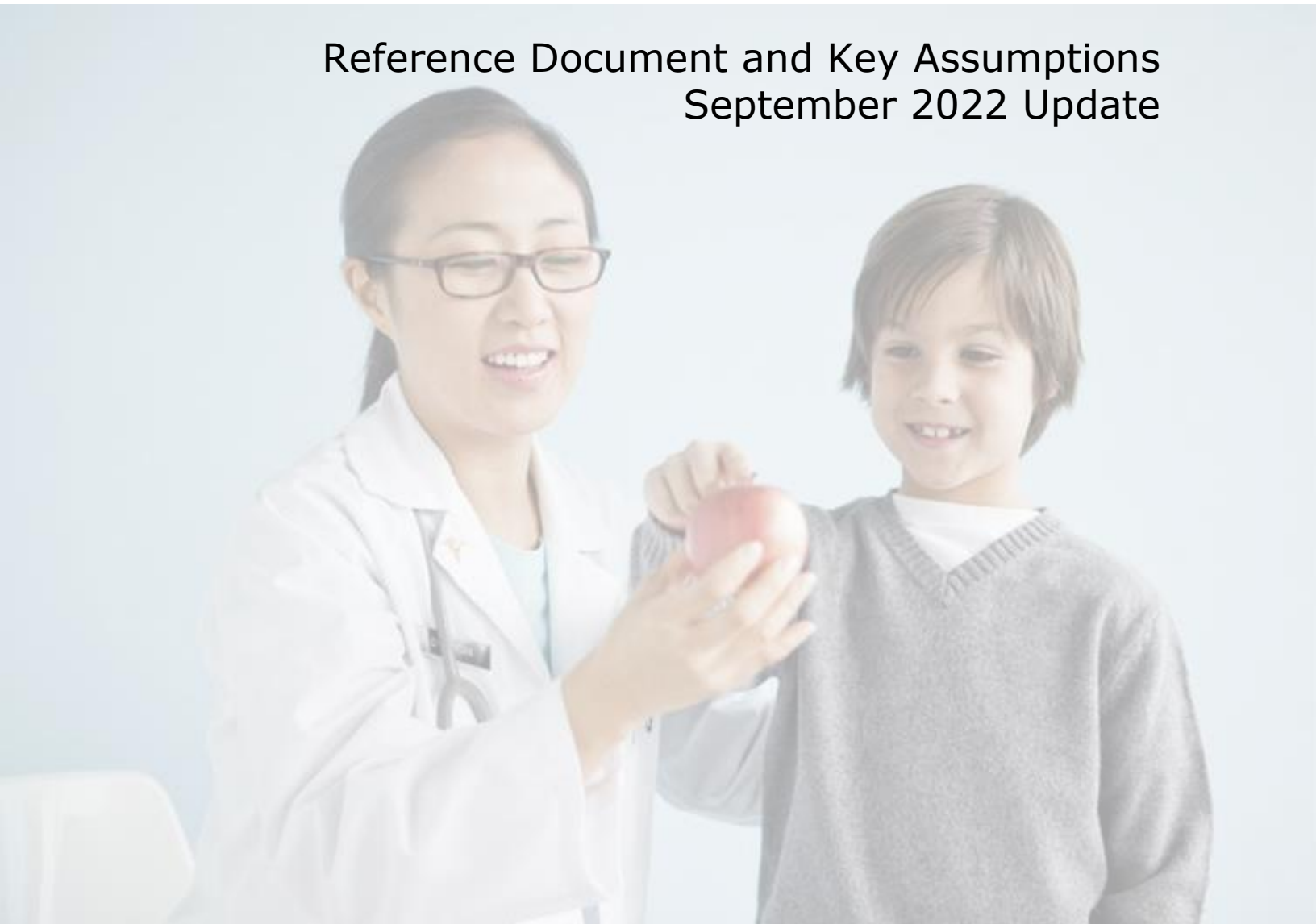


Establishing Priorities among Effective Clinical Prevention Services in British Columbia

Reference Document and Key Assumptions
September 2022 Update



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Establishing Priorities among Effective Clinical Prevention Services in British Columbia: *Reference Document and Key Assumptions*

Introduction

The report, *A Lifetime of Prevention*, was published by the Clinical Prevention Policy Review Committee (CPPRC) in December of 2009.¹ A key goal of the CPPRC was to determine which clinical prevention services are worth doing in British Columbia (BC), culminating in a proposed Lifetime Prevention Schedule (LPS). Clinical prevention services were included on the LPS if they were considered to be effective, had a significant positive impact on population health and were cost-effective.

