A MODEL FOR ESTIMATING THE ECONOMIC IMPACT OF FETAL ALCOHOL SPECTRUM DISORDER

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ABSTRACT

Background
Fetal alcohol spectrum disorder (FASD) is a group of disorders with lifelong disabilities that require a large amount of support from various services including health, community, remedial education, and many others. Thus, FASD has a huge economic and societal impact.

Objectives
To develop a sound methodology for calculating a comprehensive, evidence-based picture of the economic impact of FASD for Canada.

Methods
The economic model was developed within the framework of the revised International Guidelines for Estimating the Costs of Substance Abuse. In addition, the Guidelines generated during the first national Roundtable held by the Public Health Agency of Canada were employed. The methodologies of the few existing studies on the economic cost of FASD from Canada and USA were also considered.

Results
A new and comprehensive methodology for estimating of the economic impact of FASD is presented. The model includes the direct and indirect costs associated with the experiences of those affected by FASD, as well as those of their families/caregivers during multiple life/developmental stages. Preliminary cost estimates for the main cost drivers for Canada are presented.

Conclusion
The developed methodology is appropriate for use in Canada, and has the potential to be used by other countries. The challenges associated with implementing the economic model and estimating the economic costs of FASD are discussed, as are the levels of analysis.

Key Words: *Fetal alcohol spectrum disorder (FASD); fetal alcohol syndrome (FAS); economic cost; methodology*

Fetal alcohol spectrum disorder (FASD) is a group of disorders caused by maternal alcohol consumption. FASD is a non-diagnostic umbrella term that covers several alcohol-related medical diagnoses, including: fetal alcohol syndrome (FAS), partial fetal alcohol syndrome (pFAS), alcohol-related neurodevelopmental disorder (ARND), and alcohol-related birth defects (ARBD). The complexity and chronicity of FASD impacts both the individual and their family, and requires a wide range of assistance from services including health, community, remedial education and others. As a result, FASD has a huge economic and societal impact as those affected suffer a lifelong disability and may require long-term support.[1-7] Therefore, the estimation of the cost of FASD, especially, lifetime cost, is central to describing

the extent of its impact on society and to evaluating the benefits of prevention programs to society and, thus, is useful from a public policy perspective.

A recent systematic literature review conducted by the authors of this paper revealed that, currently, there are no comprehensive assessments of the economic impact of FASD in Canada, or for any other countries.[8] The few existing cost evaluation studies in Canada[7;9;10] and the United States[1;2;11-20] limit the number of cost components included, are inconsistent with one another, or are limited in their generalizability. Even though many cost components have been taken into account in these studies, the total cost associated with FASD is still significantly underestimated. This is due to the fact that several major cost components (i.e., cost of children in care, law enforcement costs, supportive housing, cost of research and prevention, and intangible costs) were not included in the studies to date, likely because of data-availability issues.

Regardless, it is very important to include all contributing cost components in order to get an accurate and valid estimate, or one as close to the reality as possible. There is an urgent need to provide accurate estimates of FASD that would encompass the diverse aspects and sectors associated with the FASD, not only in Canada, but in other countries as well.

The development of an economic impact model requires strong cross-jurisdictional and cross-sectoral partnerships. Therefore, the Public Health Agency of Canada (PHAC) has taken the lead in defining the components of a life pathway model for calculating the cost of FASD.[21] The primary objective of this study was to develop a sound methodology for calculating a comprehensive, evidence-based picture of the economic impact of FASD for Canada.

METHODS

The economic model was developed within the framework of the revised International Guidelines for Estimating the Costs of Substance Abuse.[22] In addition, recommendations on the analytic framework, components and concepts of a general Canadian model for calculating the economic impact of FASD, which arose from the first national Roundtable held by the PHAC in March 2007, were used as a guideline for developing this methodology.[21]

The methodologies of the few existing cost studies from Canada and the USA analyzed in the review mentioned above were also taken into consideration.[8]

Data on the various systems and services required by FASD-affected individuals was collected and consolidated in order to determine all of the cost components required in a comprehensive cost model. The major principle underlying the decision regarding which costs to include is the robustness of the estimate, which is in turn dependent on the availability of data.

RESULTS

Proposed Methodology for Estimating the Economic Impact of FASD

Determining the main approach of the study

It is suggested that the study of the social costs of FASD in Canada be conducted within the framework of the revised International Guidelines for Estimating the Costs of Substance Abuse[22] and can be characterized as a cost-of-illness (COI) study. Accordingly, in this study, the impact of FASD on the material welfare of the Canadian society is examined by analyzing the direct costs of resources expended for treatment, law enforcement, special education, prevention, research, etc., as well as indirect costs of productivity losses of FASD-affected individuals due to their increased morbidity and premature mortality. The productivity losses of parents/caregivers due to caring of FASD-affected individuals are also considered.

