

1
2
3 The Cardiovascular Health in Ambulatory Care Research Team (CANHEART) Performance Indicators for
4 the Primary Prevention of Cardiovascular Disease
5
6
7
8
9

10 Jack V. Tu, MD, PhD; Laura C. Maclagan, MSc; Dennis T. Ko, MD, MSc; Clare L. Atzema, MD, MSc; Gillian L.
11 Booth, MD, MSc; Sharon Johnston, MD, LLM; Karen Tu, MD, MSc; Douglas S. Lee, MD, PhD; Arlene
12 Bierman, MD, MS; Ruth Hall, PhD; R. Sacha Bhatia, MD, MBA; Andrea S. Gershon, MD, MSc; Sheldon W.
13 Tobe, MD, MSc; Claudia Sanmartin, PhD; Peter Liu, MD; Anna Chu, MHSc.
14
15
16

17
18 CANHEART Primary Prevention Indicator Expert Panel.
19
20

21
22
23 Word Count: 2634 main text; 220 abstract
24
25
26
27

28 Email: tu@ices.on.ca
29
30

31 Revised: October 6th 2016
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Abstract

Background: High quality ambulatory care can reduce cardiovascular disease risk, but important gaps exist in the provision of preventative cardiovascular care. We sought to develop a set of key performance indicators that can be used to measure and improve preventative cardiovascular care provided in the primary care setting.

Methods: As part of the Cardiovascular Health in Ambulatory Care Research Team (CANHEART) initiative (www.canheart.ca), we established a 14-member multidisciplinary expert panel to develop a set of indicators for measuring primary prevention performance in ambulatory cardiovascular care. We used a two-stage modified Delphi-panel process to rate potential indicators, which were identified from the literature and national cardiovascular organizations. The top-rated indicators were pilot tested to determine their measurement feasibility using data routinely collected in the Canadian healthcare system.

Results: A set of 28 primary prevention performance indicators were identified, which were grouped into five domains (risk factor prevalence, screening, management, control, and clinical outcomes). The major cardiovascular risk factors represented included smoking, obesity, hypertension, diabetes, dyslipidemia, and atrial fibrillation. All indicators were determined to be amenable to measurement using population-based administrative (physician services, hospitalization, laboratory, medication), survey, or electronic medical record databases.

Interpretation: The CANHEART primary prevention performance indicators may be used by clinicians, researchers and policy makers who are interested in measuring and improving primary care performance in ambulatory cardiovascular care.

Introduction

A reduction in cardiovascular disease (CVD) risk can be achieved through high quality preventative care in the primary care setting. Although evidence-based interventions exist for the major cardiac risk factors, studies have shown that these interventions are underutilized in routine clinical practice, resulting in suboptimal risk factor control.(1);(2);(3) The Cardiovascular Health in Ambulatory Care Research Team (CANHEART) (www.canheart.ca) initiative was established to improve the cardiovascular health of Canadians and to measure and improve the quality of cardiovascular preventive care in the ambulatory setting.(4) A core research objective was to develop a set of primary prevention performance indicators that: (a) were aligned with Canadian clinical practice guidelines, (b) could be measured using population-based health databases, and (c) could serve as a foundation for future quality improvement and research initiatives.

The Canadian Institute for Health Information (CIHI) and Health Quality Ontario (HQO) have identified sets of primary care indicators; however, the majority are not currently measurable in Canada due to limited data availability, and are not specific to CVD.(5);(6);(7) Furthermore, most cardiovascular care indicator sets developed in Canada and elsewhere focus on the hospital setting and treatment of patients with established CVD.(8);(9);(10);(11) Other indicator sets include indicators that cannot be measured using readily available population-based data sources, rely heavily on data obtained from patient charts,(12) or were developed according to clinical guidelines in other countries.(13) Accordingly, we set out to develop a set of Canadian performance indicators that were focused on CVD primary prevention in the ambulatory care setting, which could be measured using routinely available data, and would be useful to clinicians and/or health system managers for identifying opportunities for improvement.

Methods

Expert Panel

We established a 14-member multidisciplinary expert panel in 2012 to develop a set of indicators as a foundation for assessing primary prevention performance in ambulatory cardiovascular care. The panel consisted of Canadian academic experts from a range of disciplines to reflect the multidisciplinary nature of ambulatory cardiovascular care: 2 family physicians (SJ, KT), 4 cardiologists (DL, DK, SB, PL), and 1 each of a nephrologist (ST), geriatrician (AB), emergency physician (CA), endocrinologist (GB), respirologist (AG), stroke evaluation consultant (RH), and methodologist (CS). The

1
2
3 CANHEART principal investigator (JVT) served as the indicator panel chair. The study was approved by
4 the Sunnybrook Health Sciences Centre Research Ethics Board.
5
6

7 *Target patient population*

8
9
10 The target population for the CANHEART performance indicators was adults 20 years and older
11 with no history of CVD (i.e. primary prevention patients). An upper age limit was not chosen, although it
12 is recognized that patients 80 years and over form a heterogeneous group with some individuals at end
13 of life in whom prevention is not indicated and others who may benefit from secondary and tertiary
14 prevention. Figure 1 summarizes the indicator selection process used to develop the indicators.
15
16
17
18

19 *Review of existing indicators*

20
21
22 A medical librarian performed a literature search of the MEDLINE (1996-2012), EMBASE (1980-
23 2012), Cochrane Database of Systematic Reviews (2005-2012), and Health Star (1966-2012) databases to
24 identify relevant ambulatory cardiovascular care indicators, performance measures, and clinical practice
25 guidelines. Key search terms included “cardiovascular diseases”, “quality indicators”, “performance
26 measure”, “ambulatory care”, and “benchmarking.” We also searched the grey literature to identify
27 quality indicators and practice guidelines developed by leading organizations in Canada and the United
28 States including the American Heart Association/American College of Cardiology Foundation, Canadian
29 Cardiovascular Society (CCS), CIHI, Canadian Stroke Strategy, and HQO. Bibliographies of relevant
30 articles and reports were hand-searched.
31
32
33
34
35
36
37
38

39 *Indicator development*

40
41 Indicators were developed using a two-staged modified Delphi process(14) and the CCS’s Best
42 Practices for Quality Indicator Development.(15) A key criterion in developing indicators was that they
43 be measurable using population-based health databases currently available in Canada, such as: (a)
44 health administrative databases (e.g. physician claims, medication, laboratory, hospitalization), (b)
45 survey data (i.e. Canadian Community Health Survey), and (c) electronic medical record (EMR)
46 databases. Where possible, indicators were harmonized with Canadian clinical practice guidelines
47 endorsed by both a national speciality organization (e.g. CCS, Canadian Diabetes Association) and the
48 Canadian Cardiovascular Harmonized National Guidelines Endeavour (C-CHANGE) initiative, a national
49 effort to harmonize primary care cardiovascular prevention guidelines.(16);(17) The panel also
50
51
52
53
54
55
56
57
58
59
60

1
2
3 endeavoured to include indicators where processes of care leading to improved patient outcomes have
4 been demonstrated by evidence from clinical trials.
5
6

