Team-based versus traditional primary care models and short-term outcomes after hospital discharge

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ABSTRACT

BACKGROUND: Strategies to reduce hospital readmission have been studied mainly at the local level. We assessed associations between population-wide policies supporting team-based primary care delivery models and short-term outcomes after hospital discharge.

METHODS: We extracted claims data on hospital admissions for any cause from 2002 to 2009 in the province of Quebec. We included older or chronically ill patients enrolled in team-based or traditional primary care practices. Outcomes were rates of readmission, emergency department visits and mortality in the 90 days following hospital discharge. We used inverse probability weighting to balance exposure groups on covariates and used marginal structural survival models to estimate rate differences and hazard ratios.

RESULTS: We included 620 656 index admissions involving 312 377 patients. Readmission rates at any point in the 90-day post-discharge period were similar between primary care models. Patients enrolled in team-based primary care practices had lower 30-day rates of emergency department visits not associated with readmission (adjusted difference 7.5 per 1000 discharges, 95% CI 4.2 to 10.8) and lower 30-day mortality (adjusted difference 3.8 deaths per 1000 discharges, 95% CI 1.7 to 5.9). The 30-day difference for mortality differed according to morbidity level (moderate morbidity: 1.0 fewer deaths per 1000 discharges in team-based practices, 95% CI 0.3 more to 2.3 fewer deaths; very high morbidity: 4.2 fewer deaths per 1000 discharges, 95% CI 3.0 to 5.3; p < 0.001).

INTERPRETATION: Our study showed that enrolment in the newer team-based primary care practices was associated with lower rates of postdischarge emergency department visits and death. We did not observe differences in readmission rates, which suggests that more targeted or intensive efforts may be needed to affect this outcome.

Hospital readmissions are costly, representing $1.8 billion in annual health care spending in Canada (excluding fees for physician services). In the weeks following discharge, older or chronically ill patients are at increased risk of adverse events (e.g., complications or errors related to new medications), and many will return to the hospital. As many as 1 in 5 Medicare patients (≥ 65 yr) admitted to hospital for any cause in the United States are readmitted within 30 days after discharge, and about 1 in 4 patients return to the emergency department within that time. Older age, increased comorbidity and complexity of medical condition are associated with using a disproportionate amount of health care resources across various settings and an increased risk of 30-day readmission.

Hospital readmission has been the focus of much policy attention in the US and elsewhere as a potential intervention point and as a quality measure of hospital care. High rates of 30-day readmission may also indicate poor integration of the health care delivery system, one in which care is poorly coordinated across settings. Similarly, post-discharge emergency department visits, which account for about 40% of all acute post-discharge care encounters and contribute a meaningful share of hospital spending, have also been proposed as a novel marker of inadequate care coordination. A portion of all-cause hospital readmissions and post-discharge emergency department visits are deemed preventable. Investigations of the capacity of innovations in primary care delivery implemented on a large scale to affect post-discharge outcomes are lacking.
Primary care reform initiatives across Canada targeted many of the characteristics of the US Patient-Centered Medical Home model, including improved access, continuity and coordination of care. In Canada, the province of Quebec implemented Family Medicine Groups as a new practice model of multidisciplinary team-based primary care. Family Medicine Groups are designed to unite 6 to 12 family physicians and 1 or 2 nurses to provide primary care for a group of enrolled patients, with a broad range of services (e.g., case management, extended hours and emergency on-call services). By the end of 2005, about 100 Family Medicine Groups (230 sites) were operational in the province, although traditional primary care models (group or solo practices) remained the dominant type of primary health care organizations at the time.

Our study objective was to assess whether rates of readmission, emergency department visits and mortality in the 90 days after hospital discharge differed between older or chronically ill patients enrolled in multidisciplinary team-based primary care practices and those enrolled in traditional practices. We performed subgroup analyses by patient morbidity level.

