Research Letter

Utilization and outcomes of HbA_{1c} testing: a population-based study

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Improved glycemic control through blood glucose monitoring and pharmacotherapy is recommended to reduce the risk of microvascular complications in people with type 1 and type 2 diabetes mellitus.^{1,2} Measurement of glycosylated hemoglobin (HbA_{1c}) has been advocated as a means of determining the adequacy of glycemic control.³ Guidelines developed in at least 13 countries recommend one or more HbA_{1c} tests annually and target levels under 8%.⁴

Using population-based administrative health databases, we examined HbA_{1c} testing frequency and outcomes between September 1, 1999, and September 1, 2000, for all individuals with diabetes aged 20 years or more who lived in eastern Ontario. In 2000, the adult population of eastern Ontario (defined as all areas east of a line connecting Arnprior in the north and Trenton in the south) was 1.09 million; the county-level prevalence of diabetes in 1999 ranged from 4.9 to 6.4 cases per 100 population.^{5,6} Patients who died or moved out of the area during the study year were excluded to ensure an entire year of observation.

People with diabetes mellitus were identified using a validated algorithm that combined diagnostic information from physician service claims and hospital discharge abstracts.⁷ Women with gestational diabetes were excluded. The Canadian Institute for Health Information Discharge Abstract Database was used to count hospital admissions owing to hyperglycemia, which were based on a most-responsible ICD-9 diagnosis (International Classification of Diseases, 9th revision) coded 250.1 through 250.3. The Ontario Health Insurance Plan (OHIP) database was used to count visits to general or family practitioners, specialists (i.e., endocrinologists and internists) and hospital emergency departments by people with a diagnosis of diabetes. The Database of Laboratory Tests in Eastern Ontario was used to determine the numbers and results of all HbA_{1c} tests performed in eastern Ontario laboratories during the study year, with the exception of tests conducted at hospitals in the towns of Cornwall and Hawkesbury (about 1.5% of all tests in eastern Ontario).⁶ Each person in the 3 databases had a unique anonymous identifier that allowed accurate data linkage across the data sets.

We summarized HbA_{1c} testing frequency and outcomes and used logistic regression analysis to investigate the association of frequency and outcomes with age, sex, rural resi-

dence and utilization of the health care system. Because results could be clustered by physician offices or laboratories, which could increase the likelihood of apparent statistical significance, we used a conservative *p* value of 0.001 to determine significance. We categorized test outcomes as ideal or optimal according to the Canadian Diabetes Association guidelines⁸ by comparing each test result with the laboratory's upper limit of normal for the test.

We identified 63 699 people in eastern Ontario with a diagnosis of diabetes. Of these, only 58% had HbA_{1c} tests during the study year (Table 1). Fewer than half of those who had one or more tests had results that were ideal or optimal. Testing was most common among patients 50–74 years old; the youngest adults (aged 20–34 years) were the least likely to have had tests. The likelihood of having had an HbA_{1c} test also increased with the number of physician visits. Younger individuals had poorer test outcomes, as did those who visited specialists more often and underwent more tests.

Our results are similar to those of a smaller 1995 Canadian study of physician charts,⁹ which found that only 53% of patients with type 2 diabetes had HbA_{1c} testing during 1 year and that 87% of those had optimal or acceptable blood glucose levels (although only 57% of the test results would be categorized as ideal or optimal if current guidelines⁸ were used). The association between number of visits to specialists and suboptimal test results may well reflect selective referral patterns to specialists for patients with more refractory hyperglycemia.

Our study had limitations, although we expect their effect on the findings was small. First, the results might not apply to the rest of the province. Second, some patients could have had tests performed by laboratories outside of the study area; because of the large study area and referral patterns within it, however, this would affect only a small minority of patients. Third, validation studies suggest that up to 14% of people with diabetes would not have been captured by our administrative databased algorithm because they use physician services infrequently. Exclusion of these patients would likely contribute to an overestimation of testing rates, since their pattern of physician use also suggests that they are unlikely to have undergone HbA_{1c} testing.⁷ Fourth, most specialist physicians in the Kingston area are not paid on a fee-for-

Table 1: Frequency and outcomes of glycosylated hemoglobin (HbA_{1c}) tests over a period of 1 year among eastern Ontario patients with diabetes

