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# Changing the Schedule of Medical Benefits and the Effect on Primary Care Physician Billing: Quasi-Experimental Evidence from Alberta

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# Changing the Schedule of Medical Benefits and the Effect on Primary Care Physician Billing: Quasi-Experimental Evidence from Alberta

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**Abstract**

We exploit a quasi-experiment in the province of Alberta, Canada, to identify how changes in the schedule of medical benefits affected the provision of primary care services to patients with multiple co-morbidities. Specifically, Alberta introduced a new fee code to compensate physicians for completing a comprehensive annual care plan (CACP) for qualifying patients. During the period of study, primary care physicians could practice in two settings: (i) solo practice; or (ii) primary care networks (i.e., team based care). This paper asks how the policy change affected physician-billing patterns and whether delivery structure affected physician-billing.

Data come from Alberta's administrative physician claims data, covering the full population of Alberta and all services provided by primary care physicians, for one year before and two years after the policy change. We employ a difference-in-differences methodology and implement a set of robustness checks to control for confounding from other contemporaneous changes that may have occurred in Alberta as well as unobserved physician heterogeneity.

Our results suggest the new fee code became the sixth most billed code in its first year (totalling $17.9 million), but was billed by only a small proportion of physicians (roughly 2% of physicians accounted for 20% of total billings). The fee code was disproportionately billed by physicians in team-based care (PCNs), and increased the billing of other complementary fee codes by 5%-10% (or roughly $80 million). The results suggest the unintended consequences of a well-intentioned policy can be costly.

JEL Codes: I10, I13, I18
Keywords: physician payment; physician behaviour; difference-in-differences

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# 1 Introduction

Health care in Canada is a provincial responsibility. Each of the 10 Canadian provinces finance medically necessary hospital and physician services through a single-payer system using general tax revenue. One set of medically necessary physician service relate to primary care services provided by physicians.

A continual challenge faced by many provincial ministries of health is the increased proportion of provincial populations with chronic conditions and multiple chronic conditions. This has been seen at the national level (e.g., McLeod (2011)), as well as the provincial level. For example, the Canadian province of Alberta has experienced a 67% increase in the proportion of its population with Diabetes from 1995 to 2009 (Johnson and Balko (2011)). At the same time, there has been an increase in the proportion of Albertans with diabetes who have diabetes and hypertension (Hemmelgarn et al. (2011)).

The increasing proportion of patients with multiple chronic conditions is a particular concern for provincial ministries of health as people with multiple chronic conditions are in worse health (by definition) and tend to use more health care services (McLeod (2011), Johnson et al. (2011)). Patients with multiple chronic conditions in particular face challenges with respect to managing their health and navigating the health care system. It has been suggested effective management of multiple chronic conditions requires significant participation by the patient and their physician, as well as a paradigm shift from episodic care to comprehensive and coordinated care.

Given the challenges of involving patients, incentivizing providers, and instituting a paradigm shift from episodic to comprehensive, coordinated care, a natural question to as is how can a health care authority (such as a provincial government) improve care for patients with multiple chronic conditions? Alberta's solution was to: (i) provide patients with the information necessary to take better care of themselves; and (ii) incentivize primary care physicians to deliver the information to patients using the existing fee-for-service payment model. Information was provided to patients through a comprehensive annual care plan (CACP). A CACP is a single document containing relevant information for the patient, prepared by a patient's primary care physician, and communicated by the primary care physician through direct contact with the patient. Primary care physicians were incentivized to prepare and deliver a CACP through the introduction of a new fee code (health

service code 03.04J). Alberta introduced both CACPs and HSC 03.04J were introduced on April 1, 2009.

Economic theory provides broad predictions regarding physician behavioural responses to the three primary payment mechanisms (fee-for-service, capitation, and salary). Recent overviews of some of these issues include: Leger (2008), McGuire (2011), Christianson and Conrad (2011). While this is an oversimplification, fee-for-service is argued to incentivize physicians to provide more than the optimal quantity of services. In fact, in the presence of excess physician capacity many (but not all) researchers expect so-called "physician induced demand" whereby the asymmetric information between a physician and his/her patient allows the physician to generate demand for services beyond those medically necessary. For example, a physician may ask a patient to return in two weeks to discuss their test results even though a phone call from a nurse could either inform the patient their results indicate no problem; or schedule a follow-up appointment if the results are not benign.

Interestingly, the academic research exploring pay-for-performace payment schemes, such as the introduction of the HC 03.04J, has found mixed results on the effectiveness of changing behaviour. Some evidence from Ontario suggests pay-for-performance incentives in Ontario have are generally not been very effective at changing behaviour (Li et al. (2013)), although Kralj and Kantarevic (2013) find more positive results looking at the diabetes incentive in Ontario. Van Herck et al. (2010) conducted a systematic evaluation of 128 studies on a wide range of pay-for-performance initiatives. They observed a remarkable range of program effects. Some initiatives had zero or negligible effects on outcomes, while the evaluation of others found appreciable benefits. Context, design details, and initial conditions all seem to play a very important role.

This paper asks how did the introduction of 03.04J affected the delivery of primary care to patients with multiple chronic conditions? We use the introduction of CACPs and 03.04J on April 1, 2009 as a quasi-experiment to identify how changes in the schedule of medical benefits affected the provision of primary care services to patients with multiple co-morbidities. Specifically, we as what was the effect of 03.04J on a primary care physician's billing of visit codes? And, did the introduction of 03.04J have an indirect effect on total billing by increasing the number of 'visit' claims made?