Methods

Data source
The Régie de l’assurance maladie du Québec (RAMQ) pays for health services provided by hospitals and physicians for all people registered with the province’s universal health insurance program. We linked data from RAMQ databases using a unique lifetime identifier encrypted from the personal health insurance number. Data were obtained from the registered person files, which contain patient demographics; the physician claims files, which contain physician services performed in hospital, office or clinic; hospital files, which include information about each hospital admission; and physician information files, which contain information on the enrolling primary care physician, including practice type and characteristics, number of patients and services provided, and income source. RAMQ databases also contain information on the specialty of the billing physician.

Study design
The study is based on a large cohort of patients that has been described previously. The cohort was created through linkage of data from administrative health databases between November 2002 and January 2005. Since 2002, primary care physicians enrol “vulnerable patients” into their practice by billing a fee code if a patient is 70 years of age or older or has one or more specified chronic health conditions, including psychosis, chronic obstructive pulmonary disease, moderate to severe asthma, pneumonia, cardiovascular disease, cancer associated with past, present or future chemotherapy or radiotherapy treatments, cancer in a terminal phase, diabetes, alcohol or drug withdrawal, drug addiction treated with methadone, HIV/AIDS or a degenerative disease of the nervous system. The fee code is available to primary care providers in both new and traditional primary care practices.

Outcome measures
We considered the incidence of hospital readmission within 90 days after discharge as our primary outcome. For secondary outcomes, we examined the incidence of an emergency department visit and death up to 90 days after discharge. We further distinguished emergency department visits not associated with readmission, which included all visits for which there was no admission on the same day or following day.

Covariates
All covariates were measured at the time of the index admission. We included patient age, sex and major diagnostic categories, and time since enrollment by a primary care physician. We used a material deprivation index based on the 2006 census dissemination areas as a measure of neighbourhood socioeconomic status, and a categorical variable developed by the Quebec National Institute of Public Health to represent the patient’s residential geographic location as a function of the proximity to an urban centre and to a tertiary or secondary referral hospital. We controlled for the number of previous admissions, the time since previous use of inpatient care, the patient morbidity level and relative intensity of hospital resource use. We assigned a patient morbidity level from 1 of 3 Resource Utilization Bands (moderate, high or very high) calculated using the Johns Hopkins Adjusted Clinical Groups Case-Mix System and based on diagnostic codes for both inpatient and outpatient utilization in the calendar year before the index admission. Resource Intensity Weights reflect the relative use of hospital resources, adjusted for age, comorbidities.
and complexity level. In some specifications, we also included physician characteristics (age, sex, years in practice, total number of patients and income source [e.g., short-term care establishment, salary, emergency services]) and indicator variables for each hospital as covariates (Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/160427/-/DC1).

**Statistical analysis**

We first derived a propensity score from a logistic regression of Family Medicine Group enrolment at index admission on predictors. Covariates and model specifications are listed in Appendix 1. We derived stabilized inverse probability weights from propensity scores to balance covariates across exposure groups. We constructed separate sets of weights to investigate effect heterogeneity by morbidity level. Finally, we built flexible parametric survival mixture models weighted by inverse probability weights that allowed us to estimate both the subdistribution cumulative incidence functions and time-dependent cause-specific hazard ratios (HRs). The use of such models was necessary to account for competing risks (death and readmission) and for complex time-dependent associations in the post-discharge period. We used cluster bootstrapping to obtain 95% confidence intervals (CIs), and indicator variables or single imputation for missing data on covariates. We used Stata/MP 14 for all analyses.

**Ethics approval**

The Commission d’accès à l’information du Québec gave ethics approval.

**Results**

The cohort included 351,113 older or chronically ill patients admitted to hospital in Quebec for any cause between November 2002 and January 2009, which represented 749,537 hospital admissions. Of those admissions, we excluded 128,881 (17.2%) from 106,176 patients (Figure 1). We included a total of 620,656 index admissions for any cause (312,377 patients). The stabilized inverse probability weights chosen had a mean close to 1, small standard errors and a reasonable range (Appendix 2, available at www.cmaj.ca/lookup/suppl/doi:10.1503/160427/-/DC1).