7
8 In the first round of indicator ratings, panelists as well as seven additional external experts were
9 emailed a list of 109 potential performance indicators (13 population health and 96 health services)
10 identified from the literature review, with draft definitions of each indicator's numerator, denominator,
11 data source for measurement, and source document (Appendix 1). Panelists were asked to rate the
12 indicators using the CCS Quality Indicator Rating Scale. This is a 7-point Likert Scale comprising individual
13 ratings for four attributes: importance, scientific acceptability, feasibility, and overall rating.(15)
14
15 Panelists were able to provide comments to identify any potential issues with an indicator.
16
17
18
19

20
21 In a second round in-person meeting of expert panel members, mean preliminary ratings for
22 each indicator were presented with the detailed indicator definitions and issues noted by panelists. The
23 importance and feasibility of measuring each indicator in the Canadian provincial health system context
24 was discussed, and panelists could suggest alternative indicators. Panelists then re-rated each indicator.
25
26 Of 96 potential indicators, 75 with a mean overall score ≥ 5.0 were retained. Among these, 13 population
27 health indicators (e.g. prevalence of diabetes, smoking, etc.) were automatically retained as necessary
28 measures of baseline population health amenable to population health and clinical interventions.
29
30 Subsequently, a summary document was circulated to the expert panel and a follow-up teleconference
31 held to discuss the second rating results. At this stage, in an effort to reduce the number of indicators
32 chosen to a manageable set, it was decided to focus the initiative on primary prevention, thus,
33 eliminating secondary prevention indicators from further consideration (n=12). This left 63 indicators
34 remaining for pilot testing.
35
36
37
38
39
40
41

42 *Pilot Testing*

43
44 Measurement feasibility was pilot tested on a cohort of 9.4 million adult primary prevention
45 patients in Ontario from the CANHEART 'big data' initiative, created through linkage of multiple
46 population-based databases using unique encoded identifiers.(4) Pilot testing included defining indicator
47 numerators, denominators and exclusion criteria, and modifying these as appropriate. Indicators not
48 feasible to measure due to data quality and availability issues were excluded (n=19).
49
50
51
52
53
54
55
56
57
58
59
60

Results

Overall, 28 indicators characterizing the most important aspects of CVD primary prevention in Canada were selected for the final set of CANHEART primary prevention performance indicators. Indicators were grouped into four risk factor domains, including seven prevalence, four screening, eight management and four intermediate outcome indicators, plus a fifth domain of five long-term outcome indicators (Tables 1 and 2). Indicators were grouped in these domains opposed to the classic Donabedian framework of structures, processes, and outcomes(18) to better align with the practices involved in monitoring population health and providing primary care to patients. Subject areas included the cardiac risk factors: smoking, obesity, hypertension, diabetes, dyslipidemia and atrial fibrillation, as well as primary care utilization since primary care access is a necessary intermediary of other primary care performance measures. Detailed information on guidelines and evidence supporting the use of each indicator, suggested data sources, and numerator and denominator definitions can be found in Appendix 2.

Risk factor prevalence measures

The prevalence of traditional cardiovascular risk factors was included in the final set of performance measures because the panel felt that measures of a population's cardiovascular health, although largely outside the direct control of primary care providers, are relevant to public health planners and policymakers in establishing health system and community priorities, and could be influenced by both population health and clinical interventions. Several of the prevalence measures are routinely determined using Statistics Canada's Canadian Community Health Survey, which permits trend analysis and health region-level estimates.(19) The prevalence of conditions such as hypertension and diabetes can be measured using validated chronic disease algorithms, or alternatively EMR databases.(20) An indicator reflecting the percentage of the population who visited a primary care provider, the gatekeeper for access to specialists in Canada, was also included as accessing primary care is a precondition for lowering CVD risk through health system interventions.(21)

Risk factor screening indicators

Screening of modifiable cardiac risk factors, specifically obesity, hypertension, diabetes and dyslipidemia are recommended by Canadian and international practice guidelines (22);(23);(24);(25);(26);(27) and were highly rated by the expert panel for their importance in identifying individuals who would benefit from behavioural modification counseling and/or medical intervention. In

1
2
3 addition to being universally accepted contributors to CVD, the risk factors selected for screening are
4 also common, appropriately screened for in the ambulatory care setting, and their management
5 supported by scientific evidence. Furthermore, diabetes and dyslipidemia screening could readily be
6 obtained using physicians claims databases,(28) and obesity and hypertension screening from EMR
7 databases.
8
9

10 11 12 *Risk factor management indicators*

13
14
15 To capture aspects of CVD primary prevention performance among the population with CVD risk
16 factors, eight indicators of risk factor management were included. For smoking, the proportion of
17 smokers who received smoking cessation counseling was selected, while the proportion of patients
18 receiving drug-based treatment was chosen for hypertension, diabetes, dyslipidemia and atrial
19 fibrillation. Although the accuracy of determining smoking cessation counseling rates from physician
20 claims and EMR databases is unknown, the significance of smoking as a cardiac risk factor necessitated
21 the inclusion of this measure. Prescription rates for individuals with diagnosed CVD risk factors could be
22 measured using EMR databases or through linkage of drug claims databases with health administrative
23 databases. Since risk factor management by family physicians requires primary care visits, the panel
24 also recommended measurement of the annual number of primary care visits as a surrogate marker of
25 access.
26
27
28
29
30
31
32
33

34 35 *Intermediate outcome indicators*

36
37
38 Similar to risk factor management, the panel recognized the value of intermediate outcome
39 indicators of risk factor control in reducing CVD risk, and recommended four indicators in this domain:
40 percentage of patients with hypertension with controlled blood pressure, diabetic patients with
41 controlled blood glucose, statin users with controlled lipid levels, and patients with atrial fibrillation
42 taking warfarin with time in therapeutic range (see Table 1 for definitions). However, it was
43 acknowledged that the population considered may vary as clinical judgment is required when deciding
44 on aggressiveness of treatment and control targets may not be suitable for all individuals. Most of these
45 indicators can be measured through linkage of health administrative, drug claim, EMR and laboratory
46 databases.
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Long-term outcome indicators

To determine the long-term impact of ambulatory cardiovascular prevention efforts, the panel recommended assessment of clinical outcomes at the health region level, including hospitalization rates for acute myocardial infarction, stroke and heart failure, rates of revascularization with either percutaneous coronary intervention or coronary artery bypass graft surgery, and cardiovascular death and/or all-cause mortality rates. All-cause mortality rates can be used as an indicator of CVD prevention efforts as CVD is the second leading cause of death in Canada,(29) some interventions (e.g. statins) can reduce all-cause mortality, and many jurisdictions may have significant delays in obtaining cause of death data. Data for these measures are routinely available from hospital discharge abstract and vital statistics databases with recommended International Classification of Diseases (ICD)-9 and -10 codes reported elsewhere.(4) The panel refrained from specifying time periods for most indicators because the choice will vary with the clinical context, availability of data, and the local needs of users.

Interpretation

The CANHEART Primary Prevention Indicator panel identified 28 performance indicators to evaluate key elements of CVD risk prevention and management in the primary care setting. While considerable effort in Canada has been devoted to measuring and improving the quality of hospital-based cardiac care such as in the EFFECT study,(30) far less attention has been focused on improving ambulatory cardiovascular care performance and preventing new cardiovascular events, for which over 350,000 Canadians were hospitalized in 2011(31) and increasing numbers are anticipated to be affected due to the aging population.(32) The American Heart Association has identified a set of primary prevention performance measures;(13) however, their focus is on process of care indicators whereas the CANHEART set covers the health system continuum from population health to care delivery processes to outcomes.

