

ORIGINAL RESEARCH

Utilization and Expenditure on Blood Glucose Test Strips in Canada

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ABSTRACT

OBJECTIVE: The objective of this study was to explore utilization patterns and expenditures on blood glucose test strips (BGTs) in Canada according to concurrently prescribed diabetes treatments.

METHODS: We conducted a retrospective utilization analysis using administrative claims data from available public and private drug plans in Canada. Utilization and expenditures on BGTs were calculated, as was the average daily frequency of BGTs use by concurrent diabetes pharmacotherapy.

RESULTS: Expenditures on BGTs in Canada in 8 public drug plans in 2006 were \$247 million, while those in private drug plans were in excess of \$81 million. Almost half of total expenditures were for patients not using insulin, despite a lower average number of BGTs claimed per day compared with those using insulin.

INTERPRETATION: In private and public drug plans in Canada, current utilization and expenditure on BGTs is considerable. Given the size of the investment and lack of convincing evidence that routine self-monitoring of blood glucose is beneficial for patients not using insulin, there may be more cost-effective strategies for improving the health of this population.

KEYWORDS: blood glucose test strips, Canada, cost, diabetes, drug utilization, expenditure, frequency, self-monitoring of blood glucose

RÉSUMÉ

OBJECTIF : L'objectif de l'étude était d'examiner l'utilisation des bandelettes d'analyse pour l'épreuve de glycémie (BAEG) et leurs coûts au Canada en fonction du traitement prescrit contre le diabète.

MÉTHODES : Nous avons effectué une analyse rétrospective de l'utilisation des BAEG à partir des données administratives sur les demandes de remboursement adressées à des régimes publics et privés d'assurance médicaments canadiens. On a calculé le nombre de BAEG utilisées, leurs coûts ainsi que la fréquence d'utilisation quotidienne des BAEG en fonction de la pharmacothérapie antidiabétique.

RÉSULTATS : En 2006, les BAEG ont coûté 247 millions de dollars à huit régimes publics d'assurance médicaments canadiens et plus de 81 millions de dollars aux régimes privés d'assurance médicaments canadiens. Près de la moitié de ces sommes découlaient des demandes adressées par des patients non insulinotraités, même si ceux-ci utilisent en moyenne chaque jour moins de BAEG que les patients insulinotraités.

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INTERPRÉTATION : Les BAEG entraînent actuellement des coûts considérables pour les régimes publics et privés d'assurance médicaments canadiens. Compte tenu de ces coûts et vu qu'il n'y a pas de données convaincantes qui démontrent l'utilité des BAEG chez les patients non insulinotraités, l'utilisation de BAEG pourrait ne pas être la stratégie la plus efficace pour l'amélioration de la santé chez les patients non insulinotraités.

MOTS CLÉS : diabète, autosurveillance de la glycémie, bandelettes d'analyse pour l'épreuve de glycémie, fréquence, coût, dépenses, utilisation de médicaments, Canada

INTRODUCTION

Self-monitoring of blood glucose (SMBG) is a common method for people with all types of diabetes to assess their current glycemia. For patients with diabetes using insulin, national and international bodies universally agree that SMBG is an essential component of daily diabetes management (1-8). Use of SMBG enables patients with insulin-treated diabetes to detect hypoglycemia and enhance the effectiveness of insulin through self-adjustment of doses (1,2,4,8).

For patients with type 2 diabetes not using insulin, however, there is evidence that routine SMBG produces minimal clinical benefits. Hypoglycemia is rare (9) in this population (with the exception of individuals treated with insulin secretagogues), and the degree to which patients can adjust doses of oral antihyperglycemic agents in response to SMBG readings is limited (1,2,4). Moreover, a recent systematic review conducted by the Canadian Agency for Drugs and Technologies in Health (CADTH) reported that SMBG produces only marginal improvement in glycated hemoglobin (A1C) levels in patients who are not using insulin, and there was a lack of evidence that reports on clinically important outcomes (e.g. microvascular complications, macrovascular complications) (10). These results are similar to those of other systematic reviews (11-13).

