Canadian Agency for Drugs and Technologies in Health

Agence canadienne des médicaments et des technologies de la santé

OPTIMAL THERAPY REPORT

COMPUS

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Current Utilization of Blood Glucose Test Strips in Canada

Supporting Informed Decisions

À l'appui des décisions éclairées

This report is prepared by the Canadian Optimal Medication Prescribing and Utilization Service (COMPUS), a service of the Canadian Agency for Drugs and Technologies in Health (CADTH).

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Dr. Marshall Dahl, MD PhD FRCPC
Clinical Associate Professor,
Division of Endocrinology,
University of British Columbia

Contributors from COMPUS

Denis Bélanger, BScPhm ACPR
Director, COMPUS Topics and Research

Heather Bennett, BPharm PhD
Manager, COMPUS Research

Chris Cameron, BSc DipEng MSc
Health Economist

Melissa Severn, MISt
Information Specialist

Barb Shea, BSP
Vice-President, COMPUS

Sumeet R. Singh, BScPhm MSc RPh
Officer, Optimal Practice

COMPUS Expert Review Committee

Dr. Lisa Dolovich, Chair
Research Director and Associate Professor, Department of Family Medicine, McMaster University
Ambulatory Care Pharmacotherapy Specialist, St. Joseph's Healthcare
Associate Director, Centre for Evaluation of Medicines

Dr. Mike Evans, Vice-Chair
Director, Patient Self-Management and Knowledge Support
Centre for Effective Practice, Department of Family and Community Medicine, University of Toronto
Director, Health Media Lab, Li Ka Shing Knowledge Institute
Staff Physician, Toronto Western Hospital
Associate Professor, University of Toronto

Members

Dr. Michael Allen
Associate Professor,
Director, Evidence-based Programs,
Continuing Medical Education, Dalhousie University

Dr. Marilyn Caughlin
Family Practitioner

Dr. Scott Klarenbach
Assistant Professor, Department of Medicine, Division of Nephrology, University of Alberta
Fellow, Institute of Health Economics

Ms. Cathy MacNutt
Public Member

Mr. Panos Petrides
Public Member

Dr. Adil Virani
Director, Pharmacy Services, Fraser Health Authority
Associate Professor, Faculty of Pharmaceutical Sciences, University of British Columbia

Specialist Expert Members

Dr. Marshall Dahl
Clinical Associate Professor,
Division of Endocrinology,
University of British Columbia

Dr. Heather Dean
Professor of Pediatrics and Child Health
Associate Dean (Academic), Faculty of Medicine,
Department of Pediatrics, Section of Pediatric Endocrinology and Metabolism, University of Manitoba

Dr. Ann Colbourne
Director, Division of General Internal Medicine,
University of Alberta

Dr. Ehud Ur
Professor of Medicine,
University of British Columbia
Head, Division of Endocrinology,
St. Paul's Hospital and Vancouver General Hospital

Conflicts of Interest

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ABBREVIATIONS

C$	Canadian dollars
CAC	COMPUS Advisory Committee
CADTH	Canadian Agency for Drugs and Technologies in Health
CCOHTA	Canadian Coordinating Office for Health Technology Assessment
CERC	COMPUS Expert Review Committee
COMPUS	Canadian Optimal Medication Prescribing and Utilization Service
NIHB	Non-Insured Health Benefits (Program)
NPDUIS	National Prescription Drug Utilization Information System
SMBG	self-monitoring of blood glucose

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1 INTRODUCTION

In March 2004, the Canadian Optimal Medication Prescribing and Utilization Service (COMPUS) was launched by the Canadian Coordinating Office for Health Technology Assessment (CCOHTA) — now the Canadian Agency for Drugs and Technologies in Health (CADTH) — as a service to federal, provincial, and territorial jurisdictions and other stakeholders. COMPUS is a nationally coordinated program, funded by Health Canada.

The goal of COMPUS is to optimize drug-related health outcomes and cost-effective use of drugs by identifying and promoting optimal drug prescribing and use. Where possible, COMPUS builds on existing applicable Canadian and international initiatives and research. COMPUS goals are achieved through three main approaches:

- identifying evidence-based optimal therapy in prescribing and use of specific drugs
- identifying gaps between evidence-based optimal therapy and clinical practice, then proposing evidence-based interventions to address these gaps
- supporting the implementation of these interventions.

Direction and advice are provided to COMPUS through various channels, including the following:

- the COMPUS Advisory Committee (CAC): includes representatives from the federal, provincial, and territorial Health Ministries and related health organizations
- the COMPUS Expert Review Committee (CERC): advisory in nature and provides recommendations related to the identification, evaluation, and promotion of optimal drug prescribing and use in Canada
- stakeholder feedback.

1.1 COMPUS Expert Review Committee

The COMPUS Expert Review Committee (CERC) consists of eight Core Members appointed to serve for all topics under consideration during their term of office. As well, three or more Specialist Experts are appointed to provide their expertise in recommending optimal therapy for one or more specific topics. For the insulin analogues and blood glucose test strips, the four endocrinologists/diabetes specialists were appointed as Specialist Experts. Two of the Core Members are Public Members who bring a lay perspective to the committee. The remaining six Core Members hold qualifications as physicians, pharmacists, or health economists, or have other relevant qualifications with expertise in one or more areas such as, but not limited to family practice, internal medicine, institutional or community clinical pharmacy, pharmacoeconomics, clinical epidemiology, drug utilization expertise, methodology, affecting behaviour change (through health professional and/or patient and/or policy interventions), and critical appraisal. The Core Members, including Public Members, are appointed by the CADTH Board of Directors.

The mandate of CERC is advisory in nature and consists of providing recommendations and advice to CADTH's COMPUS Directorate on assigned topics that relate to the identification, evaluation, and promotion of optimal practices in the prescribing and use of drugs across Canada. The overall perspective used by CERC members in producing recommendations is that of public health care policy makers in pursuit of optimizing the health of Canadians within available health care system resources.

2 THE ISSUE

The COMPUS Advisory Committee (CAC) has identified management of diabetes mellitus as being a priority area for optimal practice initiatives, based on the following criteria:

- large deviations from optimal utilization (overuse or underuse)
- size of patient populations
- impact on health outcomes and cost-effectiveness
- potential to effect change
- benefit to multiple jurisdictions
- measurable outcomes.