These International Guidelines, developed by several well-known world experts in the field and produced by the Canadian Centre on Substance Abuse (1st edition) and the World Health Organization (2nd edition), present a general framework for the development of valid and credible estimates of the economic costs of substance abuse by exploring definitional and methodological issues and data requirements.[23] In addition, using these guidelines will enhance the comparability of such estimates with other countries.

We propose to use a modified prevalence-based *human capital approach*, which is conceptually based on opportunity costs. The

human capital approach measures the value of lost productivity in terms of expected future earnings of people who die prematurely from substance abuse (in this case, due to FASD). A prevalence-based approach measures the current year costs based on new cases and previously existing cases. Costs are resources spent on an activity that could have been spent otherwise, and thus are lost to other streams. In other words, if there had been no cases of FASD in Canada, the resources invested in the treatment of these cases could have been used elsewhere. This approach makes it clear that the current situation is to be compared to a *counterfactual scenario*. In this case, the scenario of no past or current use of alcohol up to, and including, 2011 should be used. Under these circumstances, there would be no cases of FASD in Canada in a specific year (up to and including 2011) and thus, no need to provide treatment and services for these people. The counterfactual milieu just described captures the general use of the counterfactual scenario assumptions underlying this study.

Definition of costs (social costs versus private costs)

In COI studies, only the social costs are considered. In the economic literature, "social costs" are referred to as "external costs" or "externalities". The major direct costs considered are external costs (i.e., those costs borne by individuals other than the person with the substance abuse problem). The International Guidelines do not recommend including "private cost" in social cost estimates. Private costs (such as costs of purchasing alcohol, and transfer payments - welfare payments to persons disabled by substance abuse) are not included in cost estimates.[22] Even though the family burden and costs associated with caring for a person with FASD are high, they should be estimated in a separate analysis. For more discussion on private and social costs please see references. [23,24]

Welfare costs

A certain proportion of individuals with FASD are users of social services of various kinds, including physical support services (e.g., the provision of supported accommodation) or income support (e.g., unemployment or disability benefits, sickness benefits). The welfare costs involved relate to payments borne by the province/territory. It is important to ensure that double counting of costs and benefits does not take place.[22,23] If an individual with FASD receives welfare benefits it would be inaccurate to include both the productivity losses and the cost of welfare benefits. Therefore, only the welfare administrative costs for individuals with FASD and their caregivers should be included in the estimation of the economic cost of FASD. Welfare payments to people with FASD should not be included.

Tangible versus intangible costs

Tangible costs can be defined as costs which, when reduced, yield resources that are then available to the community for consumption or investment purposes. Intangible costs, which include pain, suffering, stress, and bereavement, when reduced or eliminated do not yield resources available for other uses when reduced or eliminated.[22] Intangible costs are borne by all people involved (i.e., FASD-affected individual, siblings, parents/caregivers, etc.). As much of the efforts of the health care system are focused on the reduction of intangible costs, it is apparent that these costs are very important, albeit difficult to quantify. It is extremely difficult to place a value upon intangible costs and the temptation exists to ignore them. However, to do so may lead to misleading and unreasonable results. Thus, it is desirable to assess the intangible impact of FASD on caregivers, patients, siblings and society.

Avoidable costs

This model includes both avoidable costs (saved through effective government and social policy interventions and programming) and unavoidable costs. In comparison with avoidable costs, unavoidable costs will continue to be borne because of existing FASD cases, and because some level of alcohol use/abuse during pregnancy is likely to remain a feature of Canadian society, as well as in many other societies, for the foreseeable future.

Conservative approach and sensitivity analysis

The International Guidelines often allow several methodological alternatives to calculations. However, as a general rule, if several different approaches are possible, we recommend using the more conservative approach (using the lower cost alternatives where appropriate alternatives exist).

Given the potential impact of cost studies, this principle is very important, as different stakeholders will scrutinize the results of cost studies, and, ultimately, the credibility and final impact of the study will depend on the conservativeness of the assumptions. In addition, we recommend conducting sensitivity analyses on the main assumptions with different options, which will allow the reader and policy maker to determine costs for alternative assumptions that they consider more likely.

