IPART
New South Wales

Independent Pricing and Regulatory Tribunal

Case study 5 – Appendicectomy

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 outcomes 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 – appendicectomy (surgical removal of the appendix). (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.[a]

a 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.

Box 1.2 IPART's case studies

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 appendicectomy as one of the case studies?

Appendicectomy was selected as one of the clinical areas for detailed study because it involves:

- moderate volumes[1]
- large differences in reported costs between hospitals, and
- differences in configurations of care.

1.2 What was the scope of the appendicectomy case study?

The appendicectomy case study compared the costs, configurations of care and outcomes related to surgical removal of the appendix. We used diagnostic related groups (DRGs) to define the surgical procedure 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 appendicectomy case study

DRG	Description
G07A	Appendicectomy with catastrophic or severe complication or comorbidity
G07B	Appendicectomy without catastrophic or severe complication or comorbidity

Appendicectomies are usually performed as emergency procedures on people who have an infected or ruptured appendix (acute appendicitis).[2] The surgery is generally performed using one of two methods:

- open surgery, with an incision being made through the lower right abdominal wall, or
- laparoscopic surgery, with one to three small incisions being made through the abdominal wall for a camera and instruments to pass through.[3]

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

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1 In 2007/08, 25,197 appendicectomies were undertaken in Australian hospitals. 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).

2 AllHealth medical reference and symptom finder, (http://www.allhealth.com.au/html/s02_article/article_view.asp?keyword=appendicectomy).

3 All Health medical reference and symptom finder, (http://www.allhealth.com.au/html/s02_article/article_view.asp?keyword=appendicectomy); Better Health Channel (http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Appendicectomy); American College of Surgeons (http://www.facs.org/public_info/operation/brochures/app.pdf).

1.3 What were the key findings of the appendicectomy case study?

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

- the number and mix of appendicectomy 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 appendicectomy patient care at each hospital
- indicators of outcome, safety and quality for appendicectomies for each hospital.

Our key findings are summarised below.

1.3.1 Number and mix of patients

We found that the number of appendicectomy cases and mix of patients did not vary significantly across the study hospitals. Over 90% of appendicectomy patients at each study hospital are classified as DRG G07B[4].

1.3.2 Average length of stay

The average length of stay for patients in the more common, less complex DRG G07B was fairly similar at the study hospitals. For patients in this DRG, RNSH and BLH had shorter average length of stays and GH had the longest.

1.3.3 Costs of inpatient care

To compare the costs related to the case study areas at the study hospitals, we examined the management and use of a selection of clinical resources used directly for patient care in that area. For appendicectomy, 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.[5]

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4 Appendicectomy without catastrophic or severe complication or comorbidity.

5 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*.

We focused on costs for the patients in DRG G07B[6], which comprises over 90% of appendicectomies across the study hospitals. Costs for patients in DRG G07A[7] (the less common, more complex DRG) can vary widely due to several factors, including the significant difference in the time a relatively small number of patients spent in the Intensive Care Unit. As such, looking at patients in DRG G07B provides a better understanding of the cost differences across the study hospitals.

Cost of nursing staff in wards

We found that average length of stay and nursing staff mix were the main drivers for nursing costs at the study hospitals. With inpatient fractions (IFRACs) set to 1[8], hospitals with:

- lower average length of stays – RNSH and BLH – had lower nursing costs per acute episode
- staff mixes with higher proportions of enrolled nurses (ENs) and assistants in nursing (AINs) – GH and BLH – had slightly lower nursing costs per day.

The hospitals use IFRACs to allocate staff time to acute care and other staff responsibilities. We found that nursing costs were highly sensitive to the IFRACs the hospitals apply to them. RNSH uses a lower IFRAC than the other study hospitals. When all nursing costs are attributed to inpatient care (ie, IFRAC=1), the cost variation between the hospitals is significantly smaller than when the hospital's IFRACs are used.

Imaging and pathology costs

Study hospitals had different imaging and pathology test costs. Hospitals with greater use of CT scans, MRIs and ultrasounds – in particular, RNSH – generally had higher imaging costs.

National Hospital Cost Data Collection

The National Hospital Cost Data Collection (NHCDC) reports estimates of average hospital costs based on data it collects from hospitals around Australia.[9] 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.[10] 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

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6 Appendicectomy without catastrophic or severe complication or comorbidity.
7 Appendicectomy with catastrophic or severe complication or comorbidity.
8 Setting IFRACs to 1 means that we allocated 100% of the nursing time to inpatient care.
9 In NSW, these cost estimates are often compiled by area health services, rather than individual hospitals.
10 Commonwealth Department of Health and Ageing, *National Hospital Cost Data Collection, Round 12, 2007-2008*, September 2009.

substantially. Give 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, imaging and pathology costs. For pathology we used the final NHCDC estimates. We found a greater degree of consistency in the hospitals' nursing costs than is reflected in the NHCDC estimates.

1.3.4 Configurations of care

We identified the following major differences in the way the study hospitals managed and provided care for appendicectomy patients:

- the type of diagnostic testing conducted, and
- the type of surgery performed.

Type of diagnostic testing conducted

There are different configurations of care for diagnosing acute appendicitis. This can lead to patients experiencing longer delays to treatment at some hospitals than is necessary, as well as those hospitals incurring higher diagnostic costs. In particular, it is unclear whether it is appropriate for clinicians to use ultrasounds as a diagnostic tool in appendicectomies.

Quick diagnosis and treatment of acute appendicitis is particularly important for young women. However, the proportion of patients receiving surgery within 24 hours of admission did not increase substantially for patients aged 20 years and under.

This may be due to the same diagnostic process (eg, ultrasound, CT/MRI) being followed prior to surgery, irrespective of a patient's age. As younger patients are less likely to be suffering from other conditions which have symptoms similar to appendicitis, adopting such a uniform diagnostic process may be inappropriate, leading to unnecessary testing and delays.

Type of surgery performed

There is considerable variation in the rates of laparoscopic surgery for appendicectomies across the study hospitals. RNSH and BLH had the highest rates and GH had the lowest rate.

Patients who underwent laparoscopic surgery had lower average length of stays than those who underwent open surgery. However, the cost of equipment used during laparoscopic surgery is generally higher.

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 the 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.

While collecting data, we found that the number of deaths, wound infections and unplanned returns to theatre for appendicectomy patients at the study hospitals were very small. As such, we expanded the scope of the clinical indicators to cover 'general surgery', so that the data included both cholecystectomy and appendicectomy patients.

We considered the performance of the study hospitals against the clinical indicators. We found that there were no statistically significant differences between the study hospitals' risk-adjusted 30-day mortality rates. However, JHH and RPAH had the highest risk-adjusted wound infection rates.

1.4 What are the key implications of these findings?

Use of diagnostic tests

There is a case for NSW Health to arrange for appropriate clinical expert groups to 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, they should consider whether these diagnostic tools only be used for certain patient groups (eg, older patients who are more likely to be suffering from other conditions with symptoms similar to appendicitis).

Relative costs and benefits of laparoscopic vs open surgery

Patients who underwent laparoscopic surgery had lower average length of stays than those who underwent open surgery. This may suggest that laparoscopic surgery leads to lower nursing costs. However, the cost of equipment used during laparoscopic surgery is generally higher.

