What Happens after Cardiac Arrest? Patterns of Care with Patient Enrollment

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Abstract: Survivors of cardiac arrest remain at high risk of death, recurrence of cardiac events, cognitive impairment from brain damage, and mental health issues. They may benefit from ongoing monitoring of cardiac risk factors, early screening for mental health issues, and co-ordination of multiple specialist care; this requires continuity of care in primary care. Primary care reforms in Ontario, Canada have led to the majority of general practitioners (GP) voluntarily switching from fee-for-service remuneration to enhanced patient enrolment models, in which GPs are encouraged, and in the capitated models required, to formally enroll most patients attached to their practice. Formal enrolment of a patient designates a GP as responsible for the patient's ongoing preventative and chronic care needs, for which the GP receives pay-for-performance incentives. Successful implementation of incentives targeting GP continuity of care requires building a two-sided relationship, wherein patient behaviour also responds to GP behaviour under incentives. We investigate how cardiac arrest patients' GP visit behaviour differs across primary care models in Ontario. Using Ontario administrative health data from Apr 1st, 2004 to Mar 31st, 2010, we identify cardiac arrest survivors, and conduct duration analysis on time to first GP outpatient follow up visit, following patients up to Mar 31st, 2011. We also consider secondary follow up duration outcomes including time to diagnostic testing and specialist visits. We distinguish between visits to any GP; visits to a patient's own regular GP, as defined by a virtual rostering algorithm based on two years of visit history; and visits to other GPs. We find that enrolled patients visit their own (other) GP sooner (later) compared to patients whose regular GP is fee-for-service. A similar pattern generally carries through for diagnostic testing/specialist visits ordered/referred by a patient's own/other GP. Results are consistent with a hypothesis of better continuity of care for enrolled cardiac arrest survivors, but causal interpretation of incentives cannot be established in the present empirical framework.

Keywords: Remuneration Incentives - Primary Care– Continuity of Care — Cardiac Arrest

1 Introduction

A large research literature addressing incentives in healthcare and the public sector more broadly suggests that individual behavior responds to shifting compensation schemes, although not always in the manner foreseen by policymakers (e.g., Burgess & Ratto, 2003). Within the broad health sector, the ramifications of physician payment models can impact many components of the healthcare sector, including technology-intensive interventions in acute care hospital settings and ongoing services in long term care settings. In Canada, primary care physicians - i.e., family physicians or general practitioners (GPs) - are gatekeepers, regulating access to specialist and diagnostic services based on health needs in order to counteract the moral hazard induced by universal first dollar public health insurance coverage. In this environment the behavior of GPs, and consequently the incentives acting on them, can have direct impacts on specialist and diagnostic service utilization.

The role of GPs as gatekeepers also means that access barriers to GPs may lead to delays in access to outpatient specialist and diagnostic services. In some medical contexts, this could lead to preventable deteriorations of health, translating into declines in survival or health-related quality of life, and/or escalations in subsequent utilization. This is especially likely to be a concern after a severe acute medical event, which may require timely outpatient follow-up. As part of the acute to chronic care transition, effective follow up in primary care can serve several useful functions. Patients may be at risk of chronic complications on a number of dimensions of health need, and coordination by GPs of multiple specialists who may not directly communicate with each other can be useful. Regular monitoring of risk factors and screening for early detection of deterioration are other ongoing follow-up roles where primary care is typically employed. Ongoing activities related to chronic and preventative care requires a clear delineation of responsibility clarifying which physician is responsible for a patients ongoing health needs. This requires the presence of a relationship between family physician and patient, wherein continuity of care can be established.

Primary care in Canada's most populous province, Ontario, has undergone significant reform over the last 15 years. A major component of this involved widespread adoption of remuneration models for GPs which incorporate incentives to promote continuity of care. Prior to these reforms, an overwhelming majority of GPs in the province were compensated on a purely fee-for-service (FFS) basis. In this setting, it is not clear which physician is responsible for a particular patient's chronic and preventative care needs. Following the introduction of several enhanced Patient Enrolment Models (PEM) as part of the payment reform process, the majority of GPs in Ontario have chosen these payment models over pure FFS compensation.

A feature common to all PEMs is that physicians are encouraged, and in the capitated models required, to formally enroll (i.e., roster) most patients in their practice (Although, with constraints, some patients may remain attached to the practice without official enrolment). Enrolment formalizes which GP is responsible for a patients ongoing chronic and preventative care needs – thus establishing a basis for continuity of care. For enrolled patients, GPs receive pay-for-performance incentives to provide preventative and chronic care. For some of these payment models GPs also receive large capitation payments for a core basket of services to enrolled patients. This can also induce an orientation for preventive care by effectively imposing costs on GPs if patient health deteriorates (Sweetman & Buckley, 2014).

Arguably, one metric to evaluate the continuity of care in the transition from acute to chronic care is time to first outpatient GP visit after hospital discharge. The strength of the GP-patient relationship can also be further gauged by looking at a patient's time to visit their own

regular GP versus another GP. Although the choice to visit a GP is largely under the control of a patient, the patient makes this choice contingent on several state variables, one of which is likely to be their own perceived quality of their relationship with their GP. The value of this relationship state variable may be increased or decreased by actions of a patient's regular or other GPs, and it may also depreciate naturally in the absence of maintenance or investments by a GP. Establishing a physician-patient relationship, and thus, continuity of care depends on behaviour of both physicians and patients. Thus, promoting continuity of care through incentives hinges on a physician's ability and willingness to engage in relationship building activities that may influence observable patient behaviour. Again, one observable measure of patient behaviour that may provide information about the latent relationship state variable is time to GP visit a after an acute event.

In this study, we use duration analysis techniques to investigate the presence of systematic relationships between primary care models in Ontario and post-discharge timeliness of outpatient GP visits. We also distinguish between visits to any GP versus the patient's own regular GP (as defined by their 2 year pre-discharge visit history). Because the need for follow up and patient follow up behaviour is contingent on a broad and heterogeneous range of disease categories or health states, we choose to focus present analysis on a tightly defined clinical category which is also a severe acute condition - cardiac arrest. We identify survivors of cardiac arrest in Ontario using administrative health data from Ontario over Apr 1st, 2004 to Mar 31st, 2010 and follow patients up to Mar 31st, 2011

Cardiac arrest is associated with a poor prognosis in subsequent mortality and quality of life. Survivors are at a high risk of recurring cardiac problems, including recurring arrests or myocardial infarction. Furthermore, they may have suffered neurological damage, leading to cognitive or motor function impairment. Finally they may suffer from mental health issues including post-traumatic stress, depression or anxiety. Thus, there are diverse dimensions of health need for these patients, which likely require responses by several specialist types - and coordination in primary care. Thus, we also consider as secondary measures of interest, time to first outpatient specialist visit, focusing on cardiologists, general internists, neurologists, and psychiatrists to match plausible dimensions of health need. Analogous to GP visits, we distinguish between specialist visits referred by a patient's regular GP versus another GP, as well as visits referred by anyone (or no one). We interpret the patient's own GP's involvement in specialist referral as a measure of continuity of care. Additionally, we look at time to first diagnostic testing, including lab testing and diagnostic radiology (again broken down by tests ordered by regular / other GP or anyone). This may give us a sense of the patient's regular GP's early involvement with monitoring activities, which could include management of cardiac risk factors.

We find that patients whose GP enrolls them into a PEM visit their own (other) GP sooner (later) compared to patients whose regular GP is fee-for-service (Hazard Ratio = 1.784 for visit to regular GP comparing enrolment into a PEM versus FFS; $P < 0.001$). A similar pattern generally carries through for diagnostic testing/specialist visits ordered/referred by a patient's regular GP. In particular, the hazard ratio of time to first psychiatrist visit referred to by the regular GP comparing enrolment into a PEM to FFS is 3.048 ($P < 0.01$). This may suggest that these patients have greater GP involvement in management of their mental health, which could be beneficial for early screening in primary care.

The remaining discussion is organized as follows. Section 2 provides clinical background on cardiac arrest, including prognosis and a discussion of survivor needs. Background on primary care reform and physician incentives in Ontario is provided in section 3. Section 4 provides details

of our data and empirical strategy. Results and Concluding remarks are presented, respectively, in sections 5 and 6.

2 The Prognosis of Cardiac Arrest Survivors

Cardiac arrest is the sudden loss of blood circulation and pulse because of cardiac electrical failure that leads to a disruption in the heart's pumping mechanism. It is the third leading cause of death in the U.S. (Neumar et al., 2015). It may be caused by, but is distinct from, a "heart attack", or myocardial infarction, and is a more severe condition. The extent of its severity can be gauged by the bleakness of short-term survival prospects. Survival to discharge in the U.S. is less than 6% for out-of-hospital cardiac arrest, and 24% for in-hospital arrest (Graham, et. al., 2015). Also, due to loss in blood flow, and hence oxygen and glucose supplied to the brain, patients are also at high risk for neurological injury, which can lead to a decline in cognitive functioning. This has obvious implications for quality of life.

Less is known about the long-term prognosis of cardiac arrest due to limited large sample studies with long-term outcomes. Chan et al. (2013) is the largest study with long-term outcomes that we are aware of; using U.S. Medicare data they find that 1-year mortality and rehospitalization rates for survivors of in-hospital cardiac arrest over the age of 65 is high, at 41.5% and 65.6% respectively. There is also a high risk of recurrent cardiovascular events. Graves et al. (1997) report that 16% of out-of-hospital cardiac arrest patients had recurrent cardiac arrest within 3 years, and 19% had a myocardial infarction using data from Goteborg, Sweden. Long-term neurological consequences can range from mild cognitive disorders to seizures, movement disorders or cognitive deficits which impede daily functioning (Khot & Tirschwell, 2006). Furthermore, as can be imagined, survivors often suffer anxiety or depression symptoms (Kamphuis et al., 2002). Reported anxiety, depression, cognitive issues, loss in daily functioning, chronic fatigue, as well as posttraumatic stress disorder can all contribute to decline in the quality of life (Moulaert, 2014).

Generally, most research has deservedly focused on improving the acute care response to cardiac arrest. A recent, Netherlands based, single blind randomized control trial, implemented a nurse-led post-discharge follow up program to screen for emotional and cognitive issues, provide information, promote self-management, and refer to specialists as needed; they find significant improvement in terms of the SF-36 domains of emotional, mental, and general health (Moulaert, 2014). A number of components of follow up care which may be beneficial for survivors can fall in traditional domains of primary care. This includes secondary/tertiary prevention (i.e. preventing symptoms/deterioration) of chronic disease including ongoing potential cardiovascular problems. This may involve monitoring and managing cardiac risk factors, which may include regular lab work (e.g. blood sugar, cholesterol, C-reactive protein). Additionally, primary care is often considered the first line of defense for early detection and management of patients at risk for mental health issues. Furthermore, survivors may be in need of eventual follow up with several specialists who may not communicate with each other, and the co-ordination of these services along with follow up in primary care may be useful. All of these dimensions of care require continuity of care, including a strong ongoing relationship between patients and their GPs. Encouraging such relationships and continuity of care is one of the areas of focus of the literature on physician incentives.