Indirect costs: Productivity losses of FASD-affected individuals and their parents/caregivers

The cost of productivity losses due to FASD-attributable premature death or permanent disability should be estimated using a modified human capital method which assumes that prematurely deceased workers can be replaced from a pool of available unemployed workers across an average replacement period of 3 months.[25] Productivity losses should be calculated as the sum of lost wages for the replacement period and the monetary value of leisure that the replacement workers' forgo for paid work, assuming that the societal opportunity cost of their leisure (i.e., the cost of sacrificed leisure) equals their marginal reservation wage (i.e., the lowest wage at which they are willing to work). As recommended by the Canadian Coordinating Office for Health Technology Assessment[26], a discount rate of 5% (the most commonly used) should be used in order to maximize comparability with other cost studies.

Productivity costs due to premature mortality

The productivity cost of premature mortality should be calculated as the sum of the cost to replace the prematurely deceased worker (estimated based on gender-specific average wage, adjusted for gender- and age-specific labor force participation) and the discounted present value of the replacement worker's projected future stream of marginal reservation wages, adjusted for productivity growth as well as gender- and age-related labor force participation, using the aggregate numbers of years of potential life lost by gender and age group.

Productivity costs due to morbidity

a) Productivity losses of FASD-affected individuals

Some proportion of individuals with FASD can have different degrees of mental impairment and/or other physical disabilities; therefore, these individuals are unlikely to achieve a level of productivity comparable to the general population. Productivity losses due to permanent disability of FASD-affected individuals can also be estimated using the modified human capital method.

In addition, methods used by the American cost study[15] for estimating productivity losses by FAS individuals can also be utilized. This study assumes that each level of mental impairment correspond to an expected level of productivity reduction. The severe to profoundly mentally impaired (2.5% of the total FAS population) are expected to be completely disabled (100% reduction in productivity). Forty-five percent of the FAS-affected population experience mild to moderate mental impairment and are considered to have a reduction in productivity of 25% and 50%, respectfully. A productivity reduction of 10% is assumed for those with minimal brain dysfunction.

b) Productivity losses of parents/caregivers of FASD-affected individuals

Productivity losses of parents/caregivers due to caring for FASD-affected individuals can also be calculated using the modified human capital approach and data from the first Canadian study on measuring the burden and cost of prenatal alcohol exposure at the patient level.[7,9] Indirect costs such as productivity losses attributable to days of missed work due to caring for a child with FASD were estimated based on The Health Services Utilization Inventory (HSUI). This estimation allowed for the number of workdays missed by parents/caregivers of FASD-affected individuals to be derived. The value of productivity losses was obtained by multiplying the number of workdays missed by the average daily wage and the average labour force participation rate.

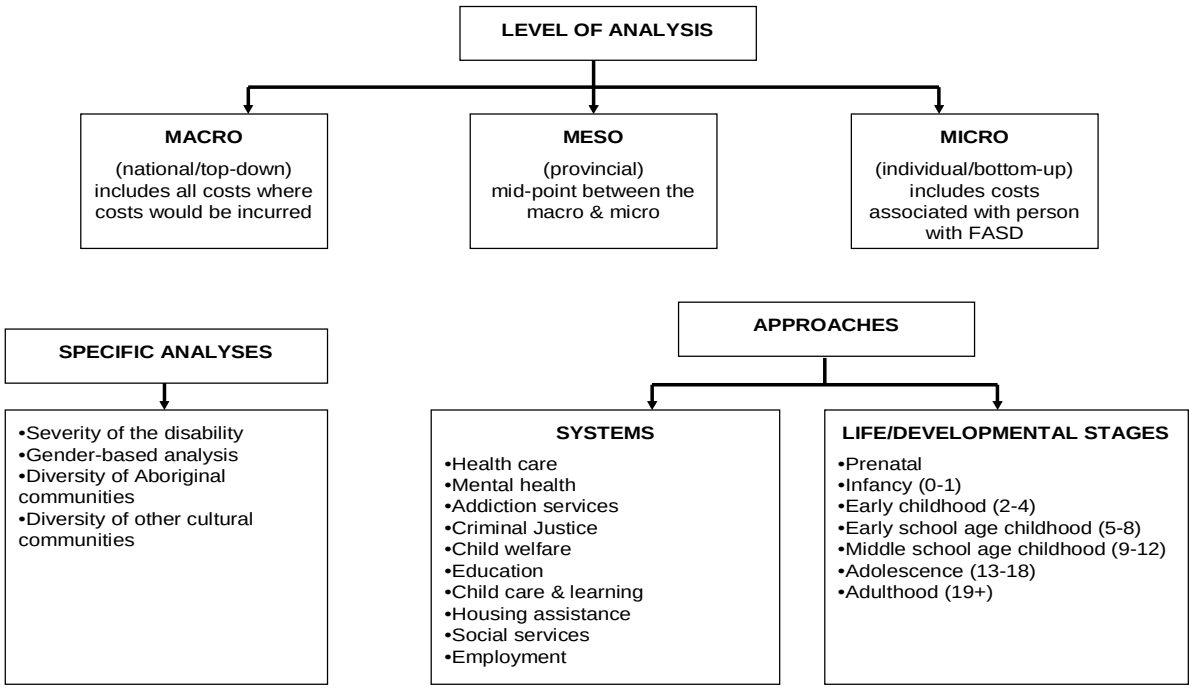
Level of analysis

The analytic level at which the model should be developed must be considered: a macro-level (national level) analysis, a micro-level (individual