Within diabetes mellitus management, optimal use of blood glucose test strips in patients with type 1, type 2, and gestational diabetes mellitus was identified by CAC as a priority topic.

Despite widespread use, there is controversy regarding the benefits of self-monitoring of blood glucose (SMBG), especially in patients with type 2 diabetes mellitus not using insulin.[1-4] Moreover, the optimum frequency of testing has not been defined in any population.[5,6] A need exists for the identification of clinical and economic evidence relating to the optimal prescribing and use of SMBG. Costs associated with SMBG are rising due to the increasing prevalence of diabetes in Canada and higher rates of self-monitoring.[7] In 2005/2006, the Nova Scotia Seniors' Pharmacare Program spent $4 million on blood glucose test strips, approximately 60% of which was spent on beneficiaries who were not using insulin agents.[8] In Saskatchewan, of the $6.5 million spent on diabetic testing supplies in 2001 (most of it on blood glucose test strips), approximately half was for people who were not using insulin agents.[9] Evidence relating to the optimal prescribing and use of SMBG may assist policy decision makers, consumers, and health care providers in making informed decisions for patients with type 1, type 2, and gestational diabetes mellitus.

2.1 Diabetes Mellitus

Diabetes mellitus is a chronic disease characterized by the body's inability to produce sufficient insulin and/or properly use insulin.[10] Type 1 diabetes mellitus occurs in approximately 10% of patients with diabetes, and it results when little or no insulin is produced by the body.[11] Type 2 diabetes mellitus is a metabolic disorder caused by varying degrees of insulin resistance; the body usually produces insulin, but is unable to use it properly.[11] When inadequately managed, diabetes is likely to result in poor glycemic control.[10] Impaired glycemic control, if prolonged, may result in diabetes-related complications (e.g., ischemic heart disease, stroke, blindness, end-stage renal disease, lower limb amputation).[12,13]

The global prevalence of diabetes is estimated to be 246 million and is projected to increase to 380 million by 2025.[14] In 2004/2005, approximately 1.8 million (5.5%) Canadians aged 20 years and older had diagnosed diabetes.[15] However, it is estimated that 2.8% of the general adult population has undiagnosed type 2 diabetes mellitus,[5] and the true prevalence of diabetes may actually approach 2.0 million.[16]

2.1.1 Management of blood glucose levels in diabetes mellitus

One goal of diabetes mellitus management is to maintain control of blood glucose levels in order to reduce the patient's risk of developing long-term diabetes-related complications. Lifestyle modifications (i.e., weight control, proper nutrition, and adequate exercise), the use of medications (e.g., insulin and oral antidiabetic drugs), and SMBG are recommended approaches in improving glycemic control.[5] This report focuses on the use and frequency of blood glucose testing by patients with diabetes.

2.1.2 Technology description — self-monitoring of blood glucose

The purpose of SMBG is to collect detailed information about glucose levels across various time points each day and take appropriate action should those levels be outside the desired range.[7,17] SMBG requires that patients prick their finger with a lancet device to obtain a small blood sample (0.3 µL to 5 µL).[7,17] The blood is applied to a reagent strip or blood glucose test strip, and glucose concentration is determined by inserting the blood-laden strip into a reflectance photometer, or an electrochemical sensor.[7] Results, based on an automated reading, are available from the photometer within five to 30 seconds.[7] The results can be stored in the glucose meter's electronic memory or recorded in the patient's logbook. It has been suggested that patients can adjust food intake, physical activity, and pharmacotherapy in response to their blood glucose readings and thus are better able to maintain optimal glycemic control on a day-to-day basis.[7,17]

3 OBJECTIVE

The objective of this report was to explore current utilization patterns of blood glucose test strips in Canada.

4 PROJECT OVERVIEW

Once a topic is selected, COMPUS undertakes activities related to key areas in the COMPUS procedure. The CAC provides advice and guidance throughout the process, from topic identification, through to feedback and approval of recommendations and supporting interventions. CERC, as described in Section 1.1, provides expert advice and recommendations on the topic area relating to the identification, evaluation, and promotion of optimal prescribing and use of drugs. A broad range of stakeholders are invited to provide feedback at key stages in the COMPUS process.

To identify and promote the implementation of evidence-based and cost-effective optimal therapy in the use of blood glucose test strips, COMPUS follows the process outlined in the flow chart to the right (Figure 1).

This document provides a detailed report of the methods and results of the utilization analysis (see green highlight in Figure 1) that was performed as part of the blood glucose test strip project.

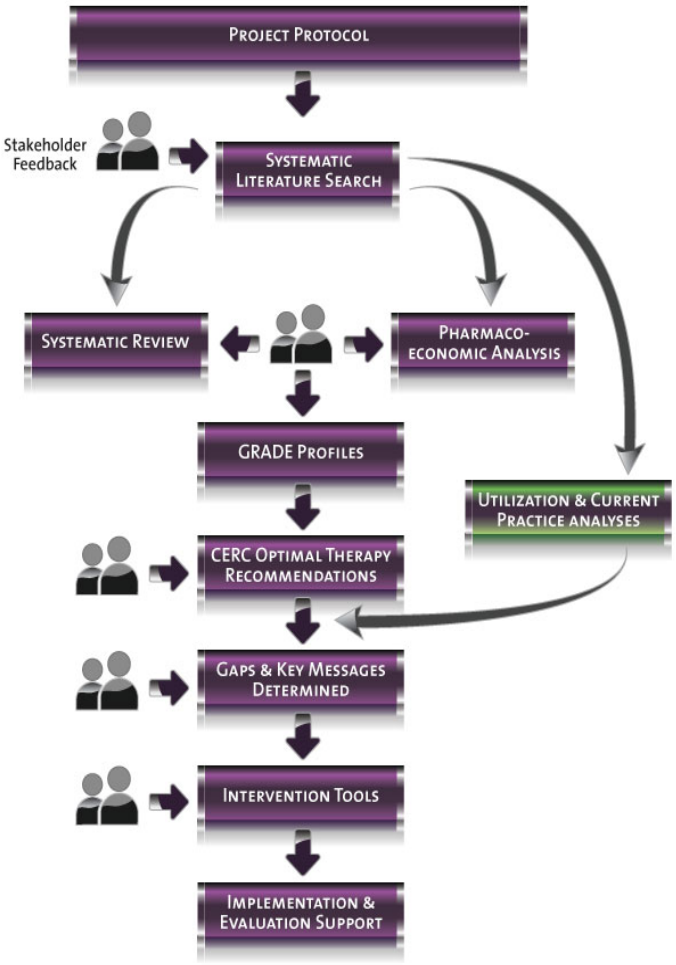


Figure 1: Flow chart of COMPUS process

5 METHODS

Administrative claims data from publicly and privately funded drug plans in Canada formed the basis of this retrospective database analysis. Frequency and cost of blood glucose test strips claimed per person, per day, were calculated, as were total utilization and expenditure on blood glucose test strips.