# 2 Alberta's Primary Care Environment

## 2.1 Comprehensive Annual Care Plan (CACP)

A CACP is a single document containing: (a) clearly defined goals which are mutually agreed upon between the patient and the primary care physician; (b) a detailed review of the patient's chart, current therapies, problem list, and past medical history; (c) any relevant information that may affect the patient's health and/or treatment options (including, but not limited, to demographics and lifestyle behaviours); (d) the patient's values and personal health goals, with respect to their complex need; and (e) an outline of the expected outcomes resulting from the plan, including possible end-of-life issues. The CACP must be communicated by the primary care physician through direct contact with the patient (or patient's agent). Confirmation the plan was communicated verbally and in writing to the patient must be documented through the primary care physician and patient's signature on the CACP. The CACP must be retained in the patient's medical record (Alberta Health & Wellness (2009)).

The CACP is intended to benefit patients, physicians, and the health care system. The process of developing and maintaining a CACP is intended to benefit patients by: (i) helping patients to better understand and manage their health; (ii) helping patients navigate the health system; (iii) improving patient access to a team of appropriate health care providers; and (iv) providing patients with a tool to help identify and achieve their goals as they manage their health.

The creation of a CACP is intended to benefit primary care physicians by: (i) facilitating appropriate remuneration for the time and effort required to effectively manage complex patients with multiple co-morbidities; (ii) assisting primary care physicians in coordinating and managing patient care; (iii) improving communication with their patients; and (iv) enhancing collaboration with other health care providers.

For the health care system, the CACP is intended to: (i) promote comprehensive, coordinated care for patients with multiple co-morbid chronic conditions; (ii) improve patient care and service delivery; and (iii) support the continued development of chronic disease management and primary care strategies in Alberta.

## 2.2 Health Service Code 03.04J

The HSC 03.04J is intended to remunerate primary care physicians for the development, documentation, and administration of a CACP for a patient with a "complex need". Patients are defined as having a "complex need" if they have two or more eligible diagnoses as defined by Alberta Health & Wellness. Table 1 lists the eligible diagnoses and divides them into two groups (A and B). HSC 03.04J defines a patient as having"complex needs" if they have two or more diagnoses in group A, or one diagnoses in group A and at least one diagnoses in group B.

The primary care physician most responsible for a patient is eligible to claim HSC 03.04J. A primary care physician may only claim HSC 03.04J once per patient per year. This includes all ongoing communication as required, including re-evaluation of the patient and the CACP within a year of the date of first claim.

Table 1: Eligible Diagnostic Codes defining Complex Needs under 03.04J

| **Group A** | | **Group B** | |
|---|---|---|---|
| Hypertensive Disease | (ICD 401) | Mental Health Issues | (ICD 290-319) |
| Diabetes Mellitus | (ICD 250) | Obesity | (ICD 278) |
| Chronic Obstructive Pulmonary Disease | (ICD496) | Addictions | (ICD 303-304) |
| | | Tobacco Use | (ICD 305.1) |
| Asthma | (ICD 493) | | |
| Heart Failure | (ICD428) | | |
| Ischaemic Heart Disease | (ICD413-414) | | |

## 2.3 Primary Care Delivery Structures

Primary care physicians in Alberta can practice as either a solo practice physician, or as a member of a Primary Care Network (PCN). A solo practice physician is a single physician, working in a single location, paid by fee-for-service (Manns et al. (2012), Campbell et al. (2013)). A PCN primary care physician is a member of an interdisciplinary team of physicians and allied health care providers (including nurses, dieticians, and pharmacists) located at one or more physical locations. Alberta introduced the first PCNs in 2005, with new PCNs being introduced annually. In addition to the standard fee-for-service physician payments, the PCN receives a $50 capitation payment per year in order to support activities outside of the fee-for-service payment model, but within the objectives

of the PCN. When a PCN is formed, they must specify certain objectives (i.e. priority services provided) of the PCN such as after hours care, seniors' care, or care for patients with complex and chronic conditions. The PCN capitation payment can be used to pay for the PCN's allied health care providers which are intended to support the PCN's objectives (Manns et al. (2012), Campbell et al. (2013)).

The type of primary care delivery structure, and resulting payment models, will have direct implications on the resources available to a primary care physician for service provision. Solo practice physicians generally have fewer resources available to provide care relative to physicians based in a PCN. The is primarily due to the additional labour available in a PCN through additional primary care physicians, and/or additional allied health care providers.

# 3 Data

## 3.1 Data Sources

The analysis uses two of Alberta Health's administrative databases: (i) the Practitioner payments database; and (ii) the population registry. The Alberta Practitioners database contains information on physician services received by individuals in Alberta from a fee-for-service primary care physician for three fiscal years (April 1, 2008 to March 31, 2011).[1] The population registry provided basic demographic information on patients.

## 3.2 Variables

Each record represents one health service code claim by a specific primary care physician for a specific patient and provides information on the specific health service code claimed (including: the dollar value of the code, the date of claim, and any diagnostic codes accompanying the claim[2]), the forward sortation area[3] of the physician's practice, a flag for whether the physician provided the service while working in a PCN on the date of the claim, basic physician characteristics (e.g. age, sex), and basic patient characteristics (e.g. age, sex).

[1] According to the Canadian Institute for Health Information (2011), 92.8% of total clinical physician payments in Ontario were fee-for-service (FFS).

[2] Each record provided a primary diagnostic code, with a possible secondary and tertiary diagnostic code. Each diagnostic code was based on the International Classification of Diseases, 9th Revision, (ICD-9) codes.

[3] The forward sortation area is the first three digits of the postal code.

We constructed two variables. First, the Alberta Health Service zone (a categorical variable with five categories: North, Edmonton, Central, Calgary, and South) was constructed based on the forward sortation area of the physician's practice.[4] The intention was to control for any unobserved effects of the geographic administrative health area where the service was provided. Second, the number of patient visits each month to each primary care physician was constructed based on the number of claims for specific visit codes (03.03A or 03.04A). The intention was to control for the volume of services provided by the physician.

