

Patient and primary care physician characteristics associated with billing incentives for chronic diseases in British Columbia: a retrospective cohort study

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Abstract

Background: Incentive payments for chronic diseases in British Columbia were intended to support primary care physicians in providing more comprehensive care, but research shows that not all physicians bill incentives and not all eligible patients have them billed on their behalf. We investigated patient and physician characteristics associated with billing incentives for chronic diseases in BC.

Methods: We conducted a retrospective cohort analysis using linked administrative health data to examine community-based primary care physicians and patients with eligible chronic conditions in BC during 2010–2013. Descriptive analyses of patients and physicians compared 3 groups: no incentives in any of the 4 years, incentives in all 4 years, and incentives in any of the study years. We used hierarchical logistic regression models to identify the patient- and physician-level characteristics associated with billing incentives.

Results: Of 428 770 eligible patients, 142 475 (33.2%) had an incentive billed on their behalf in all 4 years, and 152 686 (35.6%) never did. Of 3936 physicians, 2625 (66.7%) billed at least 1 incentive in each of the 4 years, and 740 (18.8%) billed no incentives during the study period. The strongest predictors of having an incentive billed were the number of physician contacts a patient had (odds ratio [OR] for > 48 contacts 134.77, 95% confidence interval [CI] 112.27–161.78) and whether a physician had a large number of patients in his or her practice for whom incentives were billed (OR 42.38 [95% CI 34.55–52.00] for quartile 4 v. quartile 1).

Interpretation: The findings suggest that primary care physicians bill incentives for patients based on whom they see most often rather than using a population health management approach to their practice.

For nearly 2 decades, there has been concern about the decline in primary care, including both the availability of primary care providers^{1,2} and the comprehensiveness of their practices.^{3,4} Starting in 2003/04, incentive payments for a range of chronic diseases were put in place in British Columbia to encourage provision of comprehensive primary care.⁵ Additional per-patient annual payments for accepting longitudinal responsibility for care of patients with 1 or more chronic conditions were intended to emphasize the value of, and enable more physicians to provide, “full-service” family practice.⁶ More than a decade into the availability of fee-for-service-based chronic disease and complex care incentives in BC, only about two-thirds of primary care physician billed incentives.⁷

Previous analyses in BC showed that the likelihood of billing an incentive is strongly related to data-derived characterization

of physician practice style, with “walk-in” style physicians billing very few to no incentives.⁸ The incentive program overall has shown little effect on patient care, with small increases in some clinical process measures of care (such as increased prescribing for patients with chronic obstructive pulmonary disease)⁹ but no effect on acute care admissions or cost savings.⁷ Furthermore, among patients who qualified for the complex care incentive, those who had incentives billed on their behalf

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had lower costs and higher continuity of care both before and after the start of the incentive program.⁷ These observations, particularly the latter, are consistent with the international literature, which overall suggests that incentives tend to be billed by providers already providing higher-quality care or in contexts where care was already improving.¹⁰⁻¹² Observational study designs are prone to selection bias.¹³ The tendency is to think of these biases in terms of patient-related selection factors, but, in the case of incentives, when not all physicians participate, there clearly may be selection effects at the physician level as well. Therefore, although incentives do not appear to alter the course of care,^{7,9} they may be a surrogate measure that differentiates the type of primary care people are receiving.

We investigated physician and patient characteristics associated with receipt of an incentive. We compared 2 distinct groups of patients who qualified for incentives: those who had an incentive billed on their behalf in all study years, and those who did not have an incentive billed on their behalf in any study year. We hypothesized that people without an incentive billed on their behalf see more primary care physicians and have lower overall continuity of care; that people without an incentive billed on their behalf tend not to see physicians who bill incentives for their patients; and that characteristics of a patient's primary care physician are a stronger determinant of incentive billing than patient characteristics.

Methods

Setting

Incentive payments for chronic diseases were introduced in BC in 2003/04, with additional incentives being added in 2006/07 and then again in 2009/10. These incentives can be billed annually by physicians for each eligible patient for whom they commit to providing ongoing management and care (Table 1). Figure 1 shows that there was no appreciable increase in the proportion of physicians engaged with the incentive program in BC or the proportion of patients for whom incentives were billed after the complex care incentives were introduced. It is a result of this sustained trend that this study was conducted.

Data sources

Consistent with previous analyses of the incentive programs,^{7,9} we used linked administrative data from Jan. 1, 2010, to Dec. 31, 2013, including the BC Medical Services Plan fee-for-service physician payment files,¹⁵ a registered patients file containing demographic information,¹⁶ physician demographic characteristics from the College of Physicians and Surgeons of British Columbia¹⁷ and data on all prescriptions filled in the province.¹⁸ Population Data BC provided all data for the study with unique, study-specific identification codes to ensure nonidentifiability of both physicians and patients. This study focuses on fee-for-service payment patterns and characteristics of physicians and patients enrolled in the BC Medical Services Plan, information that is completely captured in these databases.