5.1 Data Source

Aggregate-level and claims-level data were provided by Brogan Inc.[18] Aggregate-level data were available for the publicly funded drug plans in British Columbia, Saskatchewan, Manitoba, Ontario, Québec, Nova Scotia, Newfoundland and Labrador, and the Non-Insured Health Benefits (NIHB) Program. Claims-level data were available for the Ontario Drug Benefit Program and 67% of privately funded drug plans in Canada[18] (Nevzeta Bosnic, Brogan Inc., Ottawa, ON: personal communication, September 8, 2008).

The National Prescription Drug Utilization Information System (NPDUIS) was contacted to obtain claims-level data for other publicly funded drug plans in Canada. Among jurisdictions submitting data to NPDUIS, data on diabetes testing supplies were included for publicly-funded drug plans in Nova Scotia, Manitoba, and Saskatchewan. At the time of analysis, units dispensed were not available in the NPDUIS data. Consequently, frequency of blood glucose test strips dispensed per person, per day, could not be calculated.

5.2 Data Analysis

Aggregate-level data, total utilization (i.e., number of blood glucose test strips claimed), expenditures, and average cost per blood glucose test strip 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 two-step process. First, patients had to have made at least one claim for blood glucose test strips between January 1, 2006 and December 31, 2006. Their most recent claim for blood glucose test strips was identified as their index claim, and data for the 12-month interval following the index claim formed the basis of the analyses. Second, patients had to be active in the database by having at least one claim in the 12-month follow-up period. This ensured that patients did not die or switch drug plans. Data were classified by treatment groups, as follows:

- patients using insulin alone
- patients using insulin plus oral antidiabetes drug(s)
- patients using oral antidiabetes drug(s) alone
- patients not using pharmacotherapy for diabetes.

The total number of patients, total number of claims for blood glucose test strips, total number of blood glucose test strips claimed, and total expenditure on blood glucose test strips were calculated by treatment group and type of drug plan. As well, the average daily number of blood glucose test strips claimed, and the average daily expenditure per person, were calculated by treatment group and age group (i.e., <15 years, 15 to 24 years, 25 to 44 years, 45 to 64 years, ≥ 65 years).

6 RESULTS

6.1 Publicly Funded Drug Plans in Canada

Data on current utilization and expenditure on blood glucose test strips in Canadian public drug plans is presented in Table 1. Annual expenditures in 2006 ranged from C$5.7 million for 6.4 million blood glucose test strips in Newfoundland and Labrador to C$109.4 million for 153.0 million blood glucose test strips in Ontario. The average cost per blood glucose test strip ranged from C$0.72 in Ontario to C$0.89 in Newfoundland and Labrador.

Table 1: Number of Blood Glucose Test Strips Claimed, Total Expenditure, and Average Cost Per Blood Glucose Test Strip for Publicly Funded Drug Plans in Canada in 2006, by Jurisdiction

Jurisdiction	Number of Blood Glucose Test Strips Claimed	Expenditure (C$)	Average Cost of Blood Glucose Test Strips (C$)
British Columbia	37,917,214	28,508,780	0.75
Manitoba	14,629,288	11,674,293	0.80
Newfoundland & 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
Québec	80,417,880	66,275,986	0.82
Saskatchewan	12,976,577	10,268,123	0.79

C$=Canadian dollars; NIHB=Non-Insured Health Benefits (Program)

6.2 Ontario Drug Benefit Program

6.2.1 Blood glucose test strip utilization

During the twelve-month analysis period, 269,235 Ontario Drug Benefit Program patients made 1.2 million claims for 153 million blood glucose test strips for a total expenditure of C$109.4 million (Table 2). The majority of patients who claimed for blood glucose test strips (83%) were ≥ 65 years of age.

Table 2: Number of Patients in Ontario Drug Benefit Program Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Age and Treatment Group						
Treatment Group	**Number of Patients By Age Group (Years)**					Total
	< 15	**15–24**	**25–44**	**45–64**	**• 65**	
Insulin alone	508	686	2,242	4,862	22,661	30,959
Insulin + OAD	6	44	1,019	6,506	22,639	30,214
No pharmaco-therapy for diabetes	93	135	1,507	4,417	40,972	47,124
OADs alone	12	100	3,342	20,874	136,610	160,938
Total	619 (0%)	965 (0%)	8,110 (3%)	36,659 (14%)	222,882 (83%)	269,235 (100%)

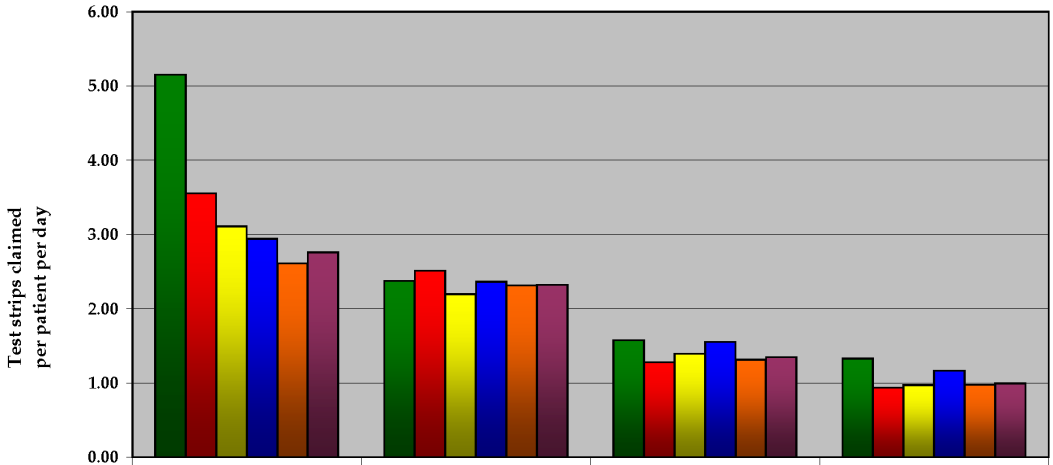
OADs=oral antidiabetes drug(s)