Two binary variables were also created to indicate: (i) any HSC claimed in the 'post' period after the introduction of HSC 03.04J (i.e., after April 1, 2009); and (ii) whether a physician was in the 'treatment' group. A primary care physician is classified as being in the treatment group if they made at least one claim of HSC 03.04J in 2009/10 or 2010/11.

### 3.3 Descriptive Statistics

Table 2 presents descriptive statistics for the HSC 03.04J during the first two fiscal years (2009/10 and 2010/11) after the introduction of 03.04J. The base rate for HSC 03.04J in 2009/10 was $206.70, then increased by 3.4% to $213.80 in 2010/11. In its first year, 1,359 different primary care physicians made a total of 86,439 claims for HSC 03.04J costing a total of $17.9 million. There was a 10.5% increase in the number of claims in 2010/11 over 2009/10. A primary care physician who claimed at least one HSC 03.04J, on average, claimed 63.6 (in 2009/10) and 68.2 (in 2010/11) HSC 03.04J.

Table 2: Descriptive Statistics - 03.04J

| | **2009/10** | **2010/11** | % Δ (YTY) |
|---|---|---|---|
| | (1) | (2) | (3) |
| Base Rate of 03.04J | $206.70 | $213.80 | 3.4% |
| # of 03.04J Claims | 86,439 | 95,495 | 10.5% |
| Amount paid for 03.04J (Millions $) | 17.9 | 20.4 | 14.0% |
| # of Physicians claiming 03.04J | 1,359 | 1,401 | 3.1% |
| Avg. # of 03.04J Claims per Physician | 63.6 | 68.2 | 7.2% |

[4]For clarity, a map of the Alberta Health Service zones is presented in Appendix A1.

Table 3 shows how HSC 03.04J became one of the most billed health service codes by primary care physicians in 2009/10. In 2009/10, primary care physicians billed a total of $915.9 million dollars. Seven specific health service codes account for approximately 75% of total billings by primary care physicians. The sixth most billed code (03.04J) accounts for $17.9 million in 2009/10, and $20.4 million in 2010/11 (or, approximately 2% of total billings). The top two health service codes (03.03A and 03.04A) are both "visit" codes. There was a 30% increase in the billing of 03.03A from 2008/09 to 2009/10 (from $346.2 million to $452.4 million), and a 28% increase in the billing of 03.04A from 2008/09 to 2009/10 (from $83.8 million to $107.5 million). Both 03.03A and 03.04A can be billed in conjunction with 03.04J.

Table 3: Most Billed HSC, by Primary Care Physicians, 2008-2011

| | **2008-2009** | | | **2009-2010** | | | **2010-2011** | | |
|---|---|---|---|---|---|---|---|---|---|
| | HSC | $ | % of Total | HSC | $ | % of Total | HSC | $ | % of Total |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 1 | 03.03A | 346.2 | 44.3 | 03.03A | 452.4 | 49.4 | 03.03A | 470.7 | 48.3 |
| 2 | 03.04A | 83.8 | 10.7 | 03.04A | 107.5 | 11.7 | 03.04A | 116.1 | 11.9 |
| 3 | 08.19G | 37.5 | 4.8 | 03.01AA | 38 | 4.1 | 03.01AA | 42.6 | 4.4 |
| 4 | 03.03Z | 37.4 | 4.8 | 08.19G | 37.8 | 4.1 | 08.19G | 41.5 | 4.3 |
| 5 | 03.03D | 32.8 | 4.2 | 03.03D | 32 | 3.5 | 03.03D | 34.6 | 3.6 |
| 6 | 03.03L | 12.7 | 1.6 | 03.04J | 17.9 | 2.0 | 03.04J | 20.4 | 2.1 |
| 7 | 03.05DN | 12.2 | 1.6 | 03.03B | 12.5 | 1.4 | 03.04C | 13.4 | 1.4 |
| Other | | 218.8 | 28 | | 217.8 | 23.8 | | 235.4 | 24.2 |
| **Total** | | 781.3 | | | 915.9 | | | 974.8 | |

Note: Amount Billed ($) is in Millions of $

03.03A: Visit not requiring a complete history or evaluation

03.04A: Comprehensive visit

03.01AA After hours time premium

08.19G: visit (Psychiatric Treatment)

03.03D Hospital visits

03.03Z Short Visit, patient aged 75 and older

Figure 1 shows the average monthly billings by primary care physicians in the treatment (03.04J billers) and control (03.04J non-billers) groups from April 2008 to March 2011 (one fiscal year before, and two fiscal years after, the introduction of HSC 03.04J). Primary care physicians in the treatment group consistently bill $8,000 to $10,000 more per month than physicians in the control group. The variation in monthly billing is similar across both groups. Interestingly, there appears

to be an increase in monthly billing starting April 2009 (after the introduction of 03.04J) for the treatment group, but less of an increase for the control group. The same March-to-April increase is not apparent in 2010.