Clinical prevention services (CPS) are defined as:

Manoeuvres pertaining to primary and early secondary prevention (i.e., immunization, screening, counselling and preventive medication/device) offered to the general population (asymptomatic) based on age, sex and risk factors for disease and delivered on a one-provider-to-one-client basis, with two qualifications:

- (i) the provider could work as a member of a care team or as part of a system tasked with providing, for instance, a screening service; and*
- (ii) the client could belong to a small group (e.g. a family, a group of smokers) that is jointly benefiting from the service.*

This definition does not refer to the type of provider or the type of funding. This allows for the evaluation of the appropriate implementation of the service as a separate program planning matter.

Since 2009, a total of 30 CPS have been reviewed by the Lifetime Prevention Schedule Expert Committee (LPSEC) for potential inclusion in the LPS.

This document is a companion document to *Establishing Priorities among Effective Clinical Prevention Services in British Columbia*. It provides a record of all key model assumptions in one location.

This document (*Reference and Key Assumptions*) is divided into the following sections:

- A brief **overview of the process** for reviewing CPS to determine whether or not the LPSEC will recommend the inclusion or exclusion of the CPS on the lifetime prevention schedule.
- An overview of the **key assumptions** made throughout the project.

¹ Clinical Prevention Policy Review Committee. *A Lifetime of Prevention: A Report of the Clinical Prevention Policy Review Committee*. 2009. Available at http://www.health.gov.bc.ca/library/publications/year/2009/CPPR_Lifetime_of_Prevention_Report.pdf. Accessed July 2017.

- A **reference section** in which **specific assumptions** are considered in more detail and the impact of individual disease states in terms of their impact on life expectancy, quality of life and costs are identified and described. The reference section, for example, includes information on CPS intervention rates, how costs are converted into 2017 Canadian dollars, how a disease state affects an individual's (and their caregiver's) quality of life (QoL) and how to calculate this in the models, and the ongoing costs of care for disease state survivors.

An Overview of the Process

The process for evaluating clinical prevention services in British Columbia is carried out in four sequential steps and includes addressing the following four questions.

STEP 1 – Is the Service Effective?

To answer this question we depend on thorough reviews completed by other respected agencies, primarily the work by the Canadian Task Force on Preventive Health Care (CTFPHC) and the US Preventive Services Task Force (USPSTF).

If these agencies find that the prevention service works (i.e. effectively achieves what it is intended to achieve), then we move on to STEP 2. For example, in 2016 the CTFPHC recommended universal screening for colorectal cancer between the ages of 50 and 74.² The 2021 USPSTF recommended universal screening for colorectal cancer between the ages of 45 and 75.³ For modelling purposes, when a difference in recommendations occurs, we tend to follow the recommendation based on the most current evidence.

In British Columbia, there were 2,945 new colorectal cancer cases and 1,115 deaths from colorectal cancer in 2018.⁴ Research by the CTFPHC indicates that screening for colorectal cancer between the ages of 50 and 74 would result in a 22% reduction in mortality from colorectal cancer and an 18% reduction in the incidence of late stage colorectal cancer.⁵

STEP 2 – What is the Impact on the British Columbia Population of Implementing the Service?

To answer this we calculate what we call the clinically preventable burden (CPB) associated with implementing the service. The CPB is defined as the total quality-adjusted life years that could be gained if the clinical preventive service were delivered at recommended intervals to a British Columbia birth cohort of 40,000 individuals over the years of life that a service is recommended.

When calculating the CPB, two key drivers are considered. First, how much of the population does the service impact? If it only impacts a small proportion of the population, the CPB would be small. In the case of screening for colorectal cancer, the population impacted is everyone living in British Columbia between the ages of 45-75. Furthermore, colorectal cancer is a fairly common cancer, with approximately 3,000 new cases identified annually in British Columbia.