The CANHEART indicators are not meant to form an exhaustive list, but rather, cover the most important aspects of primary cardiovascular care. More detailed indicators for specific cardiovascular risk factors and diseases have been developed by other organizations. The CANHEART indicators are relevant to multiple stakeholders from patients to primary care providers, public health and policy-makers who must collaborate to improve CVD prevention and risk factor reduction. A common core set of indicators can enable these stakeholder groups to evaluate effects beyond primary care providers and to identify priorities for improvement. While healthcare providers are often most interested in process

1
2
3 measures which seem within their control,(33) comprehensive performance measurement should also
4 include outcome indicators to enable a full assessment of improvement efforts.(34) Charting progress in
5 cardiovascular risk factor prevalence, control, management and outcomes over time and across regions
6 can also help evaluate the impact of policies aimed at improving the quality of primary cardiovascular
7 care and reducing CVD.
8
9

10 11 12 *Implementation Challenges*

13
14
15 Assessing primary prevention performance in ambulatory care is challenging because there is no
16 single data source in Canada which comprises all of the information required. Thus, measurement of
17 many indicators will require linkage of multiple data sources, and we have undertaken extensive pilot
18 testing to establish the feasibility of measuring each indicator using a CANHEART ‘big data’ cohort, which
19 will be reported separately.(4) Although data sources such as EMR databases are not yet available in all
20 Canadian provinces, the rapid shift towards electronic health information systems will allow for their
21 greater availability in the future. Inclusion of indicators for which the validity of data is uncertain, such
22 as smoking cessation counseling, will hopefully lead to better documentation and methods of
23 measurement. Modification of indicator definitions, including the population of interest, measurement
24 time frame, and data source may be necessary. Depending on local priorities, data availability, and
25 resources, end-users may choose to focus their efforts on performance goals appropriate for their
26 jurisdiction.
27
28
29
30
31
32
33
34
35
36

37 *Limitations*

38
39 Although the panel sought to include the most important aspects of cardiovascular primary
40 prevention in the final indicator set, some relevant measures were not included such as those related to
41 diet and physical activity, patient experiences, unnecessary testing, and care coordination. These subject
42 areas were not included due to limitations in data availability at the population level, uncertainties in
43 their association with patient outcomes, or issues in defining such indicators. However, we plan to
44 update the indicator list and definitions as new data sources and clinical studies become available.
45 Additionally, as some patients may not be suitable candidates for some indicators (e.g. due to
46 medication allergies, co-morbidities, patient preferences, choosing lifestyle modifications over
47 medications), benchmark rates may not be 100% and could vary by population. Nevertheless, we believe
48 that measurement of these indicators is an important first step to future work in determining
49 benchmarks for each of these indicators. Performance on certain indicators may also reflect complex
50
51
52
53
54
55
56
57
58
59
60

1
2
3 non-health system level community factors (e.g., smoking bylaws, built environment) or factors outside
4 the control of the health system (e.g. socioeconomic status, ethnicity). Differences in patient
5 characteristics also influence the frequency of primary care visits and services required (e.g. less healthy
6 patients may have more frequent visits); however, we included the average number of visits to primary
7 care providers as a general measure of access because it may be useful for health planning purposes
8 when comparing differences in service provision across regions to ensure equitable access.
9
10
11
12
13

14 **Conclusion**

15
16
17 In summary, the prevention of CVD in Canada has the potential to improve the quality of life of
18 many Canadians, and reduce its overall burden on the Canadian healthcare system as the population
19 ages. Historically, performance in CVD prevention in Canada has been difficult to assess. The
20 CANHEART Primary Prevention Indicators have been created to address this knowledge gap, providing a
21 means to evaluate cardiovascular-related ambulatory care, and identify target areas for health system
22 performance improvement in Canada and other countries.
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **Contributors:** Jack Tu conceived of the study and Laura Maclagan analyzed the data. All authors
4 contributed to the design of the study and interpretation of the results. Jack Tu and Laura Maclagan
5 drafted the manuscript, and the other authors critically reviewed it. All authors approved the final
6 version to be published and agreed to be guarantors of the work.
7
8
9

10
11 **Funding:** The CANHEART initiative is funded through a Chronic Diseases Team Grant (TCA 118349) from
12 the Institute of Circulatory and Respiratory Health-Canadian Institutes of Health Research (CIHR), CIHR
13 Foundation Grant (FDN-143313) and a Canadian Vascular Network (CVN) seed grant. The CVN is funded
14 by the CIHR in partnership with Hypertension Canada. This study was supported by the Institute for
15 Clinical Evaluative Sciences (ICES), which is funded by annual grants from the Ontario Ministry of Health
16 and Long-Term Care (MOHLTC). Dr. J Tu is supported by a Tier 1 Canada Research Chair in Health
17 Services Research and an Eaton Family Scholar award. Dr. Lee is supported by a mid-career award from
18 the Heart and Stoke Foundation and is the Ted Rogers Chair in Heart Function Outcomes. Dr. Gershon is
19 supported by a PSI fellowship in translational research, PSI Foundation. Dr. K Tu is supported by a
20 research scholar award from the Department of Family and Community Medicine at the University of
21 Toronto.
22
23
24
25
26
27
28
29
30

31 **Disclaimer:** The opinions, results and conclusions expressed herein are those of the authors and are
32 independent from ICES and the funding sources. No endorsement by ICES, the Ontario MOHLTC, CVN or
33 CIHR is intended or should be inferred.
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure 1. Flow chart of CANHEART primary prevention performance indicator selection process

