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Hospitalizations for ambulatory care sensitive conditions across primary care models in Ontario, Canada

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Abstract

The study analyzes the relationship between the risk of a hospitalization for an ambulatory care sensitive condition (ACSC), and the primary care payment and the organizational model used by the patient (fee-for-service, enhanced fee-for-service, blended capitation, blended capitation with interdisciplinary teams).The study used linked patient-level health administrative databases and census data housed at the Institute for Clinical Evaluative Sciences in Ontario. Since the province provides universal health care, the data capture all patients in Ontario, Canada's most populous province, with about 13 million inhabitants. All Ontario patients diagnosed with an ACSC prior to April 1, 2012, who had at least one visit with a physician between April 1, 2012, and March 31. 2013, were included in the study (n=1,710,310). Each patient was assigned to the primary care model of his/her physician. The different models were categorized as Fee-for-Service (FFS), enhanced-FFS, blended capitation, and interdisciplinary team. A logistic regression was used to model the risk of having an ACSC hospitalization during the one-year observation period. Adjustments were made for patient characteristics (age, sex, health status, and socio-economic status) and for the geographic location of the practice. Using patients belonging to FFS models as the reference group, the risk of an ACSC hospitalization was higher for patients belonging to the blended-capitation model using interdisciplinary teams (Adjusted Odds Ratio [AOR] = 1.06, 95% confidence interval [CI] = 1.00-1.12) and lower for enhanced-FFS (AOR = 0.78, CI= 0.74-0.82) and blended capitation patients (AOR = 0.91, CI= 0.86-0.96).

Using patients with hypertension as the reference group, the odds of an ACSC hospitalization were much higher for patients with any other ACSC and increased with patients' morbidity. The risk was lower for patients of higher socio-economic status (AOR=0.63, CI=0.60-0.67) in the highest neighborhood income quintile.

Key words: Primary care; financial incentives; payments; ambulatory care sensitive conditions

Introduction

Hospitalizations due to ambulatory care sensitive conditions (ACSCs) are considered potentially preventable because they are related to conditions that should not require hospitalizations, if they are appropriately treated and managed in a primary care setting (Billings et al., 1993; Bindman, Chattopadhyay, & Auerback, 2008; Brown et al., 2001; Caminal, Starfield, Sanchez, Casanova, & Morales, 2004; Chen, Farwell, & Jha, 2009; Laditka, Laditka, & Probst, 2005). Recent systematic reviews examined the literature on ACSC hospitalizations, and the findings support the validity of a hospitalization rate as an indicator of the quality of primary care as long as adequate adjustment is made for variation in patient characteristics (Eggli, Desquins, Seker, & Halfon, 2014; A. Rosano et al., 2013).

The rate of ACSC hospitalizations has been used as an indicator of both access to and effectiveness of primary care. The rate is also used as a measure of the effectiveness of new policies aimed at strengthening the primary care sector (Brown et al., 2001; Burgdorf, 2014; Ibanez-Beroiz et al., 2014; Nedel, Facchini, Martin-Mateo, Vieira, & Thume, 2008; Rubinstein et al., 2014; Sundmacher & Kopetsch, 2015). In cross-country comparisons, ACSC hospitalization rates were lower in the health systems with a stronger primary care sector (as opposed to a hospital-centric health care system) and in systems where the primary care physicians had a more important role, including as a gatekeeper to specialist services (Aldo Rosano et al., 2013). In the United States, a higher rate of ACSC hospitalizations was observed in regions with a lower supply of primary care physicians (Laditka et al., 2005) and amongst people facing financial barriers, such as people with no health care insurance who have to pay out-of-pocket for primary care visits (Billings et al., 1993). Similar results were found in countries with universal health care insurance: visits to the emergency department and admissions for ACSCs were found to be higher for low-income people (Huntley et al., 2014; Roos, Walld, Uhanova, & Bond, 2005), despite their higher utilization of primary care services (Roos et al., 2005).

Both primary care practice models and physician remuneration are considered important determinants of patient access to care for ACSCs. For example, in the United States, the patient-centered medical home model has been associated with lower ACSC hospitalization rates (Yoon et al., 2013). Aside from the practice characteristics, physician payment alone may provide different incentives for appropriate care management of patients with ACSCs. Fee-for-Service (FFS) remuneration has been criticized for incentivizing short visits that might not be sufficient to appropriately care for complex chronic conditions, however FFS does incent additional visits by the same physician. The FFS payment method has generally been associated with an overprovision of care (Brosig-Koch, Hennig-Schmidt, Kairies-Schwarz, & Wiesen, 2015; Gosden et al., 2000). In contrast, capitation payment does not penalize physicians for having longer patient visits but does incent referrals to other care providers as opposed to additional visits with the same primary care physician (Liddy et al., 2014).

The literature on ACSC hospitalizations is limited in relation to specific characteristics at the practice level that could affect the quality of primary care delivery, in terms of the method of payments to primary care physicians and in terms of organizational characteristics of the primary care practice, such as whether the practice provides interdisciplinary care to address the diverse health needs of patients. In addition, most studies have only examined ACSCs at the population level, measuring rates in specific population groups or in comparing regions. To our knowledge, this is the first study to look at how a primary care model may affect the likelihood of an ACSC hospitalization for a patient, in a context of universal health insurance for physician and hospital services.

The Canadian province of Ontario offers an important opportunity to examine the relationship between physician remuneration and practice model and patient ACSC hospitalizations in the context of universal health insurance for physician and hospital services. Ontario has actively reformed primary care payment starting in 2004 and has evolved to have a variety of common payment and practice models for primary care.

Patients can choose to see any physician. Physicians in Ontario can decide the model they wish to practice in and can be identified according to their payment models (FFS, enhanced-FFS, and blended capitation). The enhanced-FFS and blended capitation mechanisms are based on patients being enrolled with their physician. Enrolment is optional on both the physician's and the patient's sides but not available for FFS physicians. Physicians are paid on a FFS basis for seeing patients who are not enrolled with them. In 2010, 26% of Ontarians were not enrolled with a physician (i.e. their physician was paid on a FFS basis for the care), 33% were enrolled with a physician in enhanced-FFS, 35% were enrolled with a physician in a blended capitation payment model and the remaining 5% were patients of other unique models of primary care (Glazier, Zagorski, & Rayner, 2012).

Enhanced-FFS is a model that mixes FFS with additional payments for enrolled patients for the provision of specific services which are related mostly to prevention and disease management. The enhanced-FFS model has been associated with better continuity of care compared with the pure FFS model (Kralj & Kantarevic, 2012). Ontario has implemented blended-capitation that provides additional payments for a list of specific services, such as chronic disease management. Because capitation rates in Ontario are only age and sex adjusted, patients enrolled are likely to be healthier and to require minimum care (Glazier et al., 2012; Rudoler, Laporte, Barnsley, Glazier, & Deber, 2015). It is possible that the payment incentives in the blended capitation model may lead to the provision of less patient care than is necessary and to a greater likelihood of an ACSC hospitalization compared to those in FFS models, all else being equal. On the other hand, the incentives for providing chronic disease management and requirements for after-hours care to improve access (Haggerty et al., 2008) could counter balance that effect.

