ORIGINAL ARTICLE

Increasing diabetes testing adherence with incentives in rural Northwestern Ontario

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Abstract

Introduction: The health outcomes of rural Canadians have been described as poor and can in some part be related to diabetes mellitus. Despite the high mortality and morbidity rates associated with the disease, compliance with management remains low. Research has shown that a small financial incentive used to modify patient behaviour, can improve outcomes in cardiac disease and exercise adherence. This study aims to evaluate if a small financial incentive awarded to rural Northwestern Ontario patients with diabetes who complete an haemoglobin A1c (HbA1c) test, would result in greater compliance in test completion.

Methods: Patients were recruited through two Northern rural clinics. Participants were divided into two groups: Group A received a financial incentive, whereas Group B received a letter of reminder. HbA1c tests were recorded every 6 months for 2 years and compliance was analysed using a *t*-test and Chi-square.

Results: One hundred and forty-six participants were recruited with 30 lost to follow-up. Overall, the incentive group completed a statistically significantly higher number of HbA1c tests compared to those in the control group. In addition, it was noted that there was an increase in test adherence for participants that received reminder letters, although not an initially expected outcome of the study.

Conclusion: The results suggest that either a financial incentive or a reminder directed towards rural Canadians could have a benefit in promoting health behaviours to subsequent medical management of diabetes mellitus.

Keywords: Diabetes, financial incentives, HbA1c test, rural medicine

Résumé

Introduction: Les résultats en matière de santé des Canadiennes et Canadiens vivant en milieu rural ont été décrits comme médiocres et peuvent en partie être liés au diabète sucré. Malgré les taux élevés de mortalité et de morbidité associés à cette maladie, l'observance du traitement reste faible. La recherche a montré qu'un petit incitatif financier utilisé pour modifier le comportement du patient, peut améliorer les résultats dans les maladies cardiaques et l'adhésion à l'exercice. Cette étude vise à évaluer si une petite incitation financière accordée aux patients diabétiques des régions rurales du nord-ouest de l'Ontario qui effectuent un test HbA1c, entraînerait une plus grande conformité dans l'exécution du test.

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Méthodes: Les patients ont été recrutés dans deux cliniques rurales du nord. Les participants ont été divisés en deux groupes: Le groupe A a reçu une incitation financière, tandis que le groupe B a reçu une lettre de rappel. Les tests HbA1c ont été enregistrés tous les 6 mois pendant 2 ans et la conformité a été analysée à l'aide d'un test t et d'un chi carré.
Résultats: 146 participants ont été recrutés, dont 30 ont été perdus lors du suivi. Dans l'ensemble, le groupe incitatif a réalisé un nombre statistiquement significatif de tests d'HbA1c par rapport aux participants du groupe témoin. De plus, une augmentation de l'adhésion aux tests a été remarquée pour les participants qui ont reçu des lettres de rappel, bien que ce ne soit pas un résultat initial attendu de l'étude.
Conclusion: Les résultats suggèrent que soit une incitation financière, soit un rappel destiné aux Canadiennes et Canadiens des zones rurales pourrait avoir un avantage dans la promotion des comportements de santé pour la gestion médicale ultérieure du diabète sucré.

Mots-clés: Gestion du diabète sucré, incitation financière, médecine rurale, test HbA1c

INTRODUCTION

Diabetes mellitus is one of the leading causes of morbidity and mortality in Canada. The abnormal insulin activity in diabetes results in hyperglycaemia, which is the causative factor in its downstream effects.[1] Type II diabetes, previously called 'adult-onset' diabetes, is responsible for 90% of cases.[2] Risk factors for type II diabetes include poor diet with the consumption of high glycaemic index foods, sedentary lifestyles with a lack of exercise and genetics.[2] There are a number of sequelae in patients with diabetes, which affect multiple organ systems, most notably causing cardiovascular and renal diseases.[1] Due to the increase in mortality associated with these diseases, correct management of diabetes is vital. However, high rates of poor compliance to management adherence have resulted in large costs to the health-care system, which when calculated in 2012 over a 10-year time span, yielded approximately $15 billion dollars.[3] There is also evidence to suggest that directing risk reduction procedures towards those who are at the highest risk could save up to $1.48 billion over the same time period.[3]

Overall, the management of diabetes is multifactorial and typically includes medical and lifestyle changes.[2] However, alongside these two is an emerging topic known as behavioural changes. Behavioural changes include modifications that can alter human behaviour and improve outcomes.[4] Diabetes is no different and there are emerging goals to refine the way diabetes care is delivered to incorporate a more holistic approach that also includes a behavioural aspect.[4,5] One method to altering behaviour is through gifts, financial incentives or encouraging reminders. Previously, the Ontario government introduced financial incentives for physicians with a diabetes incentive billing code in 2002.[6] However, there were no associated improvements in diabetes care with the involvement of physician incentives. When focusing on the patient, financial incentives have had the ability to alter behaviours and increase adherence relating to exercise regimens and healthy cardiac behaviours; two fields closely related to diabetes prevalence.[7,8] Similarly, a pilot study in Wisconsin demonstrated early evidence of incentives focusing on increased diabetes testing adherence.[9] Therefore, there may be an association between financial incentives focused on patients rather than physicians, and improved outcomes in diabetes management with regard to testing. However, this research was mostly done internationally. In Canada, there has been little research into the effects of patient-focused incentives for diabetes management in rural areas.