We found considerable variation in the rates of laparoscopic surgery across the study hospitals. As such, we consider that there is a case for NSW Health to arrange for appropriate clinical expert groups to consider the relative costs and benefits of laparoscopic vs open surgery for appendicitis.

Variation in wound infection rates

There were significant differences between the study hospitals in relation to wound infection rates. These differences should be investigated further by NSW Health.

1.5 List of recommendations

1 That NSW Health and appropriate clinical expert groups note the variation in the use of imaging tests for diagnosing appendicitis. 28

2 That NSW Health arranges for appropriate clinical expert groups to consider establishing standard protocols for diagnosing appendicitis, indicating when it is appropriate to use CT scans, MRIs and ultrasounds. 28

3 That as part of establishing standard protocols for diagnosing appendicitis, NSW Health arranges for appropriate clinical expert groups to consider whether CT scans, MRIs and ultrasounds should only be used for certain patient groups (eg, older patients who are more likely to be suffering from other conditions with symptoms similar to appendicitis). 30

4 That NSW Health arranges for appropriate clinical expert groups to consider the relative costs and benefits of laparoscopic versus open surgery for appendicitis. 33

5 That NSW Health and clinical expert groups review the variation in wound infection rates for appendicectomy surgery at the study hospitals, and if appropriate, take steps to address the variation. 43

1.6 What does the rest of this report cover?

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

- Chapter 2 compares the number and mix of appendicectomy patients at the study hospitals.
- Chapter 3 compares the length of stay for appendicectomy patients at the study hospitals, and describes the method we used to compare length of stay on a consistent basis.
- Chapter 4 describes how we analysed the costs of appendicectomy 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 5 compares the configurations of care for appendicectomy patients at the study hospitals and highlights key differences.

- Chapter 6 discusses the indicators of outcome, safety and quality for appendicectomy 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, detailed information on data sources for the risk-adjusted outcome indicators and a glossary.

2 Number and mix of patients across study hospitals

We identified the total number of appendicectomy cases at each hospital during the study period, and the proportions of these that were emergency admissions. We then compared the mix of cases by identifying the proportion of patients within each DRG. In addition, we considered the age of patients at the study hospitals.

We found that the number and mix of appendicectomy patients that the study hospitals treated were fairly uniform. However, there was a difference in the average age of patients at the study hospitals.

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

2.1 Number of appendicectomy cases at each study hospital

Our data indicates that the 5 study hospitals treated a total of 1,182 appendicectomy cases during the study period. It also shows that the number of cases at each hospital was broadly the same, as was the proportion of cases that were emergency admissions (see Table 2.1).

Table 2.1 Appendicectomy cases at study hospitals, DRGs G07A and G07B

	RPAH	GH	RNSH	BLH	JHH	All study hospitals
Number of cases	248	252	269	153	260	1,182
Transfers in (%)	2	20	1	3	2	6
Emergency admissions (%)	96	79	99	94	96	93

Note: See Boxes 2.1 and 2.2 for details on how we calculated the number of cases, and identified emergency admissions and transfers in. 'Emergency admissions', 'planned admissions', 'transfers in' and 'transfers out' are not mutually exclusive categories, so adding together the proportion of patients in these categories will not necessarily equal 100%. For example, some patients may be on the waiting list as a planned admission, but be admitted through the emergency department, and so also be categorised as an emergency admission.

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

RPAH, RNSH and JHH had similar numbers of cases with 248, 269 and 260, respectively. GH also had a similar number of cases with 252, which is a significant number for a hospital of its size. GH acts as an acute referral facility on the Central Coast, and as such received the highest percentage of 'transfers in'. BLH had 153 cases.

Box 2.1 provides more detail on how we calculated the number of cases at each hospital.

Box 2.1 How we calculated the number of appendicectomy cases

To calculate the number of appendicectomy cases at the 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 an appendicectomy (ie, episode sequence number had to be 1).

The approach prevented double counting. It excluded cases where the patient was admitted for a different procedure and later reclassified to an appendicectomy DRG.

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

In nearly all study hospitals, over 90% of patients were admitted through the emergency department. The percentage was lower at GH (79%), primarily due to all of the patients that were 'transferred in' at GH not passing through the emergency department (and so not being included in the emergency figures).

Box 2.2 describes the method we used to identify emergency admissions and transfers in.

Box 2.2 How we identified emergency admissions and transfers in

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 transfers in field in the admitted patient data, transfers in were calculated using a linkage key developed by the Australian Institute of Health and Welfare.

2.2 Comparison of casemix at the study hospitals

Our data indicate that the relative proportions of cases in each DRG do not vary significantly across study hospitals. However, there were differences in the proportion of patients in different age groups.

2.2.1 DRG complexity

The appendicectomy case study contains two DRGs: G07A[11] and G07B[12]. Patients coded in the G07A category are the most complex category of patient. Table 2.2 shows the percentage of cases 'coded'[13] in each appendicectomy DRG.

Table 2.2 Percentage of cases coded in each appendicectomy DRG

	RPAH	GH	RNSH	BLH	JHH	All study hospitals
	%	%	%	%	%	%
G07A – Appendicectomy with catastrophic or severe CC	8	8	9	6	9	8
G07B - Appendicectomy without catastrophic or severe CC	92	92	91	94	91	92

Note: "CC" = complication or comorbidity.

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

Across the study hospitals, over 90% of patients are in DRG G07B.[14]

In order to help assess if the coders in each hospital are coding patients similarly, IPART compared the average number of diagnosis codes per appendicectomy patient in the five hospitals.

Table 2.3 Average number of diagnosis codes per patient in study hospitals

	RPAH	GH	RNSH	BLH	JHH
Average number of diagnosis codes per patient	2.0	2.0	1.6	1.6	1.8

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

The number of diagnosis codes in the inpatient data was fairly similar across the hospitals – ranging from 1.6 diagnosis codes per patient at RNSH and BLH to 2.0 at RPAH and GH.

11 Appendicectomy with catastrophic or severe complication or comorbidity.

12 Appendicectomy without catastrophic or severe complication or comorbidity.

13 Coding is explained in further detail in the Chapter 6 of the main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*.

14 The emergency admissions referred to in Table 2.1 cover both DRGs.

2.2.2 Age of patients

Table 2.4 shows the average age of patients who had appendicectomies at the study hospitals.

Table 2.4 Age of patients

	RPAH	GH	RNSH	BLH	JHH	All study hospitals
Average age (years)	30	27	33	28	29	29
Range (years)	5-94	3-90	14-86	6-76	2-87	2-94
Proportion of patients in different age groups						
20 years and under (%)	25	52	19	40	39	34
50 years and over (%)	6	11	11	11	13	10

Note: Age at date of admission.

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

The average age of patients in all hospitals was 29 years old, ranging from 27 years for GH to 33 years for RNSH. The youngest patient was 2 years old and the oldest was 94 years old.

Overall, only 10% of patients were more than 50 years old, while 34% were less than 20 years old. GH had a far greater proportion of under-20 year olds in its patient mix when compared to the other study hospitals.