Variable development

Primary care physicians

Our focus was physicians who provided community-based primary care. We limited analysis to primary care physicians who saw 100–6500 unique patients in a year. We chose the lower limit to exclude physicians who had very small fee-for-service practices, and the upper limit to exclude what are likely errors in the data, as 6500 represents seeing 25 unique patients 5 days per week for all 52 weeks of the year. We excluded physicians who billed any specialty consultation fee items (as this makes providers ineligible for the incentive fee items¹⁴), those who did not see any patients eligible for the incentives (which might happen, for example, in a focused practice) and those who were not assigned as a continuity provider for any patients (which eliminated physicians not providing the majority of primary care to the patients they see, as this may indicate working in walk-in clinics or locums). We assigned physicians as the regular provider to individual patients in cases in which they were the primary care provider seen most often, as measured by the highest number of visits. In case of a tie, we used highest dollars billed; if still tied, we used physician most recently visited. These methods are consistent with previous analyses in BC and elsewhere.^{7,19}

Table 1: Summary of incentive programs in British Columbia

Incentive program	Eligible patient conditions	Annual incentive fee, \$
Chronic Disease Management	Diabetes, chronic obstructive pulmonary disease, heart failure	125*
Complex Care Planning and Management	≥ 2 of the following conditions: diabetes, chronic renal failure, heart failure, chronic respiratory condition, cerebrovascular disease, ischemic heart disease, chronic neurodegenerative disease, chronic liver disease	315

Source: British Columbia Medical Services Commission payment schedule November 2010.¹⁴
 *The chronic disease management program also included an incentive for hypertension valued at \$50. We excluded this incentive because of its lower dollar value and lower complexity of needs of patients who are diagnosed only with hypertension.

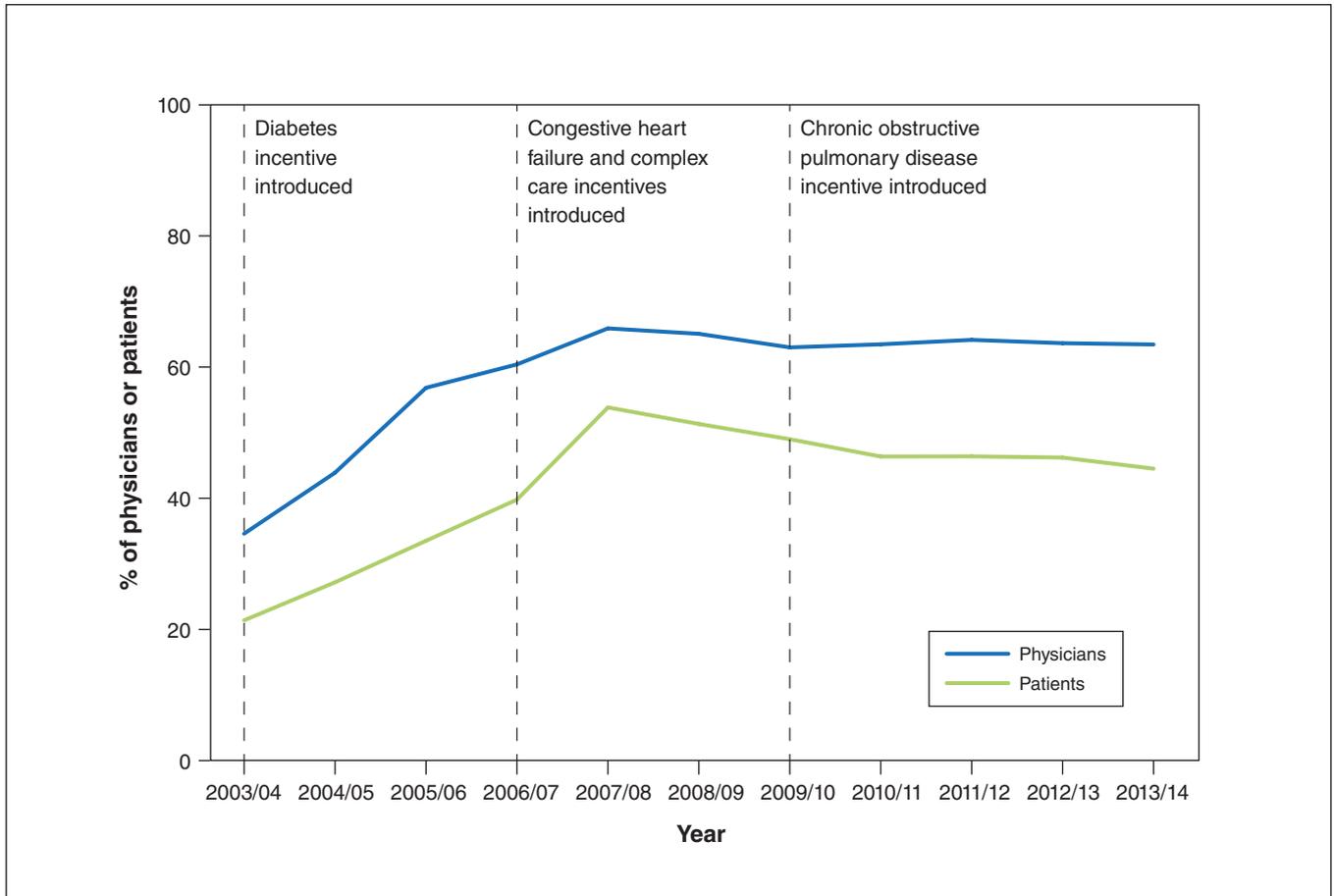


Figure 1: Proportion of primary care physicians who billed at least 1 chronic care or complex care incentive payment, and proportion of patients who had an incentive billed on their behalf, 2003/04 to 2013/14. Source: British Columbia Medical Services Plan (physician billing) information¹⁵ and author calculations.

