Primary care model enrolment and hospital length of stay in Ontario:
patient rostering associated with reduced length of stay, significant health system savings

by Boris Kralj, PhD
Jasmin Kantarevic, PhD
OMA Economics Department

OVER THE LAST DECADE, THERE HAS BEEN A SIGNIFICANT REFORM TO PRIMARY HEALTH CARE IN ONTARIO IN TERMS OF MODELS OF CARE DELIVERY AND MODES OF PHYSICIAN PAYMENT. A MAIN OBJECTIVE OF THIS REFORM AND INVESTMENT WAS TO IMPROVE PATIENT ACCESS AND QUALITY OF CARE RELATIVE TO THE TRADITIONAL FEE-FOR-SERVICE MODEL.

The reform was implemented through the development of a variety of new primary care models, which to date have attracted over two-thirds of primary care physicians. The new models differ mainly in how physicians are paid for their core services (e.g., fee-for-service, capitation). All other elements, which embed the principles of patient-centred care, are quite similar across different models. Examples of these elements include patient enrolment, provision of after-hour services, quality incentives (e.g., preventive care bonuses, chronic disease management), and interdisciplinary teams.

Primary care physicians in Ontario today participate in a wide spectrum of the new patient enrolment models (PEM). The PEMs are of two main types. The harmonized models, such as the Family Health Network (FHN) and the Family Health Organization (FHO), are blended capitation models. The non-harmonized models, such as the Family Health Group (FHG) and the Comprehensive Care Model (CCM), are enhanced fee-for-service (FFS) models. Physicians can choose which PEM to join, but they can also remain in the traditional FFS model. Currently, the most popular model is the FHO, with over 4,000 participating family physicians. Approximately, 8,000 Ontario family physicians practise in a PEM model, with almost 10 million enrolled patients.

Patient enrolment, or “rostering,” is a process in which patients are formally registered with a primary care provider or team. Patient rostering facilitates accountability by defining the population for which the provider is responsible. Formal patient enrolment with a primary care physician lays the foundation for a proactive approach to chronic disease management and preventive care. Enrolment provides for continuity, or longitudinality, of the care relationship between patients and physicians. Currently, almost 10 million of Ontario’s 13 million population is rostered to about 8,000 primary care physicians. Research has indicated that enrolment to a primary care practice and patient-centred care results in lower health system costs. However, this cost saving has not yet been demonstrated in Ontario.

Impact of Primary Care Reform in Ontario
The reform has been largely successful in addressing the problem of unattached patients. For example, over 2.1 million patients who previously had no family doctor (“orphan patients”) are now enrolled in a primary care model.

Today, hospital inpatient costs are $85 million lower than they would have been without primary care reform.
In addition, recent research documents that physicians in the new models provide more services, work more days, and see more patients than comparable physicians in the traditional fee-for-service model.\(^3\) These are major achievements of the reform in providing timely access to continuous and comprehensive primary health care. Furthermore, recent research documents that the reform also has a positive impact of the quality of care in targeted areas, such as preventive care (e.g., Pap smears, mammograms, flu shots for seniors, colorectal cancer screening) and chronic disease management (e.g., diabetes).\(^4\) In addition, the reform may also help contain the overall costs of medical care as physicians in the new models refer fewer patients to specialists than their fee-for-service counterparts (e.g., the regular GP office visit is $33.70, while the average specialist consultation is over $150).

An area of impact that has yet to be explored is the impact of primary care reform on hospital-related costs. This is an important issue from a cost perspective given that the largest single component of health expenditures is spending on hospitals (almost 40% of provincial government spending on health). The focus of this paper is to examine what impact patient enrolment has on the length of stay of hospital inpatients, and hence hospital sector costs. We compare the acute length of stay of hospitalized patients enrolled with a PEM family doctor to those who are not enrolled.