Second, what is the effect size of the service? For example, if a service reduced the risk of death by 1%, its effect size would be 1/10th of a service that reduced the risk of death by 10%. As noted above, the effect size for screening for colorectal cancer is a 22% reduction in mortality from colorectal cancer and an 18% reduction in the incidence of late stage colorectal cancer. If the service impacts a larger proportion of the population but the effect is minimal, then the CPB would also be small.

² Canadian Task Force on Preventive Health Care. Recommendations on screening for colorectal cancer in primary care. *Canadian Medical Association Journal*. 2016; 188(5): 340-8.

³ US Preventive Services Task Force. Screening for colorectal cancer: US Preventive Services Task Force Recommendation statement. *JAMA*. 2021; 325(19): 1965-1977.

⁴ See http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Colorectal_2018_20210305.

⁵ Canadian Task Force on Preventive Health Care. Recommendations on screening for colorectal cancer in primary care. *Canadian Medical Association Journal*. 2016; 188(5): 340-8.

The services with the highest CPB are those that impact a large segment of the population and have a relatively large effect.

In calculating the CPB, we try and compare what is currently happening in British Columbia with other regions of the world for the service under consideration. We find a region that has done the best possible job of implementing the service and compare this “best-in-the-world” result to the current provision of this service in British Columbia. This gives a sense of how much service improvement is possible (i.e. the gap between the current British Columbia service and “best-in-the-world”). For example, current screening rates for colorectal cancer between the ages of 50 and 74 in British Columbia approximate 50%.⁶ Screening in the US state of Massachusetts, however, has achieved rates of 77%.⁷

The CPB is calculated using a measure called a quality-adjusted life year (QALY). In calculating CPB both benefits and harms associated with the service are taken into account. Note that not all services have identified harms associated with them.

If we are able to achieve colorectal cancer screening rates of 77% in a British Columbia birth cohort of 40,000, then our calculations suggest that we could add 3,588 QALYs or a CPB of 3,588.

STEP 3 – Is the Service Cost-Effective?

To answer this we calculate the cost per QALY added associated with implementing the service. The first part of this process, namely the calculation of the CPB as the net gain in QALYs, has been calculated during STEP 2. In STEP 3, we focus on estimating the costs associated with implementing the service, including the costs associated with screening and any interventions needed.

When looking at time costs, we include the time costs of both clinicians and the individuals receiving the service. Placing a monetary value on patient time costs is important as we are asking otherwise healthy individuals to engage with the health care system even though, in the long term, they may not be the ones who benefit.

In estimating the overall cost of the service, we take into account both costs resulting from the service as well as costs that might be avoided as a result of the service. For example, the costs associated with screening for colorectal cancer in a BC Birth cohort of 40,000 are estimated at \$113.3 million. Since screening for colorectal cancer reduces the number of new colorectal cancers and deaths, we would also expect a reduced cost of \$77.7 million in caring for these individuals. The net costs would therefore be \$35.6 million (\$113.3 million – \$77.7 million).

At the end of STEP 3, we calculate the cost per quality-adjusted life year. In our example this means dividing the \$35.6 million in net costs by the 3,588 QALYs for a cost per quality-adjusted life year of \$9,921.

We refer to this cost per quality-adjusted life year as the cost-effectiveness of providing the service. More specifically, cost-effectiveness is defined as the average net cost per quality-adjusted life year gained in typical practice by offering the clinical preventive service at recommended intervals to a British Columbia birth cohort over the recommended age range.

⁶ Singh H, Bernstein C, Samadder J et al. Screening rates for colorectal cancer in Canada: a cross-sectional study. *Canadian Medical Association Journal Open*. 2015; 3(2): E149-57.