Physician characteristics included age, sex and region of practice (according to the 5 health authority regions in BC).

Classifying other aspects of physician practice style

Other variables included total billings per year, number of unique patients and proportion of eligible patients for whom an incentive was billed. We defined eligible patients as those with conditions covered by the incentive program. Since the eligibility criterion for the incentive program was a diagnosis of the specified chronic disease, we required at least 2 physician diagnoses or 1 hospital diagnosis within a 2-year period, a validated methodology for how chronic disease is identified in administrative data.^{20,21} We chose this more conservative approach (2 physician diagnoses rather than 1 physician diagnosis) to ensure that all included patients were truly eligible. We also required patients to be eligible no later than Dec. 31, 2010, the first year of the study period. Once eligible, patients were deemed eligible over time; they did not have to qualify in each 2-year period.

We excluded patients who died during the study period, those who were not registered at least 275 days in each year of analysis, those who had no physician visits during the study

period (since they would not have had an opportunity to have an incentive billed on their behalf), those who appeared (based on the data available) to be residing in long-term care at any point during the study period (as they use primary care differently and are not the main target of the incentive program) and those who were assigned a regular provider who was not part of the final physician cohort.

Patient characteristics included age, sex, health authority region of residence, neighbourhood income (defined by means of postal code of patient’s residence²²) and number of incentive-eligible chronic conditions.

Classifying other aspects of health care use

Other patient variables were chosen based on previous analyses^{7,9} and hypothesized relations; these included encounters with primary care providers paid outside the fee-for-service system, total number of physician visits over the study period, total number of primary care physicians seen over the study period, the recency of eligibility for the incentives and continuity of care, measured with the usual provider continuity index²³ (number of visits with the primary care physician seen most often divided by the total number of visits to all primary care physicians per year).

Statistical analysis

Descriptive analyses of eligible patients and physicians compared 3 groups: no incentives, incentives in some years and incentives in all years. For patients, this differentiated those who had incentives billed on their behalf consistently (i.e., in all 4 study yr), inconsistently (i.e., in some years) and not at all. For physicians, the groups differentiated those who billed incentive fee codes in all, some or none of the 4 study years. The main outcome of interest was the contrast between incentives in all 4 years versus incentives in no years. We used standardized differences in descriptive analyses to quantify differences between groups.

We used hierarchical regression models to identify the patient- and physician- level characteristics associated with incentives, with the outcome of receipt of incentive in all 4 years versus in no years. We used the SAS GLIMMIX procedure (SAS Institute) to estimate logistic regression models with random intercepts at the individual physician level. We used a logit link function and a binary distribution. Both patient-level and physician-level fixed effects were entered, and patients were nested within primary care physicians based on the primary care physician with whom they had the most contacts over the 4 years. We did not include any geographic clustering within the analysis. We used the median odds ratio (OR) as an alternative to the interclass correlation to describe variation across physicians, as recommended for logistic regression.²⁴

Ethics approval

The University of British Columbia Behavioural Research Ethics Board approved this study.

Results

There were 578 907 patients eligible to receive incentives by the end of 2010. We excluded 96 239 patients who died during the study period or were not registered at least 275 days per year, 6355 patients who had no physician visits or only specialist visits, and 17 384 patients residing in long-term care. We also excluded 30 159 patients whose usual provider of care physician was excluded from the cohort of primary care physicians. This left a final cohort of 428 770 patients (Figure 2).

A total of 142 475 eligible patients (33.2%) had an incentive billed on their behalf in all 4 study years, and 152 686 (35.6%) never did (Table 2). There were more eligible males than females overall, but there was little difference between the sexes in the likelihood of being in the all-years–incentive versus no-incentive group. Age was positively associated with having an incentive billed in all 4 years, even within a population of eligible patients (standardized difference for age overall = 0.66). Standardized differences for geographic region, socioeconomic status, number of different primary care physicians seen over the 4 years, whether there was contact with a non–fee-for-service physician and number of years since the patient was eligible for incentives were all small. Standardized differences were moderate for continuity of care, and were large for number of eligible conditions and overall number of primary care physician visits.

There were 6214 physicians eligible to bill incentives during the study period. We excluded 5 physicians who billed specialty consultations, 1896 who billed fewer than

