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# A method for comparing and combining cost-of-illness studies: an example from cardiovascular disease

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## Abstract

*This paper describes a method for comparing and combining the results of various cost-of-illness (COI) studies. The method consists of seven steps: identify the study design; stratify according to the cost components; create concatenated cost components; adjust for inflation; adjust for population growth; compare cost estimates; and combine cost estimates. Based on this method, and using published data from 1986, 1993 and 1994, the cost of cardiovascular disease was estimated to be $20.1 billion in Canada in 2000, or $653 per person per year. One cost component, premature mortality, was found to have significantly decreased over time.*

*The method described in this paper is sophisticated yet simple to use, and provides an efficient way to update, compare and combine cost estimates. By analyzing changes in cost components over time, it contributes to the projection methodology of cost information from multiple COI studies. It also greatly facilitates economic impact analyses to provide up-to-date information for healthy public policies.*

***Key Words**: cardiovascular disease; cost-of-illness; economic analysis; statistical method*

## Introduction

A cost-of-illness (COI) study estimates two types of costs of an illness: the direct costs (medical and non-medical) associated with the illness, and the indirect costs associated with lost productivity due to morbidity or premature mortality.[1] In studying and estimating the economic impact of illnesses, questions often arise as to how to compare, and even combine, the estimates from various COI studies for the same time period and same geographic region and even over time and across geographic regions. For example, three studies reported that the total cost of cardiovascular disease in Canada was $16,846 million in 1986,[2] $19,721 million in 1993,[3] and $17,961 million in 1994.[4] Given the differences in the cost items considered, calendar time and total population in Canada in the various studies, how can these cost figures be compared on an equal basis to look for possible time trends? Furthermore, based on published data, how can these cost figures for various study years be combined to obtain the best estimate for a particular target year? Can the only available data for 1986, 1993 and 1994 be combined to provide the best estimate for 2000?

This paper describes a method for comparing and combining the results of various COI studies, illustrated step-by-step with the above example from cardiovascular disease.

## The method

The proposed method comprises seven steps (Table 1):

### *Step 1: Identify the study design*

The first step is to identify the study design of the cost-of-illness study. It is inadvisable to compare or combine cost estimates from COI studies that have used different study designs, because different designs are based on different philosophies and approaches. The checklist in Table 2 helps to identify the study design. There are four major characteristics that determine the design of a COI study: the estimation method, the adjusting factors, the time frame, and the point of view.[3,5–7]

#### 1. Estimation method

Two major estimation methods are used in COI studies: the human capital approach and the willingness-to-pay approach. These two methods generate results that are not comparable to each other, with willingness-to-pay estimates being normally higher than human capital estimates.[3]

**The human capital (HC) approach,** developed by Rice and colleagues,[8–12] estimates indirect costs associated with illness and premature death in terms of productivity losses (forgone income). This approach applies current average earnings by age and sex to lost market time and imputes the market value of time withdrawn. For example, the number of days lost from work (or unpaid work) is multiplied by the age- and sex-specific salary per day. The HC approach values earnings and housekeeping services, but excludes the costs associated with pain and suffering, leisure time, and volunteer work, the productivity of which is not reflected in earnings.

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**TABLE 1**
**Seven steps for comparing and combining results of cost-of-illness studies**

**Step 1: Identify the study design**
1. Estimation method
2. Adjusting factors
   - 2a. Discount rate for future income
   - 2b. Inflation rates for costs from past years
   - 2c. Weights for disability
3. Time frame
4. Point of view

**Step 2: Stratify according to the cost components**
1. Direct costs
2. Indirect costs
3. Intangible costs

**Step 3: Create concatenated cost components**

**Step 4: Adjust for inflation**

**Step 5: Adjust for population growth**

**Step 6: Compare cost estimates**

**Step 7: Combine cost estimates**

**TABLE 2**
**A checklist for identifying the design of cost-of-illness studies**

**1. What is the estimation method?**
[ ] The human capital approach
[ ] The willingness-to-pay approach
[ ] Other approaches
[ ] Do not know

**2. What are the adjusting factors?**
**a. What is the discount rate for future income?**
[ ] The discount rate is _____%
[ ] The discount rate is not used
[ ] Do not know

**b. Are consumer price indices used to inflate costs from past years?**
[ ] Yes
[ ] No
[ ] Do not know

**c. What are the weights for disability?**
[ ] The weights are _____
[ ] The weights are not used
[ ] Do not know

**3. What is the time frame?**
[ ] The prevalence-based model
[ ] The incidence-based model
[ ] Other time frames
[ ] Do not know

**4. What is the point of view?**
[ ] Society's viewpoint
[ ] Government's viewpoint
[ ] Other viewpoints
[ ] Do not know

**The willingness-to-pay (WTP) approach** considers the amount people are willing to pay to decrease their risk of injury, disease or death.[13,14] It is a method of evaluating costs by asking people (patients, families, experts) what they would be willing to pay to avoid a certain undesirable state. This approach is subjective and may be difficult to use when assessing the WTP in the elderly and children, due to the complexity of the questions asked.

## 2. Adjusting factors

Several adjusting factors are used in cost estimation: the discount rate for future income, inflation rates for past costs, and weights for partial income loss from disability.

### *2a. Discount rate for future income*

Future income losses are discounted to account for the fact that future income of $1 will be worth less than present income of $1, because the latter can be invested and increase in value over time.[7] The discount rate is not related to inflation, because even when there is zero inflation, a dollar received today will be worth more than a dollar received in the future.

Normally, **a discount rate**, or assumed rate of annual return on investments, of 5%[15] is used, but it can range from 2% to 10%.[4] Using a discount rate of 5%, for example, $105 received in the second year would be discounted to a present value of $100 in the first year. Different discount rates will lead to different cost estimates. The present value (PV) of a future value (FV) after t years, given an annual discount rate of r, is[15]

$$PV = FV\,[1/(1+r)^t].$$

### *2b. Inflation rates for costs from past years*

Cost data from past years could be inflated to the same base year value, using a **consumer price index (CPI).**[6,16,17] The base year value (BYV) of a past year value (PYV) is calculated from the base year CPI (BCPI) and the past year CPI (PCPI)[15]

$$BYV = PYV\,[BCPI/PCPI].$$

### *2c. Weights for disability*

For calculating the cost of disability, **weights** are used to adjust the daily income, since a day of disability does not necessarily mean that all activities are relinquished for that day. For each day of disability, only part of the daily income is lost due to a lower level of productivity. For example, the following weights for varying degrees of severity of disability are suggested by Wilkins and Adams:[18] Cannot do major activity (work, housework, school), 0.5; Restricted in major activity, 0.4; Restricted in minor activity, 0.3.

**TABLE 3**
**Step 1: Identifying the design of three cost-of-illness studies for cardiovascular disease in Canada**

| Canada, 1986<br>Wigle et al., 1990[2] | | Canada, 1993<br>Moore et al., 1997[3] | | Canada, 1994<br>Chan et al., 1996[4] | |
|---|---|---|---|---|---|
| **1. Estimation method** | | | | | |
| Human capital approach | | Human capital approach | | Human capital approach | |
| **2. Adjusting factors** | | | | | |
| **a. Discount rate for future income** | | | | | |
| 6% | | 6% | | 6% | |
| **b. Inflation rates for costs from past years** | | | | | |
| CPI* | | CPI | | CPI | |
| **c. Weights for disability** | | | | | |
| Lost major activity | 0.5 | Very severe | 0.8-1.0 | Lost major activity | 0.5 |
| Restricted major | 0.4 | Somewhat severe | 0.5 | Restricted major | 0.4 |
| Restricted minor | 0.3 | Major | 0.3 | | |
| | | Minor | 0.0-0.2 | | |
| **3. Time frame** | | | | | |
| Prevalence model | | Prevalence model | | Prevalence model | |
| **4. Point of view** | | | | | |
| Society's viewpoint | | Society's viewpoint | | Society's viewpoint | |

* CPI = consumer price index

### 3. Time frame

Different studies may consider different time frames for cost estimation: the annual time frame (prevalence-based) or the lifetime time frame (incidence-based). Because of the simpler data requirement, prevalence-based models have been more widely used than incidence-based ones.[5]

**The prevalence-based model** quantifies economic costs by measuring all costs due to illness occurring within a given time period, usually a single year, regardless of the time of disease onset.[3,5,8,9] The prevalence approach is good for measuring the effectiveness of cost control and how well health care expenditure targets are met.[3,19]

**The incidence-based model** quantifies the total lifetime costs of new cases of an illness with onset in the base year.[3,5,8] Since it estimates the costs of new cases of illness in the base year from the beginning to the end of the illness (cure or death), this model is computationally labour intensive. The incidence approach is good for predicting the future effects of changes in current illness patterns.[5]

### 4. Point of view

Different points of view (perspectives) can also lead to different cost estimates. Although there are several possible perspectives, it has been recommended that all cost-effectiveness, cost-benefit, and cost-utility studies should take the society's perspective.[7]

The **society's perspective** considers costs to all sectors of society. It has several characteristics. First, costs incurred by all sectors of society are included: individuals, employers, governments, the health care system, private health insurers, or shared arrangements between any of these sectors.[4,5] Second, since the costs reflect what members of society give up, they also include the loss of forgone productivity (i.e., earnings) due to illness and injury[7] or premature death.[5] Similarly, they include a value associated with the forfeiture of an individual's healthy time.[7] Third, the costs do not include transfer payments between parties within the society, such as social welfare payments, because these transfer payments only shift the burden from the individual to society and do not change the society's total resources.[3,5] Fourth, costs of administering transfer payments attributable to illness are included, because these administrative costs would not have been consumed in the absence of illness.[5]

The **government's perspective** considers costs to the government only, such as costs to the health care and justice systems.[5] It has several characteristics. First, it considers costs to all sectors of the government, such as the federal, provincial and territorial (or state), and local governments.[7] Second, transfers of funds from society to the individual, such as social welfare payments, pension, and workers' compensation, are included as costs.[3] Third, lost productivity due to illness, injury, and premature death are not considered costs to the government.[3]

There are other perspectives. The **health care providers' perspective** considers costs imposed on various types of hospitals, health maintenance organizations, and other health care providers.[7] The **business perspective** considers the impact of illnesses on health-related employee benefits.[7] The **individual's perspective** considers the out-of-pocket costs of illness.[7] From the individual's perspective, costs can be **internal** (costs borne by the individuals and possibly by their families, who are also affected by an illness) or **external** (costs borne by those who are not affected by the illness).[5]

After using the checklist in Table 2 to determine that the various cost estimates have been derived from studies of the same or similar design, one can then proceed to Step 2.

## *Step 2: Stratify according to the cost components*

Step 2 stratifies and examines cost estimates in the various cost-of-illness studies according to their cost components to find out what kinds of costs are included. Even though the studies may be of the same design, different cost components included in the studies will make the comparison invalid. Basically, there are three main categories of costs: direct, indirect and intangible.[3,5,6] Each category can be further subdivided into its cost components. Detailed lists of examples of direct, indirect

**TABLE 4**
**Step 2: Cost of cardiovascular diseases by cost component for Canada, 1986, 1993 and 1994 ($ million)**

| Cost component | Canada, 1986 Wigle et al., 1990[2] | Canada, 1993 Moore et al., 1997[3] | Canada, 1994 Chan et al., 1996[4] |
|---|---|---|---|
| **Direct costs** | | | |
| 1. Hospitals | 3,539 | 4,862 | 5,690 |
| 2. Other institutions | | | 784 |
| 3. Medical care | 621 | | |
| 4. Physicians | | 867 | |
| 5. Medical services | | | 1,138 |
| 6. Other professionals | | | 12 |
| 7. Drugs | 749 | 1,565 | 1,386 |
| 8. Research | 53 | 60 | 150 |
| 9. Pensions and benefits | 247 | | |
| 10. Other | | | 1,191 |
| **Total direct costs#** | **5,209** | **7,354** | **10,351** |
| **Indirect costs** | | | |
| 11. Short-term disability* | 163 | 425 | |
| 12. Chronic disability* | 3,306 | | |
| 13. Long-term disability* | | 4,502 | |
| 14. Disability | | | 1,817 |
| 15. Premature mortality | 8,168 | 7,440 | 5,793 |
| **Total indirect costs#** | **11,637** | **12,367** | **7,610** |
| **Total costs#** | **16,846** | **19,721** | **17,961** |

\# Totals may not add up due to rounding.

* Short-term and chronic long-term disability costs are mutually exclusive.

and intangible costs have been provided elsewhere.[5,13]

**Direct costs** are the resources expended for prevention activities or health care.[1] These include hospitals and other health care institutions, physicians and other health care professionals, drugs and appliances, health science research, administration, and other related health care expenditures.[3,4,20] Direct costs may include labour, such as that of health professionals and support staff, as well as capital, such as equipment, buildings, supplies, utilities and land.[4]

**Indirect costs** are the resources forgone as the result of a health condition.[1] They are related to lost productivity due to disability and premature mortality, causing absence from work or non-market activities.[4,6] Non-market activities such as housekeeping are sometimes omitted from analyses, or sometimes evaluated as a certain percent of the value of market activity.[6]

**Intangible costs** are costs of pain, suffering, anxiety, grief and loss of leisure time, for which a monetary value is assigned.[5,6,13] Intangible costs are normally estimated by the willingness-to-pay (WTP) approach.

### *Step 3: Create concatenated cost components*

Once the cost components are identified, the next step is to create a uniform, mutually exclusive list of concatenated cost components for the various cost-of-illness studies, and recalculate or discard cost values if necessary. This is based on a detailed analysis of the list of cost components by cost categories (direct, indirect, and intangible) carried out for the various COI studies in Step 2. The costs that are included or excluded in each cost component in each COI study must be specified. A uniform, mutually exclusive list of cost components can be created for the various COI studies by concatenation, i.e., linking together similar cost components in different COI studies. As this is a key component in preparing the data for the comparison process, care must be used to ensure that this step is as objective as possible.

### *Step 4: Adjust for inflation*

If the costs being compared are not from the same year, or if several cost estimates from the same study year are used to provide a cost estimate for a different target year, there is a need to inflate or deflate cost estimates from various years to a constant year level to make them comparable. For example, when various COI studies were done for different years, the cost estimates needed to be inflated or deflated, using CPI, to a constant year level to adjust for inflation. When the costs being compared are for the same year, there is no need to inflate. However, if several studies for the same year are used to provide the best estimate for another year of interest, cost estimates must be inflated or deflated to that year. (This article does not deal with COI studies that are conducted in different countries with different currencies, in which case the questions of differential inflationary processes and money exchange fluctuations must be addressed.)

### *Step 5: Adjust for population growth*

Besides inflation, another factor that affects valid comparison of cost estimates is population growth over the years. The per capita cost for each cost component, and the per capita cost for all cost components for the various COI studies can be estimated by applying the total populations in those study years.