### Data and Analysis

The data used is from the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD), supplemented by OHIP administrative data on patient enrolment status. The data are linked via encrypted patient numbers to construct the database used in the analysis. Specifically, we extracted all inpatient admissions for the first six months of 2009/10 fiscal year (April 1, 2009 – September 30, 2009), a total of 536,628 cases. We retained patients who were admitted directly via the admitting department of reporting facilities or via the emergency department, and those patients who were discharged to a home setting with support services or discharged home with no support services, or those who left against medical advice. This generated 360,930 cases for analysis.

Length of stay (LOS) is defined as the number of acute days in hospital and represents the length of time the patient was actively treated from date of admission to date of discharge. The distribution of the length of stay is depicted in the figure on page 18.

CIHI assigns an Expected Length of Stay (ELOS) for every acute care inpatient stay. The ELOS is an estimation of the typical acute care length of stay for an inpatient visit and does not include time spent in Alternate Level of Care. Inpatient visits are assigned an ELOS by first being placed into clinically relevant and statistically homogenous groups, called Case Mix Groups (CMGs), based on the diagnosis most responsible for the inpatient stay and the most relevant clinical intervention, if any, performed on the patient. Within these CMGs, inpatient visits are then further defined by the following five factors identified as having a significant impact upon a

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contant</td>
<td>-0.021902</td>
<td>0.0030650</td>
</tr>
<tr>
<td>PEM Patient</td>
<td>-0.020886</td>
<td>0.0026259</td>
</tr>
<tr>
<td>ln(ELOS)</td>
<td>0.893157</td>
<td>0.0015923</td>
</tr>
</tbody>
</table>

Sample Size: 360,638

### Table 2

<table>
<thead>
<tr>
<th>Model</th>
<th>PEM Patient Coefficient</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLS</td>
<td>-0.020886</td>
<td>0.0026259</td>
</tr>
<tr>
<td>Q_25</td>
<td>-0.020285</td>
<td>0.0047364</td>
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<tr>
<td>Q_50 (median)</td>
<td>-0.012697</td>
<td>0.0035276</td>
</tr>
<tr>
<td>Q_75</td>
<td>-0.044091</td>
<td>0.0024874</td>
</tr>
<tr>
<td>Q_90</td>
<td>-0.059984</td>
<td>0.0041337</td>
</tr>
<tr>
<td>IQR (Q_75 - Q_25)</td>
<td>-0.023806</td>
<td>0.0070573</td>
</tr>
</tbody>
</table>
patient’s length of stay and hospital resource use: patient age,6 presence co-morbidities,6 use of 16 specific interventions,7 the number of intervention events8 and the use of an out-of-hospital intervention.9 The ELOS is calculated annually using three years of previous inpatient data collected by CIHI under the Discharge Abstract Database.10 A regression model described in the Appendix (see p. 19) is used by CIHI to calculate the ELOS.11

While the CIHI ELOS measure is a very good measure of what the acute length of stay for a patient should be, it does not control or account for the patients’ PEM (enrolment) status. We augment the ELOS measure by introducing PEM status via a multivariate OLS (ordinary least squares) and Quantile regression modeling. Given the skewed distribution of the LOS and ELOS variables, we employ a natural logarithm transformation in our regression models. Specifically, we estimate the following:

\[
\text{Ln(LOS)} = \text{Constant} + \beta_0 \text{PEM Patient} + \beta_1 \text{Ln(ELOS)} + \varepsilon
\]

The variable PEM Patient is equal to 1 if the patient was enrolled with a PEM family physician at the time of hospital admission, and 0 otherwise. Regression coefficients (\(\beta\)) from the models are converted to percentage increase impacts as follows: \(100(e^\beta - 1)\). All analyses were performed using STATA, version 12.

As noted above, in addition to OLS regression, we use quantile regression. Quantile regression reduces the importance of outliers and functional form assumptions and allows us to examine features of the distribution in addition to the mean. By supplementing the estimation of conditional mean functions with techniques for estimating an entire family of conditional quantile functions, quantile regression is capable of providing a more complete statistical analysis of the stochastic relationships among random variables. Rather than assuming that the covariates shift only the location or scale of the conditional distribution, quantile regression methods enable us to explore potential effects on the shape of the distribution as well. Therefore, for example, the effect of a policy intervention such as primary care reform on the length of patients’ hospitalization spell might be to lengthen the shortest spells while reducing the probability of very long spells. The mean intervention effect in such circumstances might be small and insignificant, but the intervention effect on the shape of the distribution of patient spell lengths could, nevertheless, be quite significant.