Table 3 presents the number of patients, claims, test strips claimed, and average number of tests strips claimed per patient, per day, in the Ontario Drug Benefit Program. The majority of claims (54%) and the greatest number of blood glucose test strips claimed (79 million) were by patients using oral antidiabetes drug(s) alone. However, the average daily number of blood glucose test strips was higher for patients using insulin alone (2.76 strips per day [standard deviation=3.71]), and for those using insulin with oral antidiabetes drug(s) (2.32 strips per day [standard deviation=4.53]) than for patients taking oral antidiabetes drug(s) alone (1.35 strips per day [standard deviation=2.24]) and for those not using pharmacotherapy for diabetes (0.99 strips per day [standard deviation=1.46]). For patients using insulin alone, those ≤ 15 years of age claimed 1.5 to 2.0 times more blood glucose test strips per day than did older patients.

Table 3: Number of Patients, Claims, and Blood Glucose Test Strips in a 12-Month Period for Patients in the Ontario Drug Benefit Program Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment Group				
Treatment Group	**Number (%) of**			**Average Number of Strips Claimed Daily Per Patient (Standard Deviation)**
	Patients	**Claims**	**Blood Glucose Test Strips Claimed**	
Insulin alone	30,959	225,542 (18%)	31,198,044 (20%)	2.76 (3.71)
Insulin + OAD	30,214	197,005 (16%)	25,589,681 (17%)	2.32 (4.53)
OADs alone	160,938	662,288 (54%)	79,151,388 (52%)	1.35 (2.24)
No pharmacotherapy for diabetes	47,124	147,335 (12%)	17,079,794 (11%)	0.99 (1.46)
Total	269,235	1,232,170 (100%)	153,018,907 (100%)	1.56 (2.75)

OAD=oral antidiabetes drug(s)

Figure 2: Average Number of Blood Glucose Test Strips Claimed Per Patient, Per Day, from the Ontario Drug Benefit Program, for Patients Who Made At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group



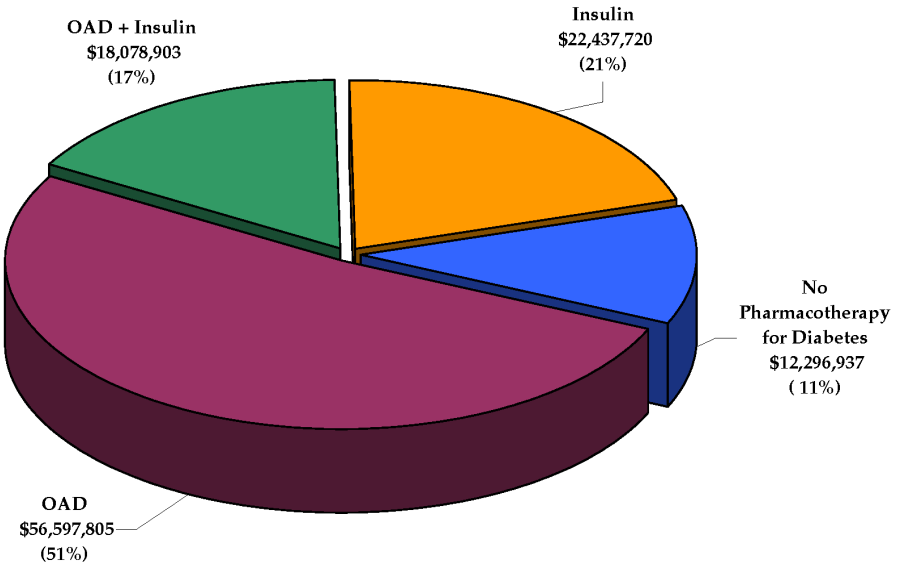
	Insulin	OAD + insulin	OAD	No pharmacotherapy for diabetes
< 15y	5.15	2.37	1.58	1.33
15-24y	3.55	2.51	1.28	0.94
25-44y	3.11	2.20	1.39	0.97
45-64y	2.94	2.36	1.55	1.17
≥ 65y	2.61	2.31	1.32	0.97
All ages	2.76	2.32	1.35	0.99

OAD=oral antidiabetes drug; y=years

6.2.2 Expenditures on blood glucose test strips

Of the total C$109.4 million expended by the Ontario Drug Benefits Program on blood glucose test strips, the majority (62%) was for patients who did not make claims for insulin (Figure 3: OAD + No Pharmacotherapy). Of the total number of blood glucose test strips claimed, patients taking oral antidiabetes drug(s) without insulin accounted for 51% (79 million blood glucose test strips), those using insulin only or insulin plus oral antidiabetes drug(s) for 38% (57 million strips), and those not using pharmacotherapy for diabetes for 11% (17 million blood glucose test strips). Table 4 presents expenditure on blood glucose test strips, stratified by age and treatment group. Regarding age, substantially more was expended on blood glucose test strips for the ≥ 65 years age group (C$86 million) than for the 15 to 24 years age group (C$686,000), primarily for patients taking either oral antidiabetes drug(s) or no pharmacotherapy for diabetes (C$57 million dollars or 66%).