level) analysis, or a meso-level (provincial level) analysis. A macro approach will allow for better comparability of data, as it is drawn from various sources, and is more likely to capture costs invested on a national level, however, it is not possible to measure the economic impact without reliable estimates of the national prevalence and incidence rates. A micro approach will allow for an economic impact model to commence in the absence of complete national prevalence data, by utilizing data drawn from sample populations, albeit it is strongly influenced by macro-level events and conditions and has the inherent difficulty of systematic linkage. With this being said, most research is done on a micro level and thus, is a more feasible and practical approach. In regard to a meso-level analysis, extrapolation and data comparison is not always possible.

The levels of analysis, approaches and components in calculating the economic cost associated with FASD are presented in Figure 1.

FIG. 1 Levels of analysis, approaches and components in calculating the economic cost associated with FASD



SPECIFIC ANALYSES

Severity of the disability

The severity of the disability (defined by degree of cognitive delay, behavioural problems, comorbidities, and organ anomalies) needs to be taken into consideration. For example, in the Stade et al.[7] cost analysis, the severity of the disability was significant and a direct predictor of costs. Annual costs per individual with FASD, which included direct costs (medical, education, social services), indirect costs (productivity losses), and out-of-pocket costs increased with the severity of illness: the costs doubled for children

who had a severe disability compared to those children who were mildly affected.

However, this direct relationship between disability and cost may not be the same for all cost drivers. For example, direct health care cost will definitely be greater for those who have more disabilities and impairments (mentally and physically), while the direct cost of law enforcement may be greater for those who do not have significant cognitive delay.

Gender-based analysis

Some studies suggest a gender-specific effect of fetal alcohol exposure on childhood mental health outcomes[27-32], but others have noted no gender differences.[33,34] A gender-based analysis would allow an assessment of the differential economic impact that FASD has on males compared to females, however gender differentiated cost data may be difficult to obtain.