Figure 1: Average Monthly Billing, Pre- and Post-Introduction of 03.04J

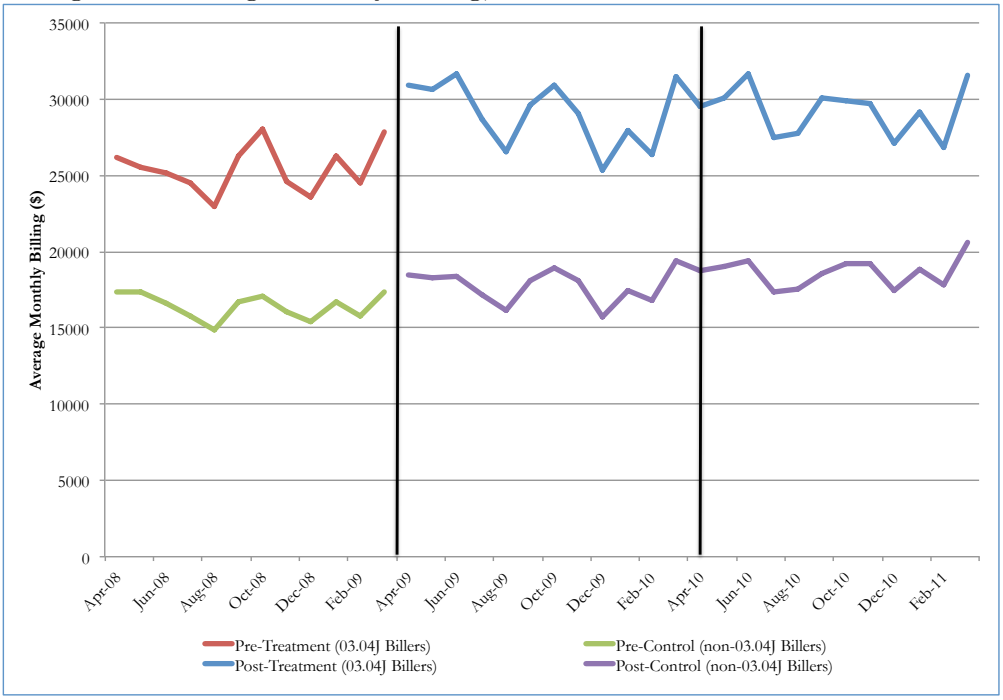


Table 4 shows PCN based primary care physicians disproportionately billed 03.04J. Table 4 presents summary statistics of 03.04J claims by the two primary care delivery structures (PCN and non-PCN). Information on the proportion of Alberta patients who receive care from a PCN and the proportion of primary care physicians who practice in a PCN are also reported to provide context. In both 2009/10 and 2010/11, approximately 87% of all 03.04J claims come from a PCN based primary care physician. This is notably higher than the proportion of patients rostered with a PCN (∼73%) and the proportion of primary care physicians who practice in a PCN (∼53%).

Table 5 shows that while non-PCN physicians disproportionately billed fewer HSC 03.04J, the non-PCN based primary care physicians were more intense billers of HSC 03.04J. Table 5 presents the number of 03.04J claims, the number of discrete physicians who billed at least one HSC 03.04J, and the average number of claims per physician. In 2009/10, the 11,828 HSC 03.04J claims by non-PCN based primary care physicians were billed by 130 different primary care physicians (for an average of 91.0 03.04J claims per physician). This is higher than the 60.7 03.04J claims per

Table 4: 03.04J claims, by Delivery Structure

| | 2009/10 | | | 2010/11 | | | Alberta (2011) | |
|---|---|---|---|---|---|---|---|---|
| | # of Claims | $ (Millions) | % of Total | # of Claims | $ (Millions) | % of Total | Patients | Physicians |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Non-PCN | 11,828 | 2.5 | 13.7 | 11,958 | 2.6 | 12.5 | 26.6% | 47.2% |
| PCN | 74,611 | 15.4 | 86.3 | 83,537 | 17.8 | 87.5 | 73.4% | 52.8% |
| Total | 86,439 | 17.9 | 100 | 95,495 | 20.4 | 100 | | |

note: Patient and physician data come from Primary Care Initiative (2014). According to the 2011 Census, the population of Alberta was 3,645,257 (Statistics Canada (2014)). According to Alberta's administrative physician claims data, there were approximately 4,730 primary care physicians.

PCN based primary physician.

In 2010/11, the 11,958 HSC 03.04J claims by non-PCN based primary care physicians were billed by 140 different primary care physicians (for an average of 85.4 03.04J claims per physician). This is a slight decrease from the higher than the 91.0 03.04J claims in 2009/10, but still notably higher than the 66.2 03.04J claims per PCN based primary physician in 2010/11.

Table 5: Average 03.04J claims per physician, by Delivery Structure

| | 2009/10 | | | 2010/11 | | |
|---|---|---|---|---|---|---|
| Delivery Structure | # of Claims | # of Providers | # Claims Per Provider | # of Claims | # of Providers | # Claims Per Provider |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Non-PCN | 11,828 | 130 | 91.0 | 11,958 | 140 | 85.4 |
| PCN | 74,611 | 1230 | 60.7 | 83,537 | 1261 | 66.2 |
| Total | 86,439 | 1360 | 63.6 | 95,495 | 1401 | 68.2 |

### 3.4 Descriptive Statistics by Treatment and Control Groups

Table 6 presents descriptive statistics of physician characteristics (age and sex) and practice characteristics (AHS zone, PCN practice) by fiscal year for the treatment and control groups. The control group tends to be older than the treatment group (48 years old vs. 46 years old). It appears male physicians make a larger share of the treatment group, however the control group has approximately 15% of the sample not reporting their sex.

As for practice characteristics, 90% of the treatment group is comprised of physicians based in

a PCN compared to about a third (33%) of the control group. This is not surprising given Table 4. It is difficult to compare differences across practice location (by AHS zone) since more than a third (33.3%) of the control group has AHS zone unknown.

Overall, the treatment and control groups meaningfully differ with respect to physician age (the treatment group is younger) and practicing in a PCN (the treatment group is predominantly PCN based).