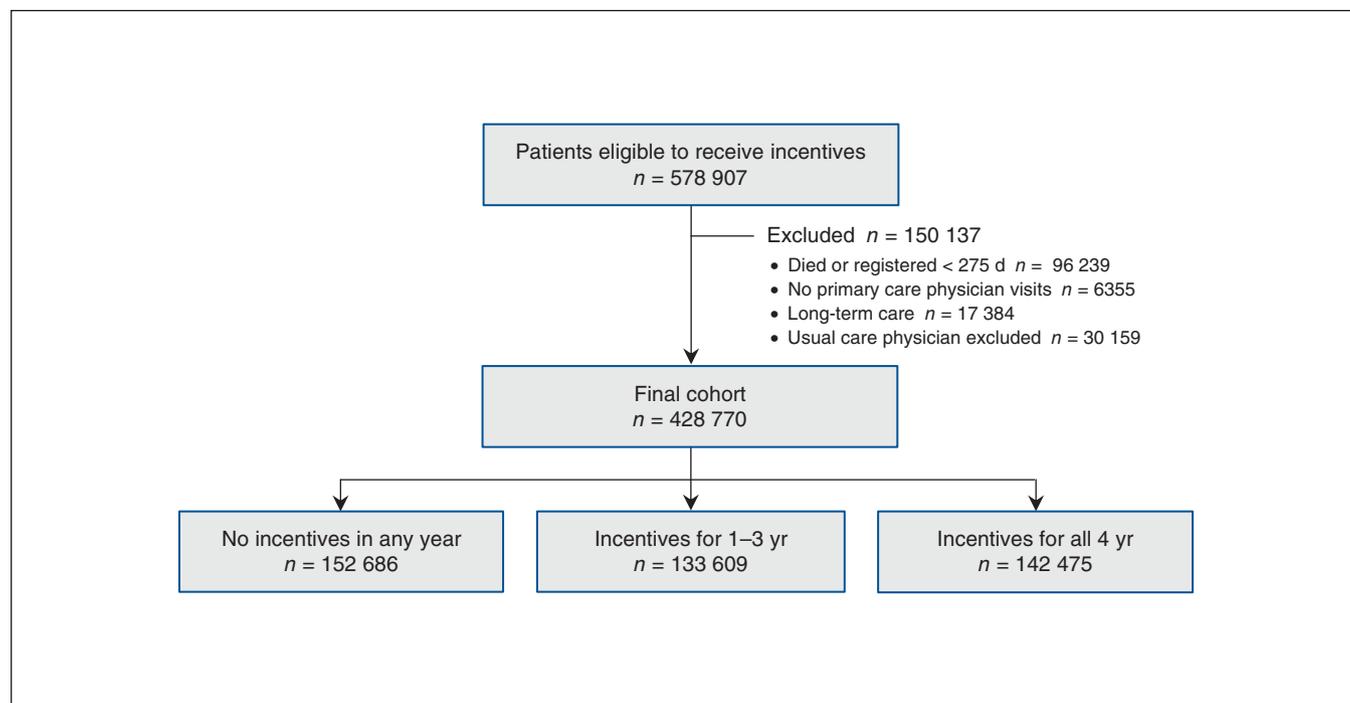


Figure 2: Flow diagram showing selection of patient cohort.

Table 2: Characteristics of patients who had incentives billed on their behalf in all, some or none of the study years, 2010–2013

Characteristic	No. (%) of patients*				Standardized difference (no incentive billed v. billed in all 4 yr)
	Overall n = 428 770	No incentive billed in any year n = 152 686	Incentives billed in 1–3 yr n = 133 609	Incentives billed in all 4 yr n = 142 475	
Sex					
Female	204 832 (47.8)	77 014 (50.4)	62 402 (46.7)	65 416 (45.9)	0.09
Male	223 811 (52.2)	75 644 (49.5)	71 169 (53.3)	76 998 (54.0)	
Missing	127 (< 0.1)	28 (< 0.1)	38 (< 0.1)	61 (< 0.1)	
Age group, yr					
≤ 17	6815 (1.6)	6309 (4.1)	407 (0.3)	99 (0.1)	0.66
18–44	35 635 (8.3)	23 921 (15.7)	8090 (6.1)	3624 (2.5)	
45–74	258 623 (60.3)	91 170 (59.7)	86 245 (64.6)	81 208 (57.0)	
≥ 75	127 697 (29.8)	31 286 (20.5)	38 867 (29.1)	57 544 (40.4)	
Health authority					
Interior Health	75 525 (17.6)	24 566 (16.1)	22 679 (17.0)	28 280 (19.8)	0.17
Fraser Health	157 241 (36.7)	57 683 (37.8)	49 993 (37.4)	49 565 (34.8)	
Vancouver Coastal Health	96 180 (22.4)	38 239 (25.0)	28 595 (21.4)	29 346 (20.6)	
Vancouver Island Health Authority	76 642 (17.9)	24 275 (15.9)	24 055 (18.0)	28 312 (19.9)	
Northern Health	22 709 (5.3)	7722 (5.1)	8133 (6.1)	6854 (4.8)	
Missing	473 (0.1)	201 (0.1)	154 (0.1)	118 (0.1)	
Income quintile					
Q1 (lowest)	94 909 (22.1)	33 513 (21.9)	29 975 (22.4)	31 421 (22.0)	0.00
Q2	92 858 (21.7)	32 973 (21.6)	28 935 (21.7)	30 950 (21.7)	
Q3	85 283 (19.9)	30 213 (19.8)	26 298 (19.7)	28 772 (20.2)	
Q4	79 239 (18.5)	28 158 (18.4)	24 710 (18.5)	26 371 (18.5)	
Q5 (highest)	71 983 (16.8)	26 168 (17.1)	22 136 (16.6)	23 679 (16.6)	
Missing	4498 (1.0)	1661 (1.1)	1555 (1.2)	1282 (0.9)	
No. of incentive-eligible conditions first yr					
1	248 472 (57.9)	113 697 (74.5)	78 964 (59.1)	55 811 (39.2)	0.78
2	139 278 (32.5)	34 036 (22.3)	43 197 (32.3)	62 045 (43.5)	
3	36 868 (8.6)	4651 (3.0)	10 463 (7.8)	21 754 (15.3)	
4	4152 (1.0)	302 (0.2)	985 (0.7)	2865 (2.0)	
Date of diagnosis of first eligible condition(s)					
2010	45 768 (10.7)	18 937 (12.4)	16 703 (12.5)	10 128 (7.1)	0.29
1–4 yr prior (2006–2009)	165 924 (38.7)	66 063 (43.3)	51 125 (38.3)	48 736 (34.2)	
≥ 5 yr prior (2005 or earlier)	217 078 (50.6)	67 686 (44.3)	65 781 (49.2)	83 611 (58.7)	
Non-fee-for-service encounter					
No	305 037 (71.1)	108 066 (70.8)	96 018 (71.9)	100 953 (70.9)	–0.00
Yes	123 733 (28.9)	44 620 (29.2)	37 591 (28.1)	41 522 (29.1)	
No. of primary care physician visits over 4-yr study period					
1–6	13 654 (3.2)	10 922 (7.2)	2595 (1.9)	137 (0.1)	0.73
7–12	26 185 (6.1)	16 692 (10.9)	7936 (5.9)	1557 (1.1)	
13–24	90 973 (21.2)	38 604 (25.3)	31 702 (23.7)	20 667 (14.5)	
25–48	168 835 (39.4)	51 541 (33.8)	53 039 (39.7)	64 255 (45.1)	
> 48	129 123 (30.1)	34 927 (22.9)	38 337 (28.7)	55 859 (39.2)	
No. of primary care physicians seen over 4-yr study period					
1–2	63 259 (14.8)	25 431 (16.7)	18 064 (13.5)	19 764 (13.9)	0.08
3–4	96 166 (22.4)	34 188 (22.4)	29 117 (21.8)	32 861 (23.1)	
≥ 5	269 345 (62.8)	93 067 (61.0)	86 428 (64.7)	89 850 (63.1)	
Usual provider continuity index, mean ± SD†	7.0 ± 2.1	6.6 ± 2.3	6.8 ± 2.1	7.6 ± 1.7	0.49