3 Primary Care Reform in Ontario

The literature on physician incentives with particular reference to primary care reform in Canada and/or Ontario is discussed in Hurley et al. (1999); Hutchison et al. (2011); Sweetman & Buckley (2014). We focus on four central features of the remuneration and funding reforms: (1) Enrollment/rostering; (2) Pay-for-performance; (3) capitation; and (4) interdisciplinary worker funding. These features are incorporated into reformed payment models in different configurations which we clarify below.

Primary care physicians in Ontario were traditionally almost all remunerated by pure FFS. FFS can encourage physicians to over-provide services and minimize the time spent on each resulting in a loss of quality. Another feature of traditional FFS, as implemented in Ontario, is that there is no formalization of which physician is responsible for a particular patient. This deficiency may be especially consequential for the provision of preventative care and the management of chronic illness, as well as other elements related to continuity of care.

Ontario has had experience with alternative physician compensation schemes in primary care as early as 1963. But adoption of alternative models did not become widespread until well after the provincial government announced primary care reform as a priority in 1996– with the goal of improving access, quality, continuity of care, and provider/patient satisfaction. By 2000, alternative payment models still only accounted for roughly 5% of patients, but a substantial transformation followed, especially with the introduction of four new payment models between 2002 and 2006, so that by 2013, 72% of all GPs had voluntarily switched to an alternative payment model (Sweetman & Buckley, 2014). A fifth model introduced in this time frame is dedicated to rural and northern practices. We leave out discussion of this model as well as earlier models, as they account for a very small share of existing practices. They are excluded from our data analysis.

Family Health Networks (FHNs) and Family Health Organizations (FHOs) have some minor differences, but many common features including practices being mandated to have at least three physicians working in a group, and age-sex specific capitation payments to provide a basket of core services to each enrolled patient. They also receive 15% (initially 10%) of the regular FFS compensation rates for these services. One of the main differences between FHNs and FHOs is that the number of services in the FHO basket is 132 fee codes for FHOs versus 69 for FHNs, and hence they receive larger capitation payments. Services outside of the capitated basket are paid FFS. Both FHNs and FHOs have an access bonus, which is a payment made to physicians from which penalties are deducted if their enrolled patients see a GP from outside of the group practice, and that for FHOs is larger commensurate with the larger basket.

In contrast to FFS, both capitation and access bonuses create incentives for the under-provision of primary care services. Capitation discourages service provision by the enrolling physician, and the access bonus provides incentive for the enrolling physician to discourage patients from GP utilization outside the practice. In contrast to "pure" capitation, incentives for under-provision are balanced in Ontario's "blended" implementation. One aspect of blending is the 15% shadow billing rate as mentioned above for core services provided to enrolled patients. Blending is also achieved by regular FFS compensation for all services outside the core services basket for enrolled patients. Finally, FHOs/FHNs may have patients who are "attached" to their practice without being formally enrolled. Compensation for these patients is based on purely FFS. There are constraints on the amount of services that can be rendered to the unenrolled side of a GPs practice in these models. Firstly, these GPs are required to have a minimum number of

enrolled patients. Secondly, there is a financial cap on the FFS compensation that can be paid out to unenrolled patients for core services each year.

Enrollment, or equivalently, rostering of patients is in itself a key feature of all four payment models we consider. Thus collectively these alternative models in Ontario are often referred to as Patient Enrollment Models (PEMs). Enrollment is designed to formalize a one-to-one relationship between a patient and primary care physician. It clarifies which physician is responsible for preventative care and chronic disease management and establishes a basis for continuity of care. The operationalization of enrollment differs across the capitated models (FHN and FHO), versus the other two payment models we consider. These models, which do not contain any major capitation component, are often referred to as enhanced FFS (as opposed to pure or traditional FFS).

The first enhanced FFS model we consider, introduced in 2003, was the family health group (FHG). The comprehensive care model (CCM) followed in 2005, with the main difference being that FHG physicians were required to practice in groups of 3 or more (like FHOs and FHNs), whereas CCMs could be based on a single physician. The main feature shared across these two models, which is also a component of the capitated models we discussed above, is pay-for-performance (PFP) incentives for enrolled patients. Thus enrollment is operationalized through PFP incentives for all enrolled patients we consider, but also through capitation for FHOs and FHNs. Incentives from PFP include direct bonuses/payments for (1) preventative care services (e.g. flu shots and Pap smears, etc.); and (2) managing chronic conditions (heart failure, diabetes, etc.). Again, such payments apply only for enrolled patients, and not for unenrolled patients that see a PEM physician, irrespective of how regularly the patient sees this physician. The incentive mechanism through which PFP encourages continuity of care through enrollment is direct and straightforward. An additional incentive mechanism, which is more nuanced, is built into the structure of capitation, and may independently produce an additional preventative orientation in a physician. This can happen because of a transfer of risk to the physician in capitation, which occurs due to the fact that, within an age-sex group, capitation payments are fixed, even though utilization may increase due to deteriorations in health. This means that capitated GPs would face future costs (or alternatively savings) if they pursue less (more) preventative care. This transfer of risk also creates incentives to "cream-skim" healthier patients into the practice, or alternatively, into the enrolled side of the practice. Thus two types of selection behaviours may be observed in capitated models or in PEMs in general. The first is selection of patients into the practice, which we refer to as outside of practice selection. The second is within practice selection, meaning selection of patients by a PEM physician into the enrolled/unenrolled side of their practice.

The final feature of PEM incentives which we discuss is interdisciplinary funding. This is implemented within Ontario's Family Health Teams (FHT). These FHTs do not constitute a physician payment model per se. The four payment models mentioned above (FHO, FHN, FHG, and CCM) are mutually exclusive methods of compensation for physician services. Whereas the interdisciplinary funding in a FHT group is additional funding to compensate interdisciplinary health workers (e.g. nurse practitioners, nurses, pharmacists, dieticians, social workers, mental health workers, etc.) who are integrated into the FHT physician group. In exchange physicians are expected to service a larger practice of patients. Being in a FHT may have behavioural consequences for physicians because opportunity for specialization can allow physicians and other health workers to focus on a tighter scope of practice. This may increase efficiency as well as

quality and have some independent impact on continuity of care. Only capitated groups (FHOs and FHNs) are allowed to be FHTs.

4 Data and Empirical Framework

4.1 Data Sources and Selection

The data for this study consists of several administrative databases provided by the Ontario Ministry of Health and Long Term Care (MOHLTC), linked primarily through encrypted patient health numbers, physician identifiers, and physician group identifiers. We select our primary patient sample from Ontario's Discharge Abstract Database (DAD), which carries up to 25 diagnoses related fields per patient discharge for all inpatient admissions in the province. From the DAD we identify all patients with cardiac arrest as a diagnosis after initial admission into an Ontario acute care hospital. We include patients aged 18 and above, who survive to discharge over Apr 1st, 2004 to Mar 31st, 2010. This includes patients who suffered in-hospital cardiac arrest, as well as patients who suffered out-of-hospital cardiac arrest, and survived long enough to be admitted into inpatient care. We include only patients with valid registered Ontario health insurance numbers, where the province is responsible for payment, and exclude subsequent events per patient. For patients whose discharge status indicated transfer into another acute care facility, we follow them through subsequent transfers to identify and exclude patients who died during a transferred admission. For these patients, we take date of discharge and other clinical variables from the last admission in the chain of hospital transfers from which they are discharged alive. This results in an initial selection of 7,023 patients/admissions.

Patients' encrypted health numbers are matched with OHIP claims data to determine physician visits, and to the Client Agency Program Enrolment (CAPE) database to determine physician-patient enrolment relationships. Claims data are also used to determine patient relationships with a GP using "virtual rostering/enrollment" - where patient visit history is used to establish evidence of a patient's fidelity to a particular physician in the absence of an observable formalized agreement.

The need for virtual rostering arises in this context for two important reasons. First, CAPE data only records patient enrolment with physicians in PEMs. For physicians who practice on a purely FFS basis, we have no means to assign patients to their "regular" family physician without engaging their visit history. Thus, virtual rostering facilitates some comparisons between patients whose regular GP is FFS versus PEM, which we cannot make with CAPE data alone. A second reason why virtual rostering is useful is because, even for PEM physicians, a portion of their practice consists of unenrolled patients. Thus, all unenrolled patients do not necessarily see a FFS service doctor primarily; some may, instead, regularly see a PEM physician on the unenrolled side of the physician's practice. Although PEM incentives may not apply to such physicians, fixed characteristics of physicians that select into PEM models may still affect patient behavior and

outcomes in ways that are systematically different from FFS physicians. Again, comparisons involving this patient group can only be made with virtual rostering in our data.

To identify patients in a physician's virtual roster, we use patients' OHIP claims history with family physicians from two years prior to cardiac arrest related hospital discharge. PEM Physicians are required to submit shadow billing, even in capitated practices, but capitated physicians are compensated at a rate of only 10% or 15% of the regular FFS rate for equivalent services within their core basket of services. For this reason we use the approved claims dollar amount provided in the OHIP data to assign patients to a physician. This is a measure of utilization equivalent to fee-for-service billings for equivalent services. The family physician for which we find a unique maximum dollar amount of total approved claims in two years of a patient's visit history assigns that patient to the physician's virtual roster. We refer to a patient's virtually rostering physician, interchangeably as the patient's regular or own GP (as opposed to other GPs).

CAPE data contains information on true patient enrolment data (as used by MOHLTC to compensate physicians). It also contains information on the payment model and physician group of the enrolling physician. The virtual rostering algorithm we use based on OHIP claims data provides us a physician identifier, but no information on the physician group or payment model. We get this by merging with the Corporate Provider Database (CPDB) using physician identifiers. The physician group identifier field in both CAPE and CPDB is then used to merge with data on which groups receive FHT interdisciplinary funding. Mortality data is taken from the Registered Person's Database (RPDB) which is merged by health number. Finally, a patient rurality measure is derived from the 2008 Rurality Index of Ontario by merging with the patient postal code as recorded in the DAD. Note that although, we restrict our cardiac arrest survivor sample to March 2010. We have the ability to follow these patients in terms of visits/claims and mortality for the following fiscal year, that is, until the end of March, 2011.