### *Step 6: Compare cost estimates*

At this step, once the per capita and total costs of illness at the constant year level are calculated, the cost figures are directly comparable because they have been ad-

**TABLE 5**
**Step 3: Cost of cardiovascular diseases by concatenated cost component for Canada, 1986, 1993 and 1994 ($ million)**

| Cost component | Canada, 1986 Wigle et al., 1990[2] | Canada, 1993 Moore et al., 1997[3] | Canada, 1994 Chan et al., 1996[4] |
|---|---|---|---|
| **Direct costs** | | | |
| 1. Hospitals | 3,539 | 4,862 | 5,690 |
| 2. Other institutions | | | 784 |
| 3. Physicians | 621 | 867 | 1,138 |
| 4. Other professionals | | | 12 |
| 5. Drugs | 749 | 1,565 | 1,386 |
| 6. Research | 53 | 60 | 150 |
| 7. Other | | | 1,191 |
| **Total direct costs#** | 4,962 | 7,354 | 10,351 |
| **Indirect costs** | | | |
| 8. Short-term disability | 163 | 425 | |
| 9. Long-term disability | 3,306 | 4,502 | |
| 10. Disability | | | 2,341* |
| 11. Premature mortality | 8,168 | 7,440 | 6,642* |
| **Total indirect costs#** | **11,637** | **12,367** | **8,984*** |
| **Total costs#** | **16,599** | **19,721** | **19,335*** |

# Totals may not add up due to rounding.

* These revised figures are based on the Disability Survey Method, which is the same method used in the other two studies. The figures in Table 4, based on the baseline estimates reported in Chan et al., 1996, were derived from the average of estimates from the Disability Survey Method and the Disability Insurance Payment Method.

justed for inflation and population growth over the years. Graphical or other methods, such as regression, can be used to compare and determine whether the inflation-adjusted and population-adjusted cost estimates from various studies are reasonably homogenous and consistent.

### *Step 7: Combine cost estimates*

When it is considered that the constant-dollar per capita cost estimates for some cost components are reasonably homogenous and consistent over the years, the cost estimates from several COI studies can be combined by taking the average to provide the best estimate of the per capita costs for those cost components for a target year. However, when a time trend is detected over the years for the constant-dollar per capita cost estimates for some other cost components, regression methods should be used to estimate the per capita costs for those other cost components for a target year. The total costs for each cost component for the target year can be calculated by applying the total population size in the target year.

## An example from cardiovascular disease

In a literature review, three cost-of-illness studies were identified for cardiovascular disease in Canada: for the years 1986,[2] 1993,[3] and 1994.[4] It was desirable to compare the cost estimates to see if there is any time trend and to combine the cost estimates from the various studies to obtain the best estimate of the cost of cardiovascular disease in Canada for the most recent year for which data are available.

### *Step 1: Identify the Study Design*

Table 2 was used to help identify the study designs of the three COI studies for cardiovascular disease in Canada. All three studies used the human capital approach, discount rate of 6%, inflation based on CPI, prevalence model, and the society's viewpoint. Although the weights for disability were somewhat different (Table 3), the three studies were considered to be generally similar in their design.

### *Step 2: Stratify according to the cost components*

Cost components considered in the three COI studies were first listed in a tabular form (Table 4), and their definitions examined in detail (Appendix). It was found that some of the cost components, although given a different name in each study, in fact referred to the same cost. For example, in the three studies, "medical care", "physicians", and "medical services" referred to the same cost component, i.e., physician and related medical services. In two studies, "chronic disability" and "long-term disability" were found to mean the same thing. One study included cost components that were not considered by the other two studies: "other institutions", "other professionals", and "other direct costs". However, this study provided only one overall disability cost component, and failed to differentiate between short-term and long-term disability. Through stratification, some inconsistencies in cost components were identified.

### *Step 3: Create concatenated cost components*

A new, uniform, mutually exclusive list of cost components was created by concatenation (Table 5). Non-mutually exclusive cost components from the three studies were classified together by creating a uniform cost component called "physicians" to represent "medical care", "physicians", and "medical services" from the three studies. Cost components that should not be included in a COI study with the society's viewpoint, such as pensions and benefits, were discarded, because the society's viewpoint does not consider transfer payments between sectors within the society as real costs. Some cost values were recalculated from the published data to ensure that they were comparable to the cost values in the other studies for the same cost component. For example, the baseline estimates for dis-

**TABLE 6**

**Step 4: Cost of cardiovascular diseases by concatenated cost component for Canada, 1986, 1993 and 1994 in 2000 Canadian constant dollars ($ million)***

| Cost component | Canada, 1986 Wigle et al., 1990[2] | Canada, 1993 Moore et al., 1997[3] | Canada, 1994 Chan et al., 1996[4] |
|---|---|---|---|
| **Direct costs** | | | |
| 1. Hospitals | 5,214 | 5,373 | 6,176 |
| 2. Other institutions | | | 851 |
| 3. Physicians | 915 | 958 | 1,235 |
| 4. Other professionals | | | 13 |
| 5. Drugs | 1,104 | 1,729 | 1,505 |
| 6. Research | 78 | 66 | 163 |
| 7. Other | | | 1,293 |
| **Total direct costs#** | **7,311** | **8,126** | **11,236** |
| **Indirect costs** | | | |
| 8. Short-term disability | 240 | 470 | |
| 9. Long-term disability | 4,871 | 4,975 | |
| 10. Disability | | | 2,541 |
| 11. Premature mortality | 12,034 | 8,221 | 7,210 |
| **Total indirect costs#** | **17,145** | **13,666** | **9,752** |
| **Total costs#** | **24,455** | **21,792** | **20,988** |

* Canadian dollars are inflated to 2000 dollar level by consumer price indices. The inflators are for 1986 dollars, 1.4733; 1993 dollars, 1.1050; and 1994 dollars, 1.0855.

\# Totals may not add up due to rounding.

ability and premature mortality reported in one study[4] were based on the average of estimates from the Disability Survey Method and the Disability Insurance Payment Method. Since the Disability Survey Method was used in the other two studies,[2,3] the cost values were recalculated for this study to make them comparable to the other two (Table 5). In cases where recalculation was not possible, some cost values had to be discarded from the comparison. Disability costs, for example, were not separated into short-term disability and long-term disability in one study[4] and therefore could not be used for comparison with the values from the other two studies.[2,3]

## Step 4: Adjust for inflation

Because the three COI studies reported cost estimates for Canada for different years, namely 1986, 1993, and 1994, the figures were inflated by applying an inflator based on CPI for the various years to the 2000 Canadian constant dollar level (Table 6). For example, $3,539 million (Table 5, column 1) × 1.4733 (Table 6, inflator in footnote) = $5,214 million (Table 6, column 1).

## Step 5: Adjust for population growth

The per capita cost for each cost component, and the per capita cost for all cost components, for Canada for 1986, 1993 and 1994, were calculated based on the total Canadian population in those years (Table 7, columns 1–3). For example, $5,214 million (Table 6, column 1) / 26.2 million (Table 7, population size in footnote) = $199.01/person (Table 7, column 1).

## Step 6: Compare cost estimates

These figures (Table 7, columns 1–3) are now directly comparable because they are based on the 2000 constant dollar level and have been adjusted for population growth over the years. The per capita costs are fairly constant, in terms of 2000 Canadian constant dollars, for Canada for 1986, 1993 and 1994 (Figure 1). (In Figure 1, a logarithmic scale for per capita cost is preferred to a linear scale to show percentage change rather than absolute change.) The total direct costs also remain fairly constant with time. The only exception is perhaps premature mortality, the per capita cost estimate of which is higher in 1986 than in 1993 or 1994, in 2000 constant dollars. This results in a decrease of the total indirect costs, and therefore the total costs, over time.

Linear regression (SPSS "Linear Regression" procedure)[24] was used to confirm whether the apparent cost of premature mortality for the three studies has fallen from 1986 to 1993 to 1994. Results of the regression analysis indicated that costs of hospitals, physicians, drugs and research were homogenous and consistent over the study years, but that the cost of premature mortality dropped significantly over time ($p = 0.033$) (Table 8).

## Step 7: Combine cost estimates

For those per capita cost estimates that were considered reasonably homogenous and consistent over the years, estimates were averaged for 1986, 1993 and 1994 to provide the best estimate of the per capita costs for 2000 (Table 7, column 4). For example, for direct costs for hospitals, ($199.01 + $185.92 + $211.51)/3 = $198.81. For premature mortality, the per capita cost for 2000 was estimated by projection based on regression results. For example, from Table 8, $52,037.024 + 2000(–$25.97 /year) = $97.02 (Table 7, column 4). By adding up the cost estimates for direct and indirect costs, the cost of CVD for Canada in 2000 was estimated to be $653.02 per person (Table 7, column 4). The total per capita cost of $653.02 was not obtained by averaging the three study total costs of $933.40, $754.05 and $718.77 (which would have given $802.07), or by regression analysis of those three total costs (which would have given $564.51), but by adding up the cost values in column 4. In this way the cost estimate is more complete because two studies[2,3] did not provide cost estimates for cost components such as other institutions, other profes-

**TABLE 7**

**Steps 5, 6, 7: Per capita and total cost of cardiovascular diseases by concatenated cost component for Canada, 1986, 1993, 1994 and 2000 (estimated) in 2000 Canadian constant dollars[@]**

| Cost component | Canada, 1986 per capita cost ($) Wigle et al., 1990[2] | Canada, 1993 per capita cost ($) Moore et al., 1997[3] | Canada, 1994 per capita cost ($) Chan et al., 1996[4] | Canada, 2000 per capita cost ($) (estimated) | Canada, 2000 total cost ($ million) (estimated)^ |
|---|---|---|---|---|---|
| **Direct costs** | | | | | |
| 1. Hospitals | 199.01 | 185.92 | 211.51 | 198.81* | 6,123 |
| 2. Other institutions | | | 29.14 | 29.14 | 898 |
| 3. Physicians | 34.92 | 33.15 | 42.29 | 36.79* | 1,133 |
| 4. Other professionals | | | 0.45 | 0.45 | 14 |
| 5. Drugs | 42.14 | 59.83 | 51.54 | 51.17* | 1,576 |
| 6. Research | 2.98 | 2.28 | 5.58 | 3.61* | 111 |
| 7. Other | | | 44.28 | 44.28 | 1,364 |
| **Total direct costs** | **279.05** | **281.18** | **384.79** | **364.25** | **11,219** |
| **Indirect costs** | | | | | |
| 8. Short-term disability | 9.16 | 16.26 | | 12.71* | 391 |
| 9. Long-term disability | 185.92 | 172.15 | | 179.04* | 5,514 |
| 10. Disability[&] | | | 87.02 | – | – |
| 11. Premature mortality | 459.31 | 284.46 | 246.92 | 97.02** | 2,988 |
| **Total indirect costs** | **654.39** | **472.87** | **333.97** | **288.77** | **8,894** |
| **Total costs** | **933.40** | **754.05** | **718.77** | **653.02** | **20,113** |

@ Canadian population in 1986, 26.2 million; 1993, 28.9 million; 1994, 29.2 million; 2000, 30.8 million.

* Estimated by taking the average of cost estimates from the three previous studies.

** Estimated by projection by linear regression based on cost estimates from the three previous studies.

^ Estimated by multiplying the per capita cost with the total population size in 1998.

& The Chan et al., 1996 study was excluded from the estimate for lack of data by short-term and long-term disability.

sionals, and other costs, as did one study.[4] In the calculations, a decision was made to use the short-term disability and long-term disability estimates from two studies[2,3] and to discard the disability estimate from one study.[4] Besides being more complete, the cost estimate is more accurate as regression showed a significant time trend in only one cost component and not in the others.

The total costs for each cost component for 2000 (Table 7, column 5) were calculated by applying the total Canadian population in 2000. For example, for direct costs for hospitals, $198.81/person (Table 7, column 4) × 30.8 million (Table 7, population size in footnote) = $6,123 million (Table 7, column 5). The total cost of CVD for Canada in 2000 was estimated to be $20,113 million, in 2000 dollars (Table 7, column 5).

## Discussion

Cost-of-illness (COI) studies are frequently conducted to estimate direct costs associated with an illness, and indirect costs associated with lost productivity due to morbidity or premature mortality. Economic costs of illnesses are important information for public health decisions. However, available economic cost estimates quickly become out of date, and updating economic costs often calls for a new study which is tedious and time-consuming. In addition, the newly conducted study may suffer from limitations such as the unavailability of data for certain cost components for the target year of interest. Estimation of COI based on multiple published studies proves to be more efficient and more stable than conducting a new study.

This paper describes a method for comparing and combining various COI studies conducted in a single year or multiple years, within the same or different geographical locations using the same currency. The method can also be used to provide the best cost estimate for a target year, based on cost estimates from previously published studies.

The proposed method is sophisticated yet simple to use. The input requirements to the method are minimal, including only the cost estimates from previously published COI studies, the consumer price indices for the period from the various study years to the target year, and the population sizes in the study years and in the target year.

By applying this method, investigators are able to calculate the best estimate of costs of illness based on currently existing, avail-

**FIGURE 1**
**A comparison of per capita cost (in 2000 Canadian constant dollars), by cost component, of cardiovascular disease in three Canadian cost-of-illness studies**

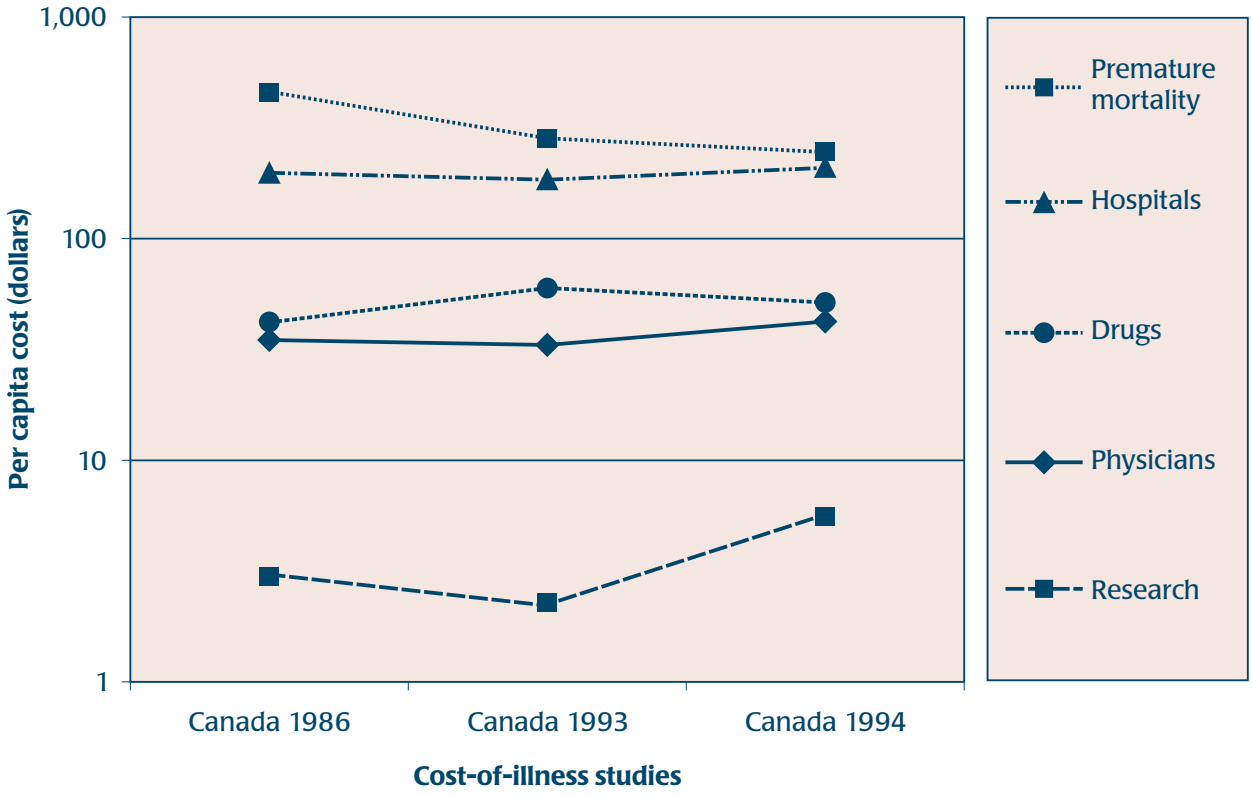


**TABLE 8**
**Univariate linear regression models for various costs based on calendar year, using cost of cardiovascular disease data for Canada in 1986, 1993 and 1994***

| Dependent variable | Constant | Regression coefficient for year | p-value | Model goodness-of-fit $R^2$ |
|---|---|---|---|---|
| **Direct costs** | | | | |
| 1. Hospitals | -394.295 | 0.298 | 0.935 | 0.010 |
| 2. Other institutions | NE# | NE | NE | NE |
| 3. Physicians | -936.184 | 0.489 | 0.710 | 0.193 |
| 4. Other professionals | NE | NE | NE | NE |
| 5. Drugs | -3280.087 | 1.673 | 0.383 | 0.679 |
| 6. Research | -331.713 | 0.168 | 0.723 | 0.178 |
| 7. Other | NE | NE | NE | NE |
| **Indirect costs** | | | | |
| 8. Short-term disability | -2005.211 | 1.014 | NE | NE |
| 9. Long-term disability | 4092.666 | -1.967 | NE | NE |
| 10. Disability | NE | NE | NE | NE |
| 11. Premature mortality | 52037.024 | -25.970 | 0.033 | 0.997 |

* Based on SPSS "Linear Regression" procedure.[22]

\# NE, not estimable

able data. The use of this method is demonstrated in this paper with an example from cardiovascular disease. In this example, three COI studies, which were conducted in Canada in three different years, 1986, 1993 and 1994, were compared and combined to produce the best estimate for the per capita cost of cardiovascular disease for Canada, 2000.

