead>
<tr>
<th>Cases</th>
<th>LOS1</th>
<th>LOS2</th>
<th>LOS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>no..</td>
<td>days</td>
<td>days</td>
<td>days</td>
</tr>
<tr>
<td>RPAH</td>
<td>51</td>
<td>16.3</td>
<td>16.2</td>
</tr>
<tr>
<td>GH</td>
<td>133</td>
<td>18.0</td>
<td>18.6</td>
</tr>
<tr>
<td>RNSH</td>
<td>86</td>
<td>14.1</td>
<td>16.5</td>
</tr>
<tr>
<td>BLH</td>
<td>89</td>
<td>26.7</td>
<td>32.2</td>
</tr>
<tr>
<td>JHH</td>
<td>107</td>
<td>16.6</td>
<td>28.9</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>466</td>
<td>18.4</td>
<td>22.9</td>
</tr>
</tbody>
</table>

Note: In a few instances LOS2 (and LOS3) may be slightly shorter than LOS1 because LOS1 is calculated using hours on the ward while LOS2 is calculated using days. Therefore, if a patient is admitted in the morning for surgery and discharged early afternoon of the next day, the average length of stay would be 30 hrs or 1.25 days; under LOS2 this would be 1 day and under LOS1 this would be 1.25 days.

Source: HIE inpatient statistics, 2008/09 and IPART analysis.

The acute episode length of stay at BLH for DRG B70A is 26.7 days, significantly longer than any other hospital. However, the total number of hospital days (when transfers are included) is similar to the other hospitals (33.7 days). The episode length of stay (LOS1) at BLH is significantly longer than at any of the other hospitals because rehabilitation care begins in the acute wards and patients are reclassified as non-acute (ie, the type change is made – see Box 4.2) only when they move to a rehabilitation ward. The hospital length of stay (LOS2) is longer because BLH has on-site rehabilitation facilities, so that patients do not need to be transferred to separate facilities for rehabilitation.

Stroke patients at GH, RPAH and RNSH spend less time in these hospitals because they are transferred to rehabilitation facilities located at other hospitals.

The hospital length of stay (LOS2) in JHH is the second longest at 28.9 days, partly because patients are transferred to a ‘residential ward’ within the hospital as part of their rehabilitation. JHH has the longest total length of stay (LOS3) of 40.5 days. As previously noted, JHH’s patients tend to have longer stays because many of them come from rural areas where it is harder to get follow-up care or nursing homes places.

This DRG provides a very good example of the effect differences in coding practices on the episode length of stay (LOS1). It is also a good example of the effect of the location of rehabilitation facilities on the hospital length of stay (LOS2). It clearly demonstrates that the most comparable measure is LOS3, which includes transfers in from other hospitals and, more importantly, transfers to off-site rehabilitation facilities.
Box 4.2  Episode type changes

Consistent with approved practice, hospital stays can be administratively split, or ‘fragmented’, into a number of episodes reflecting changes in the type of care provided. The episode types used in the HIE are:

1. Hospital Boarder
2. Acute Care
3. Rehabilitation Care
4. Palliative Care
5. Maintenance Care
6. Newborn Care
7. Other Admitted Patient Care
8. Geriatric Evaluation and Management
9. Psycho-geriatric
10. Organ Procurement.

For example, an elderly patient with a stroke may typically have two or more episodes – an ‘acute’ episode, a ‘rehabilitation’ episode and, perhaps, a ‘psycho-geriatric’ episode for a patient with confusion or dementia.

Hospital practices relating to episode type changes differ. For example, for stroke patients some hospitals do the type change from ‘acute care’ to ‘rehabilitation care’ when the patient is ready for rehabilitation, while others do the type change only when the patient physically moves to a rehabilitation ward or facility.

4.1.3  Length of stay for stroke patient in DRG B70B

Table 4.3 provides average length of stay comparisons for stroke patients in the next most complex category DRG B70B\(^{23}\). The length of stay is shorter than for the patients in DRG B70A, by an average of 9 days for the acute length of stay (LOS\(_1\)) and 15 days for the total length of stay including transfers (LOS\(_3\)).

There is less variation between the hospitals in this DRG than in DRG B70A. GH (not BLH) has the longest episode length of stay (11.2 days) for this DRG, while JHH has the longest total stay (18.0 days).

Similar to our finding for DRG B70A, LOS\(_3\) is a more comparable measure of the length of stay between the study hospitals than either the episode length of stay (LOS\(_1\)) or the hospital length of stay (LOS\(_2\)).

---

\(^{23}\) Stroke with severe complication or comorbidity.
Table 4.3  Average length of stay for stroke DRG B70B

<table>
<thead>
<tr>
<th>Cases</th>
<th>LOS1</th>
<th>LOS2</th>
<th>LOS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>no.</td>
<td>days</td>
<td>days</td>
<td>days</td>
</tr>
<tr>
<td>RPAH</td>
<td>91</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td>GH</td>
<td>143</td>
<td>11.2</td>
<td>11.4</td>
</tr>
<tr>
<td>RNSH</td>
<td>114</td>
<td>8.4</td>
<td>9.2</td>
</tr>
<tr>
<td>BLH</td>
<td>65</td>
<td>10.8</td>
<td>15.5</td>
</tr>
<tr>
<td>JHH</td>
<td>110</td>
<td>8.7</td>
<td>14.3</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>523</td>
<td>9.5</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Source: HIE inpatient statistics, 2008/09 and IPART analysis.

4.1.4 Length of stay for stroke patient in DRG B70C

Table 4.4 compares lengths of stay for stroke patients in the least complex category DRG B70C\(^\text{24}\) (excluding patients with a diagnosis of transient global amnesia). The length of stay is shorter than for the patients in DRB B70A, by an average of 12 days for the acute length of stay (LOS1) and 22 days for the total length of stay including transfers (LOS3).

GH has the longest episode length of stay (8.4 days) for this DRG, while RNSH has the longest total stay (11.3 days).

For this DRG there is comparatively little difference between the acute episode stay (LOS1) and the total stay (LOS3) because these patients need less rehabilitation.

Table 4.4  Average length of stay for stroke DRG B70C

<table>
<thead>
<tr>
<th>Cases</th>
<th>LOS1</th>
<th>LOS2</th>
<th>LOS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>no.</td>
<td>days</td>
<td>days</td>
<td>days</td>
</tr>
<tr>
<td>RPAH</td>
<td>74</td>
<td>6.1</td>
<td>6.1</td>
</tr>
<tr>
<td>GH</td>
<td>119</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td>RNSH</td>
<td>116</td>
<td>6.8</td>
<td>6.8</td>
</tr>
<tr>
<td>BLH</td>
<td>47</td>
<td>7.1</td>
<td>9.9</td>
</tr>
<tr>
<td>JHH</td>
<td>116</td>
<td>5.4</td>
<td>6.4</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>472</td>
<td>6.8</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Note: Patients with a diagnosis of transient global amnesia are excluded.
Source: HIE inpatient statistics, 2008/09 and IPART analysis.

\(^{24}\) Stroke without catastrophic or severe complication or comorbidity.
4.1.5 Length of stay for stroke patient in DRG B70D

DRG B70D includes patients who die or are transferred in less than 5 days. The average length of stay at the study hospital is less than 2 days.

Table 4.5 Average length of stay for stroke DRG B70D

<table>
<thead>
<tr>
<th>Cases no.</th>
<th>LOS1 days</th>
<th>LOS2 days</th>
<th>LOS3 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPAH</td>
<td>43</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>GH</td>
<td>63</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td>RNSH</td>
<td>58</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>BLH</td>
<td>51</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>JHH</td>
<td>67</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>282</td>
<td>1.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Source: HIE inpatient statistics, 2008/09 and IPART analysis.

4.2 Patients with lengths of stay of more than 30 days

Table 4.6 compares the percentage of cases with a length of stay of greater than 30 days for all stroke patients (including DRG B70D).

Table 4.6 Percentage of cases with episode and total stay greater than 30 days

<table>
<thead>
<tr>
<th>LOS1</th>
<th>LOS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPAH</td>
<td>3</td>
</tr>
<tr>
<td>GH</td>
<td>7</td>
</tr>
<tr>
<td>RNSH</td>
<td>1</td>
</tr>
<tr>
<td>BLH</td>
<td>16</td>
</tr>
<tr>
<td>JHH</td>
<td>4</td>
</tr>
<tr>
<td>All study hospitals</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: Includes DRGs B70A, B70B, B70C and B70D.
Source: HIE inpatient statistics, 2008/09 and IPART analysis.

BLH has the highest percentage of long-stay cases, RNSH the lowest percentage. BLH’s high percentage of long-stay acute episodes reflects the fact that rehabilitation care takes place both in the acute wards and in on-site rehabilitation facilities, and patients are typed changed only when they move to a rehabilitation ward.

This case study and some of our other of our case studies (eg, hips), demonstrate the need to link the episodes for each patient, so that the full patient journey is considered (including stays in other hospitals or facilities). This is discussed in further detail in Chapter 5 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*. 
5 Costs of providing inpatient care

To compare the costs of caring for stroke patients at the study hospitals we examined the major clinical resources used to provide inpatient care during their ‘acute episode’ (ie, using LOS1). The clinical resources we examined were:

- nursing staff in wards
- imaging
- pathology.

The sections below discuss our analysis of the estimated costs for each of these resources across the study hospitals. They also compare our estimated costs with estimates based on provisional or final data reported to NSW Health by Area Health Services as part of the NHCDC.25

The care of stroke patients involves significant allied health costs such as speech pathology, occupational therapy and physiotherapy. We did not include these allied health costs in our data collection or analysis.

Note that given the scope of our task for this study, we were not able to undertake a full bottom-up costing of all the above resource categories. Instead, we used a range of approaches, based on the most reliable and consistent data we could obtain in the time available. The methodologies we used are outlined in the sections below, and discussed in more detail in our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*. Also note that while senior and junior medical staff are a major cost for stroke patients, we were not able to compare the use and management of these clinical resources due to the lack of consistent data.

5.1 Cost of nursing staff in wards

Nursing is one of the largest expenditure areas in hospital budgets and is a significant part of the cost of providing acute care to stroke patients.