Figure 3: Expenditure By the Ontario Drug Benefit Program on Blood Glucose Test Strips Claimed in a 12-Month Period, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment Group



OAD= oral antidiabetes drug

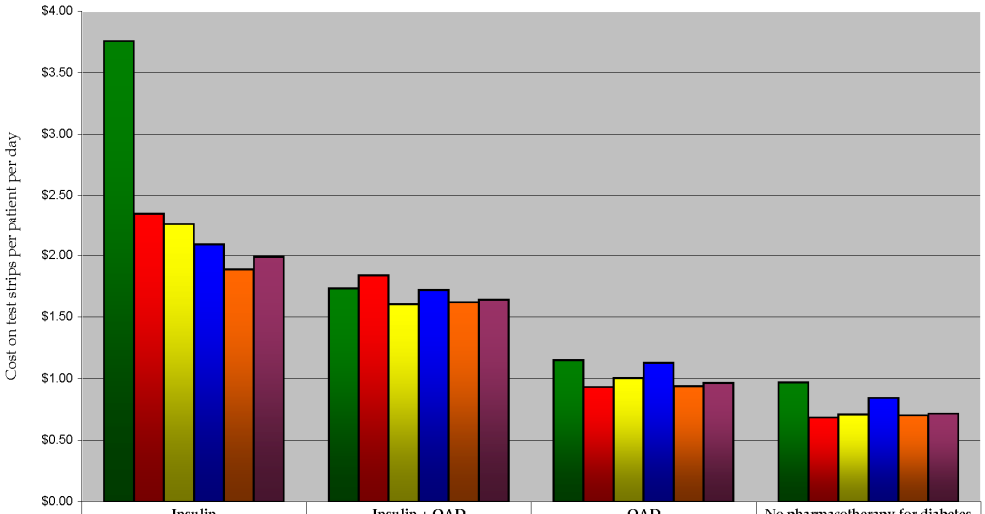
Table 4: Expenditure on Blood Glucose Test Strips Claimed from the Ontario Drug Benefit Program in a 12–month Period, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group

Treatment Group	Expenditure (C$) on Blood Glucose Test Strips By Age Group (Years)					Total Expenditure (C$)
	< 15	15–24	25–44	45–64	∘ 65	
Insulin alone	696,829	589,287	1,844,269	3,705,141	15,602,195	22,437,721
OAD + insulin	3,791	29,482	595,896	4,079,787	13,369,947	18,078,903
OADs alone	5,027	33,989	1,224,342	8,578,494	46,755,953	56,597,805
No pharmacotherapy for diabetes	32,820	33,659	389,576	1,357,177	10,483,704	12,296,936
Total	738,467	686,417	4,054,083	17,720,599	86,211,799	109,411,365

C$=Canadian dollars; OAD=oral antidiabetes drug(s)

The average daily expenditure for patients taking oral antidiabetes drugs (C$0.96) and those not using pharmacotherapy for diabetes (C$0.71) was lower than for patients using insulin plus oral antidiabetes drugs (C$1.64) and for those using insulin alone (C$1.99). For patients using insulin alone, those ≤ 15 years of age expended .6 to 2.0 times more on test strips per day than did older patients (Figure 4).

Figure 4: Average Daily Expenditure Per Claimant for Patients Who Had At Least One Ontario Drug Benefits Program Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group



	Insulin	Insulin + OAD	OAD	No pharmacotherapy for diabetes
< 15y	$3.76	$1.73	$1.15	$0.97
15-24y	$2.35	$1.84	$0.93	$0.68
25-44y	$2.25	$1.60	$1.00	$0.71
45-64y	$2.09	$1.72	$1.13	$0.84
≥ 65y	$1.89	$1.62	$0.94	$0.70
Total	$1.99	$1.64	$0.96	$0.71

OAD= oral antidiabetes drug; y=year

6.3 Privately funded drug plans

6.3.1 Blood glucose test strip utilization

For privately funded drug plans, 203,343 beneficiaries were included in the analysis. During the twelve-month analysis period, there were 892,189 claims for 101.1 million blood glucose test strips for a total expenditure of C$82 million. Of those who claimed for blood glucose test strips, the majority (68%) were 45 to 64 years of age (Table 5).

Table 5: Number of Patients in Privately Funded Drug Plans Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Age and Treatment Group

Treatment Group	Number of Patients (%) By Age Group (Years)					Total
	< 15	15–24	25–44	45–64	∘ 65	
Insulin alone	3,421	4,082	12,117	13,939	1,713	35,272
Insulin + OAD	32	146	2,922	15,048	1,999	20,147
OADs alone	18	191	12,993	81,284	11,367	105,853
No pharmacotherapy for diabetes	272	481	9,247	25,015	4,056	39,071
Total	3,743 (2%)	4,900 (2%)	37,279 (19%)	135,286 (68%)	19,135 (10%)	200,343

OAD=oral antidiabetes drug(s)

The majority of claims for blood glucose test strips were made by patients using oral antidiabetes drug(s) (53%), and those not using pharmacotherapy for diabetes (19%). Of all patients, 18% were using insulin alone, and 10% were using insulin plus oral antidiabetes drugs (Table 6).

Of the total number of strips claimed, the majority (54%) were claimed by patients using insulin alone (40%) and those taking oral antidiabetes drugs plus insulin (14%). Patients using oral antidiabetes drugs without insulin, and those not using diabetes-related pharmacotherapy, accounted for 36% and 10% of the total number of blood glucose test strips claimed, respectively (Table 6).

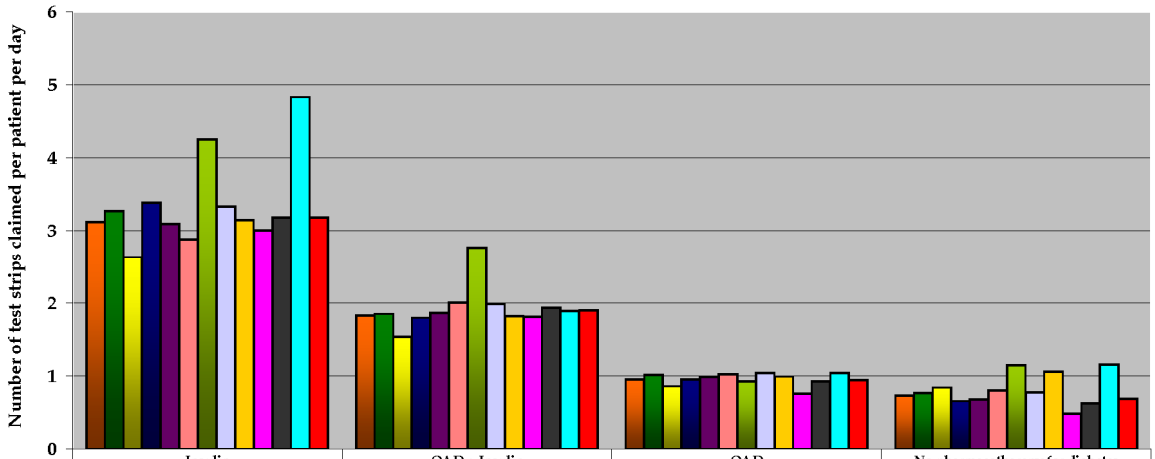
Patients using insulin alone, and those using insulin plus oral antidiabetes drugs, claimed more blood glucose test strips per day (3.18 [standard deviation=2.70], and 1.90 test strips per day [standard deviation=1.48], respectively) than did patients taking oral antidiabetes drugs without insulin (0.94 test strips per day [standard deviation=0.85]) and those not using pharmacotherapy for diabetes (0.69 test strips per day [standard deviation=1.95]) (Table 6). The geographic variation in the average daily per person use of blood glucose test strips is provided in Figure 5. For patients using insulin, those $\leq$ 15 years of age claimed 1.6 to 2.1 times more blood glucose test strips per day than those in older age groups (Figure 6).