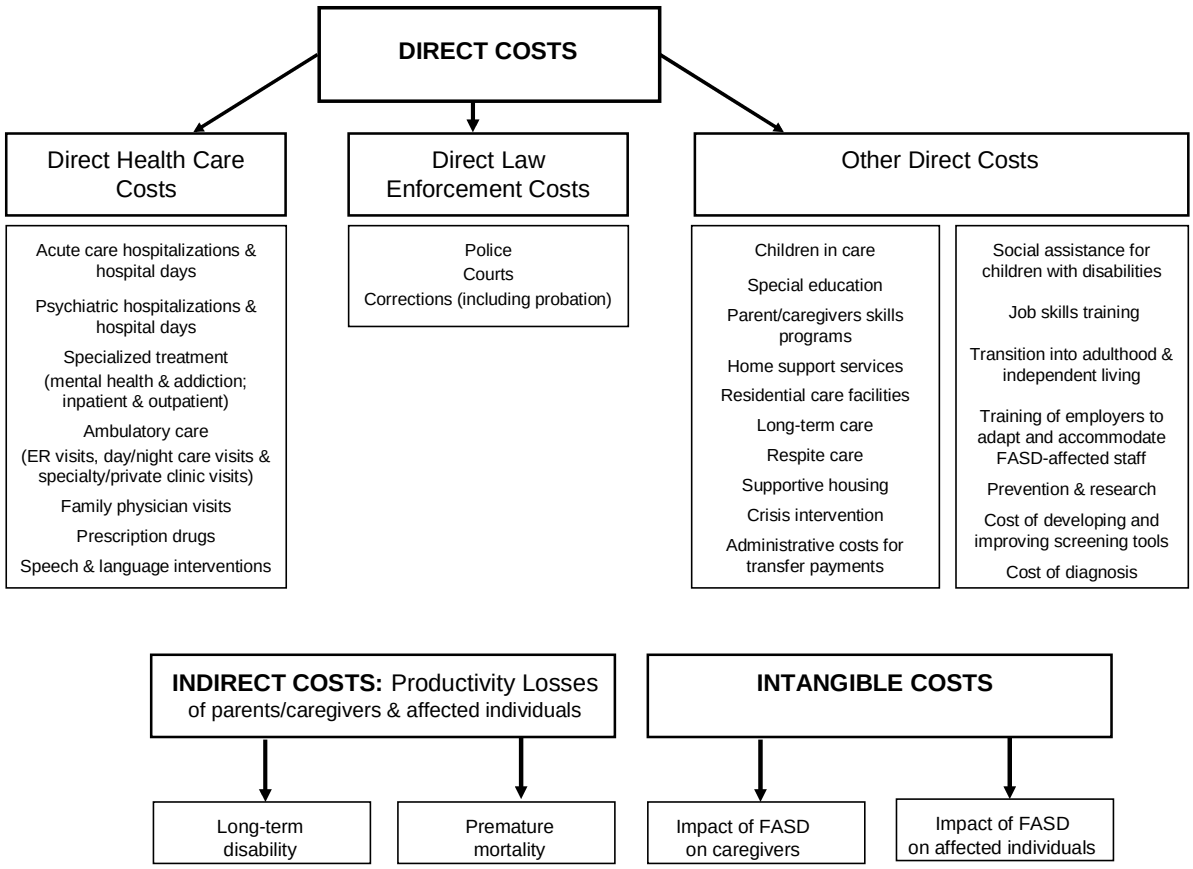
Diversity of Aboriginal communities

The economic impact model should reflect the diversity of Aboriginal communities, not just the diversity between non-Aboriginals and Aboriginals, but also within the Aboriginal population. Aboriginal peoples in Canada comprise the First Nations, Inuit and Métis.

Other cultural communities

Any economic impact model should be culturally appropriate and consider the cultural nature of the country/setting in which it is carried out in. For example, the multicultural nature of Canada has resulted from the immigration of people from all over the world, with this immigration comes variations in levels of education, social norms, and beliefs. These variations can have an impact on any or all cost domains.

FIG. 2 Costs to be included in calculating the economic cost impact associated with FASD



Life/developmental stages

FASD-affected individuals require assistance throughout their lives. Services required, eligibility criteria, and developmental progression, are a few examples of why the costs of FASD at different ages are likely to vary, and in turn why each life stage must be analyzed separately.

Ethical issues

The major ethical consideration of this type of research endeavor involves confidentiality and privacy issues with regard to data collection. Personal information/identifiers may be associated with certain data, and confidentiality and privacy must be ensured and maintained throughout the investigation. Another ethical consideration is to ensure respect for vulnerable persons. Additionally, respect for the culture and traditions of Aboriginal peoples and other cultural communities must be maintained while seeking data for these specific populations. Lastly, due to the sensitive nature of the topic, minimizing any potential harm (i.e., emotional harm, guilt of the mother, potential stigmatization of the child) is another ethical principle to be considered. For a comprehensive list of the recommended cost drivers to be included in an estimation of the total cost impact of FASD, please refer to Figure 2.

Please note that the major principle underlying the decision regarding which costs to include is the robustness of the estimate, which is in turn dependent on the availability of data. All cost components and possible sources of costs listed in Figure 2 are thoroughly described in the full report, which is available from the authors.

Piloting the model: Preliminary FASD cost estimates for Canada

Below is a discussion describing a few of the main cost drivers.

Direct cost of health care

FAS is individually coded in the International Classification of Diseases (ICD) Version 9, Clinical Modification (CM) and Version 10[35], which can be used to obtain health care data: ICD-9-CM: Alcohol affecting foetus via placenta or breast milk 760.71; and ICD-10: Fetal alcohol syndrome (dysmorphic) Q86.0.

The majority of the data for Canada, for example, the number of acute inpatient hospitalizations and hospital days, the number of psychiatric care hospitalizations and hospital days, the number of emergency department visits and hours of care, and the number of day surgery visits and hours of care, as well as the average cost per day and per hospitalization, can be obtained from the Canadian Institute for Health Information (CIHI) on both a national and provincial/territorial level.

Estimation of direct health care cost associated with FASD is a very challenging task because, as it was described earlier, FASD is an umbrella term, not a medical diagnosis, and does not have any specific ICD code(s). However, FASD is associated with many disabilities due to the central nervous system damage and other systems caused by the prenatal alcohol exposure.

In order to calculate health care burden and its costs associated with FASD, first of all, it is necessary to know how many diseases are associated with FASD. Therefore, we reviewed epidemiological and medical literature and developed a list of more than 200 disease conditions associated to FASD, coded according to the ICD-10 (Popova et al., unpublished; a full list of diseases associated with FASD is available from the authors of this paper). Moreover, from these available studies, we reviewed the proportions of affected persons with FAS and FASD having each particular disease condition. Based on these data, it would be possible to estimate attributable fractions for each disease condition (ongoing research).

