Quality of care in Australian public and private hospitals[1]

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Presented at Australian Conference of Health Economists
Sydney
September 30 – October 1, 2010

Abstract

This analysis examines the quality of in Australian public and private hospitals, where quality is measured using an in-hospital standardised mortality ratio. Using hospital-level data, the determinants of in-hospital mortality across both Australian public and private hospitals are estimated with a negative binomial regression using hospital-level pooled nation-wide ABS and AIHW establishment and patient data from 2003-04 to 2006-07. The largest (and most comparable) public and private hospitals were found to have similar adjusted mortality ratios. Smaller public hospitals were generally found to have greater than expected levels of mortality.

To estimate the interaction between the quality of care and the technical efficiency of public and private hospitals, the estimated hospital-standardised mortality ratios were then included as regressors in the stochastic distance function to estimate hospital technical efficiency. A description of that analysis is contained in a companion paper Measuring the technical efficiency of public and private hospitals in Australia. *Overall, Australian acute hospitals were estimated to have scope to improve their efficiency by about 10 per cent in the existing policy environment.*

1 This analysis was originally published in the Productivity Commission (PC) report *Public and Private Hospitals: Multivariate Analysis*, which was released in May 2010. This publication supplemented an earlier PC research report *Public and Private Hospitals*, which was released in December 2009. The authors would like to acknowledge the contribution of external referees Adjunct Professor Timothy Coelli and Professor Jim Butler to the analysis, and the assistance of the ABS and the AIHW in facilitating the assembly and analysis of the dataset. The findings and views reported in this paper are those of the authors and do no necessarily reflect the views of the Productivity Commission.

1 Introduction

Interest in the efficiency of Australian hospitals is becoming more and more important due to the escalating demands placed on our health system by an ageing population, heightened community expectations regarding health care, and increasing costs of new medical technologies. By improving efficiency within hospitals, there is an opportunity to free up resources for use elsewhere, either within hospitals or the broader health care sector, in order to improve the community's wellbeing. The importance of hospital efficiency within health policy is emphasised by the new funding arrangements centred around the idea of a 'national efficient price' that currently form the basis of the Australian Government's commitment to activity-based funding.

Considering efficiency of hospitals in isolation is of limited value — it is important to account for variation in the quality and effectiveness of care provided. If the efficiency of a hospital is graded only on the number of outputs produced per volume of inputs then it is possible that hospitals providing sub-standard services will rank better than those placing a greater emphasis on the quality and effectiveness of care.

Both Australian and overseas literature on hospital efficiency suggests three commonly used approaches to examining hospital efficiency. The first compares a hospital's performance solely in terms of the quantity of (intermediate) outputs provided by the hospital (for example, Dor and Farley 1996; Jacobs 2001; Rosko and Chilingerian 1999; Scott and Parkin 1995; Webster, Kennedy and Johnson 1998). Such services include the number of separations, procedures, emergency department visits, and outpatient department services. Approaching efficiency in this manner allows the differentiation of hospital activity across services provided (through the use of casemix), whilst also avoiding the difficulty of attributing resource use to hospital outcomes (as opposed to outputs) (Hollingsworth and Peacock 2008). It does not, however, incorporate the prospect of a tradeoff between quantity and quality of services, potentially penalising hospitals focussed upon delivering quality services.

The second approach is to compare hospital performance solely in terms of a clearly identifiable patient health outcome, such as unplanned re-admission rates and mortality rates (for example, Chua, Palangkaraya and Yong 2008; Jensen, Webster and Witt 2007). The attraction of this approach is that it provides a clear measure of the resources used to achieve a particular health outcome. Its disadvantage is that it provides no information about which we can judge the efficient use of scarce resources in a hospital environment.

A third approach is to compare hospital efficiency in terms of both quantity of outputs and partial indicators of health outcomes. This is the approach taken in twos papers, which examine the relationship between hospital efficiency and quality of care with a focus on whether there are systematic differences in the efficiency of public and private hospitals within Australia.

In this (the first) paper, we estimate the in-hospital-standardised mortality ratios (HSMRs) using hospital-level data for public and private hospitals between 2003-04 and 2006-07. Unlike in-hospital mortality rates, HSMRs account for differences in the characteristics of patients treated and the activities of hospitals, factors which are outside the control of hospitals (ACSQHC 2009). It is defined as the ratio of the number of observed deaths in a given hospital divided by the number of deaths that would have been expected, after adjusting for factors that affect the likelihood of in-hospital death, multiplied by 100.

Similar methods to account for the quality of hospitals have been used elsewhere (Paul 2002; Herr 2008; Yaisarwang and Burgess 2006; Zuckerman, Hadley and Iezzoni 1994), but this is the first time in Australia that we have been able to calculate the HSMRs for public and private hospitals nationally.

2 Predicting hospital mortality

The number of expected in-hospital deaths for a given hospital was estimated using a negative binomial regression, while controlling for a range of hospital and patient characteristics that are likely to affect in-hospital mortality. This approach differs from the common method of producing HSMRs, where the expected mortality rate of a hospital is predicted from a logistic regression using patient-level data (see, for example, Ben-Tovim et al. 2009; CIHI 2007, 2010; Heijink et al. 2008). This approach was necessitated by a lack of patient-level data, but is not without precedent — Korda et al. (2007) use a negative binomial to examine the effect of health care on avoidable mortality rates in Australia.

