To: Canadian Council for Tobacco Control

From: Groupe d'Analyse Économique

Date: April 9, 2002

Re: Impact of an anti-tobacco campaign on direct health care costs in Canada

1. INTRODUCTION

The Groupe d'Analyse Économique recently released a study on tobacco-related health care costs in Québec. This study concluded that a combined decrease of 1% in smoking prevalence and of one cigarette per day among daily smokers would translate into annual savings of $10 to $20 million for the Québec health system. In the present study, these estimates are relied upon to generate comparable figures for Canada. The methodology is also extended to include additional diseases and assess the robustness of these estimates.

2. TOBACCO CONSUMPTION AND HEALTH CARE COSTS

Tobacco consumption is by far the most important risk factor for lung cancer[1] and is also a significant risk factor for other diseases including heart diseases, chronic obstructive pulmonary diseases (COPD), and cancer of the mouth.[2] Decreasing tobacco consumption could therefore reduce health care costs, and increase the quality of life of those who stop smoking or decide not to start.

This study measures such reductions in health care costs with a multivariate regression analysis that provides a statistical link between tobacco consumption and the incidence of certain diseases. The analysis only accounts for direct health care costs, such as hospitals, physicians, and research. Indirect costs such as productivity losses are not included; therefore, estimates provide a lower bound and may understate true total costs. Three sets of results are presented. The first builds on previous estimates used in the Québec study, the second extends the methodology to additional diseases, and the third tests the

1 Surgeon General, Reducing the health consequences of smoking: 25 years of progress, Washington, D.C.: U.S. Government Printing Office, 1989, cited by Health Canada : <http://www.hc-sc.gc.ca/hpb/lcdc/bc/updates/lung_f.html#2> (site visited on February 28, 2001). Also, see Schairer, E. and E. Schoniger, "Lung Cancer and Tobacco Consumption," *International Journal of Epidemiology,* 2001 (30) pp. 24-27.

2 Makomaski Illing, E. M. and M. J. Kaiserman, "Mortality Attributable to Tobacco Use in Canada and its region, 1991" *Canadian Journal of Public Health,* July-August 1995, pp. 257-265 and Makomaski Illing, E. M. and M.

methodology to assess the robustness of results using two alternatives. The effects of an anti-tobacco campaign are then simulated based on these estimates.

Lung Cancer and Heart Diseases

The results indicate that a 1% reduction in smoking prevalence in Canada may be associated with a decrease of 4,85 cases of heart disease per 100,000 people and 0,44 cases of lung cancer per 100,000 people. Moreover, a decrease of one cigarette smoked per day for daily smokers may be linked to a 3.2 per 100,000 decrease in lung cancer. For the country as a whole, this implies that in 1999, every combined decrease of 1% in smoking prevalence and of one smoked cigarette per day for daily smokers could be associated with a 1,479 reduction in cases of heart disease cases and 1,108 in cases of lung cancer. These translate into health care cost savings of $39.5 million.[3] Since these two conditions represent 28.9% of tobacco related hospital days[4], the maximum health care costs savings could amount to $39,5 million / 28,9% = $136,7 million following a decrease of 1% in smoking prevalence and of one smoked cigarette per day among daily smokers. Such calculations assume that the unit cost of treatment for other tobacco-related diseases are similar to that of heart disease and lung cancer. A more conservative estimate may fall between $40 million and $80 million. This range is comparable to others found in the literature as indicated below:

	Health care cost savings due to a reduction of 1% in smoking prevalence
Groupe d'Analyse Économique[5]	$39,5 million to $136,7 million (or $40 to $80 million)
The Costs of Substance Abuse in Canada[6]	Up to $96,6 million
Lightwood and Glantz[7]	$23,0 million (cardiovascular diseases and acute myocardial infarction only)

J. Kaiserman, "Mortality Attributable to Tobacco Use in Canada and its region, 1994 and 1996," <http://www.hc-sc.gc.ca/hpb/lcdc/publicat/cdic/cdic203/cdc203b_e.html> (site visited on February 21, 2001).

3 The costs of these conditions is derived from *Economic Burden of Illness in Canada, 1993*, <http://www.hc-sc.gc.ca/hpb/lcdc/publicat/burden/table2_e.html> (site visited on February 20, 2001) and Evans, W. K., B. P. Will, J.-M. Berthelot and M. C. Wilson, "The Economics of Cancer Management in Canada," *Lung Cancer* 14, 1996, pp. 19-29. The number of cases for each condition is provided by Health Canada: <http://cythera.ic.gc.ca/dsol/> (site visited on February 28, 2001 and April 2, 2001) and the health care price index is from Statistics Canada (Matrix 9940, Databank Number P100200). The number of cases of COPD is based data from the Canadian Institute for Health Information.

4 Main other tobacco-related diseases are COPD, and cardiovascular diseases. These represent 17,4% of deaths and 39,7% of hospital days due to tobacco. More recent estimates are available for mortality, but to our knowledge, not for hospital days. Source: Single et al., *The Cost of Substance Abuse in Canada*, June 1996.