Note: SD = standard deviation.
*Except where noted otherwise.
†Scaled to 1–10.

100 ($n = 1805$) or more than 6500 ($n = 80$) unique patients in a year, 224 who did not see any patients eligible for incentives and 153 who were not matched as a continuity of care provider to any patients in the final cohort. This left a total cohort of 3936 primary care physicians (Figure 3).

Two-thirds of physicians (2625 [66.7%]) billed at least 1 incentive in each of the 4 study years, 571 (14.5%) billed in 1–3 years, and 740 (18.8%) billed no incentives during the study period (Table 3). Overall, the 4-year group billed incentives for an average of 30.7% of eligible patients seen, compared to 5.7% for the 1- to 3-year group and (by definition) 0% for the nonincentive group. Those who billed in all 4 years had higher average total payments than the other physician groups, but otherwise standardized differences between the groups were small.

Regression results showed that male patients had higher odds than female patients of having an incentive billed on their behalf (OR 1.42, 95% confidence interval [CI] 1.39–1.45), as did older patients (e.g., OR for ≤ 17 yr 0.04, 95% CI 0.03–0.05), those residing in less metropolitan health authorities (e.g., OR for Northern Health 1.68, 95% CI 1.36–2.06), those in lower-income neighbourhoods (OR 1.15 [95% CI 1.11–1.19] for lowest v. highest quintile) and those eligible for more incentives at the start of the study period (e.g., OR for 4 incentives 5.87, 95% CI 5.00–6.89) (Table 4). The likelihood of having incentives billed increased with increased number of primary care physician visits (OR for > 48 contacts 134.77, 95% CI 112.27–161.78) but declined with

increasing number of different primary care physicians seen (e.g., OR 0.82 [95% CI 0.78–0.85] for ≥ 5 v. 1–2). Continuity of care had a positive association with incentives, with an OR of 1.31 (95% CI 1.30–1.32) for each increase of 0.1 on a scale of 0–10.

Male physicians were less likely to bill incentives than female physicians (OR 0.86, 95% CI 0.77–0.95) (Table 4). The likelihood of billing incentives decreased with increasing physician age (e.g., OR 0.83 [95% CI 0.74–0.94] for 55–64 yr v. 45–54 yr). Patients were more likely to have an incentive billed on their behalf if they saw physicians who had higher participation, as measured by the proportion of eligible patients for whom an incentive was billed (e.g., OR 42.38 [95% CI 34.55–52.00] for quartile 4 v. quartile 1).

Interpretation

The only hypothesis supported by these analyses is that seeing fewer different primary care providers and higher continuity of care are both associated with a higher likelihood of having an incentive billed. Patients without an incentive billed on their behalf, however, did see physicians who billed incentives, so the absence of incentive billing is not a matter of a mismatch between providers and patients. Perhaps more important, characteristics of both patients and physicians were strongly associated with billing of incentives.