Physicians working in a blended-capitation model were able to form interdisciplinary teams called Family Health Teams (FHTs) which offer multiple theoretical advantages, such as patient education in managing their condition and a higher quality of care (Lin, Xirasagar, & Laditka, 2004; Russell et al., 2009; Sommers, Marton, Barbaccia, & Randolph, 2000). FHTs are considered to adhere to the seven principles of the patient-centered medical home (PCMH) model, i.e., a personal physician, physician-directed medical practice, whole-person orientation, coordination and integration of care, quality and safety, enhanced access, and payment reflective of the value for patients (Rosser, Colwill, Kasperski, & Wilson, 2011). Given the empirical evidence about better quality of care in an interdisciplinary team setting, one may expect to find lower odds of ACSC hospitalizations for patients in FHTs, as compared to patients in FFS.

Physicians have no incentives to avoid ACSC hospitalizations for their patients under any of the models.

Methods

The study period is April 1, 2012, to March 31, 2013, which was the most recent fiscal year for which the data was available at the time of the analysis. We adopted the Canadian Institute for Health Information (CIHI, 2012) definition of ACSC hospitalizations as those related to seven chronic conditions: angina, asthma, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), diabetes, grand mal status and other epileptic convulsions,[1] and hypertension. The study population consisted of all Ontarians aged 18 to 74 previously diagnosed with these conditions. An ACSC diagnosis was defined by at least two physician billings or one acute hospital admission record with one of the seven conditions mentioned above between April 1, 2010 and March 31, 2012, i.e. in the 24-month period prior to the year under study. This is the method used in Ontario to determine the prevalence and the incidence of chronic diseases (Hux & Tang, 2003). Individuals who died during the study period were excluded.

Data Sources and Variables

This study was conducted at the Institute for Clinical Evaluative Sciences (ICES) which houses Ontario health care administrative databases. The ICES uses an ICES Key Number (IKN) to uniquely identify each person and to allow for linkage of patient-level data across databases covering different care settings including primary care and hospitals.

[1] Hereafter referred to as epilepsy for the sake of simplicity.

The outcome variable was a binary variable that takes the value of one if the individual had one or more hospitalizations for a pre-existing ACSC between April 1, 2012, and March 31, 2013, which was the most recent fiscal year for which data were available.

The independent variables of interest were binary variables for the patient's primary care model (FFS, enhanced-FFS, blended capitation, or FHT). Patient from other models were excluded from the study because of the small numbers and the unique characteristics and the diversity within these other models. The primary care model variables corresponded to the model of the physician with whom the patient was enrolled.

The analyses were adjusted for the patient's age, sex, and health status. For the health status, there was a flag for each of the ACSC and hypertension was used as the reference group (since each patient had to have at least one of the ACSC to be in the study population). In addition, the Johns Hopkins Adjusted Clinical Group System (ACG®) weight of each patient was included. We included each patient's neighborhood income quintile which was based on the postal code of the individual, and is a commonly used proxy for socio-economic status (SES) (Lane, Maxwell, Gruneir, Bronskill, & Wodchis, 2015). The Rurality Index of Ontario (RIO) score was included to adjust for a patient's geographic location, acknowledging that the rurality and proximity to health care services may affect the probability of an ACSC hospitalization. The RIO score is a continuous variable that takes a value between 0 and 100; lower values indicate an urban location.

Data on hospitalizations were taken from the CIHI - Hospital Discharge Abstract Database (DAD). The IKNs in the DAD were used to link to patients' data contained in other databases, and to retrieve the main diagnostic code (the main reason for the hospitalization), and the date of the admission to the hospital. Each patient's primary care model was determined from the Client Agency Program Enrolment (CAPE) database which contains physician rosters and also indicates the primary care model with which each physician is affiliated. The vast majority of patients seeing a physician in an enrolment model are enrolled with the physician. Treatment of non-enrolled patients presented a challenge. In some studies, patients were "virtually" enrolled with the physician they had most of their primary care with (Rudoler, Deber, et al., 2015; Rudoler, Laporte, et al., 2015). However, physicians do not receive any bonus payment for the chronic disease management of non-enrolled patients. In addition, non-enrolled patients are not entitled to the same benefits in terms of obtaining on-call and after-hours access. Hence, the decision was made to categorize the non-enrolled as FFS patients. Sensitivity analyses were conducted with "virtual" enrolment and with making non-enrolled a separate category (results in appendix). Models were mutually exclusive, so each patient could only belong to one model.

Patients' socio-demographic data were collected from the Ontario Registered Persons Database (RPDB). Each patient's ACG® weight was calculated, using a patient's health services utilization data from the 24-month period prior to the study period, with diagnostic data from the DAD and from the billings in the OHIP database. OHIP is a database of the billings from physicians and contains individual-level information on the services provided.

Statistical Analysis

This study examined the risk for a patient i to have a hospitalization for any of the seven chronic ACSCs, conditional on that individual having an ACSC and clustered at the level of the physician j. The logistic regression was defined as:

$$\log(\text{ACSCH}\,|\text{having an ACSC})_{ij} = \beta_0 + \beta_1 \textit{enhanced-FFS}_{ij} + \beta_2 \textit{blended\_cap}_{ij} + \beta_3 \textit{FHT}_{ij} + \beta_4 \textit{RIO}_{ij} + \beta_5 \textit{age}_{ij} + \beta_6 \textit{male}_{ij} + \beta_7 \textit{ACG}_{ij} + \beta_8 \textit{ACSC}_{ij} + \beta_9 \textit{Two\_or\_moreACSCs}_{ij} + \beta_{10} \textit{incomequintile}_{ij} + \varepsilon_{ij}$$

Although we report the results from the statistical model above, other specifications were tested for the case-mix variables including more restricted forms with removal of one or more of the variables (ACG® weight, binary variables for each ACSC, binary variable for two or more ACSCs). We also ran a more comprehensive specification that included interaction terms between each two-way combination of the ACSCs (eg. CHF and diabetes) and between some of the ACSCs and payment models in which the physician received an incentive for chronic disease management. Physicians in enhanced-FFS and in blended capitation models receive an incentive for the appropriate management of diabetes and of CHF and dummy variables were created and tested for each of these incentives. The results from these model specifications are available in supplemental material. We also conducted separate analyses for each ACSC. Income quintile was measured with binary variables using income quintile one, the lowest income group, as the reference.

We found that the interaction variables did not have a significant effect or improve the fit to the data and hence these were removed from the final model. The case-mix variables that were kept were those for which the model had the best fit based on the C-statistic.

Tests were conducted to determine whether differences observed on patient characteristics were significant between FFS patients and patients of each other model (enhanced-FFS, blended capitation, and FHT).

The study received approval from the Research Ethics Boards of the University of Toronto and the Sunnybrook Health Sciences Centre.