Patient characteristics at index admission and standardized differences between exposure groups before and after weighting are shown in Table 1. After weighting, there were no standardized differences on measured covariates across exposure groups before and after weighting are shown in Table 1. After weighting, there were no standardized differences on measured covariates greater than 10% between team-based and traditional practices (Table 1).

We observed no meaningful or statistically significant differences in the cumulative incidence of hospital readmissions between team-based and traditional practices after adjusting for covariates (Table 2). Patients enrolled in team-based practices had a lower adjusted cumulative incidence of emergency department visits, of emergency department visits not associated with readmission and of death at 30 days after discharge and beyond (Table 2).

Table 3 shows cause-specific adjusted HRs estimated from marginal structural survival models for the association between enrolment in a team-based primary care practice at index admission and readmission or emergency department visits. Relative to patients enrolled in traditional primary care practices, those in team-based practices had similar 30-day rates of readmission, 3% lower rates of emergency department visits and 5% lower rates of emergency department visits not associated with readmission. The HRs typically moved slightly toward the null value between the 30th and the 90th day after discharge, except for readmission rates, which were 4% higher among patients enrolled in team-based practices by the end of the follow-up period (Table 3).

We found no statistically significant interaction between Family Medicine Group enrolment and morbidity level on the multiplicative scale. In Figure 2, we present the adjusted 30-day differences in cumulative incidence of postdischarge outcomes between team-based and traditional primary care practices by subgroup of patient morbidity level (i.e., additive scale). The 30-day difference for emergency department visits not associated with readmission differed according to morbidity level (moderate morbidity: 3.5 fewer visits per 1000 discharges in team-based practices, 95% CI 1.4 more to 8.4 fewer visits; very high morbidity: 10.3 fewer visits per 1000 discharges, 95% CI 5.4 to 15.2), but it was not statistically significant (p = 0.3). The 30-day difference for mortality differed significantly according to morbidity level (moderate morbidity: 1.0 fewer deaths per 1000 discharges in team-based practices, 95% CI 0.3 more to 2.3 fewer deaths; very high morbidity: 4.2 fewer deaths per 1000 discharges, 95% CI 3.0 to 5.3; p < 0.001).

**Interpretation**

In our study, about 1 in 4 older or chronically ill patients admitted to hospital for any cause returned to the hospital within 30 days after discharge (including readmission and emergency department visits).
Table 1 (part 1 of 2): Characteristics at index admission of older or chronically ill patients admitted to hospital for any cause, by primary care model, 2002–2009*