A major concern in the combination of COI estimates derived across studies and in particular across time into single cost estimates at some future time is the possibility of changes in the component costs over time. This concern is directly addressed in the proposed method by using regression analysis to model the changes in the cost components. The method therefore contributes to a sophisticated projection of cost information from multiple COI studies.

The proposed method is limited to geographical regions that use the same currency, such as Canada. It does not deal with COI studies that are conducted in different geographical regions (or countries) with different currencies. In the future, the method needs to be adapted to address the questions of differential inflationary processes and money exchange fluctuations.

## Acknowledgments

The authors would like to acknowledge Richard Lemay and Rachel Moore's thoughtful comments and suggestions.

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## APPENDIX

### Details of the cost components of three cost-of-illness studies for cardiovascular disease (CVD) in Canada

| Canada, 1986<br>Wigle et al., 1990[2] | Canada, 1993<br>Moore et al., 1997[3] | Canada, 1994<br>Chan et al., 1996[4] |
|---|---|---|
| **Direct costs** | | |
| **1. Hospitals** | | |
| Hospital care expenditure. Excluded cost of hospital-supplied drugs. | National hospital expenditure, for acute care, long-term care, and psychiatric hospitals. Included the costs of operating and maintaining the reporting public hospital during the year (e.g. gross salaries and wages covering all medical staff remuneration, employee benefits, supplies and other expenses). | Included ward costs, procedures, supplies, diagnostic tests, drugs, administration for general hospitals, specialty hospitals, pediatric hospitals, psychiatric hospitals, rehabilitation centres, extended care, and remote outposts. Included capital expenditures. |
| **2. Other institutions** | | |
| Not considered. | Not considered because it was unable to estimate costs by diagnostic category. | Included homes for the aged and nursing homes. |
| **3. Medical care/ 4. Physicians/ 5. Medical services** | | |
| [Labelled "Medical care"]. Cost of medical services provided by physicians. Included general medical examinations and special investigations. | [Labelled "Physicians"]. National physician care expenditure. Included professional fees paid by provincial medical care insurance plans, physicians' salaries and contractual professional incomes, fee payments by workers' compensation boards, and direct expenditures by federal agencies and private sector payments for physicians' services not covered by provincial plans. Excluded physicians on hospital, public health agency payrolls, etc. | [Labelled "Medical services"]. Included physician services, laboratory services, and diagnostic procedures. |
| **6. Other professionals** | | |
| Not considered. | Not considered. | Included private nursing, and physiotherapy. |
| **7. Drugs** | | |
| Included cost of drugs distributed to the Canadian consumer through drugstores and hospitals for treatment of CVD. | Included prescription drugs, non-prescription drugs, personal health supplies bought in retail stores and prescription drugs purchased for hospital use. | Included out-patient prescription drugs, and professional (dispensing) fees. |
| **8. Research** | | |
| Health science research. | Health science research. Included basic research (e.g., metabolism, immunology) and other non-disease areas of health science research (e.g., medical history, equipment grants). | Included federal and provincial sources, granting agencies, nonprofit groups, post-secondary institutions, and foreign sources. |
| **9. Pensions and benefits** | | |
| Pensions are net payments for disability pensions from the Canada Pension Plan (CPP) and the Quebec Pension Plan (QPP). Benefits included employment insurance health-related benefits, and workers' compensation expenditure on temporary disability, worker pensions and fatal benefits; but excluded money spent on workers' compensation health care benefits. | Not considered, because these are transfer payments which should not be regarded as direct costs. Including them will lead to double counting since both the individual's lost productivity and reallocation of resources used to compensate the loss are counted. | Not considered. |

**APPENDIX *(continued)***

**Details of the cost components of three cost-of-illness studies for cardiovascular disease (CVD) in Canada**

| Canada, 1986<br>Wigle et al., 1990[2] | Canada, 1993<br>Moore et al., 1997[3] | Canada, 1994<br>Chan et al., 1996[4] |
|---|---|---|
| **10. Other** | | |
| Not considered. | Not considered because data are unavailable. | Included home care, ambulances, home appliances, public health, administration, miscellaneous. |
| **Indirect costs** | | |
| **11. Short-term disability** | | |
| Short-term disability as measured in terms of the Canada Health Survey,[21] which reported short-term disability during the two weeks prior to interview. Included all types of activity limitation (in or out of the labour force). Weights for loss of productivity for short-term disability: restricted in major activity (0.4); restricted in minor activity (0.3). | Lost productivity due to short-term disability based on 1994 National Population Health Survey[22] definitions. Weights for loss of productivity for short-term disability: days in bed (0.8–1.0); days of reduced major activity (0.5). | Not considered separately. |
| **12. Chronic disability/ 13. Long-term disability** | | |
| [Labelled "Chronic disability"]. Loss of productivity caused by chronic (long-term) disability. The measure of chronic disability was an inability or a restricted ability to perform a major or minor activity based on the Canada Health Survey[21]. Included any activity limitation, rather than just restricted labour force participation. Weights for loss of productivity for chronic disability: cannot do major activity (0.5); restricted in major activity (0.4); restricted in minor activity (0.3). | [Labelled "Long-term disability"]. Lost productivity due to long-term disability based on 1994 National Population Health Survey[22] definitions. Included both psychiatric hospitals and institutionalized population. Weights for loss of productivity for long-term disability: very severe (0.8–1.0); somewhat severe (0.5); somewhat major in household or minor in institution (0.3); minor in household (0.0–0.2). | Not considered. |
| **14. Disability** | | |
| Not considered in this manner. | Not considered in this manner. | Included both short-term and long-term disability. Based on the 1991 Ontario Health Survey[23] projected to the Canadian population, with 0.6 weight adjustment for household labour. Weights for loss of productivity: cannot do major activity (0.5); restricted in major activity (0.4). (The estimate from disability insurance payment method is not used here because it is not comparable to the methodologies used in the other 2 studies.) |
| **15. Premature mortality** | | |
| The present value of future income lost due to premature mortality. Included those in and those out of the labour force at the time of death. Discount rate of 6% per year for future earnings. | The present value of lost productivity due to premature mortality. Included loss of labour force and unpaid work resulting from premature mortality. Employment income refers to total income received by persons 15 years of age and over during 1993 as wages and salaries, net income from unincorporated non-farm business and/or professional practice, and net farm self-employment income. | Average forgone earned income due to premature mortaltiy, with 0.6 weight adjustment for household labour. Excluded transfer payments and investment income. A discount rate, or assumed rate of return on investments, of 6% was used. |

# Cancer incidence in young adults in Canada: preliminary results of a cancer surveillance project

*Loraine D Marrett, Jennifer Frood, Diane Nishri, Anne-Marie Ugnat and the Cancer in Young Adults in Canada (CYAC) Working Group*

## Abstract

*Surveillance of cancer in young adults has been neglected, despite Sir Richard Doll's having emphasized its importance a decade ago. This report describes the patterns, time trends and regional variation in cancer incidence in Canada's young adults. In 1987–1996, 97,469 cancers were diagnosed in Canadians aged 20–44, with almost two-thirds in females. Ten types of cancer accounted for 83% of diagnoses in women and 74% in men. The most common cancers in young women were breast, cervix, melanoma, thyroid and ovary, and in young men were testis, non-Hodgkin's lymphoma, melanoma, colorectal and lung. Although incidence rose only slightly for total cancer between 1969 and 1996, it increased dramatically for several specific types of cancer: lung (women), melanoma, testis, thyroid and non-Hodgkin's lymphoma. Incidence declined for a few cancers (colorectal, lung (men), cervix and ovary). Lung cancer incidence was significantly lower than the Canadian average in Prairie women and non-significantly high in Quebec (both sexes), while the rate of melanoma was significantly low in Quebec (both sexes) and high in women in the Pacific region.*

***Key Words:*** *incidence; neoplasms; surveillance; time trends*

## Introduction

Although a diagnosis of cancer in young adulthood (ages 20–44 years) is a relatively rare event, the consequences of such a diagnosis are great: at the time they are diagnosed with cancer, these individuals have most of their potential years of life ahead of them, and so may either spend decades living with the effects (physical, reproductive, social, emotional and spiritual) of cancer diagnosis and treatment or have tragically shortened lives, with major repercussions on their families and on society in general.

Surveillance of cancer patterns and trends in young adults has been neglected, despite considerable surveillance activity in both children and the population as a whole. Sir Richard Doll, in his plenary address at the meeting of the Society for Epidemiologic Research in Buffalo, New York in 1991, emphasized the importance of surveillance in this age group:

> "The trends in young adults are, I suggest, by far the most important for assessing our progress against cancer for two reasons. First, because the trends can reflect only relatively recent changes in the prevalence of carcinogenic agents and are not confused by the effects of changes in the distant past and, second, because young people tend to adopt new habits before the old."[1]

This report presents preliminary data from a project being undertaken by the Cancer in Young Adults in Canada (CYAC) Working Group (members are listed in the Appendix). The main purpose of the project is to describe cancer patterns in those aged 20–44 in Canada, including identification of the most common forms of cancer and description of the trends over time and regional variation in the incidence of these common cancers.

## Materials and methods

### Materials

Cancer incidence data for the period 1969–1996 were obtained from Health Canada. These data originate with the provincial and territorial cancer registries, but have been provided to Statistics Canada to form the National Cancer Incidence Reporting System (1969–1991) and the Canadian Cancer Registry (1992–1996).[2] Data in the Canadian Cancer Registry are internally linked at Statistics Canada so that patients registered with the same diagnosis in more than one province are counted only once. Health Canada receives a copy of this file without nominal information.

Health Canada provided frequencies by year of diagnosis, sex, five-year age group at diagnosis, region and type of cancer for those aged 20–44 at diagnosis. Cancer type is coded according to the 9th Revision of the International Classification of Diseases (ICD-9).[3] (Note that non-melanoma skin cancers, ICD-9 code 173, are not included.) Canada has been divided into six regions: Pacific (British Columbia); Prairie (Alberta, Saskatchewan, Manitoba); Ontario; Quebec; Atlantic (Nova Scotia, New Brunswick, Prince Edward Island, Newfoundland); and North (Northwest Territories and Nunavut, Yukon). Health Canada also provided corresponding population data.[4]

**Author References**

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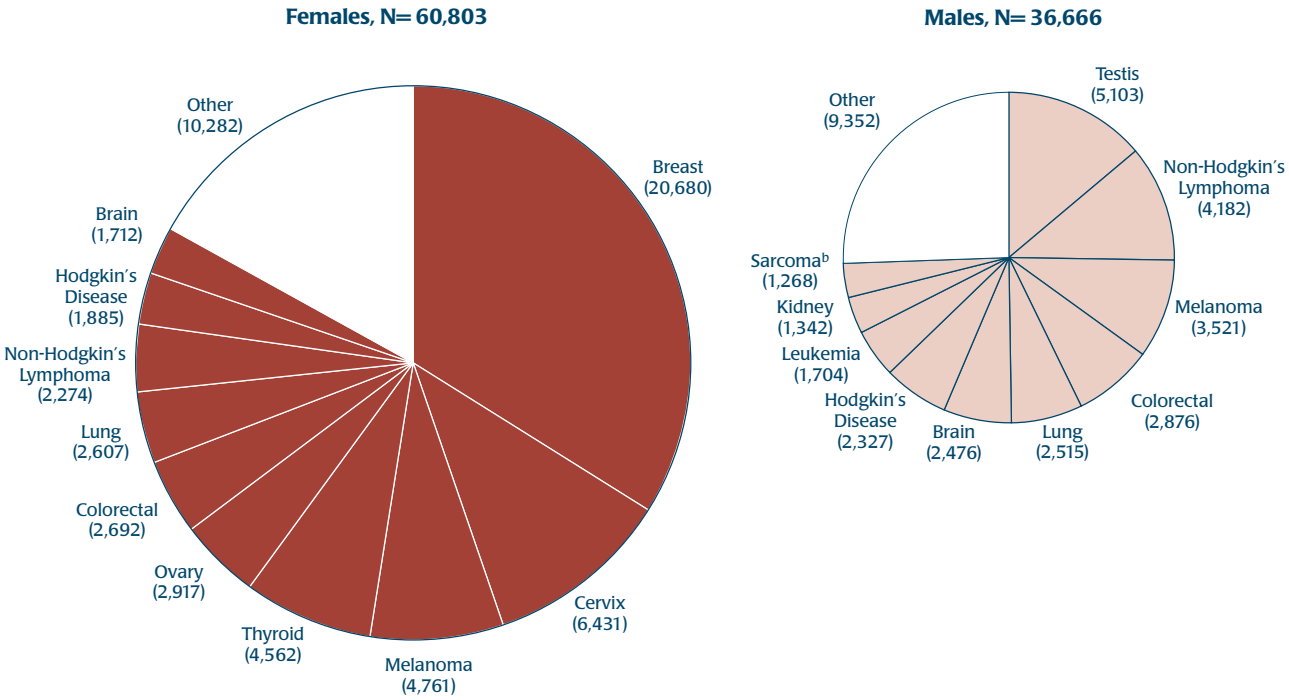
**FIGURE 1**
**Frequencies for the 10 most common cancers in young adults (ages 20–44), by sex, Canada, 1987–1996[a]**




[a] Non-melanoma skin cancers not included. Surface areas of circles are proportional to the numbers of cancers.

[b] Bone and connective tissue.

## *Methods*

Cancer types for each sex were ranked on the basis of the number of cases diagnosed during the most recent 10-year period, 1987–1996. Those occurring most frequently were included in more detailed analyses.

Incidence rates were age-standardized in five-year age groups (20–24, 25–29, 30–34, 35–39, and 40–44) to the age distribution of the 1991 Canadian population.[5] Trends in incidence rates over the 28-year period 1969–1996 were examined for all of Canada by sex for total cancer, all types of cancer affecting both sexes (total cancer minus reproductive and male and female breast cancers), and each of the most common cancer types. In order to estimate the average annual percent change (AAPC), the logarithm of the annual age-standardized rate was modelled as a function of the year of diagnosis using linear regression and SAS PROCs REG and GLM.[6] Both linear and quadratic terms were included in the initial model. If the quadratic term was non-significant ($p > 0.05$), the linear model was assumed to be adequate and the AAPC was estimated by the formula AAPC = (exp(beta)-1) * 100; 95% confidence limits were likewise calculated by transforming the confidence limits for the estimated slope. When a significant quadratic term suggested that the trend over time was not linear, the AAPC was not estimated. Trends were displayed graphically using three-year moving average rates.

