Distinguishing between tertiary and secondary facilities: a case study of cardiac diagnostic-related groups (DRGs)

Paul Rouse, Ajit Arulambalam, Ralph Correa, Cornelia Ullman

Abstract

Aim To develop a classification of tertiary cardiac DRGs in order to investigate differences in tertiary/secondary product mix across New Zealand district health boards (DHBs).

Method 67 DRGs from 85,442 cardiac cases were analysed using cost weights and patient comorbidity complexity levels, which were used as a proxy for complexity.

Results The research found high variability of severity within some DRGs. 5 DHBs are the main providers of 27 DRGs which are high cost and identified as tertiary by several ADHB clinicians; the same 5 DHBs have on average higher severity by DRG than the other DHBs.

Conclusions NZ tertiary hospitals have a product mix of DRGs with higher complexity than secondary hospitals. Funding based on case weights needs to recognise the additional resource requirements for this higher complexity.

For over a decade now, New Zealand hospitals have been funded on the basis of diagnostic-related groups (DRGs) based budgets. The length of stay (LOS) by DRG is the crucial parameter in determining the amount of costs associated with each DRG and thus the hospital budget. Hospitals are, however, rewarded or penalised depending on whether their LOS by DRG is lower or higher than the averaged LOS used for setting DRG costs.

A review of the literature shows that there is recognition of complexity in LOS as a cost driver. This is well recognised in the management accounting and strategic management literature.\(^1,6,5\) Research into the impact of complexity in healthcare reports nearly half of a hospital’s cost behaviour is driven by complexity.\(^2,3\) However the impact of complexity on revenues when funding is based on cost based schemes has not been addressed widely in the literature.

Furthermore, the impact of complexity on cost reimbursement in these structures can lead to serious underfunding issues. Reasons for this underfunding are hypothesised in Ernst and Rouse\(^4\) who report the results of a survey showing that this problem is faced by most Western countries.

When DRGs are used as products for funding purposes, several problems arise. First, DRGs represents a mapping of outputs that may not completely capture everything an organisation does, even when focused solely on inpatients. Nonetheless, they provide a basis for costing efforts to obtain cost weights such as the WIES system.

The second problem occurs when there is variability of complexity within a DRG as shown in Figure 1. Both DRGs have the same mean average complexity but DRG2 has much greater variability. From a funding perspective, this can lead to under or
over reimbursement since cost weights are essentially averages and will reflect the average complexity levels within a DRG. Justified hospital expenditure is typically determined by its casemix and thus its managers tend to view any deficit in terms of the lack of appropriate funding.

**Figure 1. Variability in complexity for two DRGs**

![Diagram showing variability in complexity for two DRGs with DRG1 and DRG2 distributed across a spectrum of complexity from low to high]

**Figure 2. Secondary (hospital A) and tertiary (hospital B) hospitals product mix**

![Diagram showing the product mix for hospital A and hospital B with product mix categories including non-tertiary, low complex, standard mix, and high-tertiary, high complex]

Third, while the Ministry of Health (MoH) designates some hospitals as tertiary within service categories, there is no official agreement on what constitutes a tertiary DRG. This is complicated further by the existence of the aforementioned DRGs that exhibit considerable variability of complexity so that they can fall into what we call hybrid tertiary DRGs at high ends of complexity but remain secondary at the lower end.

Tertiary hospitals might be expected do more tertiary work than secondary hospitals. If we assume that there are some DRGs that are clearly tertiary, they will do more of these tertiary DRGs as well as more of the high complex hybrid DRGs resulting in a
skewed distribution of high complexity for tertiary hospitals and lower complexity for secondary hospitals as shown in Figure 2.

Method

This research uses cardiac DRGs across all NZ DHBs to develop a classification of tertiary DRGs and examines their effects on complexity across DHBs. This was compared to a classification provided by clinicians at ADHB.

Major Diagnosis Category 5 (MDC 5) covers diseases and disorders of the circulatory system and is mainly referred to as Cardiovascular Services. MDC 5 has been chosen because it was estimated to represent very different categories in terms of complexity and costs. Data was extracted from the New Zealand National Minimum Data Set comprising all inpatient treatments undertaken in New Zealand during the financial year 2006/07 and coded under MDC 5. 86,599 patient events were coded under MDC 5 and after treatments delivered in private settings of 1157, the data for this research contained 85,442.

WHO describe tertiary health services as medical and related services of high complexity and usually high cost. Complexity in health can be described in a number of ways. It can refer to the procedure(s) performed on a patient (e.g. open heart surgery), the use of specialised equipment (e.g. ventilators), specialised nursing care (e.g. intensive care unit), types of tests (e.g. laboratory tests), and by severity. Severity is a medical assessment that recognises that the treatment of diseases and disorders can be made more difficult and expensive by the presence of comorbid conditions and the development of complications during the episode of care. Comorbid complexity codes (cc) are defined as additional diagnoses that are likely to result in significantly greater resource consumption. Severity is summarised by assigning a Patient Clinical Complexity Level (PCCL) to each episode.

The PCCL is a measure of the cumulative effect of a patient’s complications and co-morbidities and is designed to prevent similar conditions from being counted more than once. PCCL scores range in value from 0 (No comorbidity or complication), 1 (Minor comorbidity or complication), 2 (Moderate comorbidity or complication), 3 (Severe comorbidity or complication) and 4 (surgical and neonates only -Catastrophic comorbidity or complication).

Several analyses were conducted to construct an index of complexity. The analysis reported here uses PCCL as a proxy for complexity.

