

Refereed papers

Effectiveness of an HbA1c tracking tool on primary care management of diabetes mellitus: glycaemic control, clinical practice and usability

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ABSTRACT

Objective To determine if a laboratory data report (the HbA1c Tracking Tool) could be used as an effective intervention to improve diabetes management.

Design A longitudinal quasi-experimental cohort design was used to test the effectiveness of an HbA1c summary report sent to primary care physicians for all patients having HbA1c levels greater than 7%.

Setting Moncton, New Brunswick, Canada.

Sample selection Administrative data from all adult patients with diabetes who had had at least two HbA1c measurements within the year prior to the initiation of the HbA1c Tracking Tool, and who had had five years of HbA1c measurements (2002–2007) overall was included.

Interventions In March 2006 all primary care physicians began receiving HbA1c summary reports (through the HbA1c Tracking Tool) as a means to improving the management of diabetes.

Main outcome measures (a) patient glycaemic control as indicated by HbA1c levels, (b) physician adherence to practice guidelines as indicated by

measuring the mean number of HbA1c tests ordered per patient per year, and (c) physician usage rates of the HbA1c Tracking Tool in clinical practice.

Results The sample ($n=955$) was divided into three subgroups based on flagged HbA1c level (7–<8%, 8–9%, >9%). The strongest effect of the intervention was found in the two groups with the poorest glycaemic control. The effect was stronger in the >9% group (from 10.1 to 9.3%), than in the 8–9% group (a drop of 8.5 to 8.3%). Longitudinal analyses over a five-year period indicated the same findings. Patients were also found to receive more tests across time (from 2.45 tests per year to 3.0 across five years). In terms of usage, 92.1% of the physicians surveyed used the tool in their practice.

Conclusion Routinely collected hospital laboratory data can be used both as the basis for an information-based intervention and as a tool to monitor quality of diabetes care.

Keywords: computerised medical records system, diabetes mellitus, glycosylated haemoglobin

Introduction

The prevalence of diabetes in Canada is increasing at an alarming rate and primary care physicians play a key role in the care of patients with diabetes. The Canadian National Physician Survey (2007)¹ found that 88.7% of primary care physicians care for patients with diabetes. According to the Public Health Agency of Canada and the Canadian Diabetes Association, over two and a quarter million Canadians have diabetes, and more than 60 000 new cases are diagnosed each year.² Population-based studies have estimated the true prevalence of diabetes in Canada may be >7%.^{3–5}

Over 40% of Canadians with diabetes are expected to develop long-term complications as a result of diabetes, such as stroke, myocardial infarctions, nephropathy, and peripheral vascular disease.² However, a number of investigations have shown that optimal glycaemic control can reduce the incidence of microvascular complications in both type 1 and type 2 diabetes.^{6–8} Current clinical practice guidelines target haemoglobin HbA1c level >7% for patients with type 1 and 2 diabetes and recommend monitoring HbA1c levels every three months until optimal control is achieved.⁹ Not only does HbA1c measurement serve as an intermediate health outcome in clinical settings, but it can also be used as an evidence-based performance measure to assess the quality of diabetes care.¹⁰

A number of strategies to improve primary care management of diabetes have been developed and such initiatives as clinical resource nurses, diabetes education centres, and office recall systems have been shown to enhance the management of patients with diabetes. A recent Cochrane Review¹¹ showed that organisational interventions that enhanced structured recall and review of patients also improved diabetes management. These findings show that electronic health records can play a vital role in improving healthcare quality. Computer-generated paper reminder systems have also been found to increase rates of cancer screening and adult immunisations.^{12–14}

The purpose of the present study was to determine if a laboratory data report (the HbA1c Tracking Tool) could be used as an effective intervention to improve primary care management of diabetes mellitus patients. Three indicators were used to measure the effectiveness of the intervention: (a) patient glycaemic control as indicated by HbA1c levels, (b) physician adherence to clinical practice guidelines as indicated by measuring the mean number of HbA1c tests ordered per patient per year, and (c) usage rates of the HbA1c Tracking Tool by primary care physicians.

