Role of Interprofessional Primary Care Teams in Preventing Avoidable Hospitalizations and Hospital Readmissions in Ontario, Canada: A Retrospective Cohort Study

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Abstract

Background: Improving health system value and efficiency are considered major policy priorities internationally. Ontario has undergone a primary care reform that included introduction of interprofessional teams. The purpose of this study was to investigate the relationship between receiving care from interprofessional versus non-interprofessional primary care teams and ambulatory care sensitive condition (ACSC) hospitalizations and hospital readmissions.

Methods: Population-based administrative databases were linked to form data extractions of interest between the years of 2003-2005 and 2015-2017 in Ontario, Canada. The data sources were available through ICES. The study design was a retrospective longitudinal cohort. We used a “difference-in-differences” approach for evaluating changes in ACSC hospitalizations and hospital readmissions before and after the introduction of interprofessional team-based primary care while adjusting for physician group, physician and patient characteristics.

Results: As of March 31 st , 2017, there were a total of 778 physician groups, of which 465 were blended capitation Family Health Organization (FHOs); 177 FHOs (22.8%) were also interprofessional teams and 288 (37%) were more conventional group practices (“non-interprofessional teams”). In this period, there were a total of 13,480 primary care physicians in Ontario of whom 4,848 (36%) were affiliated with FHOs —2,311 (17.1%) practicing in interprofessional teams and 2,537 (18.8%) practicing in non-interprofessional teams. During that same period, there were 475,611 and 618,363 multi-morbid patients in interprofessional teams and non-interprofessional teams respectively out of a total of 2,920,990 multi-morbid adult patients in Ontario. There was no difference in change over time in ACSC admissions between interprofessional and non-interprofessional teams between the pre- and post intervention periods. There were no statistically significant changes in all cause hospital readmission s between the post- and pre-intervention periods for interprofessional and non-interprofessional teams.

Conclusions: Our study findings indicate that the introduction of interprofessional team-based primary care was not associated with changes in ACSC hospitalization or hospital readmissions. The findings point for the need to couple interprofessional team-based care with other enablers of a strong primary care system to improve health services utilization efficiency.

Background

Improving health system value and efficiency are considered major policy priorities internationally.1,2 While health system costs continue to be a challenge across jurisdictions, hospitalizations for ambulatory care sensitive conditions (ACSCs) and hospital readmissions have been a focus for policymakers.3,4,5, 6 ACSC hospitalizations are potentially avoidable by preventing the inception of disease, controlling an acute episodic illness, or managing a chronic condition effectively.7 When care is delivered to patients when and where they need it, hospital readmissions can sometimes be prevented.8 Evidence has suggested a link between the burden of multi-morbidity and health services use, particularly

hospitalizations.9,10,11,12 Hence, multi-morbid patients continue to be a key focus from a clinical care and population health perspective.13,14,15,16 Interprofessional team-based care may have an important role to play in caring for multi-morbid patients by offering a collaborative approach to prevent ACSC hospitalization and hospital readmissions.

During the 1990s, federal and provincial governments in Canada faced fiscal challenges that resulted in limited healthcare spending and investments in primary care innovation.17 In the 2000s, Ontario introduced primary care reform in response to the recommendations of various federal and provincial reports.18,19 Primary care reform movement in Ontario included three major policy initiatives: new physicians' reimbursement and organizational models, patient enrolment with a primary care provider and support to interprofessional team-based care.24 During the last twenty years, more than one third of Ontario primary care physicians have voluntarily transitioned from traditional fee-for-service practice to blended capitation payment and in some cases received additional funding to support interprofessional team members to join their practice.20 Ontario interprofessional Family Health Teams have many similarities with Quebec Family Medicine Groups, Alberta Primary Care Networks and the Patient-Centered Medical Home in the United States (US).21,22,23,24

In Ontario, reducing hospitalization for ACSC conditions and all-cause readmission are strategic priorities.25,26 In this study, we examined the association between the introduction of primary care interprofessional teams and unplanned ACSC hospital admissions and all cause hospital readmissions among multi-morbid patients. We compared changes in those outcomes over time among physicians remunerated through the same physician payment model, some of whom transitioned to interprofessional team-based practice. We hypothesised that multi-morbid patients who receive care from an interprofessional teams will have lower ACSC hospital admissions and all-cause readmissions over time when compared to patients receiving care from non-interprofessional teams.