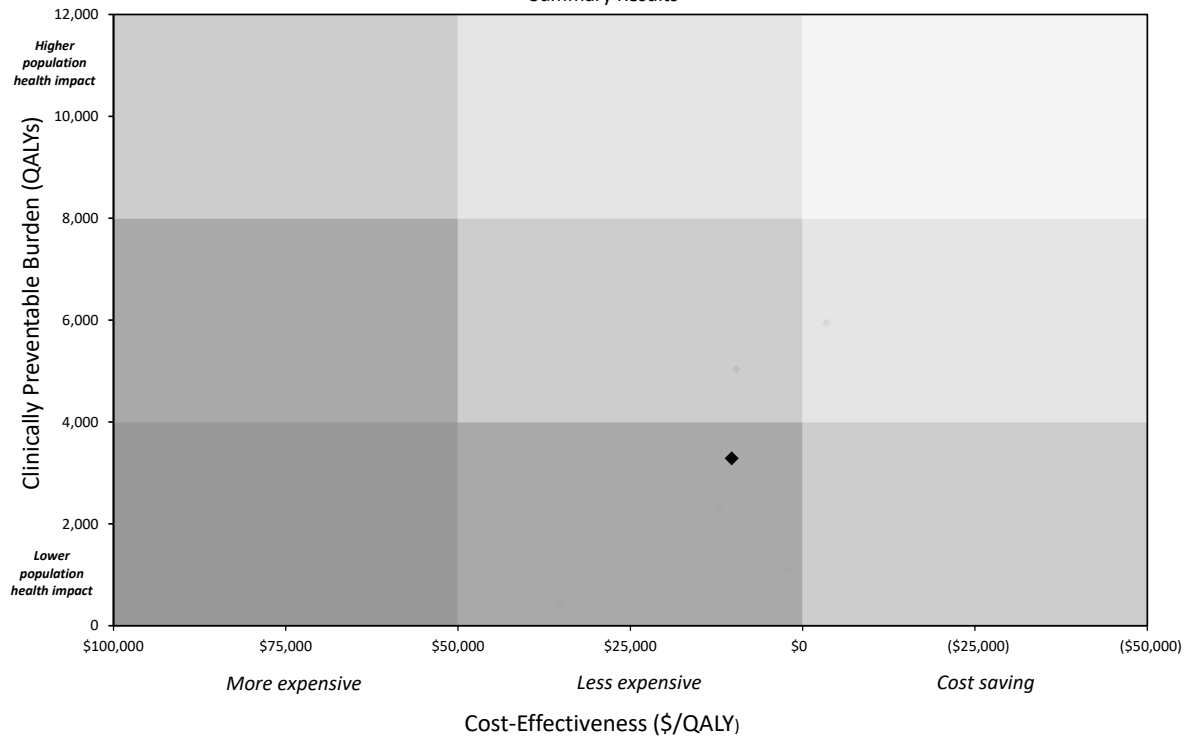
⁷ National Cancer Institute. *Screening and Risk Factors Table*. 2017. Available at <https://statecancerprofiles.cancer.gov/risk/index.php>. Accessed August 2017.

STEP 4 – How Does the Service Compare with Other Effective Services?

In the final step we compare all the services that have gone through STEPS 1-3. By this stage we have calculated a unique CPB value and cost-effectiveness ratio for each service. The CPB and cost-effectiveness for each service is used to locate that service on the grid in Figure 1 below. Services that fall within the upper right hand segment have the highest population health impact (based on their clinically preventable burden) and are cost-saving. Services that fall within the lower left hand segment have the lowest population health impact and are relatively expensive to implement.

Screening for colorectal cancer between the ages of 45 and 75 in a British Columbia birth cohort of 40,000 results in an estimated clinically preventable burden of 3,588 and a cost-effectiveness of \$9,921. This places the service in the lower row with respect to clinically preventable burden and the middle column with respect to cost-effectiveness (see Figure 1).

Figure 1: Establishing Priorities Among Effective Clinical Prevention Services in BC
Combining Clinically Preventable Burden and Cost-Effectiveness
Summary Results



The results generated through this process are a key step in determining which current clinical prevention services in British Columbia require a concerted focus and which new clinical prevention services should be implemented. These results, however, should not be used in isolation. Any changes to service provision should be undertaken only when this research is supplemented by additional analyses, including a business plan and budget impact analysis. These supplementary analyses are important in addressing additional questions required in decision-making, such as the feasibility and total costs of enhancing current services or implementing new services.