Results

The study population contained 1,710,310 patients with an average age of just over 52. About 12% of the patients had two or more ACSCs. Patients characteristics were similar across models, except for the reference group (FFS), in which patients were younger (mean age 46), less likely to be male (46%) and more likely to have asthma (26% versus 16% for the whole study population). The proportion of patients from neighborhoods of lower income quintiles was higher amongst FFS patients than amongst patients in any other model, with 23.2% and 21.2% of FFS patients in income quintiles one (lowest income quintile) and two, respectively. Only 16.1% of FFS patients were in the highest income quintile. Patients in blended capitation and FHT models were generally healthier and wealthier. Patients in blended capitation and in FHT were less likely to have asthma and epilepsy, and were less likely to have 2 or more chronic conditions compared to the FFS patients. However, they had a higher prevalence of diabetes, CHF, COPD, hypertension and angina and a higher rurality. Patients in enhanced-FFS were less likely to have COPD, asthma, CHF, angina, or epilepsy. They were more likely to have diabetes or hypertension, or two or more conditions compared to FFS patients.

Physicians in all enrolment models receive incentives for the management of diabetes and hypertension, which could explain the higher rates of these conditions in all models compared to FFS. Although the differences in the prevalence of each condition are significant, some are quite small (less than a percentage point) (Table 1).

[Table 1. Descriptive Statistics for all Patients with ACSCs and by Primary Care Model]

In Table 2, the rates of ACSC hospitalization for patients with each different condition and for each model are reported. The differences in the percentage of hospitalizations suggest that some conditions are more likely than others to lead to an ACSC hospitalization, i.e., CHF (from 5.93% for blended capitation patients to 6.84% FHT patients) and COPD (from 2.74% in FFS patients to 7.64% in FHT patients). Rates of hospitalizations are the lowest for patients with hypertension (varying between 0.47% in enhanced-FFS patients and 0.59% in FFS patients, depending on the model to which the patient belongs). Separate analyses were conducted for on the odds of a hospitalization for each ACSC.

[Table 2. ACSC hospitalizations across models and for each condition]

The results from the logistic regression are reported in Table 3. In the table, the adjusted odds ratios measure for each variable the risk that a patient has an ACSC hospitalization compared to the reference group. The primary care model binary variables were the independent variables of interest for our analysis.

The adjusted odds ratio (AOR) of an ACSC hospitalization for FHT patients was 1.06 (95% Confidence Interval [CI] = 1.00-1.12) compared to FFS patients. For enhanced-FFS patients, the

AOR was 0.78 (CI=0.74-0.82), whereas the AOR was 0.91 (CI=0.86-0.96) for blended capitation patients, using FFS patients as the reference group.

The odds of an ACSC hospitalization are 1.41 (CI=1.39-1.42) with each increase in the unit of the ACG® weight and 1.01 (CI=1.01-1.01) with each increase of one unit in the RIO score. A diagnosis of any ACSC other than hypertension, which was the reference group, was also associated with higher odds of a hospitalization. The odds of a hospitalization decrease markedly for patients living in neighborhoods with higher income quintiles (AOR=0.63, CI=0.60-0.67 for patients in neighborhoods in the highest income quintile (5), compared to the lowest income quintile), and for older patients (AOR=0.997, CI=0.996-0.998 for each additional year).

[Table 3. Odds of an ACSC Hospitalization for ACSC Patients, Using FFS Patients as the Reference Group]

The odds of an ACSC decreased when a patient had two or more ACSC. To investigate the reason that could explain this result, interaction terms between every possible combination of two ACSCs were constructed and a separate analysis was conducted with these additional variables. Although many coefficients on these interaction terms were significant, they did not improve the predictive power of the model and coefficients on the primary care model variables were not affected with the exception of the coefficient on the FHT variable, which became insignificant. The coefficients on each separate ACSC increased while most interaction terms showed lower odds of hospitalization.

Separate analyses were conducted for each ACSC. Results show that the AOR of a hospitalization are consistently lower for patients in enhanced-FFS compared to FFS patients, and significant for all conditions except CHF. The AOR were also lower for all conditions for patients in blended capitation models, but only significant for COPD and hypertension. The AOR of a hospitalization for patients in a FHT were higher for all conditions except angina and hypertension. In FHT patients, only the lower AOR for hypertension was significant (see appendix). In comparing different model specifications in terms of the choice of variables to control for health status, the results were consistent.

Sensitivity analyses were conducted through a different categorization of the non-enrolled patients. When treated as a separate group, the non-enrolled had a significantly higher risk of an ACSC hospitalization [AOR=1.14, CI=1.05;1.23] (see appendix). The coefficients were slightly changed but the directions of the effects of primary care models were consistent. When the non-enrolled patients were virtually enrolled to their physician, the odds of an ACSC hospitalization for FHT patients increased [AOR=1.16, CI=1.08;1.24] while those of blended capitation patients became not significantly different from those of FFS patients. Descriptive statistics of the non-enrolled patients suggest that these patients are more similar to the FFS patients on the observable characteristics (results in Appendix).

Discussion

The results show that there are significant differences between primary care models in the risk of an ACSC hospitalization, after adjustments are made for other factors, such as patient characteristics and geographic location.

Patients who belonged to blended capitation models without a team-based practice had a lower risk of an ACSC hospitalization, as compared to FFS patients. Enhanced-FFS patients had the lowest risk, which is interesting given that the enhanced-FFS is the closest to the FFS model. These results are aligned with a recent study, which focused on asthma care and found better asthma care and fewer emergency department visits for asthma amongst patients of enhanced-FFS physicians, as compared to patients of FFS physicians (To et al., 2015). The finding could mean that the specific differences between the FFS and the enhanced-FFS models are particularly important and beneficial to patient outcomes. It could also be due to selection of physicians into the enhanced-FFS model. Enhanced-FFS physicians receive additional payments for providing comprehensive care. Hence, enhanced-FFS physicians have incentives to maximize the intensity of services and to manage chronic conditions for a patient population. Taken together, these elements may potentially support the development of a better patient-physician relationship than the relationship in the FFS model. This kind of relationship could explain the lower risk of an ACSC hospitalization amongst patients of enhanced-FFS physicians. The fact that the patient population of enhanced-FFS physicians had, on average, a lower health status may also lead to a higher intensity of care. This intensity of care may benefit the management of an ACSC and explain why the risk of an ACSC hospitalization is lower amongst enhanced-FFS patients, as compared to FFS patients. Alternatively, it is possible that the incentives in place for enhanced-FFS physicians lead to over-diagnosis of patients; i.e., the enhanced-FFS patients may be actually healthier than they appear in the data. Future research could examine the costs of care across models for the ACSC population.

FHT patients (where physicians are also remunerated through blended capitation) had a higher risk of an ACSC hospitalization, as compared to FFS patients. These results were consistent in all three models in treating non-enrolled patients as being FFS patients, virtually enrolled, or as a separate group. These results may appear to contradict the results of other studies that have associated interdisciplinary care with better care and better outcomes for patients with diabetes in Alberta (Manns et al., 2012) and, in the US, with a decrease in the ACSC hospitalizations and costs (Yoon et al., 2013). The result from our analysis suggest that although the FHT may share some characteristics with the US medical homes (Rosser, Colwill, Kasperski, & Wilson, 2010; Rosser et al., 2011) and with the Alberta Primary Care Networks, they have some distinctive features that could lead to the different outcomes observed. Patients with better access to primary care and better care are expected to have a lower risk of complications and/or hospitalizations. It should be noted that the selection of physicians and patients into primary care models was not accounted for here. Longitudinal analyses would allow for the examination of these differences over time, and inform as to whether the odds of an ACSC hospitalization change over time for FHT patients compared to FFS patients. Data about some characteristics of the FHTs such as the length of time they have been in operation and the types of services and professionals included in the practice, were not available. Hence, future analysis and results might indicate that FHTs practices were in the process of establishing themselves when this study took place.