3 Length of stay across study hospitals

We examined the average length of stay of appendicectomy 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 appendicectomy 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 3.1 provides more detail on these measures. The sections below set out our analysis of length of stay for all appendicectomy cases, as well as for each appendicectomy DRG, with a focus on LOS1 and LOS3.

Box 3.1 The 3 measures of length of stay we used for appendicectomy 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 4).

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).

3.1 Comparing length of stay for all appendicectomy patients

Table 3.1 compares the average length of stay for appendicectomy patients across the study hospitals, using the LOS1 and LOS3 measures.

Table 3.1 Average length of stay for all appendicectomy patients

	RPAH days	GH days	RNSH days	BLH days	JHH days	All study hospitals days
LOS1	3.1	3.6	2.8	2.7	3.2	3.1
LOS3	3.3	4.0	2.8	2.9	3.4	3.3

Note: DRG G07A and G07B.

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

The average total number of days in hospital (LOS3) for appendicectomies at the study hospitals was 3.3 days. Patients at RNSH and BLH had the shortest stays on average, with 2.8 days and 2.9 days respectively. Patients at RPAH and JHH had similar average total stays, with 3.3 days and 3.4 days respectively. GH had the longest average total stay, with 4.0 days.

3.2 Comparing length of stay by appendicectomy DRG

Table 3.2 compares the average length of stay for appendicectomies by DRG across the study hospitals, using the LOS1 and LOS3 measures.

Table 3.2 Average length of stay for appendicectomies by DRG

	RPAH days	GH days	RNSH days	BLH days	JHH days	All study hospitals days
DRG G07A						
LOS1	6.6	11.1	7.0	6.8	7.2	7.7
LOS3	7.7	15.4	7.0	7.1	9.1	9.3
DRG G07B						
LOS1	2.8	3.0	2.4	2.5	2.8	2.7
LOS3	2.8	3.1	2.4	2.6	2.8	2.8

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

Average length of stay for the less common, more complex DRG G07A[15] can be significantly influenced by a few outlier cases. As such, there is a large difference between the study hospitals, ranging from 7.0 days at RNSH to 15.4 days at GH.

There is smaller range for DRG G07B[16], which comprises over 90% of all appendicectomies at the study hospitals. Average total number of days in hospital ranges from 2.4 days at RNSH to 3.1 days at GH.

15 Appendicectomy with catastrophic or severe complication or comorbidity.
16 Appendicectomy without catastrophic or severe complication or comorbidity.

4 Costs of providing inpatient care

To compare the costs of caring for appendicectomy 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, and
- pathology.

The sections below discuss our analysis of the estimated costs for each of these resources across the study hospitals. For some resources, they also compare our estimated costs with estimates based on provisional or final data reported to the NSW Department of Health by area health services as part of the NHCDC.[17]

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 junior and senior medical staff are a major cost for appendicectomies, we were not able to compare the use and management of these clinical resources due to the lack of consistent data.

We have focused on costs for the patients in DRG G07B[18], which comprises over 90% of appendicectomies across the study hospitals. Costs for patients in DRG G07A[19] (the less common, more complex DRG) can vary widely due to several factors, including the significant difference in the time a relatively small number of patients spent in the Intensive Care Unit. As such, looking at patients in DRG G07B provides a better understanding of the cost differences across the study hospitals.

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17 Due to time constraints, we used the final data only where there were substantial differences between the provisional and final data. For this case study we used final NHCDC data only for pathology costs.

18 Appendicectomy without catastrophic or severe complication or comorbidity.

19 Appendicectomy with catastrophic or severe complication or comorbidity.

4.1 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 the acute care of patients having appendicectomies.

4.1.1 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 4.1 and in more detail in Chapter 8 of our main report.[20] Further, these estimates should be considered in light of the discussion in Chapter 3 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).

4.1.2 Use of IFRACs

The hospitals use inpatient fractions (IFRACs) to allocate staff time to acute care and other staff responsibilities. We calculated 2 sets of inpatient nursing costs, the first using the hospitals' IFRACs and the second setting all IFRACs to 1.[21] We did this because we were concerned that IFRACs may not be consistently applied by the hospitals.

BLH has an IFRAC of 1, RPAH and JHH have IFRACs of 0.97, GH has an IFRAC of 0.93, 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.

4.1.3 Ward nursing costs for appendicectomy patients

Average ward nursing costs per acute episode

Table 4.1 contains our estimates of the average ward nursing costs per acute episode for DRG G07B. The last row shows the direct nursing costs from the provisional data for the NHCDC.

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20 IPART, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*, July 2010.

21 Setting IFRACs to 1 means that we allocated 100% of the nursing time to inpatient care.

Using the existing IFRACs, the average ward nursing cost per acute episode ranges from $469 at RNSH to $693 at JHH. When all nursing costs are attributed to inpatient care (ie, IFRAC=1), it leads to a smaller variation in nursing costs across the study hospitals, ranging from $594 at BLH to $718 at GH.

When compared to our estimates, the NHCDC contains a much greater difference in nursing costs between the study hospitals. Direct nursing costs for DRG G07B range from $601 at RNSH to $1,082 at RPAH.

Main factors affecting nursing costs

Our analysis indicates that the average ward nursing cost per acute episode is affected by four main factors:

- IFRACs
- acute episode length of stay (ie, LOS1)
- nursing staff-to-patient ratio (ie, nursing hours per patient day)
- nursing staff mix.

IFRACs affect both the nursing costs per acute episode and the nursing costs per patient day (ie, per day of the acute episode). See Table 4.1 and Table 4.2. 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 there is a strong relationship between the second factor, the length of stay, and acute episode costs. The hospitals with the shortest acute episode length of stay – RNSH and BLH with 2.4 and 2.5 days respectively – had the lowest acute episode nursing costs.

Along with the acute episode length of stay, we found that the nursing cost per patient day has a strong influence on the acute episode cost. In turn, the staff-to-patient ratio (third factor) and the staff mix (fourth factor) affect the nursing cost per patient day.

In principle, a hospital with a low staff-to-patient ratio is likely to have lower costs per patient day than a hospital with a higher staff-to-patient ratio. However, a lower staff–to-patient ratio can be offset by higher costs per nursing hour if there is a lower proportion of Enrolled Nurses (ENs), Assistants in Nursing (AINs) and student/trainee nurses in the staff mix.

Our analysis suggests that the average nursing cost per patient day at the different hospitals depends more on staff mix than the staff levels (see Table 4.2, Table 4.3 and Table 4.4). To demonstrate this, we note that GH, BLH and JHH have a similar number of nursing hours per day, with 6.5 hours, 6.8 hours and 6.8 hours respectively (IFRACs=1). However, the average nursing cost per patient day is lowest at GH and BLH and highest at JHH, with $239, $240 and $255 respectively (IFRACs=1). This is because GH and BLH have a higher share of ENs, AINs and

student/trainee nurses in their staffing mix than JHH, with 27%, 30% and 14% respectively.[22]

Table 4.1 Ward nursing costs per acute episode, with and without IFRAC

	RPAH	GH	RNSH	BLH	JHH
LOS1 (days)	2.8	3.0	2.4	2.5	2.8
Episode nursing cost with IFRAC	$681	$667	$469	$594	$693
IFRAC	0.97	0.93	0.77	1.00	0.97
Episode nursing cost, IFRAC =1	$703	$718	$606	$594	$713
NHCDC direct ward costs	$1,082	$1,012	$601	$694	$938

Note: DRG G07B. Episode nursing cost calculated using acute episode LOS measure (LOS1).