The negative binomial model is premised on the assumption that each hospital has an underlying mortality rate that can be multiplied by an ‘exposure’ to determine the expected number of deaths. In this case, the exposure is the number of casemix-adjusted separations. Further, over very small exposures, the probability of observing more than one death is small compared to the size of the exposure (Cameron and Trivedi 2005; Kennedy 2003; Winkleman and Boes 2006).

3 HSMRs as an indicator of hospital quality

The usefulness of the ratio of observed to expected deaths as an indicator of hospital quality has been subject to wide discussion, particularly in both Canada and the United Kingdom, where HSMRs are routinely reported (CIHI 2009; Dr. Foster Health 2010). It is generally recognised that mortality is a useful indicator of hospital quality for several reasons regarding its intrinsic nature and its relationship with other quality measures. First, a number of studies have demonstrated that lower HSMRs are associated with better performance in other quality indicators. For example, HSMRs are shown to have an inverse relationship with adherence to processes of care across a range of conditions, although this effect is often relatively small (Jha et al. 2007; Werner and Bradlow 2006).

Second, hospital deaths are well-defined and generally accurately reported outcomes (Ben-Tovim et al. 2009). Finally, HSMRs can also be calculated from routinely collected administrative data which may be as good at predicting risk as more expensive and less-accessible clinical databases (Aylin, Bottle and Majeed 2007; Miyata et al. 2008).

This means that a hospital that demonstrates a sustained increase in HSMRs or a persistence of HSMRs above 100 is recognised as a useful trigger for further investigation into hospital practices that may affect mortality (Zahn et al. 2008).

Other authors, however, have cautioned that HSMRs are limited in their ability to reflect hospital quality (Brien and Ghali 2008) because they do not account for differences in admission and discharge practises and make no allowance for differences in underlying morbidity rates with the surrounding population. HSMRs are broad in scope, and so do not readily point to the source of problems within a facility, provide no direct evidence as to other aspects of hospital quality (such as unplanned readmissions), and are regarded as poor predictors of adverse events or unexpected deaths (Penfold et al. 2008).

These criticisms can be addressed if HSMRs are estimated and interpreted appropriately. For example:

- while they are broad indicators, HSMRs can provide a suggestion of whether or not there is a problem of quality of care to be investigated by the hospital
- concerns regarding underlying morbidity rates in patient populations can be addressed through an appropriate risk-adjustment process
- HSMRs are not intended to be used to measure adverse events or unexpected deaths (Wen et al. 2008)
- risk adjustment provides an acceptable level of discrimination so that the residual variation between hospitals has ‘a substantial systematic element’ that justifies the use of HSMRs (Ben-Tovim et al. 2009).

Mohammed et al. (2009) also raise the possibility that HSMRs might be biased because risk-adjustment processes are premised on the assumption that risk factors are constant across hospitals, when this may not actually be the case. This is referred to as the ‘constant risk fallacy’, and could arise if coding practices differed across hospitals.

Ben-Tovim, Woodman, Hakendorf and Harrison (2009) tested the constant-risk hypothesis for Australian public hospitals using a procedure similar to that used by Mohammed et al. (2009), concluding that it is generally valid to assume constant risk across hospitals for many factors. However, the authors did find that the risk associated with being an emergency patient or being admitted from another hospital did vary across hospitals, and it was not clear as to whether risk was constant across diagnostic coding categories.

4 Hospital data

The dataset used in this analysis consisted of 459 acute overnight hospitals, which amounted to a total of 1806 observations for the years 2003-04 to 2006-07. The observations comprised:

- 343 public hospitals contributing 1354 observations
- 99 private hospitals contributing 389 observations
- 17 public contract hospitals contributing 63 observations.

Public hospitals are defined as hospitals that are 'owned' by state and territory governments and which are declared under legislation to be public hospitals. Private hospitals are privately-owned and managed and treat mostly privately funded patients. Public contract hospitals are those that are managed or owned by a non-government entity, but are declared under legislation to be public hospitals or which are contracted by governments to provide mostly public hospital services. Examples include the Mater hospitals in Brisbane, St Vincent hospitals in Sydney and Melbourne, and Calvary Public hospital in the ACT.

Data on public hospital establishments were drawn from the National Public Hospital Establishments Database (NPHED) held by the Australian Institute of Health and Welfare (AIHW). Data on private hospital establishments were drawn from the Private Health Establishments Collection (PHEC) held by the Australian Bureau of Statistics (ABS). Patient-level data on morbidity for both public and private hospitals were drawn from the National Hospital Morbidity Database (NHMD) held by the AIHW.

The dataset captures nearly all public acute hospitals and approximately 42 per cent of all private hospitals in Australia. Psychiatric hospitals, free-standing day hospitals and sub-acute and non-acute facilities were excluded from the analysis because they generally offer a more limited range of services compared to acute overnight hospitals.

Since data on private hospitals were only made available on a voluntary basis, it is acknowledged that the sample of private sector data used in this analysis may not be fully representative of Australia's private hospital sector. In particular, there is a under-representation of not-for-profit hospitals compared to for-profit hospitals: not-for-profit hospitals comprise around 43 per cent of all private hospitals in Australia (AIHW 2009a) but only 15 per cent of the sample of private hospitals in the analysis. This also leads to an under-representation of the smaller-sized private hospitals, as many of these are not-for-profit establishments.