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25 Due to time constraints we used final NHCDC data only where these were substantially different from the provisional data. For this case study we used final NHCDC data only for pathology costs.
We calculated and compared the nursing cost per acute episode for DRGs B70B and B70C (excluding transient global amnesia patients). We excluded DRG B70A because of the complexity introduced into the analysis by time spent in ICU and the different structures for ICU and high dependency units at the different hospitals. These differences mean that we could not calculate comparable costs across the study hospitals for this DRG. We also excluded DRG B70D (patients who died or were transferred within 5 days), for the reasons previously explained.

5.1.1 Methodology

To analyse this cost and allow comparisons with the NHCDC, we focused on:

- the cost of nursing staff in wards (ie, excluding those of nursing staff in operating theatres or senior nursing categories that provide area-wide or hospital-wide functions)

- nursing costs for the acute episode only (ie, LOS1).

Our methodology for estimating nursing costs and its limitations are briefly described in Box 5.1 and in more detail in Chapter 8 of our main report. Further, these estimates should be considered in light of the discussion in Chapter 4 on the limitations of using LOS1 relative to LOS3 (the length of stay for the acute episode plus other episodes plus up to one transfer in and one transfer out).

5.1.2 Use of IFRACs

The hospitals use inpatient fractions (IFRACs) to allocate staff time to acute care and other staff responsibilities. We calculated two sets of inpatient nursing costs, the first using the hospitals’ IFRACs and the second setting all IFRACs to 1. We did this because we were concerned that IFRACs may not be consistently applied by the hospitals. IFRACs also underlie the NHCDC estimates of ward costs.

BLH has an IFRAC of 1, RPAH, GH and JHH have IFRACs of 0.90, while RNSH has an IFRAC of 0.77. These IFRACs may be valid, because ward nursing staff (except at BLH) may spend time on non-inpatient activities (eg, staffing outpatient clinics). However, the purpose of our analysis is to show how sensitive the nursing cost estimates are to IFRACs. IFRACs also underlie the NHCDC estimates of ward costs.

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26 IPART, NSW Health costs and outcomes study by IPART for selected NSW hospitals, July 2010.
27 Setting IFRACs to 1 means that we allocated 100% of the nursing time to inpatient care.
28 IFRACs may differ between the hospitals for valid reasons, because the ward nursing staff in some hospitals may spend more time on outpatient or administrative activities than those in other hospitals. The purpose of our analysis is to show how sensitive the nursing cost estimates are to IFRACs.
5.1.3 Ward nursing costs for stroke patients

Table 5.1 shows our estimates of direct nursing costs for the study hospitals for DRGs B70B and B70C. The table also shows the direct nursing costs from the provisional data for the NHCDC, which we compare with our estimates of cost.

Our analysis indicates that the cost per episode is affected by four main factors:

- IFRACs
- length of stay
- nursing hours per patient day (ie, staff-to-patient ratio)
- nursing staff mix.

IFRACs affect both the nursing costs per episode and the nursing costs per patient day (see Table 5.1 and Table 5.2). Setting IFRACs to 1 increases the costs at all the hospitals except BLH, but has the biggest impact on RNSH because the IFRACs used at this hospital are the lowest.

We found that there is a strong relationship between the second factor, the length of stay, and episode costs. There is a straightforward relationship when IFRACs are set to 1: hospitals with a longer length of stay have higher cost per episode than hospitals with a shorter length of stay. For example, when IFRACs = 1 GH has the longest length of stay (9.9 days) and the highest cost per episode ($2,079), while JHH has the shortest length of stay (7.0 days) and the lowest cost per episode ($1,298).

The number of nursing hours per patient day and the staff mix determine the nursing cost per patient day. In principle, a hospital with a high staff-to-patient ratio is likely to have higher costs per patient day than a hospital with a lower staff-to-patient ratio. But a higher number of hours per patient day can be offset by lower costs per nursing hour if there is a high proportion of Enrolled Nurses (ENs) and Assistants in Nursing (AINs) in the staff mix. However, our analysis suggests that the average cost per patient day at the different hospitals depends more on staffing levels than the staff mix. The staff mix results in only a small variation in the average cost per nursing hour, from $34 at JHH to $36 at RPAH and BLH (Table 5.3).

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29 We combined the nursing costs for DRGs B70B and B70C because the only significant difference between the DRGs was the length of stay. Combining the DRGs made it easier to compare the hospitals’ nursing costs, and did not compromise the analysis.

30 The nursing categories are explained in Chapter 8 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*. 
To demonstrate the relative impacts of staffing levels versus staff mix, we note that GH and RNSH both provide 5.4 hours of care per patient day (with IFRACs), but their staff mix is very different: at GH a full 43% of nurses are ENs or AINs, while at RNSH only 26% of nurses are ENs or AINs. Despite the differences in staff mix, the hospitals have a cost per patient day that varies by only $1.

Our analysis indicates that RPAH has both a higher number of nursing hours per patient day and a significantly lower percentage of ENs and AINs than any of the other hospitals (18% combined). As a consequence, RPAH has the highest cost per patient day. JHH has the lowest number of nursing hours per patient day and as a consequence has the lowest cost per nursing day (Table 5.2 and Table 5.3). The lower staff-to-patient ratio at JHH may reflect high ward occupancy rates, and/or possibly staff shortages.

The direct nursing costs from the provisional data for the NHCDC are higher than our costs for all hospitals (except RPAH when IFRAC=1). The costs for GH and BLH are particularly high compared with our costs. (See Table 5.1 and Figure 5.1.)

### Table 5.1 Ward nursing costs per episode for DRGs B70B and B70C, with and without IFRACs

<table>
<thead>
<tr>
<th></th>
<th>LOS1 acute episode</th>
<th>LOS3 hospital + transfers</th>
<th>Episode nursing cost with IFRAC</th>
<th>IFRAC</th>
<th>Episode nursing cost, IFRAC = 1</th>
<th>NHCDC direct ward costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>days</td>
<td>days</td>
<td>$</td>
<td>No.</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>RPAH</td>
<td>7.4</td>
<td>12.4</td>
<td>1,792</td>
<td>0.90</td>
<td>1,997</td>
<td>1,900</td>
</tr>
<tr>
<td>GH</td>
<td>9.9</td>
<td>13.1</td>
<td>1,866</td>
<td>0.90</td>
<td>2,079</td>
<td>3,000</td>
</tr>
<tr>
<td>RNSH</td>
<td>7.6</td>
<td>14.1</td>
<td>1,432</td>
<td>0.77</td>
<td>1,872</td>
<td>2,027</td>
</tr>
<tr>
<td>BLH</td>
<td>9.3</td>
<td>13.9</td>
<td>2,026</td>
<td>1.00</td>
<td>2,025</td>
<td>3,143</td>
</tr>
<tr>
<td>JHH</td>
<td>7.0</td>
<td>12.7</td>
<td>1,168</td>
<td>0.90</td>
<td>1,298</td>
<td>1,904</td>
</tr>
</tbody>
</table>

**Note:** Episode nursing cost calculated using acute episode LOS measure (LOS1). Patients with a diagnosis of transient global amnesia have been excluded.

**Source:** IPART analysis from HIE inpatient statistics, 2008/09, payroll data and provisional cost data 2008/09, NHCDC.

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31 We have included student nurses with the ENs and AINs because they have a similar hourly rate.

32 We note however that the hourly cost of RNs is higher at GH ($40) than at RNSH ($38). This suggests that GH has a higher proportion of senior RNs than RNSH, and/or that RNs at GH do more overtime than RNs at RNSH.
### Table 5.2  Nursing costs and hours per patient day for DRGs B70B and B70C, with and without IFRACs

<table>
<thead>
<tr>
<th>Facility</th>
<th>Nursing Costs per Patient Day ($)</th>
<th>Nursing Hours per Patient Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With IFRAC</td>
<td>IFRAC=1</td>
</tr>
<tr>
<td>RPAH</td>
<td>243</td>
<td>271</td>
</tr>
<tr>
<td>GH</td>
<td>188</td>
<td>210</td>
</tr>
<tr>
<td>RNSH</td>
<td>189</td>
<td>247</td>
</tr>
<tr>
<td>BLH</td>
<td>219</td>
<td>219</td>
</tr>
<tr>
<td>JHH</td>
<td>167</td>
<td>185</td>
</tr>
</tbody>
</table>

**Source:** HIE inpatient statistics, 2008/09, payroll data and IPART analysis.

### Table 5.3  Nursing costs and hours by award category for DRGs B70B and B70C, with IFRACs

<table>
<thead>
<tr>
<th>Award Category</th>
<th>All</th>
<th>CNS</th>
<th>RN</th>
<th>EN</th>
<th>AIN</th>
<th>Students/trainees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Hours by Award Category (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>100</td>
<td>8</td>
<td>73</td>
<td>8</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>GH</td>
<td>100</td>
<td>3</td>
<td>54</td>
<td>38</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>RNSH</td>
<td>100</td>
<td>4</td>
<td>70</td>
<td>16</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>BLH</td>
<td>100</td>
<td>1</td>
<td>62</td>
<td>22</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>JHH</td>
<td>100</td>
<td>3</td>
<td>65</td>
<td>25</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Nursing Cost per Hour ($)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>36</td>
<td>45</td>
<td>38</td>
<td>29</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>GH</td>
<td>35</td>
<td>39</td>
<td>40</td>
<td>30</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>RNSH</td>
<td>35</td>
<td>46</td>
<td>38</td>
<td>30</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>BLH</td>
<td>36</td>
<td>44</td>
<td>41</td>
<td>29</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>JHH</td>
<td>34</td>
<td>42</td>
<td>37</td>
<td>30</td>
<td>23</td>
<td>19</td>
</tr>
</tbody>
</table>

*There is no significant change to these figures with IFRAC=1.*

**Note:** CNS = Clinical Nurse Specialist; RN = Registered Nurse; EN = Enrolled Nurse; AIN = Assistant in Nursing. See the Glossary at the end of the Appendices for descriptions of these nursing levels.

**Source:** HIE inpatient statistics, 2008/09, payroll data and IPART analysis.
Figure 5.1  Comparison of direct ward nursing costs per episode for DRGs B70B and B70C

Note: Patients with a diagnosis of transient global amnesia are excluded.
Source: IPART analysis from HIE inpatient statistics, 2008/09, payroll data and provisional cost data 2008/09, NHCDC.
Box 5.1 How we estimated nursing costs

IPART used a model for each hospital to allocate ward nursing costs to each DRG grouping and compare nursing costs.