Regional variation in incidence was examined by calculating age-standardized rates by sex, cancer type and region for the period 1987–1996. A regional rate was considered significantly different from that for all provinces and territories combined if its 95% confidence interval (calculated using a binomial approximation) excluded the all-Canada rate. Except for total cancer, the North was excluded from the regional analysis because of small numbers for many of the cancer types; the North reported only 270 cancers diagnosed in young adults in this decade.

# Results

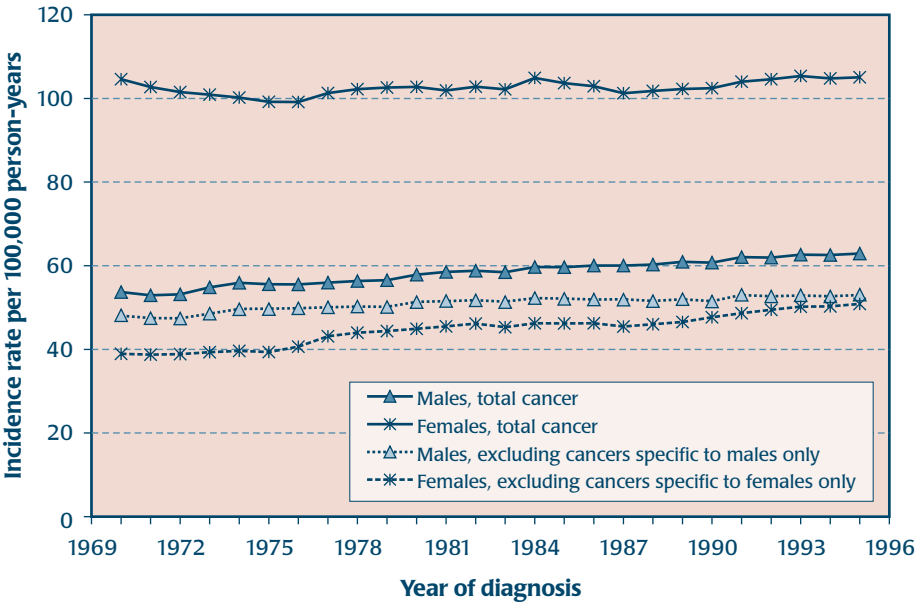
## *Common cancers*

Between 1987 and 1996, 97,469 cancers were diagnosed in young adults. Cancer occurred about twice as often in women as in men aged 20–44: there were 60,803 cancers diagnosed in young adult women and 36,666 in young adult men (Figure 1). Restricted to those cancers that can occur in both sexes (i.e., excluding cancers of the reproductive system and of the female breast), the numbers were closer, with a slight excess of men (28,426 women; 31,165 men).

The most common cancers for each sex are also shown in Figure 1. Ten types accounted for 83% of the cancers in young women and 74% of those in young men. The female breast was by far the most common site of cancer (n = 20,680), representing 21% of the cancers diagnosed in both sexes combined and 34% of cancers in women.

Several of the other top-ranked cancers arose in the reproductive system: cervix

**FIGURE 2**
**Age-standardized[a] three-year moving average incidence rate for total cancer[b] and total cancer excluding types specific to one sex only, in young adults (ages 20–44), by sex, Canada 1969–1996**




[a] Standardized to the 1991 Canadian population age distribution.

[b] Excludes non-melanoma skin cancers.

**TABLE 1**
**Estimated average annual percent change (95% confidence limits) in incidence rate in young adults (ages 20–44), by sex and cancer type, Canada, 1969–1996**

| | Males | Females |
|---|---|---|
| Total cancer[a] | 0.66 (0.55, 0.78) | NL[b] |
| Total cancer, excluding types specific to one sex | 0.56 (0.37, 0.75) | 1.23 (1.05, 1.41) |
| Colorectal | −0.43 (−0.77, −0.08) | −1.39 (−1.69, −1.08) |
| Lung | −0.94 (−1.32, −0.55) | NL↑ |
| Melanoma | NL↑ | NL↑ |
| Breast | – | NL |
| Cervix | – | NL↓ |
| Ovary | – | −0.82 (−1.16, −0.47) |
| Testis | 2.73 (2.36, 3.10) | – |
| Thyroid | 2.83 (2.05, 3.61) | NL↑ |
| Non-Hodgkin's lymphoma | 3.69 (3.30, 4.08) | 2.68 (2.16, 3.20) |

[a] Non-melanoma skin cancers not included.

[b] NL indicates that the best-fitting line is non-linear. An arrow following NL indicates the direction of the dominant trend, where one is clearly evident.

and ovary (ranks 2 and 5 respectively) in women and testis (rank 1 in men). Although the ranks differed between sexes, some cancers were common in both men and women: non-Hodgkin's lymphoma, melanoma, Hodgkin's disease, and cancers of the colorectum, lung and brain. Thyroid cancer was much more common in women (n = 4,562) than in men (n = 1,206, not shown).

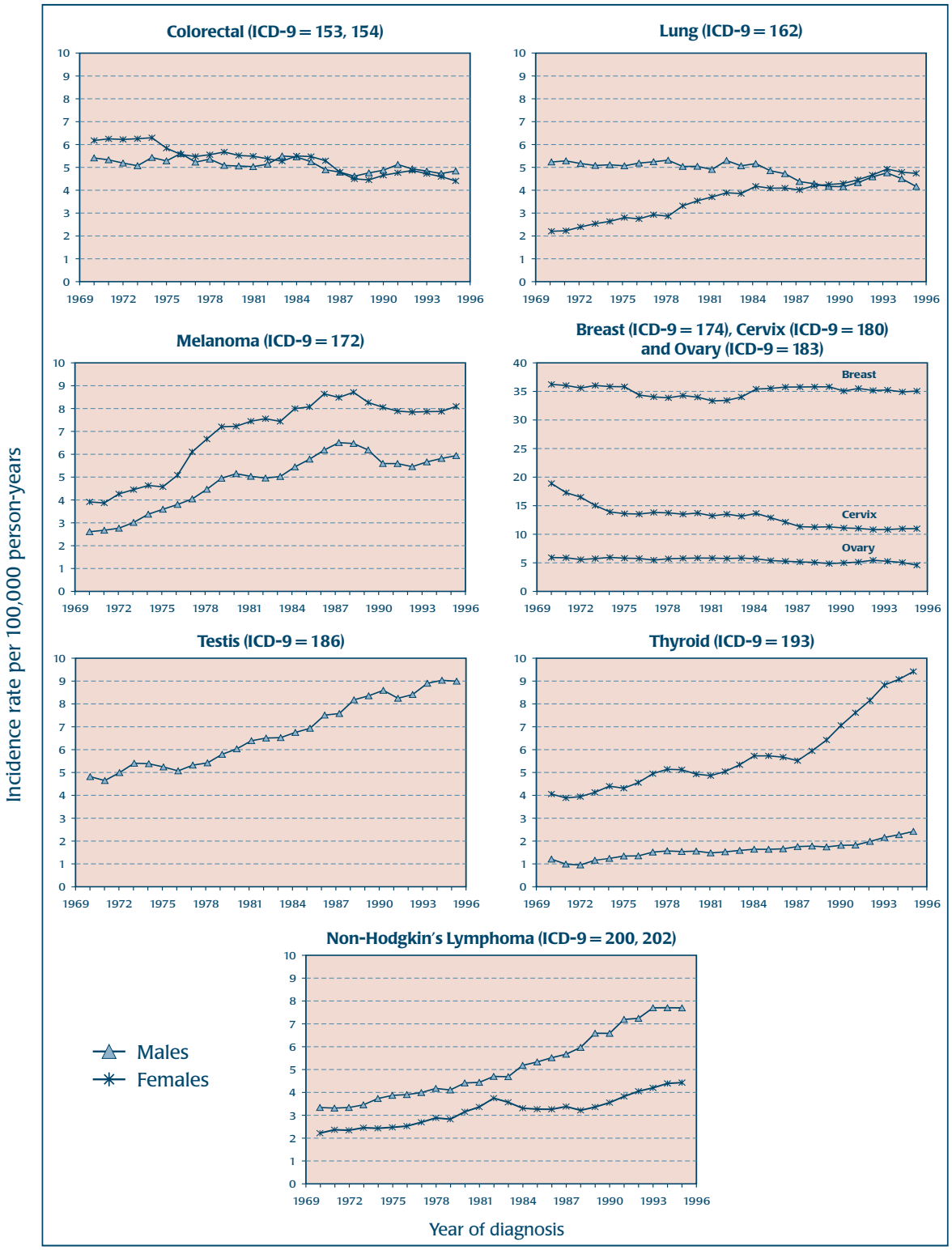
## *Trends over time*

Cancer incidence increased slightly over the period 1969–1996 in both young men (0.66% per year) and young women (non-linear trend) (Figure 2 and Table 1). The consistent and substantial female excess for total cancer is evident in Figure 2. However, when limited to cancers that can occur in both sexes, rates were similar for men and women although there was a slight excess in men. Rates have been increasing significantly for this subgroup of cancer types (0.56% per annum in males and 1.23% in women).

Figure 3 presents trends for the most common cancers, while Table 1 shows the results of the regression analysis. Perhaps the most striking feature of these trends is the strong increase evident for a number of cancers. The increase was linear and more than 2% per year for testicular cancer (2.73% per year); thyroid cancer in men (2.83% per annum); and non-Hodgkin's lymphoma in both sexes (3.69% in men and 2.68% in women, per annum). For some additional types of cancer, substantial increases occurred over the time period (Figure 3: lung, women; melanoma, both sexes; thyroid, women) but because the rate of change was not consistent over time, a single AAPC could not adequately summarize the trend. Of these, it is encouraging to note that recent melanoma trends are either flat or downward and that the increase in lung cancer incidence in women has slowed in recent years. Significant linear decreases occurred for colorectal cancer (both sexes), lung cancer (men only) and cancer of the ovary, although a downward trend is also evident for cervical cancer (non-linear because of a recent slowing in the rate of decline). Although the trend for breast cancer is also non-linear, incidence has been stable over the past decade.

Figure 3 also permits description of the male to female rate ratios. While incidence was consistently higher in males for non-Hodgkin's lymphoma, females had higher rates of melanoma and much higher rates

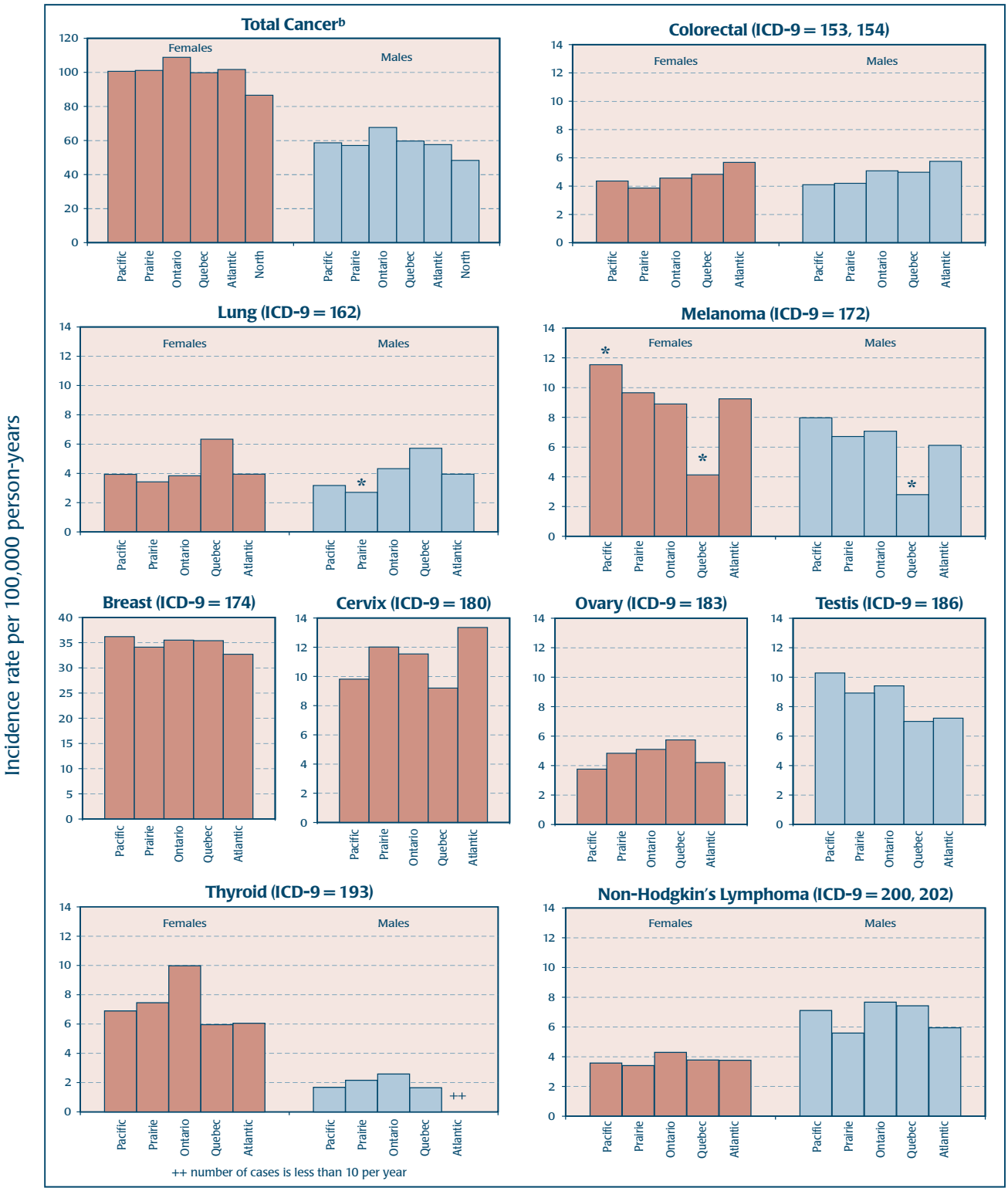
**FIGURE 3**
**Age-standardized[a] three-year moving average incidence rate for common cancers in young adults (ages 20–44), by sex, Canada 1969–1996**




[a] Standardized to the 1991 Canadian population age distribution.
Note that the scale is different for the breast, cervix and ovary cancer graph.

## FIGURE 4

**Age-standardized[a] incidence rate for common cancers in young adults (ages 20–44), by region and sex, Canada, 1987–1996**




[a] Standardized to the 1991 Canadian population age distribution.
[b] Non-melanoma skin cancers not included.
* Significantly different from the Canadian rate ($p < .05$).
Note that scales are different for total cancer and for breast cancer.

of thyroid cancer. Over time, male and female incidence rates have converged for lung and colorectal cancers and diverged somewhat for non-Hodgkin's lymphoma and thyroid cancer.

### *Regional variation*

There was virtually no variation in total cancer incidence across the country, although rates were slightly lower in the North and higher in Ontario (Figure 4). There were a few striking regional differences in site-specific incidence. Quebec had higher rates of lung cancer (non-significant) and lower incidence of melanoma (significant) for both men and women. The Prairies had low rates of lung cancer, significantly so in women, while the Pacific region had high rates of melanoma (significant in women). Ontario's females had considerably higher rates of thyroid cancer than those in other regions (non-significant); a slight excess was evident in Ontario men as well.

There was an apparent west- to-east gradient in colorectal and ovarian cancer incidence while the reverse was true for testicular cancer and for melanoma (with the exception of the very low rates in Quebec).