Table 6: Descriptive Statistics, by Treatment/Control Group and Fiscal Year

| | 2008-2009 | | | 2009-2010 | | | 2010-2011 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Treatment | Control | Total | Treatment | Control | Total | Treatment | Control | Total |
| Physician Characteristics | | | | | | | | | |
| Age | 45.6 | 47.9 | 46.9 | 45.8 | 48.1 | 47.1 | 46.2 | 48.1 | 47.3 |
| | (1,479) | (2,011) | (3,490) | (1,582) | (2,029) | (3,611) | (1,656) | (2,111) | (3,767) |
| Female (%) | 38.4 | 33.8 | 35.3 | 38.7 | 35.4 | 36.5 | 39.0 | 36.4 | 37.3 |
| | (572) | (1,016) | (1,588) | (616) | (1,099) | (1,715) | (650) | (1,114) | (1,764) |
| Male (%) | 61.6 | 50.9 | 54.4 | 61.3 | 49.7 | 53.7 | 61.0 | 50.9 | 54.5 |
| | (916) | (1,531) | (2,447) | (976) | (1,546) | (2,522) | (1,018) | (1,559) | (2,577) |
| Sex Unknown (%) | 0.0 | 15.4 | 10.3 | 0.0 | 14.9 | 9.9 | 0.0 | 12.7 | 8.2 |
| | - | (463) | (463) | - | (464) | (464) | - | (389) | (389) |
| AHS Zone | | | | | | | | | |
| Calgary (%) | 37.2 | 25.8 | 29.6 | 36.5 | 25.3 | 29.1 | 36.6 | 27.0 | 30.4 |
| | (554) | (776) | (1,330) | (581) | (787) | (1,368) | (610) | (826) | (1,436) |
| Central (%) | 10.8 | 6.9 | 8.2 | 11.0 | 7.0 | 8.3 | 10.9 | 7.1 | 8.5 |
| | (161) | (207) | (368) | (175) | (216) | (391) | (182) | (218) | (400) |
| Edmonton (%) | 30.2 | 22.3 | 24.9 | 30.4 | 21.7 | 24.7 | 30.4 | 22.6 | 25.4 |
| | (449) | (672) | (1,121) | (484) | (675) | (1,159) | (507) | (693) | (1,200) |
| North (%) | 10.8 | 6.5 | 7.9 | 11.2 | 6.3 | 8.0 | 10.9 | 6.6 | 8.1 |
| | (161) | (195) | (356) | (178) | (197) | (375) | (182) | (202) | (384) |
| South (%) | 10.8 | 3.5 | 5.9 | 10.5 | 3.4 | 5.8 | 10.5 | 3.4 | 5.9 |
| | (160) | (106) | (266) | (167) | (107) | (274) | (175) | (103) | (278) |
| Unknown (%) | 0.2 | 35.0 | 23.5 | 0.4 | 36.3 | 24.1 | 0.7 | 33.3 | 21.8 |
| | (3) | (1,054) | (1,057) | (7) | (1,127) | (1,134) | (12) | (1,020) | (1,032) |
| PCN Practice | | | | | | | | | |
| No (%) | 10.2 | 67.7 | 48.6 | 9.7 | 67.2 | 47.7 | 10.4 | 65.2 | 45.9 |
| | (151) | (2,037) | (2,188) | (155) | (2,089) | (2,244) | (174) | (1,995) | (2,169) |
| Yes (%) | 89.9 | 32.3 | 51.4 | 90.3 | 32.8 | 52.3 | 89.6 | 34.9 | 54.1 |
| | (1,337) | (973) | (2,310) | (1,437) | (1,020) | (2,457) | (1,494) | (1,067) | (2,561) |

note: Means reported, sample size reported below mean (in brackets).

# 4 Empirical Methodology

As noted above, we exploit the introduction of 03.04J on in April 2009 as a quasi-experiment. However, two concerns immediately arise regarding: (i) potential bias from non-random selection of primary care physicians into the treatment group (i.e. primary care physicians who billed at least one HSC 03.04J); and (ii) confounding by the PCN delivery structure since the PCN delivery structure differs from solo-practice in meaningful ways other than just the fee-for-service payment model.

## 4.1 Difference-in-Differences Methodologies

To estimate the effect of introducing fee code 03.04J on primary care physician billing patterns, we employ a three different difference-in-differences (DID) models. The DID approach is a standard methodology to analyze the effects of a policy change on an outcome of interest (Bertrand et al. (2004), Donald and Lang (2007), Imbens and Wooldridge (2009), Angrist and Pischke (2009)). In model 1, we use the standard DID (with parallel trend assumption). In model 2, we include physician fixed effects to account for any unobserved physician characteristics potentially affecting non-random selection into the treatment group. Finally, model 3 relaxes the parallel trend assumption of model 1, allowing for differential time trends between the treatment and control groups, and includes physician fixed effects of model 2.

### 4.1.1 Standard DID with parallel trend assumption

The standard DID specification is given by:

$$\log y_{it} = \beta X_{it} + \gamma Post_t + \rho D_i + \delta(Post_t \times D_i) + \theta_t + \mu_{it} \tag{1}$$

where $y_{it}$ is the total amount billed in month $t$ by physician $i$, $X_{it}$ is a set of observable (time varying and time invariant) physician/practice characteristics, $Post_t$ is a dummy variable equal to one for observations after and including April 2009 (the post period), $D_i$ is a dummy variable equal to one for physicians who are in the treatment group (i.e., physicians who make at least one 03.04J claim), $Post_t \times T_i$ is an interaction term that takes the value of one for physicians in the treatment

group in the post period (after the introduction of 03.04J), $\theta_t$ are month/year fixed effects, and $\mu_{it}$ is the idiosyncratic error term. The two parameters of interest are $\delta$ which captures the DID effect of 03.04J on primary care physician billings, and $\beta_{PCN}$ which capture the effect of PCNs on primary care physician billings. To account for possible autocorrelation in $y_{it}$, we estimate model (1) with clustered standard errors.