| Characteristic                                           | Primary care model | Absolute standardized difference, % | Before weighting | After weighting |
|----------------------------------------------------------|--------------------|--------------------------------------|-----------------|----------------|
|                                                          | Team-based n = 107 345 | Traditional n = 513 311 | | |
| Patient characteristics                                   |                    |                                      |                 |                |
| Female sex, no. (%)                                      | 56 568 (52.7)       | 270 672 (52.7)                     | 0.1             | 1.3            |
| Age, yr, mean                                            | 73.3               | 73.3                                 | 3.8             | 3.2            |
| Morbidity level, no. (%)                                 |                    |                                      |                 |                |
| Moderate                                                 | 19 136 (17.8)       | 86 812 (16.9)                      | 2.4             | 0.0            |
| High                                                     | 30 677 (28.6)       | 143 285 (27.9)                     | 1.5             | 0.2            |
| Very high                                                | 57 532 (53.6)       | 283 214 (55.2)                     | 3.2             | 0.2            |
| Admission cost, Can$,† mean                              | 5656               | 5656                                | 1.3             | 0.1            |
| Length of hospital stay, d, mean                         | 7.2                | 7.2                                 | 4.8             | 0.1            |
| Time since last admission, d, mean                       | 400                | 409                                 | 1.9             | 4.7            |
| Major diagnostic group, no. (%)                          |                    |                                      |                 |                |
| Infectious and parasitic diseases                        | 2184 (2.0)          | 10 764 (2.1)                       | 0.4             | 0.0            |
| Tumours                                                  | 10 618 (9.9)        | 54 298 (10.6)                      | 2.3             | 0.7            |
| Endocrine, nutritional and metabolic diseases            | 2015 (1.9)          | 10 620 (2.1)                       | 1.4             | 0.1            |
| Diseases of the blood and blood-forming organs           | 1971 (1.8)          | 9341 (1.8)                         | 0.1             | 0.6            |
| Diseases of the nervous system                           | 2968 (2.8)          | 13 614 (2.7)                       | 0.7             | 0.1            |
| Diseases of the circulatory system                       | 14 392 (13.4)       | 81 220 (15.8)                      | 6.8             | 1.4            |
| Diseases of the respiratory system                       | 7542 (7.0)          | 42 433 (8.3)                       | 4.7             | 0.3            |
| Diseases of the digestive system                         | 20 799 (19.4)       | 90 639 (17.7)                      | 4.4             | 0.4            |
| Diseases of the respiratory system                       | 11 226 (10.5)       | 48 033 (9.4)                       | 3.7             | 0.2            |
| Diseases of the skin and subcutaneous tissue             | 1449 (1.3)          | 7465 (1.5)                         | 0.9             | 0.3            |
| Diseases of musculoskeletal system and connective tissue | 7105 (6.6)          | 32 451 (6.3)                       | 1.2             | 0.0            |
| Diseases of the genitourinary tract                      | 3312 (3.1)          | 13 196 (2.6)                       | 3.1             | 0.5            |
| Symptoms, signs and ill-defined conditions               | 4240 (3.9)          | 23 044 (4.5)                       | 2.7             | 0.7            |
| Congenital anomalies or birth defect                     | 3797 (3.5)          | 22 848 (4.5)                       | 4.7             | 0.4            |
| Extrinsic causes of morbidity/mortality, abnormal findings| 7014 (6.5)          | 27 338 (5.3)                       | 5.1             | 0.4            |
| Injuries and poisoning                                   | 5107 (4.8)          | 19 749 (3.8)                       | 4.5             | 0.6            |
| Factors influencing health and contact with health services| 1606 (1.5)          | 6258 (1.2)                         | 2.4             | 0.4            |
| Time since enrolment with primary care physician, yr, mean| 2.5                | 2.5                                 | 16.2            | 0.3            |
| Year of index admission, no. (%)                         |                    |                                      |                 |                |
| 2002/03‡                                                 | 9524 (8.9)          | 81 184 (15.8)                      | 21.2            | 1.1            |
| 2004                                                    | 19 088 (17.8)       | 103 224 (20.1)                     | 5.9             | 2.2            |
| 2005                                                    | 21 317 (19.9)       | 105 660 (20.6)                     | 1.8             | 1.3            |
| 2006                                                    | 19 210 (17.9)       | 95 528 (18.6)                      | 1.9             | 0.8            |
| 2007                                                    | 18 556 (17.3)       | 94 428 (18.4)                      | 2.9             | 2.8            |
| 2008/09‡                                                | 19 650 (18.3)       | 33 287 (6.5)                       | 31.0            | 0.4            |
| Material deprivation quintile, %                         |                    |                                      |                 |                |
| 1 (low)                                                  | 11 166 (10.4)       | 71 791 (14.0)                      | 11.0            | 0.1            |
| 2                                                       | 17 142 (16.0)       | 83 240 (16.2)                      | 0.7             | 0.2            |
| 3                                                       | 22 266 (20.7)       | 99 303 (19.3)                      | 3.5             | 1.1            |
| 4                                                       | 25 249 (23.5)       | 107 648 (21.0)                     | 6.1             | 0.1            |
Patients enrolled in team-based primary care practices had a 5% lower 30-day risk of emergency department visit not associated with readmission, and significantly fewer patients died in the early period after hospital discharge compared with patients enrolled in traditional primary care practices. The strength of these associations diluted beyond 30 days after discharge. We did not find that team-based primary care delivery models were associated with lower rates of readmission within 30 days. In fact, rates of readmission were on average higher by 4% among patients enrolled in team-based practices over the complete 90 days of follow-up after discharge. Lower 30-day rates of death associated with enrolment in team-based primary care were predominantly observed among patients within the highest level of morbidity.