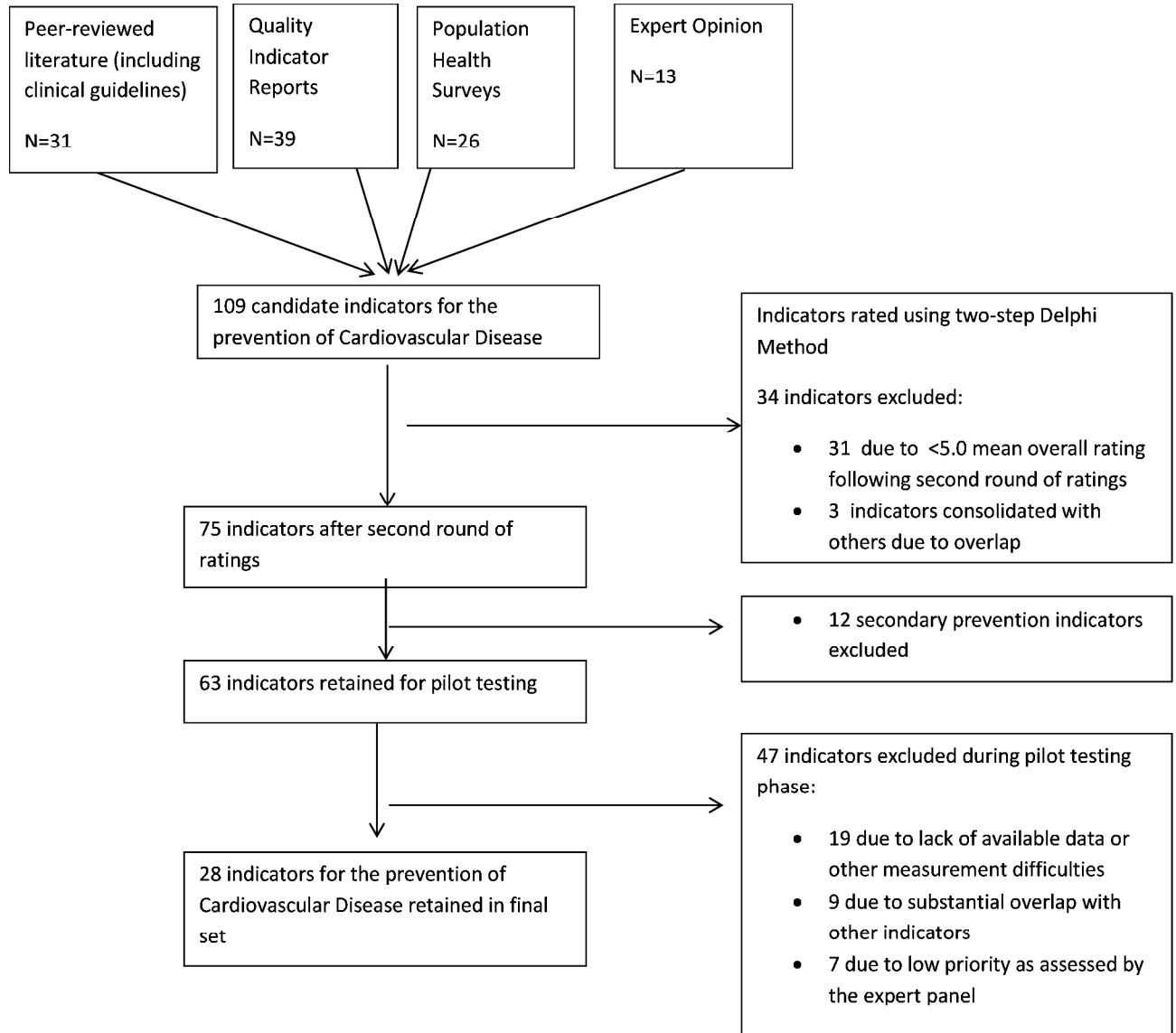


Table 1. CANHEART Primary Prevention Performance Indicators

	Smoking	Obesity	Hypertension	Diabetes	Dyslipidemia	Atrial Fibrillation	Access to Primary Care
Prevalence	Prevalence of smoking	Prevalence of obesity	Prevalence of hypertension	Prevalence of diabetes	Prevalence of high lipid levels (e.g., total cholesterol \geq 5.2mmol/L)	Prevalence of atrial fibrillation	Percentage of individuals who have visited a primary healthcare provider
Screening		Percentage of patients with height and weight measured	Percentage of patients who had their blood pressure measured	Percentage of patients age 40 and older who had had a full fasting blood glucose or HbA1c screening test in the past 36 months	Percentage of men age 40 and older and women age 50 and older who have had a full lipid profile in the past 5 years		
Management	Percentage of smokers who received smoking cessation counselling		Percentage of patients with hypertension taking \geq 1 antihypertensive medication OR Mean number of antihypertensive medications taken among patients with hypertension	1. Percentage of patients with diabetes taking anti-diabetic medications 2. Percentage of patients with diabetes age 55 and older taking ACE inhibitors/ARBs 3. Percentage of patients with diabetes age 40 and older taking statin medication	Percentage of high-risk primary prevention patients taking statins (e.g. LDL>5.0, High Framingham risk score, diabetic)	Percentage of patients with atrial fibrillation taking warfarin or direct oral anticoagulants	Mean number of primary care visits per year (e.g. for hypertension, diabetes, etc.).
Intermediate outcomes			Measured blood pressure control (<140 mm Hg systolic and <90 mmHg diastolic) among patients with hypertension* OR Emergency department visit rate for hypertension among patients with hypertension	Percentage of patients with diabetes with HbA1c controlled (\leq 7%) [†]	Percentage of patients taking statins for primary prevention who have their lipid levels controlled (LDL-C \leq 2.0mmol/L)	Percentage of time in therapeutic range (INR 2-3) among patients with atrial fibrillation on warfarin	

*Patients with diabetes should be treated to attain blood pressures of <130mmHg systolic and <80mmHg diastolic(35). [†] Less stringent HbA1c targets of 7.1%-8.5% may be used in some patient groups with diabetes such as those with limited life expectancy and high levels of functional dependency(36).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Table 2. Outcome Indicators (Age-adjusted and/or age, sex-stratified rates per 1000 person-years measured over a minimum 3 year period)

- Acute myocardial infarction rate
- Stroke (ischemic/hemorrhagic) rate
- Congestive heart failure (requiring hospitalization) rate
- Revascularization (PCI/CABG) rate
- Cardiovascular and/or all-cause mortality rate

PCI denotes percutaneous coronary intervention, CABG coronary artery bypass graft surgery

Confidential

References

- 1 Braga MFB, Casanova A, Teoh H, Dawson KG, Gerstein HC, Fitchett DH, et al. Treatment gaps in the management of cardiovascular risk factors in patients with type 2 diabetes in Canada. *Canadian Journal of Cardiology* 2010;26(6):297-302.
- 2 Hennessy DA, Tanuseputro P, Tuna M, Bennett C, Perez R, Shields M, et al. Population health impact of statin treatment in Canada. *Health reports* 2016;27(1):20.
- 3 Joffres MR, Hamet P, MacLean DR, Gilbert J, Fodor G. Distribution of blood pressure and hypertension in Canada and the United States. *American Journal of Hypertension* 2001;14(11):1099-105.
- 4 Tu JV, Chu A, Donovan LR, Ko DT, Booth GL, Tu K, et al. The Cardiovascular Health in Ambulatory Care Research Team (CANHEART) using big data to measure and improve cardiovascular health and healthcare services. *Circulation: Cardiovascular Quality and Outcomes* 2015;8(2):204-12.
- 5 Canadian Institute for Health Information. Pan-Canadian Primary Healthcare Indicators. Ottawa, Ontario; 2006. Report No.: 1 Vol 1.
- 6 Canadian Institute for Health Information. Pan-Canadian Primary Healthcare Indicators. Ottawa, Ontario; 2006. Report No.: 1 Vol 2.
- 7 Steering Committee for the Ontario Primary Care Performance Measurement Initiative. A Primary Care Performance Measurement Framework for Ontario. 2014. Report No.: Phase One.
- 8 Tu JV, Khalid L, Donovan LR, Ko DT, for the Canadian Cardiovascular Outcomes Research Team / Canadian Cardiovascular Society Acute Myocardial Infarction Quality Indicator Panel. Indicators of quality of care for patients with acute myocardial infarction. *Canadian Medical Association Journal* 2008 Oct 21;179(9):909-15.
- 9 Lee DS, Tran C, Flintoft V, Grant FC, Liu PP, Tu JV, et al. CCORT/CCS quality indicators for congestive heart failure care. *Canadian Journal of Cardiology* 2003;19(4):357-64.
- 10 Levine GN, Bates ER, Blankenship JC, Bailey SR, Bittl JA, Cercek B, et al. 2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention and the 2013 ACCF/AHA Guideline for G₄^a. *Circulation* 2016 Mar 14;133(11):1135-47.
- 11 Lambie L, Mattke S, and the Members of the OECD Cardiac Care Panel. Selecting Indicators for the Quality of Cardiac Care at the Health Systems Level in OECD Countries. 2004.
- 12 Burge FI, Bower K, Putnam W, Cox JL. Quality indicators for cardiovascular primary care. *Canadian Journal of Cardiology* 2007;23(5):383-8.