This study adjusted for a number of patient characteristics. Most of these characteristics were found to be significantly associated with the risk of an ACSC hospitalization. The higher risk of an ACSC hospitalization for patients in more rural areas and for patients in neighborhoods of lower income quintiles are consistent with a previous Canadian study that looked at the risk of hospitalization for hypertension in four provinces amongst patients diagnosed with hypertension (Walker et al., 2013).

The study by Walker et al. (2013) also found an increased risk of a hospitalization for hypertension in the presence of comorbidities. The results in Table 3 show that the risk of an ACSC hospitalization was actually lower for patients with two or more ACSCs. A closer examination of the characteristics of patients indicated that the majority of the patients with two or more ACSCs had hypertension as one of the conditions, which was the condition that has the lowest risk of a hospitalization; the AOR for each of the other ACSCs is higher than 1. Hence, the AOR of having two or more ACSCs mostly reflects the combined risk of ACSC (other than hypertension) along with hypertension as compared to patients who only had one condition. Because the risk of hospitalization is lowest amongst patients with only hypertension, the effect is to dull the existing differential between hypertension and the other chronic conditions. People who have multiple conditions may also have more encounters with health care providers and benefit from better monitoring and management of their conditions as a result.

The results reported in Table 2 show that the risk of having an ACSC hospitalization increases amongst patients living in neighborhoods in lower income quintiles which is consistent with the results from studies in Manitoba (Roos et al., 2005), in the United States (Basu, Mobley, & Thumula, 2014; Finegan, Gao, Pasquale, & Campbell, 2010), in Australia (Ansari, Rowe, Ansari, & Sindall, 2013) and in Italy (Agabiti et al., 2009). Lower hospitalization rates have also been observed in wealthier regions, which were compared to regions with lower incomes, in Germany, Italy (Aldo Rosano et al., 2013) and also Sweden (Lofqvist, Burstrom, Walander, & Ljung, 2014). The present study suggests that there are differences across primary care models. The higher risk of an ACSC hospitalization for people living in lower income neighbourhoods could mean that there is lower access to quality care in poorer neighbourhoods, creating barriers for people to manage their chronic conditions.

A few researchers have stressed the importance of considering health status and the types of patients' ACSCs when ACSC hospitalizations are examined (Eggli et al., 2014; Finegan et al., 2010; Saver, Wang, Dobie, Green, & Baldwin, 2014). The results of the present study support this point, given that the ACG® weight and each ACSC condition significantly affected the odds of an ACSC hospitalization. Having COPD, as compared to having hypertension, represented a particularly important risk factor; this figure aligned with higher rates of hospitalization for patients with COPD that were found in Spain (Ibanez-Beroiz et al., 2014). In Ontario, some of the chronic conditions on the list of ACSCs, namely, diabetes and chronic heart failure, receive particular attention through financial incentives associated with their management and treatment. Given the higher risk of hospitalization associated with COPD, it could be helpful to offer incentives to physicians to provide higher-quality care for COPD. However, the efficacy of such incentives may be limited. When testing a model with interaction terms between the models which physicians received additional payment for chronic disease management and the conditions for which these payments were offered (diabetes and CHF), we observed no significant effect on the odds of an ACSC hospitalization. In the UK, studies examining the Quality and Outcomes Framework found performance-based incentives were associated with reduced hospitalizations for patients with ACSCs (Dusheiko, Doran, Gravelle, Fullwood, & Roland, 2011; Harrison et al., 2014). The incentives in Ontario are limited to processes of care such as measuring the HbA1c level in patients with diabetes as opposed to outcomes (such as having their patients' HbA1c levels within clinical guidelines targets).

The descriptive data on the ACSC population suggests some differences amongst patients across primary care models, particularly amongst the patients in the reference group. FFS patients were younger and from lower income quintiles, while patients in blended capitation models were wealthier; these findings are consistent with what has been found in the general Ontario population (Glazier et al., 2012). Blended capitation patients appear to be generally healthier than those in other primary care models, with a lower average ACG® weight of 0.761, as compared with the FFS patient average of 0.793. Given that capitation payments are adjusted only for age and sex and not for additional measures of health status, physicians in blended capitation models have an incentive to serve generally healthier patients (Hutchison & Glazier, 2013) and physicians with healthier patient population are likely to be attracted to these payment models. Hence, the observed results are consistent with what could be expected, given the incentives in place in Ontario and the current literature on the characteristics of patients served in the various primary care models in Ontario.

The finding that the odds of an ACSC hospitalization increase with rurality is also consistent with figures from other countries. Indeed, ACSC hospitalization rates were reported to be higher in rural areas in the U.S. (Basu et al., 2014) and in Germany (Burgdorf, 2014). The increased risk associated with rurality could be related to the longer travel distances to hospitals. Hospital staff might admit patients at a lower level of severity when they consider that the patients travelled a long distance to the hospital and that the patients could not necessarily return easily if their situations worsened. The increased risk of hospitalization associated with rurality could also reflect limited access to primary care in some areas where recruitment and retention of physicians are challenges, and where patients do not visit their physicians as often as they should because of the distance to a doctor's office. Physicians in rural areas might also need to take a larger caseload, and thus make themselves less available to their patients.

It is interesting to note that the types of patients' ACSCs vary across primary care models; it is possible that, if physicians self-select themselves into a primary care model, and there is evidence suggesting that they do (Rudoler, Deber, et al., 2015), their choices would be based on their patient populations and on the proposed incentives of the different models. For example, in Ontario, the finding was that physicians in blended capitation models were more responsive to a diabetes management program, as compared to physicians in FFS models (Kantarevic & Kralj,

2013) and that patients in blended capitation models were more likely than those in enhanced-FFS models to receive the recommended tests for diabetes monitoring (Kiran, Victor, Kopp, Shah, & Glazier, 2014). This finding suggests not only that the quality of diabetes care may be better in blended capitation models, but also that primary care physicians may specialize in the care of specific chronic conditions that are prevalent in their patients' population.

It is important to remember that ACSC hospitalizations are considered potentially preventable, a consideration that means that a proportion of them may not be avoidable (Freund et al., 2013). It is not possible to know from the study data which ones may be avoided and which ones may not and, hence, it is not possible to know if these are equally distributed across primary care models. Nonetheless, Billings and others promote that better management of chronic conditions in primary care should be associated with better health, and therefore fewer hospitalization (Billings et al., 1993; Caminal et al., 2004; A. Rosano et al., 2013).

The study does not account for patients' health behaviors, and yet unhealthy behaviors are associated with higher risks of an ACSC hospitalization (Tran, Falster, Douglas, Blyth, & Jorm, 2014). However, there is no evidence that patients with healthier behaviors would sort themselves into different models.

The study is focused on primary care models and not on the characteristics of the physicians working in each of these models. Recent evidence suggests that physicians may be self-selecting into these models (Rudoler, Deber, et al., 2015), a choice that could be based on their practice styles, preferences, and client base. The self-selection of physicians means that some of the effects observed in the adjusted odds ratios of the primary care model could potentially be partly related to physicians' characteristics. However, there is also evidence suggesting that physicians adapt their practice styles to their working environments (de Jong, Westert, Lagoe, & Groenewegen, 2006; Wolinsky, 1982).