Several factors or mechanisms may influence rates of readmission, emergency department visits and death, including patient- (e.g., severity of illness), physician- and community-level factors that are not captured in administrative health databases. Unmeasured differences in case-mix across primary care delivery models compared in this study may have biased our analytical results. Family Medicine Group practices may enrol patients with less functional limitations or with lower severity, which in turn would make them appear to perform better in terms of mortality and other postdischarge outcome measures. To minimize the risk of residual confounding, we effectively balanced measured covariates that we believe to be reasonable proxies for patient health status and severity at index admission, and we modelled covariates, time-dependent effects and interactions flexibly (e.g., restricted cubic splines). Further, physician participation and patient enrolment in primary care models depend largely on physician preferences and characteristics (e.g., physicians who joined Family Medicine Groups have less years of practice), which may in turn affect the way patients are managed in an outpatient setting. The use of inverse probability weights based on measured physician and patient characteristics at index admission may have accounted for this selection bias to some degree, but not completely.

In the absence of unmeasured confounding, that team-based primary care practices were associated with lower mortality but not lower readmission rates suggests that Family Medicine Group practices keep their sickest patients alive longer, which in turn increases their likelihood of being readmitted. This hypothesis is consistent with the lower mortality that occurred predominantly among patients in the higher morbidity subgroups, and with the higher rates of readmission among Family Medicine Group patients that occurred later in the follow-up period rather than earlier. However, in this study, the subdistribution cumulative incidence functions and the cause-specific HRs were qualitatively similar, which suggests that competing events (e.g., death) played a minor role in driving associations with readmission and other postdischarge care encounters.

That lower rates of postdischarge emergency department visits not associated with readmission and mortality associated with team-based primary care practices occurred primarily among patients in the highest morbidity level suggests that nurses and physicians in Family Medicine Group practices

### Table 1 (part 2 of 2): Characteristics at index admission of older or chronically ill patients admitted to hospital for any cause, by primary care model, 2002–2009*

| Characteristic | Primary care model | Absolute standardized difference, % | Before weighting | After weighting |
|---------------|--------------------|------------------------------------|-----------------|---------------|
|               | Team-based n = 107 345 | Traditional n = 513 311 | | |
| 5 (high)      | 23 418 (21.8)       | 116 428 (22.7)     | 2.1             | 2.1           |
| Missing       | 8104 (7.5)          | 34 901 (6.8)       | 2.9             | 1.7           |
| Geographic region, no. (%) | | | | |
| Urban/university§ | 24 461 (22.8)       | 184 971 (36.0)     | 29.4            | 1.8           |
| Suburban      | 45 359 (42.3)       | 197 775 (38.5)     | 7.6             | 0.5           |
| Intermediate  | 30 301 (28.2)       | 100 593 (19.6)     | 20.3            | 0.4           |
| Rural         | 7014 (6.5)          | 28 277 (5.5)       | 4.3             | 1.8           |
| Missing       | 210 (0.2)           | 1695 (0.3)         | 2.6             | 0.3           |
| Enrolling primary care physician characteristics | | | | |
| Female sex, no. (%) | 25 339 (23.6)       | 121 211 (23.6)     | 7.1             | 2.0           |
| Time since graduation, yr, mean | 23.8 | 24.7 | 11.9 | 5.1 |
| No. of patients per year, mean | 2104 | 1857 | 23.4 | 0.6 |
| % of physicians with proportion of income from acute care establishment ≥ 80% | 2.0 | 0.0 | 15.7 | 1.1 |

* Covariate specifications listed here may not reflect the specifications used in statistical models. Refer to Appendix 3 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/160427/-/DC1) for a full list of covariates, specifications and 2-way interactions.

