The Relationship Between Financial Incentives and Quality of Diabetes Care in Ontario, Canada

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OBJECTIVE—We assessed the impact of a diabetes incentive code introduced for primary care physicians in Ontario, Canada, in 2002 on quality of diabetes care at the population and patient level.

RESEARCH DESIGN AND METHODS—We analyzed administrative data for 757,928 Ontarians with diabetes to examine the use of the code and receipt of three evidence-based monitoring tests from 2006 to 2008. We assessed testing rates over time and before and after billing of the incentive code.

RESULTS—One-quarter of Ontarians with diabetes had an incentive code billed by their physician. The proportion receiving the optimal number of all three monitoring tests (HbA_{1c}, cholesterol, and eye tests) rose gradually from 16% in 2000 to 27% in 2008. Individuals who were younger, lived in rural areas, were not enrolled in a primary care model, or had a mental illness were less likely to receive all three recommended tests. Patients with higher numbers of incentive code billings in 2006–2008 were more likely to receive recommended testing but also were more likely to have received the highest level of recommended testing prior to introduction of the incentive code. Following the same patients over time, improvement in recommended testing was no greater after billing of the first incentive code than before.

CONCLUSIONS—The diabetes incentive code led to minimal improvement in quality of diabetes care at the population and patient level. Our findings suggest that physicians who provide the highest quality care prior to incentives may be those most likely to claim incentive payments.

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Diabetes accounts for an increasing proportion of the global burden of disease and currently is the fifth or sixth most common cause of death in most developed countries (1). It is well established that appropriate monitoring and treatment can significantly reduce the incidence of diabetes complications and improve overall morbidity and mortality (2–6). However, numerous studies, both globally and in Canada, have shown that the quality of diabetes care, measured by adherence to recommended processes or attainment of treatment goals, consistently falls short of evidence-based guidelines (7).

Over the last decade, many countries have implemented pay-for-performance programs in an effort to improve the quality of health care, but there still is limited evidence to support the effectiveness of this approach (8,9). In 2002, the government in Ontario, Canada, introduced a new fee code for primary care physicians to encourage regular, comprehensive management of diabetic patients (10). When introduced, this code could be billed a maximum of three times a year per patient at a value of $37.00 (Canadian) per visit and required maintenance of a diabetes flow sheet that tracked cholesterol, hemoglobin A_{1c} (HbA_{1c}), retinal eye examination, blood pressure, weight, and other parameters relevant to diabetes management (11). It is unclear, however, whether the new incentive code has had any impact on the quality of care provided.

In this study, we aimed to investigate the quality of diabetes care, measured by receipt of three evidence-based monitoring tests, and to assess the impact of the new diabetes incentive code in Ontario on quality of care at the population and patient level. We also sought to identify patient and physician characteristics associated with higher quality care.

RESEARCH DESIGN AND METHODS

RESEARCH DESIGN AND METHODS—We used available administrative claims data to examine the use of the diabetes incentive code and assess receipt of evidence-based monitoring tests among individuals with diabetes in Ontario. Data were accessed through a comprehensive research agreement with the Ontario Ministry of Health and Long-Term Care. Prior to data analysis, all patient and provider identifiers were removed and replaced with unique encrypted numbers. This study was approved by the research ethics board of Sunnybrook Health Sciences Centre in Toronto, Ontario.

Outcome measures

Diabetes incentive code. We assessed use of the Diabetes Management Assessment fee code using physician service claims to the Ontario Health Insurance Plan (OHIP). OHIP coverage is extended to all permanent residents of Ontario. When the code was introduced in 2002, it could be billed a maximum of three times a year per patient at a value of $37.00 (Canadian) per visit and required maintenance of

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a diabetes flow sheet that tracked key parameters such as cholesterol, eye exams, and HbA_{1c}.

Quality of diabetes care. We assessed the receipt of three evidence-based monitoring tests for diabetes care using data from OHIP service codes: frequency of retinal eye examination (using optometry and ophthalmology claims to OHIP), frequency of HbA_{1c} measurement, and frequency of cholesterol measurement. We defined the optimal screening frequency during the 2-year study period as follows based on recommendations from the Canadian Diabetes Association 2003 Clinical Practice Guidelines (12): one retinal eye exam, four HbA_{1c} tests, and two cholesterol tests.

Study design and population

Patient and physician characteristics associated with quality of diabetes care. We conducted a cross-sectional analysis, from 1 April 2006 to 31 March 2008, to assess patient and physician characteristics associated with use of the diabetes incentive code and quality of diabetes care. We identified Ontarians aged ≥40 years using the Ontario Diabetes Database, a registry of Ontario patients diagnosed with diabetes generated using a validated administrative data algorithm (13). Patients were included if they were diagnosed with diabetes on or prior to 31 August 2006. Patients were excluded if they resided in a long-term care facility, registered with the OHIP after 31 March 2006, or died before 31 March 2008. We included primary care physicians in active practice in August 2008.