Table 6: Number of Patients, Claims, and Blood Glucose Test Strips in a 12-Month Period, for Patients in Privately Funded Drug Plans Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment Group

Treatment Group	Number (%) Of			Average Number of Strips Claimed Daily Per Patient (Standard Deviation)
	Patients	Claims	Blood Glucose Test Strips Claimed	
Insulin alone	35,272 (18%)	305,413 (18%)	40,977,853 (40%)	3.18 (2.70)
Insulin + OAD	20,147 (10%)	122,075 (10%)	13,962,111 (14%)	1.90 (1.48)
OADs alone	105,853 (53%)	366,086 (53%)	36,362,579 (36%)	0.94 (0.85)
No pharmacotherapy for diabetes	39,071 (19%)	98,615 (19%)	9,774,919 (10%)	0.69 (1.95)
Total	203,343	892,189 (100%)	101,077, 462 (100%)	1.38 (1.85)

OAD=oral antidiabetes drug(s)

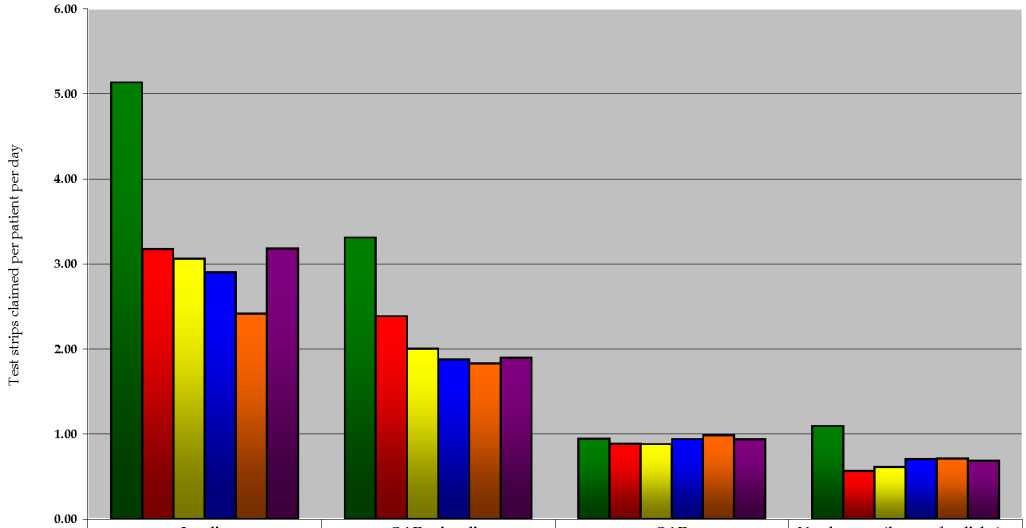
Figure 5: Average Daily Number of Test Strips Claimed Per Patient From Privately Funded Drug Plans in Canada, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment Group and Jurisdiction



	Insulin	OAD + Insulin	OAD	No pharmacotherapy for diabetes
AB	3.12	1.83	0.95	0.73
BC	3.27	1.85	1.01	0.76
MB	2.64	1.53	0.86	0.84
NB	3.38	1.80	0.95	0.65
NL	3.09	1.86	0.98	0.67
NS	2.88	2.00	1.02	0.80
NW	4.25	2.76	0.92	1.15
ON	3.33	1.98	1.04	0.78
PEI	3.14	1.82	0.99	1.06
QC	3.01	1.81	0.76	0.48
SK	3.18	1.93	0.93	0.62
YU	4.83	1.89	1.04	1.16
Canada	3.18	1.90	0.94	0.69

AB=Alberta; BC=British Columbia; MB=Manitoba; NB=New Brunswick; NL=Newfoundland and Labrador; NS=Nova Scotia; NW=Northwest Territories; OAD=oral antidiabetes drug; ON=Ontario; PEI=Prince Edward Island; QC=Québec; SK= Saskatchewan; YK=Yukon

Figure 6: Average Number of Blood Glucose Test Strips Claimed Per Patient Per Day, from Privately Funded Drug Plans in Canada, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group



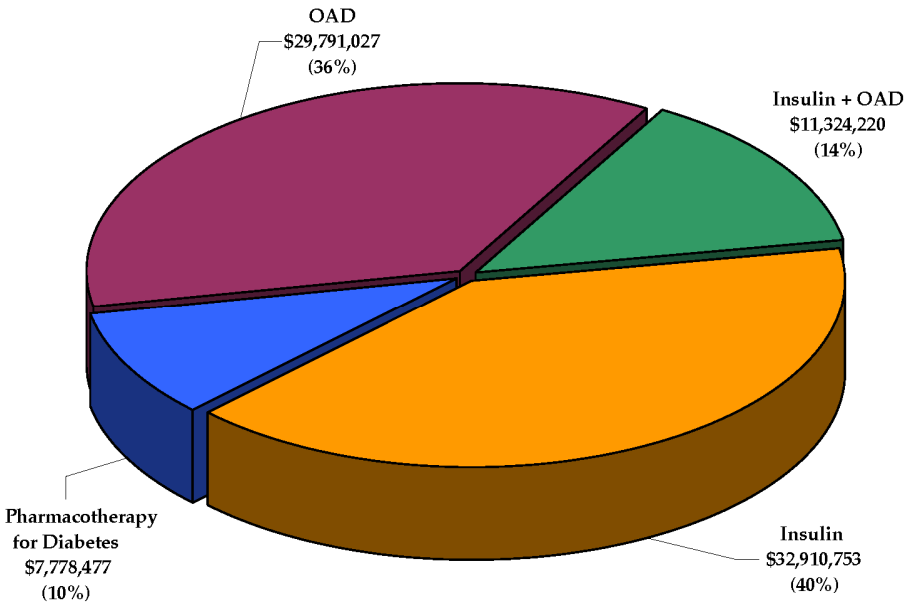
	Insulin	OAD + insulin	OAD	No pharmacotherapy for diabetes
< 15y	5.13	3.31	0.95	1.10
15-24y	3.18	2.39	0.89	0.57
25-44y	3.06	2.01	0.88	0.61
45-64y	2.90	1.88	0.94	0.71
≥ 65y	2.42	1.83	0.99	0.71
All ages	3.18	1.90	0.94	0.69

