

Systematic Review/Meta-analysis

Cardiovascular Risk Factor Management Performance in Canada and the United States: A Systematic Review

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See editorial by Teo and Dokainish, pages 300–302 of this issue.

ABSTRACT

Background: Comparative cardiovascular risk factor care across North America is unknown. We aimed to determine current performance in Canada and the United States (US).

Methods: A systematic review was conducted of Medline and EMBASE (to June 1, 2014). Eligible studies reported on screening, awareness, treatment, or control rates for hypertension, dyslipidemia, diabetes, and smoking. Categorical performance 'ratings' on the basis of the most successful US health plans were used to classify rates as sub-optimal (< 50%), below target (50%-70%), above target (70%-90%), or optimal (> 90%).

Results: A total of 127 studies reporting on 10,510,324 individuals across North America were included. Hypertension awareness (84.3%) and treatment (82.0%) rates in Canada and the US (82.7% and 75.6%,

RÉSUMÉ

Introduction : La prise en charge des facteurs de risque cardiovasculaire en Amérique du Nord n'a pas fait l'objet d'études comparatives. Nous avons pour objectif de déterminer la performance actuelle au Canada et aux États-Unis (É.-U.).

Méthodes : Nous avons procédé à un examen systématique de Medline et d'EMBASE (jusqu'au 1^{er} juin 2014). Les études admissibles faisaient état des taux de dépistage, de sensibilisation, de traitement ou de maîtrise de l'hypertension, de la dyslipidémie, du diabète et du tabagisme. Nous avons utilisé les « cotes » de performance catégoriques s'appuyant sur les régimes de santé les plus prospères des É.-U. pour classer les taux comme étant sous-optimaux (< 50 %), sous les cibles (50 %-70 %), au-dessus des cibles (70 %-90 %), ou optimaux (> 90 %).

Hypertension, dyslipidemia, diabetes, and smoking are established coronary heart disease risk factors whose effective management has

been shown to reduce cardiovascular (CV) events.¹⁻⁵ National guidelines recommend screening for these risk factors universally among patients with established coronary heart disease and among targeted at-risk populations for primary prevention of CV disease.⁶⁻⁸ There are also guidelines specific to the detection and management of hypertension,^{9,10} dyslipidemia,¹¹⁻¹³ diabetes,^{14,15} and smoking,^{16,17} as well as recommendations to enhance the implementation of CV practice guidelines.¹⁸

It is unclear to what extent CV guidelines have been implemented in routine clinical practice. Physician awareness

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See page 400 for disclosure information.

respectively) were above target, whereas control in both nations was below target (68.1% vs 51.8%, respectively). Canadian awareness, treatment, and control rates for dyslipidemia (42.7%, 40.9%, and 41.5%, respectively) were suboptimal, and American indicators were generally below target (61.5%, 43.0%, and 63.6%, respectively). Canada and the US showed diabetes awareness (88.2% vs 86.8%) and treatment rates (82.3% vs 82.5%) above target. However, glucose control was suboptimal in Canada (35.3%), and below target in the US (58.8%). There was a modest decline in absolute smoking prevalence rates in Canada from 1999 to 2013 (25.2% to 14.6%). Screening for tobacco use (72.2%) and counselling rates (73.8%) in the US were above target.

Conclusions: Substantial variation exists in cardiovascular risk factor care across North America. Standardized reporting, dissemination of practice guidelines, and setting explicit goal-directed targets for performance might facilitate improvement.

of CV prevention guidelines in the United States (US) is high, yet adherence by primary care physicians remains suboptimal.¹⁹ Moreover, data on achievement for screening and treatment of traditional CV risk factors in North America are limited,²⁰ and there are no sources unifying this information. Canada and the US have similar medical education and training environments,²¹ but independent CV practice guidelines.^{7-12,15,16} Canada has universal health insurance, whereas coverage in the US is improving.^{22,23} In this landscape, an investigation of CV management and reporting standards for these factors is warranted. We therefore set out to determine current performance and regional variation of quality measures of CV risk factor care in Canada and the US through a systematic review of rates of screening, awareness, treatment, and control of hypertension, dyslipidemia, diabetes, and smoking in North America.

Methods

For the complete study methods, please refer to the *Methods* section of the [Supplementary Material](#).

Literature search

We performed a systematic review according to the **Meta-analysis of Observational Studies in Epidemiology (MOOSE)** guidelines.²⁴ We limited the systematic literature search to Medline and EMBASE between January 1, 2000 to June 1, 2014, to focus our review on contemporary studies.

