

***From Stroke Prevention to  
Health Gain***

***Final Report***

Christina Mills  
Steve Manske  
Maureen Dobbins  
Roy Cameron

Prepared by the

Centre for Behavioural Research  
and Program Evaluation  
National Cancer Institute of Canada

Submitted to Ontario Prevention Clearinghouse

September, 2002



Canadian Cancer Society  
Société canadienne  
du cancer



National  
Cancer Institute  
of Canada

Institut national  
du cancer  
du Canada



## Acknowledgments

We thank those individuals who assisted with this report:

Cindy Andrew and Susan Scott (SPS Research & Evaluation Inc.)  
Myrna Gough, Sarah Lambert (MOHLTC)  
Shirley Bryan, Yang Mao, Gregory Taylor, Peter Walsh, Chris Waters (Health Canada)  
Donna Mitchell, Health Promotion Consultant  
Kara DeCorby (McMaster University)  
Anne Lessio (Ontario Heart Health Resource Centre)  
Kelly Anne Velle, Jennifer MacWhirter (Health Behaviour Research Group)

In addition, we benefited from the advice of reviewers:

Connie Clement (Ontario Prevention Clearinghouse)  
Geoff Dunkley (Ottawa-Carleton Health Department)  
John Garcia (Cancer Care Ontario)  
Trevor Hancock (BC Ministry of Health)  
Dexter Harvey (University of Manitoba)  
Jack Lee (Ontario Public Health Association)  
Gregory Taylor (Health Canada)

## Suggested Citation

Mills, C., Manske, S., Dobbins, M., & Cameron, R. *From Stroke Prevention to Health Gain*. Final Report. CCS/NCIC Centre for Behavioural Research and Program Evaluation, University of Waterloo, Waterloo, Ontario, 2002.

For further information regarding this report, please contact:

Centre for Behavioural Research and Program Evaluation  
Canadian Cancer Society/National Cancer Institute of Canada  
Lyle S. Hallman Institute  
University of Waterloo  
200 University Avenue West  
Waterloo, ON  
N2L 3G1  
Tel: (519) 888-4520  
Fax: (519) 886-6424  
Email: [cbrpe@healthy.uwaterloo.ca](mailto:cbrpe@healthy.uwaterloo.ca)

## AUTHOR AFFILIATIONS

**Christina Mills, MD, FRCPC**

President, Canadian Public Health Association

Visiting Scientist, Centre for Behavioural Research and Program Evaluation

Hallman Visiting Professor, Faculty of Applied Health Sciences, University of Waterloo

**Steve Manske, Ed.D.**

Research Associate, Centre for Behavioural Research and Program Evaluation

Research Assistant Professor, Department of Health Studies & Gerontology, University of Waterloo

**Maureen Dobbins, RN, Ph.D.**

Assistant Professor, School of Nursing, McMaster University

Public Health Associate, Hamilton-Wentworth Department of Social and Public Health Services

Post-Doctoral Fellow, Canadian Health Services Research Foundation

Member, Canadian Centre for Evidence-Based Nursing

**Roy Cameron, Ph.D.**

Professor, Department of Health Studies and Gerontology, University of Waterloo

Director, Centre for Behavioural Research and Program Evaluation

Member, Conference of Principal Investigators, Canadian Heart Health Initiative

Member, Canadian Cancer Society/National Cancer Institute of Canada's Joint Advisory Committee on Cancer Control

Member, Institutional Advisory Board, Institute for Cancer Research, Canadian Institutes of Health Research

Member, Ministerial Advisory Council on Tobacco Control, Health Canada

Refer to Table of Contents for Author Biosketches

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	i
1.0 INTRODUCTION .....	1
2.0 OVERVIEW OF THE ETIOLOGY AND PREVENTABILITY OF STROKE .....	2
2.1 Non- Modifiable Risk Factors and Broader Determinants .....	2
2.2 Modifiable Risk Factors .....	3
2.3 Protective Factors .....	5
3.0 THE BURDEN OF STROKE IN ONTARIO .....	5
4.0 SCOPE FOR PRIMARY PREVENTION OF STROKE IN ONTARIO .....	9
5.0 EFFECTIVENESS OF COMMUNITY-BASED PREVENTION PROGRAMS .....	15
6.0 CONTEXT: CURRENT APPROACHES TO CHRONIC DISEASE PREVENTION .....	18
6.1 International .....	19
6.2 Level of Integration .....	26
6.3 Strategy Content (What) .....	27
6.4 Strategy Implementation (How) .....	27
6.5 Players (Who) .....	27
6.6 Infrastructure .....	28
6.7 Canada .....	28
6.8 Ontario .....	29
7.0 RATIONALE FOR A POPULATION-BASED STROKE PREVENTION APPROACH INTEGRATED WITH CHRONIC DISEASE PREVENTION .....	30
7.1 Why Population-Based? .....	30
7.2 Why Integrated with Chronic Disease Prevention and Health Promotion? .....	32
7.3 The Rationale in a Nutshell .....	33
8.0 GUIDING PRINCIPLES FOR A COMMUNITY-BASED DELIVERY SYSTEM FOR CHRONIC DISEASE PREVENTION AND HEALTH PROMOTION .....	34
9.0 A MODEL FOR INTEGRATED CHRONIC DISEASE PREVENTION AND HEALTH PROMOTION .....	39
REFERENCES .....	46
TABLES	
Table 2.1: Well-Documented Modifiable Risk Factors for Stroke .....	4
Table 2.2: Less Well-Documented Modifiable Risk Factors for Stroke .....	5
Table 3.1: Stroke Mortality, by Sex and Age Group, Ontario, 1998 .....	6
Table 3.2: Hospitalizations for Stroke, by Sex and Age Group, Ontario, 1999 .....	6

Table 3.3: Age-Specific Mortality Rates, Ontario and Regions, 1991-96.....	7
Table 3.4: Projected Population by Age Group, Southwestern Ontario, 2000-2020.....	9
Table 3.5: Estimated Number of Community Residents in Ontario Living with the Effects of Stroke, 1994-2001.....	9
Table 4.1: Prevalence of Modifiable Risk Factors for Stroke in Ontario 2000/2001.....	11
Table 4.2: Variability of Modifiable Risk Factor Prevalence in Ontario.....	12
Table 4.3: Difference in PAR% Between Ontario and Public Health Units with Lowest Risk Factor Prevalence.....	14
Table 4.4: Potential Reduction of Stroke Burden in Ontario.....	15
Table 5.1: Findings of Reviews Rated Strong and Moderate.....	17
Table 6.1: Comparison of International Approaches to Chronic Disease Prevention.....	23
Table 7.1: Comparison of High Risk and Population Strategies for Disease Prevention and Health Promotion.....	32

## FIGURES

Figure 3.1: Cerebrovascular Disease Mortality in Ontario, 1998 by Age and Sex.....	8
Figure 3.2: Hospitalizations for Stroke in Ontario, 1999 by Age and Sex.....	8
Figure 7.1: Socio-behavioural Risk Factors for Chronic Diseases.....	34
Figure 8.1: CSAP-SAMHSA Guidelines for Prevention Programming.....	36
Figure 9.1: Overview of an Integrated Chronic Disease Prevention Approach.....	40

## APPENDICES

APPENDIX 1: METHODS AND DATA SOURCES.....	55
APPENDIX 2: A REVIEW OF REVIEWS.....	57
A2.1 Introduction.....	57
A2.2 Methods.....	57
A2.3 Results.....	58
Table A2.1: Description of Literature Reviews.....	59
Table A2.2: Elements of Interventions.....	63
Table A2.3: Knowledge.....	64
Table A2.4: Blood Pressure.....	64
Table A2.5: Smoking.....	65
Table A2.6: Physical Activity.....	66
Table A2.7: Weight.....	67
Table A2.8: Cholesterol.....	68
Table A2.9: Diet.....	69
Table A2.10: CVD Mortality.....	69
Table A2.11: CVD Risk.....	70

Table A2.12: CVD Morbidity.....	70
A2.4 Included Reviews.....	71
ANNEX A: Journals for which Hand-Searching was Completed.....	75
ANNEX B: Quality Assessment Tool, Dictionary and Decision Tree.....	76
<b>APPENDIX 3: CHRONIC DISEASE PREVENTION FRAMEWORK ONTARIO-BASED CONSULTATION.....</b>	<b>82</b>
ANNEX A: Organizations Contacted for Interviews and Organizations Participating in Interviews .....	88
<b>APPENDIX 4: FIGURES .....</b>	<b>90</b>
Figure A4.1: Range of Interventions for Prevention of Chronic Disease.....	90
Figure A4.2: Socioeconomic Influences on Cardiovascular Disease from a Life Course Perspective .....	90
Figure A4.3: A Life Course Approach to NCD Prevention .....	91
Figure A4.4: A Life Course Approach to Chronic Disease Prevention.....	92
Author Biosketches.....	93

## **EXECUTIVE SUMMARY**

As part of a response to the Joint Stroke Strategy Working Group (JSSWG)'s recommendation in June 2000 that the Ministry of Health and Long-Term Care (MOHLTC) "support health promotion efforts that contribute to the primary prevention of stroke," the Ontario Prevention Clearinghouse (OPC) requested that the Centre for Behavioural Research and Program Evaluation (CBRPE) develop a paper succinctly making the case for integrating community-based stroke prevention into an integrated chronic disease prevention strategy. Accordingly, the current document provides an overview of etiology of stroke, current burden in Ontario, scope for primary prevention and evidence for effectiveness of community-based health promotion. It then provides a model and guidelines for community-based disease prevention, based on a scan of frameworks and approaches used in different jurisdictions (including internationally) to organize thinking and efforts toward stroke and chronic disease prevention.

Stroke is the result of damage to the brain, whether ischemic (when a blood clot or atherosclerotic plaque clogs a blood vessel in the brain) or hemorrhagic (when a blood vessel in the brain ruptures). In Ontario, as it is worldwide, stroke is a major cause of death and disability. Modifiable risk factors amenable to community-based prevention include hypertension, smoking, diabetes (the strongest well-documented risk factors which are also prevalent in the Ontario population), obesity, physical inactivity and excessive alcohol use (less well-documented). Prevalence ranges from 4.2% for diabetes to 49.6% for physical inactivity.

Stroke is a leading cause of death (it accounts for about 6% of deaths) and adult neurological disability in Ontario. A large proportion of the survivors require some form of chronic care; about 128,000 Ontarians are living with the effects of stroke. The JSSWG reported that stroke costs the Ontario economy almost a billion dollars a year (low of \$719 million to high of \$964 million). With the aging of the Ontario population, this burden can only increase. By 2031, when the entire baby boom generation has passed the age of 65, the age group at highest risk will be two and a half times the size it was in 1995: the effect of population aging could well outweigh the effects of improvements in treatment and encouraging temporal trends to reduced age-specific hospitalization rates. Only a modest increase in numbers of Ontarians hospitalized for stroke is expected (about 9% between 1995 and 2010), but a small increase in incidence can result in substantial increases in prevalence when accompanied by increased survival.

Within Ontario, there is considerable variation both in stroke burden and in the prevalence of modifiable risk factors. We calculated the ratio of prevalence rates between the Ontario average and the public health unit (PHU) demonstrating the lowest rate for each risk factor. These ratios vary between 1.22 for physical inactivity and 1.76 for diabetes. The portion of the ratio above 1.0 represents the important scope for primary prevention. We calculated the potential benefit by comparing the Population Attributable Risk Percent (PAR%) for Ontario for each risk factor with that for the lowest prevalence PHU. This procedure provides a realistic, and indeed conservative, internal benchmark of the benefits of bringing the provincial risk factor prevalence down to levels that have already been demonstrated to be achievable in at least one area of the province. The differences between the lowest PAR% and Ontario's average range from just under 1% to around 10%; these may seem marginal, but when applied to population burden can be important. Potential savings for individual risk factors range from \$7 million to \$96 million

dollars annually, and if all were reduced to the best rates already seen in Ontario, the savings in health costs would be almost \$140 million dollars annually just for stroke. There would be even greater savings from reductions in other chronic diseases which share these risk factors, on the order of 6 to 9 times those calculated here for stroke.

Our assessment is that the best available research evidence supports the effectiveness of comprehensive, community-based prevention on knowledge, behaviour and important intermediate health outcomes. It is also suggestive that the impact on intermediate health outcomes translates eventually into longer term health benefits in morbidity and mortality. More and longer-term research is needed to substantiate the ultimate impact of intermediate outcomes on disease incidence, morbidity and mortality, and this will require vision and long-term commitment from governments and granting agencies.

With the aging of Ontario's population, population-based primary prevention is the only way we can hope to reduce the population burden of stroke and other chronic diseases with which it shares important modifiable risk factors. Clinical prevention in susceptible individuals cannot address the underlying causes of incidence and needs to be complemented with a population approach. A population approach is not only where the greatest health gains are achievable, but is the only strategy which can sustain the gains made. Integrating stroke prevention with chronic disease prevention is the strategy of choice for reasons of opportunity, feasibility, and economy.

The authors of this report and the Ontario Prevention Clearinghouse recommend that MOHLTC take advantage of the enormous base of evidence, experience, and expertise worldwide and undertake a concerted effort for health gain through population-based primary prevention and health promotion. Specifically, we recommend that the Province:

1. Initiate a provincial strategy for health gain, focusing on shifting the population distribution of common risk factors for stroke and the highest impact non-communicable diseases.
2. Enable and require local health authorities to prepare local health improvement plans, ensuring they have the capacity (knowledge, skills, tools, systems, and resources) to do so.
3. Enhance Ontario's surveillance program to ensure it adequately supports the planning, design, monitoring, and assessment of the health gain strategy.
4. Establish common evaluation and reporting processes across all chronic disease prevention and health promotion activities.
5. Develop a strategic research agenda to identify best practices in population-based chronic disease prevention.
6. Invest in an integrated, community-based chronic disease prevention system with appropriate capacity to provide a preventive dose at a population level.
7. Build on the strengths accrued in the Ontario Heart Health Program and other province-wide and national health promotion initiatives.

8. Encourage linkage and integration of existing community coalitions to form the base from which to plan and implement programs, providing them with central policy, technical, information, media and social marketing support.

The following are suggested feasible and necessary next steps to move the health gain agenda forward in Ontario:

1. Establish a steering committee with a mandate to accelerate efforts to further integrate work in primary prevention of stroke, other chronic diseases and health promotion.
2. Develop an internal and external consultation strategy convening key stakeholders to develop a practical plan based on this report and other relevant documents to begin the integration right now, building on existing capacity.
3. Advocate and support work to develop thinking on integrated chronic disease control and health gain, specifically, consider affiliating formally with the Chronic Disease Prevention Alliance of Canada.
4. Coordinate with federal and other provincial/territorial governments in developing national chronic disease control and health gain strategies and advocate with fellow ministries of health for mechanisms to enable better sharing of experiences, lessons and resources relevant to these.
5. Develop and support a publication agenda to produce a series of papers that address strategic issues of concern.

## 1.0 INTRODUCTION

The Ontario Ministry of Health and Long-Term Care (MOHLTC) and the Heart and Stroke Foundation of Ontario (HSFO) convened a Joint Stroke Strategy Working Group (JSSWG) which reported in June 2000.<sup>1</sup> Part of its mandate was to "identify existing critical gaps and develop new approaches for strengthening current stroke prevention programming." The JSSWG concluded that "stroke is highly preventable. The number of Ontarians at risk of stroke can be significantly reduced through lifestyle modifications such as smoking cessation and the promotion of increased physical activity and good nutrition". It recommended that the MOHLTC "support health promotion efforts that contribute to the primary prevention of stroke".

As part of the response to the JSSWG's recommendations, the Ontario Prevention Clearinghouse (OPC) received funding from the Ministry of Health and Long-Term Care to develop proposals to improve 1) the integration of stroke prevention work in the stroke care and treatment system and 2) the integration of stroke prevention in the work of health promoters throughout the health system. In March 2002, the OPC approached the Centre for Behavioural Research and Program Evaluation (CBRPE) for assistance in meeting the second of these two aims, asking us to develop a paper succinctly making the case for integrating community-based stroke prevention into an integrated chronic disease prevention strategy. Work proceeded between May 2 and June 28, 2002, resulting in the current paper which will:

- Provide an overview of the etiology of stroke, with particular attention to modifiable risk factors which are amenable to a population-based (as opposed to a clinical) approach to prevention;
- Describe the current burden of stroke in Ontario and the distribution of its modifiable risk factors, with a view to assessing the scope for primary prevention;
- Review the evidence for effectiveness of community-based health promotion activities relevant to primary prevention of stroke;
- Assess the applicability of frameworks used in different jurisdictions (including internationally) to organize thinking and efforts toward stroke and chronic disease prevention; and,
- Recommend an approach for integrating primary stroke prevention into a broader chronic disease prevention framework.