Variables used in predicting mortality

In the estimation of the HSMRs, the choice of factors to control for was drawn largely from Ben-Tovim et al. (2009); CIHI (2010); Heijink et al. (2008); Wen et al. (2008). Patient-risk characteristics adjusted for include:

- age (1-4 years, 5-19 years, 20-59 years, 60-69 years, 70 years and older)
- gender
- Indigenous status
- Average length of stay (for medical, surgical and other patients)
- socioeconomic status (measured by the Socio-economic Index for Areas — Index of Relative Disadvantage and Advantage (SEIFA index)) (ABS 2008a)
- Major Diagnostic Category, adjusted for casemix
- Transfer status
- Charlson index of comorbidity (Charlson et al. 1987).[2]

Hospital characteristics taken into account include:

- specialist facilities (palliative care unit, high-level intensive care unit, residential care unit, domiciliary care unit, and rehabilitation unit)
- teaching status (defined according to whether a hospital was affiliated with a university to provide undergraduate medical education).
- proportion of patients who are treated as public patients
- network membership
- Evans and Walker index (Evans and Walker 1972).
- hospital size (very large, large, medium or small)

In addition, a ratio measure of the number of accident and emergency occasions of services to the number of casemix-adjusted separations was used to capture a hospital's volume of

2 The Charlson index is an odds-ratio of the risk of mortality within one year. For example, a Charlson score of 6 indicates a 6:1 (or 86 per cent) chance of the patient dying within one year.

accident and emergency services relative to its total size of operation. This, in part, accounts for differences between hospitals in the overall severity of their cases, allowing for a corresponding difference in mortality risk.

Further, the proportion of patients treated with surgical and other procedures was used to reflect the extent to which a hospital specialises in surgical and other diagnosis-related group (DRG) cases, as opposed to medical DRG cases which require a different level of resource intensity. This was included in order to further distinguish differences in overall mortality risk.

5 In-hospital mortality

Coefficients from the negative binomial regression of hospital mortality can be presented as incidence rate ratios (IRRs) for the individual factors that may affect in-hospital mortality (table 1) Negative binomial regressions model mortality levels as a rate that is subject to a level of exposure — in this case, the number of total separations. The IRR represents the percentage increase in the incidence of mortality given a one-unit increase in the independent variable.[3] For example, an IRR of 1.10 indicates that a one unit increase in the independent variable would lead to a 10 per cent increase in the mortality rate. An IRR of 0.90 indicates that a one-unit increase in the independent variable leads to a 10 per cent decline in the mortality rate.

The interpretation of categorical ‘share’ variables requires care. These are categorical variables that represent the share of patients, as a percentage, that correspond to that category. As with other regressions, any marginal effect of an increase in a categorical variable is relative to the default category for that group of variables. For example, the IRR for the share of patients aged over 70 is the ratio of expected mortality following a one percentage point increase in the share of those aged over 70 to the level of expected mortality without that increase. It is important to remember that a one percentage point increase in the share of those aged over 70 is relative to the default age category, and therefore simultaneously corresponds to a decrease in the share of those aged between 20 and 59.

3 That is, the incidence rate ratio (*IRR*) for hospital *i* for a binary variable x_i that affects mortality rate y_i can be expressed as:

$$IRR_i = \frac{E(y_i \mid x_i = 1)}{E(y_i \mid x_i = 0)}.$$

Table 1 **Effects of patient and hospital characteristics on mortality**
Incidence rate ratios

Variable	*IRR*	*Variable*	*IRR*
Age (%)		**Major Diagnostic Category (cont.)**	
Age <1 yr	0.992	Mental diseases and disorders	1.015**
Age 1–4	1.006	Drug and alcohol related diseases	0.952*
Age 5–19	0.969***	Injuries, poisoning and effects of drugs	0.998
Age 60–69	0.990	Burns	1.032
Age ≥70	1.014***	Factors influencing health status	1.008
Female (%)	0.999	**Patient's socioeconomic status (%)**	
Indigenous status (%)	0.994***	SEIFA 1	1.005***
Charlson score (%)		SEIFA 2	1.004***
2 ≤ Charlson < 3	1.000	SEIFA 3	1.005***
3 ≤ Charlson < 4	1.003	SEIFA 4	1.005***
4 ≤ Charlson < 5	0.994	**Other**	
5 ≤ Charlson < 6	1.003	Surgery/other (% of seps.)	0.978***
Charlson ≥ 6	1.131***	Ratio of emerg. visits to seps.	1.000
Average length of stay		Transfers from other hospital (% of admissions)	0.976***
ALOS (medical)	1.156***	Transfers to other hospital (% seps.)	1.006
ALOS (surgical)	0.989*	Sameday (% of seps.)	1.003
ALOS (other)	1.000	Top five MDCs (% of seps.)	0.977***
Major Diagnostic Category – casemix adjusted (%)		**Hospital characteristics**	
Eye diseases and disorders	1.013**	Recognised teaching hospital	0.990
Ear, nose, mouth and throat diseases and disorders	1.003	Neonatal intensive care unit	1.048
Respiratory diseases and disorders	1.038***	Obstetric unit	0.920
Circulatory diseases and disorders	1.023***	Intensive care unit	1.053
Digestive diseases and disorders	1.049***	Coronary care unit	1.010
Hepatobiliary and pancreatic diseases and disorders	1.017	Palliative care unit	1.253***
Musculoskeletal and connective tissue diseases and disorders	1.023***	Domiciliary care unit	0.997
Skin, subcutaneous tissue and breast diseases and disorders	1.009	Rehabilitation unit	0.924**
Endocrine, nutritional and metabolic diseases and disorders	0.993	Evans & Walker 2 (x 100)	1.002
Kidney and urinary tract diseases and disorders	1.009	Large hospital	1.181***
Male reproductive diseases and disorders	0.996	Medium hospital	1.221**
Female reproductive diseases and disorders	1.027***	Small or very small hospital	1.638***
Pregnancy, childbirth and the puerperium	1.014**	**Time**	
Newborns and other neonates	1.017	2005	0.967*
Diseases and disorders of blood, blood forming organs, immunological disorders	0.989	2006	0.961*
Neoplastic disorders	1.017**	2007	0.958*
Infectious and parasitic diseases	1.014		