Outcomes

Outcomes of interest were rates of screening, awareness, treatment, and target control achievement for hypertension, dyslipidemia, diabetes, and smoking.

Résultats : Nous avons inclus un total de 127 études faisant état de 10 510 324 individus de l'Amérique du Nord. Pour ce qui est de l'hypertension, les taux de sensibilisation (84,3 %) et de traitement (82,0 %) au Canada et aux É.-U. (82,7 % et 75,6 %, respectivement) se situaient au-dessus des cibles, tandis que les taux de maîtrise dans les deux pays se situaient sous les cibles (68,1 % vs 51,8 %, respectivement). Pour ce qui est de la dyslipidémie au Canada, les taux de sensibilisation, de traitement et de maîtrise (42,7 %, 40,9 % et 41,5 %, respectivement) étaient considérés comme étant sous-optimaux, alors que les indicateurs des É.-U. se situaient généralement sous les cibles (61,5 %, 43,0 % et 63,6 %, respectivement). En ce qui concerne le diabète, le Canada et les É.-U. montraient des taux de sensibilisation (88,2 % vs 86,8 %) et de traitement (82,3 % vs 82,5 %) au-dessus des cibles. Cependant, la maîtrise de la glycémie était sous-optimale au Canada (35,3 %), et sous les cibles aux É.-U. (58,8 %). Les taux de prévalence absolue du tabagisme au Canada ont connu un déclin modeste de 1999 à 2013 (25,2 % à 14,6 %). Le dépistage de l'utilisation du tabac (72,2 %) et les taux de counseling (73,8 %) aux É.-U. se situaient au-dessus des cibles.

Conclusions : Il existe une variation substantielle entre la prise en charge des facteurs de risque cardiovasculaire en Amérique du Nord. Les rapports normalisés, la diffusion des lignes directrices de pratique et l'établissement de cibles explicites orientées vers l'objectif de performance aideraient à l'amélioration.

Categorization of performance

We used a categorical 'ratings' system on the basis of previous studies of preventive services.^{25,26} We categorized achieved performance for risk factor measures as suboptimal (< 50%), below target (50%-70%), above target (70%-90%), or optimal (> 90%) to allow for clinically meaningful comparisons.

Results

Baseline characteristics

We identified 397 potential articles, which, after full-text review and additional input, resulted in 127 final studies for inclusion (Fig. 1).²⁷⁻¹⁵³ Among these articles, 21 studies reported on Canadian metrics,^{27-31,33,34,36-42,50-55,153} 97 studies reported on American indicators,⁵⁶⁻¹⁵² and 9 studies reported on both countries.^{32,35,43-49} There were 58 hypertension study articles,^{27-44,56-94,145} 36 on dyslipidemia,^{45-49,87,88,95-117,146-150,152} 23 on diabetes,^{45,47,48,50-55,87,88,116,118-126,150,151} and 19 on smoking.^{127-144,153} Table 1 shows the data sources and descriptive characteristics for each risk factor metric evaluated. Most included surveys had a good representation of women (close to 50%). Most surveys reported on adult populations aged 18 or 20 years and older, however, some studies focused on higher-risk ages 35-45 years and older. Because some studies published a number of independent reports focused on various risk factor care, the final number of publications exceeded the final number of included studies/surveys according to data source. A study flow diagram depicting this is shown in Figure 1.

The most frequently used surveys in Canada on the basis of our included studies were the **Canadian Health Measures Survey (CHMS)**, **Canadian Community Health Survey**