Finally, the cross-sectional approach represents a limitation to the interpretation of the results, in the sense that it provides information about the correlations, rather than about causal relationships between, primary care models and ACSC hospitalizations.

Conclusion

The results suggest that characteristics such as health status and, socio-economic status are important determinants of whether a patient with an ACSC is admitted to hospital. Yet the results show that, even when adjustments are made for patients' characteristics, primary care physician payment and practice model that a patient belongs to matters in the patient's risk of an ACSC hospitalization.

References

Agabiti, N., Pirani, M., Schifano, P., Cesaroni, G., Davoli, M., Bisanti, L., . . . Perucci, C. A. (2009). Income level and chronic ambulatory care sensitive conditions in adults: a multicity population-based study in Italy. *Bmc Public Health, 9*, 457. doi: 10.1186/1471-2458-9-457

Ansari, Z., Rowe, S., Ansari, H., & Sindall, C. (2013). Small area analysis of ambulatory care sensitive conditions in Victoria, Australia. *Popul Health Manag, 16*(3), 190-200. doi: 10.1089/pop.2012.0047

Basu, J., Mobley, L. R., & Thumula, V. (2014). The Small Area Predictors of Ambulatory Care Sensitive Hospitalizations: A Comparison of Changes over Time. *Social Work in Public Health, 29*(2), 176-188. doi: 10.1080/19371918.2013.776316

Billings, J., Zeitel, L., Lukomnik, J., Carey, T. S., Blank, A. E., & Newman, L. (1993). Impact of socioeconomic status on hospital use in New York City. *Health Aff (Millwood), 12*(1), 162-173.

Bindman, A. B., Chattopadhyay, A., & Auerback, G. M. (2008). Interruptions in Medicaid coverage and risk for hospitalization for ambulatory care-sensitive conditions. *Ann Intern Med, 149*(12), 854-860.

Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarz, N., & Wiesen, D. (2015). The Effects of Introducing Mixed Payment Systems for Physicians: Experimental Evidence. *Health Economics*. doi: 10.1002/hec.3292

Brown, A. D., Goldacre, M. J., Hicks, N., Rourke, J. T., McMurtry, R. Y., Brown, J. D., & Anderson, G. M. (2001). Hospitalization for ambulatory care-sensitive conditions: a method for comparative access and quality studies using routinely collected statistics. *Can J Public Health, 92*(2), 155-159.

Burgdorf, F. (2014). Potentially Avoidable Hospital Admissions in Germany: An Analysis of Factors Influencing Rates of Ambulatory Care Sensitive Hospitalizations Reply. *Deutsches Arzteblatt International, 111*(35-36), 600-601. doi: 10.3238/arztebl.2014.0600b

Caminal, J., Starfield, B., Sanchez, E., Casanova, C., & Morales, M. (2004). The role of primary care in preventing ambulatory care sensitive conditions. *Eur J Public Health, 14*(3), 246-251.

Chen, L. M., Farwell, W. R., & Jha, A. K. (2009). Primary care visit duration and quality: does good care take longer? *Archives of Internal Medicine, 169*(20), 1866-1872. doi: 10.1001/archinternmed.2009.341

de Jong, J. D., Westert, G. P., Lagoe, R., & Groenewegen, P. P. (2006). Variation in hospital length of stay: Do physicians adapt their length of stay decisions to what is usual in the hospital where they work? *Health Services Research, 41*(2), 374-394. doi: 10.1111/j.1475-6773.2005.00486.x

Dusheiko, M., Doran, T., Gravelle, H., Fullwood, C., & Roland, M. (2011). Does Higher Quality of Diabetes Management in Family Practice Reduce Unplanned Hospital Admissions? *Health Services Research, 46*(1p1), 27-46. doi: 10.1111/j.1475-6773.2010.01184.x

Eggli, Y., Desquins, B., Seker, E., & Halfon, P. (2014). Comparing potentially avoidable hospitalization rates related to ambulatory care sensitive conditions in Switzerland: the need to refine the definition of health conditions and to adjust for population health status. *Bmc Health Services Research, 14,* 25. doi: 10.1186/1472-6963-14-25

Finegan, M. S., Gao, J., Pasquale, D., & Campbell, J. (2010). Trends and geographic variation of potentially avoidable hospitalizations in the veterans health-care system. *Health Serv Manage Res, 23*(2), 66-75. doi: 10.1258/hsmr.2009.009023

Freund, T., Campbell, S. M., Geissler, S., Kunz, C. U., Mahler, C., Peters-Klimm, F., & Szecsenyi, J. (2013). Strategies for reducing potentially avoidable hospitalizations for ambulatory care-sensitive conditions. *Ann Fam Med, 11*(4), 363-370. doi: 10.1370/afm.1498

Glazier, R., Zagorski, B., & Rayner, J. (2012). Comparison of Primary Care Models in Ontario by Demographics, Case Mix and Emergency Department Use, 2008/09 to 2009/10. Toronto: Institute for Clinical Evaluative Sciences.

Gosden, T., Forland, F., Kristiansen, I. S., Sutton, M., Leese, B., Giuffrida, A., . . . Pedersen, L. (2000). Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians. *Cochrane Database Syst Rev*(3), CD002215. doi: 10.1002/14651858.CD002215

Haggerty, J. L., Pineault, R., Beaulieu, M. D., Brunelle, Y., Gauthier, J., Goulet, F., & Rodrigue, J. (2008). Practice features associated with patient-reported accessibility, continuity, and coordination of primary health care. *Ann Fam Med, 6*(2), 116-123. doi: 10.1370/afm.802

Harrison, M. J., Dusheiko, M., Sutton, M., Gravelle, H., Doran, T., & Roland, M. (2014). Effect of a national primary care pay for performance scheme on emergency hospital admissions for ambulatory care sensitive conditions: controlled longitudinal study. *BMJ, 349,* g6423. doi: 10.1136/bmj.g6423

Huntley, A., Lasserson, D., Wye, L., Morris, R., Checkland, K., England, H., . . . Purdy, S. (2014). Which features of primary care affect unscheduled secondary care use? A systematic review. *BMJ Open, 4*(5), e004746. doi: 10.1136/bmjopen-2013-004746

Hutchison, B., & Glazier, R. (2013). Ontario's primary care reforms have transformed the local care landscape, but a plan is needed for ongoing improvement. *Health Aff (Millwood), 32*(4), 695-703. doi: 10.1377/hlthaff.2012.1087

Hux, J. E., & Tang, M. (2003). Patterns of prevalence and incidence of diabetes. In J. E. Hux, G. L. Booth, P. M. Slaughter & A. Laupacis (Eds.), *Diabetes in Ontario: An ICES Practice Atlas* (pp. 2-15). Toronto: Institute for Clinical Evaluative Sciences.