## Discussion

Overall, cancer occurs relatively infrequently in young adults: diagnoses in this group accounted for only 8.7% (10,331/118,631) of all newly diagnosed cancers in Canada in 1996.[7]

In contrast, about 1% of cancer diagnoses occur in 0–19 year olds and 90% in those aged 45 and over.

The types of cancer that occur most often in young adults and their relative frequencies are different from those in both older adults and children. They represent a mix of cancers common in children and adolescents (brain cancer, Hodgkin's disease, non-Hodgkin's lymphoma), those very common in older adults (breast, colorectal and lung), and some which are not particularly common in either (melanoma, testis, thyroid).

The sex ratio is also very different from that for cancers at other ages. While there is a male excess of cancer both in childhood/adolescence and after age 60,[4] females have a striking excess of cancer in young adulthood, with a female-to-male incidence rate ratio of about two. The female excess is explained almost entirely by the much greater frequency of breast and reproductive system cancers in women compared with men.

Several of the cancers that occur commonly in this age group have been increasing in incidence over the nearly 30-year time span of these data, some dramatically (melanoma, thyroid cancer and non-Hodgkin's lymphoma in both sexes, lung cancer in women and testis cancer in men). The reasons for some of these increases have been established (e.g., increasing sun exposure for melanoma and increased smoking for female lung cancer) but for some (e.g., testis cancer), the reasons are unknown).

Although a few strong regional patterns are evident, caution is required in interpreting regional differences because Canada's cancer registry is really an amalgam of separate province-level registries, each with its own operating procedures, supportive legislation and registration rules.

As Sir Richard Doll has made clear,[1] cancer surveillance in young adults may be particularly informative. Cancers in this age group may represent "sentinel events", providing warning of the effects of new or changing exposures/behaviours, including early adoption of protective behaviours. Thus, examination of cancer trends and patterns in this age group may alert the researcher to the need to seek information on possible explanatory exposures/behaviours, and may even provide clues to what these might be. This will be the focus of future study by the CYAC Working Group.

Further, for cancers that are also common in older age groups, trends in young adults may forecast future trends in older adults. For example, one possible interpretation of the decline/stabilization of melanoma incidence in this age group over the most recent decade is that the young have been adopting "sun smart" behaviour that has translated into an end to the increase in the incidence of melanoma. One can speculate that melanoma rates may stabilize and eventually decline in future decades in the older age groups, where to date incidence has continued to increase as the current generation of young adults ages.

## Conclusions and future directions

Despite Sir Richard Doll's recommendation a decade ago, there has been virtually no systematic surveillance of cancer patterns and trends in young adults. The CYAC Working Group was established to rectify this situation, at least in the Canadian context. At a workshop in Toronto in October 2000, the Working Group adopted a protocol for a study to describe cancer in young adults in Canada over the past three decades. The primary objectives of the project are to describe the most important forms of cancer in young men and young women in Canada at the present time; to document incidence and mortality trends from these cancers and for important histologic subtypes thereof, where appropriate; and to interpret the trends in terms of likely responsible risk factors/exposures. This paper presents preliminary data only for the first and part of the second of these objectives. In the future, the CYAC Working Group will focus on the remaining objectives. In particular, its members will be conducting literature reviews and searching for sources of data to help address hypotheses suggested by incidence patterns and the literature, with the ultimate goal of making recommendations for public health actions and priority research.

The Working Group will also be refining and updating the results presented here using data provided directly by the provincial cancer registries. This will result in more current and more comparable data than presented herein, and will permit investigation and understanding of data anomalies or artefacts that might affect interpretation of trends and regional variation. For example, rules for what constitutes a second primary cancer differ between registries; unless standardized, variations in rules could result in artefactual regional differences for some cancers, particularly those of the breast, skin (melanoma) and colon where multiple cancers of the same organ are relatively common. In addition, quality and completeness of cancer data vary across registries

and across time. The individual registries are in the best position to help the Working Group understand the changes and limitations of their data, as these relate to interpreting regional patterns and trends.

## Acknowledgements

Health Canada's Centre for Chronic Disease Prevention and Control provided funds for the workshop held in Toronto in October 2000 at which the CYAC Working Group developed the protocol for this project. Thanks to Mrs. Gini Hunter and Ms. Sheila Wing for their help in organizing a successful workshop.

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### Appendix

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Cross-Canada Forum

# Use of focus group methodology in the development of an Ontario farmers' sun safety survey

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## Abstract

*Farmers are at higher risk for skin cancer; US studies indicate that they do not use adequate sun protection. Little data on Canadian farmers' sun exposure are available, and a literature review suggests a strong need to develop a comprehensive, easy to complete farmers' sun safety survey in order to identify sun safety issues in the farming community. A literature review contributed to the development of a draft farmers' sun safety survey. Preliminary testing of the survey with 207 Ontario farmers supported the usefulness of the questionnaire, but weaknesses remained in phrasing and missed concepts. To augment the questionnaire's development, focus groups were held with farmers in four Ontario communities to clarify the phrasing of survey questions concerning the amount of sun exposure, the use of sun protection practices, family/personal history of skin cancer, and skin cancer attitudes and knowledge. This paper reports on what was learned substantively from these focus groups.*

***Key Words**: farmers, focus group method; skin cancer, survey design*

## Introduction

The "National Survey of Sun Exposure and Protective Behaviours" determined that nearly 20% of persons residing in Ontario aged 15+ during the summer of 1996 had a job that required them to work outdoors.[1] Over 60% of these reported spending more than two hours per day, on average, working outdoors. This study demonstrated that although outdoor workers were more likely to wear hats and clothes than other adults, they did not use other sun protection measures, such as sun avoidance, seeking of shade, use of sunscreen, or wearing of sunglasses.[1] However, this survey of 1,000 Ontario adults did not capture more detailed information about specific occupational groups, actual details of exposure (in terms of hours per day, time of day, etc. beyond the statistics quoted above) or details of protection (i.e., type of hat, type of clothing). Yet the results indicate that a sizeable segment of Ontario's outdoor workers is experiencing significant sun exposure during the summer months without taking adequate measures to minimize the effects of such exposure. One such group is Ontario's farmers.

Farmers are at higher risk for skin and lip cancer, both of which are associated with substantial exposure to sunlight.[2–4] There is some evidence that farmers are at increased risk of ocular melanoma,[5–7] although other studies have not reported this association.[8–10] Melanoma and non-melanoma skin cancers have been increasing in incidence in fair-skinned populations around the world, including Canada;[11] skin cancer is by far the most commonly occurring cancer in Canada.[12] Yet two US studies that examined farmers' sun safety practices indicated that a minority of farmers protect their skin.[2,13]

Behavioural research, in particular research based on the Health Belief Model (HBM), has been used to explain why some individuals adhere to prevention practices while others do not. The HBM predicts that preventive action will be taken if people believe that they are susceptible to a disease, that the disease will seriously impact their lives, that the preventive action will reduce their chance of acquiring the disease, and that the preventive action is easy to follow.[14] In addition, the individual's age, gender, educational level, knowledge of the disease, and prior contact with the disease have been implicated as further influences in the preventive decision-making process.[13] Based on this model, the strongest predictors of health protective behaviours were "perceived barriers", which were demonstrated to be negatively associated with efforts to reduce sun exposure in Wisconsin dairy farmers, and "lack of knowledge of skin cancer" played only a minor role. When a group of Australian outdoor workers, however, was subjected to an educational intervention trial, an increase in sun-protection behaviours was seen.[15] This result suggests that knowledge may play a more important role in prevention practices than has been previously demonstrated.

A pilot survey of sun exposure and behaviour in Ontario farmers was undertaken in October 1998. The draft survey was completed by 207 farmers attending a plowing match in Frontenac County in southeast-

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ern Ontario. A member of the study team administered the survey. Data from the survey demonstrated that nearly 30% spent eight hours or more in the sun each day, on average, between April and October. Nearly 35% of the 207 participants reported wearing a wide-brimmed hat always or most of the time, and only 22% wore long-sleeved shirts always/most of the time. Most of the respondents (85%) routinely wore long pants. Few farmers (25%) used sunscreen on a regular basis and only about 44% reported wearing sunglasses "always/most of the time". These pilot results suggest that Ontario farmers do indeed have high exposure and are likely not using adequate sun protection. This survey revealed some barriers (i.e., sunscreen is "too sticky"), but this information was obtained only anecdotally, during follow-up interviews with approximately 30 of the original survey participants. Results on the use of protection are similar to those reported by researchers in the United States in that approximately 37% of men reported wearing wide-brimmed hats and long-sleeved shirts.[2,13] Almost all of the 207 participants voiced concern over the wording of the preliminary survey, prompting a further need to investigate whether the questions asked were clear and relevant to the farming community.

In 1996, there were 851,400 Canadian farmers, almost 100,000 of whom reside in Ontario.[16] Apart from the results of the small pilot study noted above, information is lacking concerning how much sun exposure they receive, and how this varies by type of farming. While there are effective ways to reduce sun exposure, the level of knowledge about these and the actual protective practices of Ontario farmers are not known. Barriers, perceived or real, to effective sun protection among farmers are likewise not known.

This report describes the results of focus groups with Ontario farmers, the purposes of which were to develop a survey to measure the knowledge, attitudes and behaviours of farmers with regard to sun-safety practices, and to ascertain the most appropriate strategy to implement the survey.

## Methods

Surveys are commonly developed to measure the extent of a population's knowledge, attitudes, intentions to act, and behaviours. There are several different methods used by researchers to develop survey instruments. Typically, investigators develop a draft questionnaire through a team brainstorming process, by compiling questions from other, previously developed survey instruments, and/or through input from colleagues and representatives of the survey target population. This step is generally followed by a review by other experts to identify ambiguities in wording, item selection, and response option. Next, the questionnaire is revised based on the responses of a pre-test subsample of the intended survey population. The pre-test also aids in testing the psychometric properties of the instrument and the feasibility of the survey distribution method. Finally, the revised survey instrument is disseminated to the target audience. In addition, it is now becoming increasingly common to conduct focus group interviews, either before developing or prior to implementing a structured questionnaire.[17–19] This process can help identify issues to be included in the questionnaire, formulate question categories, simply fine-tune wording on particular questions, and/or ascertain the most effective strategies to reach the target population with the survey instrument.

### *Development of initial draft questionnaire*

A draft of the farmers' sun safety survey instrument was developed after a thorough review of the English language published literature. MEDLINE was searched using a combination of key words for sun exposure, farmers, questionnaires, and surveys. Reference lists of key studies were prepared and three experts (dermatologists and/or epidemiologists) were consulted for content. The initial draft questionnaire was then prepared, incorporating as many of the questions as possible identified by the literature search and expert input.

The initial draft instrument contained the following components: demographic information, sun protection practices, personal/family history of skin cancer, skin examination practices, and skin cancer knowledge, attitudes and beliefs. The "sun protection practices" section included questions on the amount of sun exposure and the frequency of use of clothing, sunscreen, work gloves, and sunglasses as sun protection aids. Twenty-two questions were included in the original questionnaire. The majority of the questions were closed-ended, offering the participant specific response options (with a residual or "other" category); others used a Likert-type scale. After consulting the Ontario Sun Safety Working Group (OSSWG) and three survey design experts, the second draft questionnaire was expanded to 36 questions, but the skin examination practices section was shortened.

The second draft questionnaire was pretested with 10 farmers who were patients at either the Women's College Hospital or the Toronto Sunnybrook Regional Cancer Center pigmented lesion clinics. Revisions of the questionnaire were made on the basis of any difficulties encountered during the pre-testing. A shortened version of the second draft questionnaire, focusing on demographics and sun protection practices, was administered at the 1998 International Plowing Match in Frontenac County, Ontario. The purpose of this comparatively brief survey was to obtain baseline data on the current sun protection practices of Ontario farmers and the reasons for any limited usage of such practices. Although additional sun exposure information would have been beneficial, the questionnaire was limited to two pages in length to optimize participation. Two hundred and seven Ontario farmers were surveyed at the time. Further revisions to the questionnaire, which consisted mostly of question rewording, were made based on the analysis of the data provided by farmers surveyed at the plowing match. The final draft questionnaire, which consisted of 36 questions (with additional sub-questions, the total number of items to which a respondent could reply was 66), was administered to the focus groups. Chart 1 (in appendix) illustrates the survey question sections, issues addressed in each section, and the number of items per section.

## Focus groups

Four focus groups were planned, comprising farmers from four different farming communities across the southern part of Ontario. Two of the focus groups were affiliated with the Ontario Farm Safety Association Incorporated, while the other two were assembled through contacts with community-based organizations. The groups were conducted in English and tape-recorded (with participants' permission) to facilitate data capture and analysis. The University of Toronto approved the ethical conduct of this study.

An informational package was distributed to participating farmers' groups prior to the meeting. This package included a cover letter describing the project, the focus group questions to be asked of group participants to obtain feedback on the interpretability, clarity and completeness of the draft farmers' sun safety survey, a copy of the farmers' sun safety survey, and an informed consent form. Participants were informed that all responses would be analyzed as a group and combined with data obtained from the other focus groups. The consent form also explained that participation was voluntary and anyone could withdraw at any time during the session. Prior to the group discussion, each participant read and, if s/he agreed, signed the consent form. Each focus group participant received a small honorarium to help defray any transportation or other costs.

The focus group interviewing format included brainstorming opportunities combined with a limited set of predefined questions functioning as prompts to provoke discussion. Participants were asked to review the survey questions prior to the session, and ongoing references were made to survey sections and questions.

One trained facilitator and an assistant were present during each of the focus group sessions. The facilitator led the focus group discussion, while the assistant took notes. Participants were asked to comment on the completeness, understandability, ease of answering, and acceptability of the survey questions. During the first half-hour of the focus group session, the participants' general comments about the survey were solicited. The remaining time was devoted to assessing the survey instrument item-by-item, including its wording, content, interpretation, and comfort levels. Suggestions for additions or deletions to the survey were encouraged. The session concluded with a discussion on ways of delivering the survey to farmers to optimize the response rate.

The focus groups were conducted sequentially to build an inductive understanding of the participants' responses to the survey, so that responses from earlier groups were shared with subsequent groups. This was done to validate and elaborate the focus group data. As recommended by Kreuger,[20] the final group was used to clarify, elaborate, and confirm our understandings of the first three focus group discussions.

## Results of focus group interviews

Four focus group sessions, involving 34 farmers (28 men, six women) were conducted between the months of March and June 1999. All of the participants were white part-time or full-time farmers, and over the age of 30. The number of participants in each group ranged from five to 10, with each session lasting approximately two hours.

The majority of focus group participants believed that sun safety was an important, but not well recognized, health issue among farmers. Many participants indicated that they had learned more about sun protection and skin cancer during the focus group discussions than from any other educational sources in the past. Almost all of the participants felt that the questionnaire was of an acceptable length, requiring only 20 minutes to complete, and was sufficiently comprehensive to capture farmers' sun safety issues. Most participants felt that the questions were easy to answer. They found the closed-ended format acceptable, recognizing it as a timesaving approach (as opposed to trying to provide hand-written responses to open-ended questions). There were some recommendations, however, to modify response options to some of the questions to avoid "insulting" or "confusing" persons completing the survey. Below, we clarify the focus group participants' recommendations for changing the survey questions.

## Background information

In the "Background Information" section of the survey, participants were asked basic descriptive questions about themselves and their farming. One of the questions asks about the highest level of education the survey respondent has achieved. Initially, all focus group members objected to this question. They suggested the data to be derived from a question about education was "irrelevant" and "insulting". However, after we explained that it is one of our intentions with the survey to see if there is a correlation between education level and sun protection usage, the focus group participants accepted the need to have a question about education. We incorporated their recommendation to modify the education question to include an additional response option of graduating from university/college, as the participants suggested we could offend farmers who are asked to complete the questionnaire who have post-secondary education, in addition to an explanation as to why the question was asked.