Methods

Setting

Ontario is the most populous province in Canada with a population of 14.4 million people in 2019.27 During the last two decades Ontario primary care services payment and organization have been subject to significant changes. In the early 2000s, primary care physicians were mainly paid on a fee-for-service basis and worked individually. Currently, most primary care physicians work in organised models and are largely paid through capitation. The three dominant practice models in Ontario are: enhanced fee-for-service (85% fee-for-service, 15% capitation and bonuses, no funding for non-physician health professionals); non- interprofessional team blended capitation (20% fee-for-service, 80% capitation and bonuses, no funding for non-physician health professionals), and interprofessional team blended capitation (20% fee-for-service, 80% capitation and bonuses, and funding for non-physician health professionals).28 The dominant model in Ontario is Family Health Organization (FHO). Within FHOs groups of physicians can be practicing in either interprofessional or non-interprofessional teams. At

minimum, three physician practice together in a FHO to offer comprehensive care. FHOs were eligible to apply for additional funding to become interprofessional teams and typically include primary care physicians and nurses or nurse practitioners and at least one allied health care professional such as pharmacist, social worker or dietitian. Interprofessional teams are also eligible for funding an administrator or executive director and electronic medical records.

Study design and population

We conducted a retrospective cohort study with longitudinal design given the importance of temporal effect on interprofessional teams formation and maturation and their relationship to the outcomes under investigation. We used the “difference in differences” approach, an econometric method for evaluating changes in outcomes after policy implementation. The difference-in-differences study design compares outcomes after and before the intervention between the study group without the exposure (group A: patients in non-interprofessional teams) and the study group with the exposure (group B: patients in interprofessional teams). Two differences in outcomes are important: the difference after vs before the implementation of interprofessional teams in the group exposed (B2 −B1) and the difference after vs before the implementation of interprofessional teams in the unexposed group (A2 −A1). The change in outcomes that are related to implementation of interprofessional teams beyond background trends can then be estimated from the difference-in-differences analysis as follows: (B2 −B1) −(A2 −A1). If there is no relationship between implementation of interprofessional teams and subsequent outcomes, then the difference-in-differences estimate is equal to 0. In contrast, if the implementation of interprofessional teams is associated with beneficial changes, then the outcomes following implementation will improve in the exposed group. 29

Several population-based administrative databases were linked using unique encoded identifiers at ICES (formerly known as the Institute for Clinical Evaluative Sciences) to form data extractions of interest. We generated a cohort that included the same patients at two different points in time, pre- and post-teams’ formation. The study population included patients between 18 and 105 years old, who had two or more of a list of 17 chronic conditions as identified at the beginning of the pre-teams’ formation period, March 31st 2003 and who were part of a FHO blended capitation model as identified at the beginning of the post-teams formation period, March 31st, 2015. The chronic condition selection was based on clinical relevance and impact on the outcomes being investigated as described in previous literature.30,31,32,33,34,35 These conditions have been adopted in previous studies 36,37 and are consistent with the parameters outlined by the Department of Health and Human Services for defining and measuring chronic conditions.38 The conditions include: cancer, diabetes, asthma, chronic obstructive pulmonary disease (COPD), hypertension, chronic coronary syndrome (CCS), cardiac arrhythmia, congestive heart failure (CHF), stroke, acute myocardial infarction (AMI), renal failure, arthritis (excluding rheumatoid arthritis), rheumatoid arthritis, osteoporosis, depression, dementia and mental health conditions (full list of diagnostic information for defining the 17 selected chronic conditions under investigation in this study are included in Appendix A).

The baseline study population included people identified before interprofessional teams formation who were still identifiable after interprofessional teams formation and were part of the FHO blended capitation model. People in the baseline population were followed-up to February 28th, 2005 for first unplanned ACSC admission and up to March 31st, 2005 for first all-cause readmission and in the follow up period up to February 28th, 2017 for the first ACSC admission and up to March 31st, 2017 for all-cause readmission. Given that teams did not exist during the baseline period, assignment of patients to interprofessional and non- interprofessional teams was based on their post-intervention assignment. We excluded individuals who died and individuals who were in long term care or complex continuing care.

