The Evolution of an Inpatient Grouping Methodology - CMG+, Doing More with Less

Authors: Craig Homan¹, Minh Duong-Hua¹, Holly Homan¹, Patricia Hanna¹

Introduction
CMG+ is the inpatient grouping methodology used in Canada. It currently contains 528 distinct cells called CMGs. Canadian cost data are then used to derive standardized cost weights called Resource Intensity Weights (RIWs). In addition to the CMG, additional factors such as age, comorbidities and "Flagged Interventions" are used for final case-specific calibration of the RIWs. This paper will discuss a two year project investigating the effect of simplifying the CMG methodology and RIW calculations on the ability to predict resource consumption.

The simplification primarily revolved around two cost weight adjustments within the methodology, Flagged Interventions (FIs) and age groups. The Flagged Intervention adjustments will be the area of discussion in this paper. FIs are interventions that are markers of high cost patients, despite the fact that they are non-surgical. They may be required for patients with primary diagnoses in any body system, and will display substantially higher cost patterns when compared to other patients with similar diagnoses. Examples of Flagged Interventions include mechanical ventilation, vascular access device, parenteral nutrition, and tracheostomy.

Methods
Prior to 2015, the CMG+ methodology had 17 separate FIs with 17 different cost adjustments. The presence of each FI on its own is linked to substantially higher cost patterns when compared to similar patients who did not require those interventions. For instance if one of two patients with a hip replacement requires mechanical ventilation then they will be expected stay longer in the hospital and require many more resources. The challenge with the 17 FI adjustments however is that they often occur together which leads to thousands of interactions and added complexity to the RIW calculations.

For 2015 therefore, the 17 FIs have been placed into 3 groups based on similarity of cost effect. Each of the three groups has a single cost adjustment, reducing the number of interactions from many thousand to eight. In conjunction with the age split changes we have dramatically reduced the number of potential cells in the methodology. So much so, that we were concerned we might have lost some of the explanatory power of CMG+.

Results
To confirm the impact of our changes we ran goodness of fit statistics, comparing the 2014 methodology to the 2015. The results are shown below. Surprisingly, these statistics showed that we have actually increased our ability to explain cost despite a substantial reduction in the number of variables fed into the model. In particular, the overall R2 went up from 75.5% to 81%.

Conclusions
As a result of this analysis the new changes have been fully implemented into the 2015 grouper. The lessons learned here are that too many related variables may over-complicate the cost weight generation so that the volume of interactions hampers the performance.

Overall R-squared

<table>
<thead>
<tr>
<th>Methodology Year</th>
<th>Bias</th>
<th>MAE</th>
<th>R-Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>-10.98</td>
<td>3106.15</td>
<td>0.8081</td>
</tr>
<tr>
<td>2014</td>
<td>34.34</td>
<td>3214.01</td>
<td>0.7589</td>
</tr>
</tbody>
</table>
1. CIHI, Kanata, ON, Canada.