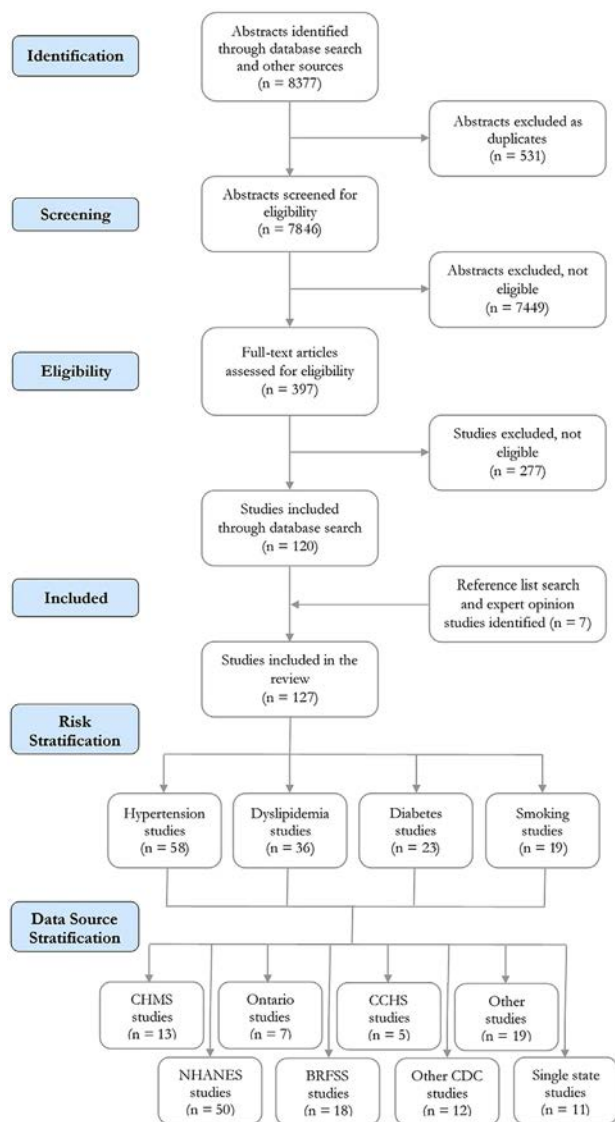


Figure 1. Study flow diagram. Shown are the sequential phases of the review, as well as the included studies stratified according to risk factor and data source. BRFSS, Behavioral Risk Factor Surveillance System; CCHS, Canadian Community Health Survey; CDC, Centers for Disease Control and Prevention; CHMS, Canadian Health Measures Survey; NHANES, National Health And Nutrition Examination Survey.

(CCHS), Ontario Survey on the Prevalence and Control of Hypertension (ON-BP), Ontario Health Insurance Plan (OHIP) records, Canadian Tobacco Use Monitoring Survey (CTUMS), and Canadian Tobacco, Alcohol and Drugs Survey (CTADS). Meanwhile, common US surveys were the National Health and Nutrition Examination Survey (NHANES), Behavioral Risk Factor Surveillance System (BRFSS), and National Ambulatory Medical Care Survey (NAMCS), all of which were conducted through the Centers for Disease Control and Prevention (CDC). Because of this large volume of information, we opted to further exclude single-state studies,^{89-91,93,138,140,144,146-148,152} outdated studies (data before 2000),^{49,138,140-143,149-152} and studies restricted to older individuals,^{30,49,53,87,88,94,126,151} unless no alternative studies were available.^{45,50-52}

Hypertension

Canada. A total of 72,576 individuals in Canada were considered within the hypertension subset (Table 2). There was an improvement in awareness and control rates from 2007 to 2013, whereas treatment remained the same. Overall, awareness and treatment of hypertension in Canada were above target rates, and control was below target.^{28,31-40,42-44} In comparison, provincial data for Ontario and Quebec showed similar performance in hypertension awareness, treatment, and control.^{28-30,36}

US. A total of 1,270,898 individuals in the US were considered within the hypertension subset (Table 2). From 2000 to 2004, hypertension screening in office-based physician practices improved from suboptimal to below target.⁸⁴⁻⁸⁶ There was a general trend of improvement in awareness, treatment, and control from 2007 to 2012. Similar to Canada, awareness and treatment in the US were above target rates; however, hypertension control was initially suboptimal and improved to below target rates.^{32,35,43,44,56-79}

State-specific data for hypertension metrics in the US were reported in the BRFSS.^{69,80-83} There was substantial interstate variability in self-reported awareness (66%-90%), treatment (55%-86%), and control (43%-66%) in 2009, although there were increasing trends of improvement since 2001. The geographic distribution of awareness, treatment, and control levels indicated the top performers were generally localized to the southeastern states, a pattern consistent with hypertension prevalence rates in the US. More specifically, hypertension awareness was above target rates for most states, but these trended toward optimal rates in the southeastern region. Meanwhile, hypertension treatment trended from below target to above target rates toward the southeastern states. Finally, achieved blood pressure control ranged from suboptimal in the western states to below target rates in the southeastern region.