Impact of the diabetes incentive code at the population level. We examined trends in quality of diabetes care over time in Ontario. We stratified people with diabetes based on the number of diabetes incentive codes they received between 2006 and 2008. These cohorts of patients were then followed from 1998 to 2008 to examine differences in receipt of evidence-based testing over time. Our primary analysis included all people diagnosed with diabetes on or prior to 31 August 2006. We assessed testing for each 2-year period from 1998 to 2008 and included individuals in the denominator only if they had been diagnosed with diabetes at the start of the 2-year period. We also conducted a secondary analysis that included only those who had diabetes on or before 1 September 1998.

Impact of the diabetes incentive code at the patient level. We created a cohort of people with diabetes who had at least one diabetes incentive code billed between 1 January 2002 and 31 August 2006, who had diabetes for at least 6 years prior to billing of the first code, and who were alive 2 years after billing of the first code. We stratified this cohort into two groups: those with one to two incentive codes billed and those with three or more codes billed from 2002 to 2006. For this cohort, we assessed the quality of diabetes care in the 2-year period after billing of the first diabetes incentive code, the 2-year period immediately before, the period 2–4 years before, and the period 4–6 years before. We compared the quality of care in each 2-year time period to the quality of care in the 2 years immediately prior.

Patient and physician characteristics

Patient age, sex, and place of residence were obtained from the Registered Persons Database, the registry for all people covered by OHIP. Coverage is extended to all permanent residents of Ontario. We derived neighborhood income quintiles by linking 2006 census data to the patients' residential postal code. Rurality was assessed using the Rurality Index of Ontario (14). We used OHIP registration after 31 August 1998 as a proxy for recent immigration. The prevalence of mental health problems was assessed using a validated algorithm based on ambulatory physician visits (15). Mental health was included as a variable because of the relatively high rates of diabetes and related complications in this population and known barriers to care (16). Patient comorbidity was determined using Aggregated Diagnosis Groups (ADGs) from the Johns Hopkins Adjusted Clinical Groups (ACG) Case-Mix System (17) (scores included diabetes as a comorbidity). Physician billing claims to OHIP linked with the hospital Discharge Abstract Database from the Canadian Institute for Health Information were used to identify patient diagnoses.

We used the Corporate Provider Database, current to 31 August 2008, to identify demographic data on practicing physicians in Ontario and the Institute for Clinical Evaluative Sciences Physician Database, current to the 2007 fiscal year, for country of graduation. Client Agency Program Enrollment tables as of 31 August 2008 were used to identify patients formally enrolled to a primary care physician practicing in a patient enrollment model. These models consisted of enhanced fee for service, nonteam capitation, and team-based capitation. A virtual roster method was used to assign people with diabetes who were not enrolled in a model to a primary care physician based on the maximum value of 18 common primary care fee codes.

Statistical analysis

We used multivariable generalized estimating equation (GEE) models to examine the association between patient and physician characteristics and the number of incentive codes billed as well as whether patients received recommended testing using Poisson and logistic regression, respectively. GEE models are similar to typical regression models in their interpretation; however, they adjust for the correlation in outcomes that are observed between patients who see the same physician and of physicians in the same enrollment group (18). Independent variables for these models at the patient level included age, sex, neighborhood income quintile, recent registrant status, rural residence, mental illness, comorbidity, duration of diabetes, region, and enrollment model. We ran these models with and without two variables (whether the patient was seen by an endocrinologist or general internist and the number of primary care physician visits) so that the independent effects of these two variables could be examined. At the physician level, the models included primary care physician age, sex, years since graduation, and Canadian graduate status. We excluded patients from regression models if we could not assign them to a primary care physician (n = 22,954 [3.0%]).

We also used GEE models when analyzing data for the smaller cohort of Ontarians with diabetes who had at least one incentive code billed. We used GEE models to compare the likelihood of a patient receiving recommended testing in a given 2-year period compared with the 2-year period immediately prior (e.g., comparing the 2-year period after the billing of the first incentive code with the 2-year period before billing of the code).

RESULTS—We analyzed data for 757,928 people with diabetes representing ~12% of Ontario's population aged ≥40 years. When compared with the general population, people with diabetes were more likely to be older, male, low income, and long-term residents of Ontario. They also were more likely to reside in an urban area, have a psychotic mental illness, have more visits to primary care

physicians, and be enrolled to a primary care physician. Approximately 42% saw an endocrinologist or general internist during the 2-year study period. Physicians looking after diabetic patients were more likely to be an international medical graduate, older, male, and in practice for >30 years.

Use of the diabetes incentive code

Only 25% of people with diabetes had a diabetes incentive code billed during the 2-year study period, with only 8% receiving at least four of the maximum six codes permitted during the timeframe. After controlling for patient- and physician-level characteristics, individuals enrolled to primary care physicians practicing in a team or nonteam capitation model were 25% more likely to receive an incentive code than patients enrolled to an enhanced fee-for-service model (Table 1).