We calculated ‘nursing hours per patient day’, ‘nursing cost per patient hour’ and ‘nursing cost per acute episode’ for 2008/09 by:

- Mapping the wards in each hospital to cost centres – so we could use these to extract relevant payroll information for each ward.
- Extracting information from the payroll on nursing classification, nursing pay and nursing hours worked for each ward.
- Applying inpatient fractions to our total ward nursing cost – so we only included nursing costs for acute patient care. Note that some hospitals have a fraction of ‘1’ where other hospitals may have fractions like ‘0.95’ for similar wards.
- Allocating ward nursing costs to all patients on the ward, based on their time on the ward and the nursing service weights for their DRG.
- Allocating a cost of nursing care to each patient - for each step of the patient’s stay in acute care. Note that from patient level episode information we attributed a cost to each ward transfer during their ‘acute’ episode.

We then applied our estimate of nursing cost per hour to the average length of the acute episode to obtain an estimate of the ‘nursing cost per episode’. We also calculated costs with IFRAC = 1 for comparison.

Qualifications

- For our calculations, we included only direct costs of ordinary hours (excluding leave), penalty rates and overtime, obtained from payroll data.
- The number of ‘nursing hours per patient day’ depends on the occupancy rates of the wards. A higher occupancy rate reduces the hours per patient day but such a change can cause other issues, like outliers or access block.
- The ‘nursing hours per patient day’ is the share of a patient’s use of the nursing staff based on the nursing service weights. These service weights are not perfect and the mix of other patients on the ward may impact on the nursing hours attributed to a patient and hence their cost. The service weights do not take into account the generally higher cost of patients at the start of their hospital stay.
- Some wards have a mix of more acute care with rehabilitation. Fewer nursing hours and lower costs are attributed to the ‘acute’ episode in such wards compared with wards in hospitals that have a greater separation of roles (acute wards separate from rehabilitation).
- Our nursing methodology excludes ‘wards’ like emergency departments where it is particularly difficult to determine the inpatient fraction, but allocated a nursing cost for the time spent in emergency.
- Hospitals with a shorter reported length of stay for the ‘acute’ episode may be expected to have a higher number of nursing hours per day and higher daily nursing costs.
5.2 Imaging costs

Table 5.4 sets out our calculations for the average cost of all imaging tests for stroke patients, during their acute episode and on the day of their admission. It also sets out the average costs for selected high-cost tests (CT scans/MRIs, ultrasounds and fluoroscopy), as well as the direct and indirect imaging costs from the provisional data for the NHCDC. Our methodology for calculating these costs is explained in Box 5.2.

We found that imaging costs for the combined DRGs (for the whole acute episode) were highest at RNSH ($1,050) and lowest at BLH ($581). All the hospitals use CT scans and MRI, with RNSH making the most use of these tests ($705) and RPAH making the least use ($355). GH uses ultrasound more than any of the other hospitals. BLH does not currently have MRI facilities on-site, and must transport patients to Liverpool Hospital if MRI scans are required for further diagnosis or treatment. However, we understand that there is a firm proposal for an MRI at BLH and planning is well underway.

The NHCDC costs for the combined stroke DRGs (excluding B70D) fall within a narrower range than our costs – from $679 at RPAH to $944 at JHH. However, the rankings of hospitals are different between our estimates and the NHCDC estimates. Our analysis shows that RNSH has the highest cost by a significant margin, while BLH has the lowest cost. But according to the NHCDC, JHH has the highest cost and RPAH has the lowest cost. We believe that our costs are more reliable than those in the NHCDC because we have used a consistent method to calculate them based on clinical information.

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33 Excluding patients with a diagnosis of transient global amnesia and patients who died or were transferred in less than 5 days (DRG B70D).
Table 5.4  Average imaging costs for stroke patients (excluding DRG B70D)

<table>
<thead>
<tr>
<th>All imaging tests</th>
<th>CT/MRI</th>
<th>Ultrasound</th>
<th>Fluoroscopy</th>
<th>NHCDC direct and indirect costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td><strong>Acute episode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>736</td>
<td>355</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>GH</td>
<td>693</td>
<td>420</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>RNSH</td>
<td>1,050</td>
<td>705</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>BLH</td>
<td>581</td>
<td>415</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>JHH</td>
<td>790</td>
<td>521</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Day of admission</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPAH</td>
<td>270</td>
<td>205</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GH</td>
<td>257</td>
<td>223</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>RNSH</td>
<td>339</td>
<td>221</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BLH</td>
<td>219</td>
<td>178</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>JHH</td>
<td>306</td>
<td>275</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Patients with a diagnosis of transient global amnesia are excluded.
Source: IPART analysis using data from hospital imaging services and provisional NHCDC cost data, 2008/09.

We also investigated imaging costs for the individual DRGs. We found that imaging costs were lower in the less complex DRGs at GH and BLH, while imaging costs were similar for all stroke patients at the other study hospitals (Figure 5.2). Imaging costs on the day of admission were similar for all DRGs and did not vary much between hospitals (Figure 5.3). Imaging costs vary less than, for example, pathology costs by DRG because all patients have CT scans or MRI regardless of their DRG classification.

We found that the NHCDC data show far larger differences between the DRGs than our analysis of imaging costs indicates, particularly for RPAH and BLH (Figure 5.4). We believe that our costs are more reliable because we have used a consistent methodology to calculate them based on clinical information.
Figure 5.2  Average imaging costs for stroke patients – acute episode by DRG

![Bar chart showing average imaging costs for stroke patients by DRG.]

**Note:** Patients with a diagnosis of transient global amnesia are excluded.

**Source:** IPART analysis using data from hospital imaging services.

Figure 5.3  Average imaging costs for stroke patients by DRG – day of admission

![Bar chart showing average imaging costs for stroke patients by DRG and day of admission.]

**Note:** Patients with a diagnosis of transient global amnesia are excluded.

**Data source:** IPART analysis using data from hospital imaging services.
Figure 5.4 NHCDC imaging costs for stroke patients by DRG – acute episode

![Image of bar chart showing imaging costs by DRG for stroke patients]

<table>
<thead>
<tr>
<th>DRG</th>
<th>RPAH</th>
<th>GH</th>
<th>RNSH</th>
<th>BLH</th>
<th>JHH</th>
</tr>
</thead>
<tbody>
<tr>
<td>B70A</td>
<td>$1,286</td>
<td>$671</td>
<td>$307</td>
<td>$200</td>
<td>$400</td>
</tr>
<tr>
<td>B70B</td>
<td>$1,286</td>
<td>$671</td>
<td>$200</td>
<td>$600</td>
<td>$800</td>
</tr>
<tr>
<td>B70C</td>
<td>$1,286</td>
<td>$671</td>
<td>$200</td>
<td>$800</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

*Note:* Patients with a diagnosis of transient global amnesia are excluded.

*Source:* Provisional cost data 2008/09, NHCDC.

**Box 5.2 Our approach to estimating imaging costs**

We did not use a bottom-up costing approach to calculate imaging costs. Instead, we used detailed information from imaging services on the number and type of tests performed, the time and date. We use data for ‘acute’ episodes in 2008/09. As a proxy for cost, we attribute a value based on the Medicare Benefits Schedule (MBS). Each test is valued at 100% of the MBS fee.

More information is included in Chapter 11 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*

**5.3 Pathology costs**

Table 5.5 shows the value we have attributed for pathology costs for stroke patients. Our methodology for calculating these costs is explained in Box 5.3.

We found a far higher degree of consistency in the hospitals’ use of pathology for diagnostic purposes than reflected in the NHCDC. In particular, the NHCDC pathology costs for RPAH and BLH (both of which are in the Sydney South West Area Health Service) are significantly higher than both our estimated pathology costs and the other hospitals’ NHCDC costs. We believe that our costs better reflect the different usage patterns of pathology because we have used a consistent methodology to calculate them, based on clinical information.
Table 5.5  Average pathology costs for stroke patients

<table>
<thead>
<tr>
<th></th>
<th>B70A catastrophic</th>
<th>B70B severe</th>
<th>B70C(^a) not catastrophic or severe</th>
<th>DRGs B70A, B70B and B70C(^a) average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute episode</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>RPAH</td>
<td>668</td>
<td>339</td>
<td>299</td>
<td>392</td>
</tr>
<tr>
<td>GH</td>
<td>713</td>
<td>353</td>
<td>263</td>
<td>440</td>
</tr>
<tr>
<td>RNSH</td>
<td>965</td>
<td>550</td>
<td>400</td>
<td>594</td>
</tr>
<tr>
<td>BLH</td>
<td>1,002</td>
<td>415</td>
<td>264</td>
<td>634</td>
</tr>
<tr>
<td>JHH</td>
<td>586</td>
<td>273</td>
<td>217</td>
<td>352</td>
</tr>
<tr>
<td>Day of admission</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>RPAH</td>
<td>154</td>
<td>94</td>
<td>87</td>
<td>104</td>
</tr>
<tr>
<td>GH</td>
<td>110</td>
<td>98</td>
<td>77</td>
<td>95</td>
</tr>
<tr>
<td>RNSH</td>
<td>193</td>
<td>124</td>
<td>123</td>
<td>142</td>
</tr>
<tr>
<td>BLH</td>
<td>102</td>
<td>75</td>
<td>74</td>
<td>87</td>
</tr>
<tr>
<td>JHH</td>
<td>77</td>
<td>66</td>
<td>65</td>
<td>69</td>
</tr>
<tr>
<td>NHCDC (acute episode, direct and indirect costs)</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>RPAH</td>
<td>2,216</td>
<td>1,158</td>
<td>479</td>
<td>1,175</td>
</tr>
<tr>
<td>GH</td>
<td>749</td>
<td>379</td>
<td>276</td>
<td>471</td>
</tr>
<tr>
<td>RNSH</td>
<td>898</td>
<td>512</td>
<td>370</td>
<td>561</td>
</tr>
<tr>
<td>BLH</td>
<td>1,610</td>
<td>838</td>
<td>384</td>
<td>1,097</td>
</tr>
<tr>
<td>JHH</td>
<td>1,000</td>
<td>457</td>
<td>246</td>
<td>572</td>
</tr>
</tbody>
</table>

\(^a\) Our costs exclude 34 patients with transient global amnesia. The NHCDC costs include these patients.