Rural Canadians have unique health issues when compared to their urban counterparts. There are higher self-reported 'poor' health outcomes, including obesity, and dietary habits, as well as 'poor' health literacy status.[10] Cumulatively, this can result in poor adherence to disease management, such as diabetes.[10] This increases the risk of sequelae, which eventually leads to a larger burden on the health-care system. Northwestern Ontario (NWO) is no different, being that it is a geographically vast area with

unique health concerns. The rate of diabetes in the adult population is significantly higher than the Ontario average, at 14.4% compared to 12.6%, respectively.[11] This is evidence that the region is at significant risk of poor outcomes with inadequate management of chronic diseases with diabetes being no different.

Past evidence has shown that small financial incentives have the ability to improve outcomes in cardiac disease and exercise adherence, due to modification of patient behaviour. The Canadian Diabetes Association (CDA) recommends measuring haemoglobin A1c (HbA1c) every 3 months (or 120 days), to correctly determine overall management in patients with diabetes.[3] The purpose of our research study was to evaluate if small financial incentives awarded to rural NWO patients with diabetes, who complete an HbA1c test, would result in greater compliance in test completion. This is a large step in diabetes management, and if a link exists, it could create a potential target for stronger diabetes management and decreased health-care costs. It is hypothesised that those who receive an incentive for every HbA1c test over a 2-year period, would have an increase in the number of tests completed when compared to a control group.

METHODS

Study design

Participants in the study were split into two groups, with 'Group A' receiving an incentive, and 'Group B' being the control. Every 6 months from the onset of the study, a letter was mailed to the participants. The letter was a reminder of their enrolment in the study and included a 'checkbox' for them to fill in if they completed any HbA1c blood tests in that time period up to a maximum of two tests. Patient completion of A1c testing was identified using their electronic medical record. Nomenclature in the letter was encouraging and was designed to foster a positive attitude towards diabetes testing. Participants in 'Group A' would also receive a $5 gift card to a small local business, for every HbA1c test they had completed in that time period (up to a maximum of two tests, or two gift cards), thus being named the 'incentive group'. At the completion of the study, a final reminder was sent.

Recruitment

Patients were recruited at two clinics in NWO, including the Dingwall Medical Group in Dryden and the Machin Medical Clinic in Vermillion Bay. Recruitment took place over a 3-year period. Participants were randomised to their respective groups using a simple randomisation technique to either 'Group A' or 'Group B' upon entry to the study. Recruiters and study investigators were not blinded to their group status, whereas their primary care practitioners were not involved in the study randomisation and therefore were blinded to their status.

Inclusion criteria included any patients above the age of 18 who had their primary address in the Dryden or Machin region, with a primary care physician in the same jurisdiction, as well as a history of type 1 or 2 diabetes mellitus. Exclusion criteria included those under the age of 18, those with a diagnosis of gestational diabetes and those who did not reside or have a primary care physician in the aforementioned region. Those who were lost to follow-up and did not complete the full 2 years of the study were not accounted for in the number of HbA1c tests. Indigenous Northwestern Ontarians were recruited to the study but were randomised in the same way as other patients; there was no specific recruiting pattern for Indigenous people.

Measuring outcomes and statistics

HbA1c tests were recorded every 6 months and collated onto a master spreadsheet without patient identifiers. Group A was compared to Group B in regard to total HbA1c tests completed over the 2-year period using a *t*-test analysis ($P < 0.10$), as well as the total proportion of tests completed over the total time period and proportion of tests completed at each time period, using a Chi-squared analysis ($P < 0.05$).

Ethics

Research ethics was provided by the Lakehead Research Ethics Board in Thunder Bay, ON, for the duration of the study from September 2016 to September 2019. The information from the study will be kept in a secure location until September 2024, 5 years after its completion date. Access to

patient health information was granted by the Dryden Regional Health Sciences Centre and the Dryden Dingwall Clinic.