A few comments are in order about the scope of this paper:

- We will not attempt to replicate the numerous environmental scans and framework papers that have been commissioned by various offices in MOHLTC in the past few years;
- Discussion will be limited to the phase of intervention known as primary prevention, and within that, to interventions which are community or population-based, rather than clinically-based (for example, pharmacological interventions such as the prescription of statins or aspirin). Apart from the pragmatic rationale that clinical prevention is the purview of the health care system and not the public health system (which commissioned this study), the potential returns of population-based prevention are vastly greater than those of clinical intervention in high risk individuals. As Geoffrey Rose amply demonstrated in his landmark paper, "*Sick individuals and sick populations*", a large number of individuals at an only

slightly increased risk of a disease may contribute more cases than a small number of individuals at greatly increased risk, which is why reducing population incidence of disease relies on interventions directed at the entire population (in fact, only very modest gains can ever be made through clinical interventions targeting high risk individuals).<sup>2</sup> Planners need to consider the roles of both clinical and population health approaches and integrate efforts where possible.

Primary prevention is sometimes distinguished from primordial prevention,\* a term developed to refer to explicit attention to the distal or underlying determinants of health. In this paper, the term will be used to encompass both phases, primordial and primary, since in practical terms, community-based approaches often address both simultaneously. However, within the area of primordial prevention, we will not attempt to address policy areas which reach beyond the direct purview of the Ministry of Health and Long Term Care; for example, income support and other social policies which can influence the socioeconomic determinants of health. This would be part of the planning and strategic selection of interventions for a chronic disease prevention and health promotion strategy. Additional attention should be paid to the modifiable socioeconomic determinants of health in the future.

## 2.0 OVERVIEW OF THE ETIOLOGY AND PREVENTABILITY OF STROKE

Stroke is the result of damage to the brain, whether ischemic (when a blood clot clogs a blood vessel in the brain) or haemorrhagic (when a blood vessel in the brain ruptures). This paper focuses on ischemic stroke which is by far the more common, accounting for about 80% of all strokes.<sup>3</sup> In Canada, stroke is a major cause of death and disability, as it is worldwide.<sup>4</sup> Since the subject of this paper is primary prevention of stroke, it is useful to classify risk factors for stroke as modifiable and non-modifiable.

### 2.1 Non- Modifiable Risk Factors and Broader Determinants

- Age: stroke risk approximately doubles with every decade after age 55.<sup>5</sup>
- Sex: Incidence rates of stroke are higher in men than in women. There are gender differences in mean age at onset (later in females), distribution of stroke subtype (all subtypes of stroke are more common in men than women except subarachnoid hemorrhagic), case fatality rate (higher in females) and functional outcome (possibly poorer in females – evidence is fairly weak).<sup>6 7 8</sup>
- Race/ethnicity: US studies indicate that stroke incidence and mortality are higher in black men and women than in white.<sup>3</sup> In Canada, excess mortality has been observed in aboriginal women, but may be accounted for by a higher prevalence of modifiable risk factors, such as high blood pressure, diabetes, obesity, alcohol and smoking.<sup>9 10</sup>
- Family history: Increased risk of stroke may be associated with family history on both maternal and paternal sides.<sup>11</sup> Although shared exposures may account for some of the

---

\* Primordial prevention consists of actions and measures that inhibit the emergence and establishment of environmental, economic, social and behavioural conditions, cultural patterns of living, etc., known to increase the risk of disease...Primary prevention is protection of health by personal and communal efforts, such as enhancing nutritional status..." from Last, J. (Ed.) *A Dictionary of Epidemiology*, 4<sup>th</sup> ed. New York: Oxford University Press, 2001

observed effects,<sup>12</sup> twin studies support a strong heritable component.<sup>13</sup>

- Socioeconomic determinants: Men in manual occupations are 60% more likely to die from stroke than men in professional occupations, and known risk factors explain only part of the risk differential.<sup>14</sup> There are strong effects of socioeconomic status as measured by income for both ischemic and hemorrhagic stroke, and the effects are strongest among working-aged men.<sup>15 16 17</sup> (This is listed together with non-modifiable risk factors because it is outside the scope of this review. However, socio-economic determinants are modifiable but require broad multi-sectoral action to do so.)

## 2.2 Modifiable Risk Factors

Modifiable risk factors include treatable medical or physiological conditions, such as hypertension, that increase risk of stroke, as well as behaviours such as smoking and physical inactivity. Tables 2.1 and 2.2 are adapted from a scientific statement released by the American Heart Association on completion of a systematic assessment by an expert panel of modifiable and non-modifiable risk factors for ischemic stroke.<sup>4</sup> The panel classified modifiable risk factors into those for which the association is well-documented and those which are less well-documented or only potentially modifiable.

Hypertension, smoking and diabetes are the strongest well-documented risk factors which are also prevalent in the Ontario population (Table 2.1). Obesity, physical inactivity and excessive alcohol use are the strongest risk factors among those which are less well-documented (Table 2.2). The remainder of this discussion will focus on these six risk factors based on the following criteria: they are the most important and prevalent ones which are also amenable to community-based approaches to prevention (clinical conditions such as atrial fibrillation, hyperlipidemia and previous transient ischemic attack (TIA)<sup>18</sup> are excluded because of the third criterion).

- Hypertension: High blood pressure is the most powerful modifiable risk factor for stroke. The risk is four-fold for the highest levels.<sup>19</sup> Stroke risk rises exponentially as diastolic blood pressure increases between 70 and 110 mm Hg, but reduction of systolic hypertension is also beneficial.<sup>4</sup> By middle age, the probability of becoming hypertensive over the remaining life span approaches 90%.<sup>20</sup>
- Smoking: Risk of stroke increases risk by two to six times among smokers, most strongly in people under age 55. Risk returns to baseline within 5 years of quitting.<sup>21</sup>
- Diabetes: People with diabetes have double the risk of stroke compared to non-diabetic counterparts,<sup>22</sup> but the excess risk can be reduced with good treatment and metabolic control.<sup>23 24</sup> (Type II or adult-onset diabetes is the most common and is largely preventable by the same measures which reduce stroke risk). At least part of the increased risk is independent of that associated with hypertension, obesity and elevated blood lipids which are also more prevalent in diabetics.

**Table 2.1: Well-Documented Modifiable Risk Factors for Stroke<sup>a</sup>**

Risk Factor	Relative Risk	Prevalence in Ontario <sup>b</sup> (%)
Hypertension <sup>c</sup>	1.4 – 5	13.0
Smoking <sup>d</sup>	1.5 (overall) 2.5 – 4 (heavy)	20.1
Diabetes <sup>e</sup>	1.8 – 6	4.2

<sup>a</sup> Adapted from American Heart Association Scientific Statement on Stroke Prevention (2001)<sup>4</sup>

<sup>b</sup> Canadian Community Health Survey 2000/01; ages 12 and older

<sup>c</sup> Self-reported, physician diagnosed

<sup>d</sup> Daily smokers

<sup>e</sup> Self-reported, physician diagnosed

- **Obesity:** Since obesity is associated with higher blood pressure, higher blood lipids and Type II diabetes, it is not surprising that it appears as a risk factor for stroke. There is a considerable body of research suggesting that abdominal obesity (more prevalent in men) is a stronger predictor than general obesity as measured by Body Mass Index (BMI).<sup>25</sup> Among women, stroke risk increases both with increasing BMI and with weight gain after age 18.<sup>26</sup>
- **Physical inactivity:** A protective effect of physical activity for stroke has been shown for both sexes, in the Framingham Heart Study,<sup>27</sup> the Honolulu Heart Program<sup>28</sup> and Oslo study<sup>29</sup> for men and the Nurses' Health Study<sup>30</sup> and Copenhagen City Heart Study<sup>31</sup> for women. Part of the protective effect of physical activity may be due to its effect on other risk factors, such as obesity, hypertension and diabetes, but it appears to be present at all levels of these.<sup>32 33 34</sup>
- **Excessive alcohol use:** There is a direct dose-response relationship between alcohol consumption and risk of hemorrhagic stroke, but the association with ischemic stroke is more complicated, with a protective effect observed at fewer than 2 drinks per day and increased risk with increasing consumption beyond that.<sup>35</sup> There is some research suggesting that the beneficial effect may be specific to wine.<sup>36</sup>

**Table 2.2: Less Well-Documented Modifiable Risk Factors for Stroke<sup>4</sup>**

Risk Factor	Relative Risk	Prevalence in Ontario <sup>a</sup> (%)
Overweight <sup>b</sup>	1.75-2.37	32.6
Physical inactivity <sup>c</sup>	2.7	49.8
Excessive alcohol use <sup>d</sup>	1.6	19.3

<sup>a</sup> Canadian Community Health Survey 2000/01; ages 12 and older

<sup>b</sup> BMI  $\geq$  27, ages 20-64, excluding pregnant women

<sup>c</sup> Physically inactive, ages 12 and older

<sup>d</sup>  $\geq$  5 drinks on one occasion  $\geq$  12 times a year (ages 12 and older)

Adapted from American Heart Association Scientific Statement on Stroke Prevention (2001)<sup>4</sup>

### 2.3 Protective Factors

Some factors identified as protective are merely the converse of factors which increase risk; e.g., physical activity. Other more specific protective factors have been postulated; e.g., an observed protective effect of influenza vaccination<sup>37</sup> (plausible because of the contribution of inflammation to the genesis of atherosclerosis). The Nurses' Health Study found a 35% decreased risk of stroke among high consumers of whole grain foods, concluding that even one serving of whole grains per day could contribute significantly to reducing ischemic stroke; although high consumers of grains tended to have healthier patterns of behaviour in other areas, adjusting for these reduced but did not eliminate the protective effect.<sup>38</sup> There is a great deal of accumulated research support for a protective effect of diets rich in fruits and vegetables,<sup>39 40 41</sup> but it is not clear what elements contained in the diet are the actual protective factors; candidates include magnesium, potassium, calcium, fibre.<sup>42</sup> Results of intervention trials of supplementation with Vitamin E and beta-carotene have been disappointing<sup>43 44 45</sup> and evidence is inconsistent concerning possible benefits of fish and fish oils,<sup>46 47 48 49</sup> nuts and seeds.<sup>50 51 52</sup>

### 3.0 THE BURDEN OF STROKE IN ONTARIO

Stroke is a leading cause of death and adult neurological disability in Ontario. An exhaustive description of the epidemiology and burden of stroke in Ontario is found in the Report of the Joint Stroke Strategy Working Group (JSSWG) in 2000.<sup>1</sup> The JSSWG reported that stroke cost the Ontario economy almost a billion dollars a year (low of \$719 million to high of \$964 million) and found that at least 90,000 Ontarians were living with the effects of stroke. What follows constitutes a partial update with more recent data, where available.

Stroke accounted for about 6% of all deaths in Ontario in 1998. Mortality rates for males and females were 44 and 60 per 100,000, respectively (this puts Ontario just under the mean for Canada,<sup>53</sup> which in the 1990s had among the lowest mortality rates world-wide.<sup>9</sup> As shown in Table 3.1, about one quarter of deaths occurred before age 75 (32% for men and 20% for women). These corresponded to 138 Potential Years of Life Lost before age 75 (PYLL to 75) per 100,000, for a total of 16035 PYLL to 75.

**Table 3.1: Stroke Mortality, by Sex and Age Group, Ontario, 1998<sup>54</sup>**

Age Group	Deaths/100,000 males	Deaths/100,000 females	Deaths/100,000 both sexes combined	# of deaths
35-44	4.03	3.07	3.55	69
45-54	12.53	10.43	11.47	172
55-64	34.82	25.14	29.89	299
65-74	125.31	102.33	113.00	925
75-84	542.49	423.27	470.80	2166
85 +	1682.49	1642.62	1654.41	2281
Total				5912

In 1999, the last year for which data are available, there were 23,929 stroke-related hospital discharges and 327,348 hospital days,<sup>54</sup> accounting for 2.3% and 8.3% of all hospitalizations and hospital days, respectively. As seen in Table 3.2, almost 80% of hospitalizations for stroke are in people over the age of 65. The number of hospitalizations is about evenly split between males and females. (N.B. Direct measures of incidence are not available for stroke. These proxy measures for incidence of stroke will tend to underestimate incidence.)

**Table 3.2: Hospitalizations for Stroke, by Sex and Age Group, Ontario, 1999<sup>54</sup>**

Age Group	Discharges /100,000 males	Discharges /100,000 females	Discharges /100,000 both sexes combined	# of hospitalizations
35-44	31.22	28.05	29.63	592
45-54	107.63	82.28	94.81	1476
55-64	371.96	235.09	302.11	3110
65-74	977.51	625.95	789.76	6466
75-84	2031.69	1500.47	1711.72	8093
85 +	2935.01	2579.25	2685.22	3827
Total				23564

The 30-day mortality rate for stroke victims is almost 20%, and a large proportion of the survivors require some form of chronic care.<sup>55</sup> As many as half of stroke survivors report severe handicap one year following their stroke,<sup>56</sup> which underlines that the prevalence of stroke-related disability and handicap is more useful as an indicator of stroke burden than is incidence (which better indicates population risk). By 2001, 110,910 Ontarians living in the community reported

suffering residual effects of stroke.<sup>57</sup>

This number does not include people living in institutions, about 5% of the population aged 65 and older; in 1996/97, the last date for which we have data, the prevalence of stroke in the institutionalized population over age 65 was 23.2%.<sup>58</sup> If we assume conservatively that stroke prevalence in institutions was the same in 2001 as in 1996/97, that would add more than 17,000 to the number of people living with the effects of stroke, for a total of about 128,000 Ontarians.

Within Ontario, there is considerable variation in stroke burden across regions. Hospitalization rates range from 175.7 to 314.4 per 100,000<sup>59</sup> (a 1.79-fold difference), and mortality rates from 46.6 to 57.2 per 100,000.<sup>60</sup> If the lowest rates are considered an achievable benchmark, that means about 80% of hospitalizations and 23% of deaths would be avoided in the regions of highest stroke burden if they were to achieve the rates experienced in the regions with lowest rates. Table 3.3 displays regional variation in mortality by age group. With the exception of the age group over 85 years, Northern Ontario has the highest rates, with rate ratios (compared to the region with lowest mortality rates) ranging from 1.19 to 1.49.

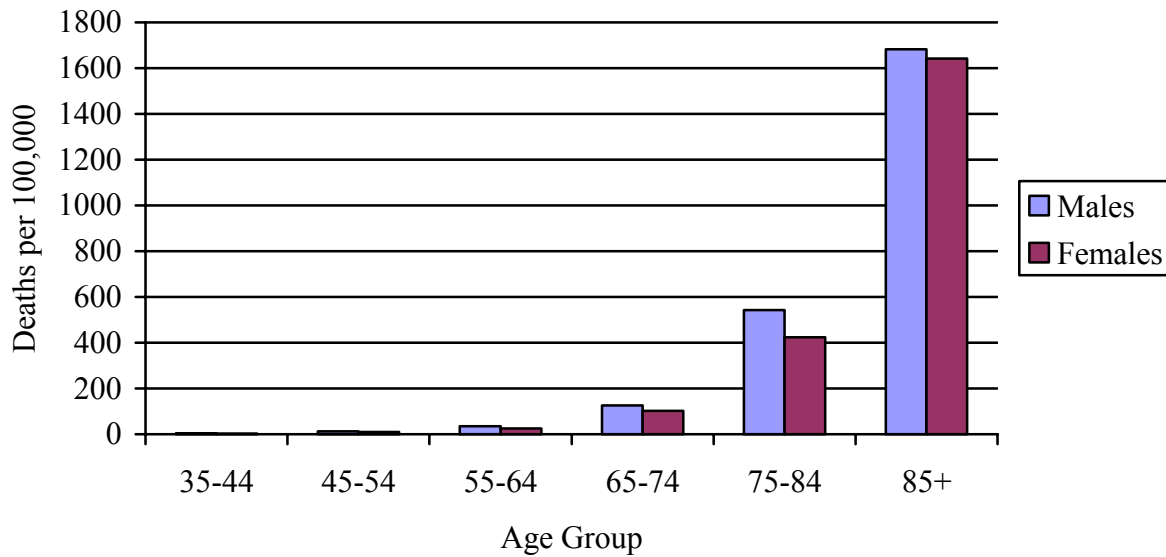
**Table 3.3: Age-Specific Mortality Rates, Ontario and Regions, 1991-1996<sup>61</sup>**

Age-specific mortality rate (per 100,000)					
Region	Age Groups				
	< 55	55-64	65-74	75-84	85 +
Central East	2.3	30.5	122.3	533.8	1961.0
Central South	3.0	37.0	135.0	546.4	1811.2
Central West	2.3	31.9	118.7	560.5	1972.9
East	2.5	34.8	129.2	515.0	1774.3
North	3.0	36.7	155.8	597.2	1776.6
South West	2.6	35.0	128.2	551.5	1859.3
Toronto	2.8	34.8	122.7	495.1	1640.1
<b>Ontario</b>	<b>2.6</b>	<b>34.4</b>	<b>128.6</b>	<b>535.6</b>	<b>1809.3</b>

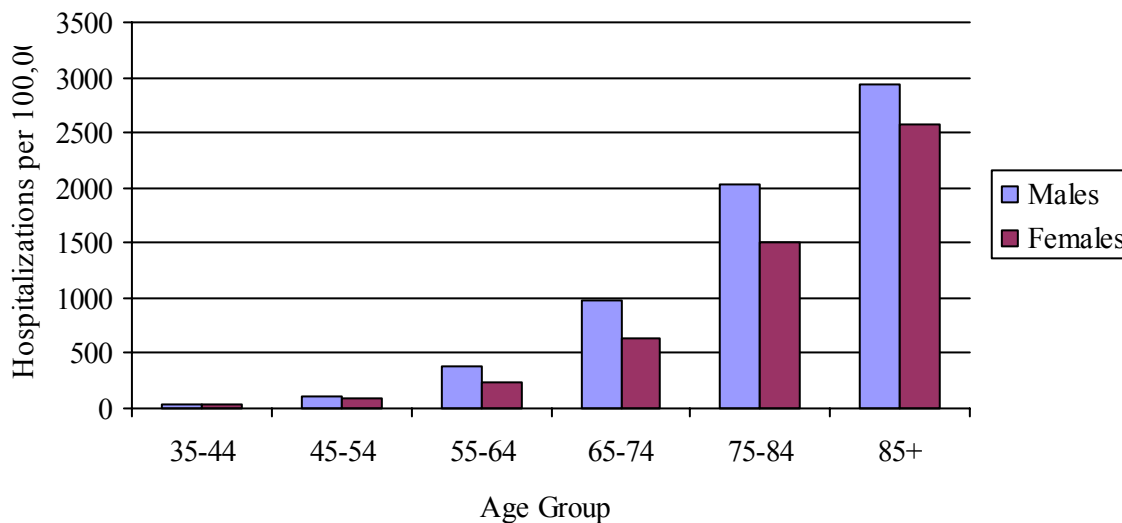
With the aging of the Ontario population, the stroke burden can only increase. By 2031, when the entire baby boom generation has passed the age of 65, the age group 65 years and over will be two and a half times the size it was in 1995 (for illustrative purposes, Table 3.4 shows the projected increases for Southwestern Ontario).<sup>62</sup> In Appendix 2 of the JSSWG report,<sup>63</sup> the Institute for Clinical and Evaluative Sciences (ICES) estimated that the effect of population aging (resulting in greater numbers of people in the age groups at highest risk of stroke [Figs. 3.1 and 3.2]) could outweigh the encouraging temporal trends to reduced age-specific hospitalization rates. Improvements in treatment leading to longer survival but with residual impairment would compound these effects on prevalence. Only a modest increase in numbers of Ontarians

hospitalized for stroke is expected (about 9% between 1995 and 2010), but a small increase in incidence can result in substantial increases in prevalence when accompanied by increased survival. This shift would further burden the rehabilitation system and create even greater impact on families and caregivers.