Source: IPART analysis using data from hospital pathology services and final NHCDC cost data, 2008/09.
Figure 5.5  Comparison of pathology costs for stroke patients per acute episode

<table>
<thead>
<tr>
<th>Hospital</th>
<th>IPART</th>
<th>NHCDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPAH</td>
<td>$392</td>
<td>$1,175</td>
</tr>
<tr>
<td>GH</td>
<td>$440</td>
<td>$1,097</td>
</tr>
<tr>
<td>RNSH</td>
<td>$594</td>
<td>$634</td>
</tr>
<tr>
<td>BLH</td>
<td>$617</td>
<td>$572</td>
</tr>
<tr>
<td>JHH</td>
<td>$561</td>
<td>$471</td>
</tr>
</tbody>
</table>

Note: Average for DRGs B70A, B70B and B70C excluding patients with a diagnosis of transient global amnesia.
Source: IPART analysis using data from hospital pathology services and final NHCDC cost data, 2008/09.

Box 5.3  Our approach to estimating pathology costs

We did not use a bottom up costing for pathology. Instead, we attributed a value for pathology tests based on internal billing data between the hospitals and the pathology services. We also used information on the time and date of tests.

Charging arrangements at each hospital are similar, but are not identical. All pathology services base their charges on the Medicare Benefits Schedule.

More information is included in Chapter 12 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*
6 Configurations of care

The term ‘configurations of care’ refers to the way that hospitals choose to manage and provide patient care, including their clinical practices. The particular configurations of care within a hospital can be influenced by a complex array of factors, including national or state-wide guidelines or protocols, the culture, practices and controls of the individual hospital, the culture and practices of each clinical unit and its leadership and the preferences of each clinician. Differences in the way hospitals manage and provide patient care can also lead to differences in the costs and outcomes of that care.

During our hospital visits, we identified and obtained information on 5 major differences in the way the study hospitals managed and provided care for stroke patients. These comprise differences in:

- Arrangements with the NSW Ambulance Service to minimise delays.
- How effectively the emergency departments worked to minimise delays.
- The administration of clot-dissolving medication (tPA).
- The use of surgery to remove clots.
- The way rehabilitation is organised.

We found that JHH and GH have bypass arrangements with NSW Ambulance Service to deliver some stroke patients to the stroke unit with minimum delay. The other hospitals do not have such arrangements.

We found that there may be delays in getting patients to the stroke unit at RPAH and RNSH due to the absence of protocols with NSW Ambulance Service for stroke patients, as well as road congestion. Also, the emergency department at RPAH is very busy.

JHH and GH have higher rates of tPA administration than any of the other study hospitals. The use of tPA for stroke is however a relatively new medical approach which is not universally accepted because it carries a risk of complications due to bleeding. Only RPAH and RNSH remove blood clots surgically.
Finally, we found that there were differences in the way hospitals arrange rehabilitation services for patients that need it. At BLH, almost all rehabilitation occurs on-site, beginning in the acute ward. The other hospitals transfer most or all their patients to other facilities for rehabilitation. Shortages of places in these rehabilitation facilities can lead to longer than necessary stays in acute wards.

The sections below discuss our findings on differences in configuration of care in more detail, after a brief discussion about the role and function of the stroke units.

### 6.1 Stroke units

Stroke units provide specialised clinical care to stroke patients in the acute phase of the disease. This care is provided by a combination of medical, nursing and allied health staff, such as physiotherapists, speech therapists and occupational therapists. NSW Health has established stroke units in a number of the major hospitals. There are currently 23 stroke units in NSW.34

Each of the study hospitals has a stroke unit. The stroke units at RPAH, JHH and GH are open at all hours, while the stroke units at RNSH and BLH are open only during working hours, Monday to Friday.

### 6.2 Rapid notification and bypass protocols with NSW Ambulance Service

Stroke is a medical emergency. It is important for people who have had a stroke or who are suspected of having a stroke to get to a hospital as soon as possible. Delays in getting to a hospital narrow the treatment options and result in more serious brain damage. The ambulance service plays a critical role in the care of stroke patients.

JHH and GH have introduced rapid notification protocols with the NSW Ambulance Service. When a patient is suspected of having had an ischaemic stroke less than 2 hours ago, the ambulance service notifies the stroke unit, bypasses local hospitals and the emergency department and takes the patient directly to the stroke unit. JHH and GH have also used the media to actively communicate to the community the need to get to hospital as soon as possible after a suspected stroke.

None of the other hospitals have rapid notification or emergency department bypass protocols with the NSW Ambulance Service, and delays occur in getting patients to the stroke units.

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Clinicians at RPAH believe there is a lack of a system between the hospitals and the NSW Ambulance Service to coordinate the rapid transfer of stroke patients. They observed that ambulances often take suspected stroke patients to other hospitals instead of RPAH. Ambulances may be diverted to other hospitals due to congestion on the roads, or sometimes because RPAH’s emergency department is very busy. We understand that this type of networking arrangement has been established for patients with heart attacks that require emergency cardiac stenting.

We believe that there is scope for the Sydney based hospitals to make better arrangements with the NSW Ambulance Service to deliver suspected stroke patients to the Stroke Units with minimum delay.

### 6.3 Emergency departments

As discussed in Chapter 3, the vast majority of stroke patients are emergency admissions, and most of these patients are admitted through the emergency department. The hospitals differ in how well the emergency department works to minimise delays.

We found that the emergency department at JHH works particularly well with the stroke unit to minimise delays. The emergency department at GH also works well. As discussed above, some suspected stroke patients at both of these hospitals bypass the emergency department and are admitted directly to the stroke unit. This both saves time and reduces the possibility of communication breakdowns.

At RNSH the stroke team is notified immediately if a suspected stroke patient arrives during standard working hours. Stroke unit staff will then go to the emergency department to do the assessment.

RPAH has a very busy emergency department, and this may cause delays for stroke patients who might be eligible for tPA treatment. These delays arise mainly because ambulances are sometimes redirected to other hospitals when RPAH’s emergency department is too busy.

We understand that senior clinicians at BLH have differences of opinion regarding the risks and benefits of using tPA for stroke. This may be a factor limiting the use of this treatment option.

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35 Some patients who are transferred from other hospitals are admitted as planned patients.
6.4 Use of Tissue Plasminogen Activator (tPA)

Tissue Plasminogen Activator (tPA) is a drug that is used to dissolve blood clots. It is used to treat ischaemic strokes (i.e., strokes caused by blood clots), and must be intravenously administered within 3 hours of the onset of a stroke. It can significantly reduce the amount of damage to the brain, leading to an earlier discharge and less loss of function. However, treating stroke with tPA carries a risk of complications due to bleeding. Some clinicians consider that the potential benefits of tPA are outweighed by the risk of bleeding. The use of tPA requires careful management by specialist staff, and involves a series of protocols such as a CT scan to confirm type of stroke, knowing the amount of time that has elapsed since the onset of the stroke, and patient monitoring. The drug has been used to treat heart attacks for many years, but has only more recently been used to treat stroke.

Treatment with tPA is not coded, so we did not have accurate data on the rate of tPA administration in the study hospitals. Instead, we relied on estimates provided by the hospitals.

JHH and GH provided tPA treatment to about 12% to 14% of stroke patients, compared with roughly 5% of patients at RPAH and RNSH. The high rate of tPA administration at JHH and GH was possible because more patients reached the stroke unit within the required time frame, partly as a result of the rapid notification and bypass protocols with NSW Ambulance Service. Less congested roads in these areas may also make it easier to get suspected stroke patients to hospital in time.

BLH had the lowest rate of tPA administration. One reason for this is that the treatment requires specialist staff to assess the patients and initiate treatment, and there was only 1 staff specialist willing and able to take on this role. We also found that there was not universal acceptance of tPA for stroke in the emergency department. In this context, it is interesting to note that BLH had the highest proportion of cases with the most severe complications or comorbidities (i.e., in DRG B70A). As discussed in Chapter 3, it is possible that the rate of tPA administration is a factor in this but we could not examine this possibility because tPA administration is not coded as a procedure in the hospital data set.

Given the importance of timing in the administration of tPA, we believe that it might be worth investigating whether it is useful (and possible) to combine NSW Ambulance Service data on response time with hospital patient data. This will help to monitor how the NSW Ambulance Service and hospitals are working together to minimise delay. It will also provide useful data for outcome indicators.

36 Research is still being conducted on the exact timeframe for tPA administration.
39 TPA was approved for ischemic strokes by the Food and Drug Administration (USA) in 1996 American Heart Association, (http://www.americanheart.org/presenter.jhtml?identifier=4751).
6.5 Clot retrieval

Another treatment method is to remove the clot mechanically. This is done by passing a wire into the clot through the blood vessels and pulling it out, using imaging technology to guide the procedure (i.e., interventional radiology). Clot retrieval is suitable for only a very small number of patients, depending on the size and severity of the stroke and how accessible the clot is. The window for treatment is longer than for tPA administration. However, there is a risk that this procedure could damage the blood vessel walls. It is also a more resource intensive procedure than administering tPA intravenously.\(^\text{40}\)

Only RNSH and RPAH do clot retrieval. RNSH does more than any other stroke unit in NSW.

6.6 Rehabilitation

The hospitals have different arrangements for providing rehabilitation. BLH undertakes most rehabilitation on site, beginning in the acute ward as soon as possible after the stroke. Patients are later transferred to a rehabilitation ward within the hospital. JHH transfers some patients to a residential ward within the hospital as part of rehabilitation. The other hospitals transfer their patients to other facilities for rehabilitation. For example, RNSH transfers patients to Greenwich or Ryde Rehabilitation facility or private facilities; RPAH frequently transfers patients to Balmain Hospital and GH sends patients to rehabilitation beds at Wyong Hospital or transitional beds at Woy Woy.

BLH provides a significant amount of rehabilitation care while patients are still in an acute ward. A specialist at one of the other study hospitals commented that he would like rehabilitation physicians to provide some services during the acute phase, because some patients are not discharged to a rehabilitation facility and therefore miss out on formal rehabilitation.

During the hospital visits, clinicians at RPAH, RNSH and GH all commented that there is a shortage of rehabilitation places. This leads to patients spending more time in the acute wards while waiting for a place, increasing the length of stay and reducing the number of acute beds available.