As a preliminary calculation, we estimated the cost of FAS-attributable acute care hospitalizations due to FAS in Canada, in 2002. The data on hospital diagnoses and length-of-stay in Canada for the year 2002 for acute care hospitals were obtained directly from CIHI on a national and provincial level for the 2nd Canadian Cost Study on Substance Abuse.[36-38] The data on the following ICD-9-CM and ICD-10 codes were extracted: 760.71 and Q86.0, respectfully.

There were 838 FAS-attributable acute care hospitalizations and 4,484 acute care hospital days, which accounted for 0.4% of the total alcohol-attributable acute care hospitalizations and hospital days in Canada, 2002 (Table 1 and 2). The mean age at diagnosis was 15 for males and 18 for females. To obtain the cost associated with acute care hospitalizations due to FAS, the

daily average cost per capita in an acute care hospital (obtained directly from CIHI) was applied to the total number of acute care hospital days due to FAS in provinces and territories of Canada. This resulted in almost $2.9 million in 2002 and almost $3.4 million in 2011 (adjusted for inflation) in Canada (Table 2).

Direct cost of law enforcement

The casual connection between FASD and involvement with the juvenile/criminal justice system has not yet been rigorously studied. However, the reported high prevalence of persons with FASD in the justice system supports the link between FASD and criminality.[39-42] Still, law enforcement is a cost component that has been neglected in FAS/FASD cost estimates to date.[4,43]

TABLE 1 Number of acute care hospital diagnoses due to morbidity attributable to FAS by gender and age in provinces and territories of Canada, 2002

CONDITION	Mean age at diagnosis		Number of hospital diagnoses																
			0-14 yrs		15-29 yrs		30-44 yrs		45-59 yrs		60-69 yrs		70-79 yrs		80+ yrs		TOTAL		OVERALL
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
British Columbia			52	37	33	33	5	9	2	2	0	0	0	0	0	0	**92**	**81**	**173**
Alberta			73	51	45	46	7	13	2	3	0	0	0	0	0	0	**127**	**113**	**240**
Saskatchewan			21	15	13	14	2	4	1	1	0	0	0	0	0	0	**38**	**33**	**71**
Manitoba			9	6	6	6	1	2	0	0	0	0	0	0	0	0	**16**	**14**	**30**
Ontario			25	18	16	16	2	5	1	1	0	0	0	0	0	0	**44**	**39**	**83**
Quebec			59	41	37	37	6	11	2	3	0	0	0	0	0	0	**103**	**91**	**194**
New Brunswick			6	4	4	4	1	1	0	0	0	0	0	0	0	0	**10**	**9**	**20**
Nova Scotia			0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
Prince Edward Island			1	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**3**
Newfoundland			3	2	2	2	0	0	0	0	0	0	0	0	0	0	**5**	**4**	**9**
Yukon			2	1	1	1	0	0	0	0	0	0	0	0	0	0	**4**	**3**	**7**
Northwest Territories			2	2	2	2	0	0	0	0	0	0	0	0	0	0	**4**	**4**	**8**
Nunavut			0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**1**
CANADA	15.1	18.0	**254**	**178**	**159**	**159**	**25**	**45**	**7**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	445	394	**838**

Data are obtained from the Canadian Institute for Health Information (CIHI).
Please note that CIHI suppresses cells for disease categories with fewer than five cases for either diagnoses/hospitalizations or hospital days in order to protect the confidentiality of the data. However, a midpoint of 2.5 was imputed on those cells, thereby producing numbers with decimals. As a result, there may be rounding errors after collapsing numbers. For each category with no diagnosis/hospitalization, a 0 was reported.

TABLE 2 Number of acute care hospital days and its cost due to morbidity attributable to FAS by gender and age in provinces and territories of Canada, 2002