Characteristic	Total no. of patients	Tested		No. of patients tested	Ideal or optimal result	
		%	OR (95% CI)		%	OR (95% CI)
Total	63 699	58.0		36 926	45.4	
Age, yr			$p < 0.001$			$p < 0.001$
20-34*	3 025	40.5	1.00*	1 224	36.3	1.00*
35-49	11 059	53.9	1.79 (1.64-1.95)	5 960	39.7	1.05 (0.93-1.20)
50-64	21 796	61.4	2.34 (2.16-2.54)	13 372	43.9	1.26 (1.11-1.42)
65-74	16 017	62.5	2.40 (2.21-2.62)	10 008	47.8	1.49 (1.31-1.69)
≥ 75	11 802	53.9	1.69 (1.55-1.85)	6 362	51.8	1.71 (1.50-1.95)
Sex			$p < 0.001$			$p = 0.54$
Male*	33 715	58.8	1.00*	19 832	45.2	1.00*
Female	29 984	57.0	0.87 (0.85-0.90)	17 094	45.7	1.01 (0.97-1.06)
Residence			$p = 0.003$			$p < 0.001$
Rural*	16 919	56.3	1.00*	9 530	41.4	1.00*
Urban	46 780	58.6	1.06 (1.02-1.10)	27 396	46.8	1.31 (1.25-1.38)
Hospital admissions for hyperglycemia			$p = 0.11$			$p < 0.001$
≥ 1*	215	63.3	1.00*	136	16.9	1.00*
None	63 484	58.0	0.78 (0.58-1.06)	36 790	45.5	2.27 (1.42-3.62)
Visits to general or family physician			$p < 0.001$			$p = 0.38$
None*	7 636	33.7	1.00*	2 573	44.0	1.00*
1	3 852	41.5	1.36 (1.25-1.48)	1 600	46.2	1.10 (0.97-1.25)
2	3 942	49.6	1.94 (1.79-2.10)	1 954	46.8	1.08 (0.96-1.22)
3	4 475	55.6	2.47 (2.29-2.67)	2 489	46.9	1.08 (0.97-1.21)
4	4 520	60.8	3.09 (2.86-3.34)	2 746	47.7	1.11 (0.99-1.24)
≥ 5	39 274	65.1	3.80 (3.60-4.01)	25 564	45.0	1.04 (0.96-1.13)
Visits to internist or endocrinologist			$p < 0.001$			$p < 0.001$
None*	53 343	54.6	1.00*	29 127	47.9	1.00*
1	3 193	69.7	2.00 (1.85-2.17)	2 225	41.6	0.79 (0.72-0.86)
2	2 501	76.1	2.89 (2.62-3.18)	1 902	38.0	0.69 (0.63-0.76)
3	1 843	78.6	3.46 (3.08-3.88)	1 449	36.0	0.65 (0.58-0.72)
4	1 179	80.2	3.78 (3.25-4.38)	946	30.8	0.53 (0.46-0.61)
≥ 5	1 640	77.9	3.38 (2.99-3.83)	1 277	27.9	0.50 (0.44-0.56)
Diabetes-related visits to ED			$p = 0.34$			$p < 0.001$
None*	62 464	57.8	1.00*	36 101	45.8	1.00*
1	991	65.9	1.09 (0.95-1.25)	653	29.1	0.58 (0.49-0.69)
≥ 2	244	70.5	1.15 (0.86-1.54)	172	18.0	0.37 (0.25-0.56)
HbA _{1c} tests			Not applicable			$p < 0.001$
1*				14 720	51.6	1.00*
2				10 252	45.8	0.81 (0.77-0.85)
3				6 381	40.4	0.65 (0.61-0.69)
4				3 330	35.6	0.52 (0.48-0.57)
≥ 5				2 243	31.8	0.44 (0.40-0.48)

Note: OR = odds ratio, CI = confidence interval, ED = emergency department.

*Reference category.

service basis and are not included in OHIP billing data. Nevertheless, excluding the Kingston area from our analyses made no substantial difference to our findings and did not affect our conclusions. Fifth, it is not possible to determine if a lack of testing is attributable to a physician's failure to order a test or the patient's failure to follow through with recommended testing.

Our finding that the youngest adults were tested least often and had the poorest test outcomes is particularly worrisome. These patients have the longest time to live with diabetes and accordingly the most to gain from interventions directed at secondary prevention. Other studies have also reported lower testing rates among younger people and improved glycemic control with age.¹⁰⁻¹⁴ Further research is required to identify how patient or physician factors, service availability and lack of continuity of primary care contribute to this gap. In the meantime, educational interventions for patients and providers should be considered, as well as policy initiatives to ensure equitable access to care.

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Editor's take

- Improved glycemic control is recommended to reduce the risk of microvascular complications in people with type 1 and type 2 diabetes mellitus. Does the frequency of testing glycemic control (through the measurement of glycosylated hemoglobin levels) affect outcomes?
- In this study, administrative health databases were used to examine the frequency and outcomes of glycosylated hemoglobin testing among eastern Ontario patients aged 20 years or more who have diabetes.
- During the study year, only 58% of the study population had tests. Those aged 34 years or less were the least likely to have been tested, and younger patients had poorer test outcomes than older patients.

Implications for practice: Initiatives are needed to address the gap in glycemic control between younger and older adults.