******* p<0.01, ****** p<0.05, and ***** p<0.1

As expected, a higher proportion of younger patients is generally associated with a lower expected mortality rate. That is, hospitals that treat a greater number of older patients are likely to experience higher levels of mortality, all else being equal. This is consistent with patient-level studies that demonstrate that the likelihood of mortality increases with age (Ben-Tovim et al. 2009).

ALOS is associated with increased mortality for medical procedures. In contrast, for surgical procedures the likelihood of death decreases as ALOS increases. This suggests that the relationship between mortality risk and length of stay is not linear, as shown by Ben-Tovim et al. (2009).

Differences in the effect of ALOS variables on mortality also reflect the different risks associated with medical and surgical procedures. The strength of this effect is reinforced by the significance and magnitude of the specialisation variables. Hospitals with a higher concentration of separations in the five diagnostic categories in which they perform the most separations have a noticeably lower IRR. Importantly, this effect is contingent on size, and is no longer significant when the sample is restricted to large and very large hospitals.

Contrary to expectations, an increase in the proportion of admitted patients who were transferred from another hospital is associated with a significant reduction in mortality. This is in contrast to the findings of Ben-Tovim et al. (2009). A possible explanation for this is that transfers between hospitals of different sizes and capacities occur for different reasons. To examine this explanation, the share of transferred admissions was interacted with the hospital size variables, with the result being that the share of admitted patients was no longer significantly related to mortality for all hospital sizes.

Hospital-standardised mortality ratios

The HSMRs for different sub-groups of hospitals are summarised in table 2. Mean HSMR scores are prone to influence by outliers, as is evidenced by the high mean relative to the median score for public contract hospitals. Over all hospitals, the mean HSMR score for private hospitals is lower than for public hospitals by around 12 percentage points, averaged over 2003-04 to 2006-07. The difference in mortality between public and private hospitals was shown to be significant at the aggregate level by including binary variables indicating management type in a specification of the mortality equation.

When disaggregated by size, there is little difference between the HSMRs for very large public and private hospitals. If the sample is restricted to include only large and very large hospitals, there is no significant difference in the mortality risk for public and private hospitals.

Table 2 **Hospital-standardised mortality ratios, by owner and hospital size, 2003-04 to 2006-07[a]**

	Very large[b]	*Large*[c]	*Medium*[d]	*Very small and small*[e]	*Total*
Public hospitals					
Mean	101.10	106.64	99.21	102.88	102.5
Standard deviation	25.22	45.77	39.45	41.32	39.2
Median	99.36	97.23	91.92	99.21	98.1
5th percentile	59.41	62.69	39.95	44.42	48.4
95th percentile	142.16	195.47	188.58	169.22	168.9
Number of observations	252	155	167	780	1354
Private hospitals					
Mean	100.30	81.78	98.54	79.70	90.8
Standard deviation	44.17	47.18	64.35	69.64	58.8
Median	96.85	76.55	91.99	72.33	85.9
5th percentile	34.28	12.13	16.02	9.54	13.2
95th percentile	180.25	169.58	221.34	182.84	197.4
Number of observations	87	85	125	92	389
Public contract hospitals					
Mean	83.29	106.55	np	np	109.2
Standard deviation	21.53	40.19	np	np	53.6
Median	77.78	96.77	np	np	88.5
5th percentile	60.27	62.13	np	np	65.0
95th percentile	142.75	202.66	np	np	199.0
Number of observations	17	39	np	np	63
Total					
Mean	103.8	95.8	99.1	101.1	100.2
Standard deviation	48.3	43.5	51.3	46.9	44.9
Median	99.2	93	92.2	97.5	96.3
5th percentile	38.7	32	22.1	37.7	36.4
95th percentile	179.4	157.6	207.4	173.5	177.5
Number of observations	356	279	295	876	1806

a The hospital-standardised mortality ratio is equal to the actual (observed) mortality rate divided by the predicted mortality rate, multiplied by 100. **b** *Very large* hospitals report more than 20 000 separations per year. **c** *Large* hospitals are report between 10 001 and 20 000 separations per year. **d** *Medium* hospitals are those reporting 5001 and 10 000 separations per year. **e** *Very small and small hospitals* reporting less than 5000 separations per year. **np** Not published due to ABS confidentiality concerns. **..** Not applicable.