Ibanez-Beroiz, B., Librero, J., Bernal-Delgado, E., Garcia-Armesto, S., Villanueva-Ferragud, S., & Peiro, S. (2014). Joint spatial modeling to identify shared patterns among chronic related potentially preventable hospitalizations. *Bmc Medical Research Methodology, 14.* doi: Artn 7410.1186/1471-2288-14-74

Kantarevic, J., & Kralj, B. (2013). Link between pay for performance incentives and physician payment mechanisms: evidence from the diabetes management incentive in Ontario. *Health Economics, 22*(12), 1417-1439. doi: 10.1002/hec.2890

Kiran, T., Victor, J. C., Kopp, A., Shah, B. R., & Glazier, R. H. (2014). The relationship between primary care models and processes of diabetes care in Ontario. *Can J Diabetes, 38*(3), 172-178. doi: 10.1016/j.jcjd.2014.01.015

Kralj, B., & Kantarevic, J. (2012). Primary care model enrolment and hospital length of stay in Ontario: patient rostering associated with reduced length of stay, significant health system savings. *Ontario Medical Review*.

Laditka, J. N., Laditka, S. B., & Probst, J. C. (2005). More may be better: evidence of a negative relationship between physician supply and hospitalization for ambulatory care sensitive conditions. *Health Services Research, 40*(4), 1148-1166. doi: 10.1111/j.1475-6773.2005.00403.x

Lane, N. E., Maxwell, C. J., Gruneir, A., Bronskill, S. E., & Wodchis, W. P. (2015). Absence of a Socioeconomic Gradient in Older Adults' Survival with Multiple Chronic Conditions. *EBioMedicine, 2*(12), 2094-2100. doi: http://dx.doi.org/10.1016/j.ebiom.2015.11.018

Liddy, C., Singh, J., Kelly, R., Dahrouge, S., Taljaard, M., & Younger, J. (2014). What is the impact of primary care model type on specialist referral rates? A cross-sectional study. *Bmc Family Practice, 15*, 22. doi: 10.1186/1471-2296-15-22

Lin, H. C., Xirasagar, S., & Laditka, J. N. (2004). Patient perceptions of service quality in group versus solo practice clinics. *Int J Qual Health Care, 16*(6), 437-445. doi: 10.1093/intqhc/mzh072

Lofqvist, T., Burstrom, B., Walander, A., & Ljung, R. (2014). Inequalities in avoidable hospitalisation by area income and the role of individual characteristics: a population-based register study in Stockholm County, Sweden. *BMJ Qual Saf, 23*(3), 206-214. doi: 10.1136/bmjqs-2012-001715

Manns, B. J., Tonelli, M., Zhang, J., Campbell, D. J., Sargious, P., Ayyalasomayajula, B., . . . Hemmelgarn, B. R. (2012). Enrolment in primary care networks: impact on outcomes and processes of care for patients with diabetes. *CMAJ, 184*(2), E144-152. doi: 10.1503/cmaj.110755

Nedel, F. B., Facchini, L. A., Martin-Mateo, M., Vieira, L. A. S., & Thume, E. (2008). Family Health Program and ambulatory care-sensitive conditions in Southern Brazil. *Revista De Saude Publica, 42*(6).

Roos, L. L., Walld, R., Uhanova, J., & Bond, R. (2005). Physician visits, hospitalizations, and socioeconomic status: ambulatory care sensitive conditions in a canadian setting. *Health Services Research, 40*(4), 1167-1185. doi: 10.1111/j.1475-6773.2005.00407.x

Rosano, A., Loha, C. A., Falvo, R., van der Zee, J., Ricciardi, W., Guasticchi, G., & de Belvis, A. G. (2013). The relationship between avoidable hospitalization and accessibility to primary care: a systematic review. *Eur J Public Health, 23*(3), 356-360. doi: 10.1093/eurpub/cks053

Rosano, A., Peschel, P., Kugler, J., Ricciardi, W., Guasticchi, G., & van der Zee, J. (2013). Preventable hospitalization and the role of primary care: a comparison between Italy and Germany. *Journal of Public Health, 21*(5), 445-454. doi: 10.1007/s10389-013-0563-x

Rosser, W. W., Colwill, J. M., Kasperski, J., & Wilson, L. (2010). Patient-centered medical homes in Ontario. *N Engl J Med, 362*(3), e7. doi: 10.1056/NEJMp0911519

Rosser, W. W., Colwill, J. M., Kasperski, J., & Wilson, L. (2011). Progress of Ontario's Family Health Team Model: A Patient-Centered Medical Home. *Ann Fam Med*, *9*(2), 165-171. doi: 10.1370/afm.1228

Rubinstein, A., Lopez, A., Caporale, J., Valanzasca, P., Irazola, V., & Rubinstein, F. (2014). Avoidable hospitalizations for ambulatory care sensitive conditions as an indicator of primary health care effectiveness in Argentina. *J Ambul Care Manage, 37*(1), 69-81. doi: 10.1097/JAC.0000000000000008

Rudoler, D., Deber, R., Barnsley, J., Glazier, R. H., Dass, A. R., & Laporte, A. (2015). Paying for Primary Care: The Factors Associated with Physician Self-selection into Payment Models. *Health Economics, 24*(9), 1229-1242. doi: 10.1002/hec.3221

Rudoler, D., Laporte, A., Barnsley, J., Glazier, R. H., & Deber, R. B. (2015). Paying for primary care: a cross-sectional analysis of cost and morbidity distributions across primary care payment models in Ontario Canada. *Social Science & Medicine, 124*, 18-28. doi: 10.1016/j.socscimed.2014.11.001

Russell, G. M., Dahrouge, S., Hogg, W., Geneau, R., Muldoon, L., & Tuna, M. (2009). Managing chronic disease in ontario primary care: the impact of organizational factors. *Ann Fam Med, 7*(4), 309-318. doi: 10.1370/afm.982

Saver, B. G., Wang, C. Y., Dobie, S. A., Green, P. K., & Baldwin, L. M. (2014). The central role of comorbidity in predicting ambulatory care sensitive hospitalizations. *Eur J Public Health, 24*(1), 66-72. doi: 10.1093/eurpub/ckt019

Sommers, L. S., Marton, K. I., Barbaccia, J. C., & Randolph, J. (2000). Physician, nurse, and social worker collaboration in primary care for chronically ill seniors. *Archives of Internal Medicine, 160*(12), 1825-1833.

Sundmacher, L., & Kopetsch, T. (2015). The impact of office-based care on hospitalizations for ambulatory care sensitive conditions. *Eur J Health Econ*, *16*(4), 365-375. doi: 10.1007/s10198-014-0578-4

To, T., Guan, J., Zhu, J., Lougheed, M. D., Kaplan, A., Tamari, I., . . . Gershon, A. S. (2015). Quality of asthma care under different primary care models in Canada: a population-based study. *Bmc Family Practice, 16*, 19. doi: 10.1186/s12875-015-0232-y

Tran, B., Falster, M. O., Douglas, K., Blyth, F., & Jorm, L. R. (2014). Health behaviours and potentially preventable hospitalisation: a prospective study of older Australian adults. *Plos One, 9*(4), e93111. doi: 10.1371/journal.pone.0093111

Walker, R. L., Chen, G., McAlister, F. A., Campbell, N. R. C., Hemmelgarn, B. R., Dixon, E., . . . Quan, H. (2013). Hospitalization for Uncomplicated Hypertension: An Ambulatory Care Sensitive Condition. *Canadian Journal of Cardiology, 29*(11), 1462-1469. doi: 10.1016/j.cjca.2013.05.002

Wolinsky, F. D. (1982). Why Physicians Choose Different Types of Practice Settings. *Health Services Research, 17*(4), 399-419.