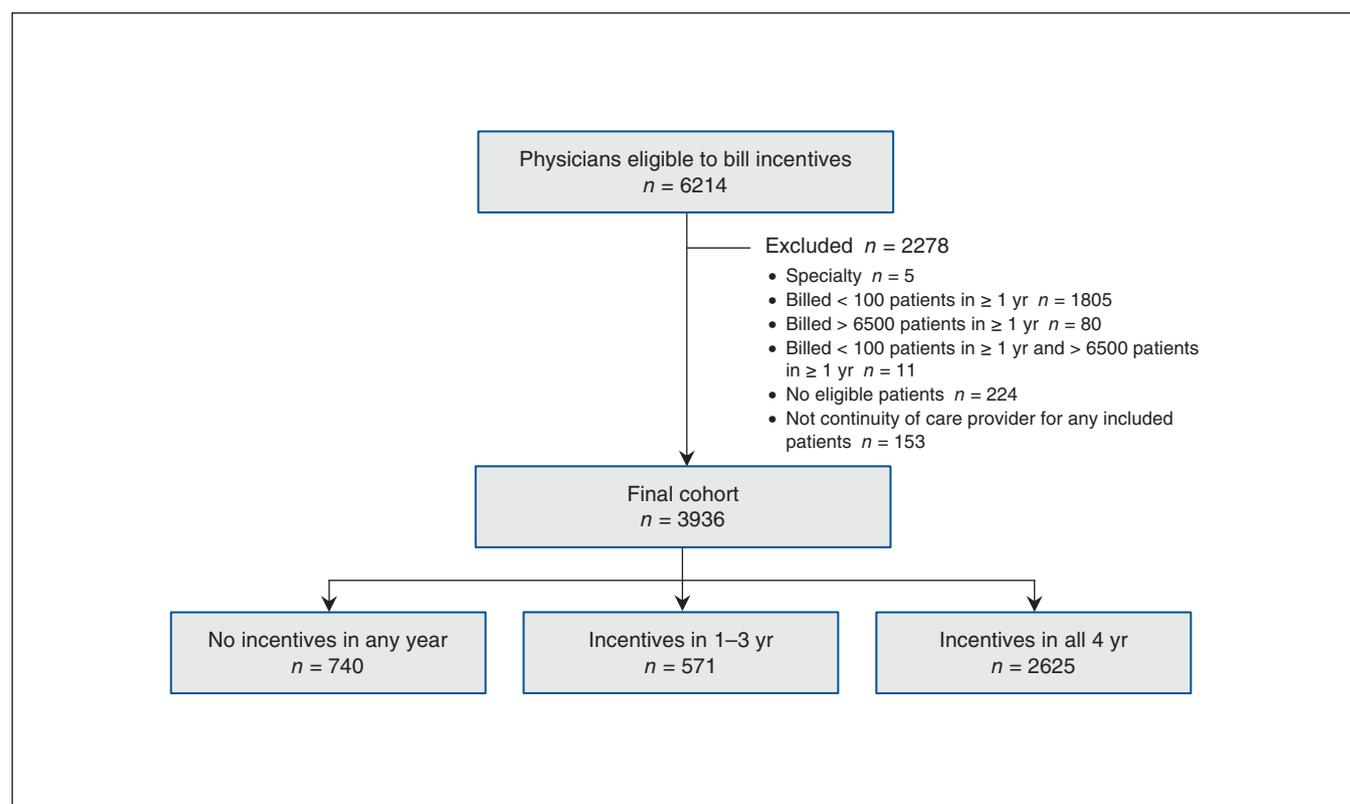


Figure 3: Flow diagram showing selection of physician cohort.

Table 3: Physician and practice characteristics for those who billed incentives in all, some or none of the study years, 2010–2013

Characteristic	Overall n = 3936	Did not bill incentives in any year n = 740	Billed incentives in 1–3 yr n = 571	Billed incentives in all 4 yr n = 2625	Standardized difference (did not bill v. billed incentives in all 4 yr)
Total billings (4-yr average), \$, mean ± SD	228 846.3 ± 128 283.0	151 462.6 ± 123 551.6	156 760.6 ± 98 024.4	266 341.5 ± 118 601.0	0.95
No. of patients (4-yr average), mean ± SD	1854.4 ± 1056.4	1742.9 ± 1279.8	1849.9 ± 1119.2	1886.8 ± 967.3	0.13
% of eligible patients for whom incentives billed (4-yr), mean ± SD	21.3 ± 19.9	–	5.7 ± 7.4	30.7 ± 17.7	2.45
Sex, no. (%)					
Female	1417 (36.0)	246 (33.2)	263 (46.1)	908 (34.6)	–0.03
Male	2519 (64.0)	494 (66.8)	308 (53.9)	1717 (65.4)	
Age group, yr, no. (%)					
< 35	158 (4.0)	25 (3.4)	49 (8.6)	84 (3.2)	0.16
35–44	766 (19.5)	155 (20.9)	153 (26.8)	458 (17.4)	
45–54	1279 (32.5)	243 (32.8)	141 (24.7)	895 (34.1)	
55–64	1168 (29.7)	192 (25.9)	123 (21.5)	853 (32.5)	
≥ 65	565 (14.4)	125 (16.9)	105 (18.4)	335 (12.8)	
Health authority, no. (%)					
Interior Health	755 (19.2)	126 (17.0)	122 (21.4)	507 (19.3)	0.17
Fraser Health	1087 (27.6)	232 (31.4)	142 (24.9)	713 (27.2)	
Vancouver Coastal Health	1033 (26.2)	199 (26.9)	159 (27.8)	675 (25.7)	
Vancouver Island Health Authority	823 (20.9)	156 (21.1)	120 (21.0)	547 (20.8)	
Northern Health	212 (5.4)	21 (2.8)	23 (4.0)	168 (6.4)	
Missing	26 (0.7)	6 (0.8)	5 (0.9)	15 (0.6)	

Note: SD = standard deviation.