Dyslipidemia

Canada. A total of 7,654,293 individuals in Canada were considered within the dyslipidemia subset (Table 3). From 2004 to 2009, testing in screening-recommended individuals (5 years) in Ontario improved from below to above target rates.^{45,47,48} However, rates of dyslipidemia awareness, treatment, and control were all considered suboptimal between 2007 and 2009.⁴⁶

US. A total of 1,194,387 individuals in the US were considered within the dyslipidemia subset (Table 3).⁹⁵⁻¹⁰⁸ There was a steady improvement in all dyslipidemia performance measures from 1999 to 2010. Screening (5 years) improved from below to above target rates, whereas awareness and control improved from suboptimal to below target rates. However, treatment rates were consistently suboptimal, even with modest improvement.⁹⁵⁻¹⁰⁸

State-specific data were also published for cholesterol screening (5 years) from 2005 to 2009 in the BRFSS.^{109-115,117} Wide variation was again seen interstate for cholesterol screening, which ranged from 66% to 80% in 2005, 66%-84% in 2007, and 68%-85% in 2009, with a temporally improving trend. Cholesterol screening was below target in the western states and improved steadily achieving

Table 1. Summary of sources reporting on CV risk factor quality metrics

Risk factor	Region	Source	Year(s)	Sample size, n	Age, years	Female sex, %	Metrics reported
Hypertension	Canada	CHMS ^{28,31-37,39,42-44}	2007-2013	17,784	20-79	53.1	A, T, C
		ON-BP ^{27,28}	2006	2551	20-79	50.9	A, T, C
		PURE study ³⁰	2005-2009	10,349	35-70	53.6	A, T, C
		Southwestern Ontario Database study ²⁹	2000-2003	46,224	≥18	55.9	T, C
	US	CCHS ^{31,37,38,40}	2008	6017	≥20	53.1	T
		NHANES ^{32,35,43,44,56-79,145}	1999-2010	28,995	≥20	51.7	A, T, C
		BRFSS ^{69,80-83}	2001-2009	356,112-432,607	≥18	N/A	T
		NAMCS ⁸⁴⁻⁸⁶	2000-2004	50,574	≥18	N/A	S, T, C
		MESA ⁸⁷	2000-2002	6024	45-84	52.4	A, C
		MEPS ⁸⁸	2000-2003	28,362	45-64	53.2	A, T
		MHS ⁸⁹⁻⁹¹	2000-2009	23,987	25-74	53.3	T
		HATT study ⁹²	2007-2008	8250	≥18	53.6	T, C
		South Carolina Study ⁹³	N/A	755	52 (Mean)	68.0	A, T, C
		CardioMonitor Survey ⁹⁴	2004	4010	65 (Mean)	47.0	T
Dyslipidemia	Canada	CHMS ⁴⁶	2007-2009	1701	20-79	53.1	A, T, C
		OHIP records ^{47,48}	2004-2005	2,116,962	40-74	38.4	S
		OHIP records ⁴⁵	2009	7,652,592	40-74	38.9	S
		WHO MONICA ⁴⁹	1995	N/A	35-64	N/A	A, T
	US	NHANES ⁹⁵⁻¹⁰⁸	1999-2010	11,308	≥20	52.0	A, T, C
		BRFSS ^{109-115,117}	2005-2009	356,112-432,607	≥18	N/A	S
		MESA ^{87,116}	2000-2002	6024	45-84	52.4	A, C
		MEPS ⁸⁸	2000-2003	28,362	45-64	53.2	A, T
		MHS ¹⁴⁶	2000-2009	23,987	25-74	53.3	T
		NCGAHH ^{147,148}	2001-2009	5031	21-84	N/A	S, A, T, C
		L-TAP ¹⁴⁹	1996-1997	4888	20-75	49.6	C
		PSCS ¹⁵⁰	1999-2000	5025	47 (Mean)	69.0	S
		Minneapolis MCO Study ¹⁵²	1996-1998	124,971	≥18	53.9	C
		WHO MONICA ⁴⁹	1989-1990	N/A	35-64	N/A	A, T
Diabetes	Canada	CCHS ⁵⁵	2001-2006	37,400	≥20	55.7	S
		OHIP records ^{47,48,50}	2004-2007	3,927,059	40-74	53.5	S
		OHIP records ⁴⁵	2009	7,652,592	40-74	55.5	S
		Statistics Canada ⁵²	1996	9042	≥40	51.9	A
		GPDMS ⁵¹	1998-1999	435	≥18	51.7	T, C
		NPS ⁵³	2009	1755	30-75	N/A	S
	US	ODD ⁵⁴	1995-2005	8,460,873	≥20	N/A	S
		NHANES ^{118-120,122-125}	1999-2012	27,861	≥20	51.1	S, A, T, C
		NHWS ¹²¹	2006-2013	62,834-75,000	N/A	N/A	T
		Community Diabetes Study ¹²⁶	2000-2001	1808	≥40	47.2	C
		MESA ⁸⁷	2000-2002	6024	45-84	52.4	A
		PSCS ¹⁵⁰	1999-2000	5025	47 (Mean)	69.0	S
		M-CARE study ¹⁵¹	1997-2000	8286	≥45	54.6	S
		NAMCS ¹²⁷⁻¹³⁰	2001-2005	29,470	≥18	60.6	S, T
Smoking	US	NCQA reports ¹³⁹	2001-2007	N/A	N/A	N/A	T
		NHIS ^{131,132,134}	2000-2010	40,000	≥18	N/A	T
		BRFSS ¹³³⁻¹³⁷	2000	14,089	≥18	57.1	T
		Wisconsin CPS ¹³⁸	1998-1999	50,000	≥15	N/A	T
		Tobacco Use Survey in Arizona ¹⁴⁰	1996-1999	10,868	≥18	N/A	S, T
		CTSHS ¹⁴¹	1996-1997	8229	≥18	N/A	T
		HIT study ¹⁴²	1999-2000	67,764	25-75	63.8	S, T
		TUSCPS ¹⁴³	1992-1999	82,532	≥15	N/A	T
WTS ¹⁴⁴	2003	1263	≥18	61.8	T		