Nevertheless, Canadian and international clinical practice guidelines (CPGs) recommend the routine use of SMBG in this population (1-7), despite the significant investment required by patients and payers (14-17). Recommendations by CPGs (1-7), however, sometimes do not consider cost and cost-effectiveness information in their deliberations (18,19). As such, guidance from CPGs may differ from those of bodies such as CADTH and others, which do take this information into account. CADTH does not recommend routine SMBG for most patients with type 2 diabetes who are not using insulin, except in special populations or in circumstances where patients may benefit from intermittent use of SMBG (8). Similar guidance has been issued by other international groups (20-21).

Blood glucose test strips (BGTs) are a significant expense for individual patients, public funding agencies and private health-benefit plans (14-17). As part of a larger initiative to assess the optimal use of this technology (<http://www.cadth.ca/index.php/en/compus/blood-glucose>), we therefore sought to determine current utilization patterns and expenditures on BGTs within public and private drug plans in Canada, and to compare these with patients' use of concurrently prescribed diabetes pharmacotherapy.

METHODS

We conducted a retrospective analysis of administrative claims data from publicly and privately funded drug plans in 2006 in Canada. The average daily number of BGTs claimed per beneficiary, as well as total utilization and expenditures on BGTs, were calculated.

Data source

Aggregate- and claims-level data were provided by Brogan Inc. (23). Aggregate-level data consist of summary utilization information — such as total BGTs claimed or total expenditure on BGTs — for a particular drug plan. Claims-level data refer to information from individual pharmacy claims; such data permit more analytical flexibility, since summary statistics can be estimated for various subgroups of interest.

The Brogan Inc. database is the largest drug claims database in Canada. It comprises aggregate- and claims-level data collected from public drug plans in 9 of the 10 provinces in Canada (Prince Edward Island and the territories do not provide data), the Non-Insured Health Benefits program (NIHB) and 67% of private drug plans in Canada.

Aggregate-level data on BGTs claims were available for 7 public drug plans in Canada: British Columbia, Saskatchewan, Manitoba, Quebec, Nova Scotia, Newfoundland and Labrador, and the NIHB. Data from other public drug plans were not available for the following reasons:

- Alberta provides coverage for BGTs through the Alberta Monitoring for Health Program, Alberta Works, Assured Income for the Severely Handicapped (AISH) program and the Special Needs Assistance for Seniors program (24), none of which do not submit data to Brogan Inc. (25).
- New Brunswick provides coverage for BGTs through the Department of Social Development; however, they do not submit data to Brogan Inc. (23).
- Prince Edward Island did not provide coverage for BGTs in 2006 (26), nor does the province submit data to Brogan Inc. (23).
- The Northwest Territories, Yukon Territory and Nunavut provide coverage for BGTs (27-29), but they do not submit data to Brogan Inc. (23).

Claims-level data were available for the Ontario Public Drug Program (OPDP) and approximately 67% of private third-party payers in Canada (23) (Nevzeta Bosnic, Ottawa, ON: personal communication, September 2008).

Data analysis

For aggregate-level data, total utilization (i.e. number of BGTs claimed), expenditures and average cost per BGTs claimed were calculated for the period January 1, 2006, to December 31, 2006.

For analysis of claims-level data, selection of data for inclusion was a 2-step process. First, beneficiaries had to make at least 1 claim for BGTs between January 1, 2006, and December 31, 2006. Their most recent claim for BGTs was identified as their index claim, and data for the 12-month interval following the index claim formed the basis of the analyses. Second, beneficiaries had to be active in the database by having at least 1 claim for any drug in the 12-month follow-up period. This ensured exclusion of deceased persons or those who switched plans. Data were classified by treatment group as follows:

- Patients using insulin alone.
- Patients using insulin plus oral antihyperglycemic agent(s).
- Patients using oral antihyperglycemic agent(s) alone.
- Patients using no pharmacotherapy for diabetes.

The total number of patients, number of claims for BGTs, number of BGTs claimed and expenditure on BGTs were calculated by treatment group and type of drug plan. As well, the average daily number of BGTs

claimed was calculated by treatment group. Utilization and expenditure by age and region (for private drug plans) are reported elsewhere (15).