Measures and data sources

ACSC Admission and Hospital Readmission

The primary outcome was hospital admissions for ACSCs, defined as the first hospital non-elective admission with a most responsible diagnosis code of: grand mal status and other epileptic convulsions, chronic obstructive pulmonary disease (COPD), asthma, diabetes, heart failure and pulmonary edema, hypertension and angina.

The secondary outcome was hospital readmissions, defined as the first subsequent non-elective all-cause readmission to an acute care hospital within 30 days of discharge, among hospitalisation for selected Case Mix Group (CMG) groups: stroke, COPD, pneumonia, congestive heart failure, diabetes, cardiac conditions, gastrointestinal conditions (List of CMGs codes in Appendix B). The primary and secondary outcomes were derived from the OHIP database and the Discharge Abstract Database (DAD) and the Registered Patient Database (RPDB) available at ICES. Both outcomes excluded people without a valid date of admission/discharge; and people who died during their hospital stay (relevant to admission but not readmission).

Physician Group and Physicians Characteristics

Physician group characteristics included the number of physicians per group and number of years under the capitation model. Physicians' characteristics included age, sex, Canadian graduate status and number of years in practice. Those variables were derived from a health care provider data registry available at ICES.

Patient Characteristics

Patients' characteristics included age, sex and recent OHIP registration as a proxy for immigration (might include recent registrants that moved from other provinces) which were identified from a population and demographics data registry available at ICES. By linking patients' postal code to census data we were able to derive neighborhood income quintiles. Income levels, adjusted for household size and specific to each community, were used to order postal codes into quintiles, with quintile 1 having the lowest relative income and quintile 5 the highest. Rurality was identified using the Ontario Medical Association Rurality Index of Ontario (RIO).39 The RIO is based on community characteristics including travel time to different

levels of care, community population, presence of providers, hospitals and ambulance services, social indicators and weather conditions. RIO scores range from zero to 100 (zero indicating the most urban and 100 the most rural). RIO scores are divided into three main categories, major urban centres, semi-urban centres and rural areas. We used the Johns Hopkins Adjusted Clinical Groups case-mix system software to assign patients into expected Resource Utilization Bands (RUBs) categories.40 The RUBs range from 0 indicating no utilization to 5 indicating very high expected utilization.

Six chronic diseases conditions (AMI, asthma, CHF, COPD, hypertension, diabetes) were defined based on previously validated population-derived ICES cohorts.41,42,43,44,45,46 For the conditions where a derived ICES cohort was not available (cancer, cardiac arrhythmia, chronic coronary syndrome, dementia, depression, arthritis (excluding rheumatoid arthritis), osteoporosis, renal failure, rheumatoid arthritis, and stroke), a similar approach for the derivation was adopted—at least one diagnosis recorded in acute care, or two diagnoses recorded in physicians' records within a two-year period. The conditions were derived using the DAD and OHIP databases available at ICES.

Statistical analysis

For the descriptive results, we generated frequencies, percentages, means and standard deviations to describe the characteristics of physician groups, physicians and patients who are either in interprofessional teams or non-teams and their respective admission and readmission rates.

For the admission and readmission models, as a first step we tested for patient clustering within physicians using a random effects logistics regression. Clustering was not significant. As a result, we ran ordinary logistic regression models with binary outcomes of ACSC admission and all-cause readmission. The independent variables added to the models were the respective physician group, physician and patient characteristics.

To estimate the difference in differences we used Generalized Estimating Equations method to account for repeated measures within patients. The independent variables added to the models were the respective physician group, physician and patient characteristics.

All study analyses were conducted using SAS v.9.3 and statistical significance was assessed at a p-value <0.05.

Ethics Approval

The use of data in this project was authorized under section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a research ethics board.

Results

Baseline physician group, physician and patient characteristics comparing interprofessional teams to non-interprofessional teams

As of March 31st, 2017, there were a total of 778 physician groups in Ontario, of which 465 were FHOs; 177 FHOs (22.8%) were also interprofessional teams and 288 (37%) were non-interprofessional teams. Compared to non-interprofessional teams, interprofessional teams had: more physicians per group and more years under the capitation model.