Quality of diabetes care

Overall, 67% of people with diabetes received a retinal eye exam during the 2-year study period. Seventy-eight percent received at least one HbA_{1c} test and 37% received the optimal number of HbA_{1c} tests (four tests). For cholesterol testing, 80% received at least one test and 59% received the optimal number of cholesterol tests (two tests). Only 27% of individuals received the optimal number of all three monitoring tests.

After adjusting for patient and physician characteristics, people with diabetes aged 65–79 years were more likely to receive optimal testing than their younger counterparts (Table 2). The greatest difference was in retinal eye exams where those aged 65–79 years were just over two and a half times more likely to receive the test than those aged 40–64 years. People with diabetes who did not live in a rural area, those without a mental illness, and those seeing a diabetes specialist over the 2-year period were more likely to receive each of the three monitoring tests. Individuals enrolled to a team or nonteam capitation model were slightly more likely to receive optimal monitoring than those enrolled to the enhanced fee-for-service model, whereas those not enrolled to any model were less likely to receive any of the three monitoring tests.

When we adjusted for patient and physician characteristics, we found that patients who received one to two diabetes incentive code billings were more likely to receive the optimal number of all three monitoring tests (odds ratio 2.23 [95% CI 2.15–2.31]); those who received three or more code billings were even more likely to receive optimal monitoring (5.79 [5.49–6.11]).

Table 1—*Patient- and physician-level characteristics associated with receipt of the diabetes incentive code*

Patient characteristics	Relative risk (95% CI)*	*P*
Patient age (years)		
40–64	1.00	Reference
65–79	1.17 (1.16–1.18)	<0.001
≥80	0.93 (0.92–0.95)	<0.001
Male	1.08 (1.07–1.08)	<0.001
Income quintile		
Missing	1.04 (0.96–1.12)	0.363
1 (lowest)	1.08 (1.07–1.10)	<0.001
2	1.09 (1.07–1.10)	<0.001
3	1.06 (1.05–1.08)	<0.001
4	1.05 (1.03–1.06)	<0.001
5 (highest)	1.00	Reference
New immigrant	1.04 (1.02–1.06)	<0.001
Rurality index		
Missing	0.99 (0.95–1.03)	0.739
0–9 (major urban)	0.97 (0.96–0.99)	0.009
10–44 (nonmajor urban)	1.00 (0.98–1.01)	0.600
≥45 (rural)	1.00	Reference
Mental health status		
Psychotic	0.86 (0.83–0.89)	<0.001
Nonpsychotic	0.89 (0.88–0.90)	<0.001
None	1.00	Reference
No. of ADGs†		
0–5	1.00	Reference
6–9	0.96 (0.95–0.97)	<0.001
≥10	0.79 (0.77–0.81)	<0.001
Duration of diabetes (years)		
0–3	0.80 (0.78–0.81)	<0.001
4–9	0.90 (0.88–0.91)	<0.001
10–14	0.95 (0.93–0.96)	<0.001
≥15	1.00	Reference
Seen an endocrinologist or general internist	0.98 (0.97–0.99)	0.001
No. of family physician/general practitioner visits	1.01 (1.01–1.02)	<0.001
Primary care model		
Enhanced fee for service	1.00	Reference
Nonteam capitation	1.26 (1.19–1.33)	<0.001
Team-based capitation	1.24 (1.17–1.31)	<0.001
Virtually rostered to enrollment model physician	0.72 (0.70–0.74)	<0.001
Virtually rostered to physician outside of an enrollment model	0.51 (0.47–0.54)	<0.001
Physician characteristics		
Male	1.10 (1.00–1.20)	0.048
Age (continuous)	0.98 (0.96–0.99)	0.000
Years since graduation	1.01 (1.00–1.02)	0.093
Canadian medical graduate	1.55 (1.38–1.74)	<0.001

Patients to whom a primary care physician could not be attributed (n = 22,954) were excluded from this analysis. *Represents the covariate-adjusted relative increase in probability of having an additional diabetes incentive code for individuals with the corresponding patient characteristics. †Johns Hopkins ACG Case-Mix System (higher numbers indicate higher comorbidity).