A specialist at RPAH believes that a significant component of rehabilitation could be provided in the home, if resources were shifted to this setting. This could be very cost effective, and could both reduce the pressure on rehabilitation facilities and free up beds in the acute wards. We recommend that NSW Health investigates the possibility of providing more rehabilitation care in the home setting.

Table 6.1 shows the proportion of patients in each DRG that were transferred to other hospitals or facilities in 2008/09. Transfers out were sometimes for specialised treatment, for example GH and JHH sometimes transferred patients to RNSH after initial treatment. However, for our study hospitals the majority of transfers were for rehabilitation. BLH transferred a very small proportion of its patients to other hospitals, reflecting their on-site rehabilitation. The other hospitals transferred far higher proportions of stroke patients to other facilities than BLH.

Table 6.1 Percentage of stroke patients transferred to another hospital - DRGs B70A and B70B

<table>
<thead>
<tr>
<th></th>
<th>DRG B70A</th>
<th>DRG B70B</th>
<th>DRG B70C</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPAH</td>
<td>45</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>GH</td>
<td>26</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>RNSH</td>
<td>28</td>
<td>36</td>
<td>23</td>
</tr>
<tr>
<td>BLH</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>JHH</td>
<td>15</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>All hospitals</td>
<td>22</td>
<td>20</td>
<td>16</td>
</tr>
</tbody>
</table>

Recommendation

6 That NSW Health arranges for appropriate clinical expert groups to consider the costs and benefits of providing more rehabilitation care in the home.
7 Outcome, safety and quality indicators

The terms of reference for this study required us to analyse available data on differences in clinical outcomes across the 5 study hospitals. However, while there are a number of safety and quality indicators being collected locally, at the state level and through clinical registries, there are few clinically agreed outcome indicators. As such, we found that data on only a few indicators of clinical outcomes are collected consistently across hospitals, or on a state-wide (or national) basis. Therefore, we worked with clinical experts to establish a set of outcome, safety and quality indicators that are clinically relevant, and for which we could feasibly obtain data in the timeframe for our study.

The sections below set out the clinical indicators we selected for stroke, discuss the indicator that we obtained from NSW Health (6-month survival rate), and show what data is available from the National Stroke Research Institute. We found that there were no statistically significant differences between the study hospitals’ risk-adjusted 6-month survival rates.

7.1 How we developed a set of clinical indicators

To identify the indicators we should focus on for this study, we worked with a number of eminent clinicians on our Clinical Reference Group\(^{41}\) to develop a set of outcome indicators. We also consulted clinicians in study hospitals and sought further advice from clinicians with specific expertise in the fields of interest, as well as other relevant organisations.

Essentially, we aimed to establish a list of indicators that were:

- widely accepted as being clinically appropriate
- likely to be available from NSW hospitals, the NSW Department of Health or other bodies, such as registries, and
- feasible for IPART to collect or calculate.

\(^{41}\) In the early stages of the review, our Clinical Reference Group comprised Professor Bruce Barraclough, Professor Clifford Hughes, Dr Michael Nicholl, Professor Ron Penny and Dr Hunter Watt. A number of other clinicians were consulted as part of this process.
Following this clinical consultation, we established the set of indicators discussed in section 7.3 below. Some of these indicators are not true outcome indicators, but are safety and quality or process indicators. We were not able to obtain data for all of these indicators.

### 7.2 Analysing indicators and risk-adjusting for patient characteristics

It’s important to recognise that hospitals’ performance against many outcome indicators is not simple to interpret and, when considered in isolation, can be misleading. Therefore, this performance needs to be analysed within the appropriate context.

In addition, hospitals treat patients with different mixes of illnesses, which can influence the likelihood of adverse outcomes at the hospitals. To make meaningful and fair comparisons of the performance of the study hospitals on some outcome indicators, the analyses were risk-adjusted for factors outside the control of the hospitals (ie, differences in patient characteristics – see Box 7.1).

Appendix B provides further details for the risk-adjusted indicator provided by NSW Health, including the data sources used, the relevant time period for the data and the adjustment factors applied.
**Box 7.1 How data on indicators was risk-adjusted for differences in patient characteristics**

To meaningfully compare the performance of the study hospitals on some outcome indicators, the hospitals’ data on these indicators needed to be risk-adjusted to account for differences in patient characteristics that can influence the likelihood of adverse outcomes. In particular, NSW Health adjusted data on survival rates for the following patient characteristics:

- age
- sex
- comorbidity, and
- socio-economic status.\(^a\)

To adjust for comorbidity, NSW Health used the Charlson index. This index simplifies the wide range of comorbidities that may affect patients. It groups clinical conditions together (using ICD 10), and assigns numerical weights (eg, 1, 2, 3) to them, based on the risk of dying associated with the condition.\(^b\) Adding together the numerical weights for a patient’s comorbidities determines the patient’s combined Charlson index score, and therefore the severity of their comorbidities.

To make these adjustments, NSW Health used logistic regression in SAS 9.2. Where there were sufficient numbers, it took repeated measures for the same person into account using multi-level modelling. Where the number of events was too low to allow the above adjustment to be carried out in full, the degree of adjustment was reduced and this was noted for each indicator.

\(^a\) The ABS Index of Relative Socio-Economic Disadvantage (IRSD) was used to estimate socio-economic status. The IRSD was assigned at Local Government Area level and grouped into quintiles from least disadvantaged to most disadvantaged for analysis.

7.3 List of clinical indicators for stroke and their availability

Table 7.1 lists the 12 indicators we selected for stroke. These indicators relate to actual care processes or outcomes of care. The table also shows what indicators are available from the National Stroke Research Institute or NSW Health. One indicator was available from NSW Health, namely the risk adjusted 6-month survival rate.

Table 7.1 Clinical indicators for stroke and data availability

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>6 month survival rates (risk adjusted)</td>
<td>Yes – data provided by NSW Health (see Appendix B)</td>
</tr>
<tr>
<td>2.</td>
<td>Access to a geographically defined stroke care unit with stroke services provided by a coordinated multidisciplinary team</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>3.</td>
<td>Stroke pathway utilisation</td>
<td>No – not collected by NSRI</td>
</tr>
<tr>
<td>4.</td>
<td>CT/MRI scan within 12 hours of arrival at hospital</td>
<td>No – collected for within 24 hours (not 12 hours) (would need to recalculate)</td>
</tr>
<tr>
<td>5.</td>
<td>Patients admitted with a diagnosis of ischaemic stroke who receive thrombolysis</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>6.</td>
<td>Patients admitted with diagnosis of stroke who receive aspirin within 48 hours</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>7.</td>
<td>Swallowing ability within 24 hours of arrival at hospital</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>8.</td>
<td>Patients admitted with a diagnosis of stroke who are discharged on anti-platelet/anti-thromboembolytic agents</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>9.</td>
<td>Patients admitted with a diagnosis of stroke who have a FIM Score recorded at discharge from hospital</td>
<td>No – not collected by NSRI</td>
</tr>
<tr>
<td>10.</td>
<td>Patients admitted with a diagnosis of stroke who have a Modified Rankin Score recorded at discharge from hospital</td>
<td>Yes – available from NSRI</td>
</tr>
<tr>
<td>11.</td>
<td>Average number of days patient admitted with diagnosis of stroke spent at home in first 90 days post stroke</td>
<td>No – not collected by NSRI</td>
</tr>
<tr>
<td>12.</td>
<td>People returning to usual place of residence following hospital treatment – percentage</td>
<td>Yes – available from NSRI</td>
</tr>
</tbody>
</table>

7.3.1 Data collected by the National Stroke Research Institute

We approached the National Stroke Research Institute (NSRI) to help us collect the data for these indicators. The NSRI confirmed that they have most of the required data from their audit programs. However, we needed permission from the National Stroke Foundation and/or the hospitals to gain access to the data. We were unable to obtain the data on time for our study, and recommend that NSW Health pursue collection of the data from NSRI. We also collected any indicators that were available from NSW Health.
Recommendation:

7. That NSW Health pursues the collection of the data on outcome indicators from the National Stroke Research Institute.

### 7.3.2 6-month survival rates

This indicator measures the survival rate for patients within 6 months of a stroke.

NSW Health provided survival data and survival rates for stroke patients for the 5 hospitals and calculated and provided risk-adjusted odds ratios for these rates using the method set out in Box 7.2.

NSW Health risk-adjusted each hospital’s survival data for patient age, sex, comorbidities (using the Charlson index) and socio-economic status using the approach set out in Box 7.1.

In the 3-year period 2005/06 to 2007/08, there were 5,408 hospital admissions for the 5 hospitals for stroke. The overall crude 6-month survival rate was 726.9 per 1,000. There were no statistically significant differences in risk-adjusted survival rates between the 5 hospitals.
Box 7.2 Calculating survival rates

The NSW Department of Health’s Centre for Epidemiology and Research calculated risk-adjusted odds ratios for survival for patients treated in each study hospital in the stroke case study area, using the methodology outlined below. We note that the NSW Department of Health does not usually undertake this type of analysis.

Data sources

The analysis for mortality and survival, apart from in-hospital mortality, was carried out using linked records of the NSW Admitted Patient Data Collection (APDC) and NSW Registry of Births, Deaths and Marriages death registration data. The analysis for in-hospital mortality was carried out using linked records of the APDC. In-hospital deaths and deaths from all causes were included for all relevant indicators.

Case-based analysis

As one person may have more than one admission for a specified condition, the analyses were ‘case-based’, where a case represents a hospital admission for a specified condition. This means that, for example, if a person died after 2 hospital admissions for a specified condition and the death occurred within the period specified by the indicator, then the case and therefore the death would be counted twice.

Adjusting for risk and comparing hospitals

Indicators were adjusted for patient age, sex, comorbidity and socio-economic status as described in Box 7.1.

Hospitals that were not significantly different in the adjustment model (at p<0.05) were grouped.
Box 7.3 Risk-adjusted odds ratios

Risk-adjusted odds ratios were calculated for hospitals in order to highlight differences in rates between the hospitals.\(^a\) The ‘odds ratio’ is the ratio of the odds of an event occurring at one hospital to the odds of it occurring at another hospital.\(^b\)

If the odds ratio between two hospitals is:

- \(1\) – the event is equally likely to occur at both hospitals
- \(>1\) – the event is more likely to occur at the first hospital
- \(<1\) – the event is less likely to occur at the first hospital.