A full technical report is available at: http://www.cadth.ca/media/pdf/compus_CU_Report-BGTS.pdf.

RESULTS

BGTS utilization in publicly funded drug plans

Utilization and expenditure on BGTs in Canadian public drug plans are presented in Table 1. Annual expenditures in 2006 ranged from \$5.7 million in Newfoundland and Labrador to \$109.4 million in Ontario. The average cost per BGTs ranged from \$0.72 in Ontario to \$0.89 in Newfoundland and Labrador.

Claims-level data were available only for the OPDP. During the 12-month analysis period, 269 235 beneficiaries covered under OPDP claimed 153 million BGTs, for a total expenditure of \$109.4 million (Table 2). A large proportion of total costs (63%) were expended on patients using oral antihyperglycemic agent(s) and no insulin, or using no pharmacotherapy for diabetes who together account for 78% of all patients claiming BGTs. However, the average daily number of BGTs was higher for patients using insulin alone (2.76 strips per day [SD=3.71]) and using insulin with oral antihyperglycemic agent(s) (2.32 strips per day [SD=4.53]) than for patients taking oral antihyperglycemic agent(s) alone (1.35 strips per day [SD=2.24]) or using no pharmacotherapy for diabetes (0.99 strips per day [SD=1.46]).

Table 1. Number of BGTs claimed, total expenditure and average cost per BGTs for publicly funded drug plans in Canada in 2006, by jurisdiction

| <i>Jurisdiction</i> | <i>Number of BGTs claimed</i> | <i>Expenditure, \$</i> | <i>Average cost of BGTs, \$</i> |
|---------------------------|-------------------------------|------------------------|---------------------------------|
| British Columbia | 37 917 214 | 28 508 780 | 0.75 |
| Manitoba | 14 629 288 | 11 674 293 | 0.80 |
| Newfoundland and Labrador | 6 389 093 | 5 712 101 | 0.89 |
| NIHB | 11 390 452 | 9 627 089 | 0.85 |
| Nova Scotia | 8 562 232 | 6 312 395 | 0.74 |
| Ontario* | 153 018 907 | 109 411 365 | 0.72 |
| Quebec | 80 417 880 | 66 275 986 | 0.82 |
| Saskatchewan | 12 976 577 | 10 268 123 | 0.79 |
| Total | 325 301 643 | 247 790 132 | 0.76 |

*Approximated, based upon claims-level data (Table 2); total expenditure among patients who made at least 1 claim for BGTs between January 1, 2006, and December 31, 2006

BGTS = blood glucose test strip

NIHB = Non-Insured Health Benefits program

Table 2. Number of patients (%), BGTs (%), average daily utilization and total expenditure (%) in a 12-month period for patients in the OPDP who had at least 1 claim for BGTs in 2006, by treatment group

| Treatment group | Patients, n | BGTs claimed, n | Total test strip expenditure, \$ (%) | Average BGTs claimed daily per patient, n (SD) |
|---------------------------------|--------------------|------------------------|---|---|
| Insulin alone | 30 959 (11) | 31 198 044 (20) | 22 437 721 (20) | 2.76 (3.71) |
| Insulin + OAA | 30 214 (11) | 25 589 681 (17) | 18 078 903 (17) | 2.32 (4.53) |
| OAA alone | 160 938 (60) | 79 151 388 (52) | 56 597 805 (52) | 1.35 (2.24) |
| No pharmacotherapy for diabetes | 47 124 (18) | 17 079 794 (11) | 12 296 936 (11) | 0.99 (1.46) |
| Total | 269 235 | 153 018 907 | 109 411 365 | 1.56 (2.75) |