It is possible that the if the availability of primary care is an important determinant of in-hospital mortality (Heijink et al. 2008; Jarman et al. 1999), then the HSMRs of smaller public hospitals may also reflect the relative absence of primary care in more remote communities.

Differences in HSMRs can displayed by classifying hospitals into high, intermediate and low mortality groups, as per CIHI (2007). Hospitals classed as being high mortality refers to those with HSMRs and confidence intervals in excess of 100, while low mortality hospitals were estimated to have HSMRs and confidence intervals below 100. Hospitals with HSMRs and confidence intervals that intersected 100 were classed as intermediate.

Of the 163 large and very large hospitals included in the sample for all four years, around 15 per cent were low for all four years, 11.7 per cent were high for all four years and 11 per cent were intermediate. Around 35 per cent moved between having intermediate and low HSMRs, and the remaining 28 per cent moved between having intermediate and high HSMRs. Variation was much larger for the medium, small and very small hospitals, with only around 4.5 per cent classed as low for all four years, and 3.8 per cent remaining as high over this time. This is in part attributable to the increasing impact of individual deaths on mortality rates as the number of separations decrease.

Caterpillar plots

Ben-Tovim et al. (2009) present HSMRs graphically, with hospitals ranked by HSMRs on the *x*-axis and HSMRs on the *y*-axis. These plots provide a readily accessible means of displaying the distribution of HSMRs across a hospital sub-sample, along with confidence intervals that provide an indication of the reliability of the estimates.[4]

The HSMRs for very large, large and medium-sized public and private hospitals across Australia in 2006-07 are presented in the following three figures.[5] As is evident, the size of the confidence intervals increases as the size of hospitals diminish.[6] It is for this reason that plots for the numerous small and very small hospitals have not been presented.

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4 The confidence intervals shown in the caterpillar plots are calculated in the same manner as CIHI (2007) and Ben-Tovim et al. (2009), using what is referred to as Byar's approximation. Where $\mathbf{X}_i$ represents a vector of patient and hospital characteristics, the lower confidence limit for hospital *i* is given by the equation:

$$HSMR_{iLL} = \frac{deaths_i}{E(deaths_i \mid \mathbf{X}_i)} \text{ x } \left(1 - \frac{1}{9(deaths_i)} - \frac{1.96}{3\sqrt{deaths_i}}\right)^3 \text{ x } 100$$

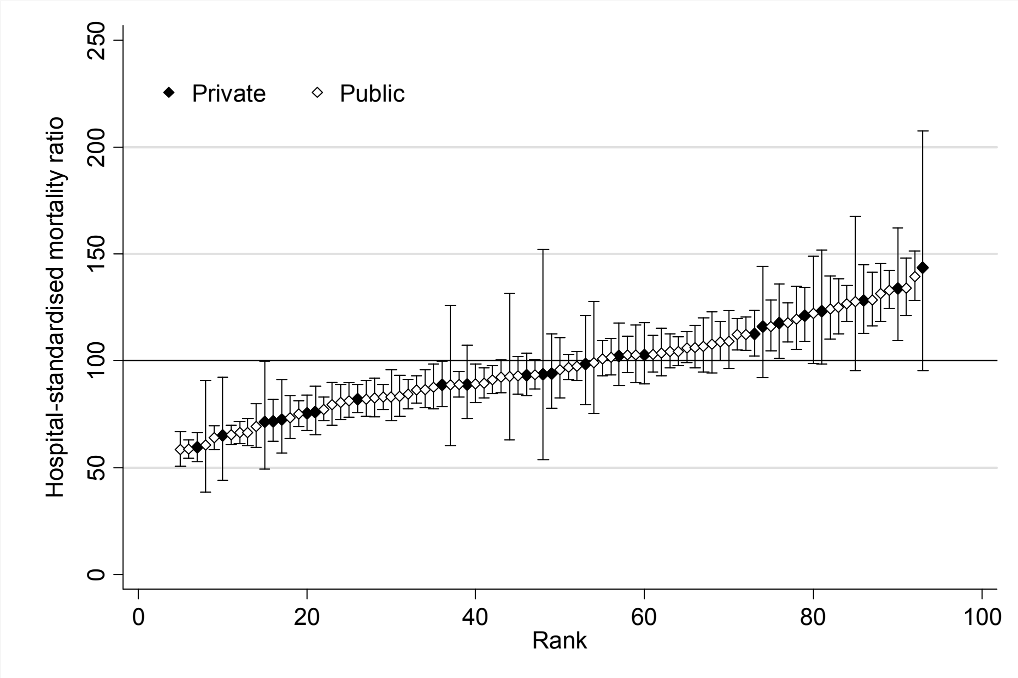
Similarly, the upper confidence limit is given by:

$$HSMR_{iUL} = \frac{(deaths_i + 1)}{E(deaths_i \mid \mathbf{X}_i)} \text{ x } \left(1 - \frac{1}{9(deaths_i + 1)} - \frac{1.96}{3\sqrt{(deaths_i + 1)}}\right)^3 \text{ x } 100$$

5 Public contract hospitals are not identified separately due to ABS confidentiality requirements. As a result, they are classified as private hospitals in these figures figure. In addition, the 5 per cent lowest and highest HSMR estimates for each hospital size grouping are not published due to ABS confidentially concerns.