A few of the participants suggested that the answer options pertaining to type of farming be shortened. For example, the participants recommended that we collapse "dairy farming" and "livestock farming" into one response because these activities are essentially the same for most farmers.

Many farmers felt that the question about financial security was irrelevant and recommended that it should be dropped or a rationale provided for its inclusion in the survey. We refined the question on financial security by providing an explanation that financial resources may be a factor in sun-protection practices, and moved the question from section 1, "Background Information", into section 2, "Time in the Sun".

## Time in the sun

In this section, many participants felt that clarification was needed as to whether being in a tractor cab, whether enclosed by ultraviolet-protected glass or not, was really considered to be "outdoors". We re-

fined the survey to gather data on the amount of time that included "tractor work, regardless of whether you are in a cab or under a covering".

When questioned about sun protection use, a few of the focus group members felt that "T-shirts" and "Short-sleeve shirts" should be treated as two different sun protection practices, requiring separate questions. Moreover, some of the participants felt that there should be additional questions on whether they wore shirts at all when farming. In addition, the majority of focus group members felt that some of the answer options as to why certain sun protection practices were not done should be eliminated so as not to insult the respondents.

### *Other questions*

In the section on "Personal/Family History", focus group participants recommended that we drop most of the questions asking them to reflect on their childhood. Everyone felt that they would remember a severe sunburn, but would not remember how much exposure to the sun they experienced before they were 12 years old.

Most participants felt that farmers do not know how to examine their skin to identify a suspicious lesion, and most suggested that their physicians may not be doing this routinely during a physical examination. Thus, with respect to questions on the farmers' sun safety survey pertaining to "Skin Examination Practices", the participants felt that additional questions were needed to determine the farmers' level of knowledge of the practice of basic skin examination and to assess their level of action if a suspicious lesion was found.

In the "Knowledge and Attitudes" section, we asked group participants their opinion of the question in the draft survey that asked survey participants to rank a list of 10 health concerns according to importance (where 1 was the most important health concern and a 10 was the least important health concern). Several focus group participants had difficulty ranking the list of 10 health concerns because some of the terms used to describe the health issues were unknown to them. Instead, they recommended that survey participants should be asked to identify, from a list of 10 options, the three most serious health concerns for farmers.

Information about skin cancer and sun safety may be available from a variety of sources, including health care providers, public health personnel, the Canadian Cancer Society and other community-based organizations, the Canadian Association of Dermatologists, and the federal and provincial governments. We felt it was important to include questions on the survey about how farmers acquire knowledge about skin cancer and sun safety. Focus group participants felt that friends and family were important answer options and recommended we included these options in the survey. Finally, some participants recommended that presentations be made at plowing matches and conferences/workshops of the Ontario Farm Safety Association Incorporated (including local chapters). Materials on sun safety, such as pamphlets, videos and other media, could also be provided at these events.

Chart 2 illustrates the survey sections and question issues for the revised version of the survey, as well as the number of question items, based on the findings from the focus groups. The revisions resulted in a total of 64 items to which responses could be obtained.

### *Survey dissemination*

All in all, participants felt that the questions were relevant, and that the health-related issue of sun safety was of sufficient concern to individual farmers as to merit the design and implementation of the survey. As further indication of the acceptability of the survey, many participants, who were senior members of the Ontario Farm Safety Association Incorporated for their locale, expressed willingness to assist in any further steps to ensure the successful dissemination of the survey. Enthusiasm for the project generally, and sun safety in particular, was further demonstrated when many of the members requested that more pamphlets and written information be made available to them at their local farm safety association offices.

Many participants felt that the survey could be disseminated through channels facilitated by the Ontario Farm Safety Association Incorporated and the Ontario Farmers' Association. They felt that the cover letter, as currently designed and signed by the scientists, would be effective, but some thought that having a senior member of the Ontario Farm Safety Association Incorporated sign the cover letter as well may increase the response rate. Several participants suggested that current surveys they receive from agriculture chemical manufacturers attach a small financial incentive (a "toonie") to recognize the time taken by the farmer to complete and return the survey. Others, however, felt that completing the survey was "educational" and that, in itself, was a reward. It was also recommended that the return envelope should be self-addressed and pre-stamped. Furthermore, to increase the response rate, some of the participants suggested prize draws, sunscreen coupon enclosures, and prizes from various seed companies.

## Discussion

The focus groups of Ontario farmers provided useful information on the design, content, wording, and implementation of a farmers' sun safety survey. Recruitment of participants to the focus groups was successful, supported extensively by working directly with farmers' associations and community-based groups, and conducting the groups in convenient, community-based settings optimized participation. According to focus group participant feedback, providing information packages that included a copy of the survey to be discussed prior to the focus groups facilitated the participant's preparation for, and stimulated interest in, the groups.

It is possible that some selection bias occurred during recruitment (a significant number of the participants were formally affiliated with the Ontario Farm Safety Association Incorporated). However, since the purposes of the focus groups were to identify weaknesses in the wording of the questionnaire and to identify mechanisms to optimize the response rate, a sampling methodology that relied on key organizations to which farmers are affiliated was

appropriate. The fact that the participants may have been uniquely well informed about occupational health and safety issues, including sun safety, should be construed as a positive contribution to the development of a survey to identify, in a comprehensive manner, the most important issues concerning farmers' sun exposure and sun-protective behaviours. Furthermore, the Ontario Farm Safety Association Incorporated may be an effective mechanism to facilitate the dissemination of the sun safety survey.

Participants agreed that sun exposure and sun safety were of sufficient concern to farmers to warrant the design and implementation of the farmers' sun safety survey. The focus groups yielded important and useful feedback to modify the survey in ways that will make questions clearer and easier to complete.

It is apparent from this instrument development study that current knowledge about sun safety is lacking in the farming community (as may be the case with other groups and individuals). Our next step is to test the psychometric properties of the survey, including reliability, validity, and responsiveness, in order to have an instrument that can be used to assess the needs of the farming community. Because the focus groups were conducted in Ontario, it will also be necessary to test the instrument with farmers residing in other jurisdiction to determine if the questions and wording are acceptable, clear and complete.

## Conclusions

Given the large number of farmers in Ontario, the substantial sun exposure they experience, presumably over many years, the apparent lack of sun protection employed, the relatively high frequency of harmful effects of overexposure to the sun such as skin cancers and cataracts, with their attendant costs to the individual and to the health care system, and the lack of regulations covering farmers' sun exposure and use of protective measures in their workplaces, it is important to develop strategies for voluntary reduction of their sun exposure. This cannot be done until we know more about their current exposure, protection, perceived barriers and knowledge and their determinants. The knowledge derived from the farmers' sun safety survey will, we anticipate, yield data to allow for the design and implementation of sun-safety strategies (i.e., interventions targeting certain types of farmers, age groups, etc.).

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## Appendix

**CHART 1**
**Farmers' sun safety survey questions: original survey sections and key issues covered**

| Survey section | Key issues questioned | No. items |
|---|---|---|
| Background Information | Location, age, sex, ethnicity, education, occupation, type of farming performed, personal financial situation | 8 |
| Time in the sun | Time spent in the sun (selected periods of the year) "on an average day", methods used to seek shade, other sun avoidance practices (e.g., clothing, hat, gloves, sunscreen, sunglasses | 26 |
| Personal/family history | Location as a child, time spent in the sun during childhood (up to age 12), sunburn experience, natural skin colour, personal and familial skin cancer experience (if any) | 11 |
| Skin examination practices | Self-examination of skin, frequency, source of learning about skin self-exam, experience with physician performing a skin self-exam | 5 |
| Knowledge and attitudes | Knowledge of skin cancer risk factors and sun safety practices (including tanning), factors influencing decision to perform sun safety practices, primary health concerns, general knowledge of skin cancer (including types), sources of information, information needs | 16 |

**CHART 2**
**Farmers' sun safety survey questions: revised survey sections and key issues covered**

| Survey section | Key issues questioned | No. items |
|---|---|---|
| Background information | Location, age, sex, ethnicity, education (reworded), occupation, type of farming performed, personal financial situation | 7 |
| Time in the sun | Time spent in the sun (selected periods of the year) "on an average day", sun protection practices (clothing, hat, sun screen, other protective practices (e.g., seeking shade) | 24 |
| Personal/family history | Location as a child, prior severe sunburn experience, natural skin colour, personal and familial skin cancer experience (if any) | 10 |
| Skin examination practices | Self-exam of skin, partner examination of skin, frequency, sources of knowledge to perform skin self-exam, physician exams, if physician discussed sun-protection | 7 |
| Knowledge and attitudes | Knowledge of skin cancer risk factors and sun safety practices (including tanning), factors influencing decision to perform sun safety practices, primary health concerns, general knowledge of skin cancer (including types), sources of information, information needs | 16 |

Cross-Canada Forum

# An integrated exploration into the social and environmental determinants of health: the Saskatchewan Population Health and Evaluation Research Unit (SPHERU)

*Ronald Labonte, Nazeem Muhajarine, Sylvia Abonyi, Georgia Bell Woodard, Bonnie Jeffery, George Maslany, Michael McCubbin and Allison Williams*

## Abstract

*The Saskatchewan Population Health and Evaluation Research Unit (SPHERU) is a new interdisciplinary research institute established by the Universities of Saskatchewan and Regina. SPHERU developed four of its research programs using a hierarchic model of health determining conditions and contexts. In descending order these programs include:*

- *Economic and Environmental Globalization, Governance and Health*
- *Community/Environment as a Health Determinant*
- *Multiple Roles, Gender and Health*
- *Determinants of Healthy Childhood Development*

*A fifth program researching the determinants of health of indigenous peoples spans all four levels. Two research projects, one on power, control and health, and another on community capacity building approaches to human service programs, assist SPHERU in developing the theoretical linkages between its programs. This article describes SPHERU's research model and the Unit's approach to research and summarizes each of its current research programs and projects.*

***Key Words:*** *interdisciplinary research; population health; population health conceptual models*

## Introduction

The Saskatchewan Population Health and Evaluation Research Unit (SPHERU) is a newly established (1999) non-profit research institute. It is governed by a board of representatives of the universities of Saskatchewan and Regina and three other founding partners, Saskatchewan Health, the Saskatchewan Association of Health Organizations and the Health Services Utilization and Research Commission. Ronald Labonte was hired as its first Director in late 1999. The first group of multidisciplinary researchers was hired in July of 2000. Since then, SPHERU has developed five different research programs and several research projects, obtained research funding from several national and provincial research agencies and begun to establish itself as a "new" Canadian focal point for health research.

This article is written to introduce health researchers and policy makers to SPHERU, its approach to research, its developing research programs and some of its current activities. We would like to describe our deliberative strategy to be interdisciplinary, integrated and theoretically linked in all of our research, and to invite collaborations with researchers or other stakeholder organizations, groups or individuals interested in our programs of study.

## Mission statement

All new organizations begin by framing a broad goal, or mission, for their work. SPHERU's mission is

> "To be a centre of excellence in research that will create new knowledge and understandings of population health, contribute to health policy and planning, inform public policy at all levels of governance, incorporate a population health perspective into the education of health professionals, and be a resource for public debate on population health."

This lofty intent can be distilled into simpler language. Decades of past research identify the primacy of our social and environmental conditions in influencing our health and well-being. SPHERU's interests lie in better explaining *how* these different living conditions affect different health

**Author References**

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outcomes for different people in different places. We are interested in the *how* so that we might be better able to identify the *what*, in terms of policy options. We want our research findings to be relevant to policy decision-makers. This means working closely with policy makers in framing our research and ensuring that each study incorporates a policy analysis component. We include several policy makers as co-investigators in our research, and others sit as members of our Board of Directors. That's a healthy start.

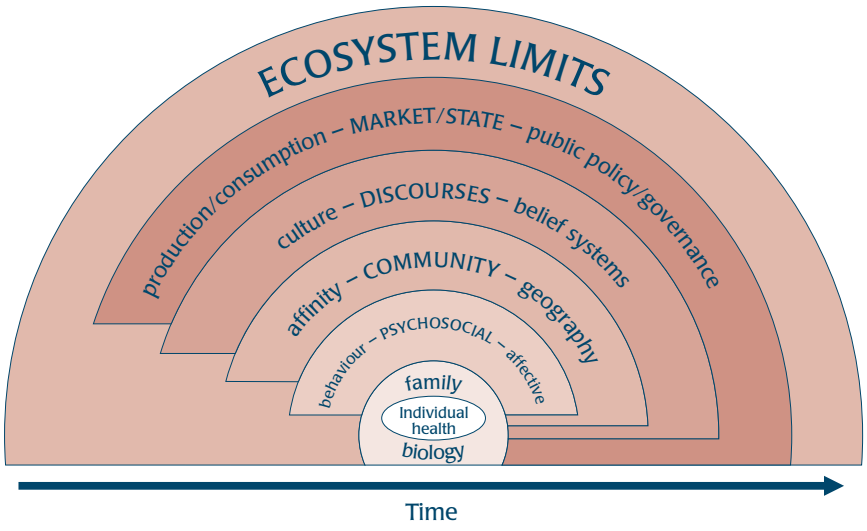
We are aware that policy making is more than just a matter of providing relevant research findings to government bureaucrats and elected officials. It is about politics. As one current phrase expresses, "We do not yet have evidence-based policy making so much as policy-based evidence making". Many of the most important determinants of population health are embedded in economic, social and political structures of inequality. Remedial policies that reduce these inequalities face an uphill battle, so to speak. Part of the force that pushes these policy options up into the political arena of decision-making is civil society and its many organizations. Another principal underlying our mission statement, then, is working closely with community constituencies to ensure that we are asking the right questions, and that there is an organized public interested in the answers.

Finally, both policy makers and an organized public require assistance in untangling the messy web of population health determinants. We regard making research expertise accessible to the public, especially as it applies to understanding the strengths and limitations of specific research findings, as an important moral, as well as practical, obligation. Our public communication must be clear, concise and understandable. It is not enough for research to fill the pages of journals or advance the academic careers of researchers.

## SPHERU's research model

Population health research covers a vast potential territory. To help us map this territory, SPHERU developed the simple model representing broadly defined categories of health determining conditions.

**FIGURE 1**
**SPHERU's conceptual research model**




(Figure 1). Each of these categories (or levels) can be studied as a separate health determinant. Unlike other similar models, however, we do not portray them as different bands of a rainbow. Each affects the others, so they "touch" not only on health, but also on every other level or "band" in our model. Better understanding the health impacts of the relationships between the levels is as important as understanding the health impacts of each level by itself.

The overarching level is that of our ecosystem. Without a healthy planet, nothing else matters. Environmental health is not yet an integral part of SPHERU research, but we intend to have it become so in the future.

The next level is that of market/state relationships. Economic activities are based on production and consumption, increasingly global in scale. There are limits to this, which our planet and societies now face. We need to produce and to consume to be healthy, but produce and consume how much? Produce and consume what? How fairly? These are questions of public policy and governance. They are also central to the SPHERU research program on *Economic and Environmental Globalization, Governance and Health*, which incorporates a global environmental perspective in its research. An overview of each of our programs follows later in this article.

Below the broad sweep of market/state relations lies that of community (both geography or neighbourhood and affinity or interest) and discourse (peoples' cultural or other belief systems). Some belief systems dominate others, partly due to economic and power differences in the level above. But dominant beliefs are also challenged by local actions and, increasingly, linked actions by communities of affinity that stretch around the planet. What mix of beliefs, what balance of diversity with consensus, what local programs, services and structures, create the greatest equity in health for people? These questions are integrated within the *Community/Environment as a Health Determinant* research program.