Acknowledgement

The process for evaluating clinical prevention services in British Columbia was initially based on the process developed by the HealthPartners Research Foundation in the United States.^{8,9} In 2008 the HealthPartners Research Foundation provided the Lifetime Prevention Schedule Expert Committee with a number of models assessing the clinically preventable burden and cost-effectiveness of various clinical prevention services in the US. The Lifetime Prevention Schedule Expert Committee updated these models using British Columbia-specific data. The process in both British Columbia and the US has since evolved. All British Columbia models, for example, are now 'homegrown'. In the US, the renamed HealthPartners Institute continues to assess clinical prevention services using more sophisticated modelling approaches.¹⁰ They are also one of a number of groups in the US providing modelling support to the United States Preventive Services Task Force in assessing the effectiveness of various clinical prevention services.^{11,12}

⁸ Coffield A, Maciosek M, McGinnis J et al. Priorities among recommended clinical preventive services. *American Journal of Preventive Medicine*. 2001; 21(1): 1-9.

⁹ Maciosek M, Coffield A, Edwards N et al. Priorities among effective clinical preventive services: results of a systematic review and analysis. *American Journal of Preventive Medicine*. 2006; 31(1): 52-61.

¹⁰ Maciosek M, LaFrance A, Dehmer S et al. Updated priorities among effective clinical preventive services. *The Annals of Family Medicine*. 2017; 15(1): 14-22.

¹¹ Owens D, Whitlock E, Henderson J et al. Use of decision models in the development of evidence-based clinical preventive services recommendations: methods of the US Preventive Services Task Force. *Annals of Internal Medicine*. 2016; 165(7): 501-8.

¹² Dehmer S, Maciosek M, Flottemesch T et al. Aspirin for the primary prevention of cardiovascular disease and colorectal cancer: a decision analysis for the US Preventive Services Task Force. *Annals of Internal Medicine*. 2016; 164(12): 777-86.

Key Assumptions

The following key assumptions have been made throughout this project.

Duplication of Effort

In order to prevent duplicate evidence reviews, the Lifetime Prevention Schedule Expert Advisory Committee decided to refer any recommendations regarding immunizations to the Immunization Programs and Vaccine Preventable Diseases Service of the British Columbia Centre for Disease Control¹³ and any recommendations regarding prenatal care, intrapartum care and immediate postpartum care (up to 8 weeks) to the Perinatal Services BC (PSBC) guidelines.¹⁴ Note, however, that universal screening of newborns in BC for critical congenital heart defects, severe combined immune deficiency, biotinidase deficiency and carnitine uptake disorder has been assessed using the LPS methodology.

Delivery Mechanism(s)

The definition of clinical prevention is independent of delivery mechanism(s) or provider type(s). Determining which delivery mechanism or provider type would be most suitable for each service will be assessed in subsequent phases of the policy cycle where decisions will be made on whether and, if so, how to implement. Further evidence reviews may be undertaken during these phases as well as in operational planning.

For the purposes of this project, we have had to make assumptions about delivery mechanisms and provider type in order to estimate the costs of providing the service. Estimating costs is required in calculating cost-effectiveness. For consistency and comparability between the various preventive services, we chose to use a general physician's office as the delivery mechanism and provider type whenever appropriate. That is, if an established delivery mechanism is not in place, then we assumed, for costing purposes, that it would take place in a general physician's office. For example, no program currently exists in BC for screening and interventions to reduce falls in community-dwelling elderly, so we assumed this would take place in a general physician's office.

Patient Costs

CPSs are offered to the asymptomatic general population. As such, people are being asked to give up some of their time for a service which has a (relatively small) chance of detecting a clinically relevant issue. Alternatively, they may be asked to give up some of their time for a behavioural counselling intervention that has a modest potential for success. As such, it is important to value this time and include it in the base case analysis in an assessment of the cost-effectiveness of the intervention. Increasingly, groups such as the US Second Panel on Cost-effectiveness in Health and Medicine are recommending the inclusion of both patient and caregiver time and effects in economic evaluations (see below).

For the purposes of consistency and comparability, we have assessed this time by including travel time to and from the intervention as well as time during the intervention and then valued this total time based on average wage rates for the BC population. In the sensitivity analysis for each service, we have excluded patient costs so that the impact of these costs on the cost-effectiveness of the service can be more easily determined.