Method

Design

Data for this study were obtained from two sources. First, administrative data were used to access information about patients' HbA1c levels and adherence to practice guidelines. HbA1c levels for all patients with diabetes are measured by the medical laboratory services at the Moncton Hospital using the High Performance Liquid Chromatography technique and results are stored within the South-east Regional Health Authority of New Brunswick (SERHA) Laboratory Information System. In March 2006, all primary care physicians began receiving HbA1c summary reports for 1997 to the present for all patients having HbA1c levels greater than 7%. These HbA1c tracking reports were printed on fluorescent paper. Subsequent to a three-month intervention period initiation, data from these reports were entered into an SPSS (V15) database. Variables included current and previous HbA1c levels, age, sex and the patient's primary care physician. The number of HbA1c tests taken by each of these patients per year was also determined from the laboratory data.

Second, all primary care physicians at SERHA in 2006 were invited to participate in a short survey asking about their use of the HbA1c Tracking Tool and for demographic information about the physicians.

Setting

SERHA serves a population of approximately 180 000 people, which includes patients from urban (57%) and rural (43%) communities within the province of New Brunswick. SERHA is serviced by 78 primary care physicians.¹⁵ This study was granted ethics approval by the SERHA Research Ethics Board.

Selection of participants

All patients older than 18 years of age with diabetes (type 1 and type 2) with at least two HbA1c measurements within the year prior to the initiation of the HbA1c Tracking Tool, and with five years of HbA1c measurements (2002–2007) were included in the study. Prospective HbA1c levels were added to the database for 12 to 15 months after the introduction of the Tracking Tool. All primary care physicians servicing SERHA received a survey.

Analysis

The sample was divided into three subgroups based on HbA1c level at study initiation (7–<8%, 8–9%, >9%). Similar groups had been used in previous studies.¹⁶ Descriptive analyses were carried out for both patients and physicians. For the first and second measures (HbA1c levels and number of HbA1c tests per patient per year), two mixed analyses of variance (ANOVAs) were used. The mixed ANOVA allows a test of both a between-groups factor (i.e. HbA1c subgroups) and a repeated-measures factor (i.e. a comparison of the same individuals the year before and the year after the intervention of the Tracking Tool) in the same statistical test. Repeated measures with trend analyses were performed to track changes across five years. These analyses test whether the change across time is best represented by a linear trend (i.e. a straight line), a quadratic trend (i.e. a U-shaped curve), or a cubic trend (i.e. where the direction of change shifts twice). Finally, the percentage of physicians surveyed using the Tracking Tool in their practice was calculated. For all analyses, a significance criterion of $p < 0.05$ was used.

Results

During the project study period 2302 patients received HbA1c tests. After applying the study inclusion criteria, 955 patients were available for analysis. Overall 56% of patients were in the 7–<8% category, 28.2% were in the 8–9% category and 15.8% of patients were in the >9% category group (see Table 1).

A one-way analysis of variance showed that the three groups differed on age, $F(2952) = 20.1$, $p < 0.001$, $\eta^2 = 0.04$, with Tukey's HSD post hoc tests showing that patients with higher HbA1c levels were younger.

A chi-squared test confirmed that groups did not differ significantly on gender ($\chi^2(df = 2) = 1.98$, $p = 0.37$).

The response rate for the physician survey was 49.4% (38 out of 77), with 19 males and 19 females. The majority of physicians were between 40 and 59 years of age (52%); 10 (26.3%) had been practising for less than five years, 14 (36.8%) had been practising for more than 20 years and the rest had been in practice for between five and 20 years.

Glycaemic control

To investigate the effect of the introduction of the HbA1c Tracking Tool across the three HbA1c categories of patients, a 2 (one year before/one year after tracking tool) x 3 (HbA1c patient categories) mixed ANOVA was carried out. For the 7–<8% group, the average HbA1c score was slightly higher ($M = 7.7$, $SD = 0.60$) after the intervention than before ($M = 7.5$, $SD = 0.3$), $F(1533) = 128.9$, $p < 0.001$, $\eta^2 = 0.20$). For the 8–9% group, the average HbA1c score was slightly lower ($M = 8.3$, $SD = 0.84$) after than intervention than before ($M = 8.5$, $SD = 0.3$), $F(1269) = 13.7$, $p < 0.001$, $\eta^2 = 0.05$). Finally, for the >9% group the average HbA1c was lower after the intervention ($M = 9.3$, $SD = 1.3$) than before ($M = 10.1$, $SD = 0.95$), $F(1150) = 54.65$, $p > 0.001$, $\eta^2 = 0.27$). Results did not differ when adjusted for age.