BGTS = blood glucose test strip

OAA = oral antihyperglycemic agent

OPDP = Ontario Public Drug Program

Table 3. Number of patients (%), BGTs (%), average daily utilization and total expenditure (%) in a 12-month period for patients in privately funded drug programs who had at least 1 claim for BGTs in 2006, by treatment group

| Treatment group | Patients, n (%) | BGTs claimed, n (%) | Total test strip expenditure, \$ (%) | Average BGTs claimed daily per patient, n (SD) |
|---------------------------------|------------------------|----------------------------|---|---|
| Insulin alone | 35 272 (18) | 40 977 853 (40) | 32 910 753 (40) | 3.18 (2.70) |
| Insulin + OAA | 20 147 (10) | 13 962 111 (14) | 11 324 220 (14) | 1.90 (1.48) |
| OAA alone | 105 853 (53) | 36 362 579 (36) | 29 791 027 (36) | 0.94 (0.85) |
| No pharmacotherapy for diabetes | 39 071 (19) | 9 774 919 (10) | 7 778 477 (10) | 0.69 (1.95) |
| Total | 200 343 | 101 077 462 | 81 804 477 | 1.38 (1.85) |

BGTS = blood glucose test strip

OAA = oral antihyperglycemic agent

BGTS utilization in privately funded drug plans

During the 12-month analysis period, 200 343 beneficiaries covered under private drug plans in Canada claimed 101 million BGTs, for a total expenditure of \$81.8 million (Table 3). (Based on an extrapolation of the available data, which represent approximately 67% of claims made to Canada's privately funded drug plans, 303 500 beneficiaries covered under private plans claimed a total of 151 million test strips at a total cost of \$122 million in 2006.) A large proportion of total costs (46%) were expended on patients who were using oral antihyperglycemic agent(s) or no pharmacotherapy for diabetes who together account for 72% of all patients claiming BGTs. However, patients using insulin alone and those using insulin plus oral antihyperglycemic agents claimed more BGTs per day (3.18 [SD=2.70] and 1.90 [SD=1.48] strips per day, respectively) than patients taking oral antihyperglycemic agents without insulin or using no pharmacotherapy for diabetes (0.94 [SD=0.85] and 0.69 [SD=1.95] strips per day, respectively).

INTERPRETATION

This is the first Canadian utilization study to provide insight into healthcare expenditures on BGTs at the national level. Annual expenditures on BGTs in Canada in 8 publicly funded drug plans in 2006 was approximately \$248 million, while \$82 million was spent in privately funded drug plans. These estimates are conservative, since they do not capture expenditures in special drug programs (e.g. Nova Scotia Diabetes Assistance Program, Alberta Monitoring for Health Program), out-of-pocket expenditures by patients for BGTs and data not submitted to Brogan Inc. (e.g. Northwest/Yukon territories and Nunavut) (23) and represents only 67% of private pays or claims.

This study also provides information regarding expenditures by concurrent diabetes pharmacotherapy. In the OPDP, \$109.4 million was spent on BGTs, of which \$68.8 million was spent for patients not using insulin therapy. In privately funded drug plans, \$81.8 million was spent on BGTs, with \$37.5 million expended for patients who were not using

insulin. Similar findings have been reported in previous analyses of individual provinces (30,31) and in the United States (32). The magnitude of expenditures among patients not using insulin is not surprising, since the population of patients with type 2 diabetes (the majority of whom do not use insulin) is much larger than the population with type 1 diabetes in Canada (33,34).

This study also provides insight into differences in utilization by type of drug plan. Average daily utilization appears to differ slightly between the OPDP and privately funded drug plans. For patients taking insulin only, average daily utilization appears to be higher in privately funded drug plans. In contrast, daily utilization was higher in the OPDP for patients using insulin in conjunction with antihyperglycemic agents, oral antihyperglycemic agents alone and no diabetes pharmacotherapy.

In general, average daily utilization in Canada among patients using insulin appears to be in accordance with guidance from most major national and international bodies (1-7), including CADTH. These bodies universally agree that SMBG plays an essential role in the daily management of patients with diabetes treated with insulin, since it facilitates effective insulin use by allowing for dose adjustments based on readings and for safety considerations (i.e. detection of hypoglycemia) (1-7). National and international bodies recommend at least 1 test per day in patients who are using insulin (1,2,6,8); however, recommended frequencies are as high as 4 or more per day, depending upon the type of insulin regimen (1-3,6).