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- 13 Redberg RF, Benjamin EJ, Bittner V, Braun LT, Goff J, Havas S, et al. ACCF/AHA 2009 Performance Measures for Primary Prevention of Cardiovascular Disease in Adults A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Performance Measures for Primary Prevention of Cardiovascular Disease) Developed in Collaboration With the American Academy of Family Physicians; American Association of Cardiovascular and Pulmonary Rehabilitation; and Preventive Cardiovascular Nurses Association Endorsed by the American College of Preventive Medicine, American College of Sports Medicine, and Society for Women's Health Research. *Journal of the American College of Cardiology* 2009 Sep 29;54(14):1364-405.
 - 14 Fink A, Kosecoff J, Chassin M, Brook RH. Consensus methods: characteristics and guidelines for use. *American journal of public health* 1984;74(9):979-83.
 - 15 Tu JV, Abrahamyan L, Donovan LR, Boom N, Canadian Cardiovascular Society Quality Indicators Steering Committee. Best practices for developing cardiovascular quality indicators. *Canadian Journal of Cardiology* 2013;29(11):1516-9.
 - 16 Tobe SW, Stone JA, Brouwers M, Bhattacharyya O, Walker KM, Dawes M, et al. Harmonization of guidelines for the prevention and treatment of cardiovascular disease: the C-CHANGE Initiative. *Canadian Medical Association Journal* 2011;183(15):E1135-E1150.
 - 17 Tobe SW, Stone JA, Walker KM, Anderson T, Bhattacharyya O, Cheng AY, et al. Canadian Cardiovascular Harmonized National Guidelines Endeavour (C-CHANGE): 2014 update. *Canadian Medical Association Journal* 2014;186(17):1299-305.
 - 18 Donabedian A. Evaluating the Quality of Medical Care. *The Milbank Memorial Fund Quarterly* 1966;44(3):166-206.
 - 19 Statistics Canada. Canadian Community Health Survey-Annual Component. 2016 Apr 29.
 - 20 Williamson T, Green ME, Birtwhistle R, Khan S, Garies S, Wong ST, et al. Validating the 8 CPCSSN case definitions for chronic disease surveillance in a primary care database of electronic health records. *The Annals of Family Medicine* 2014;12(4):367-72.
 - 21 Starfield B, Shi L, Macinko J. Contribution of Primary Care to Health Systems and Health. *Milbank Q* 2005 Sep;83(3):457-502.
 - 22 Anderson TJ, Gregoire J, Hegele RA, Couture P, Mancini GJ, McPherson R, et al. 2012 update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. *Canadian Journal of Cardiology* 2013;29(2):151-67.
 - 23 Cheng AY, Lau DC. The Canadian Diabetes Association 2013 clinical practice guidelines GÇöraising the bar and setting higher standards! *Canadian journal of diabetes* 2013;37(3):137-8.
 - 24 Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E, et al. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]. *Canadian Medical Association Journal* 2007;176(8):S1-S13.

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- 25 Leung AA, Nerenberg K, Daskalopoulou SS, McBrien K, Zarnke KB, Dasgupta K, et al. Hypertension Canada's 2016 Canadian Hypertension Education Program Guidelines for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. *Canadian Journal of Cardiology* 2016;32(5):569-88.
 - 26 Lindsay P, Connor Gorber S, Joffres M, Birtwhistle R, McKay D, Cloutier L. Recommendations on screening for high blood pressure in Canadian adults. *Can Fam Physician* 2013 Sep;59(9):927-33.
 - 27 US Preventive Services Task Force. Screening for High Blood Pressure: U.S. Preventive Services Task Force Reaffirmation Recommendation Statement. *Annals of Internal Medicine* 2007 Dec 4;147(11):783-6.
 - 28 Borkhoff CM, Saskin R, Rabeneck L, Baxter NN, Liu Y, Tinmouth J, et al. Disparities in receipt of screening tests for cancer, diabetes and high cholesterol in Ontario, Canada: a population-based study using area-based methods. *Canadian Journal of Public Health* 2013;104:e284.
 - 29 Statistics Canada. CANSIM table 102-0561: Leading causes of death, by sex (both sexes). Statistics Canada 2015 December 10 [cited 2016 Sep 8]; Available from: URL: <http://www.statcan.gc.ca/tables-tableaux/sum-som/I01/cst01/hlth36a-eng.htm>
 - 30 Tu JV, Donovan LR, Lee DS. Effectiveness of public report cards for improving the quality of cardiac care: The effect study: a randomized trial. *JAMA* 2009 Dec 2;302(21):2330-7.
 - 31 Heart and Stroke Foundation-Statistics. Heart and Stroke Foundation 2016 Available from: URL: <http://www.heartandstroke.on.ca/site/c.pvl3leNWJwE/b.3581729/k.359A/Statistics.htm#References>
 - 32 Rawson NS, Chu R, Ismaila AS, Terres JAR. The aging Canadian population and hospitalizations for acute myocardial infarction: projection to 2020. *BMC cardiovascular disorders* 2012;12(1):1.
 - 33 Rubin HR, Pronovost P, Diette GB. The advantages and disadvantages of process-based measures of healthcare quality. *International Journal for Quality in Healthcare* 2001;13(6):469-74.
 - 34 Mainz J. Defining and classifying clinical indicators for quality improvement. *International Journal for Quality in Healthcare* 2003 Dec 5;15(6):523-30.
 - 35 Dasgupta K, Quinn RR, Zarnke KB, Rabi DM, Ravani P, Daskalopoulou SS, et al. The 2014 Canadian Hypertension Education Program recommendations for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. *Canadian Journal of Cardiology* 2014;30(5):485-501.
 - 36 Imran SA, Rabasa-Lhoret R, Ross S, Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Targets for Glycemic Control. *Can J Diabetes* 2013;37(2013):S31-S34.