¹³ See <http://www.bccdc.ca/health-professionals/clinical-resources/communicable-disease-control-manual/immunization>. Accessed September 2017.

¹⁴ See <http://www.perinataleservicesbc.ca/health-professionals/guidelines-standards>. Accessed September 2017.

Spillover Effects

Spillover effects occur when the illness of a child or family member has an economic or quality of life impact on the broader family or caregiver(s).

Few of the economic evaluation guidelines emanating from international health technology assessment agencies specifically mention spillover effects. They do, however, make broader recommendations of which costs and effects to include, often depending on the perspective of the analysis.

The Canadian Agency for Drugs and Technologies in Health (CADTH) *Guidelines for the Economic Evaluation of Health Technologies*¹⁵ document, for example, recommends that the reference case take the perspective of the public health care payer with a more limited inclusion of costs and effects. If the perspective is a societal one, however, then “the impact of the intervention on time lost from paid and unpaid work by both patients and informal caregivers as a result of illness, treatment, disability or premature death should be included in an additional non-reference case analysis” (pg. 21). These guidelines do mention spillover effects, but only tangentially. They note that there “may be health states for which the estimation of utilities is particularly challenging, due to both limited data and the lack of consensus on methods (e.g., health states for individuals with disabilities, states affecting vulnerable populations, temporary health states, states with spillover effects on informal caregiving). Given the dearth of information with which to estimate utilities for such health states, the analysis of uncertainty will be especially important” (pg. 47).

The UK National Institute for Health and Care Excellence (NICE) *Guide to the Methods of Technology Appraisal*¹⁶ is silent on the specific issue of spillover effects but does note that “the perspective on outcomes should be (the inclusion of) all direct health effects, whether for patients or other people” (pg. 34).

The recommendations from the US Second Panel on Cost-effectiveness in Health and Medicine¹⁷ indicate that “all cost-effectiveness analyses should report 2 reference case analyses: one based on the health care sector and another based on the societal perspective” (p.1093). Furthermore, the analysis conducted from the societal perspective should consider “all parties affected by the intervention and (count) all significant outcomes and costs that flow from it, regardless of who experiences the outcomes or bears the costs” (p. 1095). The detailed recommendations from the US Second Panel indicate that “(i)f spillover effects on family/caregivers are likely to represent an important category of health outcomes associated with an intervention that averted or reduced the severity of an illness of a family member, an attempt should be made to value these effects and incorporate them into the CEA. Further, these spillover effects should be included in reference case analyses for both the health care sector and societal perspectives” (p. 188).¹⁸ A reference case is “a set of standard

¹⁵ Canadian Agency for Drugs and Technologies in Health Methods and Guidelines. *Guidelines for the Economic Evaluation of Health Technologies: Canada*. 2017. Available at <https://www.cadth.ca/guidelines-economic-evaluation-health-technologies-canada-4th-edition>. Accessed June 2017.

¹⁶ National Institute for Health and Care Excellence. *Guide to the methods of technology appraisal 2013*. 2013. Available at <https://www.nice.org.uk/process/pmg9>. Accessed August 2017.

¹⁷ Sanders G, Neumann P, Basu A. et al. Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. *Journal of the American Medical Association*. 2016; 316(10): 1093-103.

¹⁸ Neumann PJ, Sanders GD, Russell LB, et al, editors. *Cost-Effectiveness in Health and Medicine*. 2nd ed. New York: Oxford University Press; 2017.

methodological practices that all cost-effectiveness analyses should follow to improve comparability and quality.”¹⁹

As noted earlier, one of the key assumptions is that patient costs should be part of the reference case and that the more narrow perspective of the health care system (*excluding* these patient costs) be included in a secondary sensitivity analysis. This same assumption should apply to spillover effects. The nascent nature of research on spillover effects, however, precludes their inclusion in the current analysis.

In making this assumption, the committee recognizes that while there is a large academic literature acknowledging the existence of spillover effects, there is a much smaller literature on how to measure such effects, and even less literature actually measuring the effects.^{20,21,22,23,24,25,26,27,28}

The one exception in the current modelling is the inclusion of parental time costs associated with caring for a child with spina bifida in the sensitivity analysis of the *Folic Acid Supplementation in Reproductive-age Women for the Prevention of Neural Tube Defects* model.