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

Table 4.2 Nursing costs and hours per patient day, with and without IFRAC

		RPAH	GH	RNSH	BLH	JHH
Nursing costs per patient day	With IFRAC	$244	$222	$197	$240	$248
	IFRAC=1	$252	$239	$254	$240	$255
Nursing hours per patient day	With IFRAC	7.0	6.0	5.7	6.8	6.6
	IFRAC=1	7.2	6.5	7.3	6.8	6.8

Note: DRG G07B.

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

Table 4.3 Proportion of nursing hours by nurse award category, with IFRAC[a]

	RPAH	GH	RNSH	BLH	JHH
	%	%	%	%	%
CNS & RN					
CNS	11	6	6	2	11
RN	67	67	72	68	75
Total	79	73	78	70	86
EN, AIN & student/trainee					
EN	14	24	14	23	11
AIN	4	0	3	4	2
Student/trainee	3	3	5	3	0
Total	21	27	22	30	14

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

Note: DRG G07B. 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.

22 The nursing categories are explained in Chapter 8 of our main report, *NSW Health costs and outcomes study by IPART for selected NSW hospitals*.

Table 4.4 Nursing costs per hour by award category, with IFRAC[a]

	RPAH	GH	RNSH	BLH	JHH
	$/per hour	$/per hour	$/per hour	$/per hour	$/per hour
All	35	37	35	35	37
CNS	45	46	45	42	43
RN	36	40	37	39	38
EN	28	29	27	29	29
AIN	22	23	23	22	22
Student/trainee	20	20	19	21	18

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

Note: DRG G07B. 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.

Box 4.1 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.

4.2 Imaging costs

Table 4.5 sets out our calculations for the average cost of all imaging tests for appendicectomy patients in DRG G07B, 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 and ultrasounds), 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 4.2.

Table 4.5 Average imaging cost per patient, DRG G07B

	RPAH	GH	RNSH	BLH	JHH
	$	$	$	$	$
Acute episode					
All imaging tests	100	124	150	136	104
CT/MRI	70	103	93	114	54
Ultrasound	11	10	47	0	37
NHCDC direct and indirect imaging costs	136	91	136	168	115
Day of admission					
All imaging tests	62	69	101	102	66
CT/MRI	41	60	59	85	30
Ultrasound	7	3	37	0	25

Source: IPART analysis using data from hospital imaging services and provisional cost data 2008/09, NHCDC.

The average test costs ranged from:

- $100 at RPAH to $150 at RNSH during the period of the patient's acute episode, and
- $62 at RPAH to $102 at BLH on the day of admission. RNSH also had a relatively higher test cost on the day of admission ($101).

This range in costs is broadly consistent with the range of direct and indirect imaging costs included in the NHCDC. The NHCDC has imaging costs for DRG G07B ranging from $91 at GH to $168 at BLH.

The higher average costs for imaging at RNSH appear to be driven by the greater use of ultrasound in diagnosis and monitoring. Further, it appears that imaging costs at BLH and GH are impacted by their higher use of CT/MRI scans during the period of the patient's acute episode.

Box 4.2 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*.

4.3 Pathology costs

Table 4.6 shows average pathology costs for appendicectomy patients in DRG G07B. Our methodology for calculating these costs is explained in Box 4.3.

Table 4.6 Average pathology cost per patient, DRG G07B

	RPAH	GH	RNSH	BLH	JHH
	$	$	$	$	$
Acute episode	204	127	234	185	199
Day of admission	105	66	133	83	92
NHCDC direct and indirect pathology costs	181	140	191	169	253

Source: IPART analysis using data from hospital pathology services and final cost data 2008/09, NHCDC.

The average test costs ranged from:

- $127 at GH to $234 at RNSH during the period of the patient's 'acute' episode, and
- $66 at GH to $133 at RNSH on the day of admission.

Pathology costs are much lower at GH than the other hospitals but this is due to a charging anomaly (with some costs excluded from anatomical pathology).

The average direct pathology costs included in the NHCDC (final costs) for appendicectomies in DRG G07B ranges from $140 at GH to $253 at JHH.

Box 4.3 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 MBS.

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

5 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.

The sections below describe the following major differences we found between the hospitals:

- the type of diagnostic testing conducted, and
- the type of surgery performed.

5.1 Type of diagnostic testing conducted

While appendicectomies are generally a common procedure with few adverse consequences, acute appendicectomies are regarded an emergency procedure because the appendix may burst leading to infection. Time from admission and diagnosis to surgery in the operating theatre is very important for people with acute appendicitis. Delaying treatment, either through conducting unnecessary tests or failing to conduct the appropriate ones to identify the appendicitis, can have adverse consequences for patients.

There is no definitive test to diagnose appendicitis and diagnosis is sometimes difficult because of similar symptoms caused by other illnesses. As such, different approaches are used by different clinicians in different hospitals. This can have cost implications, as well as affecting patient outcomes. As an example, using imaging tests (eg, CT scans/MRIs) to diagnose appendicitis is a higher cost approach than coming to a clinical diagnosis based on the nature and location of acute appendix related pain.

Our discussions with clinicians at different hospitals indicated a range of views existed about the use of ultrasounds or CTs as diagnostic tools in cases of suspected appendicitis and for which groups of patients it was more appropriate. Some clinicians believed imaging led to lower complication rates and earlier diagnosis. Others believed that imaging results were often inconclusive (particularly ultrasounds) and in some instances led to delays in diagnosis and treatment. Our own review of selected clinical notes did identify instances where imaging results were inconclusive or where it appeared as though treatment or surgery was delayed while patients waited to obtain imaging results, which then proved to be inconclusive.

We found that there were differences in the reliance placed on imaging for diagnosing acute appendicitis at different hospitals. Average imaging costs were generally higher at RNSH when compared to the other study hospitals (see Chapter 4). However, RNSH clinicians thought that their imaging use was appropriate, resulting in an earlier diagnosis of appendicitis than would otherwise be the case. Further, the clinicians considered that there was a link between RNSH's imaging use and its shorter stays (see Chapter 3) and lower wound infection rates (see Chapter 6).

Some hospitals have introduced protocols to standardise the diagnosis and treatment of acute appendicitis. For example, the protocols developed by Flinders Medical Centre indicate the circumstances in which it is appropriate to use ultrasound or CT tests in the initial medical assessment and management of appendicitis.[23]

We think there is a case for NSW Health and appropriate clinical expert groups to note the variation in the use of imaging tests for diagnosing appendicitis and for NSW Health to arrange for appropriate clinical expert groups to consider establishing standard protocols for diagnosing appendicitis, indicating when it is appropriate to use CT scans, MRIs and ultrasounds.