The association between a larger number of different primary care physicians seen and lower likelihood of an incentive may reflect that, where care is dispersed, no primary care provider feels ownership of or responsibility for an ongoing relationship with a patient. The very strong association with number of visits, however, suggests that physicians may be prompted to bill the incentives when patients come into their office but are without a systematic population health management approach to managing their entire patient panel and identifying all patients with chronic conditions in their practice.²⁵ Given that the incentives are intended for all eligible patients, not just those who make the most visits, further research should test this hypothesis, as there is evidence that population health management results in higher-quality care.^{26,27}

The fact that younger physicians and female physicians were more likely to bill incentives suggests age and sex differences in the chosen form or type of practice. Previous studies identified both cohort effects and gender effects in practice style,^{28–30} but less is known about the drivers of these differences and whether they could be mitigated.

Limitations

As this study used only administrative data, we lacked information from patients as to whom they perceived their usual provider to be. Similarly, we lacked physician perspectives on their patient cohort. We were unable to differentiate patient choice from system factors, such as whether patients saw more primary care physicians because that is their preference or because they could not find a regular provider of care. We were not able to measure complexity of condition other than through counting the number of comorbidities. All of these variables would have added to the study but are not collected routinely. To our knowledge, there have been no validation studies related to incentive fee items; however, these data have been used in previous analyses.^{7,9}

This was a population-based study in BC, so it is representative of that population and generalizable to the BC context. Beyond the BC setting, our conclusions may be generalizable in the context of fee-based incentives and the potential for this form of operational reform to achieve desired outcomes.

Table 4 (part 1 of 2): Hierarchical regression model results*

Variable	Point estimate (95% CI)
Patient level	
Sex	
Female (reference)	
Male	1.42 (1.39–1.45)
Age group, yr	
≤ 17	0.04 (0.03–0.05)
18–44	0.24 (0.23–0.26)
45–74	0.75 (0.73–0.76)
≥ 75 (reference)	
Health authority	
Vancouver Coastal Health (reference)	
Interior Health	1.44 (1.26–1.64)
Fraser Health	1.15 (1.10–1.21)
Vancouver Island Health Authority	1.35 (1.17–1.54)
Northern Health	1.68 (1.36–2.06)
Income quintile	
Q1 (lowest)	1.15 (1.11–1.19)
Q2	1.12 (1.09–1.16)
Q3	1.11 (1.07–1.15)
Q4	1.05 (1.02–1.09)
Q5 (highest) (reference)	
No. of eligible incentives (at start of study period)	
1	0.33 (0.33–0.34)
2 (reference)	
3	2.49 (2.38–2.61)
4	5.87 (5.00–6.89)
Date of diagnosis of first eligible condition(s)	
2010 (reference)	
1–4 yr prior (2006–2009)	1.22 (1.18–1.27)
≥ 5 yr prior (2005 or earlier)	2.01 (1.94–2.08)
Non-fee-for-service encounter	
Yes	0.89 (0.86–0.91)
No (reference)	
No. of primary care physician contacts	
1–6 (reference)	
7–12	8.92 (7.39–10.77)
13–24	48.96 (40.86–58.68)
25–48	107.42 (89.59–128.79)
> 48	134.77 (112.27–161.78)
No. of primary care physicians seen	
1–2 (reference)	
3–4	0.95 (0.91–0.98)
≥ 5	0.82 (0.78–0.85)
Usual provider continuity index (continuity of care)	1.31 (1.30–1.32)

Table 4 (part 2 of 2): Hierarchical regression model results*

Variable	Point estimate (95% CI)
Physician level	
Sex	
Female (reference)	
Male	0.86 (0.77–0.95)
Age group, yr	
< 35	1.44 (1.11–1.88)
35–44	1.34 (1.17–1.54)
45–54 (reference)	
55–64	0.83 (0.74–0.94)
≥ 65	0.70 (0.60–0.81)
Health authority	
Vancouver Coastal Health (reference)	
Interior Health	1.02 (0.85–1.23)
Fraser Health	1.11 (0.97–1.26)
Vancouver Island Health Authority	1.14 (0.94–1.37)
Northern Health	1.32 (0.99–1.77)
Total billings	1.00 (1.00–1.00)
No. of patients	1.03 (1.02–1.03)
% of eligible patients for whom incentives billed	
Q1 (reference)	
Q2	3.14 (2.60–3.80)
Q3	14.25 (11.76–17.26)
Q4	42.38 (34.55–52.00)

Note: CI = confidence interval.
*All variables were included in a single model.

Conclusion

The strongest predictors of having an incentive billed on a patient’s behalf were the number of primary care physician contacts a patient had and the percentage of eligible patients for whom the primary care physician billed incentives. These findings are consistent with the notion that physicians are identifying and billing for eligible patients based on whom they see most often. Further research should identify the extent to which population health management is used by clinicians in Canada. The lack of billing of incentives may be a symptom of broader issues in primary care. It should be a priority to find out whether that is the case.

References

1. Crooks VA, Agarwal G, Harrison A. Chronically ill Canadians’ experiences of being unattached to a family doctor: a qualitative study of marginalized patients in British Columbia. *BMC Fam Pract* 2012;13:69.
2. Hay C, Pacey M, Bains N, et al. Understanding the unattached population in Ontario: evidence from the Primary Care Access Survey (PCAS). *Healthc Policy* 2010;6:33–47.
3. Chan BTB. The declining comprehensiveness of primary care. *CMAJ* 2002; 166:429–34.