As an example, assume Hospital A has 15 infections and Hospital B has 10 infections, out of 1,000 patients at each hospital. The odds of infection at Hospital A and Hospital B are 15/985 and 10/990 respectively. The odds ratio of infection between Hospital A and Hospital B is \((15/985) / (10/990)\) or 1.51. This odds ratio indicates that the odds of infection at Hospital A are around 50% higher than at Hospital B.

\(^a\) Odds ratios are widely used in medical literature to examine the effects of other variables on the relationship between two binary variables, using logistic regression (J Bland “The odds ratio”, British Medical Journal, 320, 2000, p 1468; S Simon “Understanding the Odds Ratio and the Relative Risk”, Journal of Andrology, 22 2001, p 533). The odds ratios were risk-adjusted for patient characteristics using the approach discussed in Box 7.1.

\(^b\) The ‘odds of an event occurring’ is equal to the probability that the event occurs divided by the probability that it does not occur.
Appendix
Outcome, safety and quality indicators

IPART

Case study 6 – Stroke
A Full list of recommendations from main report

Consistency of DRG groupings

Our recommendations in this area are mainly aimed at making users of hospital data aware of some of the limitations of using DRG groupings for hospital comparisons in certain clinical areas.

1. That users of hospital cost and outcome data note that DRGs may contain a range of patient types with varying clinical resource requirements, costs of care and expected clinical outcomes. Therefore DRGs may not always provide the optimal basis for comparing costs and outcomes among hospitals.

2. In light of Recommendation 1, that the NSW Department of Health, and other health research bodies at both the state and national level, consider whether DRGs are a suitable basis for determining funding and comparing performance among hospitals (for various different types of hospital activity). Where they are not suitable, continue research to develop better approaches for these areas.

Consistency of patient numbers

Our recommendations on patient numbers are aimed at making users of hospital data aware of differences in patient counting practices and patient datasets between hospitals that can affect hospital comparisons, to improve consistency of patient counting practices between hospitals and lead to better integration of patient datasets.

3. That users of hospital data note that there are differences in practices relating to counting of patients that can affect hospital patient numbers and average cost comparisons eg, counting differences relating to admission status, billing status, location of care and collaborative care arrangements.

4. In light of Recommendation 3, that NSW Health clarifies and standardises administrative procedures including guidelines for recording of non-inpatients of various types, as well as ‘collaborative care’ patients.

5. That NSW Health considers ways of better integrating patient information held locally by hospital clinical units (such as eye clinics and cardiac catheter labs) with the HIE data set.
**Consistency of lengths of stay**

Our recommendations aim to improve consistency between hospitals on length of stay measures, and to make users of hospital data aware of the limitations of measures based on ‘acute episodes’.

6 That NSW Health monitors hospital practices relating to the classification of episodes into care types and type-changing practices (eg, timing of type changes from acute to rehabilitation care) and provide clear and consistent guidelines to hospitals, so episode measures are more consistent among hospitals.

7 That users of hospital data note that 'acute episodes' often only represent a part of a patient’s hospital stay. Therefore, comparisons among hospitals using acute length of stay measures or acute costs may produce misleading results. This is particularly important for conditions that involve both acute and sub-acute care and/or transfers between facilities.

**Coding**

We have made recommendations aimed at improving the quality of medical records documentation and clinical coding in hospitals to both improve the quality of data for clinical research as well as to more accurately reflect casemix complexity.

8 That NSW Health should continue to improve the quality of medical record documentation and the accuracy and consistency of coding.

9 That hospitals should encourage consistent education on coding and facilitate communication between clinical staff and coders regarding both the coding process and the documentation required to code common clinical conditions, diagnoses or complications, such as AMI, angina and chest pain.

10 Where pathology test information can be readily extracted (eg, Cerner sites), that systems be developed so this information can be used to validate coding and support work on variation in clinical practice and measuring clinical quality.

11 That NSW Health considers undertaking further analysis to identify pathology or imaging tests that can be used to help target audits of coding and support work on variation in clinical practice and measuring clinical quality – such as identifying types of pathology tests that correspond closely with diagnosis coding.
Clinical costing

Our recommendations are aimed at improving the quality and consistency of clinical costing data, and helping to ensure that quality costing data and clinical inputs to the costing process (such as data from prosthesis, pathology and imaging systems) can be used to inform hospital management about resource use, and clinicians about clinical practice.

12 That the NSW Department of Health works with the area health services and hospitals to apply a consistent set of rules for clinical costing covering cost centres and IFRACs so that data are consistent and comparable between the hospitals.

13 That NSW Health regularly auditors the accuracy of cost centres and IFRACs used for clinical costing.

14 That NSW Health uses standard clinical data feeds (actual patient data) for clinical costing where this is feasible and useful.

15 That the data used for clinical costing purposes be available to hospitals and clinicians so they can undertake comparative analysis on clinical practices and performance.

Medical staff costs

Given our finding that there was a lack of consistency in the treatment of medical staff costs and the difficulty this created in estimating medical staff costs for our case study areas, we recommend:

16 That further work be undertaken to strengthen the quality and consistency of available information on medical staff costs.

Prosthesis costs

Our recommendations on prosthesis costs are aimed at improving prosthesis purchasing and making cost savings in this area. These should be considered in conjunction with our recommendation that clinical experts should review the appropriateness of clinical variation in prosthesis use and address this variation (see Recommendation 31).

17 That NSW Health notes the variation in prosthesis use among the study hospitals including:

- drug-eluting stents versus bare metal stents
- single chamber pacemakers versus dual chamber pacemakers
- different types of components for hip replacement procedures.

18 That NSW Health notes the range of approaches to prosthesis controls and the variation in prices currently paid for prosthesis, including for exactly the same models.
19. That NSW Health facilitates sharing of information on purchase prices for prostheses to assist price negotiations with suppliers.

20. That NSW Health optimises prosthesis cost savings through tenders, supplier price agreements and controlled approaches to prosthesis purchasing, noting that clinical consultation and cooperation is essential as is retaining some flexibility to allow for special orders when clinically indicated.

**Imaging and pathology costs**

Our recommendations are aimed at encouraging better use of imaging and pathology data, and consideration of whether there should be standard treatment of imaging and pathology within clinical costing and whether internal charges should reflect actual costs. These recommendations should be considered in conjunction with our clinical case studies, which include comparisons of imaging use, and Recommendation 31, relating to clinical variation in imaging use for diagnosing appendicitis.

21/25 That NSW Health notes that imaging and pathology data can be used to monitor changes in imaging use and inform clinical practice, and that:

- All hospitals obtain detailed reports from pathology and imaging services on their test ordering patterns, including the number of tests by major test type and the cost of these tests.

- Hospitals routinely provide data to heads of clinical units to help inform them on resource use and provision of care to improve patient outcomes and discuss trends at management meetings – for example, summary reports that include both the number of tests by test type, and the value (or preferably cost) of these tests.

- NSW Health develops reports comparing the use of imaging and pathology tests for clinical groupings and circulates these to area health services and hospitals.

22. That NSW Health considers whether, for clinical costing purposes, it is appropriate for hospitals and area health services to base the value of imaging tests on the MBS rate for these tests and, if so, what standard percentage of this rate is appropriate for use by all hospitals given the actual costs of providing the test.

23. That NSW Health seeks to obtain detailed information from the pathology services on the number and type of tests and the actual cost of undertaking a range of typical tests for future comparisons of pathology costs.

24. That NSW Health addresses issues that prevent the actual costs associated with specific pathology tests and ordering patterns being disclosed by pathology services.

26. That NSW Health considers whether the detailed cost estimates that pathology services prepare as part of the benchmarking pathology project could be used for more accurate pricing between pathology services and hospitals, to enable clinicians to consider the actual cost of their clinical decisions.
Operating theatre costs

Our recommendations in relation to operating theatres aim to facilitate improvements in theatre management arrangements, and the quality and consistency of theatre data.

27 That NSW Health notes the differences in approaches to theatre management among hospitals and consider if there is scope to share information about how the better theatre arrangements are organised.

28 That NSW Health notes the issues regarding theatre data and work with the hospitals to improve the completeness of datasheets and apply a consistent set of rules for recording operating theatre times.

29 That NSW Health considers routine auditing of the quality of data on returns to theatre and considers the best way for achieving accuracy and consistency in this indicator.

Pharmacy costs

As we were not able to undertake a detailed comparison of pharmacy services and costs, our recommendations focus on encouraging further analysis in this area.

30 That NSW Health:

– Notes the wide variation in the proportion of drugs dispensed versus held on imprest across the study hospitals.

– Monitors the value of expired pharmacy stock and compares this among hospitals.

– Considers standardised guidelines for the return of unused medication, principally to ensure patient safety but also to minimise wastage and reduce costs.

– Considers whether antimicrobial stewardship programs should be implemented at the major hospitals where such programs are not currently in place. The purpose of these programs would be to help prevent antimicrobial resistance and reduce costs by preventing inappropriate use of antimicrobials.
Configurations of care – Review of clinical variations during Stages 5 and 6 of the wider NSW Department of Health study

Our case studies identified a number of differences in the way care is provided among study hospitals in specific clinical areas. We recommend that clinical experts consider these clinical differences or clinical issues as part of Stages 5 and 6 of the wider health study. This recommendation should be dealt with in conjunction with Recommendation 36, relating to variation in indicators of safety, quality and outcomes.

31. That NSW Health arranges for appropriate clinical expert groups to consider the following clinical issues identified in our case studies; and that where appropriate, NSW Health and the expert groups take steps to address clinical differences.

- Hip joint replacement:
  - Note that separation of planned and emergency cases may reduce lengths of stay for planned (arthritis) cases.
  - Address the variation in the selection of hip prosthesis components (including press fit, cementless hip stems versus cemented hip stems and ceramic femoral heads versus metal femoral heads) among study hospitals.

- Major chest procedure:
  - Note the different clinical pathways and high day of surgery admission rates for thoracic surgery patients at RPAH compared with other study hospitals.
  - Consider whether aspects of the model of care at RPAH are suitable to be used in other hospitals.

- Breast surgery:
  - Note the early discharge models at RNSH for breast surgery patients having mastectomies and
  - Consider whether such models should be followed more widely in NSW hospitals and the types of patient cases they should be used for (eg, simpler, unilateral cases or younger patients).