The next level down describes the intersection between these local phenomena and our personal and family health. How we regard ourselves, our ability to think critically and to feel competent, the quality of our social relationships, our individual habits – these are all powerful mediators between conditions in our environment and our health and well-being. The community/family nexus is a primary focus for our research program on *Multiple Roles, Gender and Health*.

Finally, our personal health is influenced by our biological makeup (still largely unmodifiable, and with no certainty how

much that might change in the future) and by our family experiences. Early childhood is increasingly seen as an important time when our health futures are at least partially embedded in our biologies. But what are the community, as well as familial, determinants of healthy childhood? And how do cumulative experiences over time mitigate less healthy starts to life? Our final "hierarchic" research program, then, focuses on the *Determinants of Healthy Childhood Development*. SPHERU is also developing a fifth program on *Indigenous People's Health* that cuts through all of these levels.

Our model also contains a few basic assumptions:

- Elements in "higher" level orders are found in all "lower" level orders. The effects of health determining conditions cascade downwards from the global to the local.
- "Higher" orders of organization condition and constrain "lower" orders of organization. Determinants of local level health effects will be found in policies and practices that include provincial, national and global (supranational), as well as local, levels.
- "Lower" orders of organization influence the qualities of "higher" orders. Personal practices and public policies are shaped by organizations at higher political and economic levels. They also influence the structures of political and economic organizations at these levels.

These assumptions are open to empirical refute. For the moment, however, they shape our intention to explore the "determinants" of health determining conditions as broadly and as thoroughly as possible.

## Linking theories

SPHERU is attempting to link all of its research theoretically. Three theories (actually, categories of theories) are presently being used.

***Governance:*** the role of democratic and participatory forms of government in creating health promoting conditions;

***Capacity building:*** the role of social networks, economic activities, services, programs and research itself to build local ability to sustain health; and

***Power:*** the role of social and psychological power relations in creating health, and in building capacity and ensuring participatory democracy.

Two research projects, in addition to our programs, are developing our knowledge in these theoretical areas.

### *1. Capacity building*

This research project, under the banner of the University of Saskatchewan "In Motion Community Alliance for Health Research", seeks to understand community capacity building as a generic strategy for population health. Capacity building is based on equity, empowerment, and participation and works to strengthen communities, whether grassroots, inter-organizational partnerships, or networks of agencies, to organize and act to achieve their goals. Capacity building is a *means* to the end of program specific health goals. But health programs can also be a means to develop capacity building as a health-enhancing *end* in itself.

### *2. Power, control and health*

This research project currently studies the life-long interactions among social, community and psychological factors such as powerlessness, sense of control, learned helplessness and empowerment, as power-related issues. It investigates the role and impact of powerlessness in producing various health and health-risk factor outcomes. It applies this knowledge within the mental health area to improve the empowerment capacity of interventions, and the evaluation of interventions as both empowering and likely to produce mental health benefits for that reason. We hope that this empirical work will assist the Unit in better theorizing and examining how power functions as mediating phenomenon between well known differences in health outcomes and socio-economic status.

## SPHERU's research programs

SPHERU has organized its research under five broad program areas, the first four of which correspond to different levels in our model (Figure 1). These are

- Economic and Environmental Globalization, Governance and Health
- Community/Environment as a Health Determinant
- Multiple Roles, Gender and Health
- Determinants of Healthy Childhood Development
- Indigenous People's Health

Each of these is described briefly below.

### *1. Economic and Environmental Globalization, Governance and Health*

This program studies the relationship between economic globalization and population health. Studies examine the direct and indirect effects of trade and investment volumes and policies on key health-determining conditions, regulatory capacities, trade in health-damaging products and access/quality of health-promoting public services. A simple model describes the potential pathways linking recent globalization to health and quality of life (Figure 2).

#### Key research questions

How is globalization affecting socio-economic, environmental and governance "pathways" to health?

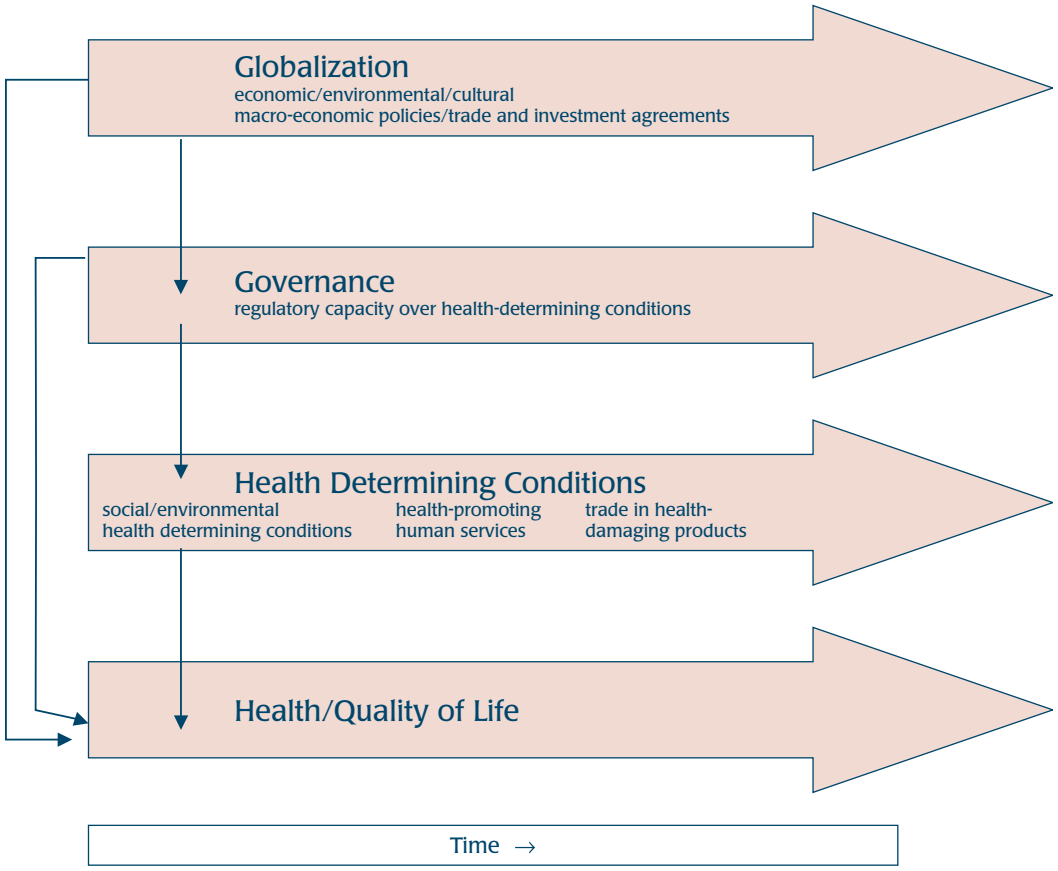
How are current trade and investment agreements specifically affecting health-determining pathways?

How should trade and investment agreements be amended so that there are absolute and relative improvements in global health?

#### Examples of current activities

- Commissioned research papers for the World Health Organization on "Globalization, Health, Trade and Sustainable Development" and on "Analytical Frameworks Linking Globalization to Health-Determining Conditions".
- "Report card" on G-7 commitments to global health and development (funded by the International Development Research Centre).

**FIGURE 2**
**A simple model for assessing pathways linking globalization and health**




- Member, national research consortium (organized through Canadian Centre for Policy Alternatives): The Impacts of Globalization and Global Trade Agreements on Health and Health Care Policy, undertaken for the Commission on the Future of Health Care in Canada.

## *2. Community/Environment as a Health Determinant*

This program focuses on the pathways and processes by which "community" operates as a direct influence on health and overall quality of life. We know that both the social and physical environments affect health, but we don't fully understand the mechanisms through which this happens. One of the most important research needs in health inequalities scholarship is to clarify the pathways through which differences in socio-economic status are manifested in everyday life, and produce, at the aggregate or community level, the systematic social gradient in health observed in most countries of the world.

### Key research questions

How do the physical and environmental characteristics of communities cause ill health, or protect and enhance good health?

What health effects result from inequalities in the physical characteristics (e.g., public parks, population density) of the community?

How do communities' socio-economic characteristics (e.g., income, education, degree of ethnic diversity) cause ill health, or protect and enhance good health?

What health effects result from the inequalities in socio-economic characteristics (e.g., income, education) of the community?

Many of these community-level determinants are linked to the effects of globalization on national, provincial and local public policies, such as provision of public services or goods, income redistribution, environmental protection and so on.

### Examples of current activities

- A major quality of life study in Saskatoon is already underway under the banner of the Community-University Institute for Social Research (CUISR). This involved a detailed analysis of existing local studies on quality of life; a comprehensive quality of life survey administered to over 800 residences, randomly selected from one of three neighbourhood clusters based on socio-economic characteristics; interviews and focus groups with persons representing different socioeconomic and demographic groups, adding depth to the statistical findings of the survey; a key informant survey of policy and program initiatives potentially affecting key determinants of quality of life disclosed by

the survey and interviews; and a multi-stakeholder "policy forum" that utilized all of the findings to develop a policy/program action plan.

- Proposals are under development for comparative research in a sample of mid-sized Canadian cities involving community and policy stakeholder groups.

### 3. Multiple Roles, Gender and Health

This research program examines socio-economic status, role occupancy, and social relationships as pathways to health status. Social roles have changed dramatically in recent decades, but knowledge of their health effects (e.g., role-strain or role-enhancement), and the modifiable social or workplace policies that influence these effects, is still incomplete.

#### Key research questions

How do different social roles (role patterns) interact to create health or illness?

What personal and social resources, both outside and inside the workplace, mediate health effects arising from high demand circumstances and occupying multiple roles?

How do social role pathways differ for women and men, and for First Nations/Aboriginal peoples?

How do social role pathways of parents influence the health of children?

The last two questions directly link this program of study to examining the upward impacts of community-level determinants, and the downward effects on child and family health.

#### Examples of current activities

- Other proposals in development include studies of current, proposed and future policy changes in Saskatchewan potentially affecting the three health determining conditions (socio-economic status, role occupancy and social relationships).
- Evaluation studies of major existing or new programmatic initiatives undertaken by health districts, Regional Intersectoral Committees (RICs) or First Nations governments within Saskatchewan that potentially affect the three health determining conditions.

### 4. Determinants of Healthy Childhood Development

This research program attempts to understand how specific factors within and between various levels of environment (prenatal, family/home, community, and global) influence children's health and well-being.

#### Key research questions

What interventions during the prenatal period are effective in breaking the intergenerational transmission of risk?

Why do children living within a specific array of family and community characteristics do better than other children in their preparedness for lifelong learning?

What are the effects of changing family relations and role expectations on children's lives?

What specific community and intersectoral partnership strategies and government policies for serving children and their families are most effective in enhancing children's health and positively changing the key determinants of children's health?

The questions posed start at an individual level, and examine the pathways upward through role relationships, to community resources, to public policy and globalizing forces.

#### Examples of current activities

- Community and Family Characteristics, Income Dynamics and Child Health Outcomes, funded by the Canadian Population Health Initiative. This research addresses such questions as: How does family economic instability affect children's health? What specific neighbourhood and family characteristics influence child health outcomes? A similar study, funded by the Health Services Utilization Research Commission, focuses specifically on families and children in Saskatchewan and primarily addresses the relationship between income stability, health and health services utilization.
- Active participation in the Centre of Excellence for Child and Youth Centred Prairie Communities, funded by Health Canada, and Understanding the Early Years (Saskatoon site), funded by Human Resources Development Canada.

### 5. Indigenous Peoples' Health

This research program studies health determinants in indigenous populations and is being developed in full collaboration with First Nations/Aboriginal communities and organizations. The program intersects with all other SPHERU research areas. It also stands alone however, attempting to consider where and how health-determining conditions are affecting positive outcomes for First Nations/Aboriginal communities, despite health-damaging historical and contemporary circumstances.

#### Key research questions

Under what conditions are some First Nations/Aboriginal people/communities doing well?

How do people create meaningful and rewarding socio-cultural environments?

Which programs and policies on health determining conditions are facilitating positive health outcomes?

#### Examples of current activities

- Evaluating the health transfer for (and with) a large tribal council in Saskatchewan.
- Examining the health impacts of community supports (or lack) for Aboriginal people returning home from in-patient rehabilitation therapy.
- Determining factors to improve HIV surveillance and community support structures in northern Saskatchewan.
- Developing community capacity measures for health and human development programs in First Nations communities (funded by the Institute of Aboriginal Peoples' Health).

## SPHERU's research faculty

SPHERU will be able to support nine full-time researchers. We presently have five, plus two research fellows and a half-time associate director. SPHERU deliberately and uniquely seeks to recruit people representing different disciplines and different research methodologies. Most of our research applications and programs are developed collaboratively. We have already learned a tremendous amount from each other in sharing our discipline-specific orientations to the same set of research problems or questions. Table 1 identifies our present faculty, the research program in which they are "lead" investigators, and their discipline backgrounds.

Population health determinants may be influenced by policies residing within boundaries, but they also transcend place. For this reason, we are already working with over 20 researchers from different universities in Canada and abroad. We encourage readers who, based on this brief synopsis of our approach and programs, may be interested in future collaborations, to contact the corresponding author (Ronald Labonte). For more information on SPHERU, visit our web site at: < www.spheru.ca. > ■

**TABLE 1**
**Current SPHERU research faculty**

| Name | Research program lead | Discipline |
|---|---|---|
| Ronald Labonte | Globalization and Health | Sociology |
| Allison Williams | Community/Environment and Health | Geography |
| Bonnie Jeffery | Multiple Roles, Gender and Health | Social Work |
| Nazeem Muhajarine | Healthy Childhood Development | Social Epidemiology |
| Sylvia Abonyi | Indigenous Peoples' Health | Anthropology |
| Michael McCubbin | Power, Control and Health | Political Science/Policy |
| Georgia Bell Woodard | Community Capacity and Health | Health Promotion |
| George Maslany | | Social Work |

## Commentary

# Horse kicks, anthrax and the Poisson model for deaths

*Gerry Hill*

Most epidemiologists use the Poisson model for deaths. In the old days we used it (and a slide rule) to calculate the standard errors of death rates and indirect standard mortality ratios. Now you can get exact limits from the Internet[1] and Poisson regression analysis[2] has made multivariate analyses of mortality and incidence data possible. It seems reasonable to ask who first introduced the model.

Most people would think of Bortkiewicz,[3] since his data on deaths from horse kicks in the Prussian army have been used as examples in many statistical textbooks, e.g.,Yule and Kendall[4] and Fisher.[5] Kendall and Stuart[6] also cite Bortkiewicz' data on suicide. Frank Haight,[7] in his extensive bibliography of the Poisson distribution, claims that there was a gap in the literature between the publication of the German edition of Poisson's book[8] in 1841 and Bortkiewicz' book in 1898. Anderson[9] states that "the first application of the distribution to real data was the now famous example of death in the Prussian Army caused by horse kicking."

Though Bortkiewicz was the first to publish, another author, apparently independently, had the idea of using deaths to illustrate the Poisson distribution. In one of the oldest textbooks on statistics, first published in 1901, Bowley[10] fitted a Poisson distribution to deaths from splenic fever in the years 1875–1894 and showed a reasonable "consilience" with the theory. Bowley adds: "The general principle that small numbers show a certain constancy is well exemplified. Specialists in all professions, from the doctor who treats only one obscure disease of the ear, to the dealer in curiosities, make their livelihood dependent on this principle of small numbers." However, Bowley adds in a footnote: "Since writing this section my attention has been called to a treatise by Dr. Bortkewitsch [sic] ... where the close agreement of the records of accidents and other occasional events to the binomial expansion is dealt with in a more exhaustive and analytical manner."