Yoon, J., Rose, D. E., Canelo, I., Upadhyay, A. S., Schectman, G., Stark, R., . . . Yano, E. M. (2013). Medical Home Features of VHA Primary Care Clinics and Avoidable Hospitalizations. *Journal of General Internal Medicine, 28*(9), 1188-1194. doi: 10.1007/s11606-013-2405-5

Tables

Table 1. Descriptive Statistics for all Patients with ACSCs and by Primary Care Model

Variable	**All**	**FFS (reference)**	**Enhanced-FFS**	**Blended Capitation**	**FHT**
N	1,710,310	296,961	654,860	493,971	264,518
Average patient age (sd)	52.4 (17.8)	46.1 (21.9)	52.8*** (16.7)	54.5*** (16.2)	54.4*** (16.6)
% Male	48.7	45.5	50***	48.9***	48.9***
Average Patient ACG® weight (sd)	0.788 (0.868)	0.793 (0.938)	0.807*** (0.846)	0.761*** (0.841)	0.785* (0.888)
% COPD	3.9	3.8	3.5***	4***	4.9***
% Asthma	16.3	26	15.6***	13.2***	12.8***
% Diabetes	33.5	28.6	33.2***	35.4***	36.1***
% CHF	1.8	1.7	1.5***	1.9***	2.2***
% Hypertension	52.4	46.3	57.7***	51.9***	47***
% Angina	3.1	2.6	2.5**	3.3***	5.1***
% Epilepsy	2.7	3.6	2.2***	2.5***	3.1***
Two or more ACSCs	12.4	11.6	14.7***	11.1***	10.1***
Average RIO (sd)	7.6 (14.3)	5.9 (13.5)	4.1*** (9.6)	9.1 (14.9)	15.3*** (19.5)
% Income quint 1	19.9	23.2	20.3***	17.9***	19.2***
% Income quint 2	20.6	21.2	21.3	19.7***	20***
% Income quint 3	20.5	19.9	21.4***	19.9	20
% Income quint 4	20.5	19.1	20.6***	21***	21***
% Income quint 5	18.1	16.1	16.3	21.1***	19.3***

Note: sd refers to standard error;

Significantly different from FFS at ***p<0.001; **p<0.01; *p<0.05

Table 2. ACSC hospitalizations across models and for each condition

	FFS	Enhanced-FFS	Capitation	FHT
Number of patients with asthma	77,328	102,003	64,246	33,753
Number of asthma patients with an ACSC hospitalization	873 (1.13%)	1,048 (1.03%)	778 (1.20%)	474 (1.40%)
Number of patients with hypertension	137,498	377,734	256,457	124,230
Number of hypertension patients with an ACSC hospitalization	812 (0.59%)	1,761 (0.47%)	1,256 (0.49%)	695 (0.56%)
Number of patients with diabetes	85,031	217,296	174,742	95,480
Number of diabetes patients with an ACSC hospitalization	1,244 (1.46%)	2,251 (1.04%)	2,108 (1.21%)	1,427 (1.49%)
Number of patients with COPD	11,415	22,756	19,626	12,898
Number of COPD patients with an ACSC hospitalization	749 (2.74%)	1,206 (5.30%)	1,218 (6.21%)	986 (7.64%)
Number of patients with CHF	15,062	9,979	8,953	5,378
Number of CHF patients with an ACSC hospitalization	331 (6.54%)	629 (6.30%)	564 (5.93%)	395 (6.84%)
Number of patients with angina	7,834	16,071	16,068	13,400
Number of angina patients with an ACSC hospitalization	215 (2.74%)	337 (2.10%)	356 (2.22%)	309 (3.31%)
Number of patients with epilepsy	10,676	14,700	12,523	8,290
Number of epilepsy patients with an ACSC hospitalization	394 (3.69%)	415 (2.82%)	359 (2.87%)	319 (3.85%)

Table 3. Odds of an ACSC Hospitalization for ACSC Patients Using FFS patients as the Reference

Variable	Odds Ratio	95% Confidence Interval
n	**1,654,106**	
FFS	**reference**	
FHT	1.062*	1.003 - 1.124
Enhanced FFS	0.778***	0.739 - 0.818
Blended Capitation	0.911**	0.864 - 0.960
Patient age	0.997***	0.996 - 0.998
Male	0.996 NS	0.964 - 1.030
ACG® weight	1.409***	1.394 - 1.425
Practice RIO	1.008***	1.007 - 1.009
Hypertension	**reference**	
COPD	8.403***	7.992 - 8.836
Asthma	1.919***	1.817 - 2.026
Diabetes	2.374***	2.280 - 2.471
CHF	4.756***	4.454 - 5.079
Angina	2.127***	1.978 - 2.287
Epilepsy	5.654***	5.279 - 6.055
Two + ACSCs	0.880***	0.835 - 0.928
Income quint 1	**reference**	
Income quint 2	0.830***	0.792 - 0.870
Income quint 3	0.778***	0.741 - 0.816
Income quint 4	0.703***	0.669 - 0.739
Income quint 5	0.631***	0.597 - 0.667
Pseudo R^2	0.1243	
Area under the curve	**0.8012**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Appendix

Table 4. Odds of an ACSC Hospitalization for Angina

Variable	Odds Ratio	95% Confidence Interval
n	**51,960**	
FFS	**reference**	
FHT	0.858	0.711 - 1.035
Enhanced FFS	0.748*	0.614 - 0.912
Blended Capitation	0.843	0.707 - 1.007
Patient age	1.020***	1.013 - 1.027
Male	1.083	0.960 - 1.222
ACG® weight	1.534***	1.485 - 1.585
Practice RIO	1.003*	1.000 - 1.007
Income quint 1	**reference**	
Income quint 2	0.695***	0.583 - 0.829
Income quint 3	0.798**	0.676 - 0.942
Income quint 4	0.658***	0.553 - 0.783
Income quint 5	0.531***	0.437 - 0.646
Pseudo R^2	0.0553	
Area under the curve	**0.7044**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 5. Odds of an ACSC Hospitalization for Asthma

Variable	Odds Ratio	95% Confidence Interval
n	**268,277**	
FFS	**reference**	
FHT	1.040	0.918 - 1.179
Enhanced FFS	0.766***	0.689 - 0.851
Blended Capitation	0.916	0.821 - 1.021

Patient age	1.015***	1.013 - 1.017
Male	0.998	0.928 - 1.074
ACG® weight	1.449***	1.419 - 1.480
Practice RIO	1.010***	1.008 - 1.013
Income quint 1	**reference**	
Income quint 2	0.784***	0.708 - 0.868
Income quint 3	0.721***	0.650 - 0.800
Income quint 4	0.613***	0.550 - 0.684
Income quint 5	0.450***	0.397 - 0.510
Pseudo R^2	0.0483	
Area under the curve	**0.6792**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 6. Odds of an ACSC Hospitalization for CHF