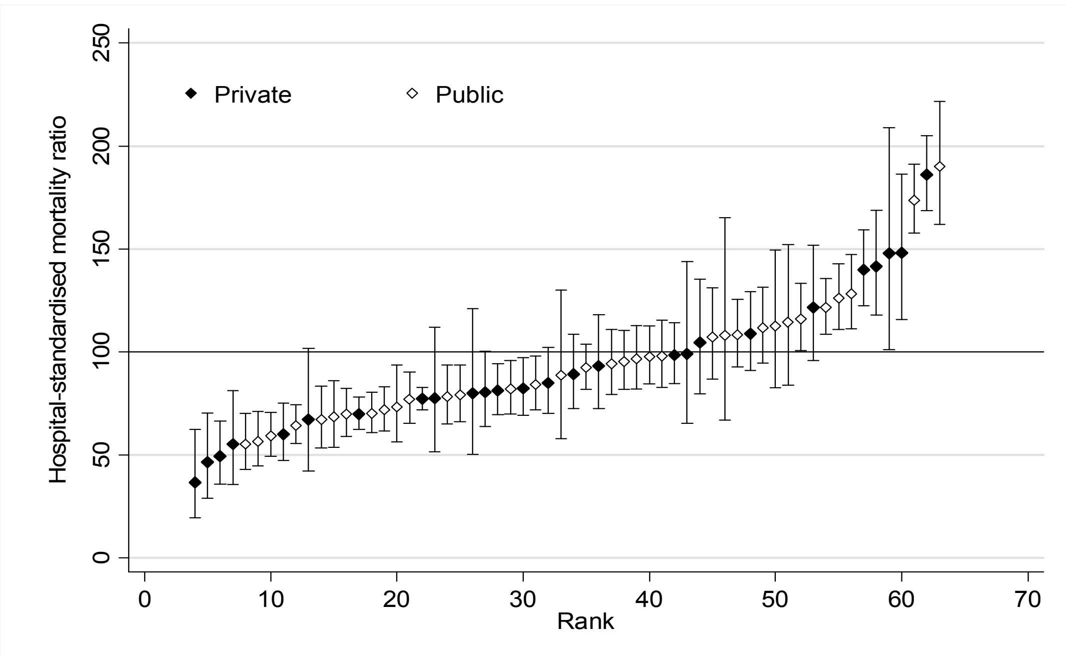
6 Technically, the size of the confidence intervals increase as the number of deaths observed in a hospital decreases.

Figure 1 **Hospital-standardised mortality ratios for very large hospitals, 2007[a]**



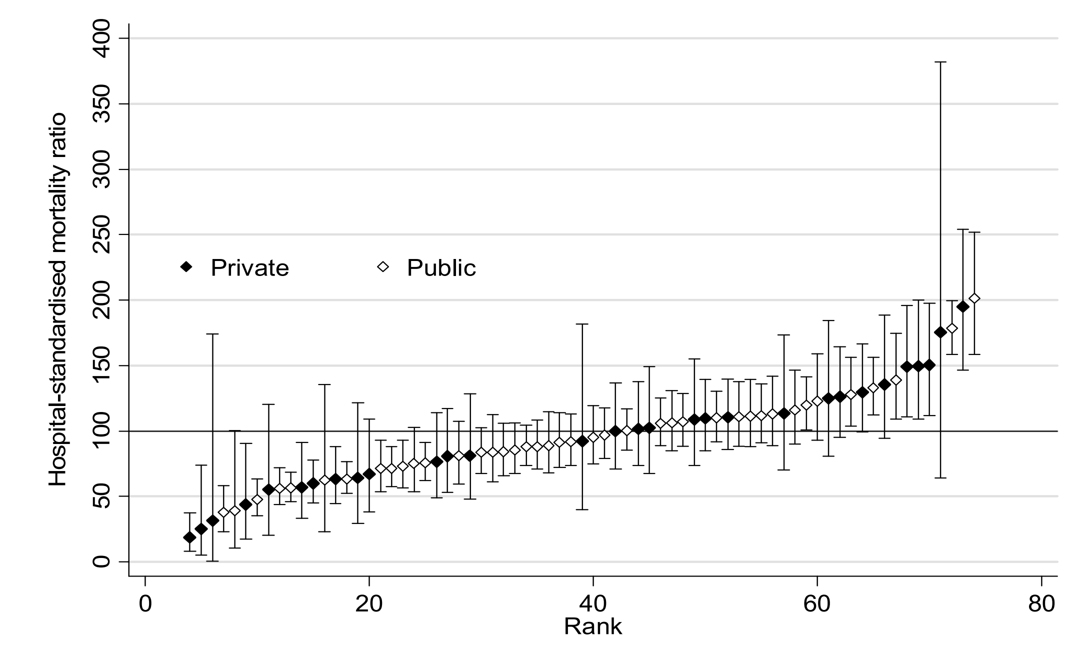
[a] Very large hospitals are those reporting more than 20 000 separations per year.