Recommendation

1 That NSW Health and appropriate clinical expert groups note the variation in the use of imaging tests for diagnosing appendicitis.

2 That NSW Health arranges for appropriate clinical expert groups to consider establishing standard protocols for diagnosing appendicitis, indicating when it is appropriate to use CT scans, MRIs and ultrasounds.

[23] Flinders Medical Centre, *Surgical & Speciality Services Protocol – Appendicitis (CC1.165)*, February 2007. See NSW Health, *Emergency Surgery Guidelines (GL2009_09)*, June 2009, Appendix F, (http://www.health.nsw.gov.au/policies/gl/2009/pdf/GL2009_009.pdf).

Clinicians consulted for this review indicated that quick diagnosis and treatment of acute appendicitis is particularly important for young women. To understand whether this is occurring at the study hospitals, we analysed the following by age groups:

- the proportion of patients where surgery commenced within 24 hours of admission (Table 5.1), and
- the average time from admission to operating theatre (Table 5.2).

Table 5.1 Time from admission to operating theatre – DRG G07B

	RPAH	GH	RNSH	BLH	JHH
	%	%	%	%	%
All patients					
≤24 hours	86	85	82	78	78
25 to ≤ 48 hours	11	12	18	19	18
49 to ≤ 72 hours	1	2	0	2	3
>72 hours	1	0	0	1	1
Patients aged 20 years and under					
≤24 hours	85	85	83	77	82
25 to ≤ 48 hours	13	14	17	21	18
49 to ≤ 72 hours	2	1	0	2	0
>72 hours	0	0	0	0	0
Patients aged 50 years and over					
≤24 hours	89	95	78	69	81
25 to ≤ 48 hours	0	5	22	15	14
49 to ≤ 72 hours	0	0	0	8	5
>72 hours	11	0	0	8	0

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

Table 5.2 Average time from admission to operating theatre – DRG G07B

	RPAH	GH	RNSH	BLH	JHH
	hours	hours	hours	hours	hours
All patients	15.3	16.2	16.7	17.7	18.3
Patients aged 20 years and under	15.3	15.2	15.9	17.1	14.9
Patients aged 50 years and over	16.9	15.6	16.1	22.2	17.5

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

The average time from admission to operating theatre was slightly lower for patients aged 20 years and under (Table 5.2). However, at most study hospitals there was not a significant increase in the proportion of patients aged 20 years and under receiving surgery within 24 hours of admission (Table 5.1). This may be due to the same diagnostic process (eg, ultrasound, CT/MRI) being followed prior to surgery, irrespective of a patient's age.

We understand that adopting such a uniform diagnostic process may be inappropriate, leading to unnecessary testing and delays. Younger patients are less likely to be suffering from other conditions which have symptoms similar to appendicitis, reducing the time (and number of tests) required to reach a diagnosis and proceed to surgery.

We did find that there were a higher proportion of patients 50 years or older at RPAH and BLH that waited more than 72 hours. This may reflect greater difficulties in diagnosing appendicitis in older patients. For example, there is an increased likelihood of other possible conditions in older age groups with symptoms similar to appendicitis, such as gastrointestinal conditions.

As part of establishing standard protocols for diagnosing appendicitis, NSW Health should arrange for appropriate clinical expert groups to consider whether CT scans, MRIs and ultrasounds should only be used for certain patient groups (eg, older patients who are more likely to be suffering from other conditions with symptoms similar to appendicitis).

Recommendation

3 That as part of establishing standard protocols for diagnosing appendicitis, NSW Health arranges for appropriate clinical expert groups to consider whether CT scans, MRIs and ultrasounds should only be used for certain patient groups (eg, older patients who are more likely to be suffering from other conditions with symptoms similar to appendicitis).

There is some variation among the study hospitals in the average time from admission to theatre (eg, it is shortest at GH and longest at BLH for patients aged 50 years and over). However, we note that time from admission to theatre is not necessarily an indicator of quality of care. Study hospitals with longer times may be appropriately postponing surgery so that it takes place within 'standard hours'.

NSW Health and the Royal Australasian College of Surgeons (RACS) are both promoting the benefits of scheduling emergency surgery, such as appendicectomy, in standard hours where clinically appropriate.[24] The standard hours operating period, usually between 8:00am and 5:00pm Monday to Friday, is when most hospitals have the maximum number of their health services operational and have maximum staffing levels.[25] Operating outside these standard hours increases staff fatigue, may impair judgment at critical moments and carries a risk of error.[26]

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24 NSW Health, *Emergency Surgery Guidelines (GL2009_09)*, June 2009, (http://www.health.nsw.gov.au/policies/gl/2009/pdf/GL2009_009.pdf); Royal Australasian College of Surgeons, *Emergency Surgery – Acute and Trauma Surgery Workshop, Consensus Statement*, 19 November 2009.

25 NSW Health, *Emergency Surgery Guidelines (GL2009_09)*, June 2009, p 24 (http://www.health.nsw.gov.au/policies/gl/2009/pdf/GL2009_009.pdf).

26 Royal Australasian College of Surgeons, *Emergency Surgery – Acute and Trauma Surgery Workshop, Consensus Statement*, 19 November 2009, p 1.

5.2 Type of surgery performed

As previously discussed, there are two main approaches to surgery – laparoscopic surgery and open surgery. The relative use of the two procedures differed across the study hospitals (see Table 5.3).

Table 5.3 Laparoscopic surgery and open surgery rates

	RPAH	GH	RNSH	BLH	JHH
	%	%	%	%	%
Laparoscopic surgery					
All patients	85	41	94	90	80
Patients aged 20 years and under	81	27	98	89	64
Patients aged 50 years and over	64	37	83	94	71
Open surgery					
All patients	13	58	5	8	19
Patients aged 20 years and under	17	72	2	11	36
Patients aged 50 years and over	29	59	17	6	24

Note: Numbers will not add to 100% due to a small number of other procedures coded as appendicectomies.
Source: HIE inpatient statistics, 2008/09 and IPART analysis.

Clinicians at GH are significantly less likely to perform an appendicectomy using laparoscopic surgery than the other study hospitals. The rate of laparoscopic surgery at GH is 41%, compared with 94% at RNSH. GH clinicians noted that its in-house registrars were relatively more junior than at RNSH, and this was one of the reasons why they tended to do more open surgery.

Most hospitals are less likely to perform laparoscopic surgery on appendicectomy patients aged 50 years and over. They prefer to instead perform open surgery. However, BLH does not follow this pattern. Its rates of laparoscopic and open surgery do not change significantly by patient age.

Table 5.4 sets out the average length of stay for laparoscopic surgery and open surgery at the study hospitals.

Table 5.4 Average length of stay (LOS1 measure) by surgical procedure type, DRGs G07A and G07B

	RPAH	GH	RNSH	BLH	JHH
	days	days	days	days	days
Laparoscopic surgery	3.0	3.1	2.6	2.6	2.8
Open surgery	4.3	4.0	6.8	4.5	4.7
Difference in average length of stay	-1.3	-0.8	-4.2	-1.9	-1.9

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

The average length of stay for laparoscopic surgery is lower at each study hospital than the average length of stay for open surgery. The range for laparoscopic surgery is 2.6 days at RNSH and BLH to 3.1 days at GH. The range for open surgery is 4.0 days at GH to 6.8 days at RNSH.