Impact of the diabetes incentive code at the population level

From 2000 to 2008, the proportion of people with diabetes receiving optimal

Table 2—*Multivariable regression analysis of the association between patient- and physician-level characteristics and receipt of recommended testing for diabetes*

	Retinal eye examinations (one exam over 2 years)		HbA_{1c} testing (four tests over 2 years)		Cholesterol testing (two tests over 2 years)		All three recommended tests (one retinal eye exam, four HbA_{1c}, and two cholesterol tests over 2 years)	
	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*
Age-group (years)								
40–64	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
65–79	2.63 (2.59–2.68)	<0.0001	1.43 (1.41–1.45)	<0.0001	1.38 (1.36–1.39)	<0.001	1.54 (1.52–1.57)	<0.0001
≥80	1.91 (1.87–1.96)	<0.0001	1.17 (1.14–1.20)	<0.0001	0.72 (0.70–0.73)	<0.001	0.95 (0.93–0.98)	<0.001
Male	0.96 (0.95–0.97)	<0.0001	1.08 (1.06–1.09)	<0.0001	1.14 (1.13–1.15)	<0.001	1.04 (1.02–1.05)	<0.0001
Income quintile								
Missing	0.88 (0.77–1.01)	0.076	0.94 (0.83–1.07)	0.370	0.88 (0.80–0.97)	0.013	0.84 (0.74–0.96)	0.010
1 (lowest)	0.91 (0.90–0.93)	<0.0001	1.01 (0.98–1.04)	0.483	0.91 (0.89–0.92)	<0.001	0.94 (0.92–0.97)	<0.0001
2	0.97 (0.95–0.98)	0.001	1.05 (1.03–1.08)	<0.0001	0.97 (0.95–0.98)	<0.001	1.01 (0.98–1.03)	0.465
3	0.98 (0.96–1.00)	0.021	1.04 (1.02–1.07)	<0.001	0.98 (0.96–0.99)	0.009	1.01 (0.98–1.03)	0.570
4	0.99 (0.97–1.01)	0.412	1.04 (1.02–1.07)	<0.0001	1.01 (1.00–1.03)	0.135	1.03 (1.00–1.05)	0.024
5 (highest)	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
New immigrant	0.98 (0.95–1.01)	0.262	1.08 (1.04–1.13)	<0.0001	1.03 (1.00–1.06)	0.027	1.05 (1.01–1.09)	0.018
Rurality index								
Missing	0.99 (0.93–1.05)	0.786	0.92 (0.83–1.02)	0.102	1.02 (0.97–1.07)	0.419	0.95 (0.86–1.05)	0.324
0–9	0.91 (0.89–0.94)	<0.0001	1.40 (1.31–1.50)	<0.0001	1.87 (1.83–1.90)	<0.001	1.40 (1.31–1.50)	<0.0001
10–44	0.99 (0.96–1.02)	0.404	1.38 (1.30–1.47)	<0.0001	1.53 (1.50–1.56)	<0.001	1.34 (1.27–1.43)	<0.0001
≥45	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
Mental health status								
Psychotic	0.66 (0.64–0.69)	<0.0001	0.83 (0.79–0.86)	<0.0001	0.64 (0.62–0.66)	<0.001	0.68 (0.65–0.71)	<0.0001
Nonpsychotic	0.80 (0.79–0.81)	<0.0001	0.82 (0.80–0.83)	<0.0001	0.83 (0.82–0.84)	<0.001	0.80 (0.78–0.82)	<0.0001
None	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
No of ADGs*								
0–5	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
6–9	1.49 (1.47–1.51)	<0.0001	1.00 (0.98–1.01)	0.602	1.12 (1.11–1.13)	<0.001	1.12 (1.10–1.14)	<0.0001
≥10	1.87 (1.83–1.92)	<0.0001	0.76 (0.74–0.78)	<0.0001	0.78 (0.76–0.79)	<0.001	0.92 (0.90–0.94)	<0.0001
Duration of diabetes (years)								
0–3	0.49 (0.48–0.51)	<0.0001	0.55 (0.53–0.56)	<0.0001	1.07 (1.04–1.09)	<0.001	0.54 (0.53–0.56)	<0.0001
4–9	0.64 (0.62–0.66)	<0.0001	0.63 (0.61–0.64)	<0.0001	1.00 (0.97–1.02)	0.845	0.66 (0.65–0.68)	<0.0001
10–14	0.78 (0.75–0.80)	<0.0001	0.75 (0.73–0.77)	<0.0001	1.00 (0.97–1.02)	0.875	0.80 (0.78–0.82)	<0.0001
≥15	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
Seen an endocrinologist or internist	1.42 (1.40–1.45)	<0.0001	1.55 (1.51–1.58)	<0.0001	1.39 (1.38–1.41)	<0.001	1.58 (1.54–1.61)	<0.0001
No. of family physician/general practitioner visits	1.03 (1.03–1.03)	<0.0001	1.06 (1.06–1.06)	<0.0001	1.07 (1.07–1.07)	<0.001	1.05 (1.05–1.05)	<0.0001
Physician-level characteristics								
Primary care model								
Enhanced fee for service	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference

Table 2—*Continued*

	Retinal eye examinations (one exam over 2 years)		HbA_{1c} testing (four tests over 2 years)		Cholesterol testing (two tests over 2 years)		All three recommended tests (one retinal eye exam, four HbA_{1c}, and two cholesterol tests over 2 years)	
	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*	Odds ratio (95% CI)	*P*
Nonteam capitation	1.14 (1.10–1.19)	<0.0001	1.21 (1.12–1.32)	<0.0001	1.10 (1.08–1.12)	<0.001	1.18 (1.09–1.27)	<0.0001
Team-based capitation	1.24 (1.20–1.28)	<0.0001	1.15 (1.08–1.23)	<0.0001	1.02 (1.00–1.04)	0.041	1.20 (1.13–1.28)	<0.0001
Virtually rostered to enrollment model physician	0.83 (0.81–0.86)	<0.0001	0.78 (0.74–0.83)	<0.0001	0.81 (0.80–0.82)	<0.001	0.78 (0.74–0.83)	<0.0001
Virtually rostered to physician outside of an enrollment model	0.71 (0.69–0.73)	<0.0001	0.65 (0.62–0.68)	<0.0001	0.61 (0.60–0.62)	<0.001	0.60 (0.57–0.62)	<0.0001
Sex (male vs. female)	0.89 (0.85–0.93)	<0.0001	0.88 (0.84–0.92)	<0.0001	0.83 (0.82–0.84)	<0.001	0.82 (0.79–0.86)	<0.0001
Age (continuous)	0.99 (0.99–1.00)	0.003	0.98 (0.97–0.99)	<0.0001	0.99 (0.99–0.99)	<0.001	0.98 (0.97–0.99)	<0.0001
Years since graduation (continuous)	1.00 (1.00–1.01)	0.010	1.02 (1.01–1.02)	<0.001	1.00 (1.00–1.00)	0.374	1.01 (1.00–1.02)	0.002
Canadian medical graduate	1.08 (1.03–1.12)	<0.001	1.22 (1.16–1.29)	<0.0001	0.98 (0.95–1.01)	0.147	1.18 (1.12–1.24)	<0.0001

Patients to whom a primary care physician could not be attributed (n = 22,954) were excluded from this analysis. *Johns Hopkins ACG Case-Mix System (higher numbers indicate higher comorbidity).

monitoring rose gradually from 16 to 27% (Fig. 1). Those who had diabetes incentive codes billed between 2006 and 2008 were historically more likely to receive recommended tests relative to those who had fewer or no incentive codes billed. For example, those who had one diabetes incentive code billed between 2006 and 2008 were more likely to receive recommended testing than those with no incentive codes billed but less likely to receive recommended testing than those with two incentive codes billed, and this relationship held true going back to 2000, prior to introduction of the incentive code. Recommended testing was increasing in the time period prior to implementation of the incentive code at a rate similar to the increase afterward. These relationships also were true when the analysis was limited to those who had diabetes diagnosed on or before 1 September 1998 (results not shown). The pattern for eye exams showed a decrease in all groups starting in 2005, remaining at a low level after that (results not shown). HbA_{1c} and cholesterol testing followed a pattern similar to that for all three tests combined (results not shown).

Impact of the diabetes incentive code at the patient level

We analyzed data for a cohort of 58,927 individuals who had at least one diabetes incentive code billed between 2002 and 2006, had diabetes for at least 6 years prior to the billing of the first code, and were alive 2 years after billing of the first code. In that cohort, 38,127 individuals had one to two codes billed and 20,800 had three or more codes billed. Demographics and comorbidities were similar in both groups. Figure 2 shows that overall there was improvement in the proportion of patients receiving recommended testing in the 2-year period after the first incentive code was billed compared with the previous 2 years (relative risk 1.22 [95% CI 1.21–1.23]) but that this improvement was not larger than in the time periods before the code was billed (1.31 [1.30–1.32] for the 2-year period before the code was billed compared with the 2-year period prior; 1.33 [1.33–1.34] for 2–4 years before the code was billed compared with the 2-year period prior). This observation was true both for individuals who received one to two codes and those who received three or more codes.

CONCLUSIONS—Our findings demonstrate limited impact of a diabetes incentive code introduced to all primary care