As a follow-up to this finding, separate repeated-measures ANOVAs were used to track mean HbA1c trends across the entire five-year period. These data are presented in Figure 1. For the >9% group, means steadily increased over the first four years and then decreased after the Tracking Tool was introduced (namely, a quadratic trend: $F(1150) = 44.9$, $p < 0.001$, $\eta^2 = 0.23$). For the 8–9% group, only slight variations occurred (fourth order trend: $F(1269) = 24.04$, $p < 0.001$,

Table 1 Study descriptive statistics by HbA1c category

Variable	HbA1c category			Total
	7–<8%	8–9	>9%	
Number	534	270	151	955
Mean age (\pm SD*)	64.0 (± 12.6)	60.4 (± 13.8)	56.8 (± 14.2)	61.8 (± 13.4)
Patient sex (%)				
Male	308 (57.7)	149 (55.2)	94 (62.3)	551 (57.7)
Female	226 (42.3)	121 (44.8)	57 (37.7)	404 (42.3)

* SD = standard deviation

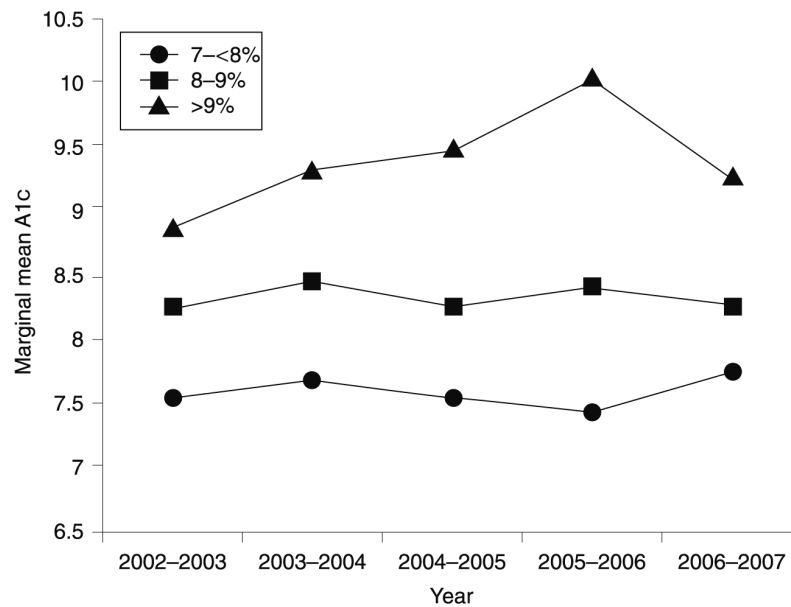


Figure 1 Marginal mean HbA1c level by HbA1c category for diabetic patients from 2002–2007 ($n = 955$)

$\eta^2 = 0.02$). For the 7–<8% group, similar small variations occurred from year to year (namely, a cubic trend: $F(1533) = 89.01$, $p < 0.001$, $\eta^2 = 0.14$).

Practice guidelines: number of HbA1c tests

Patients received more HbA1c tests per year after the intervention ($M = 3.0$, $SD = 0.91$) than the year before ($M = 2.7$, $SD = 1.0$), $F(1954) = 51.7$, $p < 0.001$, $\eta^2 = 0.05$).

Results from a repeated measures analysis across a five-year period showed that patients received significantly more tests across time ($F(43816) = 67.3$, $p < 0.001$, $\eta^2 = 0.07$). From 2002 to 2007 the mean number of tests taken was 2.45, 2.55, 2.54, 2.74 and 3.0 respectively. When numbers of tests per year were compared for each year pair, the effect sizes were as follows: $\eta^2 = 0.01, < 0.001, 0.03, 0.05$. The largest effect size thus occurred when comparing the year before with the year after the intervention.