For patients with type 2 diabetes not using insulin, evidence regarding the effectiveness of SMBG is controversial and highly debated (10,12,13,16). Indeed, a number of systematic reviews have reported that SMBG has minimal clinical benefits (10,12,13), while a recent Canadian analysis found that SMBG was unlikely to be cost-effective in this population (35). As such, guidance related to use of SMBG in this population has been variable (1,2,6-8,22). Current utilization patterns in Canada appear to be in accordance with recommendations by some bodies (1,2,7); however, they are not consistent with others (6,8,22), including CADTH (8) and groups in Europe (19-21), who do not recommend routine use of SMBG. Differences in guidance may be attributable, at least in part, to the types of evidence considered in making recommendations. Whereas most bodies (1,2,7), including the CDA (1,19), considered only evidence related to the clinical benefits of SMBG, CADTH (8) and other groups (20-21) considered both clinical and cost-effectiveness data.

Expenditures on BGTs are high (36) and rising steadily (36-38). In many drug plans in Canada and worldwide, BGTs are among the top 5 classes in terms of total expenditure (32,36), and BGTs are the most expensive com-

ponent in the intensive management of glycemic control (14-17). Furthermore, more money is spent on BGTs than is expended for all oral antihyperglycemic agents combined (14-17). For example, in Quebec in 2006, \$60 million was spent on all oral antihyperglycemic agents, while \$66 million was expended on BGTs (14,15). Given the magnitude of the investment by jurisdictions on BGTs, the opportunity cost incurred in funding this technology at current levels is substantial. (Opportunity cost represents the value of benefits foregone as the result of making a decision. In a healthcare system with finite resources, the resources expended on a particular healthcare intervention are no longer available to fund other potentially beneficial interventions or services.) Further research is needed to compare the relative effectiveness and cost-effectiveness of SMBG with competing strategies in the management of diabetes and especially for patients not using insulin.

As with all analyses, some limitations warrant mention. First, the data set used for the analysis did not contain diagnostic codes, and classification by type of diabetes was not possible. Second, estimates of BGTs utilization and expenditure for special drug programs (e.g. the Nova Scotia Diabetes Assistance Program) or data not submitted to Brogan Inc. (e.g. Northwest/Yukon territories and Nunavut) were not included in this analysis. These special drug programs, however, represent a small proportion of publicly funded drug plans in Canada. Third, a small number of patients in the OPDP who are taking diabetes drugs that are not listed as a benefit, but have coverage through a private drug plan or are paying for drugs out of pocket, may have been assigned to an incorrect treatment group. Similarly, patients paying out of pocket for BGTs would not have been captured in the analysis, potentially resulting in underestimation of utilization. Costs for BGTs may not reflect actual expenditures by jurisdiction since patient co-pays were not taken into account in the analysis. Fourth, claims-level data for publicly funded drug plans were available for the OPDP only. Thus, utilization of BGTs and related expenditures by treatment modality for other publicly funded drug programs in Canada were not measured. Finally, our analysis provides information on the average number of BGTs claimed by beneficiaries, not on actual patterns (e.g. intermittent use) of BGTs use or wastage.

In conclusion, there is considerable expenditure on BGTs in both public and private drug plans in Canada. More than half the total cost is expended on patients who are not using insulin, a group for whom SMBG has uncertain benefits. Given the size of the investment and lack of evidence of convincing benefit, there may be other more cost-effective strategies for improving the health of people with type 2 diabetes who are not using insulin. Further research is needed to compare the relative effectiveness and

cost-effectiveness of SMBG with competing strategies within this population.

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AUTHOR CONTRIBUTIONS

Each listed author contributed substantially to the conception and design of the analysis. CC analyzed the data. CC, MD and AV wrote the first draft of the manuscript. All authors reviewed the draft critically for important intellectual content and approved the final version to be published.

AUTHOR DUALITIES

LD is Chair of the COMPUS Expert Review Committee (CERC). MD has received a speaker's fee from Connaught Novo Company. No dualities of interest declared for CC, HD, ME and AV.

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