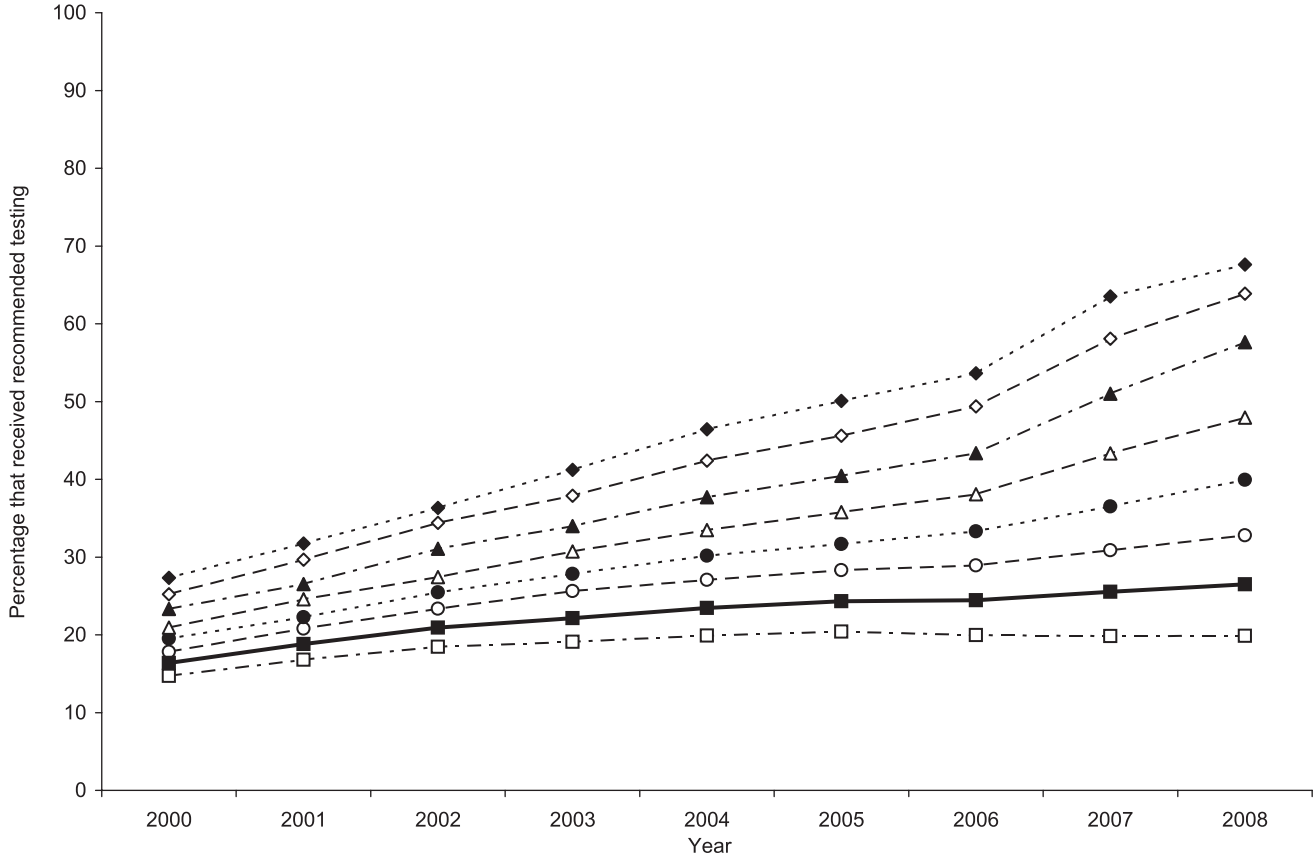

Figure 1—*Population-level analysis. Proportion of Ontarians with diabetes receiving recommended testing from 1998 to 2008 stratified by number of diabetes incentive codes billed from 2006 to 2008* (n = *757,928). Recommended testing was defined as receipt of one retinal eye examination, four HbA_{1c} tests, and two cholesterol tests in the previous 2 years. Therefore, data for 2000 represents testing done from 1998 to 2000.* ◆ *and dotted line, six or more incentive codes billed from 2006 to 2008* (n = *17,223);* ◇ *and dashed line, five incentive codes* (n = *19,064);* ▲ *and dash-dot line, four incentive codes* (n = *24,285);* △ *long dash line, three incentive codes* (n = *30,312);* ● *and dotted line, two incentive codes* (n = *39,518);* ○ *and dashed line, one incentive code* (n = *63,071);* ■ *and solid line, overall* (n = *757,928);* □ *and dash-dot line, no incentive codes* (n = *564,455*).

physicians in Ontario in 2002. Only one-quarter of people with diabetes in Ontario had an incentive code billed between 2006 and 2008. At the population level, the percentage of Ontarians with diabetes receiving three evidence-based monitoring tests at the recommended intervals (retinal eye examination, HbA_{1c} measurement, and cholesterol measurement) rose gradually, reaching just over one-quarter of the population by 2008. The amount of improvement was similar in the preincentive and postincentive time periods. At the patient level, the amount of improvement in recommended testing was no greater after billing of the first incentive code than it was before.

Our findings suggest that physicians who provide the best care prior to incentives may be those most likely to claim incentive payments. In a cross-sectional analysis, billing of the incentive code and the number of times it was billed was associated with greater receipt of monitoring tests for diabetes. However, those with the greatest number of codes billed and highest quality of care between 2006 and 2008 also had the highest quality of care prior to when the codes were introduced. Others also have found that financial incentives may largely reward those with higher performance at baseline (19).