#### 4.1.2 Physician Fixed Effects

While model (1) is a reasonable starting point to estimate the effect of 03.04J's introduction on primary care physician billings, it may be the case unobserved physician characteristics could influence a physician's decision to claim 03.04J and their overall level of billing. Based on Figure 1, this seems likely since overall billing pre-April 2009 is higher for primary care physicians in the treatment group than primary care physicians in the control group. To account for the unobserved physician characteristics, we re-estimate model (1) but include and additional term, $\phi_i$, to capture unobserved individual physician fixed effects:

$$\log y_{it} = \beta X_{it} + \gamma Post_t + \delta(Post_t \times D_i) + \theta_t + \phi_i + \mu_{it}. \tag{2}$$

Again, the two parameters of interest are $\delta$ which captures the DID effect of 03.04J on primary care physician billings, and $\beta_{PCN}$ which capture the effect of PCNs on primary care physician billings.

#### 4.1.3 DID with differential trend assumption

One implication of the parallel trend assumption of model (1) is any time effects affect both the treatment and control groups the same way. Specifically, it also assumes the time trends in April 2009 (when 03.04J was introduced) did not affect the time trends (Bell et al. (1999)). However, if either: (i) the time trends are different across the treatment and control groups; or (ii) the introduction of 03.04J did affect the the time trends; then a parallel trend assumption would likely underestimate the impact of 03.04J being introduced.

To allow for a differential trend, we use the DID specification proposed by Bell et al. (1999). This model has also been recently used by Li et al. (2013) in a similar context to ours. The model

of Bell et al. (1999) assumes:

$$e_{it} = \begin{cases} \phi_i + k_T m_t + \mu_{it}, & \text{if } D_i = 1 \\ \phi_i + k_C m_t + \mu_{it}, & \text{if } D_i = 0 \end{cases}$$

where $e_{it}$ captures the unobserved individual physician fixed effects ($\phi_i$), the idiosyncratic error term ($\mu_{it}$), and an unobserved time trend ($m_t$). The specification of $e_{it}$ allow the trend ($m_t$ to differ between the treatment group ($k_T$) and control group ($k_C$).

The model of Bell et al. (1999) can be estimated using a similar approach as Li et al. (2013) by incorporating $e_{it}$ into model (2):

$$\log y_{it} = \beta X_{it} + \gamma Post_t + \delta(Post_t \times D_i) + \theta_t + \phi_i + k_n m_t + (k_T - k_C) m_t D_i + \mu_{it},$$

which can be estimated using a standard fixed-effects model with a linear time trend ($t$) plus an interaction between the linear time trend and the the treatment group dummy variable ($D_i$):

$$\log y_{it} = \beta X_{it} + \gamma Post_t + \delta(Post_t \times D_i) + \theta_t + \phi_i + \eta t + \lambda(t \times D_i) + \mu_{it}. \tag{3}$$

# 5 Regression Results

Two sets of results are presented. The first set of results are for the three primary difference-in-diffrences models The second set of results are robustness checks.

Because all three models have a semi-log form (there is a logarithmic transformation of the dependent variable) the coefficient ($\alpha$) must be transformed in order to interpret the effect of billing 03.04J on the percentage change in $y$.[5] The transformed coefficient is interpreted as the percentage change in billings ($y$) as a result of the introduction of 03.04J.

Table 7 presents the DID estimates of the introduction of 03.04J on the change in billing by primary care physicians who billed at least one HSC 03.04J. For each model, we report the coefficient estimate ($\alpha$) and the transformed coefficient $\%\Delta y = (e^{\alpha} - 1)$ for the treatment effect ($\alpha = \delta$) and PCN membership ($\alpha = \beta_{PCN}$).

[5]Specifically, in a semi-log model where the independent variable is a binary variable, as it is in our case, then the percentage change in $y$ is given by $e^{\alpha} - 1$ (Kennedy (2008)).

Table 7: Coefficient Estimates - Difference-in-Differences Models

| Model | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| | $\alpha$ | $\%\Delta y$ | $\alpha$ | $\%\Delta y$ | $\alpha$ | $\%\Delta y$ |
| Treatment Effect ($\delta$) | 0.052 | 5.3% | 0.082 | 8.5% | 0.099 | 10.4% |
| | (0.017) | | (0.008) | | (0.009) | |
| PCN Membership ($\beta_{PCN}$) | 0.174 | 19.0% | 0.166 | 18.1% | 0.163 | 17.7% |
| | (0.035) | | (0.035) | | (0.035) | |
| Physician/practice characteristics | Yes | | Yes | | Yes | |
| Month/Year fixed effects | Yes | | Yes | | Yes | |
| Individual physician fixed effects | | | Yes | | Yes | |
| Differential Trend | | | | | Yes | |
| $y_{it}$: all HSC | Yes | | Yes | | Yes | |
| Sample Size ($n$) | 110,042 | | 110,042 | | 110,042 | |
| Number of Clusters | 4,027 | | 4,027 | | 4,027 | |

Table reports coefficient estimates (with standard errors in brackets).
The percentage change in $y$ ($= e^{\alpha} - 1$) is reported next to the coefficient.
All estimates are significant at $p < 0.01$.

For model (1), we control for basic physician and practice characteristics and month/year fixed effects. The estimated coefficient of the treatment effect is 0.052 and statistically significant at the 1% level. This suggest a 5.2% increase in total billing for primary care physicians who billed 03.04J. The estimated coefficient of PCN membership is 0.174 and statistically significant at the 1%; suggesting primary care physicians in a PCN bill 19.0% more than solo-practice primary care physicians. However, as noted above, it may be the case unobserved physician characteristics could influence a physician's decision to claim 03.04J and their overall level of billing.