In this period, there were a total of 13,480 primary care physicians in Ontario of whom 4,848 (36%) were affiliated with FHOs, 2,311 (17.1%) practicing in interprofessional teams and 2,537 (18.8%) practicing in non- interprofessional teams. Compared to non-interprofessional teams, interprofessional teams had fewer patients per physician, more female physicians, more physicians in the younger age group, more physicians who were Canadian graduates and fewer years in practice (Table 1A).

During the same period, there were 475,611 and 618,363 multi-morbid patients in interprofessional and non- interprofessional teams respectively out of a total of 2,920,990 multi-morbid adult patients in Ontario.

Overall interprofessional teams had fewer new immigrant patients and more patients who reside in rural areas. Other patient characteristics were relatively similar between interprofessional and non-interprofessional teams. When compared to all physician groups, both interprofessional and non-interprofessional teams had less patients with high number of co-morbidities (Table 1B).

ACSC hospital admissions and all cause 30-day re-admissions in interprofessional teams and non-interprofessional teams by physician and patient characteristics

During the period of April 1st, 2015 to March 31st, 2017, the unadjusted results showed that interprofessional teams were found to have higher ACSC admission rates when compared to non-interprofessional teams (2.5% versus 2.1%, respectively). When we stratified the results by physician characteristics, the following had a higher ACSC admission rate: males, older physicians, and non-Canadian graduates (Table 2A). When we stratified the results by patient characteristics, the following had a higher ACSC admission rate: males, older patients, non-immigrants, patients in the lowest neighborhood income quintile, residents of a rural area, patients in the highest expected resource utilization band and patients with five and plus co-morbidities (Table 2B).

During that same period, the unadjusted results showed that interprofessional teams had a slightly higher all cause hospital 30-day re-admission rate when compared to non-interprofessional teams (15.0% versus 14.6%, respectively). When we stratified the results by physician characteristics, we found that non-Canadian graduates had a higher readmission rate (Table 3A). When we stratified the results by patient characteristics, the following had a higher readmission rate: males, patients in the older age category, residents of major urban areas, patients in the highest expected resource utilization band and patients with five or more co- morbidities (Table 3B).

When we stratified the results by males and females for both outcomes, we did not identify sex differences (results not presented but can be made available on request).

Association between enrolment in an interprofessional team model and ACSC hospital admission and all cause hospital readmission

During the post-intervention period, when we adjusted for physician group, physician and patient characteristics, being in an interprofessional team increased the likelihood of having ACSC hospital admission by 7%. For the same period, we did not find significant difference between interprofessional and non- interprofessional teams for hospital all cause readmission (Table 4).

When we examined difference in ACSC hospital admission during the after and before periods the difference was the 1.34% among both interprofessional teams (B2-B1) and non-interprofessional teams (A2-A1). Hence, there was no difference-in-differences (B2 −B1) − (A2 −A1).

When we examined difference in hospital readmission during the after and before periods the difference was 4.90% (p-value 0.0003) among interprofessional teams (B2-B1) and 1.47% (p-value 0.2798) among non- interprofessional teams (A2-A1). The difference-indifferences (B2 −B1) −(A2 −A1) was non-significant at 3.43% (p-value 0.0975) (Table 5).

Discussion

We used administrative databases to assess the association between receiving care from interprofessional and non-interprofessional primary care teams and unplanned ACSC hospitalizations and all cause hospital readmissions among multi-morbid patients. We followed the same patients before and after teams were implemented which allowed an assessment of the effect of the intervention—introduction of interprofessional team-based care. When we investigated the outcomes during the most recent available period of April 1st, 2015 to March 31st, 2017 interprofessional teams were found to have higher ACSC admission and hospital readmission rates as compared to non-interprofessional teams. However, when we compared the outcomes over time, interprofessional teams were not associated with either an increase or a reduction of ACSC hospital admission and hospital readmission.