Appendix 1. Candidate CANHEART Primary Prevention Performance Indicators (N=109)

Smoking (N=3)

- Prevalence of smoking
- Percentage of patients who received tobacco use assessment by their primary health care provider
- Percentage of smokers who received smoking cessation counselling

Weight/Obesity (N=5)

- Prevalence of overweight/obesity
- Prevalence of self-perceived overweight/obesity
- Percentage of patients who had waist circumference/ height and weight measurement (BMI) / obesity screening
- Percentage of overweight/obese patients who have had the risks of their weight discussed by their primary health care provider
- Percentage of overweight/obese patients who made lifestyle modifications to lose weight

Physical Activity (N=3)

- Prevalence of physical inactivity
- Percentage of patients who were asked about their physical activity by their primary health care provider
- Percentage of patients who report being given physical activity advice by their primary health care provider

Diet (N=3)

- Prevalence of inadequate fruit and vegetable consumption (<5 servings of fruits and vegetables per day)
- Percentage of patients who were asked about their diet by their primary health care provider
- Percentage of patients who report being given dietary advice by their primary health care provider

Alcohol Consumption (N=3)

- Prevalence of heavy drinking (≥ 5 drinks on one occasion ≥ 12 times per year)
- Percentage of patients who were asked about their alcohol consumption by their primary health care provider
- Percentage of patients who were given alcohol consumption advice

Depression (N=1)

- Percentage of patients who were asked about their mental health or emotional status by their primary health care provider

Hypertension (N=12)

- Prevalence of treated or untreated hypertension (BP \geq 140/90)
- Percentage of patients who had their blood pressure measured by their primary health care provider
- Percentage of patients with hypertension (BP \geq 140/90) who report taking their own blood pressure
- Percentage of patients with hypertension (BP \geq 140/90) who had kidney function screening (serum creatinine, urine protein)
- Percentage of patients with hypertension (BP \geq 140/90) who have been screened for modifiable risk factors (kidney function, fasting blood sugar, fasting lipid profile, blood pressure measurement, obesity/overweight)
- Percentage of patients with hypertension (BP \geq 140/90) who received lifestyle recommendations to reduce blood pressure from their primary health care provider (reduce salt intake, healthy diet, exercise, lose weight, quit smoking, limit alcohol consumption, reduce stress)
- Percentage of patients with hypertension (BP \geq 140/90) who made lifestyle changes following advice of their primary health care provider (topics as above)
- Percentage of patients with hypertension (BP \geq 140/90) prescribed anti-hypertension medication
- Percentage of patients with chronic kidney disease, hypertension (BP \geq 140/90), and proteinuria on ACE inhibitor or ARB therapy
- Self-reported blood pressure control (normal, borderline, high, or low) among patients with hypertension
- Measured blood pressure control among patients with hypertension (BP <140/90 for non-diabetics, <130/80 for diabetics)
- ED Visit rate for hypertensive emergencies among patients with hypertension

Diabetes (N=20)

- Prevalence of diabetes (Type I or Type II)
- Percentage of patients with fasting blood glucose/HbA1c screening within past 36 months
- Percentage of diabetics who report self-monitoring their blood glucose levels
- Percentage of diabetics who had HbA1c testing at least twice in past 12 months
- Percentage of diabetics who had a full fasting lipid profile screening within the previous 36 months
- Percentage of diabetics who had nephropathy screening (e.g.. albumin/creatinine ratio, microalbuminuria) within the past 12 months
- Percentage of diabetics who report blood pressure measurement by primary health care provider within the past 12 months
- Percentage of diabetics who had a foot examination within the past 12 months
- Percentage of diabetics who had obesity/overweight screening within the past 12 months
- Percentage of diabetics who had an eye examination within past 24 months
- Percentage of diabetics who report having lifestyle modifications (diet, physical activity, weight control, stress management, smoking, alcohol consumption) discussed with them by their primary health care provider

- Percentage of diabetics on anti-diabetic medications (oral agents and/or insulin)
- Percentage of diabetics who report making lifestyle modifications after diagnosis of diabetes (diet, physical activity, weight control, quit smoking, reduce alcohol consumption)
- Percentage of diabetics with proteinuria or micro-albuminuria prescribed ACE-inhibitors
- Percentage of diabetics referred for multidisciplinary care (nutritionist/dietician, podiatrist, alternative medicine, nephrologist, diabetes specialist)
- Percentage of diabetics who self-report glycemic control (well-controlled, borderline, high, or low)
- Percentage of diabetics who have achieved glycemic control (HbA1c $\leq 7\%$)
- Percentage of diabetics who have their lipid levels controlled (LDL-C ≤ 2.0 mmol/L)
- Rate of ED visits for diabetes among diabetics
- Rate of diabetic complications among diabetics (AMI, amputation above or below knee, began chronic dialysis)

Dyslipidemia (N=8)

- Prevalence of high lipid levels (total cholesterol ≥ 5.2 mmol/L)
- Percentage of men ≥ 40 and women ≥ 50 with a record of a full fasting lipid profile in the past 5 years
- Percentage of patients who had an MI, stroke who have been prescribed lipid lowering therapy
- Percentage of patients who have diabetes who have been prescribed lipid lowering therapy
- Percentage of patients who are hypertensive ($\geq 140/90$ for non-diabetics, $\geq 130/80$ for diabetics) who have been prescribed lipid lowering therapy
- Percentage of patients with established CVD who have been given lifestyle recommendations to reduce cholesterol by their primary health care provider
- Percentage of patients with CVD who self-report lipid control status (normal, borderline, high, or low)
- Percentage of patients with established CVD who have their lipid levels controlled (LDL-C ≤ 2 mmol/L)

Atrial Fibrillation (N=7)

- Prevalence of atrial fibrillation
- Percentage of patients with atrial fibrillation on anticoagulant therapy (Warfarin or direct oral anticoagulants)
- Percentage of patients with atrial fibrillation on Coumadin who receive monthly International normalized ratio (INR) monitoring
- Percentage of time in therapeutic range among patients with atrial fibrillation on Coumadin (INR 2-3)
- Percentage of patients with atrial fibrillation who have a stroke over 36 months (adjusted for CHADS score)
- Percentage of patients with atrial fibrillation who bleed over 36 months (adjusted for HASBLED score)

- Rate of ED visits for atrial fibrillation among patients with atrial fibrillation over 36 months

Ischemic Heart Disease (N=12)

- Prevalence of ischemic heart disease
- Percentage of patients ≥ 40 years of age who received an ECG (screening)
- Percentage of patients who received a global risk assessment for heart disease
- Percentage of patients who had an MI/IHD who have been prescribed antiplatelet therapy
- Percentage of patients who had an MI/ IHD who have been prescribed beta-blocker therapy
- Percentage of patients who had an MI/ IHD who have been prescribed statin therapy
- Percentage of patients who had an MI/IHD who have been prescribed ACE inhibitor or ARB or Angiotensin II Antagonist therapy
- Percentage of patients who had an MI who have been referred to cardiac rehab within 3 months of event
- Percentage of patients who had an MI/ IHD who have their blood pressure controlled ($<140/90$ for non-diabetics, $<130/80$ for diabetics)
- Percentage of patients who had an MI/IHD whose cholesterol is controlled (LDL-C <2 mmol/L)
- Percentage of patients who had an MI/IHD whose angina is controlled (CCS Class I)
- Rate of recurrent MI hospital admission among patients who had an MI

Heart Failure (N=8)

- Prevalence of heart failure
- Percentage of heart failure patients with left ventricular ejection fraction assessment by Echocardiogram, Angiogram, Nuclear Medicine, or MRI
- Percentage of heart failure patients prescribed beta-blocker therapy
- Percentage of heart failure patients prescribed ACE-inhibitor or ARB therapy
- Percentage of heart failure patients followed in a heart failure clinic
- Percentage of heart failure patients with a dietary assessment by their primary health care provider
- Rate of emergency department visits for heart failure among heart failure patients over 36 months
- Rate of hospital admission for heart failure among heart failure patients over 36 months