For model (2), we include physician fixed effects to account for unobserved physician characteristics that may affect both the decision to bill 03.04J as well as overall billing levels. The inclusion of physician fixed effects increases the estimated coefficient of the treatment effect to 0.082 and statistically significant at the 1% level. This suggest a 8.5% increase in total billing for primary care physicians who billed 03.04J. The estimated coefficient of PCN membership is 0.166 and statistically significant at the 1%; suggesting primary care physicians in a PCN bill 18.1% more than solo-practice primary care physicians.

For model (3), we now allow for differential trends across the treatment and control group, but still include physician fixed effects. The differential time trend with the inclusion of physician fixed effects now increases the estimated coefficient of the treatment effect to 0.099 and statistically significant at the 1% level. This suggest a 10.4% increase in total billing for primary care physicians

who billed 03.04J. The estimated coefficient of PCN membership decreases slightly to 0.163 and statistically significant at the 1%; suggesting primary care physicians in a PCN bill 17.7% more than solo-practice primary care physicians.

### 5.1 Robustness Checks

Models (1) to (3) are all estimated on a sample of all primary care physicians, with the log of all billings as the dependent variable. We look at two specific robustness checks: (i) a sample of "regular" 03.04J billers (primary care physicians who claimed less than 365 HSC 03.04J) representing 98% of all 03.04J billers; and (ii) defining $y_{it}$ as billing visit specific codes (rather than total billings). All robustness checks reported are estimated using model (3).[6] Table 8 presents the results of the robustness checks.

Table 8: Robustness Checks - Difference-in-Differences Model (3)

| Model | (4) | | (5) | | (6) | |
|---|---|---|---|---|---|---|
| | $\alpha$ | $\%\Delta y$ | $\alpha$ | $\%\Delta y$ | $\alpha$ | $\%\Delta y$ |
| Treatment Effect ($\delta$) | 0.095 | 10.0% | 0.066 | 6.8% | 0.066 | 6.8% |
| | (0.009) | | (0.009) | | (0.009) | |
| PCN Membership ($\beta_{PCN}$) | 0.160 | 17.3% | 0.186 | 20.4% | 0.183 | 20.1% |
| | (0.035) | | (0.037) | | (0.037) | |
| Physician/practice characteristics | Yes | | Yes | | Yes | |
| Month/Year fixed effects | Yes | | Yes | | Yes | |
| Physician fixed effects | Yes | | Yes | | Yes | |
| Differential Trend | Yes | | Yes | | Yes | |
| Exclude top 2% | Yes | | | | Yes | |
| $y_{it}$: all HSC | Yes | | | | | |
| $y_{it}$: HSC 03.03A, 03.04A & 08.18G | | | Yes | | Yes | |
| Sample Size ($n$) | 108,743 | | 100,298 | | 99,002 | |
| Number of Clusters | 3,990 | | 3,678 | | 3,641 | |

Table reports coefficient estimates (with standard errors in brackets).
The percentage change in $y$ ($= e^{\alpha} - 1$) is reported next to the coefficient.
All estimates are significant at $p < 0.01$.

The increase in total billings may simply be caused by the primary care physicians who were high billers of HSC 03.04J. Models (4) restricts the sample to only "regular" billers by excluding primary care physicians who claimed more than 365 HSC 03.04J (i.e., one claim per day) in either 2009/10 or 2010/11. This represent approximately the top 2% of primary care physicians. Model (4) is simply model (3) on the sub-set of regular billers. The estimated coefficient of the treatment

[6] We estimated all robustness checks using models (1), (2), and (3). The results from all specifications are broadly consistent with the results of the robustness checks using model (3).

effect is 0.095 and is statistically significant at the 1% level. This suggest primary care physicians who are regular billers of 03.04J increase their total billings relative to primary care physicians who do not claim 03.04J by 10%. The estimated coefficient of PCN membership is 0.160; suggesting primary care physicians in a PCN bill 17.3% more than solo-practice primary care physicians.

Models (6) defines the dependent variable to billings of visit specific codes (03.03A, 03.04A and 08.19G), rather than total billings from all fees codes. We focus on the visit specific codes since these codes are very likely to be billed in conjunction with an 03.04J claim, but also commonly billed codes in all years. Model (6) is simply model (3) on visit specific codes. The estimated coefficient of the treatment effect from model (5) is 0.066 and is statistically significant at the 1% level. This suggest primary care physicians in the treatment group increase their visit specific billings relative to primary care physicians in the control group by 6.8%. The estimated coefficient of PCN membership is 0.186; suggesting primary care physicians in a PCN bill 20.4% more than solo-practice primary care physicians.

Finally, we estimate a model on the sample of regular billers with the dependent variable being billings of visit specific codes. Model (6) is estimated using model (3). The coefficient estimate is stable at 0.066 (and, again, statistically significant at the 1% level); suggesting regular billers of 03.04J increase their billings of visit codes, relative to primary care physicians who do not claim 03.04J, by 6.8%. The estimated coefficient of PCN membership is 0.183; suggesting primary care physicians in a PCN who are "regular" billers of 03.04J bill 17.3% more than solo-practice primary care physicians.

Overall, the robustness checks suggest the results of model (3) are fairly stable and mainly generated due to the increase in billing of visit specific codes.

# 6 Discussion

What can be clearly seen is the introduction of 03.04J had a direct cost $17.9 million in its first year and $20.4 million in its second year. What can not be easily seen is the indirect costs from the introduction of 03.04J. Our DID estimates suggest the indirect costs of 03.04J were an approximately 5% to 10% increase in total primary care physician billings, and an approximately 7% increase in visit specific billings. This translates into an estimated indirect cost of $81.3 million

(10.4% of 781.3 million) increase in total billing, of which $24.3 million (6.8% of $346.2 million + $83.8 million) is due to an increase in visit specific billings.