Our regression modeling results are depicted in Table 1 and Table 2 (see p. 17).

The results indicate that patient enrolment with PEM physicians reduces the mean length of hospital inpatient stays by 2.1%. The quantile regression results indicate that this impact is larger at the top end of the distribution, 4.4% at the 75th percen-
tile and 6.0% at the 90th percentile of the distribution. Inter-quantile regression (IQR) results further support that the impact of PEM enrolment on LOS is larger for longer hospital stays.

While a mean reduction of 2.1% may seem small, the financial impacts are quite substantial. Per-diem hospital costs in Ontario vary from about $900/day in small community hospitals to almost $2,500/day in specialty hospitals. Therefore, if we use for example a per-diem cost of $1,500/day, and annualized data from fiscal 2009/10, the 2.1% reduction in length of stay for PEM patients translates into an annual savings of about $85 million to hospital expenditures. This represents the additional cost that would occur if these patients were not enrolled. Additionally, if the 20% of hospital inpatients who are currently not enrolled with PEM physicians become enrolled, it would generate additional annual savings in hospital costs of about $22 million.

Summary
While literature supports the benefits of primary care and a continuous relationship between patient and provider, there is a paucity of literature on the financial consequences of the continuity of care.

In this paper, we compared the acute length of stay of patients enrolled with family doctors participating in PEMs to those not enrolled with PEM doctors. Our results indicate that patient enrolment, or “rostering,” on average reduces acute hospital length of stay by 2.1%. This impact is larger for those with longer length of stay, 4.4% reduction at the 75th percentile of the distribution and 6% at the 90th percentile of the distribution. This reduction in the length of stay implies that the hospital inpatient costs for acute care are $85 million lower than they would have been if the primary care physicians did not participate in the new patient enrolment models. In effect, PEM enrolment has bent the health-care cost curve. Further savings of about $22 million could be achieved if all patients were enrolled.

Appendix
The Canadian Institute for Health Information uses a regression model described by the following equation to calculate the ELOS: Ln(Acute LOS Days) = f(CMG, Age, Fl, IE, OOH, Interactions) + E

Where:
Ln = Natural log function
F = Linear function
CMG = Case Mix Group
Age = Patient Age
Fl = Flagged Intervention (1 of 16)
IE = Intervention Events
OOH = Out-of-Hospital
Interactions = Interactions between factors
E = Residual

References
1. The views expressed in this paper are strictly those of the authors. No official endorsement by the Ontario Medical Association is intended or should be inferred.
5. The following age categories are used; newborn, 0-7 days, 8-28 days, 29-364 days, 1-7 yrs, 8-17 yrs, 18-59 yrs, 60-79 yrs, 80+ yrs.
6. One of 6 comorbidity levels is assigned by the estimated impact on hospital resource use of existing comorbidities.
7. The 16 flagged interventions are; cardiovascular, cell saver, chemotherapy, dialysis, feeding tubes, heart resuscitation, mechanical ventilation >= 96 hrs, mechanical ventilation < 96 hrs, paracentesis, parenteral nutrition, pleurocentesis, radiotherapy, tracheostomy, vascular access device, non-invasive biopsy, per orifice endoscopy.
8. An intervention event is defined as a trip to the operating or surgical room, regardless of number of interventions performed.
9. Only three out-of-hospital events are included; pacemaker implant, coronary angiography and percutaneous coronary intervention.
10. All provinces and territories submit acute care hospital data into the DAD. ELOS calculations are based on national data.
13. Based on 2.61 million hospital stay days by PEM patients and 0.71 million hospital stay days by non-PEM patients.

Dr. Kralj is Executive Director, OMA Department of Economics, and OMA Chief Economist. Dr. Kantarevic is Senior Director, OMA Department of Economics.