Low uptake of the diabetes incentive code in Ontario is likely attributed to several factors, including its relatively low financial value, lack of physician awareness about the code, the introduction of competing incentive codes during the same time period, and the added administrative burden of completing a diabetes flow sheet, particularly for paper-based practices. We found that primary care practices reimbursed via blended capitation were more likely to use the diabetes incentive code than fee-for-service practices. A possible reason is that the diabetes code is one of the few codes paid in full in capitation models versus other codes that are paid at 10% of their value, making the incremental value of the code much greater in capitation than in fee for service ($33.77 Canadian vs. $4.65 Canadian). Research from Australia suggests that administrative paperwork is a major barrier to uptake of diabetes incentives by general practitioners, whereas having a practice nurse and practice computerization facilitates uptake (20).

Only 27% of people with diabetes in Ontario received recommended monitoring. This proportion is far below the target of 80% announced by the Ontario Diabetes Strategy in November 2009. The poor attainment of diabetes process measures in our study is consistent with findings from other published literature examining the Canadian population (21–23). Of note, we found a large drop in eye exams in 2005, just shortly after routine eye examinations for those aged 20–64 years were delisted from Ontario's public insurance plan even though exams for people with diabetes were not delisted. This effect persisted over time. Further investigation of this issue is required to understand the degree

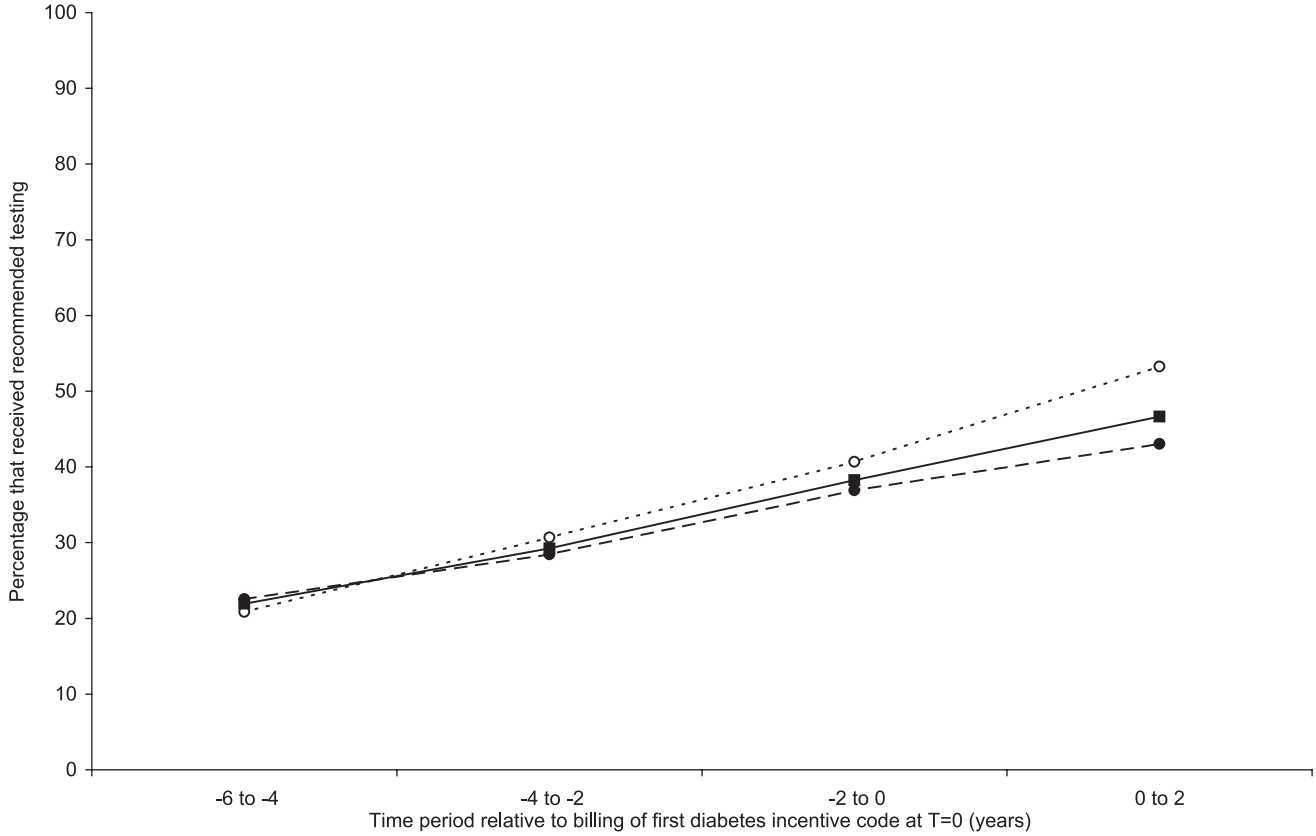

Figure 2—*Patient-level analysis. Proportion of people with diabetes receiving recommended testing before and after billing of the first diabetes incentive code* (n = *33,926*). ■ *and solid line, overall;* ○ *and dotted line, patients receiving three or more incentive codes from 2002 to 2006;* ● *and dashed line, patients receiving one or two incentive codes from 2002 to 2006.*

to which eye exams are being foregone versus taking place but being paid through private insurance or out of pocket.