The difference in laparoscopic surgery rates at the study hospitals may partly explain the difference in overall length of stay at the study hospitals (see Table 3.1). RNSH and BLH have the highest laparoscopic surgery rates (94% and 90% respectively) and the lowest average total stay (2.8 days and 2.9 days respectively). In contrast, GH has the lowest laparoscopic surgery rate (41%) and the highest average total stay (4.0 days).

That said, JHH clinicians were circumspect about laparoscopic surgery. They noted that patient satisfaction with laparoscopic surgeries had increased. However, there were mixed views among clinicians about whether they should be performing these procedures. When compared to open surgery, they didn't consider that laparoscopy reduced procedure time or the patient's length of stay.

Laparoscopic surgery generally involves significantly higher equipment costs than open surgery. One of the study hospitals provided an estimate of the average equipment costs involved in an appendicectomy:

- laparoscopic appendicectomy – $443.55
- open appendicectomy – $101.32.

A review of the literature does not clearly indicate whether laparoscopic surgery is preferable to open surgery. Some studies find that laparoscopic appendicectomy is associated with less post-operative pain, lower incidence of infectious complications[27] and shorter hospital stays.[28] Other studies suggest that laparoscopic appendicectomy increases cost[29], but has no significant impact on length of stay or complication rates.[30] Another study found that the cost implications of laparoscopic appendicectomy were uncertain as it was associated with shorter hospital stays but higher subsequent readmission rates.[31]

We consider that there is a case for NSW Health to arrange for appropriate clinical expert groups to examine the relative costs and benefits of laparoscopic versus open surgery for appendicitis.

Recommendation

4 That NSW Health arranges for appropriate clinical expert groups to consider the relative costs and benefits of laparoscopic versus open surgery for appendicitis.

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27 CP Garg, BB Vaidya, MM Chengalath, "Efficacy of laparoscopy in complicated appendicitis", 7(3) *International Journal of Surgery*, June 2009, pp 250-252.

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29 I Kehagias, SN Karamanakos, S Panagiotopoulos, K Panagopoulos, F Kalfarentzos, "Laparoscopic versus open appendectomy: which way to go?", 14(31) *World Journal of Gastroenterology* 21 August 2008, pp 4909-4914; E Sporn, GF Petroski, GJ Mancini, JA Astudillo, BW Miedema, K Thaler, "Laparoscopic appendectomy - - is it worth the cost? Trend analysis in the US from 2000 to 2005", 208(2) *Journal of the American College of Surgeons,* February 2009, pp 179-185.

30 K Kuwabara, Y Imanaka, S Matsuda, K Fushimi, H Hashimoto, KB Ishikawa, H Horiguchi, K Hayashida, K Fujimor, "Cost of open versus laparoscopic appendectomy", 159(3) *Clinica Terapeutica*, May-June 2008, pp 155-163.

31 O Faiz, J Clark, T Brown, A Bottle, A Antoniou, P Farrands, A Darzi, P Aylin, "Traditional and laparoscopic appendectomy in adults: outcomes in English NHS hospitals between 1996 and 2006", 248(5) *Annals of Surgery*, November 2008, pp 800-806.

6 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 the 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.

In collecting data for these clinical indicators, we found that the number of deaths, wound infections and unplanned returns to theatre for appendicectomy patients at the study hospitals were very small. As such, we expanded the scope of the clinical indicators to cover 'general surgery', so that the data included both cholecystectomy and appendicectomy patients.

The sections below describe the clinical indicators and consider the performance of the study hospitals against them. We found that there were no statistically significant differences between the study hospitals' risk-adjusted 30-day mortality rates. However, JHH and RPAH had higher risk-adjusted wound infection rates than the other hospitals.

6.1 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[32] 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.

[32] 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.

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.

Following this clinical consultation, we established the set of indicators discussed in section 6.3 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.

6.2 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 6.1).

Appendix B provides further details for each risk-adjusted indicator provided by NSW Health, including the data sources used, the time period of the data and the adjustment factors applied.

Box 6.1 How data on indicators was risk-adjusted for differences in patient characteristics

To make meaningful and fair comparisons of the performance of the study hospitals on some outcome indicators, the indicators were risk-adjusted to account for differences in patient characteristics that can influence the likelihood of adverse outcomes. In particular, NSW Health adjusted indicators of mortality and wound infection 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.

b Australian Institute of Health and Welfare, D Ben-Tovim, R Woodman, J Harrison, S Pointer, P Hakendorf & G Henley, *Measuring and reporting mortality in hospital patients*, March 2009, p 18, (http://www.aihw.gov.au/publications/hse/hse-69-10729/hse-69-10729.pdf).

6.3 Clinical indicators for appendicectomy

We selected 6 indicators for this case study (see Table 6.1). We analysed data from the study hospitals against these clinical indicators, with the results reported below.

The number of deaths, wound infections and unplanned returns to theatre for appendicectomy patients at the study hospitals were very small. As such, we expanded the scope of these clinical indicators to cover 'general surgery'. This means that the data includes cholecystectomy patients (DRGs H07A, H07B, H08A and H08B), as well as appendicectomy patients (DRGs G07A and G07B).

Table 6.1 Clinical indicators for appendicectomy and data availability

No.	Indicator	Available?
1.	30-day mortality rates (risk adjusted)	Y – data provided by NSW Health (see Appendix B)
2.	Unplanned return to theatre rates	Y – but data not consistently collected to enable meaningful hospital comparisons
3.	Wound infection rates (risk-adjusted)	Y – data provided by NSW Health (see Appendix B)
4.	Blood transfusion rates	N – data collected at hospital-wide level but not systematically reported by hospitals for appendicectomy patients
5.	Administration of VTE prophylaxis	N – data collected at hospital-wide level for VTE prophylaxis assessment
6.	Administration of antibiotic prophylaxis	N – data collected at hospital-wide level for antibiotic prophylaxis assessment

6.3.1 30-day mortality rates

NSW Health calculated and provided data on mortality rates within 30 days of separation for appendicectomy and cholecystectomy (referred to as general surgery), as well as the odds ratios for these rates. Odds ratios are used to highlight the differences in rates between hospitals (see Box 6.3).

NSW Health risk-adjusted each hospital's mortality data for patient age, sex, comorbidities (using the Charlson index) and socio-economic status using the approach set out in Box 6.1 and using the data set out in Appendix B.

In the 3 year period 2005/06 to 2007/08, there were 16 deaths among 6,662 hospital separations at the 5 hospitals, giving a crude mortality rate of 2.4 per 1,000. There were no statistically significant differences in mortality rates between the 5 hospitals.

Box 6.2 Calculating mortality rates

The NSW Department of Health's Centre for Epidemiology and Research calculated risk-adjusted odds ratios for mortality for patients treated in each study hospital in the appendicectomy and cholecystectomy case study areas, 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 6.1.

Hospitals that were not significantly different in the adjustment model (at $p<0.05$) were grouped.