4. Lavergne MR, Peterson S, McKendry R, et al. Full-service family practice in British Columbia: policy interventions and trends in practice, 1991–2010. *Healthbc Policy* 2014;9:32–47.
5. Tregillus V, Cavers W. General Practice Services Committee: improving primary care for BC physicians and patients. *Healthbc Q* 2011;14:1–6.
6. Longitudinal Care Incentive Program. Vancouver: General Practice Services Committee; 2015. Available: www.gpscbc.ca/what-we-do/longitudinal-care/incentive-program (accessed 2017 Dec. 11).
7. Lavergne MR, Law MR, Peterson S, et al. A population-based analysis of incentive payments to primary care physicians for the care of patients with complex disease. *CMAJ* 2016;188:E375–83.
8. McGrail K, Lavergne R, Lewis SJ, et al. The relationship between financial incentives and quality of diabetes care in Ontario, Canada. *Diabetes Care* 2012;35:1038–46.
9. Lavergne MR, Law MR, Peterson S, et al. Effect of incentive payments on chronic disease management and health services use in British Columbia, Canada: interrupted time series analysis. *Health Policy* 2018;122:157–64.
10. Kiran T, Victor JC, Kopp A, et al. The relationship between financial incentives and quality of diabetes care in Ontario, Canada. *Diabetes Care* 2012;35:1038–46.
11. Serumaga B, Ross-Degnan D, Avery AJ, et al. Effect of pay for performance on the management and outcomes of hypertension in the United Kingdom: interrupted time series study. *BMJ* 2011;342:d108.
12. Campbell S, Reeves D, Kontopantelis E, et al. Quality of primary care in England with the introduction of pay for performance. *N Engl J Med* 2007;357:181–90.
13. Shadish WR, Cook TD, Campbell DT. *Experimental and quasi-experimental designs for generalized causal inference*. Belmont (CA): Wadsworth Publishing; 2001:656. Available: <http://www.amazon.com/Experimental-Quasi-Experimental-Designs-Generalized-Inference/dp/0395615569> (accessed 2011 Apr. 15).
14. Medical Services Commission payment schedule. Victoria (BC): British Columbia Ministry of Health; 2016. Available: <https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/msc-payment-schedule-december-2016.pdf> (accessed 2017 Dec. 11).
15. British Columbia Ministry of Health. Medical Services Plan (MSP) payment information file. Victoria (BC): Population Data BC; 2011.
16. British Columbia Ministry of Health. Consolidation file (MSP registration & premium billing). Victoria (BC): Population Data BC; 2011.
17. College of Physicians and Surgeons of British Columbia. Medical Services Plan physician database. Victoria (BC): Population Data BC; 2011.
18. British Columbia Ministry of Health. Data Stewardship Committee Pharma-Net. Data extract. Victoria (BC): British Columbia Ministry of Health; 2011.
19. Stukel TA, Glazier RH, Schultz SE, et al. Multispecialty physician networks in Ontario. *Open Med* 2013;7:e40–55.
20. Lix L, Yogendran M, Burchill C, et al. Defining and validating chronic diseases: an administrative data approach. Winnipeg: Manitoba Centre for Health Policy; 2006. Available: <http://mchp-appserv.cpe.umanitoba.ca/reference/chronic.disease.pdf> (accessed 2018 Feb. 7).
21. Chronic Disease Information Working Group. BC chronic disease and selected procedure case definitions. Victoria (BC): British Columbia Ministry of Health; 2015. Available: <https://www2.gov.bc.ca/assets/gov/health/conducting-health-research/data-access/chronic-disease-registries-case-definitions.pdf> (accessed 2018 Feb. 7).
22. Wilkins R, Peters PA. PCCF+ Version 5K* User's Guide. Automated geographic coding based on the Statistics Canada Postal Code Conversion Files including Postal Codes through May 2011. Ottawa: Statistics Canada; 2012. Cat no 82F0086-XDB.
23. Breslau N, Reeb KG. Continuity of care in a university-based practice. *J Med Educ* 1975;50:965–9.
24. Merlo J, Chaix B, Ohlsson H, et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. *J Epidemiol Community Health* 2006;60:290–7.
25. Nundy S, Oswald J. Relationship-centered care: a new paradigm for population health management. *Healthbc (Amst)* 2014;2:216–9.
26. Schmittiel JA, Gopalan A, Lin MW, et al. Population health management for diabetes: health care system-level approaches for improving quality and addressing disparities. *Curr Diab Rep* 2017;17:31.
27. Bodenheimer T, Ghorob A, Willard-Grace R, et al. The 10 building blocks of high-performing primary care. *Ann Fam Med* 2014;12:166–71.
28. Crossley TF, Hurley J, Jeon SH. Physician labour supply in Canada: a cohort analysis. *Health Econ* 2009;18:437–56.
29. Hedden L, Barer ML, Cardiff K, et al. The implications of the feminization of the primary care physician workforce on service supply: a systematic review. *Hum Resour Health* 2014;12:32.
30. Watson DE, Slade S, Buske L, et al. Intergenerational differences in workloads among primary care physicians: a ten-year, population-based study. *Health Aff (Millwood)* 2006;25:1620–8.

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