A, awareness; BRFSS, Behavioral Risk Factor Surveillance System; C, control; CCHS, Canadian Community Health Survey; CHMS, Canadian Health Measures Survey; CPS, Current Population Survey; CTSHS, Community Tracking Study Household Survey; GPDMS, Group Practice Diabetes Management Study; HATT, Hypertension Assessment of Treatment to Target; HIT: Health Maintenance Organizations Investigating Tobacco; L-TAP, Lipid Treatment Assessment Project; M-CARE, Managed CARE Health Plan; MCO, managed care organizations; MEPS, Medical Expenditure Panel Survey (Agency for Health Care Research Quality); MESA, Multi-Ethnic Study of Atherosclerosis; MHS, Minnesota Heart Survey; MONICA, Multinational MONitoring of trends and determinants in CArdiovascular disease; N/A, not applicable; NAMCS, National Ambulatory Medical Care Survey; NCGAHH, North Carolina Guideline Adherence for Heart Health; NCQA, National Committee for Quality Assurance; NHANES, National Health And Nutrition Examination Survey; NHIS, National Health Interview Survey; NHWS, National Health and Wellness Survey; NPS, National Prediabetes Survey; ODD, Ontario Diabetes Database; OHIP, Ontario Health Insurance Plan; ON-BP, Ontario Survey on the Prevalence and Control of Hypertension; PSCS, Patient Safety Cohort Study; PURE, Prospective Urban Rural Epidemiology; S, screening; T, treatment; TUSCPS: Tobacco Use Supplement of the Current Population Survey; US, United States; WHO, World Health Organization; WTS, Wisconsin Tobacco Survey.

above target rates across the central US and toward the eastern states. Consistently top performing states from 2005 to 2009 were situated in the northeastern region of the US, and this was mirrored by the highest dyslipidemia prevalence rates.¹¹²

Diabetes

Canada. A total of 8,460,873 individuals in Canada were considered within the diabetes subset (Table 4). The 5-year

Table 2. Hypertension screening, awareness, treatment, and control rates in Canada and the United States

	Canada			United States		
	Rate, %	Year	Source	Rate, %	Year	Source
Screening	*	*	*	45.3	2000	NAMCS
				55.6	2003-2004	
Awareness	83.4	2007-2009	CHMS	80.6	2007-2008	NHANES
	82.9	2009-2011		81.9	2009-2010	
	84.3	2012-2013		82.7	2011-2012	
Treatment	79.9	2007-2009	CHMS	71.6	2007-2008	NHANES
	79.1	2009-2011				
	79.9	2012-2013		76.4	2009-2010	
	82.0	2008	CCHS	75.6	2011-2012	
Control	65.9 [†]	2007-2009	CHMS	48.4 [†]	2007-2008	NHANES
	64.0 [†]	2009-2011		53.3 [†]	2009-2010	
	68.1 [†]	2012-2013		51.8 [†]	2011-2012	

BP, blood pressure; CCHS, Canadian Community Health Survey; CHMS, Canadian Health Measures Survey; NAMCS, National Ambulatory Care Survey; NHANES, National Health And Nutrition Examination Survey.

* No sources reporting on this metric identified.