Our analysis is based on four major physician remuneration models; the enhanced FFS models (CCM and FHG), which provide PFP incentives to physicians for enrolled patients; and capitated models (FHO and FHN), which, in addition to aforementioned PFP incentives, compensate physicians by a fixed age-sex adjusted capitation payment for a core basket of services for enrolled patients. We exclude from the analysis, a small number of patients (N = 108; 1.5%) who are enrolled or virtually rostered with other payment models. These models are often special arrangements for rural regions or other unique practices (e.g. South Eastern Academic Medical Association). Another 517 (7.4%) observations are dropped because we were unable to identify the patient's regular GP using our virtual rostering algorithm. This brings the main sample for analysis to 6,398 patients, which is representative of 91.1% of the original cardiac arrest survivor sample. Appendix table A1 shows details of sample selection. There is some potential bias which arises due to endogenous sample selection which must be acknowledged. We address this, briefly, below. Our focus is not on the small proportion of unique payment models in specific geographic settings we exclude. Instead we address the bias introduced because of endogenous sample selection based on virtual rostering.

Patients may not be successfully virtually rostered by our algorithm for one of two reasons. The first reason is because they have not seen any GP in the two years prior to discharge. This suggests that these patients have a lower propensity to consume GP services. We show in appendix table A2 that this pattern continues beyond the cardiac arrest discharge, to the extent that, patients identified by the virtual rostering algorithm visit their GP (and get other outpatient utilization (e.g. diagnostic testing, specialist visits) sooner than those who could be virtually rostered by our algorithm. The second reason why people may not be virtually rostered by our algorithm is because they have seen more than one GP, with equal utilization, in the last two years. This suggests that a strong or exclusive physician-patient relationship may be less important for some measure of these patients.

In appendix table A3, we see that, although 60.3% of patients we identify by virtual rostering are enrolled with a PEM GP, only 21.3% of patients are enrolled among patients that could not be virtually rostered. This suggests, if we were hypothetically able to use the full sample by identifying all patients' regular GPs through virtual rostering, that coefficients comparing enrolled with unenrolled patients should increase for outcomes related to GP utilization or GP continuity of care. If this is the case, then the direction of bias from endogenous sampling would underestimate these coefficients. Most of our results suggest there is sooner (GP and other) utilization and higher continuity of care for enrolled patients. Thus, given the nature of the endogenous sampling discussed above, it suggests that true coefficients would actually be even larger for the entire cardiac arrest sample (amongst the four relevant primary care models considered).

4.2 Descriptive Statistics

There are a number of ways that we can categorize GP primary care (PC) models, and thus, patient associations with these models. One major division of patients involving PC models is enrolled versus unenrolled patients. Our administrative data gives us direct information about formal patient enrolment relationships with physicians in a PEM. Unenrolled patients' relationships to GPs are not formalized in the same way. For unenrolled patients, virtual rostering informs us (with some probability) of the PC model of the GP these patients regularly see. We can naturally divide unenrolled patients by their regular GP type – PEM versus FFS GP. For brevity, we may refer to these three categories of patients as PEM-Enrolled, PEM-Unenrolled, and FFS *patients*, even though the description more properly applies to the GP with which these patients have an enrolment or virtual enrolment based relationship. Similarly if we refer to a patient's primary care model, this means the primary care model of the GP with which the patient is enrolled/virtually enrolled.

All patients fall into one of the three mutually exclusive PC models categories, PEM-Enrolled, PEM-Unenrolled, and FFS. We further subdivide the two PEM categories into Enhanced FFS and capitated models. Finally, we subdivide capitated models into those that receive FHT interdisciplinary funding (CAP-FHT) and those who do not (CAP-Not FHT). Table 1 shows how patients in the sample are broken down into these categories. We can see that over half of patients

in the sample (N = 3502) are in Enhanced FFS practices. Of these patients, 75.5% are enrolled. In capitated practices, both FHT and not FHT, a larger proportion of patients are enrolled (roughly 86% in both). Patients with FFS and capitated practices each account for less than a quarter of patients. Family Health Teams account for only 8.0% of patients.

Table 2 shows a breakdown of overall means and standard deviation for covariates, which are also broken down by a patients PC model according to the three main categories: PEM-Enrolled, PEM-Unenrolled, and FFS. The last column shows a test of equality of means, based on a Wald test of significance after regressing each patient characteristic on the primary care categorical variable. Tests are based on linear or logistic regression models for continuous or binary discrete variables respectively, and standard errors are clustered at the hospital level. Control variables fall into the following six broad categories: (1) demographics; (2) hospital comorbidities; (3) hospital intensity of care (4); hospital admission related variables; (5) hospital discharge to locations; and (6) hospital and fiscal year fixed effects.

Demographics include age, sex and rurality. We specify age as a separate categorical variable for each sex with categories: 18-34; 35-44; 45-54; 55-64; 65-74; 75-84; and 85 or above. Rurality is based on the 2008 Rurality Index of Ontario, which is used to compensate physicians for practicing in rural areas. The measure has a range from 0 (highly urban) to 100 (highly rural) and we specify it as categories: 0; 1-10; 11-50; 51-100; and missing (N = 103; 1.6%).

Hospital comorbidities are based on diagnostic fields in the DAD related to the cardiac arrest discharge, as well as two years of diagnostic history prior to discharge. For patients that were transferred to another acute care facility after their initial cardiac arrest, we define discharge as the last discharge in any sequence of transfers. We construct a Charleson Comorbidity Index using diagnostic data. We also include a large number of individual comorbidity indicators (i.e. for myocardial infarction, congestive heart failure, arrhythmia, cerebrovascular disease, peripheral vascular disease, chronic ischemia, angina, diabetes, hypertension, chronic pulmonary disease, liver disease, renal disorder, cancer, and dementia).

Other clinical variables include a number of measures of hospital related intensity of care. This includes days in intensive care unit (specified as categories: 0; (0-1]; (1-2]; (2-3]; (3-5]; and (5, ∞)) and overall days admitted (specified as categories: 1; 2; 3-5; 6-10; 11-20; 21-50; 51 plus). Additionally, intensity of care variables also includes indicators of a number of invasive interventions (tracheostomy, pleural drainage, mechanical ventilation, central venous catheter use, feeding tube use, and dialysis). Hospital admission related variables include admission from location (home, acute care, outpatient care, and other facility), as well indicators if the patient came in by ambulance, and if the admission was elective. Hospital discharge to locations includes discharge to home, home support, long term care, and other facility. Other controls include 5 fiscal year dummies and 146 hospital dummies (both excluding base group).

For the variables listed in Table 2, we find a large number of covariates to be statistically identical across PC model. At the 5% level, this includes age, sex, rurality, and the Charleson Comorbidity Score (although age and rurality are very close to an arbitrary 5% cutoff). For the measures of comorbidity, intensity of care, or discharge to location which are not independent

across PC model, part of the correlation may be due to trends in disease prevalence, and hospital intensity or discharge practices over time, which may correspond to the trend in uptake of PEM models by GPs over the primary care reform period in Ontario. Hospital admissions from variables are not correlated with the main enrollment PC models.

Table 3 shows the some descriptive details about GP visits, our main study outcome. In our analysis we look at time to first GP visit as a duration outcome. We also differentiate between first visit to a patients regular GP, as identified by virtual rostering, versus some other GP. In table 3, we see that of the 5,733 patients who we observe as having a first follow up GP visit in our data, we know 70% see their own GP. Another 29% see another GP, while 1% sees both their own and another GP on the same day (and we cannot observe who is seen first). Of the 665 patients who do not visit a GP, we observe 83% who die in the sample. The remaining 111 patients who we do not observe visiting a GP or dying, are 1.7% of the total sample. These may be patients who have left the province / country, or this may also be due to inaccuracies in mortality data. The table illustrates, to some extent, how death of a patient is a competing risk for observing GP visits. We discuss this more in the next subsection.

4.3 Empirical Strategy

We conduct data analysis using duration models, primarily using the proportional hazard (PH) model of Cox (1972) which is a convenient framework for duration outcomes that naturally handles censored outcomes and does not require any parametric structure imposed on the baseline hazard. The conditional hazard rate is specified as

$$h(t,X) \equiv \lim_{h \to 0} \frac{\text{Prob}(t \leq T \leq t+h \mid T \geq t, X)}{h} = h_0(t) \exp(X\beta)$$

where t is analysis time (beginning at discharge in our case). The baseline hazard $h_0(t)$ is the hazard rate when covariates X are equal to zero. As is well known, $h_0(t)$ can be left completely unspecified, and is removed as a nuisance parameter from estimation using cox partial likelihood. Covariates are parametrically specified and act proportionally on the baseline and have corresponding parameter vector β. The hazard rate is essentially the density of events at time t for survivors up to time *t*, or $h(t) \equiv f(t)/S(t)$, where the survival function is defined as $S(t) \equiv \Pr(T \geq t) \equiv 1 - F(t)$. In the Cox specification, exponentiated coefficients are equal to the hazard ratio, or the ratio between the baseline hazard rate and the hazard rate associated with a one unit change in an associated covariate.

The main events of interest in our analysis are time to first outpatient GP visit after discharge (also time to other secondary utilization, i.e. lab test, specialist visit). A problem occurs when patients leave the risk set for visiting GPs due to death. Such events (i.e. death) are considered competing events or competing risks, because they prevent the main event of interest (e.g. GP visits) from occurring. Cox PH models can still be used to analyze duration outcomes under competing risks, but this requires a rather strong assumption of independence of the risks

of the main and competing events. This would mean, for example, that there is no correlation between the risk of GP visit and death for any person. If this assumption is not satisfied, this will be a source of bias in hazard ratio estimates. This should be kept in mind when interpreting results.

Another way to deal with competing risks that is popular in the medical / biostatistics literature is to focus analysis on cumulative incidence of events rather than the risk or hazard of the event. Covariate effects on incidence of an event (e.g. GP visits) depend on covariate effects on the hazard or risk of this event as well as the risk of competing events (e.g. death). For example, it is theoretically possible (perhaps through some intervention) to increase the incidence of GP visits without affecting the risk of GP visits at all, and by simply decreasing the risk of the competing event death.