Figure 2 **Hospital-standardised mortality ratios for large hospitals, 2007[a]**



[a] Large hospitals report between 10 000 and 20 000 separations per year.

Figure 3 **Hospital-standardised mortality ratios for medium hospitals, 2007**[a]



a Medium hospitals report between 5000 and 10000 separations per year.

Around 39 per cent of large public hospitals have HSMRs are below 100, in comparison to around 37 per cent of large private hospitals. For medium-sized hospitals, the difference is reversed with around 24 per cent of public hospitals and 29 per cent of private hospitals are shown with HSMRs below 100. The difference between public and private hospitals becomes more pronounced for the smaller hospitals. Around 10 per cent of very small, small and medium public hospitals have HSMRs above 100, while this is about 25 per cent for comparable private hospitals. About 45 per cent of these private hospitals have an adjusted mortality ratio that is below 100, but for comparable public hospitals, the number is notably lower, at around 10 per cent.

6 Conclusions

The estimation of HSMRs was principally motivated for the purpose of obtaining measures of the quality of healthcare in hospitals. The factors that are expected to contribute to an increase in HSMRs include:

- proportion of patients aged 70 or over
- Charlson comorbidity score of 6 or greater
- the longer the length of stay for medical admissions

- patient socioeconomic status
- palliative care unit
- the extent to which the hospital treats respiratory diseases and disorders, digestive diseases and disorders, musculoskeletal and connective tissue diseases and disorders, and female reproductive diseases and disorders, among others.

Factors that contribute to a decrease in standardised mortality include:

- the proportion of patients aged between 15 and 19 years
- the longer the length of stay for surgical admissions
- the extent to which the hospital treats drug and alcohol diseases
- the presence of a rehabilitation unit.

These each contribute to two headline findings:

- among the largest hospitals, there is no discernible distinction in the HSMRs of public and private hospitals — when all factors are taken into account
- however, among the smaller hospitals, the HSMRs of public hospitals are noticeably higher than those of private hospitals.

It is unclear exactly what is driving the higher HSMRs of smaller public hospitals. One possible contributing factor is that patient urgency is not adequately captured in the model — apart from the degree of acuity that is captured in the casemix-adjustment of the major diagnostic categories. It is reasonable to argue that smaller public hospitals receive relatively more urgent medical cases than do their private counterparts. While the Commission sought to take this into account (with a variable defined as the number of emergency department visits divided by the number casemix-adjusted separations), the variable provided to be unsatisfactory. A more suitable measure would have been to report the relative number of emergency department admissions, by triage.

Another possible explanation is that of hospital specialisation. Smaller private hospitals specialise in a narrower range of admissions. Such specialisation can provide the scope for these hospitals to obtain a degree of economies of scale, something not available to smaller, generalist, public hospitals. While the variable *percentage of separations captured by the top MDCs* captures specialisation to an extent, more could be done to capture that dimension.

A third possible reason is that it is entirely due to the relatively lower admission traffic in smaller hospitals. This can be represented by the labour productivity of hospital staff (which is represented here as the number of casemix-adjusted separations per non-medical staff member) and the occupancy rate. While both smaller public and private hospitals have lower labour productivity and occupancy rates than the larger hospitals, the relative gap is greater for public hospitals than it is for private hospitals (table 3).

Table 3 Casemix-adjusted separations and occupancy rates, by hospital type and size

	Casemix adjusted separations per non-medical staff member	*Occupancy rate*
	No.	Per cent
All hospital sizes		
Public	23.7	69.3
Private	64.7	77.5
Public contract	65.9	82.3
Very large		
Public	25.9	96.7
Private	67.1	95.0
Large		
Public	27.9	87.4
Private	65.4	77.4
Medium		
Public	26.5	80.5
Private	66.0	74.6
Small and very small		
Public	21.0	54.5
Private	60.1	64.9

a A note.

Source: PC (2010), table 3.5.

Most importantly, this study demonstrates that it is feasible to derive reasonable estimates of HSMRs for public and private hospitals, although more could be done in the future to better understand the drivers of hospital quality.

Appendix

Table 4 **Descriptive statistics**

Variables	*Public*	*Private*	*Public contract*
Age <1 yr	2.2	1.1	2.9
Age 1-4	3.2	1.4	3.4
Age 5-19	4.4	2.1	4.3
Age 20-59	44.6	45.9	49.0
Age 60-69	13.3	16.3	13.1
Age >70	28.8	30.7	24.2
Female (%)	53.1	54.5	55.5
Indigenous status (%)	9.5	0.2	1.9
Charlson = 0	72.0	77.8	70.8
Charlson < 1	10.6	6.4	8.0
2 < Charlson < 3	11.1	9.0	13.6
3 < Charlson < 4	1.9	1.4	1.6
4 < Charlson < 5	1.5	0.5	1.2
5 < Charlson < 6	2.5	4.7	3.9
Charlson > 6	0.5	0.3	0.9
ALOS (medical)	3.7	4.3	3.4
ALOS (surgical)	3.1	2.9	3.4
ALOS (other)	1.5	1.2	1.7
Medical DRGs	77.9	42.3	63.8
Surgical and other DRGs	22.1	57.7	36.2
Eye diseases and disorders	2.4	0.6	1.6
Ear, nose, mouth and throat diseases and disorders	6.5	11.0	11.3
Respiratory diseases and disorders	2.8	1.9	2.3
Circulatory diseases and disorders	5.6	2.3	3.8
Digestive diseases and disorders	2.5	2.1	2.5
Hepatobiliary and pancreatic diseases and disorders	1.2	2.3	1.2
Musculoskeletal and connective tissue diseases and disorders	0.6	0.8	0.8
Skin, subcutaneous tissue and breast diseases and disorders	9.1	8.2	8.7
Endocrine, nutritional and metabolic diseases and disorders	9.7	4.0	6.9
Kidney and urinary tract diseases and disorders	9.2	11.7	9.4
Male reproductive diseases and disorders	2.9	1.3	2.1
Female reproductive diseases and disorders	5.5	14.8	9.1
Pregnancy, childbirth and the puerperium	4.8	6.3	5.4
Newborns and other neonates	7.3	5.4	8.8