**Figure 3.1: Cerebrovascular Disease Mortality in Ontario, 1998 by Age and Sex<sup>54</sup>**



**Figure 3.2 Hospitalizations for Stroke in Ontario, 1999 by Age and Sex<sup>54</sup>**



**Table 3.4: Projected Population by Age Group, Southwestern Ontario, 2000-2020<sup>61</sup>**

Age Group	Year		
	2000	2020	% change
85 +	23206	40462	74.4
75-84	72830	90244	23.9
65-74	113946	178156	56.4
55-64	139482	236989	69.9
< 55	1167038	1146294	-1.8

Table 3.5 shows the estimated number of Ontarians resident in the community who were living with the effects of stroke over four data collection periods from 1994 to 2001. Given the calculations by ICES that the declines in numbers of hospitalizations are being turned around by demographic pressure, the substantial year-to-year increases illustrated here are worrisome.

**Table 3.5: Estimated Number of Community Residents in Ontario Living with the Effects of Stroke, 1994-2001**

Year	estimated # of household residents living with effects of stroke	% change
1994/95	73408 <sup>64</sup>	
1996/97	88276 <sup>65</sup>	20.3
1998/99	108729 <sup>66</sup>	23.2
2000/01	110910 <sup>67</sup>	10.2

In sum, stroke represents a significant burden in Ontario and the burden is expected to increase as the age group at highest risk of stroke become more numerous.

#### 4.0 SCOPE FOR PRIMARY PREVENTION OF STROKE IN ONTARIO

The scope for prevention refers to the size of the potential benefit of primary prevention in reducing the burden of stroke in Ontario. Assessing it involves consideration both of the importance of various risk factors in contributing to population burden, and the prevalence of the risk factors in the Ontario population. This section will provide an update of the prevalence data for the main modifiable risk factors presented in the Report of the Joint Stroke Strategy Working Group (JSSWG) in 2000.<sup>1</sup> We will also present calculations of the Population Attributable Risk Percent (PAR%) for each risk factor and an estimate of how much of the burden of stroke in Ontario is preventable through addressing each. Since risk increases with the number of risk

factors<sup>68</sup> and the inter-relationships among risk factors are complex (e.g., physical activity affects obesity, blood pressure and blood sugar and there is a strong relationship between body weight and both blood pressure and diabetes),<sup>69</sup> we will present a range of potential benefit for each risk factor rather than a point estimate.

PAR% is an epidemiological measure which indicates the proportion of a particular disease associated with a given risk factor.<sup>70</sup> That is, it provides an estimate of the amount of disease which is attributable to that particular risk factor, or, conversely, which could theoretically be prevented if the risk factor was eliminated. Once calculated, it can be applied to various dimensions of burden, such as incidence, mortality, hospitalizations and costs.

PAR% is calculated on the basis of the prevalence of the risk factor and the magnitude or strength of the excess risk associated with it, known as Relative Risk (RR). PAR% increases with both prevalence and Relative Risk, so the highest PAR%s are seen when both the Relative Risk and the prevalence of the risk factor are high. For example, although hypertension is by far the most powerful risk factor for stroke in terms of Relative Risk, the most prevalent ones are obesity and physical inactivity, so that the theoretical reduction in stroke burden from eliminating these risk factors is comparable to or even greater than that from eliminating hypertension. In terms of what can be achieved in the clinical setting to reduce risk to individual patients, blood pressure control is by far the most important intervention, but the greatest potential benefits on a population basis will be from reduction in overall prevalence of obesity and physical inactivity.

It must be noted that, although expressed as a percentage, the total PAR%s for all known risk factors for a disease will add up to more than 100%, because of interactions among risk factors. That is, the sum of the individual PAR percentages will include not only the discrete effects of each risk factor, but the interactive effects of all possible combinations of risk factors as well. In addition, there are correlations among the prevalences of various risk factors and univariate relative risks are different from multivariate relative risks. The main utility of calculating PAR percentage is in assessing the relative importance of risk factors on a population basis, thus assisting decision-makers in identifying those risk factors which, if substantially reduced, would yield the greatest benefits in eventual reduction of the burden of illness.

In 1992 61% of Ontarians aged 18 – 74 had at least one major modifiable risk factor for stroke.<sup>71</sup> Fully 35% of men and 30% of women had three or more risk factors.<sup>72</sup> Almost one in seven Ontarians have high blood pressure, the most powerful risk factor for stroke, rising to one in four by age 45.<sup>73</sup> Bear in mind that hypertension is frequently under-diagnosed. One of three people with hypertension are unaware that they have it, which means prevalence estimates based on self-report from surveys are very conservative. The most prevalent risk factors in 2000/2001 were obesity and physical inactivity: half of Ontarians over aged 20 to 64 were physically inactive and half were above a healthy weight (BMI $\geq$ 25); one-third had BMI >27 (See Table 4.1).

**Table 4.1: Prevalence of Modifiable Risk Factors for Stroke in Ontario 2000/2001<sup>a</sup>**

Magnitude <sup>3</sup>	Risk Factor	Relative Risk	Prevalence <sup>a</sup> (%)	
Strong (RR>4) well-documented	Hypertension <sup>b</sup>	1.4-5.0	M	12.1
			F	13.9
			All	13.0
Moderate (RR 2-4) well-documented	Smoking <sup>c</sup>	2.5-4.0 (heavy smoking) 1.5 (overall)	M	27.3
			F	21.8
			All	24.5
	Diabetes	1.8-6.0	M	4.6
			F	3.8
			All	4.2
Moderate, less well-documented	Overweight <sup>d</sup>	1.75-2.37	M	36.9
			F	28.2
			All	32.6
	Physical inactivity <sup>e</sup>	2.7	M	44.8
			F	54.6
			All	49.8
Possible	Alcohol use <sup>f</sup>	1.6	M	7.6
			F	10.4
			All	19.3

<sup>a</sup> Canadian Community Health Survey, 2000/01

<sup>b</sup> Ages 12 and over, self-reported physician, diagnosed, systolic bp>140 mmHg

<sup>c</sup> Ages 12 and over, current smokers

<sup>d</sup> Ages 20-64 (excl. pregnant women), BMI  $\geq$  27

<sup>e</sup> Ages 12 and over

<sup>f</sup>  $\geq$  5 drinks on one occasion  $\geq$  12 times per year

Adapted from American Heart Association Scientific Statement on Stroke Prevention (2001)<sup>4</sup>

Population Attributable Risk percentages are frequently used to set priorities among risk factors by calculating what proportion of the burden of disease could theoretically be removed if the risk factor were to be eliminated entirely. However, it does not by itself provide a very useful estimate of what savings could really be expected by reducing risk factor prevalence. A more practical approach is its use in estimating the scale of potential savings from targeting a given reduction in risk factors; for example, if we reduce smoking by 10%, the difference between the PAR% at observed prevalence and the PAR% at the lower smoking prevalence can be applied to measures of burden (mortality, costs, etc.) to estimate the expected benefits.

Another application of PAR% is what we would describe as internal benchmarking, the result of comparing the PAR% for Ontario and with PAR% for the areas in the province with the lowest prevalence of risk factors. It is more realistic than a standard PAR%, in that it shows what part of the theoretical benefit could be derived from bringing risk factor prevalence down to rates that have already been demonstrated to be achievable in at least one area of the province. It is also,

in Ontario's case, a conservative estimate, since there are other jurisdictions with even better risk factor profiles.

The steps in using PAR% for internal benchmarking are illustrated in Tables 4.2, 4.3 and 4.4. Table 4.2 displays intraprovincial variation in risk factor prevalence by public health unit (PHU). Examining regional variation is useful for at least two reasons:

- Identifying the areas with highest prevalence rates enables us to identify areas where the need for intervention is most pressing;
- Identifying the areas with the lowest prevalence rates provides us with another means of shedding light on the potential benefits of prevention.

**Table 4.2: Variability of Modifiable Risk Factor Prevalence in Ontario<sup>a</sup>**

Risk Factor	Ontario prevalence (%)	Lowest district <sup>b</sup> prevalence (%)	Highest district <sup>b</sup> prevalence (%)	Ratio Highest: Lowest	Ratio, Ontario: Lowest
Hypertension <sup>c</sup>	13.0	10.3	17.6	1.7	1.3
Smoking <sup>d</sup>	20.1	16.1	32.7	2.0	1.3
Diabetes	4.2	3.3	7.4	2.2	1.8
Overweight <sup>e</sup>	32.6	25.6	43.7	1.7	1.3
Physical Inactivity <sup>f</sup>	49.8	37.1	60.8	1.6	1.2
Excessive Alcohol Use <sup>g</sup>	19.3	13.7	27.7	2.0	1.4

<sup>a</sup> Canadian Community Health Survey, 2000/01

<sup>b</sup> Based on Public Health Unit districts

<sup>c</sup> Ages 12 and over, self-report of physician-diagnosis

<sup>d</sup> Ages 12 and over, daily smokers

<sup>e</sup> Ages 20 - 64 (excl. pregnant women), BMI  $\geq 27$

<sup>f</sup> Ages 12 and over

<sup>g</sup>  $>5$  drinks on one occasion  $> 12$  times per year

The ratio of the Ontario prevalence to the prevalence in the PHU with the lowest prevalence is as high as 1.76 (for diabetes) and the lowest ratio (for physical inactivity) is 1.22. This indicates substantial room for improvement. Such internal benchmarking provides the most conservative target for risk factor reduction. A report from the Institute for Clinical Evaluative Sciences estimated that about 30% of variation in cardiovascular disease burden across Ontario could be attributed to variation in prevalence of modifiable risk factors: hypertension, diabetes control, smoking, obesity, fat intake and physical inactivity.<sup>74</sup> Since these are also important modifiable risk factors for stroke, the estimate for stroke burden would be comparable (not identical, because of the different relative risks involved).

Table 4.3 shows the differences between the PAR%*s* for each risk factor for Ontario overall and for the PHUs with the lowest prevalences. The differences between the PAR% in the lowest prevalence PHU and Ontario overall range from just under 1% to around 10%. These seem marginal, but when applied to population burden can be important, as shown in Table 4.4 indicators of burden are the prevalent cases, deaths and costs reported in Section 3. If we were to reduce the burden by even the lower range of PAR%*s* summed (19%), the savings in health costs would be almost \$140 million dollars annually just for stroke.

Just as PAR%*s* for all causes sum to more than 100%, the sum of PAR% differences will always be somewhat more than the actual expected effect. But in this case, we have done the calculation for one single cause related to the shared risk factors, and not even the most common one. Although the one-fifth to one-third reduction in burden estimated here might be considered optimistic for stroke by itself, we must remember that reducing the shared risk factors would reduce not only stroke burden, but the burden of other even more common causes of death, morbidity and health care costs. So, although this estimate of savings may be considered optimistic with respect to stroke by itself, it can be considered highly conservative as an estimate of the benefits of risk factor reduction for all chronic diseases. The North Karelia Project provides a dramatic demonstration of this: launched in 1972 to reduce the burden of cardiovascular disease in one area of Finland, it first produced and accelerated reductions in risk factor prevalence and then cardiovascular mortality compared to the rest of Finland. When disseminated to the rest of the country, it also brought about substantial reductions in stroke and cancer mortality because of the risk factors they have in common.<sup>75 76</sup> Based on proportions of deaths and potential years of life lost due to stroke compared to other chronic diseases with shared risk factors (11 and 16% respectively),<sup>77</sup> the additional benefits would be on the order of 6 to 9 times those calculated in this section.

**Table 4.3: Difference in PAR% Between Ontario and Public Health Units with Lowest Risk Factor Prevalence**

Risk Factor	Relative Risk  ( <i>L=Low</i> <i>H = High</i> )	Ontario		Lowest <sup>c</sup> (PHU) %		PAR% Difference
		Prevalence <sup>a</sup> (%)	PAR% <sup>b</sup>	Prevalence (%)	PAR%	
Hypertension <sup>d</sup>	<i>L</i> 1.4	13.0	4.9	10.3	4.0	0.9
	<i>H</i> 5.0	13.0	34.2	10.3	29.2	5.0
Smoking <sup>e</sup>	<i>L</i> 1.5	24.5	10.9	16.1	7.5	3.4
	<i>H</i> 4.0	24.5	42.4	16.1	32.6	9.8
Diabetes	<i>L</i> 1.8	4.2	3.3	3.3	2.6	0.7
	<i>H</i> 6.0	4.2	17.4	3.3	14.2	3.2
Overweight <sup>f</sup>	<i>L</i> 1.8	32.6	19.6	25.6	16.1	3.5
	<i>H</i> 2.4	32.6	30.9	25.6	26.0	4.9
Physical Inactivity <sup>g</sup>	2.7	49.8	45.8	37.1	38.7	7.1
Excessive Alcohol Use <sup>h</sup>	1.6	19.3	10.4	13.7	7.6	2.8

<sup>a</sup> Prevalence data from Canadian Community Health Survey, 2000/01

<sup>b</sup>  $PAR = Prevalence \times (RR-1) / 1 + [Prev \times (RR-1)]$

<sup>c</sup> Based on Public Health Unit boundaries

<sup>d</sup> Ages 12 and over, self-reported physician-diagnosed

<sup>e</sup> Ages 12 and over, daily smokers

<sup>f</sup> Ages 20-64 (excl. pregnant women), BMI  $\geq 27$

<sup>g</sup> Ages 12 and over

<sup>h</sup>  $\geq 5$  drinks on one occasion  $\geq 12$  times per year

**Table 4.4: Potential Reduction of Stroke Burden in Ontario**

Risk Factor	PAR% Difference (from Table 4.3)  ( <i>L = Low</i> <i>H = High</i> )	Indicators of Burden			
		Prevalent cases (baseline 128,000)	Deaths (baseline 5912)	Costs, upper end (baseline \$964M)	Costs, conservative (baseline \$719M)
Hypertension	<i>L</i> 0.9	1152.0	53.0	8.7	6.5
	<i>H</i> 5.0	6400.0	296.0	48.2	36.0
Smoking	<i>L</i> 3.4	4352.0	201.0	32.8	24.5
	<i>H</i> 9.8	12544.0	579.0	94.5	70.5
Diabetes	<i>L</i> 0.7	896.0	41.0	6.7	5.0
	<i>H</i> 3.2	4096.0	189.0	30.8	23.0
Overweight	<i>L</i> 3.5	4480.0	207.0	33.7	25.2
	<i>H</i> 4.9	6272.0	290.0	47.2	35.2
Physical Inactivity	7.1	9088.0	420.0	68.4	51.1
Excessive Alcohol Use	2.8	3584.0	166.0	27.0	20.1
Sum of lowest PAR% differences	19.0	24320.0	1123.0	183.2	136.6

## 5.0 EFFECTIVENESS OF COMMUNITY-BASED PREVENTION PROGRAMS

As part of the work for this report, we conducted a literature review to evaluate the effectiveness of community-based stroke prevention programs published since 1985. Because the amount of literature available is immense and there have been numerous previous efforts to synthesize it, we decided to review these reviews, rather than delve once again into the literature of primary studies. The objective of a review of reviews is to synthesize the results of the best available literature to develop recommendations for policy and practice.