RESULTS

Participants

A total of 146 participants were found to be eligible for the study in the two communities of Dryden and Machine between September 2016 and September 2019. One hundred and sixteen participants were from the Dingwall Clinic in Dryden and a further 30 from the Machin Medical Clinic in Vermillion Bay [Table 1]. One hundred and sixteen of 146 participants completed the study, with 30 lost to follow-up. Sixty participants who completed the study were randomised to the incentive group, with the remaining 56 assigned to the control group. Patient demographics were retrieved using self-reported information which included age, gender, ethnicity, type of diabetes and self-reported last A1c test before the study started. One hundred and twenty-five patients completed their patient demographic information, which included the 116 patients, who completed this study, as well as the five patients who emigrated and four who died. This information was not assessed on the deceased patient, the one patient who withdrew, and all 19 of those lost to logistical reasons, as they did not complete the survey.

HbA1c blood tests conducted

Over the 2-year time period, there were 461 total HbA1c tests completed in both groups, with 257 out of a possible 480 (60 participants with a maximum of 8 tests in 2 years maximal possible total of 480 tests) completed in the incentive group and 204 out of a possible 448 (56 participants with a maximum of 8 tests in 2 years equals a maximal possible total of 448 tests) in the control group; the incentive group was statistically higher when using a Chi-squared analysis [$P < 0.05$; Table 2]. At each time point, there were statistically insignificant trends of greater tests completed in the incentive group when compared to the control group except for the first period at 0–3 months [$P < 0.10$; Table 2]. When comparing the total number of tests in each time period, those completed after

Table 1: Characteristics of participant and recruitment profile of type 2 diabetes mellitus patients at the Dingwall clinic in Dryden and the Machin Clinic in vermillion bay

Total number of participants recruited per site (*n*=146)		
Cohort	Dryden	Machin
Cohort 1	23	18
September 2016-2018		
Cohort 2	38	5
December 2016-2018		
Cohort 3	14	0
May 2017-2019		
Cohort 4	22	7
September 2017-2019		
Cohort 5	19	0
Planned February 2019-2021; not completed due to logistical reasons		
Total	116	30

Participant status (*n*=146)	
Total recruited	146
Total loss to follow-up	30
Voluntarily withdrew	1
Emigrated	5
Deceased	5
Lost due to logistical reasons	19
Totally completed the study	116

Patient demographics (*n*=125)	
Gender	
Male	58
Female	67
Age	
18-25	1
26-35	3
36-45	8
46-55	23
56-65	32
65-75	38
75+	20
Ethnicity	
First Nations, Inuit or Metis	30
Caucasian	77
Black	0
Asian	1
Other	11
Prefer not to answer/left blank	6
Type of diabetes	
Type 1	0
Type 2	124
Unsure	1
Time since last known A1c (self-reported)	
<3 months	86
4-6 months	14

Contd...

Table 1: Contd...	
Patient demographics (*n*=125)	
7-12 months	7
12+ months	8
Never	7
Unsure	3

reminders were mailed to both groups at 12 and 18 months, resulted in a statistically significantly higher number of completed tests [$P < 0.05$; Figure 1]. However, there was no influence on incentives alone, for these same time points.

DISCUSSION

Incentives and HbA1c testing frequency

Overall, it is observed that the incentive group completed statistically significantly higher numbers of HbA1c tests than those in the control group over the course of the study period, with both a higher complete number and higher mean of tests completed. There was no significant pattern of increased testing at specific time points in the incentive group when compared to the control. However, there were trends pointing to this, suggesting that small sample size could have influenced the lack of significance. Based on this, even in this small study with 116 participants, there was evidence that small financial incentives can increase the likelihood of completing an HbA1c blood test. This is what was hypothesised, with the goal being that behavioural modification with these small financial incentives would increase the likelihood of patients initiating their own HbA1c blood tests. Although there was no goal of the study to determine if primary practitioners had played a role in testing adherence, there was no evidence to suggest another variable played a role in the higher rates seen, as all participants were randomised to either group to reduce this possible confounder.

Including those who received incentives, there were a significantly lower average number of tests completed in either group over the 2-year period, with an average of 4.23 in the incentive group and 3.65 in the control group, compared to the recommended number of tests by the CDA. The CDA recommends eight tests be conducted in this time period, suggesting that both groups are not conforming to the current guidelines regardless of incentive strategy.[2] There was a benefit of small financial incentives on overall testing adherence, thus identifying a potential strategy of patient direct incentives as an adjunct or replacement for current physician-geared incentives. Sixty-nine per cent of participants in the study did indicate on a survey that they had completed an HbA1c in the past 3 months at the start of the study. This, however, was self-reported data and was not corroborated by the patient record as it was out of the original scope of the project. Incentives could be a step towards increasing diabetes health literacy and potentially management, further downstream with rural Canadians. The aforementioned billing code for diabetes was introduced for Ontario physicians in 2002 and did not show any benefit when the financial incentive was geared towards physicians.[6]

This is evidence that even in a small group study, financial incentives may have benefit in creating behavioural changes by creating a bridge between health management and finances. Regular blood tests may often be viewed as an inconvenience or as something that is not of importance to a patient with diabetes. However, if getting a blood test may benefit them, such as by receiving a gift card, they may be more willing to conduct this test, which may eventually lead to increased awareness surrounding their diabetes management. The incentive could remove the aspect of inconvenience and could be a model to further explore human behaviours in healthcare. Diabetes management is a multifactorial process. If involving a small financial aspect in its management results in some benefit, this could potentially reduce downstream health-care costs associated with morbidity and mortality of sequelae to a small degree. Even in the face of small financial incentives, this could be significant.

