

ECONOMICS OF HEALTH COSTS DUE TO ENVIRONMENTAL DISEASE

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Introduction

Within the last few years there has been a substantial publishing of both evidence and argument concerning real injury, and serious threats, to human health from exposures to persistent toxic substances. These publications have emerged in fairly rapid succession from independent scientists, government agencies, and non-government public interest groups. The most recent of these publications have focused on the implications of environmental contaminants, particularly neurotoxic chemicals, for children's development and health.

With this information as backdrop, the Great Lakes Science Advisory Board's Workgroup on Ecosystem Health selected several of the effects or outcomes suggested by the science for analysis from a societal and economic perspective. The selected effects include: diabetes; Parkinson's Disease; hypothyroidism; and effects on the Intelligence Quotient or IQ. Where possible, costs associated with sequelae possibly related to hypothyroidism or other neurotoxic mechanisms, such as autism, attention deficit-hyperactivity disorder (ADHD), dyslexia, and violent behaviour are also covered. The full results of this analysis were presented as a workshop paper which has been submitted for publication as part of the proceedings (1). This paper will summarize key findings.

Methods and Materials

The methods used involve the examination of several lines of evidence, including empirical, methodological, and theoretical. First, the literature was reviewed to determine the evidence leading to the published concerns that exposures to environmental agents, particularly persistent toxic substances, are plausible risk factors to children, and the chosen effects or outcomes.

Second, literature was reviewed to gauge and assess the extent to which approaches and methodology to measure such financial and economic costs and impacts, in general, are developed, and the extent to which case studies on our chosen outcomes have been undertaken. Where such methodologies and case studies existed, they were either cited, adapted, updated, or expanded.

Third, where no existing studies were found that evaluate or cost any of the selected effects, primary data sources were searched for, and where possible, estimates were made using the existing methodologies and/or economic theory. Throughout this exercise, efforts were made to develop estimates for both Canada or Canadian jurisdictions, and American as well.

Results and Discussion

The emergent evidence, and resulting concern, expressed in the literature by both government and non-government bodies and agencies, and by scientists, can be seen together with data on the costs of health care in Canada and the United States. The evidence of injury, and the health care and economic costs correlate and reflect one another. However, as an indicator of damage, it must be stressed that medical expenditures are just a proxy measure and underestimate of the value of avoiding an illness, or preventing disease.

In the United States, actual national health expenditures (public and private) totaled almost \$1.1 trillion in 1997, or almost \$4,000 per person, and 13.5% of GDP. These expenditures are projected to total \$2.2 trillion by 2008, or almost \$7,200 per person, and 16.2% of GDP). In Canada, actual national health expenditures (public and private) totaled almost \$77 billion in 1997, or just over \$2,500 per person, and 8.9% of GDP. These expenditures in 1999 amounted to about \$86 billion, or more than \$2,800 per person, and 9.2% of GDP.

There are also other direct costs that are non-medical, such as food, transportation, lodging and institutional care, compensatory educational costs, family care and in-home education, home aids, and clothing. In addition, there is another category of indirect costs, other economic, financial, personal, and social impacts and costs that are additional. Indirect costs are those that occur because of loss of potential, or loss of life or livelihood due to sickness, disability, and even death. These costs may occur because of decreased earning ability when working, or because of long-term disability that necessitates a change in type of work, or even the inability to work altogether. For example, these may be related to a decrease in productivity due to absence from work, decreased earnings potential because of potential disabilities, lost earnings due to premature mortality, and increased insurance costs.

Other intangible costs, while difficult to measure, are real nonetheless. These include the costs of pain and suffering, dread and the type of death, grief, the loss of quality and enjoyment of life, loss of life years, loss of companionship and social contact, and other non-financial outcomes of disease and medical care, including side effects of medication with pharmaceuticals.

In summary of the general results, it can be stated that the concerns about the effects on human health of exposures to PTSs, and other chemicals as well, are substantively based on the weight of evidence and the emerging science. It can also be stated that the overall, or total health expenditures incurred in both Canada and the United States are an enormous and substantially growing burden. These societal costs directly reflect a disease burden in both adults and children that contains an unknown but significant component with environmental causation as a candidate since known risk factors cannot account for it.

While this basic conclusion has been variously stated in several reports and scientific publications, it is perhaps best put in a recent (June, 2000) scientific publication of the U.S. Public Health Service, National Institutes of Health:

"An association has been found between exposure to toxic chemicals and various neuro-developmental disorders such as learning disabilities, intellectual retardation, dyslexia, attention

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deficit/hyperactivity disorder, autism, and propensity to violence. Timing of exposure can be critical to the development of these disorders that currently affect millions of children" (2)

This review found evidence of concern that environmental agents are causing clinical disease in humans, and that children are at particular risk. It also found that methodologies exist to document and estimate the societal, economic, and personal costs associated with this environmentally related disease, and has reviewed and reported on several studies that have provided such estimates.

Table 1 is a highly aggregated compilation of all the costs which were identified or estimated for each case study effect, and by jurisdiction. Recall and note that these costs are very incomplete in most cases, either by type of cost or by jurisdiction.