One way to model incidence is to compute separate Cox models for both the main and competing events ($h_m(t, X; \beta_m)$ and $h_c(t, X; \beta_c)$). Covariate associations with incidence will depend on covariate associations with the hazard of both the main and competing events. The cumulative incidence function for the main event of interest (CIF_m) will be a non-linear function of coefficients β_m, β_c and baseline hazards $h_{m0}(t)$ and $h_{c0}(t)$. An easier formulation for modeling CIF_m is due to Fine & Gray, (1999). Their approach is based on modelling the hazard of the subdistribution for the event *m*, or the subhazard function, defined as

$$\overline{h_m}(t) \equiv \lim_{h \to 0} \frac{\text{Prob}(t \leq T \leq t + h \,\&\, event\ m \mid T \geq t\ or\ (T \leq t \,\&\, not\ event\ m))}{h}$$

The advantage of this formulation is that the cumulative incidence for event *m* depends only on its subhazard, according to $CIF_j(t) = 1 - \exp\{\int \overline{h_j}(t)dt\}$. Similar to Cox PH models, the conditional subhazard rate in Fine and Gray (1999) is modelled under a proportional specification as $\overline{h_m}(t, x) = \overline{h_{m0}}(t)\exp(X\beta_m)$.

Although a convenient tool to model incidence, the interpretation of subhazard ratios under Fine and Gray (1999) is not as clear as the interpretation of standard hazard ratios. We can, however know that subhazard ratios greater (less) than one corresponds to increased (decreased) incidence. In the results section, we illustrate covariate relationships with incidence graphically. The main advantage of the approach of Fine and Gray is that independence of competing risks does not need to be assumed. But, although this method provides information about covariate associations with incidence (i.e. marginal probability), it does not provide information about which risk covariates are operating through and how. For example, this method can tell us how the probability of seeing a GP within 30 days differs between enrolled and FFS patients. It does not tell us if this is because of differences in the risk of GP visits across payment models, or if this is because of differences in mortality risk (i.e. risk of the competing event). Thus this approach is more descriptive, and attempts to answer an easier question than does the Cox PH models under independent competing risks. Of course, if independence is not satisfied, then Cox hazard ratios will be biased. Because of estimation time, we perform most of our analysis using Cox PH models, but we implement both methods for our main GP visit outcomes.

Unless otherwise stated, we use all control variables from table 2 in all regressions, and include, additionally, hospital and fiscal year fixed effects, as well as, of course, primary care variables. Our primary care variable specification focuses mainly on the three main PEM categories: PEM-Enrolled, PEM-Not Enrolled, and FFS, which are mutually exclusive and complete, as clarified in the previous subsections. In all results, the omitted or base group for comparison is FFS. A second categorical variable is also included with values: CAP-Enrolled, CAP-Not Enrolled, with the omitted category as not capitated. Recall that all PEM GPs can be divided into capitated or Enhanced FFS. Thus this capitation related categorical variable has explanatory value if only capitated patients are different from enhanced FFS patients. Also, as discussed earlier, capitated GPs may be subdivided based on whether they receive FHT interdisciplinary funding. Thus a final categorical indicates whether a patient's is in a FHT (with values FHT-Enrolled, FHT-Not Enrolled, and base of "not in a FHT"). Again the FHT variable will only have explanatory power if CAP-FHT patients' utilization differs systematically from CAP-Not FHT.

5 Results

5.1 Main Time to GP Outcomes

In this section we show results from analysis on our three main GP Visit outcomes for cardiac arrest survivors - time to first outpatient follow up visit after discharge with: (1) any GP; (2) the patient's regular GP; and (3) other GP. Figure 1 shows the unadjusted cumulative incidence for each of these outcomes. We can clearly see most patients who have follow up visits with a GP see their own GP. Roughly 80% of patients see a GP within 100 days, while the proportion that that sees their own / other GP is roughly two thirds / one third. We can also see that the probability of seeing any GP or the regular GP increases quite steeply early on in time, whereas the probability of seeing another GP, rises more gradually with time.

Results from analysis on all three GP visit outcomes are shown in table 4. Two sets of results for these three outcomes are shown under two separate column groups. The first column grouping shows hazard ratios from Cox PH models and the second column grouping shows subhazard ratios based on Fine and Gray (1999). When comparing the direction and magnitude of subhazard ratios with corresponding hazard ratios, we notice they are remarkably similar for the same outcome and explanatory variable (especially the main PC Variables PEM-Enrolled and PEM unenrolled). It should be clear, however, as discussed in the previous section, that the hazard rate and subhazard rate are not modeling the same thing; so interpretation differs across these methods. The hazard ratio is a model of risk under the assumption that the competing risk of death is independent. The subhazard ratio is not a model of the risk, as such, but is a statistical object designed so that it can be integrated up to model covariate relationships with incidence under the presence of all risks, without assuming independence.

Under both models, there is no detectable systematic relationship of outcomes with FHT-interdisciplinary funding. This may be due to lack of power because of the small amount of patients in FHTs.

Capitation incentives seem to be at play to some degree. There is modest evidence, for example, indicating under-provision (i.e. later visits) for enrolled capitated patients when compared to other PEMs. We can see that patients enrolled with capitated models visit any GP later than patients enrolled with Enhanced FFS practices. This is consistent with predictions of economic theory, as capitated GPs have incentives to under-provide their own core services since they receive fixed payments per patient for these services. Capitated GPs also have incentives to discourage patients from seeing other GPs, since they have access bonuses to which penalties apply if enrolled patients see a GP from outside the enrolling physician group. But despite enrolment with capitation being associated with later visits to any GP, the same is not detectable for either visit to regular or other GPs. This suggests that this result may lack robustness or may not be strong enough to be detectable for these outcomes.

We also find that patients who are not enrolled, but whose regular GP is capitated, are more likely to visit another GP. It is not immediately clear why this might be the case, since there are no pay-for-performance or capitation incentives associated with these patients. One possible explanation is that capitated GPs are more likely to enroll most regular patients because they face a cap on FFS payments for core services to unenrolled patients. This could mean that the remaining unenrolled patients are less attached to the practice than those in enhanced FFS practices.

For all three GP visit outcomes, the strongest and most consistent results we see are for the PEM-Enrolled or PEM-Not Enrolled indicators, compared to the base of FFS, and we focus most of the remaining discussion on these variables. Model (1) in table 4 shows results for time to first visit with any GP. We can see the hazard ratio comparing PEM-Enrolled to FFS is 1.379 ($P<0.001$), which means that, on average, enrolled patients have 37.9% percent higher risk in any time period after discharge of having their first GP visit. Under model (2), we can see that the risk of an enrolled patient seeing their own regular GP is even higher compared to FFS (HR = 1.784; $P<0.001$). Recall, we interpret the time to visit with a patient's regular GP as a measure of continuity of care. Thus, the sooner average follow up visits for enrolled patients can be interpreted as a higher presence of continuity of care. Similarly, later average time to visit with other GPs is also an indication of better continuity of care. This is what we find in model (3) of table 4 (HR comparing PEM-Enrolled to FFS = 0.854; $P<0.001$).

We conduct several joint hypothesis tests for all models in table 4. In all cases we find inclusion of the PEM-Enrolled and PEM-Not Enrolled indicators, to be highly justified ($P<0.01$ in all cases). We also test equality of the PEM-Enrolled and PEM-Unenrolled hazard ratios. For time to visit other GP we cannot detect differences between PEM-Enrolled and PEM-Not Enrolled (but both are different from FFS). This means that patients who have a relationship with a PEM GP tend to see other GPs for follow up later compared to FFS, whether they are on the enrolled or unenrolled side of the PEM GPs practice. For both time to visit any GP or regular GP, hazard ratios, comparing PEM-Enrolled to FFS are higher than those comparing PEM-Not Enrolled to

FFS (P<0.001 for both outcomes). For time to any GP visit, PEM-Not Enrolled patients see their GP equally as soon as FFS, testing at the 5% level. This suggests that service provision in terms of sooner GP visits is higher for only enrolled PEM patients. But continuity of care, as gauged by time to regular GP visit is higher than FFS for both PEM-Enrolled and PEM-Unenrolled patients (P<0.001).

Subhazard ratios based on Fine and Gray for PEM-Enrolled and PEM-Unenrolled compared to FFS are very similar to the hazard ratios discussed above. We illustrate these results graphically in figures 1 and 2, by plotting the adjusted cumulative incidence of GP visits as a function of time for PEM-Enrolled, PEM-Unenrolled and FFS patients. Figure 1 shows incidence of visit to any GP. We can see that Incidence between enrolled patients and unenrolled patients gradually departs over time until about 30 days, after which there remains a roughly 10 percentage point difference until 100 days. Figure 2 shows results for regular and other GPs in panels A and B respectively. For regular GPs (Panel A) we can see that, similar to figure 1, there is a large difference in incidence detectible at 30 days, which remains quite stable thereafter to 100 days. But unlike figure 1, differences between PEM-enrolled and FFS are larger, and differences between PEM-Unenrolled and FFS can also be seen visually. This, of course, follows from the associated subhazard ratios. For visiting other GPs (panel B) we can see that incidence is now lower for PEM patients compared to FFS, which again, is expected from subhazard estimates. We can also see that the differences between curves diverge slowly between 30 and 100 days, and the slopes rise more gently.

It is important to realize that covariate relationships with GP visit incidence may be due to mechanisms operating on both the risk of the GP visit as well as the risk of the competing event of death. In figure 5, we show results from a Cox PH model for time to death. For the specification shown, we include all controls as well as PEM variables, but do not include capitation or FHT variables (for other specifications see table A4). We can see that enrolled patients are more likely to survive than FFS patients (HR = 0.886; p<0.05), but unenrolled PEM patients are actually less likely to survive than FFS (HR = 1.154; p<0.05). This suggests that within practice selection, or selection into enrollment based on unobserved health may be present.

Model (2) of table 5 shows, for comparison, results for time to regular GP visit using the same explanatory variables as time to death in Model (1). When comparing hazard ratios between these models we notice that, although the hazard for death is working in opposing directions for enrolled and unenrolled patients compared to FFS, the hazard for visiting the regular GP is strongly working in the same direction for both of these groups. This raises a question as to whether it is plausible that covariate relationships between GP visit incidence and PEM variables can be driven solely through the competing risk. If this is not plausible this means that at least some of the systematic relationship with PEM variables and GP visit outcomes is likely to be due to the actual risk of GP visits, even if independence is not satisfied.

We must also caution that, even in the event of independent risks, systematic differences in hazard ratios should not be interpreted as purely causal. As with any other observational study design, selection effects may be present. Furthermore, without independence, selection on

mortality risk may also play a factor. Although it is possible that there is some causal role for enrolment related incentives, other candidate explanations for differences in hazard ratios can include: (1) selection of patients with heterogeneous preferences for consumption of GP services into a practice; (2) selection of a PEM practice's patients into enrollment; and (3) selection into a PC model of GPs with heterogeneous (perceived) quality or heterogeneous preferences for relationship building.