Limitations

Given the study's small sample size and the single recruitment centre, there are a number of associated limitations. Most of these limitations are due to a lack of external validity and an inability to truly extrapolate the data to other settings or sites. There is the possibility of confounding variables, such as the involvement of diabetes educators and differing advice of

Table 2: Total number of HbA1c blood tests conducted in Northwestern Ontario patients with diabetes enrolled in the study at the end of the study, and at either time point

	Incentive (*n*=60)		Control (*n*=56)	*P*
Total number of tests completed	257		204	**<0.05***
Proportion of total tests completed	0.53		0.45	**<0.10#**
Average number of tests completed	4.23±2.18		3.65±2.01	**<0.10#**
Time period	Incentive (*n*=60)	Control (*n*=56)	Total	*P*
Period 1 (0-3 months)	35	24	59[ab]	**<0.10^**
Period 2 (4-6 months)	31	23	54[ab]	=0.16
Period 3 (7-9 months)	34	29	63[a]	=0.36
Period 4 (10-12 months)	28	22	50[b]	=0.23
Period 5 (13-15 months)	37	28	65[a]	=0.10
Period 6 (16-18 months)	25	21	46[b]	=0.32
Period 7 (19-21 months)	34	28	62[a]	=0.23
Period 8 (22-24 months)	33	29	62[a]	=0.36

Bold=Statistically significant. *Statistically different using Fischer's exact test with *P*<0.05, #Statistically different using a *t*-test with a=0.10, ^Statistically different using Fischer's exact test with *P*<0.10, a is statistically significant from b using Fischer's exact test with *P*<0.05

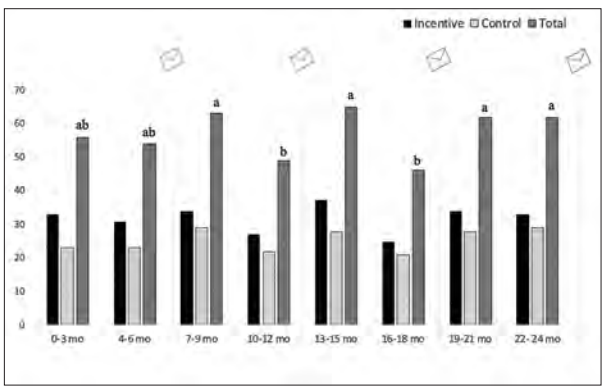


Figure 1: Comparing the number of tests completed in the incentive and control groups, as well as the total number of tests at each time period. Envelopes denote time points at which reminders were sent to either group, at 6-month intervals. *a* is statistically significant from *b* using Fischer's exact test with $P < 0.05$.

primary care practitioner's on the frequency of diabetes testing. Therefore, this study may not represent all rural centres. Randomisation should limit any confounding of this on eventual results; however, as a whole, the data should be interpreted as such.

An unexpected by-product of this study was data that could suggest reminders alone could increase the number of A1c tests completed. This was identified at 2 separate time periods when looking at the total number of tests completed, thus showing the potential role of reminders alone, in an increasing volume of HbA1c testing. However, this was not a primary outcome of the original study design, and therefore cannot be analysed. This does however open the door to a potential intervention that could be used in future studies examining the behaviours of diabetes and chronic disease management. For example, a future study could examine the effects of reminders alone, by comparing them to incentives and a control group. This study was not designed to investigate the effect of reminders against control, and this finding was just noticed in the interpretation of the data, so therefore cannot be definitively commented on.

CONCLUSION

Overall, in a study of rural Canadians focusing on the effectiveness of financial incentives in improving diabetes testing adherence, there was a mild benefit from financial incentives as compared to the control group. However, another finding was that all participants who received a reminder, with or without incentives, had a higher number of tests than in the subsequent time period. This shows that either incentives or a reminder alone could have a benefit in promoting health behaviours to subsequent medical management, which would need to be explored further in future research. Closer knowledge of diabetes management could lead to important effects in the future, with improved management of chronic diseases, which could lead to benefits on the health-care costs associated with the disease burden in rural Canadians; follow-up studies will be required to make this association.

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Conflicts of interest: There are no conflicts of interest.

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