Through a comprehensive search strategy, one of the authors (MD\*) retrieved articles meeting the following criteria: a) review article; b) the topic was relevant to public health or health promotion practice in Canada; c) the review addressed effectiveness of a community-based intervention or program focused on changing multiple risk factors; and d) there was evidence on outcomes that addressed multiple risk factors for stroke prevention. All relevance criteria had to

\* Maureen Dobbins, McMaster University, holds a CIHR grant collecting reviews in health promotion and works as part of the Cochrane Collaboration.

be met in order for a review to be included in this review of reviews. All reviews judged to be relevant were assessed for methodological quality by two independent reviewers, using a standardized, validated, quality assessment tool which had been pre-tested for reliability and validity by the Dissemination of Public Health and Health Promotion Reviews Project staff. Only those reviews rated as being either 'strong', or 'moderate' (i.e., moderately strong) for methodological quality were included in data extraction and analysis. (See Appendix 2 for a full description of the methods and results).

A total of 60 reviews were assessed for relevance. The fourteen reviews judged relevant were assessed for methodological quality. We report here only on the four reviews found to be of strong methodological quality and six rated moderately strong.

Although all but one review had at least one limitation, the number of limitations varied across all the reviews included in this synthesis. The reviews rated as Strong had three or fewer limitations, while Moderate reviews had four or five limitations. In terms of interpreting the results presented in this synthesis the greatest confidence should be given to those results reported by the Strong reviews, with slightly less confidence given to those results reported by the Moderate reviews. However, the author of this synthesis holds the opinion that the results of both the Strong and Moderate reviews provide the best evidence available in this health area.

It is also important to note the potential impact that limitations can have on the overall results. For example, research has shown that the less rigorous the research methods are the more likely a positive effect is to be reported. Therefore some caution is warranted when reviews rated as being of Moderate methodological quality report positive results.

Table 5.1 displays the distribution of findings according to outcome studied (from knowledge through behaviour to health outcome) and strength of review. Each S represents a review rated methodologically strong; each M represents a review rated moderate. So, for example, four strong reviews found a promising or positive effect on blood pressure and two moderately strong reviews found no effect.

**Table 5.1: Findings of Reviews Rated Strong and Moderate**

Outcome Assessed	Conclusions				
	Positive	Promising	No effect	Negative	Unknown
Knowledge		S			
Smoking	S	SS	MMMM		SM
Physical activity	M	SS	M		MM
Diet	M	S			MMM
Weight	S	S	MM		M
Blood pressure	S	SSS	MM		M
Cholesterol	S	SSSMM	M		
CVD risk	S	M			
CVD morbidity			S		S
CVD Mortality		M	SS		S

Four things come to mind on examining this table:

- the stronger reviews appear more likely to find a promising or positive effect;
- the greatest weight of evidence is for smoking, blood pressure and cholesterol;
- there are very few reviews of the longer-term health outcomes (morbidity, mortality) of community interventions;
- for most outcomes addressed, there are 1 to 4 reviews showing no effect.

The preponderance of positive or promising effects on behaviour and intermediate health outcomes such as blood pressure and cholesterol is persuasive, especially considering the enormous challenges of research on community-based interventions. These findings are supported by the conclusions of other processes internationally, such as the US Task Force on Community Preventive Services,<sup>78</sup> Australia's National Public Health Partnership<sup>79</sup> and the World Health Organization.<sup>80</sup>

The paucity of reviews of long term impacts such as morbidity and mortality is not surprising, since there are few studies of sufficient duration on which to base a review. Not just years but decades of follow-up are required to be able to detect the ultimate health impacts, particularly on diseases like cancer that have latency periods of 15 to 30 years. The expense of protracted follow-up requires a commitment to such research as a long-term strategic investment in health, and it is a rare government whose horizon is set that broadly.

The finding of no effect requires some discussion. If an effect is not found, there are two possible interpretations: either there was in fact no effect, or there was an effect but the study (or in this case the review) did not detect it. In clinical epidemiology, one looks not only for statistical significance but also for clinical significance, wary that a sufficiently high sample size

may result in a statistically significant effect that is of no practical use. Often researchers and reviewers apply the same standards to population-based interventions that they do to clinical interventions.

But assessing clinical significance for populations needs to involve more than determining the average change – it is preferable to call it practical significance, to avoid confusion, since we are distinguishing clinical and population approaches. The average change does not have to be of the size that would be of clinical significance to an individual for it to be of importance on a population basis. For example a study in Brazil found that a small change in average BMI was associated with a substantial shift in the BMI frequency distribution.<sup>81</sup> And, as Geoffrey Rose has convincingly demonstrated<sup>2</sup>, even a very small change in the distribution of population risk profile can profoundly affect population risk. If researchers use only average changes in a population to determine effect levels, they may well miss important effects. As Sorenson, et al., point out, “Using clinical significance alone as the standard for interpretation of the results of community intervention trials is inappropriate for research at the population level”.<sup>82</sup>

With regard to the findings of no effect on cardiovascular disease morbidity and mortality, one of the strong reviews found a positive but not statistically significant effect; another did not report an overall effect size and the follow-up time of the studies may not have been long enough to observe a measurable effect. Lack of comprehensiveness or intensity of the primary interventions may have contributed to the findings of no effect on behavioural and intermediate outcomes such as weight.

Our assessment is that the best available research evidence supports the effectiveness of comprehensive, community-based prevention on knowledge, behaviour and important intermediate health outcomes. It is also suggestive that the impact on intermediate health outcomes translates eventually into longer term health benefits in morbidity and mortality. More and longer-term research is needed to substantiate the ultimate impact of intermediate outcomes on disease incidence, morbidity and mortality, and this will require vision and long-term commitment from governments and granting agencies.

## **6.0 CONTEXT: CURRENT APPROACHES TO CHRONIC DISEASE PREVENTION**

There are innumerable initiatives under way internationally and across Canada which have relevance to the primary prevention of stroke and other chronic diseases. This section will provide a brief overview of key initiatives at each level, to illustrate the extent to which the move toward progressively higher levels of integration in disease prevention and health promotion planning is a worldwide phenomenon. We will not describe the even more numerous initiatives, programs and activities addressing single risk factors, such as tobacco, obesity and physical activity.

## 6.1 International

The **World Health Organization (WHO)** has set non-communicable disease prevention as a strategic priority because the rapidly increasing burden of chronic disease worldwide constitutes a threat not only to health, but to economic and social development, and because the burden is disproportionately felt among poor and disadvantaged populations. The strategy emphasizes integrated intervention at family and community levels to reduce common risk factors for the four most prominent non-communicable diseases (cardiovascular disease-including stroke, cancer, chronic obstructive pulmonary disease and diabetes): tobacco use, unhealthy diet and physical inactivity.<sup>83</sup>

The following text from the WHO's **Department of Noncommunicable Disease Prevention and Health Promotion** summarizes the major attributes of their approach:

“Review of studies has shown that, for substantial reductions in the levels of risk factors and in disease outcomes, delivery of interventions should be of appropriate intensity and sustained over extended periods of time. However, even modest changes in risk factor levels will have a substantial public health benefit. Experience indicates that success of community-based interventions requires:

- community participation
- supportive policy decisions
- intersectoral action
- appropriate legislation
- health care reforms
- collaboration with NGOs, industry and the private sector”<sup>84</sup>

These elements are present in virtually all the frameworks encountered during our scan of the international, national and provincial context for the current document. Even where not elaborated as a formal planning or analytic framework, they are espoused as principles. A more recent element in WHO discourse is the “life course approach,” developed in recognition of the fact that risk of for chronic disease accrues with age and is influenced by factors acting throughout the life span.<sup>85</sup> This concept has been common in organization and delivery of public health programming for some time in many jurisdictions in Canada and is also part of the way many countries conceptualize their efforts in chronic disease prevention.

Within the WHO, there is also a specific program for cardiovascular diseases, including stroke: the **Programme on Cardiovascular Diseases (CVD)** aims to reduce worldwide burden of CVD (including stroke) by addressing risk factors and their determinants, developing cost effective and equitable innovations in CVD management and monitoring trends of CVD and their risk factors.<sup>86</sup>

In 1982, the WHO's Regional Office for Europe created the **CINDI** (Country-wide Integrated Noncommunicable Disease Intervention) programme<sup>87</sup> and began working to help member countries integrate initiatives in chronic disease prevention and control through the establishment of collaborative mechanisms and methodologies. CINDI now operates in 24 countries. Health Canada's Centre for Chronic Disease Prevention and Control provides support to CINDI through its Heart Health/WHO Collaborating Centre for Policy Development in the Prevention of

## Noncommunicable Disease.

In 1995, the Pan American Health Organization (PAHO) adapted the CINDI model to the needs of the countries of the Americas and created **CARMEN** (Spanish acronym for: Actions for the Multifactorial Reduction of Noncommunicable Diseases)<sup>88</sup> as a general framework for chronic disease prevention and control. CARMEN aims to reduce risk factors for Non-Communicable Diseases (NCDs), particularly cardiovascular disease, by coordinating health promotion and disease prevention activities in communities and community health services, and is assisting member countries to build capacity for an interdisciplinary prevention model in primary health care. Hallmarks of the model include collaboration, coalition-building, the use of best practices supported by information exchange among countries, and management of hypertension and diabetes.

Several OECD countries have developed national strategies to address chronic disease prevention and health promotion, either as part of a broader portfolio of public health strategies or as specific initiatives. Table 6.1 provides an overview of the elements common to most such strategies, loosely grouped according to what each strategy tackles, how it is implemented (i.e., what tools or mechanisms are brought to bear) and what infrastructural issues are explicitly addressed.

- **Australia's National Public Health Partnership** (NPHP) (2002-2004)<sup>89</sup> provides a formal structure for national, state and territorial governments to collaborate on a joint agenda for public health. The NPHP is a rich source of conceptual, epidemiologic and developmental work on chronic disease prevention. Two very useful documents for any effort at developing integrated strategies for chronic disease control, whether at national or provincial levels, are *Preventing Chronic Disease: A Strategic Framework - Background Paper (October 2001)*<sup>90</sup> and *Guidelines for Improving National Strategy Development and Coordination*.<sup>91</sup>
- Based on the WHO's global *Health 21* programme as adapted by the WHO Regional Office for Europe, **Finland's Health 2015** programme is a longer-range plan for health improvement outlining targets extending up to around 2015. It sets out a broad framework for multisectoral and multistakeholder collaboration in health promotion addressing factors such as behaviours, environments, product safety, and community factors. Settings and life course are key dimensions in the programme.<sup>92</sup>
- **Ireland's National Health Strategy**<sup>93</sup> (2000 - 2005) makes "Better health for everyone" the first of four goals. The second objective identified to help move toward the goal is intensifying promotion of health and well-being. Specific targets are set for major behavioural risk factors already targeted in the earlier National Cancer, Cardiovascular and Health Promotion Strategies: smoking, alcohol, diet and exercise. An earlier National Health Strategy, begun in 1994, included efforts to minimize the main causes of premature deaths, namely: cardiovascular disease, cancer, and accidents.<sup>94 95 96</sup>
- **New Zealand** first appointed a principal medical officer for non-communicable disease prevention and control in 1984.<sup>97</sup> The **New Zealand Health Strategy**<sup>98</sup> sets priority areas in three groups: population health objectives, objectives to reduce inequalities in health, and service priority areas – to highlight particular services that are important in addressing the two previous sets of objectives. Eight of the thirteen priority objectives selected for implementation in the short to medium term are directly related to chronic disease

prevention: reducing smoking, improving nutrition, reducing obesity, increasing the level of physical activity, minimising harm caused by alcohol and drug use, reducing the incidence and impact of cancer, cardiovascular disease and diabetes.

- Since 1993, **Norway**'s national health policy has focussed on primary health care, disease prevention and health promotion, but there have been philosophical differences between the Ministry of Health and the National Board of Health, the former adopting WHO-based strategies and a health promotion ideology, the latter being more biomedically oriented. The **National Programme for Health Promotion** (1994-1998) was closely modelled on WHO policy, as were two state-level programmes: Health and Inequalities and Health and Children; all three focussed on increasing health promotion activities in municipalities through State-funded local projects.<sup>99</sup>
- In the **United Kingdom**, the Government's White Paper, **Saving Lives: Our Healthier Nation** (OHN), (1999-2010)<sup>100</sup> set out a public health strategy to improve health and reduce inequities through action not only on behavioural exposures (such as diet, exercise, sexual behaviour), but on factors beyond individual control which affect their health: poverty, social exclusion, employment, housing, education, and the environment. It establishes four national priority targets for 2010: cancer, coronary heart disease and stroke, accidents [sic] and mental health. Described as "the first comprehensive Government plan focussed on the main killers: cancer, coronary heart disease and stroke, accidents, mental illness..." OHN proposes tough but attainable targets in priority areas; investment in and re-orienting the NHS; addressing potent social, economic and environmental factors leading to poor health; partnerships among governments, communities and individuals; important infrastructural initiatives in workforce training and development, education, service delivery, public health standards, monitoring and research.
- In the **US**, **Healthy People 2010** (HP2010)<sup>101</sup> provides a national prevention agenda, through a statement of national health objectives and goals. Managed by the Office of Disease Prevention and Health Promotion of the Department of Health and Human Services; it proposes a list of leading health indicators, a mix of outcomes, risk factors and health system access indicators. The National Center for Chronic Disease Prevention and Health Promotion (part of the Centers for Disease Control)<sup>102</sup> is a key partner in HP2010 consortium; it supports national and state-level initiatives to reduce the burden of chronic diseases through research, surveillance, technical assistance and partnerships with health and education agencies, major voluntary associations, the private sector, and other federal agencies. Its organization reflects a mixture of disease- or condition-specific (cancer, diabetes, oral health, reproductive health), risk factor (smoking, nutrition, physical activity), and life cycle focus (adolescent and school health, adult and community health). NGO and other extra-governmental stakeholders are involved in the Healthy People 2010 Consortium,<sup>103</sup> and also through partnership with the Coalition for Healthier Cities and Healthy Communities.<sup>104</sup> They will be unveiling their CVD action plan on September 4, 2002 (website: <http://www.cdc.gov/cvh/hp2010.htm>).

- **Wales' National Health Promotion Strategy (2000)**<sup>105</sup> is a component of a broader policy initiative called **Better Health - Better Wales**, “a new approach to preventing disease and promoting health and well-being through working together.”<sup>106</sup> Its key elements are helping communities (local coalitions, community development, healthy schools, workplace health promotion and other settings-based interventions), targeted programmes directed at major behavioural risk factors, skills development, communication, healthy public policy and practice improvement, health impact assessment, research and evaluation.

**Table 6.1: Comparison of International Approaches to Chronic Disease Prevention**

	WHO	Australia	Finland	Ireland	NZ	Norway	UK	US	Wales
<i>What?</i>									
Disease/condition cluster*	x	C,D,H,I, S, Oth	C,D,DM,H,I, ,MS, Oth	C,D,H, M,I,S, Oth	C,DM,H,I, ,M,R, Oth	C,H,M,S	C,DM,H, I,M,S, Oth	C,D,DM, ,H,I,M, Oth.	C,DM,H, I,M,Oth
Common risk factors**	x	a,d,o,p,s, t, oth	a,d,o,p,t, oth	a,d,p,t	a,d,o,p,s,t	d,t	a,d,o,p,s,t	d,o,p,t, oth	a,d,p,t
Health promotion	x	x	x	x	x	x	x	x	x
Equity	x	x	x	x	x		x	x	x
<i>How?</i>									
Life course approach	x	x	x	x	x		x	x	x
Populations	x	x	x	x	x		x	x	x
Channels/sites/settings	x	x	x		x		x		x
Broader determinants	x	x	x	x	x		x		x
Systems approach	x	x	x	x	x		x		x
Outcome driven (goals)	x	x	x	x	x		x	x	x
Evidence-based	x	x	x		x	x	x	x	x
Multilevel	x	x	x	x	x	x	x		x
Environmental protection		x	x	x	x	x	x	x	x

\* Diseases: C - cancer, D - disability, DM - diabetes, H - heart disease, I - injuries, M - mental health, R - chronic respiratory disease S - stroke, Oth - other (e.g. renal disease)

\*\* Risk factors: a - alcohol, d - diet, o - obesity, p - physical activity, s - stress, t - tobacco, oth - other (e.g., cholesterol, drug use)

	WHO	Australia	Finland	Ireland	NZ	Norway	UK	US	Wales
<i>How? (continued)</i>									
Education	x	x	x	x	x	x	x	x	x
Social marketing	x	x	x	x	x	x	x	x	x
Capacity building	x	x	x	x		x			x
Coalitions/alliances	x	x	x	x	x	x		x	x
Clinical preventive services	x	x	x	x	x	x	x	x	x
Screening	x	x			x	x	x	x	x
Disease management	x	x		x	x	x	x	x	x
Health sector reform	x	x	x	x	x	x	x	x	x
<i>Who?</i>									
Stakeholder involvement	x	x	x	x	x	x	x	x	x
Inter-sectoral collaboration	x	x	x	x	x	x	x		x
Community participation	x	x	x	x	x	x	x	x	x
<i>Infrastructure</i>									
Information and surveillance	x	x	x	x	x		x	x	x
Program evaluation	x	x		x	x	x	x	x	

	WHO	Australia	Finland	Ireland	NZ	Norway	UK	US	Wales
<i>Infrastructure (continued)</i>									
Quality assurance and management (standards, accreditation, etc.)	x	x		x	x		x	x	x
Training and workforce development	x	x	x	x	x			x	x
Research and development	x	x				x	x	x	x
Knowledge transfer		x		x	x		x	x	x
Legislation		x	x	x		x	x		x
Health impact assessment			x				x		x
Funding			x	x			x		x
Sustainability				x			x		x
Management and governance		x		x	x		x		x
Course correction			x						

### ***What are the common threads in the international context?***

Many of these initiatives have not published formal frameworks or models to describe their approach, but the work they have published reveals that they have a great deal in common conceptually with those which have explicitly used frameworks to systematize their thinking and planning. Table 6.1 displays the key elements found in all or most of the approaches examined.