[†] Control defined as systolic BP < 140 mm Hg and diastolic BP < 90 mm Hg in a patient currently receiving treatment.

screening for diabetes was above target rates by 2006, while just over 1 in 3 residents of Ontario received a screening glucose test in 2005.^{54,55} Ontario 3-year screening levels in individuals older than the age of 40 years varied across the threshold target rates between 2004 and 2009.^{45,47,48} The awareness of diabetes in Canadians older than the age of 40 years was approaching optimal rates in 1996.⁵¹ However, despite the above target rates of treatment among Canadians with type 2 diabetes, achievement of recommended glucose control targets was suboptimal in 1998-1999.⁵¹

US. A total of 234,612 individuals in the US were considered within the diabetes subset (Table 4). By 2012, screening for diabetes (3 years) in the US remained suboptimal among the general population, as well as among screen-recommended patients.^{118-120,122-125} Awareness of diabetes in the general population was generally above target rates and showed improvement from 1999 to 2010. Similarly, diabetes treatment was also above target rates and improving between 1999 and 2013. Meanwhile, achievement of recommended glucose control targets was suboptimal, although this improved to below target rates from 1999 to 2010.¹¹⁸⁻¹²⁵

Smoking

Canada. Although comparative screening and cessation counselling data for smoking across Canada were not identified, smoking prevalence showed a modest decline in absolute rates (25.2% to 14.6%) from 1999 to 2013, according to the CTUMS and CTADS.¹⁵³ There was considerable interprovincial variation in changes in smoking rates, with Quebec decreasing more than 13% and Manitoba < 6%. British Columbia and Ontario maintained the lowest smoking rates throughout the years, whereas the Maritime provinces maintained the highest rates.¹⁵³

US. A total of 83,559 individuals in the US were considered within the smoking subset. Screening for tobacco use by primary care providers in the US was above target rates (72.2%)

Table 3. Dyslipidemia screening, awareness, treatment, and control rates in Canada and the United States

	Canada			United States		
	Rate	Year	Source	Rate	Year	Source
Screening	65.7 ^{*†}	2004-2005	OHIP records	69.2*	1999	BRFSS
				72.7*	2001	
				73.1*	2003	
	76.4 ^{*†}	2009	OHIP records	72.7*	2005	
				74.7*	2007	
				76.0*	2009	
Awareness	42.7	2007-2009	CHMS	48.9	1999-2000	NHANES
				50.9	2001-2002	
				62.8	2003-2004	
				61.6	2005-2006	
				60.4	2007-2008	
				61.5	2009-2010	
Treatment	40.9	2007-2009	CHMS	20.2	1999-2000	NHANES
				28.3	2001-2002	
				38.3	2003-2004	
				40.8	2005-2006	
				43.8	2007-2008	
				43.0	2009-2010	
Control	41.5 [‡]	2007-2009	CHMS	45.0 [§]	1999-2000	NHANES
				50.3 [§]	2001-2002	
				55.5 [§]	2003-2004	
				65.3 [§]	2005-2006	
				62.5 [§]	2007-2008	
				63.6 [§]	2009-2010	

BRFSS, Behavioral Risk Factor Surveillance System; CHMS, Canadian Health Measures Survey; LDL-C, low-density lipoprotein cholesterol; NHANES, National Health And Nutrition Examination Survey; OHIP, Ontario Health Insurance Plan.

* Screening defined as a blood test for cholesterol completed in the past 5 years.

[†] Study population age 50-74 years for women, 40-74 years for men.

[‡] Control defined as LDL-C level < 2 mmol/L in a patient currently receiving treatment.

[§] Control defined as LDL-C level below cutoffs according to the 2004 Adult Treatment Panel III Guidelines on the basis of risk stratification in a patient currently receiving treatment.¹⁵⁴

by 2005. However, the NAMCS reported suboptimal counselling rates (27.4%) for screen-positive patients.¹²⁷⁻¹³⁰ Meanwhile, the National Health Interview Survey (NHIS) reported below target counselling rates (50.7%-58.9%) between 2000 and 2010, whereas the National Committee for Quality Assurance indicated improving counselling that reached above target rates (61.0% to 73.8%) by 2007.¹³⁵ Finally, the BRFSS indicated that the proportion of smokers who have ever received advice to quit smoking by a health care professional was just below target rates (69.0%) in 2000.^{134,136}