Splenic fever, by the way, was, at that time, a synonym for anthrax. In the light of recent events it is interesting to note that there were, on average, 10 deaths from anthrax in the years 1875–1894 (presumably in England and Wales).

Biographies of Bortkiewicz[11] and Bowley[12] are readily available. Neither was medically qualified. Apart from the horse kicks, Bortkiewicz is best known for his correction of Marx's proposed solution to the problem of deriving prices from values, Bowley for his work on poverty.

A final note: it appears[13] that the "Poisson" distribution was first derived by de Moivre, but a change of name at this stage seems unlikely.

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## Erratum

In our previous issue, Volume 23, No. 1, we neglected to credit the cover photos.

The background photo was taken by Roger Langlois and the inset photo was taken by Wayne Paulson.

We apologize for the omission.

## Book Review

# Critical Issues In Global Health

*Edited by C Everett Koop, Clarence E Pearson, R Roy Schwarz, with a forward by Jimmy Carter*

San Francisco (US) Jossey-Bass, 2001
472 pp; ISBN 0-7879-4824-1; $76.00 (CDN)

Predicting the future with any accuracy is impossible.

For this book, Dr. Koop et al. asked international health experts from the government, private and voluntary sectors to provide their insights on the important issues facing global health in the 21st century. Building on an assessment of past successes in health, the essayists in this book have offered their perspectives on critical health issues and their insights into what can be done in the future to improve the health of populations around the world.

The book is divided into three sections. The first provides an overview of public health situations in the major regions of the world. Six country-specific analyses focus on the US, China, Russia and India – representing the four largest population groups in the world – as well as on Canada and Mexico because of their inextricable links to the US. These essays hold no surprises for policy analysts or decision makers who are aware of worldwide public and population health issues. For a reader requiring a synthesis of the health situations in other countries, they offer readable status reports without delving into the academic. Worldwide issues range from the problems of infectious diseases (Africa), to poverty (India), to factors within personal control, such as tobacco use and obesity (Russia, US, Canada). On a smaller scale, health inequities exist not only between countries, but also within them: Canada's Aboriginal populations, for example, continue to face them.

The second section, "The Organizational Landscape in Global Health", was, in my view, the most interesting section. It highlighted pressing health issues, regardless of borders, and offered "crystal ball" predictions on the future of public health in the 21st century. Building on the successes of public health interventions in the 20th century, such as the development of vaccines for smallpox, polio and measles, the essays in this section focus on the influence of the determinants of health on future health outcomes. The essayists agree on common challenges for health: globalization of trade and economic issues; the advancement of technology, both its positive effects, such as the development of biomedical research, and its negative ones, such as the widening of the gaps between developed and underdeveloped countries; communication as key to health promotion and health education; and the involvement of the government, private and voluntary sectors in health advancement with a focus on community capacity. Many of the essays talked of the importance of meeting these conditions in order to achieve health for all in the 21st century.

The key trends in the future of health are the continuing worldwide burden of chronic diseases, specifically cardiovascular diseases, partially due to the continued and increased use of tobacco. Aging populations, lower fertility rates, and growth in populations with sub-optimal health such as in India, where already malnourished girls give birth to low-birthrate babies, are demographic shifts that will also place a burden on future health advances.

I found that the essays in this section also offer the most hope for the future. They recognize a more holistic approach to health by acknowledging the importance of the interrelationships between the environment, social sciences, economics, alternative practices, nutrition, education, violence against women, and other factors. The essay on the "Relationship between Oceans and Human Health" intrigued me as a new area of exploration for integrating biomedical research with practical solutions.

The third section, "Organizations, Management, Leadership and Partnership" further discusses the synergies needed between the government, business and non-profit sectors in finding health solutions. These essays outline the important strengths and limitations of each sector and postulate that bringing them together will contribute to improvements in global health status.

The key things I liked about this book: it is not overly statistical and it strikes the right tone between academic and practical solutions, making it easy for anyone with an interest in health to understand. It contains important and insightful messages for university students, policy makers and decision makers. For those looking for a vision of public health, I recommend the opening essay of the book by Dr. Gro Brundtland. A true visionary, she offers hope that health inequities can be eradicated. I hope that there will be a check every 10 years or so to see what progress is being made. ■

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# Calendar of Events

| | | |
|---|---|---|
| **May 7–11, 2002**<br>**Montréal, Quebec** | "ISSFAL 2002 – Dietary Fats and Health"<br>5th Congress of the International Society for the Study of Fatty Acids and Lipids | ISSFAL 2002 Secretariat<br>c/o Golden Planners Inc.<br>301–126 York Street<br>Ottawa, Ontario K1N 5T5<br>Tel.: (613) 241-9333<br>Fax: (613) 565-2173<br>E-mail: info@goldenplanners.com<br>< www.issfal.org.uk > |
| **May 12–15, 2002**<br>**Montréal, Quebec** | "Injuries, Suicide and Violence: Building Knowledge, Policies and Practices to Promote a Safer World"<br>6th World Conference on Injury Prevention and Control | Congress Secretariat<br>511 place d'Armes, #600<br>Montréal, Quebec H2Y 2W7<br>Tel.: (514) 848-1133<br>Toll-free: 1 877-213-8368 (Canada and USA)<br>Fax: (514) 288-6469<br>E-mail: trauma@coplanor.qc.ca<br>< www.trauma2002.com > |
| **May 26–31, 2002**<br>**Vienna, Austria** | "Innovation and Prevention"<br>XVIth World Congress on Safety and Health at Work | Allgemeine Unfallversicherungsanstalt<br>Kongressbüro<br>Adalbert-Stifter-Strasse 65<br>A-1200 Vienna, Austria<br>Tel.: +43 1 33 111-537<br>Fax: +43 1 33111-469<br>E-mail: safety2002@auva.sozvers.at<br>< www.safety2002.at > |
| **June 5–7, 2002**<br>**New Orleans, LA, USA** | "Strengthening America through Health Education and Health Promotion Alliances"<br>20th National Conference on Health Education and Health Promotion<br>Sponsored by Centers for Disease Control and Prevention and the Association of<br>State and Territorial Directors of Health Promotion and Public Health Education | HP Conference Registration Department (ext. 220)<br>Professional and Scientific Associates<br>2957 Clairmont Road, Suite 480<br>Atlanta, GA 30329 USA<br>Tel.: 1-800-772-8232 x 220<br>E-mail: HEHP2002@psava.com<br>< www.astdhpphe.org/conf20/20confindex.htm > |
| **June 6–9, 2002**<br>**Saint John, New Brunswick** | The 5th Dietitians of Canada Annual Conference | Meredith Hunt<br>DC Central Information, Dietitians of Canada<br>Tel.: (416) 596-0857<br>Fax: (416) 596-0603<br>E-mail: centralinfo@dietitians.ca<br>< www.dietitians.ca/resources/pd_events.htm > |
| **June 6–11, 2002**<br>**Washington, DC, USA** | "Healthy Ecosystems, Healthy People: Linkages between biodiversity, ecosystem health and human health"<br>Presented by the International Society for Ecosystem Health in association with the Center for Applied Biodiversity Science at Conservation International | Healthy Ecosystems, Healthy People<br>c/o International Society for Ecosystem Health<br>Faculty of Medicine & Dentistry<br>Health Sciences Addition, H121<br>The University of Western Ontario<br>London Ontario N6A 5C1<br>Tel.: (519) 661-2111 x 86223<br>Fax: (519) 661-3797<br>E-mail: hehp@ecosystemhealth.com<br>< www.ecosystemhealth.com/hehp > |
| **June 11–13, 2002**<br>**Toronto, Ontario** | NAACCR 2002 – "Achieving Equity in Cancer Control"<br>The 2002 meeting of the North American Association of Central Cancer Registries<br>Hosted by Cancer Care Ontario | Darlene Dale<br>Cancer Care Ontario<br>Tel.: (416) 217-1228<br>E-mail: Darlene.Dale@cancercare.on.ca<br>< http://www.naaccr.org > |

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| **July 7–10, 2002**<br>**Yellowknife, Northwest Territories** | "Our Environment, Our Health"<br>93rd Annual Conference of the Canadian Public Health Association<br>Co-sponsored by the Northwest Territories/Nunavut Branch, CPHA | CPHA Conference Department<br>Tel.: (613) 725-3760 x 126<br>Fax: (613) 725-9826<br>E-mail: conferences@cpha.ca<br>< www.cpha.ca > |
| **August 18–22, 2001**<br>**Montréal, Quebec** | "Epidemiology and Modern Public Health"<br>16th World Congress of Epidemiology<br>World Epidemiological Association | Events International Meeting Planners<br>759 Square Victoria, Suite 300<br>Montréal, Quebec H2Y 2J7<br>Tel.: (514) 286-0855<br>E-mail: iea2002@eventsintl.com<br>< www.iea2002.com > |
| **November 3–5, 2002**<br>**Winnipeg, Manitoba** | "Injury Prevention Beyond 2002"<br>8th Annual Conference of the Canadian Coalition for Agricultural Safety and Rural Health | Canadian Coalition for Agricultural Safety and Rural Health<br>103 Hospital Drive, Box 76<br>Saskatoon, Saskatchewan S7N OW8<br>Tel.: (306) 966-8499<br>Fax: (306) 966-8891 |
| **December 1–4, 2002**<br>**Ottawa, Ontario** | "Science & Policy in Action"<br>The Third National Conference on Tobacco or Health<br>*Deadline for abstract submissions: June 14, 2002* | Taylor & Associates<br>18–5370 Canotek Road<br>Gloucester, Ontario K1J 9E8<br>Tel.: (613) 747-0262<br>Fax: (613) 745-1846<br>E-mail:<br>stmartin@taylorandassociates.ca<br>< www.taylorandassociates.ca > |
| **May 12–16, 2003**<br>**Vancouver, British Columbia** | "Child Health 2003"<br>3rd World Congress & Exposition | Venue West Conference Services Ltd.<br>Tel.: (604) 681-5226<br>Fax: (6040 681-2503<br>E-mail: congress@venuewest.com |

## New Principal Scientific Editor

We are very pleased to welcome Dr. Sylvie Stachenko to the position of Principal Scientific Editor of *Chronic Diseases in Canada.*

Dr. Stachenko is Director General of Health Canada's Centre for Chronic Disease Prevention and Control. She previously served as Director of Health Policy and Services with the World Health Organization Regional Office for Europe in Copenhagen, Denmark.

After graduating with a doctorate in Medicine from McGill University, Dr. Stachenko completed her residency in family medicine at the Université de Montréal and earned a Master's of Epidemiology and Health Services Administration from the Harvard School of Public Health.

Dr. Stachenko served as an associate professor of family medicine and research director at the Université de Montréal before joining the former Department of Health and Welfare, where she served as Director of Preventive Health Services, then as Director of the Adult Health Division of the former Health Promotion and Programs Branch.

National Cancer Institute of Canada
Institut national du cancer du Canada

## Notice!

**Canadian Cancer Statistics 2002**
was released
on Thursday, April 18, 2002 at 10:00am (EST)
and is accessible on the Internet at
**http://www.cancer.ca**

You can download and/or print any sections, graphs, tables, etc.
or all of this document from the above website.

If you would like to receive a hard copy of this publication,
contact your local office of the Canadian Cancer Society,
your regional office of Statistics Canada, or the
Canadian Cancer Society (National Office)
10 Alcorn Avenue, Suite 200
Toronto, Ontario M4V 3B1
Tel. (416) 934-5673
Fax. (416) 961-4189
< stats@cancer.ca >

# CDIC: Information for Authors

Chronic Diseases in Canada (CDIC) is a peer-reviewed, quarterly scientific journal focusing on the prevention and control of non-communicable diseases and injuries in Canada. This may include research from such fields as epidemiology, public/community health, biostatistics, behavioural sciences and health services. CDIC endeavours to foster communication on chronic diseases and injuries among public health practitioners, epidemiologists and researchers, health policy planners and health educators. Submissions are selected based on scientific quality, public health relevance, clarity, conciseness and technical accuracy. Although CDIC is a Health Canada publication, contributions are welcomed from both the public and private sectors. Authors retain responsibility for the contents of their papers, and opinions expressed are not necessarily those of the CDIC Editorial Committee or of Health Canada.

## Feature Articles

**Regular Feature Articles:** Maximum 4,000 words for main text body (excluding abstract, tables, figures, references) in the form of original research, surveillance reports, meta-analyses, methodological papers, literature reviews or commentaries.

**Short Reports:** Maximum 1,200 words (as above).

**Status Reports:** Describe ongoing national programs, studies or information systems at Health Canada (maximum 3,000 words).

**Workshop/Conference Reports:** Summarize workshops, etc. organized or sponsored by Health Canada (maximum 3,000 words).

**Cross-country Forum:** For authors outside of Health Canada to exchange information from research or surveillance findings, programs under development or program evaluations (maximum 3,000 words).

## Additional Article Types

**Letters to the Editor:** Comments on articles recently published in CDIC will be considered for publication (maximum 500 words).

**Book/Software Reviews:** Usually solicited by the editors (500–1,300 words), but requests to review are welcomed.

## Submitting Manuscripts

Submit manuscripts to the Editor-in-Chief, Chronic Diseases in Canada, Population and Public Health Branch, Health Canada, Tunney's Pasture, CDIC Address Locator: 0602C3, Ottawa, Ontario K1A 0L2, e-mail: cdic-mcc@hc-sc.gc.ca.

Since CDIC adheres in general (section on illustrations not applicable) to the "**Uniform Requirements for Manuscripts Submitted to Biomedical Journals**" as approved by the International Committee of Medical Journal Editors, authors should refer to this document for complete details before submitting a manuscript to CDIC (see **< www.cma.ca/publications/mwc/uniform.htm >** or Can Med Assoc J 1997; 156(2):270–7).

## Checklist for Submitting Manuscripts

**Cover letter:** Signed by all authors, stating that all have seen and approved the final manuscript and have met the authorship criteria of the Uniform Requirements and including a full statement regarding any prior or duplicate publication or submission for publication.

**First title page:** Concise title; full names of all authors and institutional affiliations; name, postal and e-mail addresses, telephone and fax numbers for corresponding author; separate word counts for abstract and text.

**Second title page:** Title only; start page numbering here as page 1.

**Abstract:** Unstructured (one paragraph, no headings), maximum 175 words (100 for short reports); include 3–8 key words (preferably from the Medical Subject Headings (MeSH) of Index Medicus).

**Text:** Double-spaced, 1 inch (25 mm) margins, 12 point font size.

**Acknowledgements:** Include disclosure of financial and material support in acknowledgements; if anyone is credited in acknowledgements with substantive scientific contributions, authors should state in cover letter that they have obtained written permission.

**References:** In "Vancouver style" (consult Uniform Requirements and a recent CDIC issue for examples); numbered in superscript (or within parentheses) in the order cited in text, tables and figures; listing up to 6 authors (first 3 and "et al." if more); without any automatic reference numbering feature used in word processing; any unpublished observations/data or personal communications used (discouraged) to be cited in the text in parentheses (authors responsible for obtaining written permission); authors are responsible for verifying accuracy of references.

**Tables and Figures:** Each on a separate page and in electronic file(s) separate from the text (not imported into the text body); as self-explanatory and succinct as possible; not duplicating the text, but illuminating and supplementing it; not too numerous; numbered in the order that they are mentioned in the text; explanatory material for tables in footnotes, identified by lower-case superscript letters in alphabetical order; figures limited to graphs or flow charts/templates (no photographs), with software used specified and titles/footnotes on a separate page.

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