The plausibility of alternative combinations of causal pathways will likely differ to some degree depending on the exact hazard ratio comparison being made. For instance, when comparing PEM-Enrolled to PEM-Not enrolled patients, differences should not likely be because of differences in GP quality (because the GPs are the same), nor because of selection into a PEM (all these patients are selected in), but could possibly be because of behavioral effects of enrollment incentives, or selection of patients into enrolment. Similarly, differences in PEM-Not Enrolled compared to FFS would not likely be due to enrollment incentives (neither imply enrolment incentives for related GPs), but could be possibly be due to patients' perceived quality of GPs selecting into a PEM, or the preferences/health of patients selected into a PEM. Explaining the mechanism behind the comparison of PEM-Enrolled to FFS is probably the most difficult, because most of the earlier candidate explanations are plausible in this case, and may all be acting simultaneously. Furthermore, since there are large differences is mortality risk across PEM variables, this may also be a complicating factor if independence of risks is not satisfied.

5.2 Secondary Time to Utilzation Outcomes

All analysis in this section is based on Cox Regression under independence. We present here, the regression results of a total of 21 separate outcomes related to time to first diagnostic testing / specialist visits. Estimation by Fine and Gray (1999) is impractical for this task. Again, under the Cox PH analysis, results may be biased if independence is not satisfied. We believe there may be some degree of correspondence between outcomes in this section and the GP visit outcomes presented earlier (e.g. between time to test ordered by GP and visit to GP). If this is true, then the subhazard ratios of Fine and Gray, if produced, may, again, be similar to the corresponding hazard ratios we present here, as was the case in the previous subsection. If this is so, then hazard ratios may give a sense of direction of covariate relationships with cumulative incidence as well. Again, because independence is being assumed in the analysis, results should be interpreted with some caution.

We can naturally divide the 21 new outcomes presented in this subsection into 3 groups of 7 outcomes. Each group of seven can be further divided into 2 broad groups of duration outcome variables. The first group (2 of 7 outcomes) is time to first diagnostic test, where testing can be a lab test, or diagnostic radiology work. The second group (5 of 7 outcomes) is time to first outpatient specialist visit. This includes any specialist, cardiologist, general internist, neurologist, and psychiatrist. These specialist categories are designed to correspond to some of the plausible dimensions of need for cardiac arrest patients that we discussed in more detail in section 2. Neurologist and psychiatrist visits correspond respectively to the health need dimensions of cogitative/motor functioning from neurological injury and mental health. Visits to cardiologist and

general internist, as well as lab testing and radiology correspond to preventing risk of deterioration of cardiac complications.

We present results in three parallel tables (6, 7 and 8). Table 6 shows results for time to first diagnostic tests and specialist visits without restricting who is ordering tests or referring to specialists. As is the case with visit to any GP, this is a measure of sooner/later service provision. Table 7 shows results for time to first diagnostic test / specialist visit where the test / specialist visit is ordered/referred by a patient's regular GP. In table 8 tests or specialist visits are ordered or referred by other GPs. In all of these tables, for the first model we reproduce results from the corresponding GP visit regression from table 4 (e.g. time to regular GP, when tests / specialist visits are ordered / referred to by the regular GP). The other 7 models per table (models 2 to 8) correspond to the 7 outcomes mentioned above.

From table 6 we see that hazard ratios comparing PEM-Enrolled to FFS for time to first lab test, diagnostic test, and specialist visit to any specialist are qualitatively similar (same direction; lower magnitude) to time to first GP visit to any GP. Again PEM-Not Enrolled does not differ from FFS. Also, capitation and FHT funding do not explain outcomes. Also no systematic differences in specialist visits to any of the specific specialists considered (e.g. cardiologist) are detectible.

Table 7 shows secondary outpatient utilization measures ordered/referred to by the patient's regular GP. Again, hazard ratios are qualitatively similar to results for time to visit the regular GP. In some cases, particularly psychiatrist visits (HR = 3.048; $P<0.01$) hazard ratios are much higher. This may be a positive indication of enrolled patients receiving more attention or GP involvement in mental health issues. Overall, results seem to suggest a higher degree of active participation or GP involvement in the referral process for enrolled patients. This may also be positive indication of higher levels of co-ordination of specialist services in a single primary care location for enrolled patients. This notion is also supported by results in table 8, where we also generally see less diagnostic test orders and specialist referrals made from outside GPs (as is the case for visit to other GP).

For secondary utilization with other GP involvement (Table 8), PEM-Not Enrolled hazard ratios are also generally significant at the 5% level, but there is no evidence of differences between PEM-Enrolled and PEM-Not Enrolled. Again this is similar to comparable hazard ratios in the time to other GP visit outcome. For secondary utilization with own GP involvement (Table 7), hazard ratios for PEM-Not Enrolled are also significant at the 5% level for all outcomes except neurologist visits. Differences in PEM-Enrolled versus PEM-Not Enrolled patients are detectible for diagnostic testing and visits to any specialist, but not for specific specialists.

6 Concluding Remarks

There are strong systematic relationships between primary care models in Ontario and time to first outpatient utilization on a number of measures for cardiac arrest survivors. Compared to FFS, being enrolled with a PEM is strongly associated with sooner first utilization of any outpatient GP services, diagnostic testing ordered by anyone, and outpatient visit to any specialist referred by

anyone (no one). This may be an indication of more aggressive outpatient service provision for enrolled patients.

Additionally, for both patients enrolled with a PEM and patients who regularly see a PEM GP, there is evidence of much higher continuity of care, as gauged by the metric of patients seeing their own (other) GP sooner (later) and having sooner testing / specialist care with involvement of their own GP in ordering tests / referring to specialists. It is possible that this has beneficial consequences for co-ordination of services. Also, this may imply better management or communication of information from multiple care providers. Sooner participation in diagnostic testing may be an indication of greater monitoring. Finally, higher GP involvement in psychiatric referral may indicate more GP involvement in patient mental health issues and may be important for early detection of patients at risk for mental health deterioration.

Most specific policy implications will of course hinge on identifying the causal pathways that are leading to observed systematic relationships. This is beyond the scope of this study. The results do suggest, however, that primary care models with enrollment based incentives may be a good candidate for trial studies of early hospital follow up programs for cardiac arrest patients. It is not clear whether capitation or interdisciplinary funding would provide any additional benefits to the extent of additional GP involvement. Although, interdisciplinary models may provide the opportunity to delegate some follow up tasks to lower cost providers.

7 Tables

Table 1 – Patient Relationship to Primary Care Models

Primary Care Model		Enrolled (Row %)	Not Enrolled (Row %)	N	% Total
PEM	Enhanced FFS	75.50%	24.50%	3,502	54.74%
	CAP-FHT	86.00%	14.00%	514	8.03%
	CAP-Not FHT	86.60%	13.40%	888	13.88%

FFS	0.00%	100.00%	1,494	23.35%
Total			6,398	100.00%

Table 2 – Patient Characteristics by Primary Care Model

Variable	All		PEM-Enrolled		PEM-Unenrolled		FFS		P-value Eq. Means
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Demographics									
RIO	10.08	16.29	10.11	15.48	10.84	17.80	9.46	17.21	0.0540
Age	65.67	14.81	66.29	14.57	64.02	15.58	65.22	14.77	0.0574
Male	0.62	0.49	0.62	0.49	0.63	0.48	0.62	0.49	0.1431

Hospital Comorbidities									
Charleson Score	2.43	2.15	2.41	2.14	2.45	2.22	2.46	2.14	0.9520
Myocardial Infarction	0.42	0.49	0.41	0.49	0.42	0.49	0.44	0.50	0.1329
Heart Failure	0.33	0.47	0.33	0.47	0.32	0.47	0.34	0.47	0.6506
Arrhythmia	0.55	0.50	0.55	0.50	0.51	0.50	0.58	0.49	0.0136
Cerebrovascular	0.10	0.29	0.09	0.28	0.10	0.31	0.11	0.31	0.0630
Peripheral Vascular	0.09	0.29	0.09	0.28	0.10	0.29	0.10	0.30	0.3576
Chronic Ischemia	0.47	0.50	0.47	0.50	0.44	0.50	0.49	0.50	0.1334
Angina	0.09	0.29	0.08	0.27	0.09	0.28	0.12	0.33	0.0003
Diabetes	0.31	0.46	0.30	0.46	0.30	0.46	0.32	0.47	0.6590
Hypertension	0.43	0.49	0.43	0.50	0.39	0.49	0.44	0.50	0.4485
Chronic Pulmonary	0.13	0.34	0.13	0.33	0.14	0.35	0.13	0.33	0.4521
Liver Disease	0.03	0.18	0.03	0.18	0.04	0.19	0.04	0.19	0.4382
Renal	0.15	0.35	0.14	0.35	0.14	0.35	0.16	0.37	0.1394
Cancer	0.09	0.29	0.10	0.30	0.09	0.29	0.09	0.28	0.2549
Dementia	0.03	0.18	0.03	0.17	0.04	0.20	0.03	0.18	0.4796
Hospital Intensity of Care									
Days Admitted	24.25	35.46	24.01	35.80	25.08	39.34	24.27	31.49	0.5295
Days in ICU	8.37	17.01	8.51	18.41	8.45	16.78	7.95	12.94	0.5066
Tracheostomy	0.07	0.25	0.07	0.25	0.08	0.27	0.07	0.26	0.0985
Pleural Drainage	0.06	0.24	0.06	0.23	0.06	0.25	0.06	0.25	0.5202
Mechanical Ventilation	0.46	0.50	0.48	0.50	0.44	0.50	0.43	0.50	0.3598
Central Venous Catheter	0.17	0.37	0.18	0.38	0.17	0.37	0.14	0.35	0.0149
Feeding Tube	0.06	0.24	0.06	0.24	0.07	0.26	0.06	0.24	0.5800
Dialysis	0.07	0.26	0.07	0.26	0.08	0.27	0.07	0.25	0.2108
Hospital Admission Variables									
From Home	0.59	0.49	0.59	0.49	0.58	0.49	0.59	0.49	0.8714
From Acute Care	0.25	0.43	0.25	0.43	0.25	0.43	0.26	0.44	0.7015
From Ambulatory Care	0.12	0.33	0.12	0.33	0.11	0.32	0.12	0.32	0.6692
From Other	0.04	0.20	0.04	0.19	0.06	0.24	0.04	0.19	0.1994
Ambulance	0.60	0.49	0.60	0.49	0.60	0.49	0.58	0.49	0.3116
Elective Admission	0.19	0.39	0.19	0.40	0.17	0.37	0.20	0.40	0.8527
Hospital Discharge to Location									
To Home	0.59	0.49	0.58	0.49	0.59	0.49	0.63	0.48	0.0011
To Home Support	0.18	0.38	0.19	0.39	0.17	0.37	0.17	0.37	0.1414
To LTC facility	0.19	0.40	0.21	0.40	0.20	0.40	0.16	0.37	0.0100
To Other Facility	0.03	0.16	0.02	0.15	0.03	0.17	0.03	0.18	0.3079
N	6,398		3,855		1,049		1,494		