† Costs in current Canadian dollars are based on resource intensity weights for an admission multiplied by its unit cost per fiscal year.

‡ These years were grouped because a small number of patients were enrolled in late 2002 (December), and a small number were followed up until early in 2009.

§ University regions are regions where there are academic health centres (e.g., Québec, Montréal and Sherbrooke).
achieve better results in the coordination of care for the highest users in the health care system. In a parallel study, we reported that rates of postdischarge follow-up by a primary care physician were higher among patients with very high morbidity enrolled in a Family Medicine Group,⁴₈ which is consistent with the above hypothesis. Nurses in primary care teams likely play a role in providing follow-up services in the postdischarge period, but this information is not captured in Quebec administrative health databases. Although early evaluations of Quebec primary care reforms highlighted important variations in how interdisciplinary collaboration was implemented in Family Medicine Groups,⁴⁹ the roles and tasks of nurses in the design of the Family Medicine Group policy include systematic follow-up and case management for patients with complex medical needs. Future research

Table 2: Unadjusted and adjusted* differences in cumulative incidence of postdischarge outcomes among older or chronically ill patients admitted to hospital, by primary care model

| Postdischarge outcome | Primary care model; unadjusted rate per 1000 discharges | Difference in rate (95% CI†) |
|-----------------------|-------------------------------------------------------|-------------------------------|
|                       | Team-based | Traditional | Unadjusted | Adjusted |
| **Within 30 d**        |            |             |            |          |
| Readmission           | 136.3      | 140.6       | −4.3 (−6.6 to −1.9) | 1.2 (−2.1 to 4.5) |
| Emergency department visit | 201.3     | 210.0       | −8.8 (−13.1 to −5.7) | −4.2 (−8.2 to −0.2) |
| Emergency department visit not associated with readmission | 159.4 | 170.1 | −10.7 (−14.0 to −8.2) | −7.5 (−10.8 to −4.2) |
| Death                 | 11.1       | 16.8        | −3.7 (−4.4 to −2.9) | −3.8 (−5.9 to −1.7) |
| **Within 90 d**        |            |             |            |          |
| Readmission           | 253.0      | 256.7       | −3.5 (−7.5 to 0.1) | 5.5 (0.8 to 10.3) |
| Emergency department visit | 321.4     | 331.4       | −10.0 (−14.3 to −7.1) | −5.3 (−10.1 to −0.4) |
| Emergency department visit not associated with readmission | 255.7 | 269.4 | −13.7 (−17.3 to −11.0) | −10.7 (−14.9 to −6.5) |
| Death                 | 22.6       | 27.0        | −4.4 (−4.4 to −3.4) | −5.0 (−7.9 to −2.2) |

Note: CI = confidence interval.
*All index admissions (n = 620 656) were included in the analysis. Covariates and 2-way interactions adjusted for are listed in Appendix 1 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/160427/-/DC1).
†Cluster bootstrapping was used to obtain 95% CIs.

Table 3: Unadjusted and adjusted* cause-specific hazard ratios (HRs) for the association between enrolment in team-based primary care practice at index admission and postdischarge outcomes