Box 6.3 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", 320 British Medical Journal 2000, p 1468; S Simon "Understanding the Odds Ratio and the Relative Risk", 22 Journal of Andrology 2001, p 533). The odds ratios were risk-adjusted for patient characteristics using the approach discussed in Box 6.1.

[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.

6.3.2 Unplanned returns to theatre rates

This indicator measures the rate of unplanned returns to theatre for patients with complications relating to general surgery performed within the previous 72 hours during the same admission. The Australian Institute of Health and Welfare (AIHW) has noted that an unplanned return of a patient to the operating room during the same admission may reflect possible problems in the performance of procedures and/or less than optimal patient management.[33]

We were unable to compare the study hospitals' performance in this area, due to problems with the consistency of this indicator. During our hospital visits, we reviewed a small sample of clinical notes for patients who appeared from the data to have been readmitted to the same hospital for any reason within 48 hours. In this small sample 'audit' of the clinical notes, we found unplanned returns to theatre that had not been reported in the HIE.

[33] Australian Institute of Health and Welfare, *Towards national indicators of safety and quality in health care*, September 2009, p 158, (http://www.aihw.gov.au/publications/hse/hse-75-10792/hse-75-10792.pdf).

There are problems with the data quality for this indicator, as it is difficult to ensure hospitals are capturing data for this indicator in a consistent manner. In particular, there is no State or Commonwealth requirement for hospitals to routinely report unplanned returns to theatre.

- Instead, some hospitals use their own local reports (rather than the HIE data set) to track unplanned returns to theatre for their internal review. Further, while data on this indicator is collected by the Australian Council on Healthcare Standards, this is only for hospitals participating in its programs.[34]
- This indicator should only pick up those returns to theatre arising from less than optimal care. However, it is often difficult in practice to identify whether patients attending the emergency departments following procedures are actually planned or unplanned returns to theatre. The AIHW has noted that future development work for this indicator includes definitional work around how 'unplanned returns' are defined and recorded.[35]
- Even with a more comprehensive definition of 'unplanned return', whether a particular incident falls within this definition will still involve some degree of subjective judgment. As such, regular audit of clinical notes may be required to ensure consistency in data collection between hospitals.

6.3.3 Wound infection rates

This indicator measures the rate of wound infections within 6 weeks of separation for general surgery. The reliability of this indicator depends on consistent reporting practices and patients re-attending hospital. We note that some infections will not be picked up if treated by a GP.

NSW Health provided information on wound infections for general surgery patients to compare hospital outcomes. It sourced the data from the APDC, included infections reported within the hospital stay and risk-adjusted the data for patient characteristics using the approach discussed in Box 6.1.

We note that the wound infection data in this study does not differentiate between 'clean' wounds (ie, sterile wounds) and 'contaminated' wounds (ie, wounds already contaminated prior to surgery or surgery into contaminated areas such as the bowel). This means that the study hospitals results need to be interpreted with caution, as their wound infection rates may not be directly comparable.

There were 52 infections among 6,665 hospital separations for the 5 study hospitals, giving an overall crude infection rate of 7.8 per 1,000 (see Table 6.2).

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34 Australian Institute of Health and Welfare, *Towards national indicators of safety and quality in health care*, September 2009, p 159, (http://www.aihw.gov.au/publications/hse/hse-75-10792/hse-75-10792.pdf).

35 Australian Institute of Health and Welfare, *Towards national indicators of safety and quality in health care*, September 2009, p 158, (http://www.aihw.gov.au/publications/hse/hse-75-10792/hse-75-10792.pdf).

Table 6.2 Wound infection within 6 weeks of general surgery, 2005/06 to 2007/08

Hospital	Risk-adjusted odds ratio	95% confidence interval
JHH	3.39	1.51-7.64
RPAH	2.51	1.21-5.19
GH, RNSH and BLH	1	

Note: Wound infection defined as ICD10AM code T81.41. See Box 6.3 for an explanation of the odds ratio. The odds ratio used in this table only compares the odds at the 5 study hospitals. It does not provide an indication of how these study hospitals compare with other hospitals.

Source: Records from the APDC (HOIST), Centre for Epidemiology and Research, NSW Department of Health.

We found that there were no statistically significant differences between GH, RNSH and BLH, so results were grouped for these hospitals. JHH and RPAH had higher odds of wound infections compared to the grouped hospitals.

6.3.4 Blood transfusion rates

This indicator measures the rate of transfusing red blood cells for appendicectomies where patients have haemoglobin levels in the range 70 g/L to 100 g/L.

According to the *Clinical Practice Guidelines on the Appropriate Use of Red Blood Cells*[36], the decision to transfuse red blood cells should be based on clinical assessment of the patient. Blood component therapy should only be given when the expected benefits to the patient are likely to outweigh the potential hazards.

Table 6.3 Guidelines for appropriate use of red blood cells

Haemoglobin level	Guideline
> 100 g/L	Use of red blood cells is likely to be inappropriate, unless there are specific indications
70 g/L to 100 g/L	Use of red blood cells may be appropriate
	The decision to transfuse should be supported by the need to relieve clinical signs and symptoms and prevent significant morbidity and mortality
< 70 g/L	Use of red blood cells is likely to be appropriate
	In some patients who are asymptomatic and/or where specific therapy is available, lower threshold levels may be acceptable

Source: National Health and Medical Research Council and the Australasian Society of Blood Transfusion, Clinical Practice Guidelines on the Appropriate Use of Red Blood Cells (http://www.anzsbt.org.au/publications/documents/AppRedBloodUse.pdf)

36 The guidelines are a joint initiative of the National Health and Medical Research Council and the Australasian Society of Blood Transfusion, in cooperation with the Commonwealth Department of Health and Aged Care, the Royal Australasian College of Surgeons, the Australian and New Zealand College of Anaesthetists, and other relevant groups (http://www.anzsbt.org.au/publications/documents/AppRedBloodUse.pdf).

When the haemoglobin level is in the range 70g/L to 100 g/L, the *Clinical Practice Guidelines on the Appropriate Use of Red Blood Cells* notes that clinical judgement about the risk of transfusion is of great importance. Use of red blood cells may be appropriate when:

- the patient is undergoing an operative procedure associated with major blood loss
- there are clinical signs, symptoms or evidence that the patient has associated impairment in oxygen transport that may be exacerbated by anaemia
- to control anaemia-related symptoms in a patient on a chronic transfusion regimen or during marrow suppressive therapy and to maintain the haemoglobin level > 80 g/L.[37]

The study hospitals collect this data at the hospital-wide level, but do not systematically report it for appendicectomy patients. Refer to Chapter 16 of our main report[38] for further information.

6.3.5 Administration of VTE prophylaxis

This indicator measures the proportion of patients who are administered venous thrombo-embolism (VTE) prophylaxis. The AIHW has noted that VTE can cause pain, loss of function and sometimes death. Further, the incidence of VTE is an indicator of the quality of postoperative care, and can reflect inappropriate or inadequate medical and nursing care. VTE invariably prolongs the duration of hospitalisation and requires additional medical intervention.[39]

The study hospitals do not systematically collect these data at the clinical level. Instead, they conduct hospital-wide audits to see whether VTE prophylaxis assessments are being conducted. Refer to Chapter 16 of our main report[40] for further information.