Usage rates

With regards to the utilisation of the HbA1c Tracking Tool, 35 (92.1%) of the 38 physicians surveyed used the HbA1c Tracking Tool to monitor patients' HbA1c levels. Twenty-seven (71.1%) showed the HbA1c Tracking Tool to patients, while eight (21.1%) gave patients a copy of the HbA1c Tracking Tool. Of the 38 primary care physicians surveyed, only two (5.3%) did not use the HbA1c Tracking Tool at all.

Discussion

This project demonstrated that an organisational intervention that relies on existing and routinely available data shows an association with primary care diabetes management. The strongest association between the intervention and diabetes management was found in the group with the poorest glycaemic control, i.e. individuals with HbA1c levels over 9%. Although these high-risk patients have been found to improve gradually over time under standard diabetes management care,¹⁶ the pre–post intervention comparison observed here was particularly dramatic. Physicians may use more aggressive therapeutic strategies when lack of glycaemic control is highlighted by the tracking tool. We also found that the number of HbA1c tests carried out was increasing over time. It may be that the tracking tool made physicians aware of the need to request frequent HbA1c testing because even though testing rates have improved steadily over the past five years, the increase was particularly strong in the year following the intervention. These results reflect better adherence to the Canadian Diabetes Association Clinical Practice Guidelines,⁹ which recommends HbA1c testing every three months. Increased testing may lead to more frequent patient visits to physicians and better continuity of care.

The tracking tool developed for the present study was designed to be user friendly and easily interpreted. Indeed, most physicians showed it to their patients and it may be that the success of the intervention hinged on patients seeing their own HbA1c levels across time, and thereby taking a more active role in their own care. More patient involvement in combination with

structured care has been found previously to raise the quality of diabetes care.^{11,17,18}

Computerised knowledge management and organisational interventions are becoming an essential part of diabetes care.^{11,19} Integrated computerised health information has been associated with better diabetes care in the US Veterans Affairs health care system,²⁰ and computerised prompting has been found to improve compliance to clinical practice guidelines.¹⁹ In the UK, the national Quality Manager and Analysis System was established to support payments since 2004 to general practitioner (GP) practices under the Quality and Outcomes Framework in an effort to influence clinical behaviour and quality care.²¹ In many of these systems, there is a requirement for expensive live databases where GP practices submit clinical and non-clinical data. In the present study, the HbA1c tool was developed using existing laboratory data. The advantage to this approach is that the regional health authority is providing a means for GPs to use existing data innovatively in order to provide the opportunity to change clinical practice behaviour and improve the quality of diabetes care. In an age of technology, computer-generated reminder and recall systems may prove to be an efficient approach to diabetes management, and based on the data obtained here (92% usage rates) this approach would be popular and would be frequently used by primary care physicians.

Limitations

There are a number of possible historical variables that may have played a role in explaining the results obtained here. It is possible that our data simply reflect the trends observed over the past ten years. Increases in glycaemic control and guideline adherence have been found in other studies.^{22–24} Moreover, increased educational efforts aimed at both physicians and people with diabetes may also explain these trends. Future studies will need to explore these findings in more detail in order to verify whether specific characteristics of patients, medical conditions and physicians influence the effectiveness of interventions based on computer-generated laboratory data. Finally, it is also possible that the high usage rates obtained reflect a bias in the physicians who responded to the survey: the physicians who use the tracking tool may have been more willing to respond to a survey concerning its use.

Conclusions

In this project, it was shown that routinely collected laboratory data can be used both as the basis for an

information-based intervention and as a tool to monitor quality of diabetes care. These data can also provide an efficient and possibly economical means to address health services research questions using large cross-sectional and longitudinal data. The HbA1c Tracking Tool is an economical option that can support patients by providing them with supplementary information to take control of their disease. Physicians can benefit from a tool that allows them to assess a patient's long-term glycaemic control and monitor their own adherence to existing clinical practice guidelines. Decision makers can use HbA1c trend analysis to explore the impact of population interventions aimed at improving diabetes care.

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CONFLICTS OF INTEREST

None.

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