Stroke (N=7)

- Prevalence of a history of stroke
- Percentage of stroke patients who have received cognitive screening (using a standardized screening tool, e.g.. MOCA)
- Percentage of stroke patients taking or prescribed aspirin/antiplatelet therapy
- Percentage of stroke patients prescribed statins
- Percentage of stroke patients referred to outpatient stroke rehab within 3 months of event
- Percentage of stroke patients followed in a secondary prevention stroke clinic
- Rate of recurrent stroke among stroke patients over 36 months

1
2
3 Primary Care Access (N=5)
4

- 5 • Percentage of population with a primary health care provider
- 6 • Percentage of population with continuous care from a primary health care provider
- 7 • Percentage of patients who self-report satisfaction with their primary health care provider
- 8 • Percentage of patients who report difficulties accessing routine/ongoing primary health care
- 9 • Percentage of patients who report difficulties obtaining immediate after-hours care for a minor
- 10 health problem
- 11
- 12

13
14 Outcomes/Other (N=12)
15

- 16 • Percentage of patients taking aspirin
- 17 • Percentage of patients taking lipid-lowering agent
- 18 • Percentage of patients taking other medications (diuretics, ARBs, calcium channel blockers,
- 19 nitrates)
- 20
- 21 • Percentage of patients who received an influenza immunization
- 22 • Percentage of patients who self-manage their chronic conditions (Diabetes, Hypertension, CHF,
- 23 Afib, Stroke, CAD)
- 24
- 25 • Primary health care support for self-management of chronic conditions (Diabetes, Hypertension,
- 26 CHF, Afib, Stroke, CAD)
- 27
- 28 • Percentage of patients with chronic conditions who reported having had enough time and
- 29 opportunity to ask questions in most visits with their primary health care provider
- 30
- 31 • Percentage of patients who report having drug insurance
- 32 • Percentage of patients who report having dental insurance
- 33
- 34 • 3-5 year cardiovascular event rate (acute myocardial infarction, stroke, congestive heart failure,
- 35 revascularization)
- 36
- 37 • Hospitalization rate for cardiac ambulatory care sensitive conditions (diabetes, hypertension,
- 38 angina, stroke, CHF)
- 39
- 40 • Cardiovascular and/or all-cause mortality rate(age and sex adjusted)
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

ID	Primary Prevention Indicator Topic Area	Numerator	Denominator	Exclusions	Preferred Data Source	Alternate Data Source(s)	Relevant Clinical Guideline
Smoking (N=2)							
SMK1	Prevalence of smoking	Number of individuals in the denominator who self-reported being/were identified as a current smoker, either daily or occasionally	Number of individuals/primary healthcare patients, 20 years of age and older	None	Survey (e.g., Canadian Community Health Survey (CCHS))	EMR	C-CHANGE (Tobe et al., 2011)
SMK2	Percentage of smokers who received smoking cessation counseling	Number of individuals in the denominator who received smoking cessation counseling	Number of individuals/primary healthcare patients, age 20 and older, who are current smokers	None	Administrative Databases (Physician Services, e.g., Ontario Health Insurance Plan (OHIP))	Survey (e.g., CCHS)	C-CHANGE (Tobe et al., 2011)
Obesity (N=2)							
WHT1	Prevalence of obesity	Number of individuals in the denominator who had a measured or self-reported body mass index ≥ 30 kg/m ²	Number of individuals/primary healthcare patients age 20 and older	Individual was pregnant at the time of body-mass index measurement	Survey (e.g., CCHS)	EMR	2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children (Lau et al., 2007 CMAJ)
WHT2	Percentage of patients with height and weight measured	Number of individuals in denominator who had their height and weight measured by a healthcare professional	Number of individuals/primary healthcare patients age 20 and older	None	EMR	N/A	2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children (Lau et al., 2007 CMAJ)
Hypertension (N=4)							
HTN1	Prevalence of hypertension	Number of patients in the denominator who have a diagnosis of hypertension OR elevated blood pressure (≥ 140 mmHg systolic or ≥ 90 mmHg diastolic) OR who self-report having hypertension	Number of individuals/primary healthcare patients 20 years of age and older	None	Administrative Databases (Validated Disease Algorithms, e.g., Ontario Hypertension Database)	EMR, Survey (e.g., CCHS)	CHEP 2016 Guidelines (Leung et al., CJC)

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

HTN2	Percentage of patients who had their blood pressure measured	Number of patients in the denominator who have had their blood pressure measured by a healthcare professional	Number of primary healthcare patients age 20 years of age and older	None	EMR	Survey (e.g., CCHS)	CHEP 2016 Guidelines (Leung et al., CJC)
HTN3A	Percentage of patients with hypertension taking ≥1 anti-hypertension medication	Number of patients in the denominator who were prescribed/self-report taking at least one anti-hypertension medication	Number of primary healthcare patients with hypertension, 20 years of age and older	None	Administrative Databases (Prescription Medication Claims, e.g., Ontario Drug Benefit Database, Validated Disease Algorithms, e.g. Ontario Hypertension Database)	EMR, Survey (e.g., CCHS)	CHEP 2016 Guidelines (Leung et al., CJC)
HTN3B	Mean number of antihypertensive medications taken among patients with hypertension	Mean number of antihypertensive medications taken among patients in the denominator	Number of primary healthcare patients with hypertension, 20 years of age and older	None	Administrative Databases (Medication Claims, e.g., Ontario Drug Benefit Database, Validated Disease Algorithms, e.g. Ontario Hypertension Database)	EMR	CHEP 2016 Guidelines (Leung et al., CJC)
HTN4A	Measured blood pressure control (<140mmHg systolic and <90 mmHg diastolic) among patients with hypertension	Number of patients in the denominator who had a blood pressure measure <140mmHg systolic and <90mmHg diastolic	Number of primary healthcare patients with hypertension, 20 years of age and older	Patients with a diagnosis of diabetes (these patients should be treated to attain blood pressures of <130mmHg systolic and <80mmHg diastolic)	EMR	N/A	CHEP 2016 Guidelines (Leung et al., CJC)
HTN4B	Emergency Department visit rate for hypertension among patients with hypertension	Number of Emergency Department visits for hypertension by patients in denominator	Number of primary healthcare patients with hypertension, 20 years of age and older	None	Administrative Databases (Emergency Medical Services, e.g., NACRS, Validated Algorithms, e.g. Ontario Hypertension Database)	N/A	CHEP 2016 Guidelines (Leung et al., CJC) Rationale: Surrogate measure of blood pressure control