| Postdischarge outcome | Unadjusted HR (95% CI†) | Adjusted HR (95% CI†) |
|-----------------------|-------------------------|------------------------|
| **Within 30 d**        |                         |                        |
| Readmission           | 0.98 (0.95 to 1.01)     | 1.01 (0.96 to 1.04)    |
| Emergency department visit | 0.95 (0.93 to 0.97) | 0.97 (0.93 to 1.00)    |
| Emergency department visit not associated with readmission | 0.92 (0.90 to 0.95) | 0.95 (0.91 to 0.98)    |
| Death                 | 0.88 (0.82 to 0.95)     | 0.95 (0.92 to 0.98)    |
| **Within 90 d**        |                         |                        |
| Readmission           | 1.01 (0.98 to 1.04)     | 1.04 (1.00 to 1.07)    |
| Emergency department visit | 1.00 (0.97 to 1.03) | 0.99 (0.95 to 1.02)    |
| Emergency department visit not associated with readmission | 0.97 (0.94 to 1.00) | 0.97 (0.92 to 1.00)    |
| Death                 | 0.93 (0.84 to 1.04)     | 0.97 (0.93 to 1.00)    |

Note: CI = confidence interval.
* Covariate specifications and 2-way interactions adjusted for are listed in Online Appendix 1.
†Cluster bootstrapping was used to obtain 95% CIs.
should investigate the role played by primary care nurses for recently discharged patients. In addition, because postdischarge follow-up by nurses was not specifically addressed in the Family Medicine Group policy, this represents a potential intervention point that could further affect patient outcomes and cost of care.

Our study is unique in examining patterns of readmissions and other post-discharge events in the context of system-level efforts to transform primary care delivery. Results from other studies that examined practice-level (or “bottom-up”) innovations implemented locally and with greater intensity may provide insight into future policy targets to scale up Canadian reforms. In the US, many of the primary care practices studied thus far that undertook transformation for enhanced care coordination within the Patient-Centered Medical Home framework were found to have significantly lower readmission rates.50–54 These often included case management, multidisciplinary teams and postdischarge follow-up. Of note, the Patient-Centered Medical Home model strongly emphasize care coordination across all elements of the health care system (e.g., hospitals, home health care, community resources and supports). The same level of emphasis on care coordination was not observed when Quebec’s Family Medicine Group policy was implemented. Strategies for care coordination examined in recent systematic reviews and meta-analyses of randomized controlled trials also found that involving more individuals in postdischarge care delivery (e.g., multidisciplinary teams and care managers) as well as supporting patient capacity for self-care led to significant reductions in hospital admissions or readmissions.25,55 A compilation of studies also found that postdischarge follow-up was associated with reductions in readmission rates,56–61 including one study conducted by our research team that highlighted particularly important reductions if follow-up was provided in a timely manner in a primary care setting (unpublished data). Consistent with our results, the evidence on team-based primary care models in Canada have pointed to small improvements in health utilization measures (not specifically in the postdischarge period), mainly lower rates of hospital admission and emergency department visits among older or chronically ill patients, and some improvements in processes of care.35,62–65

Limitations and strengths
As discussed earlier, the causal interpretation of our results is tempered by potential sources of bias, most notably by unmeasured confounding due to severity of illness and functional limitations of patients and by selection bias due to physician preferences and practice behaviours.

Our study has several methodologic strengths. We used data for more than 600,000 admissions that occurred from 2002 to 2009. The large database of patients used in this study likely reflects the population of older or chronically ill patients in Quebec who visited a primary care physician, which greatly improves the generalizability of our findings. We also used methods to address various biases,
including inverse probability weighting to address selection and collider-stratification bias, and flexible modelling of covariates and time-dependent effects to address model misspecification.

Conclusion
Our study showed that the newer team-based primary care delivery model in Quebec was associated with some better post-discharge outcomes among older or chronically ill patients, notably lower rates of emergency department visits and death. We did not observe differences in the 30-day rate of readmission between team-based and traditional practices, although the rate of readmission beyond 30 days seemed to be slightly higher among patients enrolled in team-based practices, which may or may not have been due to patients surviving longer in this group. The lack of an association between enrolment in a team-based primary care practice and readmission, and the lack of differences in any of the outcomes among patients in the lower spectrum of medical complexity, suggests that more targeted or intensive efforts may be needed to improve postdischarge outcomes among older or chronically ill patients.

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