OAD=oral antidiabetes drug; y=years

6.3.2 Expenditure on blood glucose test strips

Of the C$81.4 million spent by privately funded drug plans on blood glucose test strips during the twelve-month analysis period, approximately C$44 million (54%) was attributable to patients taking insulin, either alone or in combination with oral antidiabetes drugs. Expenditure for patients taking oral antidiabetes drugs without insulin and for those not using pharmacotherapy for diabetes was C$30 million (36%) and C$8 million (10%), respectively (Figure 7). Percentage of total spending attributable to patients using insulin, either alone or with oral antidiabetes drugs, ranged from 53% in British Columbia, Québec, Ontario, and Manitoba to 62% in Alberta. For patients using oral antidiabetes drugs alone, the percentage ranged from 28% in Prince Edward Island to 38% in Québec (Table 7).

Figure 7: Expenditure By Privately Funded Drug Plans in Canada, On Blood Glucose Test Strips Claimed in a 12-Month Period, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment Group



OAD=oral antidiabetes drug(s)

Table 7: Expenditure By Privately Funded Drug Plans Over a 12-Month Period for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Jurisdiction and Treatment Group

Province	12-Month Spending (C$000)	Insulin		Insulin + OAD		OAD		No Pharmaco-therapy for Diabetes	
		(C$000)	%	(C$000)	%	(C$000)	%	(C$000)	%
AB	4,784	2,303	48	689	14	1,454	30	338	7
BC	9,619	3,663	38	1,409	15	3,437	36	1,109	12
MB	957	394	41	111	12	350	37	101	11
NB	1,185	517	44	197	17	374	32	98	8
NL	1,195	546	46	129	11	382	32	138	12
NS	2,597	998	38	471	18	875	34	253	10
NW	44	20	46	6	15	13	30	4	9
ON	38,262	15,297	40	5,081	13	14,287	37	3,597	9
PEI	461	206	45	68	15	128	28	59	13
QC	20,522	7,972	39	2,836	14	7,845	38	1,869	9
SK	1,653	745	45	266	16	509	31	134	8
YU	122	57	47	17	14	37	30	11	9
Total	81,401*	32,718*		11,280*		29,691*		7,711*	

AB=Alberta; BC=British Columbia; MB=Manitoba; NB=New Brunswick; NL=Newfoundland and Labrador; NS=Nova Scotia; NW= Northwest Territories; OAD=oral antidiabetes drug; ON=Ontario; PEI=Prince Edward Island; QC=Québec; SK=Saskatchewan; YK=Yukon
* Some patients in dataset could not be classified by province or territory. Consequently, estimate of 81.4 million is slightly less than value (81.8 million) presented in Figure 7.

Expenditure on blood glucose test strips totalled C$4 million for the 15 to 24 years age group, C$48 million for the 44 to 64 years age group, C$48 million in the 45 to 64 years age group, and C$6 million for the ≥ 65 years age group. A greater proportion of claimants in the <15 years age group (98%) were using insulin than in the ≥ 65 years age group (35%) (Table 8).

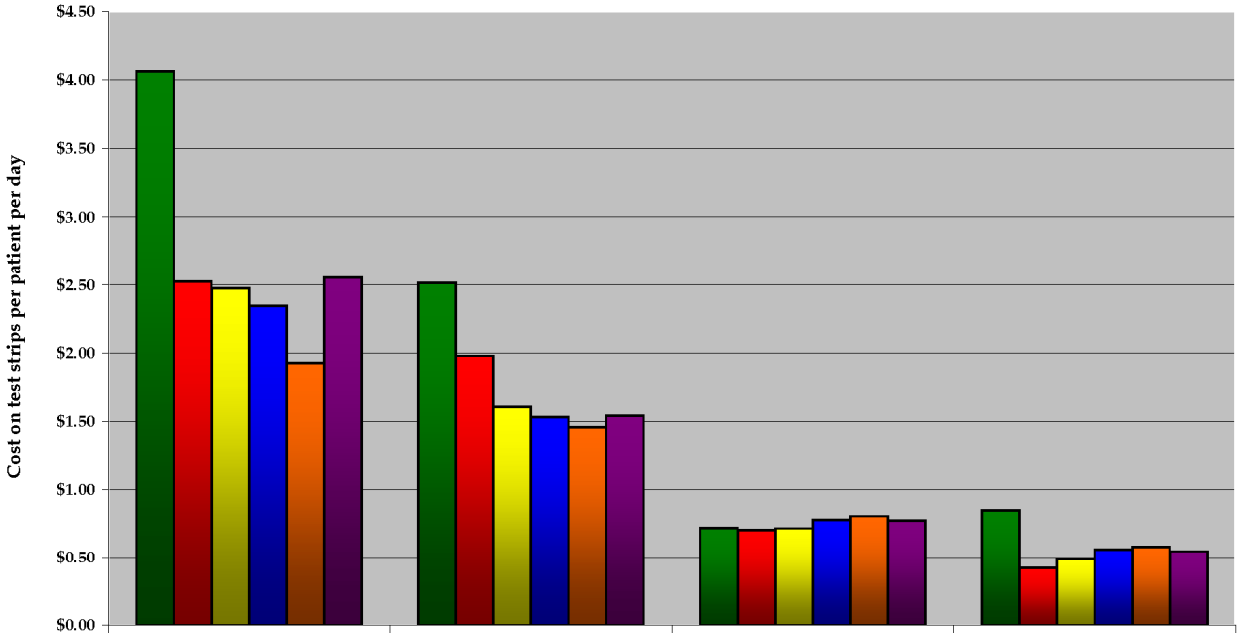
Table 8: Expenditure on Blood Glucose Test Strips Claimed from Privately Funded Drug Plans in Canada in a 12-Month Period, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group