The grand totals are as follows.

TABLE 1 TOTAL CUMULATIVE COSTS IDENTIFIED	
Total Actual Health Care Expenditures Per Year (Canada & U.S.)	\$1.19 trillion
Cost of Diabetes (Canada & U.S.)	\$111.573 billion annually
Cost of Parkinson's Disease (Ontario & U.S.)	\$13.018 billion - \$28.518 billion annually
Cost of Hypothyroidism (Ontario)	\$8.691 million annually
Costs Associated With Hypothyroidism (Ontario & U.S.; plus Canada Ritalin costs)	\$56.739 billion to \$114.673 billion annually
Loss in earnings per IQ point decrement (Canada & U.S.)	\$59 billion - \$69 billion annually
Total income loss per year due to a hypothetical 5 point IQ decrement (Canada and the U.S.)	\$295 billion - \$345 billion annually
Costs Associated with Impacts on Social Costs (Ontario & U.S.)	\$19.124 billion annually
Cost of Dynamic Economic Impacts on Growth and Development (Canada & U.S.)	
Decline of 10% of the residual	(a) \$18.5 billion (current\$) annually
Decline of 50% of the residual	(b) \$92 billion (current\$) annually
Total Cumulative Costs Identified	\$513.963 billion^a - \$710.897 billion^b
<p>a Based on the lower limit of the cost of Parkinson's disease, the lower limit of the loss in earnings per 5 IQ point decrement and the decline of 10% of the residual in the calculation of the cost of the dynamic economic impacts on growth and development.</p> <p>b Based on the upper limit of the cost of Parkinson's disease, the upper limit of the loss in earnings per 5 IQ point decrement and the decline of 50% of the residual in the calculation of the cost of the dynamic economic impacts on growth and development.</p> <p>NOTE: The "residual" is that part of the growth in national output or income that cannot be explained by increases in the factors of production, and historically accounts for more than half of this growth. It is therefore referred to as "technical change" or technical progress, which is dependent in part on the quality of human capital.</p>	

It is beyond the scope of this report to factually determine what proportion of this grand total cost is attributable to environmental causes, such as PTSs and other chemical and physical agents. Most, if not all of these diseases are multi-factorial, and may involve an environment-genetic interaction.

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However, some of these diseases appear to be of recent origin, that is post-industrial age (e.g. Parkinson's Disease), and/or are of epidemic proportions (Diabetes, and Childhood Developmental Disorders), and/or are featured by recent, large increases in prevalence. In all cases it seems that very little is really agreed upon about what actually causes or triggers the disease, however, there are known associations in all cases with environmental agents. In general, a low proportion of cases are explainable by known risk factors, perhaps around 30% or less. These known risk factors include genetics, diet, smoking, and occupation, however, as we learn more we find that these factors can have important interactions with environmental agents and associated cumulative effects, may be co-factors, and may be downstream in time in the causal process.

In the absence of a specific determination of the proportion of these diseases that are explained, by either environmental or other causes, one can only proceed to posit reasonable and alternative hypotheses about these proportions. There are a great many toxic and neurotoxic agents freely circulating in the environment and all people and potential progeny are constantly exposed to these complex mixtures and have been for many decades. Given this reality, it is neither reasonable nor prudent to assume that all these agents together have a zero effect on the human population. At the IJC Workshop, the participants were asked if any of them thought there were zero effects and no one responded yes. Therefore, it would seem reasonable to posit that at least 10% of these costs are due to environmental causes. That would yield a minimum attributable cost of \$51 to \$71 billion per year.

If one were to consider the likelihood that some of these diseases have a greater than average environmental causation (e.g. Parkinson's Disease, Childhood Developmental Disorders and IQ decrements, and possibly diabetes), then a reasoned argument can be made to increase the proportion of the costs due to environmentally induced disease. A hair-splitting solution would apportion the prevalence equally; so a 50% proportion would emerge that way. This involves an attributable cost for the subject case studies of between \$257 billion and \$356 billion per year.

It would be useful to assemble knowledgeable people to weigh the evidence, and to involve trans-disciplinary methods, in an effort aimed at a reasonable estimate of the likely *environmental burden of diseases such as those considered here*. In addition, more work is needed to expand the scope of the review and analysis reported on here. The entire burden of human disease should be considered in terms of environmental causation as a preventable factor. Accounting for the economic and social costs can contribute to a better understanding of the real scope of the many issues raised by polluted environments.

References

1. Tom Muir, and Mike Zegarac. 2000. Societal Costs of Exposure to Persistent Toxic Substances: Economics of Health Costs Due to Environmental Disease. Paper prepared for a Workshop on Methodologies for Community Health Assessment in Areas of Concern. Sponsored by the International Joint Commission, Great Lakes Science Advisory Board, Workgroup on Ecosystem Health. (Manuscript submitted for publication in EHP as part of workshop proceedings).
2. U.S. Dept. of Health and Human Services, National Institutes of Health. "Developing Brain and Environment: Critical Windows of Exposure for Children." *Environmental Health Perspectives* 108 (Supplement 3): June 2000. Pp 363-600.