Table 3 – GP Visit by Visit Type and Death

GP Visit Category	N	% Subtotal	% Total
First Visit is Uniquely Regular GP	4,007	69.9%	62.6%
First Visit is Uniquely Other GP	1,664	29.0%	26.0%
Visit Regular / Other GP Same Day	62	1.1%	1.0%
GP is Visited Subtotal	5,733	100.0%	
No GP Visit Death	554	83.3%	8.7%
No GP Visit No Death	111	16.7%	1.7%

GP is Not Visited Subtotal	665	100.0%	
Total	6,398		100.0%

Table 4 – Time to First GP Visit

	Hazard Ratio - Cox PH Model			Subhazard Ratio - Fine and Gray		
	(1)	(2)	(3)	(4)	(5)	(6)
Primary Care Variables	Any GP	Regular GP	Other GP	Any GP	Regular GP	Other GP
PEM-Enrolled	1.379***	1.784***	0.854***	1.344***	1.760***	0.903*
	(0.0534)	(0.0799)	(0.0382)	(0.0522)	(0.0809)	(0.0401)

PEM-Not Enrolled	1.034	1.310***	0.821***	1.026	1.298***	0.832***
	(0.0494)	(0.0726)	(0.045)	(0.0502)	(0.0739)	(0.0457)
CAP-Enrolled	0.885*	0.913	0.958	0.884**	0.920	0.954
	(0.0426)	(0.0474)	(0.0554)	(0.0417)	(0.0476)	(0.0536)
CAP-Not Enrolled	1.161	0.83	1.446**	1.008	0.785	1.324*
	(0.128)	(0.107)	(0.18)	(0.111)	(0.104)	(0.168)
FHT-Enrolled	0.963	0.914	1.13	0.986	0.909	1.151
	(0.0634)	(0.0661)	(0.0915)	(0.0672)	(0.0658)	(0.0925)
FHT-Not Enrolled	0.927	1.309	0.781	1.068	1.346	0.867
	(0.155)	(0.253)	(0.156)	(0.201)	(0.281)	(0.171)
Joint Hypothesis Tests						
PEM-E = PEM-U = 0	0.0000	0.0000	0.0002	0.0000	0.0000	0.0025
PEM-E = PEM-U	0.0000	0.0000	0.4520	0.0000	0.0000	0.1250
CAP-E = CAP-U = 0	0.0133	0.0850	0.0082	0.0314	0.0582	0.0544
CAP-E = CAP-U	0.0216	0.4840	0.0021	0.2640	0.2590	0.0158
FHT-E = FHT-U = 0	0.7740	0.1700	0.1380	0.9200	0.1470	0.1580
FHT-E = FHT-U	0.8300	0.0802	0.0824	0.6890	0.0743	0.1770
N	6,398	6,398	6,398	6,398	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Omitted Group for PEM variables is FFS, for CAP/FHT variables is not CAP/FHT. Exponentiated coefficients; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 5 – Cox Hazard Ratios – Comparison of Time to Death and Time to Regular GP Visit

	(1)	(2)
Primary Care Variables	Death	Visit Regular GP
PEM – Enrolled	0.886*	1.728***
	(0.0528)	(0.0743)
PEM - Not Enrolled	1.154*	1.292***
	(0.0774)	(0.0679)

Joint Hypothesis Tests		
PEM-E = PEM-U = 0	0.0001	0.0000
PEM-E = PEM-U	0.0000	0.0000
N	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Omitted Group for PEM variables is FFS

* p<0.05, ** p<0.01, *** p<0.001

Table 6 – Cox Hazard Ratios - Time to First Utilization (GP/ Specialists / Tests)

	Any GP	Diagnostic Test Ordered by Anyone		Specialist Visit Referred by Anyone				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Primary Care Variables	GP Visit	Lab	Radiology	Any Specialist	Cardiology	Internal Medicine	Neurology	Psychiatry
PEM-Enrolled	1.379***	1.130**	1.117*	1.117**	1.035	1.063	0.987	1.193
	(0.0534)	(0.0459)	(0.0557)	(0.0435)	(0.0575)	(0.0511)	(0.113)	(0.179)
PEM-Not Enrolled	1.034	1.011	1.014	1.068	0.963	1.005	0.871	1.273
	(0.0494)	(0.0503)	(0.0619)	(0.0512)	(0.0678)	(0.0588)	(0.123)	(0.220)

CAP-Enrolled	0.885* (0.0426)	0.940 (0.0470)	0.870* (0.0569)	0.932 (0.0447)	1.081 (0.0749)	0.939 (0.0578)	1.143 (0.177)	0.896 (0.171)
CAP-Not Enrolled	1.161 (0.128)	0.910 (0.106)	0.827 (0.132)	0.918 (0.103)	1.128 (0.189)	0.735* (0.113)	0.693 (0.326)	0.596 (0.318)
FHT-Enrolled	0.963 (0.0634)	1.114 (0.0762)	0.984 (0.0939)	1.057 (0.0716)	0.959 (0.0942)	0.943 (0.0862)	0.912 (0.218)	1.052 (0.293)
FHT-Not Enrolled	0.927 (0.155)	1.260 (0.220)	1.069 (0.277)	0.971 (0.166)	0.832 (0.206)	1.135 (0.285)	2.750 (1.718)	1.662 (1.222)
Joint Hypothesis Tests								
PEM-E = PEM-NE = 0	0.0000	0.0040	0.0559	0.0180	0.5370	0.3760	0.5810	0.3200
PEM-E = PEM-NE	0.0000	0.0172	0.0935	0.3230	0.2790	0.3130	0.3580	0.6910
CAP-E = CAP-NE = 0	0.0133	0.3550	0.0580	0.2660	0.4270	0.0898	0.4930	0.5440
CAP-E = CAP-NE	0.0216	0.7910	0.7650	0.9020	0.8130	0.1330	0.3060	0.4650
FHT-E = FHT-NE = 0	0.7740	0.1260	0.9520	0.7050	0.7020	0.7100	0.2450	0.7770
FHT-E = FHT-NE	0.8300	0.5070	0.7620	0.6430	0.5890	0.4850	0.0955	0.5560
N	6,398	6,398	6,398	6,398	6,398	6,398	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Omitted Group for PEM variables is FFS, for CAP/FHT variables is not CAP/FHT. Exponentiated coefficients; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 7 – Cox Hazard Ratios - Time to First Utilization Ordered / Referred by Regular GP

	Regular GP	Diagnostic Test Ordered by Regular GP		Specialist Visit Referred By Regular GP				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Primary Care Variables	GP Visit	Lab	Radiology	Any Specialist	Cardiology	Internal Medicine	Neurology	Psychiatry
PEM-Enrolled	1.784*** (0.0799)	1.716*** (0.0858)	1.888*** (0.131)	1.686*** (0.0865)	1.708*** (0.157)	1.405*** (0.103)	1.461* (0.278)	3.048** (1.226)

PEM-Not Enrolled	1.310***	1.299***	1.365***	1.302***	1.399**	1.198*	1.052	3.056*
	(0.0726)	(0.0806)	(0.117)	(0.0825)	(0.157)	(0.107)	(0.251)	(1.379)
CAP-Enrolled	0.913	0.966	0.826*	0.971	1.116	0.962	1.184	0.762
	(0.0474)	(0.0554)	(0.0689)	(0.0576)	(0.112)	(0.0848)	(0.290)	(0.276)
CAP-Not Enrolled	0.830	0.966	0.859	0.889	1.470	0.591*	1.468	0.380
	(0.107)	(0.137)	(0.189)	(0.134)	(0.351)	(0.152)	(0.924)	(0.408)
FHT-Enrolled	0.914	1.038	0.878	0.902	0.904	0.837	0.484	1.366
	(0.0661)	(0.0823)	(0.110)	(0.0764)	(0.128)	(0.114)	(0.220)	(0.649)
FHT-Not Enrolled	1.309	1.173	1.002	1.180	0.555	1.388	-	4.123
	(0.253)	(0.252)	(0.353)	(0.267)	(0.213)	(0.581)	-	(5.303)
Joint Hypothesis Tests								
PEM-E = PEM-NE = 0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0993	0.0151
PEM-E = PEM-NE	0.0000	0.0000	0.0000	0.0000	0.0458	0.0529	0.1440	0.9940
CAP-E = CAP-NE = 0	0.0850	0.8180	0.0609	0.6660	0.1680	0.1170	0.6700	0.5190
CAP-E = CAP-NE	0.4840	0.9980	0.8620	0.5790	0.2750	0.0685	0.7450	0.5330
FHT-E = FHT-NE = 0	0.1700	0.6870	0.5840	0.3550	0.2490	0.3080	0.0000	0.4540
FHT-E = FHT-NE	0.0802	0.5890	0.7220	0.2620	0.2260	0.2470	0.0000	0.4130
N	6,398	6,398	6,398	6,398	6,398	6,398	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Omitted Group for PEM variables is FFS, for CAP/FHT variables is not CAP/FHT. Exponentiated coefficients; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 8 - Cox Hazard Ratios - Time to First Utilization Ordered / Referred by Other GP

	Other GP	Diagnostic Test Ordered by Other GP		Specialist Visit Referred by Other GP				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Primary Care Variables	GP Visit	Lab	Radiology	Any Specialist	Cardiology	Internal Medicine	Neurology	Psychiatry
PEM-Enrolled	0.854***	0.802***	0.738***	0.809***	0.879	0.720***	0.650*	0.926
	(0.0382)	(0.0383)	(0.0471)	(0.0376)	(0.0727)	(0.0481)	(0.110)	(0.235)
PEM-Not Enrolled	0.821***	0.836**	0.831*	0.855**	0.780*	0.761***	0.866	1.233
	(0.0450)	(0.0485)	(0.0633)	(0.0479)	(0.0821)	(0.0614)	(0.169)	(0.343)