5 The higher estimate is due to a combined decrease in smoking prevalence and the number of cigarettes smoked per day.

6 Single, E. et al., *The Costs of Substance Abuse in Canada*, Canadian Centre on Substance Abuse, June 1996, Statistics Canada and Health Canada. This amount represents an average decrease following a long-term reduction in the prevalence of tobacco consumption. The marginal cost savings due to a decrease in tobacco consumption are likely to be lower than this average savings in the short run, but higher in the long run.

7 Lightwood, J., M. and S. A. Glantz, "Short-term Economic and Health Benefits of Smoking Cessation; Myocardial Infarction and Stroke," *Circulation*, 96(4), 1997. Based on an exchange rate of 1,5 $CAN / $US

Extension to Other Conditions

To generate a better estimate of tobacco-related health care costs, we included other conditions in the econometric estimations and tested different methodologies. Specifically, cancer of the mouth (ICD-9: 140-149), COPD (ICD-9: 496) and cardiovascular diseases (ICD-9: 430-438) were added to the sample. These conditions, along with lung cancer and heart diseases, account for about 70% of all hospital days due to tobacco consumption.[8]

Based on this new methodology, a 1% decrease in smoking prevalence is associated with a decrease of 73 cases of cancer of the mouth and 1,181 COPD cases in Canada.[9] Annual health care cost savings for these two conditions, heart diseases and lung cancer amount to $52.6 million for Canada. This estimate is in the $40 to $80 million range described earlier. Adding cardiovascular diseases and other tobacco-related conditions (other pulmonary diseases, emphysema, etc.) to this estimate would likely result in cost estimates close to the upper bound of the range.

Testing robustness with other econometric models

A potential problem with the above methodology is that a decrease in the incidence of a disease may result from factors other than lower tobacco consumption and affecting all of Canada. For example, a hypothetical regular and Canada-wide decrease in fat intake may have a negative impact on the incidence of heart diseases across Canada. If this lower fat intake is correlated with the reduction in smoking prevalence, the preceding methodology will overestimate the impact of tobacco consumption on health care costs. In order to avoid such a statistical bias, regressions were re-estimated based on the relative incidence of disease of the Canadian provinces compared to Ontario and a similarly built relative smoking prevalence. By including the *ratio* of incidence and prevalence for different provinces over incidence and prevalence for a province of reference, it becomes possible to measure the impact of tobacco consumption exclusive of any time-varying factor.[10]

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and the Canadian health care price index, as well as on Canadian and US populations of 30,750,087 and 267,636,061, respectively.

8 Single, E. et al., *The Costs of Substance Abuse in Canada*, Canadian Centre on Substance Abuse, June 1996.

9 Econometric estimations with cardiovascular diseases were unstable depending on the model used and were therefore omitted from the results. Including them would have resulted in a substantial increase of tobacco-related health care costs and we made the (conservative) choice not to include them in the estimates. These regressions seemed to point to long delays in the effect of tobacco consumption on cardiovascular diseases, a situation that would require more data and further analysis. These conclusions seem to be at odds with the existing literature on the topic.

10 A dummy variable was included for the province of Québec since consumption habits are different in that province.

These regressions confirm previous results: for each reduction of 1% in smoking prevalence, the effects are as follows:[11]

Disease	Decrease in number of cases	Savings in health care costs (million of $)
Cancer of the mouth	62	1.8
Lung cancer	98	2.3
Heart disease	2 835	26.0
Cardio-vascular disease	592	19.5
COPD	1 263	16.1
Total		65.7

The small reduction in the number of lung cancer cases is due to the non-inclusion of the number of cigarettes smoked per day in the regression. Including this variable and assuming an annual unit per day decrease in cigarette smoking among smokers, the decrease in the number of lung cancer increases from 98 to 1,078 and related cost savings increase from $2.3 million to $25 million. This yields a total of $88.6 million in health care cost savings. The lung cancer results suggest that this type of cancer is related to heavy smoking, and that there are complex statistical and accounting interactions between the number of cigarettes smoked per day and smoking prevalence. Since these interactions are impossible to model in the context of the present analysis, it is difficult to improve on the $65,7 million to $88,6 million range. This is, again, consistent with the previous range of $40 million to $80 million.

Another potential problem with the current methodology is the effect of lags between tobacco consumption and the incidence of tobacco-related diseases. Measuring these delays usually requires micro-data on a cohort of individuals followed over an extended time periods. To our knowledge, such data do not exist in Canada and the data relied upon in this study preclude such analysis. It is therefore possible that the current model captures the relationship between past decreases in tobacco consumption and current levels of illness. Various models were tested to assess such delayed effects[12] but data limitations resulted in imprecise and unstable estimates.

However, the lag analyses suggested that, for all diseases considered, past reductions in smoking prevalence have a stronger influence than contemporary reductions. Therefore, since the results of our

[11] With this specification, the regression on cardiovascular diseases is much more stable and it was decided to keep the results.