Case weights reflect the costs of treatment for individual DRGs and allow comparisons across DRGs as well as a means of aggregating volumes. The compensation a hospital receives for the treatment of a patient is based upon the case weight and a base price.

Results

There were 67 DRGs within the MDC 5 dataset and for this category, five hospitals are recognised by the MoH as tertiary: ADHB, Waikato, Capital Coast, Canterbury and Otago. In addition to these, two other DHBs (Counties Manukau and Hutt) are recognised by MoH as tertiary in other categories. These were labelled Group A and Group B respectively.

All remaining DHBs were labelled Group C. Table 1 summarises our results. Looking at row one, there were 16 DRGs with total volumes of 6909 provided where 6506 (>90%) were provided by Group A, 394 by Group B and only 9 by Group C. A similar profile is evident for the next two rows but this begins to change from row four onwards. It should be noted that Group A contains some of the largest hospitals so the volume effect is still noticeable even when the provision is only 50% or less.

Three senior clinicians at ADHB provided a classification of the 67 DRGs into tertiary / non-tertiary resulting in 23 DRGs falling into the tertiary category. Depending on whether 70% or 80% is used as a cutoff, Table 1 would classify 27 or
19 DRGs as tertiary with 78% agreement with the clinician’s classification if 70% is used as a cutoff.

Columns 9 through 12 of Table 1 report two mean averages: (i) PCCL and (ii) cost weighted PCCL. Both of these averages decline in Group A as the DRG groups move from tertiary to more non-tertiary DRGs and generally Group A have significantly higher severity compared with Groups B and C. This provides some support for Figure 2 and the proposition that tertiary hospitals have skewed distributions in terms of severity/complexity.

Other results (not reported here) confirm differences in variability (measured by the coefficient of variation) across the 67 DRGs as depicted in Figure 1. The results in columns 9 through 12 confirm that tertiary hospitals receive greater numbers of DRGs with high end severity (as measured by PCCL).

**Discussion**

The national pricing framework for NZ secondary hospital makes heavy use of cost weights, which in the past have been based on the Australian WIES system. Given that cost weights are obtained from a mean average of costs within an interval of length of stay, they are likely to represent a weighted average of complexity. If there is large variability in complexity within a DRG, this weighted average is biased to the higher volume of lower complex cases that are conducive to secondary hospital capabilities. The higher end of complexity we have called hybrid tertiary and the funding formula is such that provision of these high end cases will not be reimbursed sufficiently as shown in Figure 3. Our analysis has provided a rationale for a tertiary classification of cardiac DRGs that has used both clinical and empirical approaches with a good level of agreement, and we show that tertiary hospitals produce a higher level of complex cases than do secondary. This imbalance is recognised by the MoH through a tertiary adjuster which is a lump sum payment to recognised tertiary hospitals. This research provides some empirical support for this additional funding.

**Figure 3. Cost weights based on mean average complexity**
Table 1. DRGs by DHB and severity

<table>
<thead>
<tr>
<th>DRGs % provided by Group A</th>
<th># of DRGs</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Total</th>
<th>Cumulative</th>
<th>Overall</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;90%</td>
<td>16</td>
<td>6506</td>
<td>394</td>
<td>9</td>
<td>6909</td>
<td></td>
<td></td>
<td>1.23</td>
<td>1.33</td>
<td>1.12</td>
</tr>
<tr>
<td>&gt; 80% &lt; 90%</td>
<td>3</td>
<td>955</td>
<td>168</td>
<td>15</td>
<td>1138</td>
<td>8047</td>
<td></td>
<td>1.35</td>
<td>1.32</td>
<td>1.56</td>
</tr>
<tr>
<td>&gt; 70% &lt; 80%</td>
<td>8</td>
<td>6787</td>
<td>1168</td>
<td>1464</td>
<td>9419</td>
<td>17466</td>
<td></td>
<td>1.11</td>
<td>1.11</td>
<td>1.33</td>
</tr>
<tr>
<td>&gt; 60% &lt; 70%</td>
<td>6</td>
<td>762</td>
<td>167</td>
<td>205</td>
<td>1134</td>
<td>18600</td>
<td></td>
<td>2.25</td>
<td>2.22</td>
<td>2.56</td>
</tr>
<tr>
<td>&gt; 50% &lt; 60%</td>
<td>5</td>
<td>1569</td>
<td>498</td>
<td>846</td>
<td>2913</td>
<td>21513</td>
<td></td>
<td>2.25</td>
<td>2.22</td>
<td>2.56</td>
</tr>
<tr>
<td>&lt;50%</td>
<td>29</td>
<td>21517</td>
<td>10243</td>
<td>32169</td>
<td>63929</td>
<td>85442</td>
<td></td>
<td>0.76</td>
<td>0.71</td>
<td>0.54</td>
</tr>
<tr>
<td>Totals</td>
<td>67</td>
<td>38096</td>
<td>12638</td>
<td>34708</td>
<td>85442</td>
<td></td>
<td></td>
<td>1.23</td>
<td>1.33</td>
<td>1.12</td>
</tr>
</tbody>
</table>

- Group A - those DHBs officially viewed as tertiary for cardiac services
- Group B - those DHBs not officially viewed as tertiary for cardiac services but tertiary for other services
- Group C - those DHBs not officially viewed as tertiary for any services

Average PPCL: Group A 1.23, Group B 1.33, Group C 1.12, Overall 1.13
Average CW PCCL: Group A 3.21, Group B 5.00, Group C 1.70, Overall 1.49
Competing interests: None known.

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