CAP-Enrolled	0.958 (0.0554)	1.013 (0.0623)	0.922 (0.0850)	1.021 (0.0629)	0.912 (0.107)	0.914 (0.0891)	0.987 (0.265)	1.255 (0.420)
CAP-Not Enrolled	1.446** (0.180)	0.953 (0.138)	0.734 (0.171)	0.896 (0.130)	1.221 (0.335)	0.720 (0.177)	0.242 (0.248)	0.545 (0.573)
FHT-Enrolled	1.130 (0.0915)	0.975 (0.0864)	1.062 (0.144)	1.016 (0.0908)	1.042 (0.179)	1.091 (0.158)	1.091 (0.439)	1.585 (0.770)
FHT-Not Enrolled	0.781 (0.156)	1.104 (0.239)	1.329 (0.460)	1.156 (0.255)	0.813 (0.362)	1.595 (0.589)	7.386 (8.713)	2.804 (4.087)
Joint Hypothesis Tests								
PEM-E = PEM-NE = 0	0.0002	0.0000	0.0000	0.0000	0.0507	0.0000	0.0360	0.5820
PEM-E = PEM-NE	0.4520	0.4460	0.1160	0.3070	0.2450	0.4890	0.1430	0.3060
CAP-E = CAP-NE = 0	0.0082	0.9200	0.2970	0.6990	0.5480	0.2820	0.3840	0.6600
CAP-E = CAP-NE	0.0021	0.6890	0.3540	0.3990	0.3200	0.3580	0.1820	0.4430
FHT-E = FHT-NE = 0	0.1380	0.8610	0.6520	0.7960	0.8690	0.3830	0.2340	0.5060
FHT-E = FHT-NE	0.0824	0.5920	0.5430	0.5830	0.5990	0.3330	0.1230	0.7080
N	6,398	6,398	6,398	6,398	6,398	6,398	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Omitted Group for PEM variables is FFS, for CAP/FHT variables is not CAP/FHT. Exponentiated coefficients; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

8 Figures

Figure 1 – Unadjusted Cumulative Incidence of First GP Visit by GP Visit Type

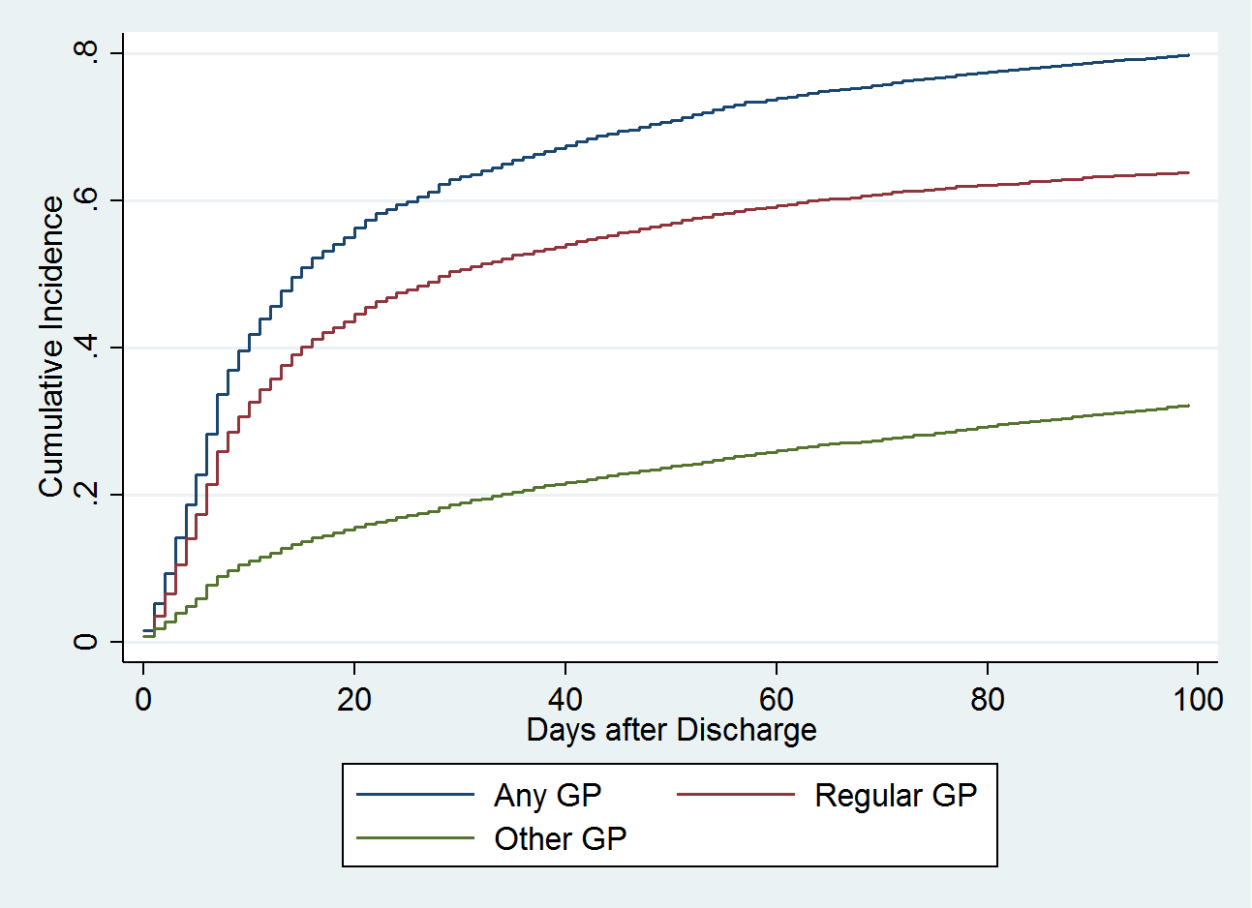
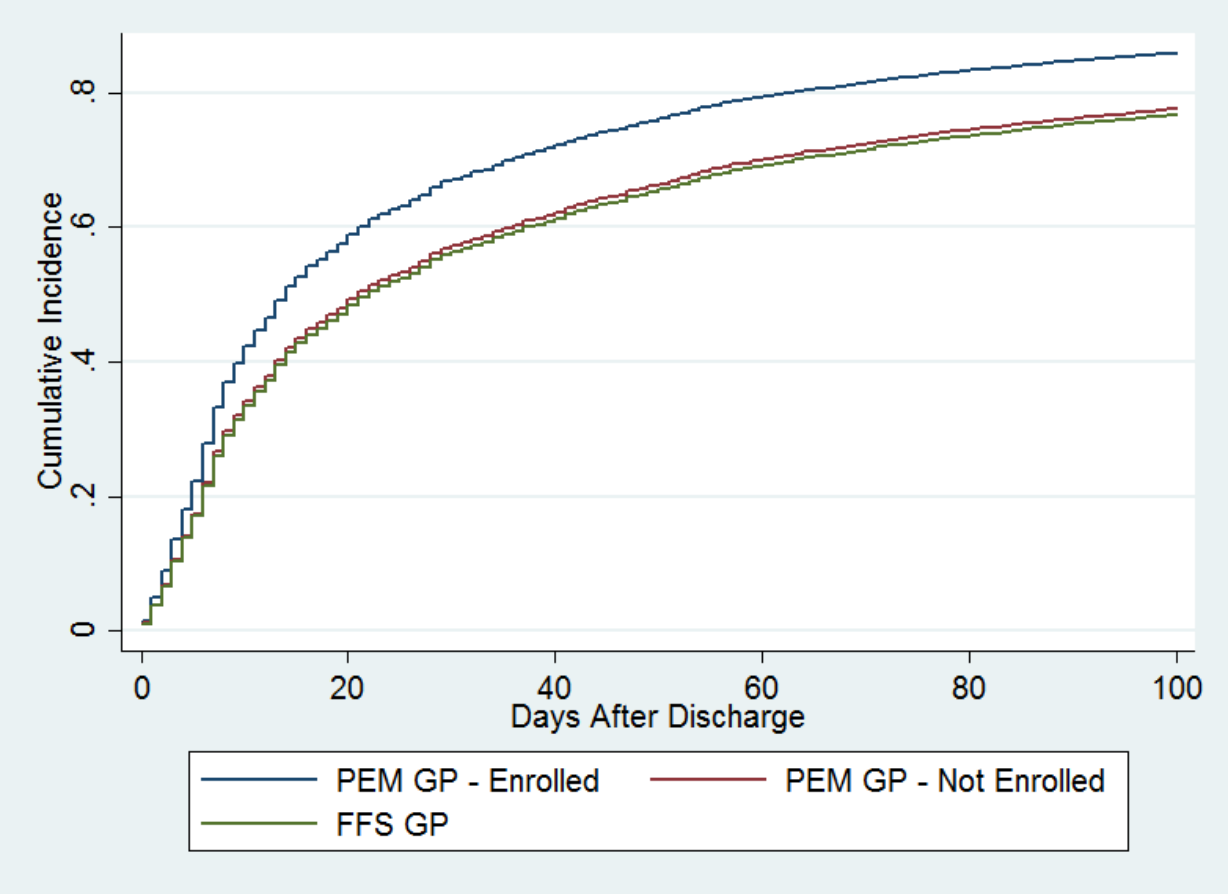

Cumulative Incidence
0
.2
.4
.6
.8
0
20
40
60
80
100
Days after Discharge
Any GP
Regular GP
Other GP