Discussion

Our systematic review of > 10.5 million individuals investigated variation in the quality of CV risk factor management in routine clinical practice in North America by compiling reports of screening, awareness, treatment, and control rates of hypertension, dyslipidemia, diabetes, and smoking since the turn of the century. To the best of our knowledge, this is the largest compendium of CV risk factor care performance and the first to provide comparative descriptive data on regional variation across Canada and the US. This review might serve as a clinical practice reference for contemporary CV preventive care achievement in North

Table 4. Diabetes screening, awareness, treatment, and control rates in Canada and the United States

	Canada			United States		
	Rate	Year	Source	Rate	Year	Source
Screening	73.4*	2001-2006	CCHS	42.4 [‡] 46.2 ^{‡,}	2005-2012	NHANES
	37.0 [†]	2005	ODD			
	74.4 ^{‡,§}	2004-2007	OHIP			
	67.2 ^{‡,§}	2009	OHIP			
Awareness	88.2 [‡]	1996	Statistics Canada	83.8	1999-2004	NHANES
Treatment	82.3 [¶]	1998-1999	GPDMS, baseline results	86.8	2005-2010	NHANES
				81.5	1999-2004	
				86.6	2005-2010	
Control	35.3 ^{¶,**,††}	1998-1999	GPDMS, baseline results	80.4 [¶]	2006	NHWS
				82.5 [¶]	2013	
				49.6 ^{**}	1999-2004	NHANES
				58.8 ^{**}	2005-2010	

CCHS, Canadian Community Health Survey; GPDMS, Group Practice Diabetes Management Study; NHANES, National Health And Nutrition Examination Survey; NHWS, National Health and Wellness Survey; ODD, Ontario Diabetes Database; OHIP, Ontario Health Insurance Plan.

* Blood glucose screening test in past 5 years.

† Blood glucose screening test in past year.

‡ Blood glucose screening test in past 3 years.

§ Study population age older than 40 years.

|| Screening-recommended patients according to American Diabetes Association Guidelines.¹⁵⁵

¶ Type 2 diabetes population only.

** Control defined as hemoglobin A1C level < 7% among all diabetes patients.

America; it also provides data on the degree of variation across regions and identifies outliers of high and low performers for each quality indicator. In elucidating these regional discrepancies, our review also highlights the need for further investigation of underlying contributory factors shaping the current CV prevention landscape.

Regional achievement of CV prevention care

Most Canadian data were produced through national surveys by Statistics Canada. In parallel, reporting on CV preventive care in the US was done primarily through national and state-level surveys conducted by the CDC. Our review identified more temporally consistent and regionally systematic reporting on CV risk factor management in the US overall. Canada, in contrast, showed more comprehensive reporting within Ontario, but to a lesser extent among the other provinces. In comparing CV risk factor care performance in the two nations, NHANES in the US and CHMS in Canada were the most analogous surveys, because they had similar sampling, data collection, and reporting methods.

In a comparison of the two countries, it is evident that Canada and the US achieved well above target rates for hypertension awareness and treatment. Although, overall, both countries' participants could benefit from improvements in blood pressure control, Canada's control rates were generally higher. In contrast, suboptimal Canadian performance rates in dyslipidemia awareness, treatment, and control were only marginally better in the US where levels were consistently below target rates. However, cholesterol screening in both nations hovered above target performance levels. Furthermore, diabetes awareness and treatment in Canada and the US were consistently above target rates, although achievement of blood sugar control remain suboptimal in Canada and below target rates in the US.

Implications for CV prevention care

There are a number of potential contributing factors that might explain the differences in each nation's performance of

which further exploration is warranted. For example, inherent differences in the health insurance infrastructure between Canada and the US might play a role in the variation.^{22,23} Furthermore, the introduction of CV practice guidelines independently within each country, such as the Canadian Hypertension Education Program guidelines, the Joint National Committee Hypertension guidelines, and the National Cholesterol Education Program guidelines, has resulted in general improvements in the prescribing rates and management of these CV risk factors.¹⁵⁶⁻¹⁵⁸ However, it is unclear whether the degree of their effect varies significantly on the basis of the extent of dissemination, the frequency of revisions, and the sources of evidence of these guidelines.¹⁵⁹ For example, Figure 2 shows the timeline of major guideline updates for hypertension and cholesterol in North America.⁹⁻¹³ Evidently, Canadian guidelines have been updated more frequently than their US counterparts. In particular, whereas a decade had passed since the Joint National Committee Hypertension guidelines update, the Canadian Hypertension Education Program guidelines were updated annually since 1999.¹⁵⁹ In addition, awareness of performance in the realm of CV prevention might be a driving motivator for improvement, and thus might highlight the importance of standardized reporting.