- Cholecystectomy:
  - Note the variation in the proportion of patients with cholelithiasis or cholecystitis who are operated on acutely as emergency admissions.
  - Consider whether this variation has significant quality of care implications.
  - Consider the relative costs and benefits of an emergency surgical services team model for ensuring early diagnosis and treatment of conditions like cholecystectomy and whether it should be more widely applied.
  - Note that costing of cholecystectomy should take into account the costs of prior related emergency department attendances. A similar approach should be adopted for other clinical conditions that are likely to involve multiple prior emergency department attendances.
Consider the relative costs and benefits of cholecystectomies with and without the use of fluoroscopy.

- **Appendicectomy**
  - Consider the variation in the use of imaging tests for diagnosing appendicitis.
  - Consider establishing standard protocols for diagnosing appendicitis, indicating when it is appropriate to use CT scans, MRIs and ultrasounds.
  - As part of establishing standard protocols for diagnosing appendicitis, consider whether CT scans, MRIs and ultrasounds should only be used for certain patient groups (e.g., older patients who are more likely to be suffering from other conditions with symptoms similar to appendicitis).
  - Consider the relative costs and benefits of laparoscopic versus open surgery for appendicitis.

- **Stroke**
  - Consider ways to reduce the proportion of stroke patients coded with a principal diagnosis of 'stroke, not specified as haemorrhage or infarction' (ICD10 code I64).
  - Consider developing consistent guidelines for the administration of tPA.
  - Consider including tPA administration as a procedure in coding standards.
  - Consider ways to improve transfers of suspected stroke patients to stroke units with minimum delay, including consultation with the Ambulance Service and Emergency Departments.
  - Investigate whether it is useful and possible to combine Ambulance Service data on response time with hospital patient data to monitor time from call to ambulance to arrival at an appropriate hospital.
  - Consider the costs and benefits of providing more rehabilitation care in the home.
  - Pursue the collection of the data on outcome indicators from the National Stroke Research Institute.

- **Cardiology – Stents, Pacemakers and Defibrillators:**
  - Address the variation in the use of drug-eluting stents versus bare metal stents among study hospitals.
  - Address the variation in the types of pacemakers used among study hospitals.
  - Investigate whether there are differences in treatment procedures, or waiting times between presentation and procedure, for patients who present to hospitals without a 24 hour cardiac catheter laboratory, compared to patients who present to hospitals with a 24 hour cardiac catheter laboratory, and whether any differences in procedure or waiting times have implications for clinical outcomes.
- Consider ways of better integrating information held in cardiac catheter laboratories with the HIE data set.

- Tracheostomy or ventilation greater than 95 hours:
  - Note that at BLH, clinicians tend to perform surgical tracheostomies, whereas at the other hospitals, these are usually performed percutaneously.

- Cataract/lens procedure:
  - Assess the costs and benefits of toric lenses and develop guidelines for their use in public hospitals.

- Hysterectomy:
  - That any future studies of hysterectomy compare the costs and outcomes for hysterectomies with the costs and outcomes of other procedures such as endometrial ablation and uterine artery embolisation.

**Improving outcome, safety and quality indicators**

While current Commonwealth and State initiatives will improve outcomes data, we have made recommendations that will assist this process.

32 That NSW Health enhances understanding and use of mortality, survival, unplanned readmission and wound infection indicators and their risk adjustment by:

- continuing to contribute to the development of ACSQHC’s safety and quality standards for these indicators
- refining the methodology used for standardising or risk-adjusting these indicators
- continuing to consult with clinicians regarding the agreed presentation of mortality, survival unplanned readmission and wound infection information
- reporting this information on a more routine and regular basis consistent with ACSQHC data sets.

33 That NSW Health encourages hospitals to put in place systems to facilitate accurate coding of comorbidities and ensures that coding practices are consistent across hospitals.

34 That NSW Health works with ACSQHC to negotiate more streamlined arrangements for access to data held by third parties (such as clinical registries) for clinical analysis, and makes these data available to hospitals and clinicians.

35 That NSW Health explores the possibility of providing outcomes information to clinicians in a more systematic way as an aid to clinical improvement and a key indicator of performance.
Indicators of safety, quality or outcomes, - review of clinical variations during stages 5 and 6 of the wider NSW Department of Health project

We have also made a number of findings relating to variations in indicators of safety, quality or outcomes. Where we have observed apparent differences among hospitals, these should be considered by clinical expert groups in completing stages 5 and 6 of the Department of Health’s wider project. These differences should be considered in conjunction with differences in clinical practice (Recommendation 31).

36 That clinical expert groups consider the following clinical issues; and where appropriate, NSW Health and clinical expert groups take steps to address clinical variations as part of Stages 5 and 6 of the broader NSW Health review:

- Review the variations in outcome, safety and quality indicators among study hospitals, including their:
  o unplanned readmission rates
  o wound infection rates for selected surgical procedures.

- Review the variation in mortality and survival rates for all major chest surgery patients and consider whether to recommend changes to clinical practice or conduct further investigation involving:
  o a larger sample of hospitals, and
  o more detailed analyses for ‘like patients’ (ie, lung cancer, infection-related abscess/pyothorax and collapsed/punctured lung patients).

- Review the variation in the following clinical indicators for hip joint replacement surgery at the study hospitals:
  o wound infection rates
  o unplanned readmission rates.

- Review the variation in wound infection rates for appendicectomy and cholecystectomy surgery at the study hospitals.

- Note the variation in the following clinical indicators relating to obstetric delivery:
  o caesarean section rates for ‘selected primipara’
  o vaginal delivery rates following primary caesarean section
  o caesarean section rates after induction of labour for ‘selected primipara’
  o repeat caesarean section rates
  o significant tear rates

and monitor changes arising from the implementation of the NSW Health policy directive, Maternity – Towards Normal Birth in NSW, to determine whether this policy effectively addresses the variation.
**Additional outcome indicators**

We made recommendations to consider the costs and benefits of collecting data for the following areas where indicators are not commonly used.

37 That NSW Health considers the costs and benefits of collecting data and monitoring performance against the following indicators:

- warfarin management
- visual outcomes for patients undergoing lens procedures.

We also made a recommendation to develop a set of standard indicators for measuring care and/or outcomes in ICUs.

38 That NSW Health undertakes further work to develop a set of standard indicators for measuring care and/or outcomes in ICUs.

**Time Out audits**

Finally, we made a recommendation to improve consistency in the number of cases audited as part of the Time Out process relative to the number of separations.

39 That NSW Health specifies the number or proportion of patient cases that should be audited as part of the Time Out process.

**Next steps - wider application of this study**

40 That NSW Health refines and develops useful aspects of this study for application more widely to other hospitals, other health settings and other clinical conditions.
B  Risk-adjusted indicator provided by NSW Health

Table B.1 indicates the data sources and risk adjustment factors used for the risk-adjusted indicator provided by NSW Health.

Table B.1 Risk-adjusted indicator provided by NSW Health

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Data Source</th>
<th>Numerator &amp; denominator</th>
<th>Risk-adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6-month survival rates</td>
<td>Linked records of the APDC and RBDM death registration data. APDC records for 2005-06 to 2007-08 and deaths to 31/12/2008</td>
<td>Numerator-Number of deaths</td>
<td>Age, sex, comorbidity (Charlson index) and socioeconomic status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Denominator- Number of cases with the following DRGs: B70A, B70B, B70C, B70D.</td>
<td></td>
</tr>
</tbody>
</table>

Note: APDC - NSW Admitted Patient Data Collection. RBDM - Registry of Births, Deaths and Marriages. A case represents a hospital admission for a specified condition. DRG - Diagnosis Related Group v 5.1. Charlson index (see Box 7.1). Socioeconomic status (see Box 7.1).