CONDITION	Number of hospital days																OVER-ALL	Average cost per day (2008)*	Cost 2002**	Cost 2011**
	0-14 yrs		15-29 yrs		30-44 yrs		45-59 yrs		60-69 yrs		70-79 yrs		80+ yrs		TOTAL					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F				
British Columbia	350	247	204	172	24	36	9	11	0	0	0	0	0	0	**586**	**467**	**1,053**	$740.54	$779,789	$826,266
Alberta	394	278	230	194	27	41	10	13	0	0	0	0	0	0	**660**	**526**	**1,186**	$759.65	$901,006	$954,708
Saskatchewan	111	78	65	55	8	11	3	4	0	0	0	0	0	0	**186**	**148**	**334**	$725.73	$242,452	$256,903
Manitoba	58	41	34	28	4	6	1	2	0	0	0	0	0	0	**97**	**77**	**174**	$564.67	$98,333	$104,194
Ontario	110	78	64	54	8	11	3	4	0	0	0	0	0	0	**185**	**147**	**332**	$674.73	$223,848	$237,190
Quebec	374	264	218	184	26	39	9	12	0	0	0	0	0	0	**627**	**499**	**1,126**	$684.49†	$770,552	$816,478
New Brunswick	38	27	22	19	3	4	1	1	0	0	0	0	0	0	**63**	**50**	**113**	$607.33	$68,912	$73,020
Nova Scotia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	$657.59	$0	$0
Prince Edward Island	2	1	1	1	0	0	0	0	0	0	0	0	0	0	**3**	**3**	**6**	$569.53	$3,269	$3,464
Newfoundland	24	17	14	12	2	2	1	1	0	0	0	0	0	0	**40**	**31**	**71**	$675.51	$47,975	$50,834
Yukon	6	5	4	3	0	1	0	0	0	0	0	0	0	0	**11**	**9**	**20**	$647.99	$12,636	$13,389
Northwest Territories	22	15	13	11	1	2	1	1	0	0	0	0	0	0	**36**	**29**	**65**	$836.92	$54,400	$57,642
Nunavut	1	1	1	1	0	0	0	0	0	0	0	0	0	0	**2**	**2**	**4**	$684.49†	$2,847	$3,017
CANADA	**1,490**	**1,052**	**868**	**733**	**102**	**154**	**37**	**48**	**0**	**0**	**0**	**0**	**0**	**0**	**2,497**	**1,987**	**4,484**	$684.49	**$3,206,018**	**$3,397,105**

*Source: Data are obtained directly from the Canadian Institute for Health Information (CIHI). Estimated average cost per day is for the most recently available year of 2008
**Inflation adjusted: the estimated cost was converted to November 2002 and November 2011 currency values respectively using the inflation calculator of Bank of Canada (http://www.bankofcanada.ca/en/rates/inflation_calc.html).
†Data were not available. The average cost per day for Canada was used as a substitute. Data on the number of hospital days due to morbidity attributable to FAS were obtained directly from CIHI.
Please note that CIHI suppresses cells for disease categories with fewer than five cases for either diagnoses/hospitalizations or hospital days in order to protect the confidentiality of the data. However, a midpoint of 2.5 was imputed on those cells, thereby producing numbers with decimals. As a result, there may be rounding errors after collapsing numbers. For each category with no diagnosis/hospitalization, a 0 was reported.

Statistics Canada does not have any FASD-specific cost data. A further challenge is that there are no widely used or standardized screening and diagnostic tools to identify the number of FASD-affected persons within the justice system, along with the added difficulty of assessing adults with possible fetal alcohol exposure.[44,45] However, a number of novel quick and easy to administer screening processes that would be appropriate in the criminal population have been developed and validated, including the FASD checklist [46] and the Asante Centre for Fetal Alcohol Syndrome Probation Officer Screening & Referral Form.[47]

Our recent systematic literature review confirmed that very little empirical evidence is available on the prevalence of FASD in the criminal justice system.[48] The few studies that have identified incarcerated offenders with FAS/D estimate that the number of undiagnosed persons in correctional facilities is very high. Using a few studies yielding available epidemiological data on the prevalence of incarceration in youths with FASD and data on the prevalence of incarceration in youths without FASD in the general population in Canada[49], we estimated that youths with FASD are *nineteen times* more likely to be in prison than youths without FASD, on any given day in a specific year.[48]

Using the estimated number of youths and adults with FAS in the correctional system in Canada[49] and the annual cost of incarceration from the Canadian Centre for Justice Statistics[*50] we estimated that the cost of corrections among youths with FAS is ranging from more than $1.1 million to $2.2 million per one year.

The cost of corrections among adults with FAS is ranging from more than $21.8 million to $43.4 million per one year. The total cost of corrections for both youth and adults with FAS is ranging from more than $22.9 million to about $45.7 million per one year (the calculations are provided in the full report, which is available from the authors).

It is worth noting that in addition to the current law enforcement costs, there are sources of possible future costs as well. These potential future costs include, but are not limited to: screening, diagnosis, correctional programs, FASD-specific probation programs, training for legal professionals and correctional officers and detailed medical-legal charts (for prosecutors and judges).

Direct cost of children in care

Fuchs et al.[51] are the first have estimated the cost of children with FASD in foster care in Canada (specifically, Manitoba in 2006; no such estimates exist in any other countries). Three categories of costs were examined for a random sample of 400 children: basic maintenance ($3,124,600, annually), special rate/special needs ($6,074,974, annually) and exceptional circumstances ($230,752, annually), for a total of $9,504,094 ($23,760 per child per year, or $65 per day per child).

