

Meeting abstract

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## A comparison of frequentist and Bayesian approaches to the estimation of long-stay per-diems

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### Introduction

Within many diagnosis related group (DRG) systems, there is recognition that a single cost weight per DRG is not suitable, and that cost weights should take into account extremely lengthy hospital stays. Long lengths of stay are considered to be due to factors largely beyond the control of the hospital, and a single weight per DRG would potentially place hospitals under financial risk.

Within Canada's acute-care, inpatient grouping methodology - Case Mix Groups (CMG+) - long-stay episodes represent approximately 4.5% of all discharges. Within a CMG (analogous to DRG), the cost weight assigned to long-stay cases consists of the typical cost weight, plus a per diem for each day the case stays beyond the CMG mean.

Within a CMG, the volume of long-stay records may be low, and the episode cost data highly variable. This results in per diem estimates of low precision. In this paper, we compare two methods for calculating long-stay per diems. We employ Bayesian methods for sparse data, and compare the results to those of the current frequentist approach.

### Methods

CMG+ uses a two-step, likelihood-based approach to estimate long-stay per diems. In the first step, per diems are estimated using a weighted, least-squares regression model fitted separately to each CMG. Only typical cases are used (i.e., deaths, signouts, transfers - and long-stay

cases are excluded). The dependent variable in this regression is the cost of the case, while the independent variable is the length of stay. This model provides an estimate of the fixed cost as well as an estimate of the per diem for typical cases.

In the second step, a weighted, least-squares regression model is fitted to the long-stay cases. The dependent variable in this regression is the ratio of the actual cost of the case to the predicted cost, where the predicted cost incorporates the typical per diems from the first step. The independent variables are case mix effects. This model provides adjustments to the typical per diems, resulting in per diems for long-stay cases.

There is a strong motivation for proposing a Bayesian alternative. First, the current long-stay per diem estimates are susceptible to cost outliers. Second, we have very good information to inform prior distributions based on aggregating information for long-stay episodes across CMG. In our Bayesian alternative, a weighted, least-squares regression model will first estimate the fixed and per diem values across all CMG. In the second step, these estimates will act as prior distributions for the weighted, least-squares regression models that estimate the typical per diem for each CMG. We will evaluate whether the Bayesian models are sensitive to the values of the prior probability distributions.

## Results

We will compare the long-stay per diems, calculated using the current frequentist approach, with those calculated using our Bayesian approach. We will evaluate the magnitude and direction of changes in the per diems, changes in explanatory power of the resulting cost weights, and changes in weighted cases by hospital and stratum of hospitals.

## Conclusion

Hospitals with a disproportionate share of long-stay cases have the most at stake when per diem values are inaccurate. For CMG with large differences, underlying causes will be pursued. We will discuss whether the computing effort associated with implementing Bayesian methods is worthwhile in terms of improvement in the accuracy and precision of per diem estimates.

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