At the same time, the interaction between the introduction of 03.04J and the existing primary care delivery structures (PCN vs. solo practice) also plays an important role in total billings. Primary care physicians in PCNs appear to bill 18% to 20% more than solo practice primary care physicians. This may be due to non-random selection of physicians into PCNs, or due to the increased resources available to a PCN primary care physician for service provision.

The paper has a few limitations. The primary limitation is the paper does not look at the health outcomes of patients. We are not able to look at health outcomes with this data for two main reasons. First, and foremost, direct measures of patient health are not contained in the administrative claims data. Second, the administrative claims data we are using only contains all fee-for-service primary care physician for three fiscal years (April 1, 2008 to March 31, 2011). We do not have information on hospitalizations, laboratory tests, or specialist physician care. This prevents us from being able to estimate patients health outcomes based on health care utilization patterns. Thus, we have no evidence whether the introduction of CACPs (and HSC 03.04J) actually improved the health of patients with multiple chronic conditions.

A second limitation relative to other contemporaneous changes to the fee schedule. When 03.04J was introduced, there was also a substantial increase in the after hours code (03.01AA), the removal of the 03.03Z (which was replaced with an age modifier for 03.03A[7]). The other contemporaneous changes may mean our results are overestimating the impact of introducing 03.04J.

The results suggest the unintended consequences of a well-intentioned policy can be costly. If health policy makers want to nudge physicians to provide different types of care in order to improve patient outcomes by changing the fee schedule (in the context of a predominantly fee-for-service payment system), they ought to account for both the direct and indirect effect of physicians' behavioural response to changes in the fee schedule.

[7]The 03.03A age modifier permits primary care physicians who see a patient 75 years of age or older can be paid for HSC 03.03A at 20% above the GP rate of $35.91 (Alberta Medical Association (2009)).

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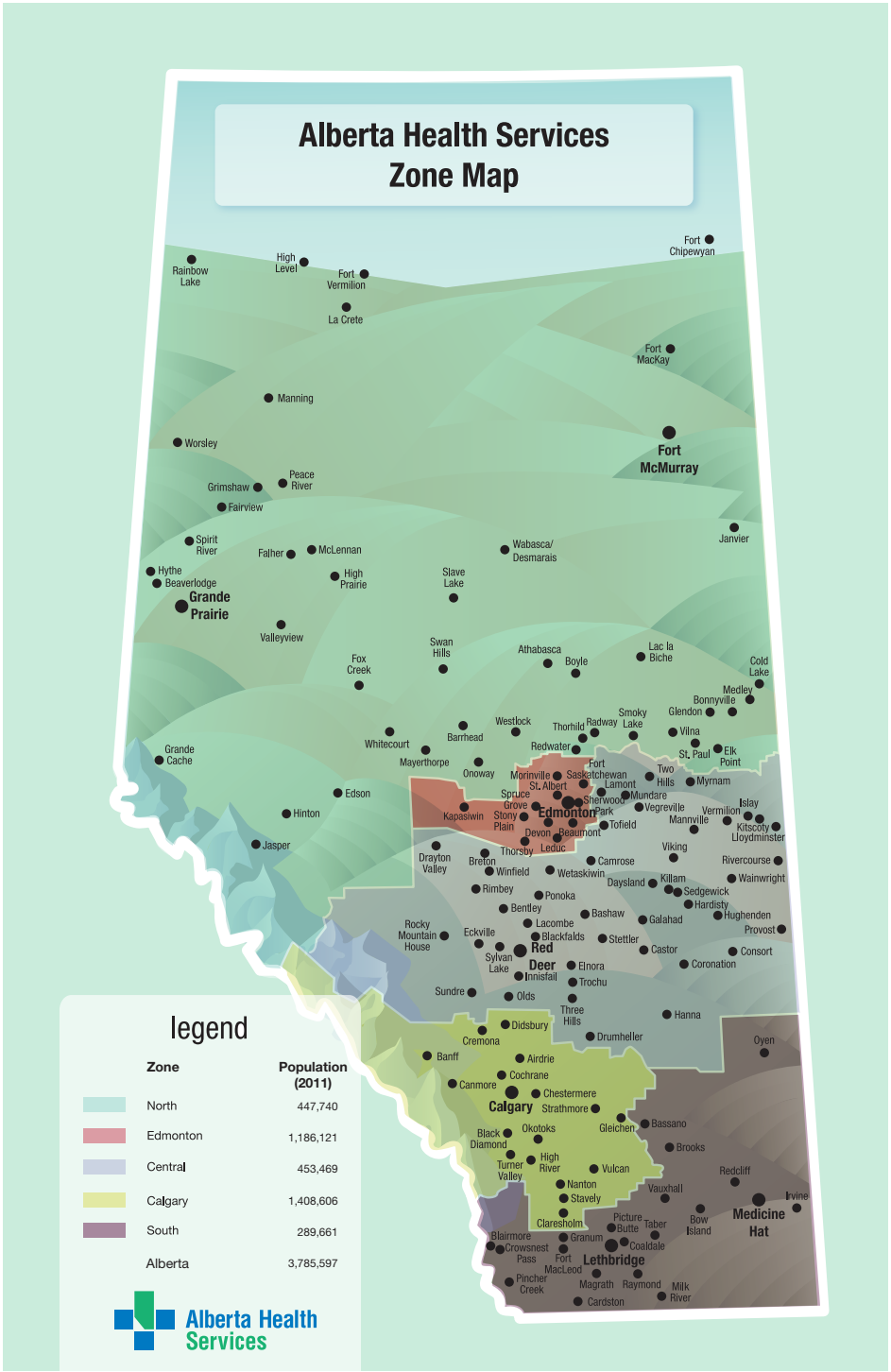
# A1 Alberta Health Services Zone Map




Source: Alberta Health Services (2011).