## **6.2 Level of Integration**

By level of integration, we refer to the breadth of the context within which health issues are framed, planning takes place, and programs delivered. For example, a program to reduce stroke risk by screening for hypertension would exhibit a low level of integration compared to a chronic disease prevention and health promotion program addressing multiple risk factors shared by stroke and other chronic diseases. At a higher level would be a chronic disease control strategy covering the entire spectrum of intervention for chronic diseases, from primary prevention, through early detection, diagnosis, treatment, supportive, rehabilitative and palliative care. The highest level of integration, within national borders at least, is seen in a broad public health or health gain strategy which examines the full range of health issues, sets priorities accordingly and implements plans in a coordinated way across the entire health system.

Most of the international approaches reviewed involve integration at a level even higher than the level of chronic disease prevention – they position chronic disease prevention and control in the larger context of public health assessment, policy development and assurance across the whole range of health issues and concerns. Within this “big picture” systems approach, they identify specific priority areas to address, depending on the particular characteristics and needs of their populations. (N.B. It is not always possible to discern from the documents available whether they began with a large systems approach and worked down to the specifics or put the larger approach together, after the fact, “building on strengths” to raise the level of coherence across disparate strategies.)

These highly integrated strategies employ what is referred to as a “systems approach.” Perhaps the term requires a bit of discussion. Myriad articles in print and on the web speak of the systems approach, but except in an engineering context, almost no one bothers to define it. Some attributes that seem to be common are that it:

- looks at components, processes and outcomes;
- both in identifying problems and proposing solutions, looks at multiple dimensions and interrelationships rather than single issues or programs;
- addresses environmental or systemic determinants of individual (and organizational) behaviour and health outcomes.

A systems approach is essential to public health, which deals with whole populations, as opposed to clinical medicine, which deals with individuals. Rather than attempting to change individual behaviours or health outcomes through individual education or other interventions directed toward identified individuals, it involves policies and supports to change the context in which individuals are exposed to or make choices about risk factors, as well as health protection measures to prevent exposures over which the individual has no control. Strategies developed using a systems approach are complex practically by definition. The result of multiple,

complementary interventions in different parts of a system is – or should be, if they are individually effective – synergy. One of the best-known models developed with a systems approach is the Precede-Proceed Framework.<sup>107</sup>

### **6.3 Strategy Content (What)**

Content refers to what the strategy takes on, how it conceptualizes the health challenge it is developed to address. Strategies are variously described as preventing disease, reducing risk factors, promoting health or reducing health inequalities. Approaches vary somewhat across jurisdictions in terms of the point of entry for the strategy (e.g. health promotion or disease prevention; if disease prevention, whether crosscutting or specific), but there is a remarkable consistency in the particulars: all address cancer and cardiovascular disease, most address diabetes, injury and mental health. Among risk factors, the two almost universally addressed are tobacco and nutrition. All the approaches incorporate broad health promotion in their content description and all but one pay at least lip service to reducing inequities in health access and outcomes.

Even in the most highly integrated strategies, the priority areas identified may not be on a single dimension – e.g., all diseases or all risk factors or all populations. More typically, they are a mix of diseases, risk factors, populations and infrastructural initiatives. For example, Australia's National Public Health Partnership includes subgroups or strategies directed at populations (aboriginal), life stage (children and youth, healthy aging), behavioural risk factors (nutrition, physical activity), environmental protection, immunization, diseases/conditions and within these, some specific conditions (cancer, cardiovascular disease, diabetes, injury and mental health). Individual strategies or programmes are linked through coordinating and supportive mechanisms in the NPHP.<sup>89</sup>

### **6.4 Strategy Implementation (How)**

This category contains two sorts of answers to the question of how the strategy is implemented. First, the operating principles by which it operates, such as addressing broad determinants of health, being outcome-driven and evidence-based. Second, the actual activities by which it achieves its effect, such as education, social marketing, environmental protection and screening. Within the operating principles, attention to broader determinants, populations, life course and the evidence base are seen almost throughout. Among activities, all include education, social marketing, clinical preventive services and health sector reform, and almost all involve coalitions or alliances and environmental protection.

### **6.5 Players (Who)**

This is the category in which there is perhaps the highest degree of congruence: stakeholder involvement (government, NGO, professional associations, consumer groups, etc.), intersectoral collaboration and community participation are now recognized virtually universally as necessary to an effective health strategy. Difficult as it may be to herd the cats, it is now the norm, and stakeholders increasingly demand real participation, not tokenism.

## 6.6 Infrastructure

The greatest variability appears in this group of elements. Most strategies acknowledge the need for surveillance, program evaluation, quality assurance and standards, training and workforce development, knowledge transfer, research and legislation to inform and support strategy implementation. Relatively few explicitly mention funding, management and governance or issues of sustainability, and only one specifically alluded to a mechanism for course correction, at least in the documents we were able to trace; it is quite possible that they are addressed in internal papers not publicly accessible.

## 6.7 Canada

Despite Canada's having been out of the gate early in terms of health promotion theory and practice, we are a relative latecomer in the field of national disease prevention or public health strategies. Nonetheless, there are many elements on which to build, both nationally and provincially. Important national groups, agencies or coalitions with an interest in chronic disease prevention or which may be assets for future efforts in chronic disease prevention include:

- The **Chronic Disease Prevention Alliance's (CDPA)** purpose is to link, connect, and support existing work at the national, provincial and local level toward an integrated prevention approach for Canada (it's draft mission is to "develop and help sustain a coordinated, country-wide movement for an integrated, population health approach to chronic disease prevention through collaborative leadership, advocacy and capacity building"). Important players include the Heart and Stroke Foundation of Canada, the Canadian Cancer Society, the Canadian Diabetes Association, the Canadian Council on Tobacco Control, Dietitians of Canada, the Coalition on Active Living and Health Canada.
- Most provinces have at least an incipient provincial chronic disease prevention alliance or provincial government strategy; those of Manitoba, Alberta and Nova Scotia are particularly well developed. Many ministries of health are officially committed to developing chronic disease prevention approaches or have explicitly included chronic disease prevention among their health goals, as have Alberta<sup>108</sup> and Saskatchewan.<sup>109</sup> British Columbia has a health goal for "Reduction of preventable illness, injuries, disabilities and premature deaths",<sup>110</sup> which certainly must include chronic diseases; presumably the new provincial Prevention and Wellness strategy to be developed in 2002-03 is intended to be the means to deliver on the goal.<sup>111</sup> Prince Edward Island's draft strategic plan calls for strategies to "...address rising demand for services through increased investments in wellness and children's health."<sup>112</sup> New Brunswick's Wellness Plan includes a Strategic Framework for Wellness, of which the first key element named is health promotion and prevention.<sup>113</sup> Atlantic Canada, both the Canadian Heart Health Initiative and the Canadian Diabetes Strategy have supported a movement towards greater coordination of efforts in chronic disease prevention.<sup>114 115</sup> There is a clear pattern developing across the country towards at least a shared risk factor primary prevention/health promotion approach, if not a thoroughgoing, goals-driven, public health process.
- The **Advisory Committee on Population Health** (to the Federal/Provincial/Territorial Conference of Deputy Ministers of Health) has established integrated chronic disease

prevention as a strategic goal and commissioned a paper to outline what a system for integrated chronic disease prevention might look like. In June 2002, the Conference of Deputy Ministers accepted ACPH recommendations regarding a research agenda, best practices and holding a conference / symposium.

Related efforts to improve clinical intervention include:

- The **Coalition on Enhancing Preventive Practices of Health Professionals** involves nine different national associations of allied health professionals particularly interested in influencing interdisciplinary work in primary care settings. Until about three years ago they focussed on improving prevention-related curricula in their respective disciplines, but have recently begun examining ways to influence policy across the system and have begun to function more as a think tank. It is the only venue where all the major health professional groups sit at the same table to improve collaborative health promotion and disease prevention; it thus has the potential to be an important ally in efforts to better coordinate clinical and population-based prevention efforts.
- The **Canadian Task Force on Preventive Health Care (CTFPHC)** provides guidelines for preventive practice in the clinical sector, using systematic reviews of research evidence and has expressed desire to expand to population health / public health processes. This of course, would require additional investment since the Task Force is underfunded even with its current more limited mandate.
- The **Primary Health Care Transition Fund** plans to disburse well over \$200M in national projects for primary care reform (leveraging an additional \$600M in provincial contributions),<sup>116</sup> and has expressed an interest in supporting the efforts at reform related to chronic disease prevention through the CTFPHC and the CDPA.

## 6.8 Ontario

The funding and positioning for health promotion in Ontario has tended to be through disease-based packages. Strategies for cancer, diabetes, stroke, osteoporosis, alcohol, and other drug use, and asthma are being developed, each with a prevention component. Similarly, the province has a mature tobacco control strategy and is in the process of developing nutrition and physical activity strategies. Multiple year funding has been in place to nurture the development of community coalitions, through initiatives such as the Ontario Heart Health Promotion Program (OHHP) and the FOCUS Resource Centre. These coalitions are funded to develop local partnerships to prevent disease and promote health in specific areas such as heart health, alcohol and drug abuse prevention, tobacco cessation etc. In addition, there appear to be parallel health promotion coalitions forming with support from NGOs and hospitals.<sup>117</sup>

The current situation within Ontario is well described in the following documents prepared for the MOHLTC or Ontario Prevention Clearinghouse as part of the Stroke Prevention Project.

- Continuation Plan for 2003 and Beyond, prepared for the Continuation Working Group of the Ontario Heart Health Network, February, 2002;
- Report on Community Capacity for Integration of Stroke Prevention in Selected Regions of Ontario,<sup>118</sup>
- OHPRS & community capacity development. Year One Final Report,<sup>119</sup>

- Donna Mitchell, a health promotion consultant to the OPC is conducting a study of factors influencing capacity of community coalitions to incorporate stroke prevention. Part 1 briefly describes provincially funded health promotion coalitions especially those working at stroke prevention and/or working with the risk factors linked to stroke.\*\*\* Part 2 explores the factors assisting and the barriers overcome by health promotion coalitions as they prepare to move to a broadened mandate.

Ontario's Mandatory Health Program and Services Guidelines Program Standards for chronic diseases<sup>120</sup> have a strong focus on prevention and include both quantitative targets and requirements for specific activities in chronic disease control and health promotion. These, together with specific initiatives listed above, constitute an important base on which a coherent and integrated prevention approach could be built. We understand that the guidelines are currently under revision, and this could be an opportunity to promote greater integration, as well as address the significant capacity challenges the system faces, both provincially and locally. The province also has the advantage of a strong association of public health professionals, the Ontario Public Health Association, which should be a powerful ally and resource.

## **7.0 RATIONALE FOR A POPULATION-BASED STROKE PREVENTION APPROACH INTEGRATED WITH CHRONIC DISEASE PREVENTION**

Given that the burden of stroke in Ontario, by whatever measure, is important, that population aging means it is likely to increase, and that a large part of that burden is preventable, it is clear that stroke demands a response from the health system. The Ministry of Health and Long Term Care recognized this in its decision to allocate resources to develop a stroke strategy.

The question remains: why should stroke prevention be integrated with a population-based strategy for chronic disease prevention and health promotion? To answer this question, it is helpful to split it into its component parts.

### **7.1 Why Population-Based?**

Because risk is continuous over a spectrum of exposure, only a minority of cases will be seen at the extreme of exposure, so the most effective strategies will be those which reduce the average level of exposure for the population, rather than identifying those at high risk for intensive intervention. The alternative to a population-based strategy is a high-risk strategy which depends on identifying individuals who, although they might feel quite well, have high levels of known risk factors, and then intervening to bring those levels in line with healthy norms. Some sort of screening system or process is needed to identify those susceptible individuals – for example, a screening program for high blood pressure with a view to bringing individuals with undetected hypertension into treatment. This is a clinically-based, rather than a population-based approach, even if the initial screening takes place in a mall or street fair, because the intervention occurs in

the clinical setting and is directed to an individual. The intent is to affect disease incidence in

---

\*\*\* Stroke risk factors include: high blood pressure, sedentary lifestyle, being overweight, smoking and excessive alcohol consumption.

the population by removing those at highest risk, that is, bringing their risk closer to baseline.

The advantages and disadvantages of high risk and population approaches, as described by Rose<sup>2</sup> (Table 7.1) are reviewed here:

- *The clinical or high risk approach* has the great advantage that interventions are (generally) appropriate to the individual, who is therefore more likely to be motivated to make changes: if she is a smoker, she is advised (and, one hopes, assisted) to quit; if his blood pressure is high it is treated (drug treatment of hypertension, dietary advice, etc.). On the other hand, **a large number of people at only slightly increased risk may contribute more cases than a small number at high risk**, so there is little population benefit. Even the benefit to the individual is questionable, since ability to predict disease on the basis of risk factors alone is weak: in the UK Heart Disease Prevention Project, risk factors alone predicted less than a third of myocardial infarctions.<sup>121</sup> And that is quite apart from the fact that it puts the onus on the individual to buck the tide of powerful social and cultural norms that encourage the smoking, eating, drinking, sedentariness, etc., that put him/her at risk. That is why Rose describes the high risk approach as palliative or temporary: it deals with the symptoms rather than the roots of the problem.
- *The population approach*, in contrast, seeks to move the whole distribution of risk factors in the population by acting on those things which determine the development of risk factors, not just fixing the risk factors once they emerge in vulnerable individuals. Rose describes it as “radical”, in that it attempts “to remove the underlying causes that make disease common”.<sup>2</sup> It is behaviourally appropriate, in that it seeks to change the social norms, not just educate individuals to resist them. Unlike the high risk approach, it decreases the proportion of susceptible individuals over time, so is more sustainable; this is analogous to the herd effect in infectious disease control, by which non-immunized individuals benefit from mass immunization because it reduces their likelihood of being exposed to the infectious agent. A population approach is necessary in order to significantly reduce disease incidence in the population, but, paradoxically, what is of benefit to the population gives no guarantee of benefit to any specific individual, which can be a barrier to motivation.

**Table 7.1 Comparison of High Risk and Population Strategies for Disease Prevention and Health Promotion** (adapted from Geoffrey Rose, 1985<sup>2</sup>)

Approach	Advantages	Disadvantages
<b>High Risk</b>	<ul style="list-style-type: none"> <li>- intervention appropriate to individual</li> <li>- subject motivation</li> <li>- physician motivation</li> <li>- cost-effective use of resources</li> <li>- benefit/risk ratio favourable</li> </ul>	<ul style="list-style-type: none"> <li>- difficulties and costs of screening</li> <li>- palliative and temporary – not radical</li> <li>- limited potential for a) individual b) population</li> <li>- behaviourally inappropriate</li> </ul>
<b>Population</b>	<ul style="list-style-type: none"> <li>- radical</li> <li>- large potential for population</li> <li>- behaviourally appropriate</li> </ul>	<ul style="list-style-type: none"> <li>- small benefit to individual (“prevention paradox”)</li> <li>- poor motivation of subject</li> <li>- poor motivation of physician</li> <li>- benefit/risk ratio?</li> </ul>

We are not proposing that Ontario discontinue clinical preventive services; there will always be a need from them. But because individuals at highest risk contribute a relatively small proportion of the cases in the population, clinical preventive services continue to be “necessary but not sufficient.” We need to complement clinical preventive services with a population-based approach if we are to achieve an important reduction in chronic disease incidence. To get the greatest population health gain, we will need to take advantage of what we know and make the best possible use of our available knowledge and resources in both clinical and population settings. We will also need to link efforts in the two settings so that efforts are complementary and opportunities for reciprocal reinforcement are maximized.