6.3.6 Administration of antibiotic prophylaxis

This indicator measures the proportion of patients who receive antibiotic prophylaxis. Administering an appropriate prophylactic antibiotic at the time of surgery can significantly reduce post operative infections.

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37 National Health and Medical Research Council and the Australasian Society of Blood Transfusion, *Clinical Practice Guidelines on the Appropriate Use of Red Blood Cells* (http://www.anzsbt.org.au/publications/documents/AppRedBloodUse.pdf).

38 *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*

39 Australian Institute of Health and Welfare, *Towards national indicators of safety and quality in health care*, September 2009, p 155 (http://www.aihw.gov.au/publications/hse/hse-75-10792/hse-75-10792.pdf).

40 *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*

The study hospitals do not systematically collect this data at the clinical level. Instead, they conduct hospital-wide audits to see whether antibiotic prophylaxis assessments are being conducted. Refer to Chapter 16 of our main report[41] for further information.

6.4 Issues for further consideration

There were significant differences between the study hospitals in relation to wound infection rates. These differences should be investigated further by NSW Health and appropriate clinical expert groups.

Recommendation

5 That NSW Health and clinical expert groups review the variation in wound infection rates for appendicectomy surgery at the study hospitals, and if appropriate, take steps to address the variation.

41 *NSW Health costs and outcomes study by IPART for selected NSW hospitals.*

Appendices

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 audits 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 prostheses 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 prostheses, 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
  - Note 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 (eg, 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:
  - unplanned readmission rates
  - 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:
  - a larger sample of hospitals, and
  - 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:
  - wound infection rates
  - 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:
  - caesarean section rates for 'selected primipara'
  - vaginal delivery rates following primary caesarean section
  - caesarean section rates after induction of labour for 'selected primipara'
  - repeat caesarean section rates
  - 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 indicators provided by NSW Health

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

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

No.	Indicator	Data Source	Numerator & denominator	Risk-adjustment
1	30-day mortality following appendicectomy and cholecystectomy surgery	Linked records of the APDC and RBDM death registration data. APDC records for 2005-06 to 2007-08 and deaths to 30/9/2008	*Numerator*-Number of deaths *Denominator*- Number of cases with the following DRGs: G07A, G07B, H07A, H07B, H08A, H08B.	Age, sex, comorbidity (Charlson index) and socio-economic status.
2	Wound infection	APDC 2006-07 to 2008-09	*Numerator*-Number of cases with a wound infection indicated by the ICD10-AM disease code of T81.41. *Denominator*- Number of cases with the following DRGs: G07A, G07B, H07A, H07B, H08A, H08B.	Age, sex, comorbidity (Charlson index) and socio-economic status.

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 6.1). Socioeconomic status (see Box 6.1). Patient data was combined for appendicectomy and cholecystectomy for the purpose of calculating risk-adjusted 30-day mortality rates and wound infection rates.

Source: NSW Health.

Glossary

Term	Abb.	Definition
95% confidence interval		A statistical term describing a range of values within which we are 95% certain that the true population value lies.
Activity-based funding	ABF	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.
Acute care		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.
Admission		The process by which a person commences a period of residential care in a health facility.
Admitted Patient Data Collection	APDC	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.
Agency for Clinical Innovation	ACI	A board-governed statutory health corporation that reports to the NSW Minister for Health and the Director-General of NSW Health.
Anaemia		A reduced level of haemoglobin, the protein that carries oxygen in the red blood cells. It has many causes, including bleeding (loss of red blood cells), low production of red blood cells, and processes that damage them. It can cause paleness, tiredness and breathlessness.
Appendicectomy		Surgical excision of the patient's appendix.
Appendicitis		A condition where the patient's appendix is inflamed and requires an emergency procedure (appendicectomy) to remove it.
Assistant In Nursing	AIN	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.
Australian Council on Healthcare Standards		An independent organisation dedicated to improving the quality of health care through performance reviews, assessment and accreditation.
Average length of stay	ALOS	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.

Term	Abb.	Definition
Bankstown-Lidcombe Hospital	BLH	One of the study hospitals included in the review.
Bureau of Health Information	BHI	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.
Casemix		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.
Casemix funding		See Activity-based funding.
Cholecystectomy		Excision of the gallbladder.
Clinical Excellence Commission	CEC	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.
Clinical Nurse Specialist	CNS	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.
Comorbidity		When a person has two or more health problems at the same time.
Computed tomography	CT scan	A non-invasive medical imaging method using X-rays and computer processing.
Diagnosis Related Group	DRG	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.
Enrolled Nurse	EN	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.
Episode funding		See Activity-based funding.
Fluoroscopy		An imaging technique that provides real-time moving images of the internal structures of a patient through the use of a fluoroscope.
Gosford Hospital	GH	One of the study hospitals included in the review.
Health Information Exchange	HIE	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.
Hysterectomy		Surgical removal of the uterus.

Term	Abb.	Definition
Independent Pricing and Regulatory Tribunal of NSW	IPART	The independent economic regulator for NSW that is undertaking this hospital study.
Inpatient fraction	IFRAC	A measure used in casemix costing. The proportion of total (or operating) costs that are attributed to admitted patients.
Intensive care unit	ICU	An area or environment in a hospital that provides the highest level of critical care and monitoring.
John Hunter Hospital	JHH	One of the study hospitals included in the review.
Laparoscopic surgery		Laparoscopic surgery is a surgical technique in which short, narrow tubes (trochars) are inserted into the abdomen through small (less than one centimetre) incisions. Through these trochars, long, narrow instruments are inserted. The surgeon uses these instruments to manipulate, cut, and sew tissue.
Length of stay 1	LOS1	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.
Length of stay 2	LOS2	LOS2 is the total length of stay in study hospital, ie, from admission to discharge at the study hospital.
Length of stay 3	LOS3	LOS3 is the total length of stay in study hospital plus up to 2 other hospitals - one transfer in and one transfer out.
Medical resonance imaging	MRI	A medical imaging technique most commonly used in radiology to visualise detailed internal structures of the body using a magnetic field.
Medicare Benefits Schedule	MBS	A listing of the Medicare services subsidised by the Australian government.
National Hospital Cost Data Collection	NHCDC	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.
NSW Health		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.
Odds ratio	OR	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.
Open Surgery		An invasive medical procedure where an incision is required for direct surgical access to the organs.
Principal referral hospital		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.
Principal tertiary referral hospital		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.
Prophylaxis		Disease prevention, also called preventive treatment.

Term	Abb.	Definition
Registered nurse	RN	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.
Royal North Shore Hospital	RNSH	One of the study hospitals included in the review.
Royal Prince Alfred Hospital	RPAH	One of the study hospitals included in the review.
Tracheostomy		A surgical procedure to cut an opening into the trachea (windpipe) so that a tube can be inserted into the opening to assist breathing.
Unplanned return to theatre rates		This indicator measures the rate of unplanned returns to theatre for patients with complications within the previous 72 hours during the same admission.
Venous Thrombo-embolism	VTE	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).