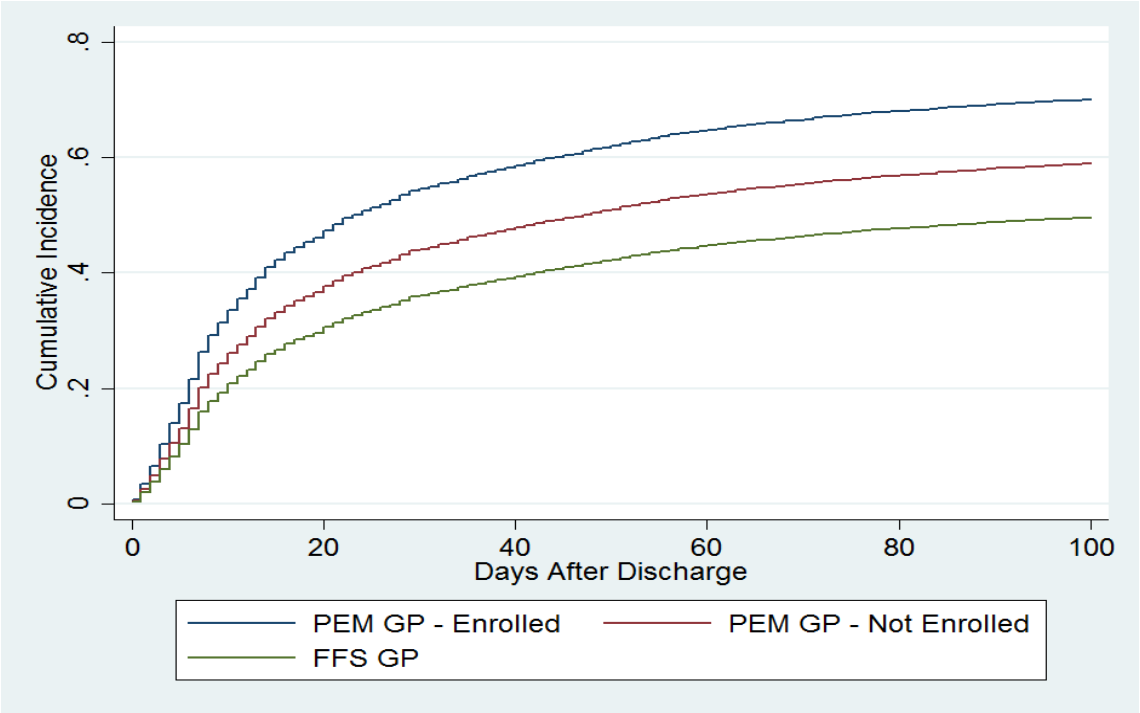
Figure 2 – Fine and Gray – Adjusted CIF of First Visit to Any GP by PC Model



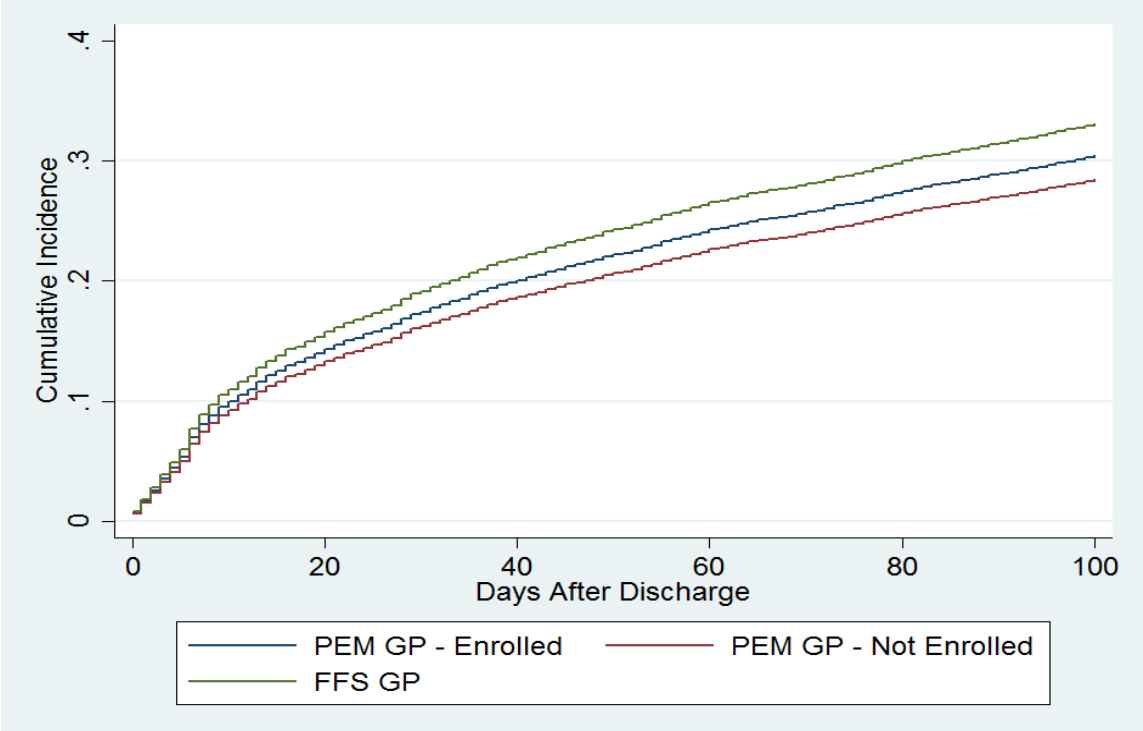
Notes: Explanatory variables include primary care variables shown in table 4, and all control variables shown in table 2, as well as year and hospital fixed effects.

Figure 3 – Fine and Gray – Adjusted CIF of First GP Visit to Regular/Other GP by PC Model

A. Visit to Regular GP



B. Visit to Other GP



Notes: Explanatory variables include primary care variables shown in table 4, and all control variables shown in table 2, as well as year and hospital fixed effects.

9 References

Burgess, S., & Ratto, M. (2003). The Role of Incentives in the Public Sector : issues and Evidence. *Oxford Review of Economic Policy*, *19*(2), 285–300.

Chan, P. S., Nallamothu, B. K., Krumholz, H. M., Spertus, J. A., Li, Y., Hammill, B. G., & Curtis, L. H. (2013). Long-term outcomes in elderly survivors of in-hospital cardiac arrest. *New England Journal of Medicine*, *368*(11), 1019–1026.

Cox, D. R. (1972). Regression Models and Life-Tables. *Journal of the Royal Statistical Society. Series B (Methodological)*, *34*(2), 187–220. http://doi.org/10.2307/2985181

Fine, J. P., & Gray, R. J. (1999). A Proportional Hazards Model for the Subdistribution of a Competing Risk. *Journal of the American Statistical Association*, *94*(446), 496–509. Retrieved from http://amstat.tandfonline.com/doi/abs/10.1080/01621459.1999.10474144#.V05v2fkrK00

Graham, R., McCoy, M. A., Schultz, A. M., & Others. (2015). *Strategies to Improve Cardiac Arrest Survival: A Time to Act*. *National Academies Press*. National Academies Press.

Graves, J., Herlitz, J., Angela, B., Axelsson, A., Ekstrom, L., Holmberg, M., … Holmberg, S. (1997). Survivors of out of hospital cardiac arrest: their prognosis, longevity and functional status. *Resuscitation*, *35*(2), 117–121.

Hurley, J., Hutchison, B., Birch, S., Dorland, J., Reid, R., & Pizzoferrato, G. (1999). *Policy considerations in the implementing capitation for integrated health systems*. *Canadian Health Services Research Foundation*. Ottawa, ON.

Hutchison, B., Levesque, J.-F., Strumpf, E., & Coyle, N. (2011). Primary health care in Canada: Systems in motion. *Milbank Quarterly*, *89*(2), 256–288. http://doi.org/10.1111/j.1468-0009.2008.00538.x

Kamphuis, H. C. M., Leeuw, J. R. J. De, Derksen, R., Hauer, R., & Winnubst, J. A. M. (2002). A 12-month quality of life assessment of cardiac arrest survivors treated with or without an implantable cardioverter defibrillator, 417–425. http://doi.org/10.1053/eupc.2002.0258

Khot, S., & Tirschwell, D. L. (2006). Long-term neurological complications after hypoxic-ischemic encephalopathy. *Seminars in Neurology*, *26*(4), 422–31. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16969743

Moulaert, V. (2014). *Life after survival of a cardiac arrest: The brain is the heart of the matter*.

Neumar, R. W., Eigel, B., Callaway, C. W., Estes, N. a. M., Jollis, J. G., Kleinman, M. E., … Sendelbach, S. (2015). American Heart Association Response to the 2015 Institute of Medicine Report on Strategies to Improve Cardiac Arrest Survival. *Circulation*, *132*(11), 1049–1070.

Sweetman, A., & Buckley, G. (2014). Ontario's experiment with primary care reform. *The School of Public Policy, University of Calgary*, *7*(11), 1–38.

10 Appendices

Table A1 – Sample Selection

Drop / Keep Criteria	Observations	Running Diff
Acute care hospitalization in DAD from FY0405 - FY1011	6,640,566	-
Cardiac arrest diagnosis (ICD-10-CA I46)	30,681	6,609,885
Survive to discharge	8,540	22,141
Valid registered Ontario health number with province responsible for payment	8,304	236
Adult (18+)	8,043	261
Drop subsequent admissions per patient	7,516	527
Drop patients who die or exceed study time in hospital transfer	7,023	493
Drop irrelevant primary care models	6,915	108
Drop patients not identified by virtual rostering	6,398	517

Table A2 – Cox Hazard Ratios in Time to First Utilization by Virtually Rostered / Un-rostered

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Any GP	Order by Anyone		Referral by Anyone				
GP PC Model	Visit	Lab Test	Diag. Rad	Spec. Visit	Cardiology Visit	Int. Med. Visit	Neurology Visit	Psychiatry Visit
Virtually Rostered by Algorithm	2.330***	1.460***	1.658***	1.494***	1.400***	1.307***	1.403	1.561*
	(0.128)	(0.0819)	(0.128)	(0.0795)	(0.114)	(0.0924)	(0.244)	(0.345)
N	6915	6915	6915	6915	6915	6915	6915	6915

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Exponentiated coefficients; Standard errors in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

Table A3 – Enrollment Status of Patients Which Could not be Virtually Rostered

Unique Regular GP Based on Virtual Rostering Algorithm	Enrolled With Doctor: No	Enrolled With Doctor: Yes	Total
No	78.7%	21.3%	517
Yes	39.7%	60.3%	6,398
Total			6,915

Table A4 – Cox Hazard Ratios – Time to Death

Primary Care Variables	(1)	(2)	(3)	(4)
PEM-Enrolled	0.904	0.886*		
	(0.0561)	(0.0528)		
PEM-Not Enrolled	1.146	1.154*		
	(0.0800)	(0.0774)		
CAP-Enrolled	0.908			
	(0.0799)			
CAP-Not Enrolled	1.052			
	(0.188)			
FHT-Enrolled	1.049			
	(0.139)			
FHT-Not Enrolled	1.000			
	(0.276)			
PEM			0.984	0.973
			(0.0556)	(0.0538)
CAP			0.927	
			(0.0741)	
FHT			1.036	
			(0.125)	
Joint Hypothesis Tests				
PEM-E = PEM-U = 0	0.0023	0.0001		
PEM-E = PEM-U	0.0005	0.0000		
CAP-E = CAP-U = 0	0.5170			
CAP-E = CAP-U	0.4490			
FHT-E = FHT-U = 0	0.9380			
FHT-E = FHT-U	0.8760			
N	6,398	6,398	6,398	6,398

Notes: Explanatory variables include primary care variables as shown above, and all control variables shown in table 2, as well as year and hospital fixed effects. Exponentiated coefficients; Standard errors in parentheses.
* p<0.05, ** p<0.01, *** p<0.001