[12] Lags were modeled with Koyck and Almon processes (see Johnston, J., Econometric Methods, Third Edition, McGraw-Hill Publishing Company, 568 pages).

analyses omit these dynamic considerations (because of the non-availability of the data), they probably understate health care cost savings resulting from reduced tobacco consumption.

3. THE CALIFORNIA TOBACCO REDUCTION PROGRAM

The reduced incidence of many diseases following a decrease in tobacco consumption has lead many states to engage in tobacco reduction programs. For example, the State of California set up a program that helped reduce tobacco consumption from 23% to 17% in 7 years.[13] The per capita cost of that program was $3,35 US from 1989 to 1993, $2,08 US from 1993 to 1996 and $2,52 US in 1999. Using this same amount per capita and an exchange rate of 1,5 $CAN/$US, this translates into $115,3 million for Canada in 1999. For that year, 25% of the Canadian population was smoking, against 18,7% in California, 19,4% in Massachusetts and 13,2% in Utah; this suggests that there is room for a substantial decrease in Canada. Assuming that a tobacco reduction program equivalent in size to that of California had a comparable effect in Canada, it is possible to estimate the cost and benefit of such a program for Canada.

4. IMPACT OF A CANADIAN ANTI-TOBACCO PROGRAM ON HEALTH CARE COSTS

Cost savings due to a tobacco reduction program are estimated over a ten-year period based on two scenarios. The first assumes that the cost of the program and its impact are similar to that of California prorated for Canada, with a $115.3 million budget, and annual decreases of 1% in smoking prevalence and of one smoked cigarettes per day for daily smokers. Health care cost savings are assumed to be $52.6 million, $65.7 million or $88,6 million.[14] A second scenario based on an annual budget of $150 million leads to proportionally higher reductions of 1,2% in smoking prevalence and of 1,2 smoked cigarettes per day for daily smokers.[15] Health care cost savings are assumed to be $52.6 million, $65.7 million or $88,6 million for a combined decrease of 1% in smoking prevalence and of one smoked cigarettes per day for daily smokers.

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13 Tobacco Control Section, California Department of Health Services, *California Tobacco Control Update*, Sacramento, California: August 2000.

14 The $52.6 million estimate does not include cardiovascular diseases and the $65.7 million estimate does not include the impact of a decrease in the number of cigarettes smoked daily. Moreover, these three possible values do not include the impact of past reductions in tobacco consumption and therefore underestimate the true value of cost savings that lower tobacco consumption could bring.

15 The study released on April 3, 2001 simulated the impact of a 1,5% drop in prevalence of tobacco consumption and of a reduction of 1,5 smoked cigarettes per day. Since Tobacco consumption is lower in Canada than in Québec, such reductions would be unrealistic and the second scenario was reduced to 1,2% and 1.2 cigarettes per day.

After ten years under the first scenario, the program saves $2.51 to $4.23 for each dollar invested. The second scenario is more aggressive, with an annual cost of $150 million and annual reduction in prevalence and consumption of 1.2% and 1.2 cigarettes per day. Even though the overall return of the program decreases (from $2.32 to $ 3.90 in benefits for each dollar invested), it is still profitable and generates a net benefit greater than the first scenario.

	Scenario #1	Scenario #2	Scenario #3
Annual decrease in the smoking prevalence	1%	1%	1%
Annual decrease in the number of cigarettes smoked per day	1	0	1
Annual cost of the program (millions of $)	115.3	115.3	115.3
Health care costs savings for a decrease of 1% in smoking prevalence and of one smoked cigarette per day among daily smokers[16]	52.6	65.7	88.6
Benefit (millions of $)	2,895.2	3,614.9	4,874.8
Total cost of the program (millions of $)	1,152.6	1,152.6	1,152.6
Net benefit (millions of $)	**1,742.6**	**2,462.3**	**3,722.2**
Benefits / Costs	2.51	3.14	4.23
Smoking prevalence after ten years	15%	15%	15%

	Scenario #1	Scenario #2	Scenario #3
Annual decrease in the smoking prevalence	1.2%	1.2%	1.2%
Annual decrease in the number of cigarettes smoked per day	1.2	0	1.2
Annual cost of the program (millions of $)	150.0	150.0	150.0
Health care costs savings for a decrease of 1% in smoking prevalence and of one smoked cigarette per day among daily smokers[17]	52.6	65.7	88.6
Benefit (millions of $)	3,474.3	4,337.9	5,849.8
Total cost of the program (millions of $)	1,500.0	1,500.0	1,500.0
Net benefit (millions of $)	**1,974.3**	**2,837.9**	**4,349.8**
Benefits / Costs	2.32	2.89	3.90
Smoking prevalence after ten years	13%	13%	13%

[16] Defined as a combined reduction of 1% of the smoking prevalence and of one smoked cigarette per day of the daily cigarette consumption among daily smokers, except in the second scenario.

[17] Defined as a combined reduction of 1% of the smoking prevalence and of one smoked cigarette per day of the daily cigarette consumption among daily smokers, except in the second scenario.