From Stroke Prevention to Health Gain

Module 1: Burden of Stroke and Scope for Prevention

Research shows compelling results

To better direct research and program funds, **policy-makers and managers** in Ontario's health care system need to know the current and projected burden of stroke in Ontario and the scope for its prevention.

Data source for this module

The authors presented data from the following sources in simple tabular or graphic format; no complex analyses were performed.

- Report of the Joint Stroke Strategy Working Group (JSSWG), 2000 — data updated where possible
- Disease Intervention Division, Centre for Chronic Disease Prevention and Control, Health Canada — hospitalizations, mortality
- Health Statistics Division, Statistics Canada (National Population Health Survey: 1996/1997; Canadian Community Health Survey, 2000/2001) — prevalence of stroke in the community and residential facilities
- Southwestern Ontario Coordinated Stroke Strategy Environmental Scan, April, 2002 — population estimates and regional mortality
- Scientific Statement on Stroke, American Heart Association — assessment of degree of evidence for causality and relative risk.

Full report

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.

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(Full report available at <http://www.opc.on.ca>.)

This research makes the case for integrating primary stroke prevention into a broader strategy for primary prevention of chronic disease. In exploring various approaches, it focuses on the following shared risk factors, which are both modifiable and amenable to a population-based approach.

- **hypertension**
- **smoking**
- **diabetes**
- **obesity**
- **physical inactivity**
- **excessive alcohol use**

Other modules in this series

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The Burden of Stroke in Ontario

Mortality and Hospitalizations

Currently in Ontario, stroke is a leading cause of death and adult neurological disability. In 1998, it accounted for about 6% of all deaths (males, 44 per 100,000; females, 60 per 100,000). This puts Ontario just under the mean for Canada which in the 1990s had among the lowest mortality rates world-wide. As shown in Table 1, about one quarter of deaths occurred before age 75.

Within Ontario, there is considerable variation in stroke burden across regions. Hospitalization rates range from 175.7 to 314.4 per 100,000 — a 1.79-fold difference — and mortality rates from 46.6 to 57.2 per 100,000 (National Population Health Survey 1994/95).

In 1999, there were 23,929 stroke-related hospital discharges (2.3% of hospitalizations) and 327,348 hospital days (8.3% of hospitalizations). As seen in Table 1, almost 80% of these hospitalizations are in people over the age of 65.

Table 1: Deaths and Hospitalizations for Stroke in Ontario [from Tables 3.1 and 3.2 of full report]

Age Group	1998 Deaths/ 100,000	1998 # of deaths	1999 Discharges/ 100,000	1999 # of hospi-talizations
35-44	3.55	69	29.63	592
45-54	11.47	172	94.81	1476
55-64	29.89	299	302.11	3110
65-74	113.00	925	789.76	6466
75-84	470.80	2166	1711.72	8093
85 +	1654.41	2281	2685.22	3827
Total		**5912**		**23564**

If the lowest rates of stroke in Ontario are considered an achievable benchmark, then in the regions of highest stroke burden, achieving those lower rates would avoid 80% of hospitalizations and 23% of deaths.

Living with the effects

The 30-day mortality rate for stroke victims is almost 20%, and a large proportion of the survivors require some form of chronic care.[*61] As many as half of stroke survivors report severe handicap one year following their stroke,[*62] 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.[*63]

The number for hospitalizations in Table 1 does not include the 5% of the population aged 65 and older living in institutions. In 1996/97, the prevalence of stroke in this population was 23.2%.[*64] 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 quoted above for 2001 of people of living with the effects of stroke, for a total of about 128,000 Ontarians.

The JSSWG reported[*1] that stroke cost the Ontario economy almost a billion dollars a year.

Key risk population increasing

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).[*68]

As reported in Appendix 2 of the JSSWG report,[*69] the Institute for Clinical and Evaluative Sciences (ICES) estimated that the effect of population aging 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.

Table 3.4 [from full report]: Projected Population Increases in Southwestern Ontario Population

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

* *

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 of both the importance of various risk factors in contributing to population burden, and the prevalence of the risk factors in the Ontario population.

Since risk increases with the number of risk factors,[*74] 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),[*76] a range of potential benefit for each risk factor is given rather than a point estimate.

This section presents 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.

PAR%

PAR% (Population Attributable Risk Percent) indicates the proportion of a particular disease associated with a given risk factor.[*77] 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.