Broader Societal Costs

In general, the reference case includes known costs to the health care system and the patient. It has been argued that broader societal costs outside of the healthcare system, such as those in education or social services, should also be taken into account to detect possible cost shifting between sectors.²⁹ These broader costs have been taken into account in three models in which they are readily known and have a significant impact on the modelling. In addition to the inclusion of parental time costs associated with caring for a child with spina bifida in the sensitivity analysis of the *Folic Acid Supplementation in Reproductive-age Women for the Prevention of Neural Tube Defects* model, we also included special education and developmental service costs. For the *Alcohol Misuse Screening and Brief Intervention* model we included costs associated with law enforcement, fire and traffic accident damage and so

¹⁹ Sanders G, Neumann P, Basu A. et al. Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. *Journal of the American Medical Association*. 2016; 316(10): 1093-103.

²⁰ Basu A and Meltzer D. Implications of spillover effects within the family for medical cost-effectiveness analysis. *Journal of Health Economics*. 2005; 24(4): 751-3.

²¹ Wittenberg E, Ritter G and Prosser L. Evidence of spillover of illness among household members: EQ-5D scores from a US sample. *Medical Decision Making*. 2013; 33(2): 235-43.

²² Wittenberg E, Saada A and Prosser L. How illness affects family members: a qualitative interview survey. *The Patient-Centered Outcomes Research*. 2013; 6(4): 257-68.

²³ Lavelle T, Wittenberg E, Lamarand K et al. Variation in the spillover effects of illness on parents, spouses, and children of the chronically ill. *Applied Health Economics and Health Policy*. 2014; 12(2): 117-24.

²⁴ Tilford J and Payakachat N. Progress in measuring family spillover effects for economic evaluations. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2015; 15(2): 195-8.

²⁵ Al-Janabi H, Van Exel J, Brouwer W et al. Measuring health spillovers for economic evaluation: a case study in meningitis. *Health Economics*. 2016; 25(12): 1529-44.

²⁶ Prosser L, Lamarand K, Gebremariam A and Wittenberg E. Measuring family HRQoL spillover effects using direct health utility assessment. *Medical Decision Making*. 2015; 35: 81-93.

²⁷ Wittenberg E and Prosser L. Health as a family affair. *New England Journal of Medicine*. 2016; 374(19): 1804-6.

²⁸ Wittenberg E and Prosser L. Disutility of illness for caregivers and families: a systematic review of the literature. *Pharmacoeconomics*. 2013; 31(6): 489-500.

²⁹ Byford S and Raftery J. Perspectives in economic evaluation. *British Medical Journal*. 1998; 316(7143): 1529-30.

on. These costs are estimated to be higher than the direct medical care costs.³⁰ For the *Screening and Interventions to Reduce Unhealthy Drug Use* model, we included criminal justice and accident damage costs.

Discounting

In the economic appraisal of health programs or interventions, costs and benefits that are spread over time are usually weighted according to when they are experienced. The further in the future, the less heavily they are weighted or the more they are discounted. This can be particularly challenging for interventions in which costs are current and benefits are further in the future (e.g. prevention). The impact of discounting is most noticeable for preventive services in children and youth, given that costs are generally current, whereas benefits and potential costs avoided may stretch over the lifetime of the individual.^{31,32,33,34}

From a health economics perspective, the usual approach is to discount both costs and benefits when calculating cost-effectiveness. However, discounting may fail to reflect a value we as a society might hold for the future of our children. The Netherlands, for example, require that a discount rate of 1.5% be applied to benefits while a discount rate of 4% be applied to costs.³⁵ It would thus be important to explicitly understand the impact of discounting in the current project. To do so, we use a 1.5% discount rate in the base case with a 3% and a 0% discount rate in the sensitivity analysis. A 0% discount rate is equivalent to not discounting. A 1.5% discount rate for the base case is currently (as of July 2017) recommended by both CADTH in Canada³⁶ and NICE in the UK.³⁷

Incorporating Information on Current Coverage

A number of the preventive services assessed in this project have an established history in the province while others may only be provided in a limited, fairly random approach (as ‘random acts of kind prevention’). With this in mind, we set out to assess CPB and CE from two perspectives. First, assuming that the service had no current coverage in the province (i.e. that the service had not yet been established in the province). Second, assessing the gap between current coverage in the province and what arguably could be considered the best possible coverage (based on information on “best-in-the-world” coverage for the service).