(Continued next page)

Table 4 (continued)

Variables	*Public*	*Private*	*Public contract*
Diseases and disorders of blood, blood forming organs, immunological disorders	1.1	0.9	2.8
Neoplastic disorders	0.4	0.5	0.9
Infectious and parasitic diseases	6.3	3.3	4.9
Mental diseases and disorders	10.1	5.4	7.4
Drug and alcohol related diseases	11.0	16.6	8.8
Injuries, poisoning and effects of drugs	22.1	57.7	36.2
Burns	3.0	-	1.2
SEIFA 1	40.5	15.2	18.4
SEIFA 2	27.5	14.7	18.2
SEIFA 3	16.1	23.3	19.6
SEIFA 4	9.7	23.4	23.4
Public patients	83.4	1.0	75.4
Non-public patients	16.6	99.0	24.6
Surgery/other (% of seps.)	22.1	57.7	36.2
Ratio of emerg. visits to seps.	3.0	0.1	1.2
Transfers from other hospital (% of admissions)	8.6	2.1	5.0
Transfers to other hospital (% seps.)	4.4	6.4	4.5
Sameday (% of seps.)	40.9	52.7	47.0
Top five MDCs (% of seps.)	56.2	66.8	59.9
Recognised teaching hospital	17.8	24.2	44.4
Member of network	12.0	-	6.3
Neonatal intensive care unit	6.7	1.5	6.3
Obstetric unit	58.5	44.2	54.0
Intensive care unit	19.9	19.3	44.4
Coronary care unit	7.0	16.7	19.0
Palliative care unit	14.5	4.9	36.5
Domiciliary care unit	58.1	2.3	49.2
Rehabilitation unit	26.0	21.9	23.8
Evans & Walker 2 *100	50.6	53.1	78.0
Located in major city	25.9	67.3	77.8
Located in inner regional area	34.2	24.9	15.5
Located in outer regional area	27.8	7.1	6.3
Located in remote area	5.8	0.5	0.3
Located in very remote area	6.3	0.2	0.1
Large hospital	11.4	21.9	61.9
Medium hospital	12.3	32.1	4.8
Small or very small hospital	57.6	23.7	6.3
For-profit	-	75.8	-
Not-for-profit	-	24.2	-
Public contract	-	-	100.0
2005	25.3	25.4	25.4
2006	25.2	24.7	23.8
2007	25.3	24.7	27.0
Number of observations	**1354**	**389**	**63**

Table 5 **Profile of sample hospitals, by outputs and inputs**

	Public	*Private*	*Public contract*
Outputs — admitted patient separations (number)			
Total separations	11 312.4	12 408.0	18 261.5
Casemix-adjusted separations	11 747.1	13 397.8	19 842.7
MDC 1 separations	896.2	478.2	1 347.2
Acute separations	9 432.3	11 609.1	15 460.9
Pregnancy and neonate separations	1 265.0	844.7	1 824.9
Mental and alcohol separations	577.7	149.3	755.3
Other separations	468.6	650.4	454.3
Outputs — non-admitted patient occasions of service (number)			
Accident and emergency	15 318.7	2 633.2	22 628.9
Allied health and dental	11 529.6	600.0	12 092.6
Mental, alcohol and psychiatric services	5 883.8	12.1	16 960.1
Dialysis and endoscopy	118.1	381.4	101.6
District nursing and outreach	5 271.8	20.5	5 314.4
Pathology and radiology	26 262.3	3 611.3	30 749.6
Other outpatients	25 332.1	289.0	31 635.4
Inputs			
Nursing staff (no.)	233.8	147.5	338.3
Diagnostic & allied health staff (no.)	76.0	8.1	114.5
Other non-medical staff (no.)	161.9	76.8	241.0
Medical & surgical supplies cost ($'000)	5 357.6	3 088.7	8 513.2
Pharmaceutical supplies ($'000)	3 049.0	1 215.5	5 782.9
Other inputs ($'000)	7 781.2	11 68.6	15 222.2
Staffed beds (no.)[a]	122.6	118.1	180.0
Number of observations	**1354**	**389**	**63**

[a] Public hospital beds are reported staffed beds, and private and public contract hospital beds are estimated staffed beds.

Source: Productivity Commission estimates based on unpublished ABS and AIHW data.

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