## 7.2 Why Integrated with Chronic Disease Prevention and Health Promotion?

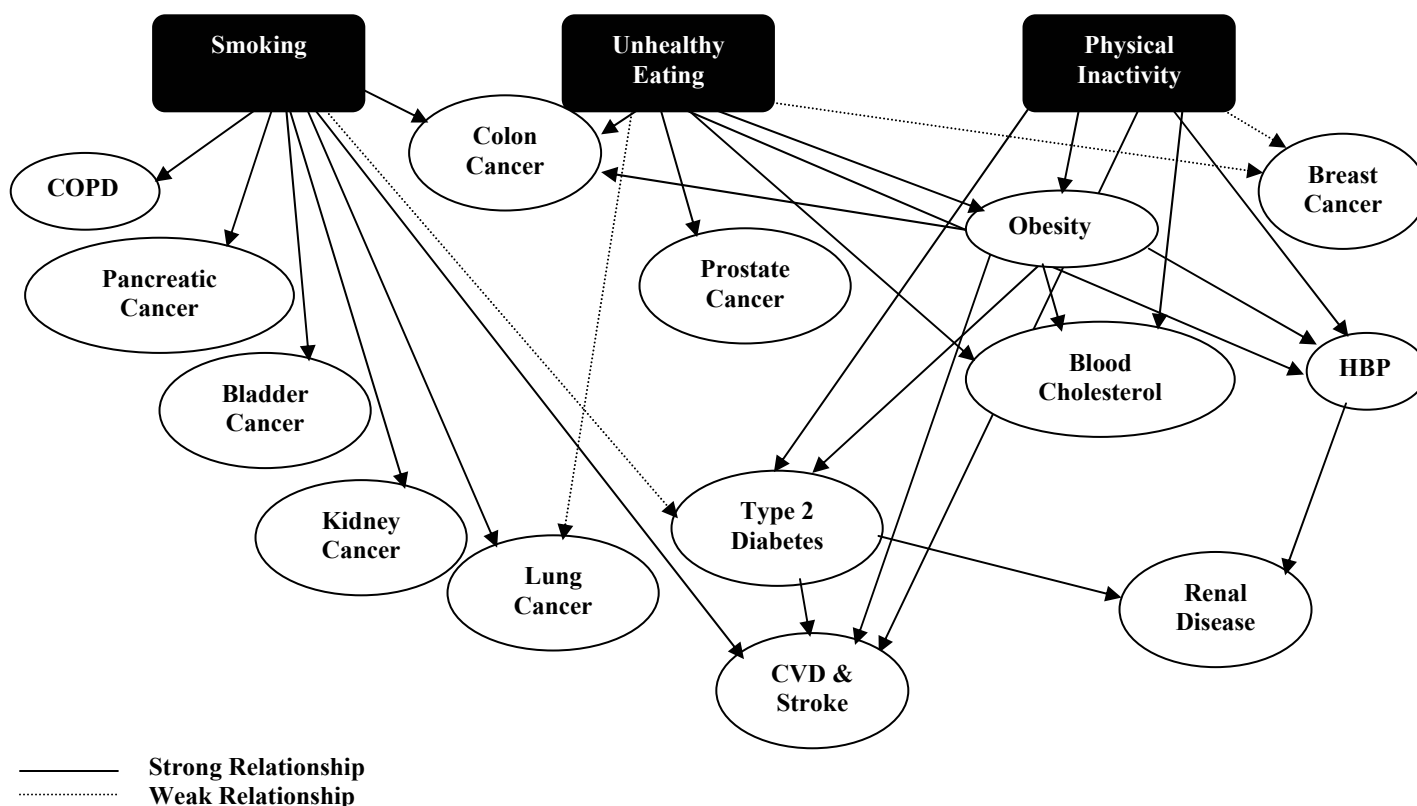
- Risk factors for stroke are shared with other major chronic diseases<sup>3 67 122 123</sup> (Fig. 7.1);
- Risk factors tend to cluster in individuals, especially at younger ages, so there is a high degree of overlap in target populations;<sup>3 124</sup>
- There is good evidence that sufficiently intensive community-based disease prevention and health promotion interventions can shift the population distribution of shared chronic disease risk factors resulting in important health gains;<sup>79</sup>
- When the risk factor profile of a country is shifted in a favourable direction, incidence of associated chronic diseases drops;<sup>79 125</sup>
- It makes economic sense. Time did not permit a full economic analysis for Ontario, but here are some examples from other jurisdictions showing the potential yield from investing in population-based chronic disease prevention and health promotion:

- Katzmarzyk, et al. estimated that about \$150 million annually in direct health care costs in Canada could be saved by reducing the prevalence of physical inactivity by 10%.<sup>126</sup> Feasibility note: As shown in Table 4.3, the prevalence ratio between the Ontario average and the health unit with the lowest prevalence is 1.22, indicating that a 10% reduction target would be more than feasible;
- The US Centers for Disease Control estimated that reducing population dietary fat intake by 1% to 3% would reduce the overall incidence of coronary heart disease by 32,000 to 92,700 cases, saving \$4.1 billion to \$12.7 billion in medical costs and productivity losses over 10 years.<sup>127</sup> Feasibility note: a 1% to 3% reduction seems achievable: the North Karelia Project resulted in a 20% decrease in saturated fat intake in men (14% in women) and an 11% reduction in population serum lipid levels within the first 10 years;<sup>72</sup>
- Even if resources were unconstrained, it would be wasteful of public funds to support a separate prevention strategy for each chronic disease.

### **7.3 The Rationale in a Nutshell**

With the aging of Ontario's population, population-based primary prevention is the only way we can hope to reduce the population burden of stroke and other chronic diseases with which it shares important modifiable risk factors (Figure 7.1). Clinical prevention in susceptible individuals (e.g., treatment of hypertension, cholesterol-lowering agents) cannot address the underlying causes of incidence and needs to be complemented with a population approach. A population approach is not only where the greatest health gains are potentially achievable, but is the only strategy which can sustain the gains made. Integrating stroke prevention with chronic disease prevention is the strategy of choice for reasons of opportunity, feasibility and economy.

**Figure 7.1 Socio-behavioural Risk Factors for Chronic Diseases** (Harvey et al. <sup>128</sup>)



## 8.0 GUIDING PRINCIPLES FOR A COMMUNITY-BASED DELIVERY SYSTEM FOR CHRONIC DISEASE PREVENTION AND HEALTH PROMOTION

Public health is “the science and art of preventing disease, prolonging life and promoting health through the organised effort of society.”<sup>129</sup> Population health is the conceptual model which underpins the practice of public health. In the simplest terms, population health is how we think; public health is what we do.

It is a fundamental ethical precept of public health that we employ the least intrusive measures necessary to accomplish a specified purpose. While this precept has most often been used in discussions about whether or how much it is proper to infringe on individual autonomy to protect the public from the spread of infectious disease, it can and should also be applied to decisions about population-based activities for at least two reasons:

- it requires an investment which might otherwise be spent on other social priorities (opportunity cost);
- the concept of autonomy is not restricted to individuals. Communities today demand to be actors in, not passive recipients of, social policy, and governments ignore at their peril what Lawrence Green refers to as the participatory imperative.<sup>130</sup>

So in the population context, the principle of least intrusiveness adds two dimensions to that of effectiveness when applied to an organized effort to prevent chronic disease and promote health in Ontario: efficiency and community participation:

- efficiency, because we should not intrude on the public's purse more than necessary to achieve the desired aim of the program;
- participation, because we should not intrude on community autonomy by imposing programs and policies on them without their active consent, and ideally their participation;

We use efficiency, rather than economy, advisedly, because economy makes dollars the bottom line, while efficiency assumes effectiveness for the dollars invested. Responsible stewardship of public resources requires that we make the best use of the knowledge and resources available to us in the service of improving population health. So, for example, if we are going to invest in interventions, we need to have adequate surveillance systems in place to assess whether they are having the desired impact. It also means taking advantage of existing knowledge and experience (e.g., building on existing Heart Health programs and coalitions rather than establishing entirely new systems).

It is with these dimensions in mind (effectiveness, efficiency and participation) that we reviewed three sets of guidelines for prevention activities from the US Centers for Disease Control's Planned Approach to Community Health (PATCH);<sup>131</sup> the Center for Substance Abuse Prevention in the US Substance Abuse and Mental Health Services Administration (CSAP-SAMHSA)<sup>132</sup> and the Ontario Heart Health Network's (OHHN) continuation plan.<sup>133</sup> The first two were selected because they were developed on the basis of a systematic distillation of international experience and thus could bring to bear a larger amount of evidence than we could sift through directly in the available time; the OHHN proposed guidelines were examined because they reflect a thorough knowledge of the Ontario context as well as of the evidence on effectiveness of community-based prevention.

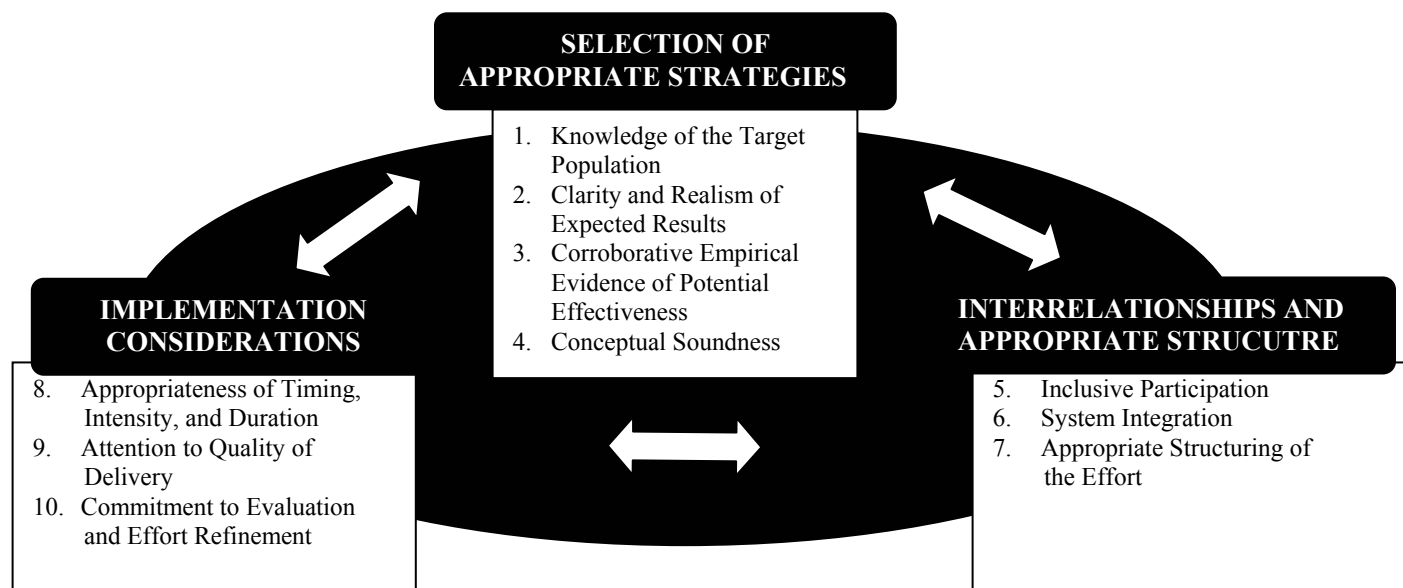
CDC incorporated as key elements in PATCH factors that they had found to be consistently present in successful cardiovascular disease prevention interventions around the world. These include:

- strong core local support and participation in the process;
- collection and analysis of local data and health issues;
- setting objectives and standards to assess progress;
- use of multiple intervention strategies to meet objectives including strategic application of behavioural sciences, community mobilization, health education, and mass media;
- continuous monitoring of problems and intervention strategies to evaluate progress and detect the need for change;
- securing support of a public health infrastructure (system).<sup>134</sup>

The CSAP-SAMHSA guidelines (see Figure 8.1) are the most fully developed both conceptually and in terms of tools provided to support planning. They are grouped under three categories: guidelines for selecting strategies, implementation considerations and interrelationships and appropriate structure – a very practical approach. There is a striking correspondence (not strictly one-to-one) between the categories they use and what we have described as the dimensions critical to a public health approach – effectiveness relates principally, although not exclusively to

selection of strategies; efficiency to implementation considerations, and participation to interrelationships and appropriate structure.

**Figure 8.1: CSAP-SAMHSA Guidelines for Prevention Programming**  
(credit: CSAP-SAMHSA<sup>135</sup>)



The Ontario Heart Health Network's proposed guiding principles for a community-based delivery system for chronic disease prevention are discussed fully in their report, Continuation Plan for 2003 and Beyond; the key elements are as follows:

- Comprehensive community approaches planned and implemented through local and provincial partnerships involving key stakeholders in a single co-ordinated system;
- Primary prevention of disease and promotion of healthy living as the focus;
- Local delivery systems that are supported by a provincial system;
- Stable partnership arrangements between the province, provincial organizations and local communities;
- Evidence-based approaches and innovation;
- Mutual accountability of communities and partners;
- Integrated programs and messages within communities to deliver all chronic disease prevention strategies.

There is a high degree of congruence among these three sets of guidelines and between them and the operating principles we propose in Section 9. There are, however, some connections which might need to be made explicit. Sustainability does not appear in either of the preceding sets of guidelines, but some of the attributes described contribute directly to it. For example, efficiency is one attribute that people readily recognize as related to sustainability – we know that if we waste resources our efforts will not be sustainable. It is also relatively easy to see how factors

(such as system integration and appropriate structuring of the effort) that contribute to efficiency will also then contribute to sustainability. The links between sustainability and both stability and infrastructure are similarly intuitive. What might not be so obvious is that the principles of inclusive participation and mutual accountability are also necessary for sustainability. They relate to the building of trust and commitment, without which no program can be sustained, no matter how well-designed and resourced.

The CSAP-SAMSHA guideline regarding “appropriateness of timing, intensity and duration” brings to mind the concept of “preventive” dose. This is the public health analogue to the therapeutic dose in clinical medicine – an adult does not expect to get relief for a headache from one-quarter of a baby aspirin – no more should we expect to see a shift in overall population risk profiles when prevention efforts are limited to scattered research studies reaching only a fraction of the population. We know from experience in tobacco control that there is a dose-response between investment in tobacco control and reduction of tobacco consumption.<sup>136</sup> Any strategy undertaken must be adequately funded to provide a preventive dose of programming.

Without paying attention to the quality and quantity of effort needed to obtain significant health outcomes, traditional small-scale demonstrations and ephemeral programs will not make a difference.  
- *Conference of Principal Investigators of Heart Health, 2000*<sup>137</sup>

A note on the concept of evidence: Evidence comes from a variety of sources and disciplines. Traditionally, public health relied most heavily on epidemiology to detect health threats through surveillance and to understand the causal relationships between exposures and health outcomes. Today we appreciate that we need to understand not only what is the case, but why it is the case and what works to change the situation if it leads to a poor health outcome. The public health science toolbox now includes a broad range of disciplines besides epidemiology: psychology, sociology, evaluation research, health systems research, and more, and we would be foolish to forego the benefits of any of them.

Different disciplines sometimes have different ideas about what constitutes rigour, and hence, what is accepted as “evidence,” which can give rise to controversy over when we have enough evidence to act. But it is our duty to act – we don’t have the luxury of debating the evidence forever or awaiting the definitive, academically invincible proof before we respond to a threat to health. Hence, any strategy or system for disease prevention and health promotion needs the means not only to generate new knowledge (through surveillance and research), but also a systematic process for assessing the state of evidence relevant to public health and bringing its implications to the attention of decision-makers. This requires infrastructure.

For related reasons, there can be a certain tension between *evidence-based* and *innovative*. Breakthroughs come when someone sees a possibility for which there has hitherto *not* been evidence – in fact, many effective public health interventions were discovered before the etiologic agent was even identified. Stimulating innovation is clearly integral to an evidence-based approach. We need to be able to allow for a recursive process in which practice and science inform one another reciprocally. Linking the policy and program components to a research agenda and a process for synthesizing new knowledge and identifying best practices<sup>136</sup> for dissemination can enable that process to occur more efficiently and ensure we get the

maximum benefits of both breakthrough thinking and painstaking investigation.

Whether we talk about best practices or better practices, the operative word is practice.

A note on complexity. It is impossible to over-emphasize the importance of resisting the craving for simple solutions! The following far from exhaustive list of the “multiples” involved in chronic disease control provides an inkling of the number and kind of dimensions we need to consider. There are:

- multiple risk factors;
- multiple diseases;
- multiple determinants of health (biology, physical environment, socioeconomic environment, culture, health system, etc.);
- multiple populations (whether determined by geography, socioeconomic status, ethnicity, language, age, attitude, etc.);
- multiple channels and settings (home, school, work, community);
- multiple jurisdictions (local, regional, provincial/territorial, national, international);
- multiple disciplines;
- multiple stakeholders;
- etc.

A strategy involving such complexities, with multiple levels of interventions that incorporate policy and environmental interventions as well programs and services, will require highly sophisticated evaluation approaches.

In a society that encourages unhealthy lifestyles, information and education don't have a fighting chance.  
-*Preventing Diabetes in Atlantic Canada*<sup>114</sup> 2000.

Randomized control trials, the traditional “gold standard” for determining efficacy, can only address a single dimension, efficacy. An evolving literature on evaluation of comprehensive public health strategies reflects attempts to develop measures to address the range of other dimensions we will need to understand to continue to improve our practice. The RE-AIM Framework extends beyond efficacy to consider reach, adoption, implementation and maintenance, all of which need to be assessed at both individual and institutional levels.<sup>138</sup>

## 9.0 A MODEL FOR INTEGRATED CHRONIC DISEASE PREVENTION AND HEALTH PROMOTION

The model\* proposed here attempts to synthesize the common elements found in the frameworks we learned about on scanning the international, national and provincial environment for approaches to chronic disease prevention. Figure 9.1 displays the elements of the model, classified according to the categories content, function, system capacity and philosophy. The category of philosophy initially was shown as a single column cutting across all the interventions, but there are some operating principles, such as evaluation and knowledge transfer, which border on being functions. Without wishing to get into tedious semantic discussions, it seemed useful to place them together with the functions, using the word “mechanisms” to convey that they are of a slightly different order than the core functions.<sup>68</sup>

**Purpose and content elements** include statements about what the approach is meant to achieve: a statement of ultimate purpose. We propose that the draft statement of purpose for the initiative be to:

- improve population health;
- reduce health inequalities and;
- prevent new cases of chronic diseases;

through reducing the population prevalence of the most prevalent and important shared modifiable risk factors for the principal causes of chronic disease in Ontario:

- tobacco;
- physical inactivity;
- unhealthy eating patterns;
- excessive use of alcohol.