Source: NSW Health.
<table>
<thead>
<tr>
<th>Term</th>
<th>Abb.</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% confidence interval</td>
<td></td>
<td>A statistical term describing a range of values within which we are 95% certain that the true population value lies.</td>
</tr>
<tr>
<td>Activity-based funding</td>
<td>ABF</td>
<td>Funding that is based on the projected amount and type of work of a facility, where standard prices are set for similar work undertaken. This has also been referred to as casemix or episode funding.</td>
</tr>
<tr>
<td>Acute care</td>
<td></td>
<td>Clinical services provided to admitted or non-admitted patients, including managing labour, curing illness or treating injury, performing surgery, relieving symptoms and/or reducing the severity of illness or injury, and performing diagnostic and therapeutic procedures. Most patients have acute or temporary ailments. The average length of stay is relatively short.</td>
</tr>
<tr>
<td>Admission</td>
<td></td>
<td>The process by which a person commences a period of residential care in a health facility.</td>
</tr>
<tr>
<td>Admitted Patient Data Collection</td>
<td>APDC</td>
<td>A database that covers all inpatient separations (discharges, transfers and deaths) from all Public (including Psychiatric), Private, and Repatriation Hospitals, Private Day Procedures Centres and Public Nursing Homes in NSW.</td>
</tr>
<tr>
<td>Agency for Clinical Innovation</td>
<td>ACI</td>
<td>A board-governed statutory health corporation that reports to the NSW Minister for Health and the Director-General of NSW Health.</td>
</tr>
<tr>
<td>Amnesia</td>
<td></td>
<td>A pathologic impairment of memory, usually the result of physical damage to areas of the brain.</td>
</tr>
<tr>
<td>Angiotensin-modifying medication</td>
<td></td>
<td>Medication that alters the blood pressure by changing the protein vessels (angiotensin) that causes increased blood pressure.</td>
</tr>
<tr>
<td>Antiplatelet medication</td>
<td></td>
<td>Medications that block the formation of blood clots by preventing the clumping of platelets.</td>
</tr>
<tr>
<td>Appendicectomy</td>
<td></td>
<td>Surgical excision of the patient’s appendix.</td>
</tr>
<tr>
<td>Assistant In Nursing</td>
<td>AIN</td>
<td>An employee that is not a registered nurse, enrolled nurse or trainee nurse, who assists the Enrolled Nurses and Registered Nurses by providing basic nursing care, working within a plan of care under the supervision and direction of a Registered Nurse.</td>
</tr>
<tr>
<td>Australian Council on Healthcare Standards</td>
<td></td>
<td>An independent organisation dedicated to improving the quality of health care through performance reviews, assessment and accreditation.</td>
</tr>
<tr>
<td>Term</td>
<td>Abb.</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Average length of stay</td>
<td>ALOS</td>
<td>The average number of days each admitted patient stays in hospital. This is calculated by dividing the total number of occupied bed days for the period by the number of actual separations in the period.</td>
</tr>
<tr>
<td>Bankstown-Lidcombe Hospital</td>
<td>BLH</td>
<td>One of the study hospitals included in the review.</td>
</tr>
<tr>
<td>Bureau of Health Information</td>
<td>BHI</td>
<td>An independent, board-governed organisation established by the NSW Government to be the leading source of information on the performance of the public health system in NSW.</td>
</tr>
<tr>
<td>Casemix</td>
<td></td>
<td>The range and types of episodes of care of patients (the mix of cases) treated by a hospital. This provides a way of describing and comparing hospitals and other services for planning and managing health care. Casemix classifications put patients into DRGs with similar conditions that use similar health-care resources, so that the activity and cost-efficiency of different hospitals can be compared.</td>
</tr>
<tr>
<td>Casemix funding</td>
<td></td>
<td>See Activity-based funding.</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td></td>
<td>Excision of the gallbladder.</td>
</tr>
<tr>
<td>Clinical Excellence Commission</td>
<td>CEC</td>
<td>A board-governed statutory health corporation with the CEO reporting directly to the NSW Minister for Health. A key role of the Clinical Excellence Commission is building capacity for quality and safety improvement in Health Services.</td>
</tr>
<tr>
<td>Clinical Nurse Specialist</td>
<td>CNS</td>
<td>A Registered Nurse/Midwife who applies a high level of clinical nursing knowledge, experience and skills in providing complex nursing/midwifery care directed towards a specific area of practice, a defined population or defined service area, with minimum direct supervision.</td>
</tr>
<tr>
<td>Clopidogrel</td>
<td></td>
<td>A drug that is used to prevent the formation of a blood clot in coronary artery disease.</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
<td>When a person has two or more health problems at the same time.</td>
</tr>
<tr>
<td>Computed tomography</td>
<td>CT scan</td>
<td>A non-invasive medical imaging method using X-rays and computer processing.</td>
</tr>
<tr>
<td>Diagnosis Related Group</td>
<td>DRG</td>
<td>A system used to classify hospital admissions into groups with similar clinical conditions (related diagnoses) and similar resource usage (hospital services). There are approximately 500 coding classes. In Australian acute hospitals, Australian refined DRGs are used (AR-DRGs). The classification categorises episodes into groups with similar conditions and similar usage of hospital resources, using information in the hospital morbidity record such as the diagnoses, procedures and demographic characteristics.</td>
</tr>
<tr>
<td>Endothelial proliferation</td>
<td></td>
<td>The process that causes restenosis, a narrowing of the blood vessel leading to restricted blood flow.</td>
</tr>
<tr>
<td>Enrolled Nurse</td>
<td>EN</td>
<td>A person holding an Enrolled Nurse qualification who works under the supervision of a Registered Nurse to provide nursing care for patients in hospitals, nursing homes and a variety of other health care organisations.</td>
</tr>
<tr>
<td>Episode funding</td>
<td></td>
<td>See Activity-based funding.</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td><strong>Abb.</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------------</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td></td>
<td>An imaging technique that provides real-time moving images of the internal structures of a patient through the use of a fluoroscope.</td>
</tr>
<tr>
<td>Gosford Hospital</td>
<td>GH</td>
<td>One of the study hospitals included in the review.</td>
</tr>
<tr>
<td>Haemorrhagic stroke</td>
<td></td>
<td>A stroke caused by lack of blood reaching the brain due to bleeding.</td>
</tr>
<tr>
<td>Health Information Exchange</td>
<td>HIE</td>
<td>A database maintained by the NSW Department of Health that contains a range of financial, patient and clinical information from hospitals and area health services.</td>
</tr>
<tr>
<td>High dependency unit</td>
<td>HDU</td>
<td>An area or environment in a hospital that provides a higher level of critical care and monitoring than is provided in a general ward, but a lower level of care provided by an intensive-care unit.</td>
</tr>
<tr>
<td>Hypotension</td>
<td></td>
<td>Decrease of systolic and diastolic blood pressure below normal, ie low blood pressure.</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td></td>
<td>Surgical removal of the uterus.</td>
</tr>
<tr>
<td>Independent Pricing and Regulatory Tribunal of NSW</td>
<td>IPART</td>
<td>The independent economic regulator for NSW that is undertaking this hospital study.</td>
</tr>
<tr>
<td>Inpatient fraction</td>
<td>IFRAC</td>
<td>A measure used in case mix costing. The proportion of total (or operating) costs that are attributed to admitted patients.</td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>ICU</td>
<td>An area or environment in a hospital that provides the highest level of critical care and monitoring.</td>
</tr>
<tr>
<td>International Normalised Ratio</td>
<td>INR</td>
<td>A comparative rating of a patient’s prothrombin time (PT) ratio. It is used as a standard for monitoring the effects of the blood thinning drug warfarin.</td>
</tr>
<tr>
<td>Ischaemic stroke</td>
<td></td>
<td>A type of stroke where blood supply to a part of the brain is decreased often due to atherosclerosis or a blood clot.</td>
</tr>
<tr>
<td>John Hunter Hospital</td>
<td>JHH</td>
<td>One of the study hospitals included in the review.</td>
</tr>
<tr>
<td>Length of stay 1</td>
<td>LOS1</td>
<td>LOS1 is the episode length of stay in study hospital, ie, from the start of the episode to the end of the episode of care.</td>
</tr>
<tr>
<td>Length of stay 2</td>
<td>LOS2</td>
<td>LOS2 is the total length of stay in study hospital, ie, from admission to discharge at the study hospital.</td>
</tr>
<tr>
<td>Length of stay 3</td>
<td>LOS3</td>
<td>LOS3 is the total length of stay in study hospital plus up to 2 other hospitals - one transfer in and one transfer out.</td>
</tr>
<tr>
<td>Medical resonance imaging</td>
<td>MRI</td>
<td>A medical imaging technique most commonly used in radiology to visualise detailed internal structures of the body using a magnetic field.</td>
</tr>
<tr>
<td>Medicare Benefits Schedule</td>
<td>MBS</td>
<td>A listing of the Medicare services subsidised by the Australian government.</td>
</tr>
<tr>
<td>National Hospital Cost Data Collection</td>
<td>NHCDC</td>
<td>The NHCDC contains component costs per DRG based on patient-costed and cost-modelled information. The NHCDC enables DRG Cost Weights and average costs for DRGs for acute in-patients to be produced.</td>
</tr>
<tr>
<td>Term</td>
<td>Abb.</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NSW Health</td>
<td></td>
<td>The broad term encompassing operational and other structures including the NSW Department of Health, Area Health Services, the Agency for Clinical Innovation, the Clinical Excellence Commission and a range of clinical taskforces.</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>OR</td>
<td>The odds of an event occurring. This is equal to the probability that the event occurs divided by the probability that it does not occur.</td>
</tr>
<tr>
<td>Open Surgery</td>
<td></td>
<td>An invasive medical procedure where an incision is required for direct surgical access to the organs.</td>
</tr>
<tr>
<td>Principal referral hospital</td>
<td></td>
<td>Hospital within peer group (principal referral hospitals 1b) classified as an acute hospital, treating 25,000 or more acute casemix weighted separations per annum, with an average cost weight greater than 1 and 1 or fewer specialty services.</td>
</tr>
<tr>
<td>Principal tertiary referral hospital</td>
<td></td>
<td>Hospital within peer group (principal referral hospitals 1a) classified as an acute hospital, treating 25,000 or more acute casemix weighted separations per annum, with an average cost weight greater than 1 and having more than 1 specialty service.</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td></td>
<td>Disease prevention, also called preventive treatment.</td>
</tr>
<tr>
<td>Registered nurse</td>
<td>RN</td>
<td>A qualified nurse who provides care for patients in a variety of healthcare settings. These include public and private hospitals, community and home-based services, nursing homes and industry.</td>
</tr>
<tr>
<td>Restenosis</td>
<td></td>
<td>The reoccurrence of stenosis, a narrowing of a blood vessel, leading to restricted blood flow.</td>
</tr>
<tr>
<td>Royal North Shore Hospital</td>
<td>RNSH</td>
<td>One of the study hospitals included in the review.</td>
</tr>
<tr>
<td>Royal Prince Alfred Hospital</td>
<td>RPAH</td>
<td>One of the study hospitals included in the review.</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td>A narrowing of a blood vessel leading to restricted blood flow.</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td>When an artery supplying blood to the brain suddenly becomes blocked or bleeds. Often causes paralysis of parts of the body normally controlled by that area of the brain, or speech problems and other symptoms.</td>
</tr>
<tr>
<td>Thrombolysis</td>
<td></td>
<td>Dissolution of a stationary blood clot along the wall of a blood vessel, frequently causing vascular obstruction.</td>
</tr>
<tr>
<td>Thrombosis</td>
<td></td>
<td>Clotting of blood, with the term usually applied to clotting within a blood vessel due to disease, as in a heart attack or stroke or as an unintended effect of surgery.</td>
</tr>
<tr>
<td>Tissue Plasminogen Activator tPA</td>
<td>tPA</td>
<td>A drug used to dissolve blood clots after a stroke so as to mitigate damage to the patient's brain.</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td></td>
<td>A surgical procedure to cut an opening into the trachea (windpipe) so that a tube can be inserted into the opening to assist breathing.</td>
</tr>
<tr>
<td>Transient global amnesia</td>
<td></td>
<td>A temporary episode of short-term memory loss without other neurological impairments.</td>
</tr>
<tr>
<td>Term</td>
<td>Abb.</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Transient ischaemic attack</td>
<td>TIA</td>
<td>A transient ischaemic attack (TIA) is a mini-stroke that warns of an impending stroke within hours, days, weeks or months. The symptoms of a TIA only last a short time, followed by a full recovery. A person who has had a TIA, or 'mini-stroke', is at greater risk of having a stroke or heart attack.</td>
</tr>
<tr>
<td>Venous Thromboembolism</td>
<td>VTE</td>
<td>The process by which blood clots occur and travel through the veins. It is the collective term for deep vein thrombosis (the formation of a blood clot in one of the deep veins within the body, such as in the leg or pelvis) and pulmonary embolism (condition in which the arteries leading from the heart to the lungs becomes blocked).</td>
</tr>
</tbody>
</table>