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

Diabetes (N=6)							
DIA1	Prevalence of diabetes	Number of patients in the denominator who have a diagnosis of diabetes (Type I or Type II) based on a validated administrative data algorithm, recorded primary healthcare provider diagnosis in the EMR, or self-report	Number of primary healthcare patients age 20 and older	None	Administrative Databases (Validated Algorithms, e.g. Ontario Diabetes Database)	EMR, Survey (e.g., CCHS)	Canadian Diabetes Association Clinical Practice Guidelines (Cheng et al., 2013 Can J Diabetes)
DIA2	Percentage of patients age 40 and older who had a full fasting blood glucose or HbA1c screening test in the past 36 months	Number of patients in the denominator who have had a fasting blood glucose screening or HbA1c screening within the past 36 months	Number of primary healthcare patients age 40 and older	Patients with a previous diagnosis of diabetes	Administrative Databases (Physician Claims, e.g., OHIP, Validated Algorithms, e.g. Ontario Diabetes Database-for exclusion criteria)	EMR, Survey (e.g., CCHS)	Canadian Diabetes Association Clinical Practice Guidelines (Cheng et al., 2013 Can J Diabetes)
DIA3	Percentage of patients with diabetes taking anti-diabetic medications	Number of patients in the denominator who are taking anti-diabetic medications (oral agents or insulin)	Number of primary healthcare patients with diabetes (type I or type II), age 20 and older	None	Administrative Databases (Medication Claims, e.g., Ontario Drug Benefit Database, Validated Algorithms, e.g., Ontario Diabetes Database)	Survey (e.g., CCHS)	Canadian Diabetes Association Clinical Practice Guidelines (Cheng et al., 2013 Can J Diabetes)
DIA4	Percentage of patients with diabetes age 55 and older taking angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs)	Number of patients in the denominator who are taking ACE-inhibitors or ARBs	Number of primary healthcare patients with diabetes (Type I or Type II), age 55 and older	None	Administrative Databases (Medication Claims, e.g., Ontario Drug Benefit Database, Validated Algorithms, e.g., Ontario Diabetes Database)		Canadian Diabetes Association Clinical Practice Guidelines (Cheng et al., 2013 Can J Diabetes)
DIA5	Percentage of patients with diabetes age 40 and older taking statin medication	Number of patients in the denominator who were prescribed statins	Number of primary healthcare patients with diabetes (Type I or Type II), age 40 and older	None	Administrative Databases (Medication Claims, e.g. Ontario Drug Benefit, Validated Algorithms, e.g. Ontario Diabetes Databases)	EMR	Canadian Diabetes Association Clinical Practice Guidelines (Cheng et al., 2013 Can J Diabetes)

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13	Dyslipidemia (N=4)						
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

LIP4	Percentage of patients taking statins who have their lipid levels controlled (LDL-C \leq 2mmol/L)	Number of patients in the denominator with most recent blood test showing LDL-C \leq 2 mmol/L	Number of primary healthcare patients age 20 and older taking statins	None	Administrative Databases (Medication Claims, e.g., Ontario Drug Benefit Database, Laboratory Databases)	EMR	Canadian Cardiovascular Society 2012 Dyslipidemia Guidelines (Anderson et al., 2013 CJC)
Atrial Fibrillation (N=3)							
AFIB1	Prevalence of atrial fibrillation	Number of patients in the denominator with diagnosis of atrial fibrillation/hospitalization or ED visit for atrial fibrillation	Number of primary healthcare patients age 20 and older	None	Administrative Databases (Hospitalization, e.g., CIHI-DAD, Physician Claims, e.g., OHIP, Emergency Medicine, e.g., NACRS)	EMR	Canadian Stroke Best Practice Recommendations, 2012-2013 (Lindsay et al., Canadian Heart and Stroke Foundation)
AFIB2	Percentage of patients with atrial fibrillation on anticoagulant therapy (warfarin or direct oral anticoagulant)	Number of patients in the denominator prescribed Warfarin or direct oral anticoagulant	Number of primary healthcare patients age 20 and older with atrial fibrillation	None	Administrative Databases (Hospitalization, e.g., CIHI-DAD, Physician Claims, e.g., OHIP, Emergency Medicine, e.g., NACRS, Medication Claims, e.g., Ontario Drug Benefit Database)	EMR	Canadian Stroke Best Practice Recommendations, 2012-2013 (Lindsay et al., Canadian Heart and Stroke Foundation)
AFIB3	Percentage of time in therapeutic range (INR 2-3) among patients with atrial fibrillation on warfarin	Number of patients in the denominator whose average INR test results was 2-3	Number of primary healthcare patients age 20 and older with atrial fibrillation on warfarin with at least one INR test result	None	Administrative Databases (Hospitalization, e.g., CIHI-DAD, Physician Claims, e.g., OHIP, Emergency Medicine, e.g., NACRS, Medication Claims, e.g., Ontario Drug Benefit Database, Laboratory Databases)	EMR	Canadian Stroke Best Practice Recommendations, 2012-2013 (Lindsay et al., Canadian Heart and Stroke Foundation)
Access to Primary Care (N=2)							

1								
2								
3								
4								
5	PC1	Percentage of individuals who have visited a primary healthcare provider	Number of patients in the denominator who have visited a primary healthcare provider	Number of primary healthcare patients age 20 and older	None	Administrative Databases (Physician Services, e.g. OHIP)		
6								
7								
8								
9								
10								
11	PC2	Mean number of primary healthcare visits per year (e.g. for hypertension, diabetes, etc.)	Number of visits to primary healthcare providers per year	Number of primary healthcare patients age 20 and older	None	Administrative Databases (Physician Services, e.g. OHIP)	EMR	
12								
13								
14								
15								
16								
17	Outcome Indicators (N=5)							
18								
19	O1	Acute myocardial infarction rate (per 1,000 person-years)	Number of hospitalizations for acute myocardial infarction among patients in the denominator	Person-years of follow-up among individuals 20 years of age and older	None	Administrative Data (Hospitalization e.g., CIHI-DAD, other databases for denominator population, e.g. Registered Persons' Database)	N/A	
20								
21								
22								
23								
24								
25								
26								
27								
28	O2	Stroke (ischemic/hemorrhagic) rate (per 1,000 person-years)	Number of hospitalizations for acute stroke (ischemic or hemorrhagic stroke) among patients in the denominator	Person-years of follow-up among individuals 20 years of age and older	None	Administrative Data (Hospitalization e.g., CIHI-DAD, other databases for denominator population, e.g. Registered Persons' Database)	N/A	
29								
30								
31								
32								
33								
34								
35	O3	Congestive heart failure (requiring hospitalization) rate (per 1,000-person-years)	Number of hospitalizations for heart failure among patients in the denominator	Person-years of follow-up among individuals 20 years of age and older	None	Administrative Data (Hospitalization e.g., CIHI-DAD, other databases for denominator population, e.g. Registered Persons' Database)	N/A	
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								

Appendix 2. CANHEART Primary Prevention Performance Indicator Definitions

04	Revascularization (percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG)) rate (per 1,000 person-years)	Number of revascularization procedures performed among patients in the denominator	Person-years of follow-up among individuals 20 years of age and older	None	Administrative Data (Hospitalization e.g., CIHI-DAD, other databases for denominator population, e.g. Registered Persons' Database)	N/A	
05	Cardiovascular and/or all-cause mortality rate (per 1,000 person-years)	Number of deaths/cardiac deaths among patients in denominator	Person-years of follow-up among individuals 20 years of age and older	None	Administrative Databases (Cause of Death Databases, e.g. Ontario Registrar General Death Database, other databases for denominator population, e.g. Registered Persons' Database)	N/A	