The costs also varied by age group: the youngest children were on average $18,008 ($49 per day) per child per year, and had a total cost of $360,165, annually; the 6 to 10 year old age group had a yearly average of $20,633 ($57 per day) per child with a total of $2,496,616; children aged 11 to 15 had an average cost per child of $26,021 ($71 per day), and total cost of $4,865,910; and children 16+ had an average at $24,742 ($68 per day) per child with a total cost of $1,781,404. Thus, the age group with the highest total costs was ages 11 to 15, followed by the 6 to 10 age group, with the age group below 6 years of age having the lowest total costs.

DISCUSSION

FASD is a public health priority in Canada, and has significant potential for prevention, both of future births of infants prenatally exposed to alcohol and of the life-long disabilities associated with FASD. An economic impact estimate is crucial in order to illustrate to policy developers and decision-makers the extent of the problem. Once policy-makers can clearly see the impact of burden and cost that FASD has in Canada, prevention initiatives are likely to soon follow.

From our preliminary estimates, which were provided above, of the annual cost of only three components of the major cost drivers, such as the cost of acute care hospitalizations due to FAS,

* The Canadian Centre for Justice Statistics[50] reports, on average, in 2008/2009, it cost $323 a day (or about $117,700 a year) to house a federal inmate. In the provincial and territorial system, the average cost was $162 a day (or about $59,100 a year). Federal costs are higher than provincial and territorial costs because of higher levels of security, as well as longer-term specialized programming.

which accounted for almost $3.4 million, the corrections cost of people with FAS (mid-point $34 million), and cost of children with FASD in foster care in only one province (i.e., Manitoba; $9.5 million[51]), we can anticipate that the annual cost of FASD is quite substantial in Canada as a whole.

There are many challenges associated with the development of such an economic model. First, FASD prevalence and incidence data is lacking, not only for the general population of Canada, but also for specific service sectors of interest (i.e., the number of individuals with FASD utilizing specific services). Thus, there is a need for accurate prevalence/incidence rates, which would facilitate accurate cost estimates.[52]

In addition, economic estimates of FASD are also dependent on the definitions and criteria used for diagnosing FASD. It is likely that the same criteria have not been used by each clinician and within each sector of service. This may result in an error in the estimation of the number of FASD-affected individuals serviced within each sector. Even though this is unavoidable, it must be recognized.

Furthermore, the lack of empirical methods for collecting cost and utilization data needs to be overcome. Since FASD impacts multiple spheres or systems, calculating the economic impact requires collaboration across many sectors and jurisdictions. The issue of comparability needs to be kept in mind when a final aggregation of the data extracted from the various systems is conducted. Therefore, defining the costs beforehand is crucial in avoiding double counting of costs in the model. It is also important to consider the lack of data availability for the many components and the robustness of the calculations of costs. Further, the model should consider the costs at the different life stages of an individual.

The next challenge is at the individual level, costs will vary by the severity of the disability, the age of the individual, and the services sought and utilized (whether because of cultural beliefs/standards, financial differences, or personal reasons), as well as eligibility differences. Thus, these variations must be taken into account. Moreover, it is important to consider the intangible affects of FASD, such as emotional stress, pain and suffering, not only on the affected individual, but also on their family/caregivers. These vague costs represent a significant burden, but are extremely difficult to quantify.

The costs associated with FASD are, in theory, largely avoidable and can be saved by effective social policies and intervention programs. However, it must be noted that the cost study, based on this model, will not estimate potential savings, since the model includes both avoidable and unavoidable costs. Also, this study should not be confused with cost-benefit or cost-effectiveness analysis.

On a final note, it is important to highlight that this model provides a theoretical and methodological framework, rather than a rigorous methodology to be applied in all situations. It is recognized that there will not be sufficient data in Canada and many other countries to implement all of the recommendations of this model, and as such, the implementation of this model will yield results that are reflective of data availability, which will differ depending on the context in which it is applied. Thus, the scope and accuracy of cost figures obtained from the utilization of this model are contingent on the data and research available to satisfy the model. As data becomes available, the model has the potential to be expanded and, some of the current assumptions used in this model may change or be omitted, if necessary.

It is a hoped that the development of a methodology designed to estimate the economic impact of FASD is appropriate not only for use in Canada, but also has the potential to be used for other countries. Once Canada, and other countries develop reasonable estimates of the costs associated with FASD it will be possible to move to cost-effectiveness analyses, and eventually to cost-benefit analyses of FASD policies and programs.

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Conflict of Interest
None declared.

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