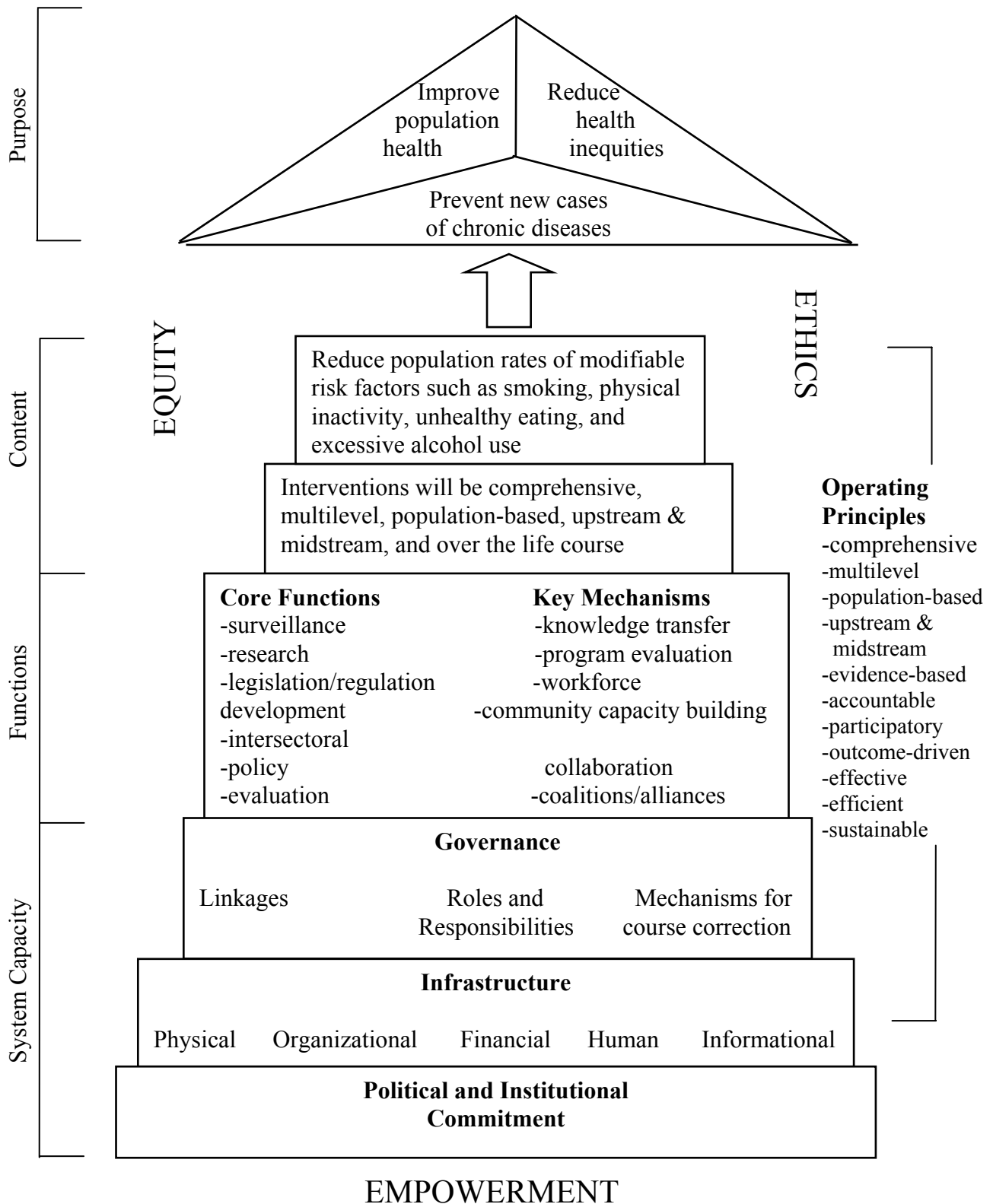
---

\* The Dictionary of Epidemiology provides two definitions of the word, “model”, which are relevant to this project:

1. *An abstract representation of the relationship between logical, analytical, or empirical components of a system*
2. *A formalized expression of a theory or the causal situation that is regarded as having generated observed data*

Both are relevant because a model is meant to be a tool for helping systematize our thinking, planning, implementation, monitoring and evaluation of an integrated chronic disease approach. To be useful in this sense, it is not enough for it to provide a high level description of the principal activities, functions, processes and relationships involved. It must also reflect the way we conceptualize disease and health, because that will determine how we frame the ultimate purpose of the approach or system. Industrial process models are usually defined in terms of their inputs and outputs, but in a public health context we must relate these to how they bring us closer to a specified social goal – in this case, chronic disease prevention. In addition, it should be explicitly embedded in the values underlying the social decision to address that goal and should state the main operating principles meant to guide strategies chosen to do so.

**Figure 9.1: Overview of an Integrated Chronic Disease Prevention Approach**



**Functional elements** include:

- A statement of core or strategic functions:
  - surveillance;
  - research;
  - legislation/regulation;
  - community capacity-building;
  - policy e.g., health impact assessment; and,
  - evaluation.
- A statement of key mechanisms or activities:
  - knowledge transfer (including education);
  - program evaluation;
  - workforce development (planning, training, recruitment, retention);
  - intersectoral collaboration;
  - coalitions/alliances; and,
  - social marketing.

**System capacity** elements include resources, tools, information, and also institutional and political commitment.

- Political and institutional commitment – to ensure the resources and linkages on which the rest depend will be there in the long term to sustain the gains achieved and the ability to address new challenges.
- Infrastructure:
  - physical;
  - organizational;
  - financial;
  - human;
  - informational.
- Governance:
  - linkages (e.g., with clinical preventive services);
  - roles and responsibilities;
  - mechanisms for course correction.

**Philosophical elements** include:

- A statement of underlying values. We propose that a draft statement of underlying values include:
  - equity;
  - empowerment;
  - ethics.

- A statement of operating principles, some of which are related to content directly and others which are cross-cutting. We propose that a draft statement of operating principles for the initiative include statements that it should be:
  - comprehensive – it does not rely on a single type of approach (such as social marketing) but exercises the most effective from among a range of instruments at society’s disposal;
  - multilevel – it seeks synergy through activities delivered at local, regional, provincial levels and through participating in national initiatives;
  - population-based – it is directed toward healthy people in their communities;
  - upstream and midstream – it addresses distal as well as proximal determinants of health outcomes (see Figure 9.1, Appendix 4, Figure A.1) based on a life course approach – it identifies and addresses opportunities to prevent disease throughout the life course, not just at the age when disease begins to manifest (See Appendix 4 for three different attempts to visualize these concepts Figures A.2, A.3 & A.4);
  - evidence-based – it systematically refers to evidence from surveillance, research and program evaluation for policy, planning and program improvement;
  - accountable – it clearly states its goals to Ontarians and periodically reports on progress;
  - participatory – it involves citizens, organizations and institutions appropriately in designing, planning, delivering and evaluating the strategy;
  - outcome-driven – it sets explicit targets and monitors progress towards their achievement;
  - effective – when different options for a response are proposed, it selects the one with the best evidence for effectiveness, to get the best results from available knowledge;
  - efficient – it manages public funds and stakeholder contributions responsibly to get the best results from available resources;
  - sustainable – it promotes systemic changes in preference to one-off interventions.

## REFERENCES

- 1 Report of the Joint Stroke Strategy Working Group. Toronto: June, 2000
- 2 Rose G. Sick individuals and sick populations, *Int J Epid* 1985;14(1):32-8.
- 3 Brownson RC, Rivington PL, Davis JR, eds. *Chronic Disease Epidemiology and Control*. Washington: American Public Health Association, 1998.
- 4 Goldstein LB, Adams R, Becker K, et al. Primary prevention of ischemic stroke: A statement for healthcare professionals from the Stroke Council of the American Heart Association. *Stroke* 2001;32:280-99.
- 5 American Heart Association. *1997 Heart and Stroke Statistical Update*. Dallas, Texas: National Center, 1996. AHA Publication 55-0524.
- 6 Wyller TB. Stroke and Gender. *J Gender-Specific Med* 1999;2(3):41-5.
- 7 Kannel WB. The Framingham Study: Historical insight on the impact of cardiovascular risk factors in men versus women. *J Gender-Specific Med* 2002;5(2):  
[www.mmhc.com/jgsm/articles/JGSM0202/kannel.html](http://www.mmhc.com/jgsm/articles/JGSM0202/kannel.html)
- 8 Mosca, L, Manson JE, Sutherland SE, Langer RD, Manolio T, Barrett-Connor E. Cardiovascular disease in women: A statement for healthcare professionals from the American Heart Association. *Circulation* 1997; 96:2468-82.
- 9 Heart and Stroke Foundation of Canada. *The Changing Face of Heart Disease and Stroke in Canada, 2000*. Ottawa: Heart and Stroke Foundation, 1999.
- 10 McIntyre L, Shah CP. Prevalence of hypertension, obesity, and smoking in 3 Indian communities in Northwestern ON. *CMAJ* 1986;134:345-49.
- 11 Kiely DK, Wolf PA, Cupples LA, et al. Familial aggregation of stroke: The Framingham Study. *Stroke* 1993;24:1366-71.
- 12 Liao D, Myers R, Hunt S, et al. Familial history of stroke and stroke risk: The Family Heart Study. *Stroke* 1997;28:1908-12.
- 13 Brass IM, Isaacsohn JL, Merikangas KR, et al. A study of twins and stroke. *Stroke* 1992;23:221-3.
- 14 Bennett S. Socioeconomic inequalities in coronary heart disease and stroke mortality among Australian men, 1979–1993. *Int J Epidemiol* 1996;25(2):266-75.
- 15 Jakovljevi D; Sarti C, Sivenius J, et al. Socioeconomic status and ischemic stroke: The FINMONICA Stroke Register. *Stroke* 2001;32:1492.
- 16 Jakovljevi D; Sarti C, Sivenius J, et al. Socioeconomic differences in the incidence, mortality and prognosis of intracerebral hemorrhage in Finnish adult population. *Neuroepidemiology* 2001;20:2:85-90.

- 17 Hart CL, Hole DJ, Davey Smith G. Comparison of risk factors for stroke incidence and stroke mortality in 20 years of follow up in men and women in the Renfrew/Paisley study in Scotland. *Stroke* 2000;31:1893-6.
- 18 Wolf PA, Cobb JL, D'Agostino RB. Epidemiology of stroke. In *Stroke: Pathophysiology, Diagnosis and Management*. Barnett JJ, Mohr JP, Stein BM, Jatsu FM (eds). New York, N.Y., Churchill Livingstone, 1992:3-29.
- 19 Lindenstrøm E, Boysen G, Nyboe J. Influence of systolic and diastolic blood pressure on stroke risk: A prospective observational study. *Am J Epidemiol* 1995;142(12):127-990.
- 20 Vasan RS, Beiser A, Seshadre S, et al. Residual lifetime risk for developing hypertension in middle-aged men and women: The Framingham Heart Study. *JAMA* 2002;287(8):1003-10.
- 21 Goya Wannamethee S, Shaper AG, Whincup PH, Walker M. Smoking cessation and the risk of stroke in middle-aged men. *JAMA* 1995;274:155-60
- 22 Canadians & Heart Health. Ottawa: Ministry of Supply & Services, 1995.
- 23 DCCT Research group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin dependent diabetes mellitus. *N Engl J Med* 1993;329:977-86.
- 24 Kuusisto J, Mykkänen L, Pyörälä K, Laaks OM. Non insulin dependent diabetes and its metabolic control are important predictors of stroke in elderly subjects. *Stroke* 1994;25:1157-64.
- 25 Walker SP, Rimm EB, Ascherio A, et al. Body size and fat distribution as predictors of stroke among US men. *Am J Epidemiol* 1996;144:1143-50.
- 26 Rexrode KM, Hennekens CH, Willett WC, et al. A prospective study of body mass index, weight change, and risk of stroke in women. *JAMA* 1997;277:1539-45.
- 27 Kiely DK, Wolf PA, Cupples LA, et al. Physical activity and stroke risk: The Framingham Study. *Am J Epidemiol*. 1994;140:608-2.
- 28 Abbott RD, Rodriguez BL Burchfiel CM, et al. Physical activity in older middle-aged men and reduced risk of stroke: The Honolulu Heart Program. *Am J Epidemiol* 1994;139:881-93
- 29 Haheim LL, Holme I, Hjermmann I, et al. Risk factors of stroke incidence and mortality: A 12-year follow-up of the Oslo Study. *Stroke* 1993;24:1484-89.
- 30 Manson JE, Stampfer MJ, Willett WC, et al. Physical activity and incidence of coronary heart disease and stroke in women. *Circulation* 1995;91(Suppl):5.
- 31 Lindenstrom E, Boysen G, Nyboe J. Lifestyle factors and risk of cerebrovascular disease in women: The Copenhagen City Heart Study. *Stroke* 1993;24:1468-72.
- 32 Blair SM, Kampert JB, Kohl III HW, et al. Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. *JAMA* 1996;276(3):205-10.

- 33 Lee I-M, Paffenbarger RS. Physical activity and stroke incidence: The Harvard alumni health study. *Stroke* 1998;29:2049-2054.
- 34 Bijnen FCB, Feskens EJM, Caspersen CJ, et al. Physical activity and cardiovascular risk factors among elderly men in Finland, Italy, and The Netherlands. *Am J Epidemiol* 1996;143(6):553-61.
- 35 National Stroke Association Stroke Prevention Guidelines Stroke Prevention Advisory Board, *J Stroke Cerebrovasc Dis*, 1998;7:162-164.
- 36 Djousse L, Ellison RC, Beiser A, et al. Alcohol consumption and risk of ischemic stroke: The Framingham Study. *Stroke* 2002;33(4):907-12.
- 37 Lavallée P, Perchaud V, Gautier-Bertrand M, et al. Association between influenza vaccination and reduced risk of brain infarction. *Stroke* 2002;33: 513-8.
- 38 Liu S, Manson JE, Stampfer MJ, et al. Whole grain consumption and risk of ischemic stroke in women: A prospective study. *JAMA* 2000;284:1534-40.
- 39 Rodriguez Artalejo F, Guallar-Castillon P, Banegas Banegas JR, et al. Consumption of fruit and wine and the decline in cerebrovascular disease mortality in Spain (1975-1993). *Stroke* 1998;29:1556-61.
- 40 Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: A review. *Int J Epidemiol* 1997;26:1-13.
- 41 Joshipura KJ, Ascherio A, Manson JE, et al. Fruit and vegetable intake in relation to risk of ischemic stroke. *JAMA* 1999;282:1233-9.
- 42 Suter PM. The effects of potassium, magnesium, calcium, and fiber on risk of stroke. *Nutr Rev* 1999;57:84-8.
- 43 Leppälä JM, Virtamo J, Fogelholm R, et al. Controlled trial of  $\alpha$ -Tocopherol and  $\beta$ -carotene supplements on stroke incidence and mortality in male smokers. *Arteriosclerosis, Thrombosis, and Vascular Biology* 2000;20:230.
- 44 Omenn GS, Goodman GE, Thornquist MD, et al. Effects of a combination of beta carotene and vitamin A on lung cancer and cardiovascular disease. *N Engl J Med* 1996;334(18):1150-5.
- 45 Hennekens CH, Buring JE, Manson JE, et al. Lack of effect of long-term supplementation with beta carotene on the incidence of malignant neoplasms and cardiovascular disease. *N Engl J Med* 1996;334:1145-9.
- 46 Morris MC, Manson JE, Rosner B, et al. Fish consumption and cardiovascular disease in the physicians' health study: A prospective study. *Am J Epidemiol* 1995;142:166-75.
- 47 Orenca AJ, Daviglius ML, Dyer AR, et al. Fish consumption and stroke in men. 30-year findings of the Chicago Western Electric Study. *Stroke* 1996;27:204-9.
- 48 Keli SO, Feskens EJ, Kromhout D. Fish consumption and risk of stroke. The Zutphen Study. *Stroke* 1994;25:328-32.
- 49 Zhang J, Sasaki S, Amano K, et al. Fish consumption and mortality from all causes,

- ischemic heart disease, and stroke: An ecological study. *Prev Med* 1999;28:520-9.
- 50 Gillman MW, Cupples LA, Millen BE, et al. Inverse association of dietary fat with development of ischemic stroke in men. *JAMA* 1997;278:2145-50.
- 51 Ricci S, Celani MG, Righetti E, et al. Fatty acid dietary intake and the risk of ischemic stroke: A multicentre case-control study. UFA Study Group. *J Neurol* 1997;244:360-4.
- 52 Seino F, Date C, Nakayama T, et al. Dietary lipids and incidence of cerebral infarction in a Japanese rural community. *J Nutr Sci Vitaminol (Tokyo)* 1997;43:83-99.
- 53 Laboratory Centre for Disease Control, Statistics Canada, 1999.
- 54 Disease Intervention Division, Centre for Chronic Disease Prevention and Control, Health Canada
- 55 Tu JV, Porter J. Stroke care in Ontario: Hospital survey results. Institute for Clinical Evaluative Sciences: January 1999.
- 56 Clarke PJ, Black SE, Badley EM, Lawrence JM, Williams JI. Handicap in stroke survivors. *Disability and Rehabilitation* 1999;21(3):116-23.
- 57 Statistics Canada, Canadian Community Health Survey, 2000/01.
- 58 National Population Health Survey: Residents of health care institutions, 1996/97.
- 59 Provincial Health Planning Database: Inpatients Events and Population Estimate Tables.
- 60 Provincial Health Planning Database: Mortality and Population Estimate Tables.
- 61 Provincial Health Planning Database, 2001 – Adapted from Southwestern Ontario Coordinated Stroke Strategy Environmental Scan. April, 2002.
- 62 Denton FT, Feaver CH, Spencer BG. The future population of Canada, its age distribution and dependency relations. *Can J Aging* 1998;17(1):83-109.
- 63 Mamdani MM, Tu JV. Prevalence of stroke-related hospital discharge over time: Emerging trends in Ontario. Institute for Clinical Evaluative Sciences: March, 2000.
- 64 Statistics Canada, National Population Health Survey, 1994/95.
- 65 Statistics Canada, National Population Health Survey, 1996/97.
- 66 Statistics Canada, National Population Health Survey, 1998/99.
- 67 Statistics Canada, Canadian Community Health Survey, 2000/01.
- 68 Manson J, Tosreson H, Ridker P, Satterfield S, Hebert P, et al. The primary prevention of myocardial infarction. *N Engl J Med* 1992;326(21):1406-16.
- 69 International Task Force for Prevention of Coronary Heart Disease. Coronary Heart Disease: Reducing the Risk: The scientific background for primary and secondary prevention of coronary heart disease, a worldwide view, 1998.  
<http://www.chd-taskforce.de/guidelines/kap23.htm>.
- 70 Last J ed. *A Dictionary of Epidemiology*, 4<sup>th</sup> ed. New York: Oxford University Press, 2001.