Treatment Group	Expenditure (C$) on Blood Glucose Test Strips By Age Group (Years)					Total Expenditure (C$)
	< 15	15–24	25–44	45–64	∘ 65	
Insulin alone	5,072,556	3,761,371	10,940,573	11,931,618	1,204,635	32,910,753
OAD + insulin	29,380	105,428	1,711,629	8,414,688	1,063,096	11,324,220
OADs alone	4,701	48,964	3,387,559	23,015,281	3,334,521	29,791,027
No pharmacotherapy for diabetes	84,170	74,179	1,663,117	5,103,198	853,812	7,778,477
Total	5,190,807	3,989,942	17,702,878	48,464,785	6,456,064	81,804,476

C$=Canadian dollars; OAD=oral antidiabetes drug(s)

Average daily expenditure on blood glucose test strips for patients using insulin alone, and those using insulin plus oral antidiabetes drugs, was C$2.56 and C$1.54, respectively. For patients taking oral antidiabetes drugs without insulin, and those not using pharmacotherapy for diabetes, the average daily cost was C$0.77 and C$0.55 per day, respectively (Figure 8).

Figure 8: Average Expenditure Per Patient Per Day On Blood Glucose Test Strips, By Privately Funded Drug Plans, for Patients Who Had At Least One Claim for Blood Glucose Test Strips in 2006, By Treatment and Age Group



	Insulin	Insulin + OAD	OAD only	No pharmacotherapy for diabetes
< 15y	$4.06	$2.52	$0.72	$0.85
15-24y	$2.52	$1.98	$0.70	$0.42
25-44y	$2.47	$1.60	$0.71	$0.49
45-64y	$2.35	$1.53	$0.78	$0.56
≥ 65y	$1.93	$1.46	$0.80	$0.58
All ages	$2.56	$1.54	$0.77	$0.55

OAD=oral antidiabetes drug

7 DISCUSSION

This study provides a number of insights into blood glucose test strip utilization and expenditure in Canada. For both publicly and privately funded drug plans, the majority of patients who claimed for blood glucose test strips were > 45 years of age, and the majority of claimants were not using insulin for the management of their diabetes. In privately funded drug plans, most claimants were between 45 and 64 years of age, while those in the publicly funded Ontario Drug Benefit Program were ≥ 65 years of age. The slightly lower age in the privately funded drug plans may be attributable to drug coverage in some jurisdictions in Canada for individuals over 65 years of age and the migration of patients to those public plans upon retirement.

In the publicly funded Ontario Drug Benefit Program, C$109.4 million was spent on blood glucose test strips, of which C$68.8 million was spent on patients not using insulin therapy. In privately funded drug plans, C$81.8 million was spent on blood glucose test strips, with C$37.5 million expended on patients who are not using insulin. The expenditure among patients who are not using insulin is not surprising when one considers that the prevalence of type 2 diabetes greatly exceeds type 1 diabetes in Canada.[11,19,20]

In the publicly funded Ontario Drug Benefit Program, 62% of total test strip expenditure was for patients not using insulin. Similar findings[21] have been reported in the Nova Scotia Seniors' Pharmacare Program, where 64% of test strip expenditure was for beneficiaries not using insulin. In contrast, 46% of total expenditure in privately funded drug plans was for patients not using insulin. Differences between publicly and privately funded drug plans may be attributable to a relatively older population enrolled in public plans. The prevalence of type 2 diabetes is much higher among elderly patients[11,19,20] and many of these patients are managed without insulin therapy.[22]

For both publicly funded and privately funded drug plans, patients using insulin — either alone or in conjunction with oral antidiabetes drugs — used more blood glucose test strips per day, and incurred higher average daily costs than did patients not using insulin. However, daily utilization and corresponding expenditure differed between the publicly funded Ontario Drug Benefit Program and privately funded drug plans. For patients taking insulin only, daily utilization and expenditure was higher in privately funded drug plans. In contrast, daily utilization and costs were higher in publicly funded drug plans for patients taking oral antidiabetes drugs; insulin, in conjunction with antidiabetes drugs; and for patients not taking pharmacotherapy.

Amongst those using insulin in both publicly and privately funded drug plans, patients < 15 years of age used more strips per day than did patients aged 15 to 24. This finding may be due to rigorous testing by parents to ensure ongoing stable glycemic control in children.[5,23] As children mature, and underlying physical processes stabilize, parental control may lessen, leading to the decreased use of blood glucose test strips observed among older patients (aged 15 to 24 years).[5,23] Available data did not allow for investigation of this assumption.

Some limitations of this analysis exist. First, claims level data for publicly funded drug plans were available for the Ontario Drug Benefit Program only. Thus, utilization of blood glucose test strips, and related expenditure, by treatment modality and age-group for other publicly funded drug programs in Canada was not estimable. Second, the data set used for the analysis did not contain diagnostic codes, and classification by type of diabetes was not performed. Third, estimates of blood glucose test strip utilization and expenditure for special drug programs (e.g., the Nova Scotia Diabetes Assistance Program) were not included in the analysis. These special drug programs, however, represent a small proportion of publicly funded drug plans in Canada. Fourth, a small number of patients in the publicly funded Ontario Drug Benefit Program who are taking drugs that

are not listed as a benefit may have been assigned to an incorrect treatment group. Finally, our analysis provides information on the average number of blood glucose test strips claimed by beneficiaries, not on actual patterns (e.g., intermittent use) of blood glucose test strip use.

8 CONCLUSION

In privately and publicly funded drug plans in Canada, current utilization of blood glucose test strips for SMBG is considerable. Large numbers of patients who use blood glucose test strips do not use insulin in the management of their diabetes. The increasing prevalence of type 2 diabetes may further increase the costs associated with SMBG. Furthermore, although it is suggested that SMBG results in improved health outcomes for people with diabetes,[24] the benefit for those with type 2 diabetes not using insulin therapy is less clear.[3,25-27] To assist those responsible for decisions regarding the optimal prescribing and use of blood glucose test strips for the management of diabetes, both clinical- and cost-effectiveness evidence on the practice of SMBG is needed.[7,28]

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