Some disparities were found in diabetes care, with those who were younger, living in rural areas, or having mental health disorders less likely to receive each of the three recommended tests, even after controlling for other factors. Patients in the lowest income quintile were less likely to receive eye examinations and cholesterol testing, but we found no disparities in care for new immigrants. As in our study, others also have found that patients with mental illness are less likely to receive recommended diabetes care (24–26). Similar to us, Brown et al. (27) found lower rates of dilated eye exams among patients of lower socioeconomic position in the U.S., whereas Khunti et al. (28) found lower compliance with most process measures for practices serving more socioeconomically deprived populations in England. Dallo et al. (29) did not find differences in self-reported receipt of eye examinations, HbA_{1c} testing, or cholesterol testing between foreign-born and U.S.-born individuals with diabetes after controlling for confounders such as age, sex, and socioeconomic status.

Pay-for-performance schemes have become a popular method for improving the quality of care, but their effectiveness still is unclear (8,9,30). The best evidence in primary care comes from the U.K. where the government introduced a comprehensive financial incentive scheme for general practitioners in 2004 that in 2006 included 16 quality indicators specific to diabetes care that assessed both processes and outcomes of care (31). Studies suggest that the introduction of the incentive scheme accelerated the rate of improvement in diabetes care but that the rate has since slowed (32) and that the scheme has reduced the quality gap in primary health care between practices serving patients with low versus high socioeconomic status (33). The financial incentives in the U.K. differ from those in Ontario markedly in that they constitute a significant portion of general practitioner income (estimated at 25%), virtually all general practitioners participate, and by the third year, general practitioners on average achieved >95% of the clinical targets including >95% of the diabetes targets (34).There also are important differences in context. For example, in the U.K., almost all general practitioners use electronic medical records that enable creation of disease registries and tracking of performance measures, and most were on a capitation model prior to the scheme's introduction. In contrast, ~30% of Ontario primary care physicians had electronic records in 2009.

Financial incentives for general practitioners introduced in Australia in 2001 are more comparable to those in Ontario. These included an incentive specific to diabetes that pays $40 (AUS) per patient per year for a completed annual cycle of care that includes parameters similar to those in Ontario's diabetes flow sheet (35). Incentive payments for diabetes and other parameters comprise ~10% of general practitioners' income and most general practitioners were paid by fee for service prior to the introduction of the incentives. As in Ontario, there was fairly low uptake of the incentive, with only 42% of eligible general practitioners in one region claiming the incentive in

2007 (20). Similar to Ontario, there is evidence that general practitioners who participated in the incentive scheme were more likely to order an HbA_{1c} test for a diabetic patient (36) and more likely to have a rigorous approach to diabetes management (20). However, it is unknown whether these differences in care preceded introduction of the incentive scheme.

Our study has limitations. First and most important was our dependence on administrative data. Adherence to recommended testing was measured using billing data for Ontario's public insurance system, which may underestimate services actually provided. Specifically, we could not include retinal eye exams paid for privately or laboratory tests done in hospitals. Second, we were only able to measure processes of care for diabetes, which may not translate to outcomes that are important to patients, providers, and payers, such as better blood glucose, cholesterol and blood pressure control, and, ultimately, reduced long-term consequences, such as hospital admissions, cardiovascular disease, and death. Third, our observational study limited our ability to distinguish between association and causation. As a result, reverse causation is a plausible explanation for the associations we found (i.e., physicians who historically provided good care were more likely to use the diabetes incentive code).

In summary, our study found limited impact of a financial incentive code for diabetes 6 years after its introduction in Ontario. At the population level, the proportion of Ontarians with diabetes receiving recommended testing rose gradually after the incentive was introduced but was rising at a similar rate beforehand and remained far below provincial targets. At the patient level, the amount of improvement in recommended testing was no greater after billing of the first incentive code than it was before. Our findings suggest that physicians who already were providing relatively good diabetes care were more likely to bill the incentive code. Ontarians with diabetes who were younger, lived in rural areas, had mental illness, or were not enrolled to a primary care model were less likely to receive recommended testing. Additional research is needed to understand whether and how financial incentives change physician behavior and how incentives influence patient outcomes for diabetes and other chronic diseases. Policy development work and research is also needed to understand and address gaps in diabetes care, particularly for those least likely to receive recommended care.

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T.K. designed the study, conducted the analysis, interpreted the results, and drafted and critically reviewed the manuscript. J.C.V. conducted the analysis, interpreted the results, and critically reviewed the manuscript. A.K. conducted the analysis and critically reviewed the manuscript. B.R.S. conceived and designed the study and critically reviewed the manuscript. R.H.G. conceived and designed the study, conducted the analysis, interpreted the results, and drafted and critically reviewed the manuscript. T.K. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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