- 71 Joffres MR, MacLean DR, O'Connor BA, Petrasovits A, Stachenko S. Canadians and Heart Health: Reducing the Risk. Ottawa: Health Canada, 1995.
- 72 1990 Ontario Health Survey.
- 73 Ministry of Health and Long-Term Care.  
[http://www.gov.on.ca/health/english/pub/hpromo/blood\\_pressure/pressure.htm](http://www.gov.on.ca/health/english/pub/hpromo/blood_pressure/pressure.htm)
- 74 Institute of Clinical Evaluative Sciences. The 'Heart' of Ontario: The Where and Why and Who of Cardiovascular Disease. *Informed* 1999;5(2).  
<http://www.ices.on.ca/PDFs/informed/vol5issue2.pdf>
- 75 North Karelia Project summary. From ProCOR at [www.procor.org/ardview.php/2/](http://www.procor.org/ardview.php/2/)
- 76 Puska P, Tuomileto J, Nissinen A, Vartiainen E (eds). The North Karelia Project: 20 year results and experiences. National Public Health Institute. Helsinki 1995.
- 77 Wong CH. Leading causes of death, Ontario 1996 – measured by incidence and of deaths, Potential Years of Life Lost, and Period Expected Years of Life Lost, Public Health and Epidemiology Report Ontario 1999;10(8) at [www.goc.on.ca/MOH/english/program/pubhealth/phero/phero\\_199908.html#Leading](http://www.goc.on.ca/MOH/english/program/pubhealth/phero/phero_199908.html#Leading)
- 78 Guide to Community Preventive Services: Systematic Reviews and Evidence-based Recommendations. [www.thecommunityguide.org/home\\_f.html](http://www.thecommunityguide.org/home_f.html)
- 79 National Public Health Partnership. Planning and Practice Improvement.  
[www.nphp.gov.au/ppi](http://www.nphp.gov.au/ppi)
- 80 Nissinen A, Ximena Berrios X, Puska P. Community-based noncommunicable disease interventions: lessons from developed countries for developing ones. *Bulletin of the World Health Organization*, 2001, 79: 963–970. From [www.who.int/bulletin/pdf/2001/issue10/bu1287.pdf](http://www.who.int/bulletin/pdf/2001/issue10/bu1287.pdf)
- 81 Shetty PS, James WTS. Body Mass Index: A Measure of Chronic Energy Deficiency in Adults. FAO Food and Nutrition Paper 56. Food and Agriculture Organization, 1994. From [www.fao.org/docrep/T1970E/t1970E/t1970e05.htm](http://www.fao.org/docrep/T1970E/t1970E/t1970e05.htm)
- 82 Sorenson G, Emmons K, Hunt MK, Johnston D. Implications of the results of community intervention trials. *Ann Rev Public Health* 1998;19:379-416. From <http://pubhealth.annualreviews.org>
- 83 World Health Organization. Global strategy for the prevention and control of noncommunicable diseases. Report by the Director General to 53<sup>rd</sup> World Health Assembly, March 22, 2000. [www.who.int/hpr/ncdglobalstrategy.pdf](http://www.who.int/hpr/ncdglobalstrategy.pdf)
- 84 World Health Organization. Department of Noncommunicable Disease Prevention and Health Promotion (NPH) [www.who.int/hpr/nphaboutus.htm#](http://www.who.int/hpr/nphaboutus.htm#) Addressing Common Risk Factors.
- 85 World Health Organization. Life course perspectives on coronary heart disease, stroke and diabetes: Key issues and implications for policy and Research. Summary Report of a

- Meeting of Experts 2–4 May 2001.  
[www.who.int/hpr/ageing/life%20course%20short%20report.PDF](http://www.who.int/hpr/ageing/life%20course%20short%20report.PDF)
- 86 World Health Organization. <http://www5.who.int/cardiovascular-diseases/main.cfm?s=0010>
- 87 WHO CINDI web site. [www.hc-sc.gc.ca/hppb/ahi/cindi](http://www.hc-sc.gc.ca/hppb/ahi/cindi)
- 88 PAHO web site, CARMEN Initiative. [www.paho.org/english/hcp/hcn/hcnarmer\\_1.htm](http://www.paho.org/english/hcp/hcn/hcnarmer_1.htm)
- 89 Australian National Public Health Partnership web site. [hna.ffh.vic.gov.au/nphp](http://hna.ffh.vic.gov.au/nphp)
- 90 Preventing Chronic Disease: A strategic framework - Background paper (October 2001)  
[www.dhs.vic.gov.au/nphp/chrondis/index.htm](http://www.dhs.vic.gov.au/nphp/chrondis/index.htm)
- 91 Guidelines for Improving National Strategy Development and Coordination (May 1999).  
<http://hna.ffh.vic.gov.au/nphp/natstrat/index.htm>
- 92 Ministry of Social Affairs and Health of Finland. Government resolution on the Health 2015 public health programme, Helsinki 2001.  
[www.vn.fi/stm/english/eho/publicat/health2015/health2015.pdf](http://www.vn.fi/stm/english/eho/publicat/health2015/health2015.pdf)
- 93 National Health Strategy (Ireland) web site. <http://www.doh.ie/hstrat/index.html>
- 94 Social Aspects of Sustainable Development in Ireland.  
[www.un.org/esa/agenda21/natinfo/countr/ireland/social.htm](http://www.un.org/esa/agenda21/natinfo/countr/ireland/social.htm)
- 95 Annual Report of the Chief Medical Officer 1999. [www.doh.ie/pdfdocs/Cmo.pdf](http://www.doh.ie/pdfdocs/Cmo.pdf)
- 96 Institute for Public Health. [www.publichealth.ie](http://www.publichealth.ie)
- 97 Chronology of Tobacco Control in New Zealand  
[www.webnz.com/healthnz/h\\_chron.htm](http://www.webnz.com/healthnz/h_chron.htm)
- 98 The New Zealand Health Strategy. December 2000 [www.moh.govt.nz/publications/nzhs](http://www.moh.govt.nz/publications/nzhs)
- 99 Fosse E. Health Promotion Policy – a Field of Research. Paper presented at the 3rd Nordic Health Promotion Research Conference, Tampere 6-9 September 2000. From  
[www.uta.fi/laitokset/tsph/conference/presentations/fosse.htm](http://www.uta.fi/laitokset/tsph/conference/presentations/fosse.htm)
- 100 Saving Lives: Our Healthier Nation. [www.ohn.gov.uk/ohn/ohn.htm](http://www.ohn.gov.uk/ohn/ohn.htm)
- 101 Office of Disease Prevention and Health Promotion, Department of Health and Human Services. [www.odphp.osophs.dhhs.gov](http://www.odphp.osophs.dhhs.gov)
- 102 National Center for Chronic Disease Prevention and Health Promotion.  
[www.cdc.gov/nccdphp/index.htm](http://www.cdc.gov/nccdphp/index.htm)
- 103 Healthy People 2010. [www.health.gov/healthypeople](http://www.health.gov/healthypeople)
- 104 Coalition for Healthier Cities and Healthy Communities. [www.healthycommunities.org](http://www.healthycommunities.org)
- 105 Promoting health and well being: Implementing the national health promotion strategy  
[www.wales.gov.uk/subihealth/content/reports/promotinghealth-e.pdf](http://www.wales.gov.uk/subihealth/content/reports/promotinghealth-e.pdf)
- 106 [www.archive.official-documents.co.uk/document/cm39/3922/3922.htm](http://www.archive.official-documents.co.uk/document/cm39/3922/3922.htm)

- 107 Green LW, Kreuter MW. *Health Promotion Planning: An Educational and Ecological Approach*, 3<sup>rd</sup> edition Mountain View, CA: Mayfield Publishing 1999. Cited at <http://www/ihpr.ubc.ca/precede.html>.
- 108 Alberta Health and Wellness Business Plan 2002-05. [www.finance.gov.ab.ca](http://www.finance.gov.ab.ca)
- 109 Saskatchewan Health. Chronic Disease Prevention, in Public Health/Population Health Services in Saskatchewan. October, 2001.  
[www.health.gov.sk.ca/phb\\_public\\_health/Chronic%20Disease%20Prevention.pdf](http://www.health.gov.sk.ca/phb_public_health/Chronic%20Disease%20Prevention.pdf)
- 110 British Columbia Office of the Provincial Health Officer, 2001.  
[www.healthplanning.gov.bc.ca/pho/hlthgoal/workguid.html](http://www.healthplanning.gov.bc.ca/pho/hlthgoal/workguid.html)
- 111 British Columbia Ministry of Health Planning Service, 2002.  
[www.gov.bc.ca/prem/popt/corereview/srvpln/hlthplanning/major\\_initiatives.htm](http://www.gov.bc.ca/prem/popt/corereview/srvpln/hlthplanning/major_initiatives.htm)
- 112 Prince Edward Island Health and Social Services Annual Report 2000-2001.  
[www.gov.pe.ca/photos/original/hss\\_annual00-01.pdf](http://www.gov.pe.ca/photos/original/hss_annual00-01.pdf)
- 113 A Wellness Strategy for New Brunswick. April, 2001.  
[www.gnb.ca/legis/comite/54/2health/contents.htm](http://www.gnb.ca/legis/comite/54/2health/contents.htm)
- 114 Lilley S. Preventing Diabetes in Atlantic Canada. Report prepared for Population and Public Health Branch, Atlantic Regional Office, Health Canada, 2000.
- 115 Newfoundland and Labrador Heart Health Program web site  
<http://www.infonet.st-johns.nf.ca/providers/nhhp/docs/CDSStrategy.html>
- 116 Primary Health Care Transition Fund. [www.hc-sc.gc.ca/phctf-fassp/english/index.html](http://www.hc-sc.gc.ca/phctf-fassp/english/index.html)
- 117 Mitchell D. Factors influencing capacity of community coalitions to incorporate stroke prevention. Report to Ontario Prevention Clearinghouse - Stroke Prevention Project, June, 2002.
- 118 Rosenbaum C, Shea J. Report on community capacity for integration of stroke prevention in selected regions of Ontario. Prepared for Ontario Prevention Clearinghouse, July 31, 2001.
- 119 Shea J, Rosenbaum C. OHPRS and community capacity development. Year One Final Report. Submitted to Ontario Prevention Clearinghouse, October, 2001.
- 120 Ontario Ministry of Health and Long Term Care. Mandatory Health Programs and Guidelines. Toronto.  
[www.gov.on.ca/health/english/pub/pubhealth/manprog/mhp\\_3.html#cdinjuries](http://www.gov.on.ca/health/english/pub/pubhealth/manprog/mhp_3.html#cdinjuries).
- 121 Heller RF, Chinn S, Tunstall Pedoe HD, et al. How well can we predict coronary heart disease? Findings in the United Kingdom Heart Disease Prevention Project. 1985. *BMJ* 1984;288:1409-11.
- 122 Schuit AJ, van Loon JM, Tjhuis M, Ocke MC. Clustering of lifestyle risk factors in a general adult population. *Preventive Medicine*, 2002;35:219-224.
- 123 Shah, C. *Public Health and Preventive Medicine in Canada*, 3<sup>rd</sup> ed. Toronto: University of Toronto Press, 1994.

- 124 Young TK, Gelskey DE, Macdonald SM, Hook E, Hamilton S. *Manitoba Heart Health Survey: Technical Report*. Winnipeg: University of Manitoba, 1990
- 125 Puska P et al. Changes in premature deaths in Finland: successful long-term prevention of cardiovascular diseases. *Bull World Health Organization* 1998;76:416-425. From [http://www.who.int/archives/pub\\_bull\\_76.html#Changes](http://www.who.int/archives/pub_bull_76.html#Changes)
- 126 Katzmarzyk P, Fledhill N, Shephard RJ. The economic burden of physical inactivity in Canada. *CMAJ* 2000;163(11):1435-40. From <http://www.cmaj.ca/cgi/reprint/163/11/1435.pdf>
- 127 Centers for Disease Control and Prevention. *An Ounce of Prevention: What are the Returns?* 2<sup>nd</sup> ed. Revised. US Department of Health and Human Services, 1999.
- 128 Harvey D, Dunphy V. Community-based health promotion. Presentation to National Forum on Chronic Kidney Disease June 21-23, 2002, Toronto.
- 129 Acheson D. *Public Health in England, Report of the Committee of Inquiry into the Future Development of the Public Health Function*. Department of Health, 1988. Cited at [www.doh.gov.uk/pub/docs/doh/pubhealth\\_intro.pdf](http://www.doh.gov.uk/pub/docs/doh/pubhealth_intro.pdf)
- 130 Green LW, Frankish JC. Health promotion, health education, and disease prevention. In Koop EC, Pearson CE, Schwarz MR, (Editors). *Critical Issues in Global Health*. San Francisco: Jossey-Bass, 2001.
- 131 Centers for Disease Control and Prevention. *Planned Approach to Community Health (PATCH)*. [wonder.cdc.gov/wonder/prevguid/TP\\_00675.shtml](http://wonder.cdc.gov/wonder/prevguid/TP_00675.shtml)
- 132 Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Prevention. *Guidelines and Benchmarks for Prevention Programming, Implementation Guide*. DHHS Publication No. (SMA) 95-3033, 1997. From [www.dmhas.state.ct.us/sig/pdf/GuidelinesBenchmarks.pdf](http://www.dmhas.state.ct.us/sig/pdf/GuidelinesBenchmarks.pdf)
- 133 Ontario Heart Health Network Continuation Working Group. Continuation Plan for 2003 and Beyond. Ontario Heart Health Network, 2002.
- 134 Kreuter MW. Patch: Its Origin, Basic Concepts, and Links to Contemporary Public Health Policy. *J Health Education* 1992;23(3):135-9. From [wonder.cdc.gov/wonder/prevguid/p0000064/p0000064.asp](http://wonder.cdc.gov/wonder/prevguid/p0000064/p0000064.asp)
- 135 CSAP-SAMHSA Guidelines and Benchmarks for Prevention Programming Implementation Guide.
- 136 Centres for Disease Control and Prevention. *Best Practices for Comprehensive Tobacco Control Programs—August 1999*. U.S. Department of Health and Human Services, Centres for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, August 1999. From <http://www.cdc.gov/tobacco/bestprac.htm>
- 137 Marketing the Heart Health Vision: Delivering the “Preventive Dose”. Ad hoc Working Group of the Conference of Principal Investigators of Heart Health. O’Conner N, Cameron R, Farquharson J, Harvey D, et al. For WHO Collaborating Centre for Policy

- Development in the Prevention of Noncommunicable Disease, Health Canada, 2000.  
From <http://www.med.mun.ca/chhdbc/pdf/HHMarketing160801.pdf>
- 138 Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM Framework. *Am J Public Health* 1999;89(9):1322-7.
- 139 McKinlay J, Marceau L. US Public Health and the 21<sup>st</sup> Century: Diabetes Mellitus. *Lancet* 2000;356:757-61. From [http://www.thelancet.com/journal/vol356/iss9231.editorial\\_and\\_review\\_10148.1](http://www.thelancet.com/journal/vol356/iss9231.editorial_and_review_10148.1)