To calculate the Population Attributable Risk%:

$$\text{PAR\%} = \frac{\text{Prev x (RR-1)}}{\text{1+ [Prev x (RR-1)}} \text{ x } 100$$

—from A Dictionary of Epidemiology (J. Last ed.)

Note: Prev = Prevention; RR= Relative Risk

Factors in calculating PAR%

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. Hence, the theoretical reduction in stroke burden from eliminating the latter 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.

In 1992, 61% of Ontarians aged 18 – 74 had at least one major modifiable risk factor for stroke.[*79] Fully 35% of men and 30% of women had three or more risk factors.[*80] Almost one in seven Ontarians have high blood pressure, **the most powerful risk factor** for stroke, rising to one in four by age 45.[*81] Bear in mind that hypertension is frequently under-diagnosed. One in 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 aged 20 to 64 were physically inactive and half were above a healthy weight (BMI≤25); one-third had BMI >27.

PAR% and benchmarking

The main utility of calculating PAR% 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.

One example of this is internal benchmarking, the result of comparing the PAR%s for Ontario with PAR%s for the areas in the province with the lowest prevalence of risk factors. It is more realistic than using a PAR% alone, 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.

To calculate the achievable prevention benchmarks:

- Calculate the PAR% for Ontario and the PAR% for the public health unit with the lowest prevalence of each risk factor.
- Subtract the lowest PAR% from the Ontario PAR% to get the PAR% difference.
- Apply the PAR% difference to the indicators of burden: prevalent cases, deaths and costs.

The steps in using PAR% for internal benchmarking are illustrated in Tables 4.3 and 4.4. Examining regional variation is useful for at least two reasons.

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

The research shows that the ratio of risk factor prevalence in Ontario to that in the PHU with the lowest prevalence is as high as 1.76 (for diabetes) and as low as 1.22 (for physical inactivity). 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, smoking, obesity, fat intake and physical inactivity.[*82] 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).

PAR% and priority setting

PAR%s 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.

Table 4-3 [from full report]: Difference in PAR% Between Ontario and Public Health Unit with Lowest Risk Factor Prevalence

		Ontario		Lowest (PHU) %		
Risk Factor	**Relative Risk (*L=Low H = High*)**	**Prevalence (%)**	**PAR%[b]**	**Prevalence (%)**	**PAR%**	**PAR% Difference**
Hypertension	*L* 1.4	13.0	4.9	10.3	4.0	0.9
	H 5.0	13.0	34.2	10.3	29.2	5.0
Smoking	*L* 1.5	24.5	10.9	16.1	7.5	3.4
	H 4.0	24.5	42.4	16.1	32.6	9.8
Diabetes	*L* 1.8	4.2	3.3	3.3	2.6	0.7
	H 6.0	4.2	17.4	3.3	14.2	3.2
Overweight	*L* 1.8	32.6	19.6	25.6	16.1	3.5
	H 2.4	32.6	30.9	25.6	26.0	4.9
Physical Inactivity	2.7[1]	49.8	45.8	37.1	38.7	7.1
Excessive Alcohol Use	1.6[1]	19.3	10.4	13.7	7.6	2.8

1 Only one estimate available.

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 of the full report. If we were to reduce the burden by even the lower range of PAR%s summed (18.4%), 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. In this case, the authors 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. 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),[*85] the additional benefits would be on the order of 6 to 9 times those calculated in this section.

Table 4-4 [from full report]: Potential Reduction of Stroke Burden in Ontario

Risk Factor		Indicators of Burden			
	PAR% Difference (*L = Low; H = High*)	**Prevalent cases (denominator 128,000)**	**Deaths (denominator 5912)**	**Costs, upper end (denominator $964M)**	**Costs, conservative (denominator $719M)**
Hypertension	*L* 0.9	1152.0	53.0	8.7	6.5
	H 5.0	6400.0	296.0	48.2	36.0
Smoking	*L* 3.4	4352.0	201.0	32.8	24.5
	H 9.8	12544.0	579.0	94.5	70.5
Diabetes	*L* 0.7	896.0	41.0	6.7	5.0
	H 3.2	4096.0	189.0	30.8	23.0
Overweight	*L* 3.5	4480.0	207.0	33.7	25.2
	H 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	18.4	23552.0	1088.0	177.4	132.3

***** For all references in this module, please refer to "References" in full report.