The results are consistent with previous evidence that looked at utilization in relation to interprofessional team-based care and found differences in quality but not in healthcare utilization and cost.47,48,49,50 One US study that evaluated the effect of multiplayer patient-centred medical home on healthcare utilization did not find a significant reduction in inpatient admissions.51 In contrast, several studies from the US assessed multiple components of the medical home model on health services utilization and found significant lower rates of avoidable hospitalization when more medical homeness was incorporated in the health system.52,53,54 Implementation of Family Health Teams appeared to contribute to a reduction in ACSC hospitalizations in a Brazilian metropolis, Belo Horizonte.55

There is a body of evidence that links chronic disease management programs to lower preventable hospitalizations.56,57,58,59 In Ontario, patients being served by both interprofessional and non-interprofessional teams have access to certain chronic disease programs including diabetes education and heart failure clinics. This could be one of the reasons for the absence of difference in our study

between receiving care from interprofessional and non-interprofessional teams in ACSC hospitalizations. Additionally, there is heterogeneity of interprofessional teams features across Ontario. Interprofessional team's composition and the skills mix vary across the different teams. Some interprofessional teams are co-located others are not. Hence, some interprofessional teams might not be ideally set up for care coordination and continuity of care. Continuity of care might be reduced within interprofessional teams if they are not well coordinated and might present a potential for fragmented care. Available evidence from a systematic review suggests that having an accessible and a long-term relationship with a primary care provider appeared to be more important in reducing potentially avoidable hospitalizations than how the primary care delivery is organized. Long-term relationships between primary care physicians and patients reduces hospitalizations for chronic ACSCs and continuity of care has been associated with both reduced health services utilization and patient satisfaction. 60,61,62 Continuity of care is critical to ensuring that everyone with chronic medical needs receive effective, timely and safe health care.63

Based on Startfield's model a strong primary care system should be the first contact for care, as well as continuous, comprehensive and well-coordinated to reduce unwanted outcomes such as preventable hospitalizations.64 It is important for any jurisdiction that has embarked on or is planning to set up primary care interprofessional team-based care to nurture all these enablers for a strong primary care system.

Our study has several limitations that should be acknowledged. First, administrative databases have not been originally set up for research purposes, which presented a potential for measurement error. However, all the databases used in our study have been validated in Ontario's context. Additionally, any potential measurement error will be non-deferential between interprofessional and non-interprofessional teams and should not bias the results in a meaningful way. Second, this is an observational study and is susceptible to unmeasured confounding. However, by comparing the outcomes over time, potential risk of bias from unmeasured confounders was limited. Third, due to the adopted study design, to be included in the study population, patients had to survive throughout the study period—April 1st, 2003 to March 31st, 2017.

However, a potential survival bias would have affected both interprofessional and non-interprofessional teams' patients equally and does not present a threat to internal validity. Fourth, ACSC medical admissions and all-cause readmissions are not all unnecessary and preventable. In contrast, in some cases, admission and readmission could be appropriate and reflect appropriate care in the community that flagged the need to be hospitalised.

Conclusion

Our study findings indicate that the introduction of interprofessional team-based primary care was not associated with reduction in avoidable hospitalizations and hospital readmissions. Those results were not in-line with our hypothesis as we expected that, over time, interprofessional teams would reduce the likelihood of ACSC admissions and readmissions. For jurisdictions aiming to expand physician participation in teams, our study results point to the need to couple interprofessional team-based care

with other enablers of a strong primary care system such as access, continuity, comprehensiveness and coordination. Policies and practices that enhance those features will help to implement interprofessional team-based care in a way that it is best able to deliver on intended outcomes such as improving health services utilization efficiency.

List Of Abbreviations

ACSCs	ambulatory care sensitive conditions
US	United States
FHO	Family Health Organization
COPD	chronic obstructive pulmonary disease
CMG	Case Mix Group
DAD	Discharge Abstract Database
Registered Patient Database	RPDB
RIO	Rurality Index of Ontario
RUBs	Resource Utilization Bands
OHIP	Ontario Health Insurance Plan

Declarations

Ethics approval and consent to participate: ICES (formerly known as Institute for Clinical Evaluative Sciences) is a prescribed entity under section 45 of Ontario's Personal Health Information Protection Act. Section 45 authorizes ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under section 45, by definition, do not require review by a Research Ethics Board. This project was conducted under section 45, and approved by ICES' Privacy and Legal Office.

Consent for publication: Not applicable

Availability of data and materials: The dataset from this study is held securely in coded form at While data sharing agreements prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS. The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

Competing interests: The authors declare that they have no competing interests

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Tables

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