Moreover, summarizing this clinical practice reference might set the stage for future efforts to evaluate gains in a manner that translate into goal-directed targets of care.^{25,26} For example, Farley et al. modelled improvement in clinical preventive services according to the number of preventable deaths in the US for each incremental improvement.²⁶ Estimates suggest we might see an additional 14,000 deaths prevented for every 10% increase in the hypertension treatment rate, whereas every 10% increase in treatment of high cholesterol might prevent a further 8000 deaths. Maciosek et al. similarly estimated the potential for additional quality-adjusted life years (QALYs) saved in the US with increased use of clinical preventive services.²⁵ For services such as cholesterol screening, we might see 4000 additional QALYs saved for each 1% increase in the rate of screening, whereas

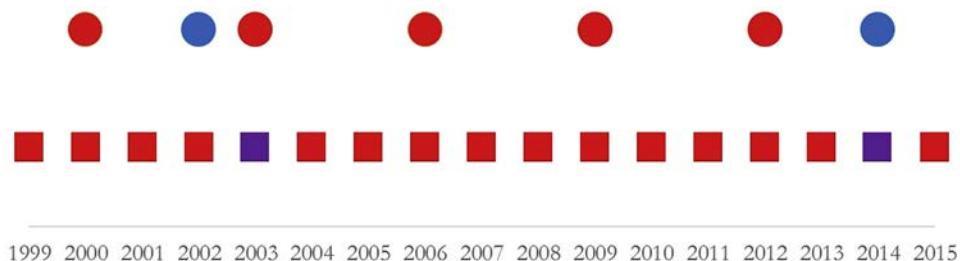


Figure 2. Frequency of hypertension and cholesterol guideline updates in North America. Shown is a publication timeline of major hypertension (squares) and cholesterol (circles) guidelines in Canada (red), the United States (blue), or both (purple) according to year.

each 1% increase in tobacco use screening and brief intervention might result in an additional 20,000 QALYs saved. In further quantifying the current rates and potential benefit of improvements in CV prevention, researchers can estimate the effect of performance improvement in Canada and the US overall and inter-regionally.

Limitations and quality of evidence

The goal of this review was to determine current performance and identify regional variation of quality of care indicators across Canada and the US. On the basis of the availability of data, the largest limitation of this study was the potential for incomplete reporting of regional or temporal trends, particularly in Canada because of an insufficient number of eligible studies. Contemporary standardized interprovincial data on traditional CV risk factors would have been more informative to identify potential disparities in the delivery of preventive CV health care services, particularly among vulnerable groups such as Aboriginal, immigrant, and those with low socioeconomic status. In addition, although the CHMS and NHANES had similar sampling, data collection, and reporting methods, the CCHS and BRFSS relied predominantly on self-report, and most Ontario surveys relied on administrative health data analyses. Results predominantly relying on self-report participant survey data might be at risk for recall or survival bias compared with data accrued using administrative health data analyses. In contrast, data on the basis of health care insurance claims might be limited by misdiagnosis or upcoding, although this is low in Canadian data.²⁰ Nevertheless, these limitations advise caution when comparing metrics across countries. We also cannot exclude the possibility that the same patient was surveyed by different studies, but the reported methods for each respective study nevertheless provided a representative sample each time. Furthermore, few studies reported data with a focus solely on a primary prevention patient population, thereby limiting our ability to describe distinct trends in this group. However, the general population samples we reviewed overwhelmingly included patients without a history of a previous CV event with a detection rate of a previous CV event of approximately 3%.²⁶ Last, the heterogeneity of study designs and data sources precluded a formal statistical comparison or meta-analytical approach.

Conclusions

This compendium of performance measures provides a contemporary reference for CV risk factor screening and

treatment in the general North American population, which subsequent CV epidemiological studies and quality improvement initiatives can compare. Although both nations performed well in terms of hypertension, improvements are warranted with respect to dyslipidemia metrics and diabetes control. Moreover, there is a lack of Canadian smoking data with which the US statistics can be compared. Overall, risk factor management has increased in both nations, although there is room for further improvement, which might be facilitated (and monitored for continuous feedback) through standardized reporting of CV risk factor care at the national and provincial/state level. The frequency and dissemination of practice guidelines might also play a role in improving CV prevention, in addition to shifting the focus to goal-directed targets of care by reporting on the number of potential preventable deaths and QALYs saved.

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Supplementary Material

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