Variable	**Odds Ratio**	**95% Confidence Interval**
n	**29,495**	
FFS	**reference**	
FHT	1.011	0.857 - 1.192
Enhanced FFS	0.983	0.847 - 1.141
Blended Capitation	0.914	0.788 - 1.060
Patient age	1.025***	1.020 - 1.030
Male	1.002	0.908 - 1.106
ACG® weight	1.333***	1.297 - 1.370
Practice RIO	1.004*	1.001 - 1.007
Income quint 1	**reference**	
Income quint 2	0.822**	0.718 - 0.942
Income quint 3	0.703***	0.608 - 0.813
Income quint 4	0.663***	0.572 - 0.768
Income quint 5	0.622***	0.532 - 0.727
Pseudo R^2	0.0430	

Area under the curve	**0.6703**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 7. Odds of an ACSC Hospitalization for COPD

Variable	**Odds Ratio**	**95% Confidence Interval**
n	**64,759**	
FFS	**reference**	
FHT	1.080	0.971 - 1.202
Enhanced FFS	0.754***	0.680 - 0.836
Blended Capitation	0.887*	0.802 - 0.981
Patient age	1.039***	1.035 - 1.042
Male	1.136***	1.064 - 1.213
ACG® weight	1.323***	1.296 - 1.351
Practice RIO	1.003**	1.001 - 1.005
Income quint 1	**reference**	
Income quint 2	0.740***	0.676 - 0.810
Income quint 3	0.738***	0.669 - 0.813
Income quint 4	0.788***	0.715 - 0.867
Income quint 5	0.617***	0.551 - 0.691
Pseudo R^2	0.0480	
Area under the curve	**0.6776**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 8. Odds of an ACSC Hospitalization for diabetes

Variable	**Odds Ratio**	**95% Confidence Interval**
n	**553,209**	
FFS	**reference**	
FHT	1.048	0.965 - 1.139
Enhanced FFS	0.797***	0.738 - 0.861
Blended Capitation	0.929	0.860 - 1.004

Patient age	0.987***	0.984 - 0.989
Male	0.927**	0.881 - 0.975
ACG® weight	1.742***	1.718 - 1.767
Practice RIO	1.011***	1.009 - 1.012
Income quint 1	**reference**	
Income quint 2	0.851***	0.794 - 0.912
Income quint 3	0.781***	0.727 - 0.840
Income quint 4	0.691***	0.639 - 0.746
Income quint 5	0.653***	0.601 - 0.709
Pseudo R^2	0.0668	
Area under the curve	**0.7239**	

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 9. Odds of an ACSC Hospitalization for epilepsy

Variable	**Odds Ratio**	**95% Confidence Interval**
n		
FFS	**reference**	
FHT	1.134	0.963 - 1.335
Enhanced FFS	0.812**	0.698 - 0.946
Blended Capitation	0.862	0.740 - 1.004
Patient age	0.997*	0.995 - 1.000
Male	0.893*	0.803 - 0.992
ACG® weight	1.358***	1.319 - 1.398
Practice RIO	1.003	1.000 - 1.007
Income quint 1	**reference**	
Income quint 2	0.814**	0.700 - 0.947
Income quint 3	0.757**	0.646 - 0.888
Income quint 4	0.757**	0.645 - 0.888
Income quint 5	0.788**	0.669 - 0.927
Pseudo R^2	0.0306	

Area under the curve	**0.6459**

Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*

Table 11. Odds of an ACSC Hospitalization when treating non-enrolled patients to enrolling physicians as a separate group.

Variable	**Odds Ratio**	**95% Confidence Interval**
N	**1,654,106**	
FFS	**reference**	
Non enrolled	1.137**	1.051 – 1.231
FHT	1.130**	1.053 - 1.213
Enhanced FFS	0.827***	0.774 – 0.884
Blended Capitation	0.969	0.906 – 1.036
Patient age	0.997***	0.996 - 0.998
Male	0.996	0.964 - 1.029
ACG® weight	1.410***	1.394 - 1.426
Practice RIO	1.008***	1.007 - 1.009
Hypertension	**reference**	
COPD	8.396***	7.985 - 8.827
Asthma	1.921***	1.819 - 2.029
Diabetes	2.372***	2.279 - 2.470
CHF	4.752***	4.450 - 5.075
Angina	2.128***	1.979 - 2.288
Epilepsy	5.640***	5.267 - 6.040
Two + ACSCs	0.881***	0.836 - 0.929
Income quint 1	**reference**	
Income quint 2	0.830***	0.792 - 0.870
Income quint 3	0.778***	0.741 - 0.816
Income quint 4	0.703***	0.669 - 0.739
Income quint 5	0.630***	0.597 - 0.667

Pseudo R^2	0.1243
Area under the curve	**0.8012**
Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*	

Table 12. Odds of an ACSC Hospitalization with virtual enrolment of non-enrolled patients to their enrolling

Variable	**Odds Ratio**	**95% Confidence Interval**
n	**1,654,106**	
FFS	**reference**	
FHT	1.160***	1.081 - 1.244
Enhanced FFS	0.846***	0.792 - 0.904
Blended Capitation	0.993	0.928 - 1.061
Patient age	0.997***	0.995 - 0.998
Male	0.992	0.960 - 1.026
ACG® weight	1.410***	1.395 – 1.426
Practice RIO	1.008***	1.007 – 1.009
Hypertension	**reference**	
COPD	8.399***	7.988 – 9.831
Asthma	1.924***	1.822 – 2.032
Diabetes	2.367***	2.274 – 2.465
CHF	4.753***	4.451 – 5.076
Angina	2.121***	1.972 – 2.281
Epilepsy	5.652***	5.278 – 6.052
Two + ACSCs	0.882***	0.836 – 0.929
Income quint 1	**reference**	

Income quint 2	0.828***	0.790 – 0.867
Income quint 3	0.775***	0.738 – 0.813
Income quint 4	0.700***	0.666 – 0.736
Income quint 5	0.628***	0.594 – 0.663
Pseudo R^2	0.1241	
Area under the curve	**0.8010**	
Note: Significant at p<0.001: ***; at p<0.01: **; at p<0.05*		

Table 13. Characteristics of non-enrolled patients and comparison with FFS patients

Variable	**FFS (reference)**	**Non-enrolled**
N	296,961	136,379
Average patient age (sd)	46.1 (21.9)	49.6*** (18.5)
% Male	45.5	45.5
Average Patient ACG® weight (sd)	0.793 (0.938)	0.794 (0.914)
% COPD	3.8	4.2***
% Asthma	26	19.6***
% Diabetes	28.6	30.8***
% CHF	1.7	1.9***
% Hypertension	46.3	49.6***
% Angina	2.6	2.9***
% Epilepsy	3.6	3.7
Two or more ACSCs	11.6	11.6
Average RIO (sd)	5.9 (13.5)	6.5*** (13.6)
% Income quint 1	23.2	22.7**
% Income quint 2	21.2	20.6***
% Income quint 3	19.9	20.1***
% Income quint 4	19.1	19.4*
% Income quint 5	16.1	16.7***

Highlights

Risk of ACSC hospitalization varies by model of payment to primary care physician

Blended capitation payment associated with lower risk of ACSC hospitalization

Enhanced-fee-for-service payment associated with lower risk of ACSC hospitalization

Higher risk of hospitalization for patients in interdisciplinary primary care teams

Neighborhood income negatively associated with ACSC hospitalizations