Incorporating Key Recent Evidence

The USPSTF is currently attempting to update their evidence review and recommendations every five years. It is possible that seminal research has been published during the interval between updates and that this research may alter recommendations. To take this into account, we considered evidence reviews from other organizations (e.g. the Cochrane Collaboration

³⁰ Rehm J, Gnam W, Popova S et al. The costs of alcohol, illegal drugs, and tobacco in Canada, 2002. *Journal of Studies on Alcohol and Drugs*. 2007; 68(6): 886-95.

³¹ Parsonage M and Neuburger H. Discounting and health benefits. *Health Economics*. 1992; 1(1): 71-6.

³² Brouwer WB, Niessen LW, Postma MJ et al. Need for differential discounting of costs and health effects in cost effectiveness analyses. *British Medical Journal*. 2005; 331(7514): 446-8.

³³ Claxton K, Sculpher M, Culyer A et al. Discounting and cost-effectiveness in NICE – stepping back to sort out a confusion. *Health Economics*. 2006; 15(1): 1-4.

³⁴ Gravelle H, Brouwer W, Niessen L et al. Discounting in economic evaluations: stepping forward towards optimal decision rules. *Health Economics*. 2007; 16(3): 307-17.

³⁵ Tan S, Bouwmans C, Rutten F et al. Update of the Dutch manual for costing in economic evaluations. *International Journal of Technology Assessment in Health Care*. 2012; 28(2): 152-8.

³⁶ Canadian Agency for Drugs and Technologies in Health Methods and Guidelines. *Guidelines for the Economic Evaluation of Health Technologies: Canada*. 2017. Available at <https://www.cadth.ca/guidelines-economic-evaluation-health-technologies-canada-4th-edition>. Accessed July 2017.

³⁷ NICE. *Methods for the Development of NICE Public Health Guidance (Third Edition)*. Available online at <https://www.nice.org.uk/process/pmg4/chapter/incorporating-health-economics>. Accessed July 2017.

and NICE in the UK) for any USPSTF or CTFPHC recommendations published more than four years ago.

Focus on the Best Available Evidence for a Conservative Approach to Implementation

An important assumption of this project is to focus on the highest level of available evidence. Given the limited capacity in the health care system, it is better to take a conservative approach by focussing on a limited number of preventive interventions that are clearly proven to be effective, will have an important impact on the health of the entire population of BC and are likely to be cost-effective. The focus should be on achieving potential coverage and an effective dose for a limited number of preventive services rather than incomplete coverage of a larger number of preventive services.

Reference Section

CPS Intervention Rate

This section of the report provides an overview of the 30 CPS reviewed by the LPSEC to date. The section begins with a one-page summary including the name of the CPS, the relevant cohort and the frequency with which the service is to be provided. In addition, an estimated rate of coverage for the service in British Columbia and the best rate in the world is provided.

Following the summary is a brief section on each of the 30 CPS. Each of these sections begins with a recommendation regarding the provision of the service. The recommendations are most frequently those of the USPSTF or the CTFPHC. In all cases, the source of the recommendation is identified in the footnotes. The last two subsections for each CPS provide available data and sources for the rate of coverage for that CPS in BC and the best rate in the world.

Summary

Potential Clinical Prevention Services in B.C. Summary of the Applicable Cohort, Service Frequency and Coverage

Clinical Prevention Services	Cohort / Timing	Frequency / Intensity	Estimated Coverage	
			B.C.	'BiW' ⁽¹⁾
Screening for Asymptomatic Disease or Risk Factors - Children/Youth (C/Y)				
Vision screening for amblyopia	Ages 3-5	At least once	93%	93%
Screening for depression	Ages 12 - 18	Annually	Unknown	7.4%
Behavioural Counseling Interventions - Children/Youth (C/Y)				
Interventions to support breastfeeding	During pregnancy and after birth	Multiple sessions	Unknown	46%
Growth monitoring and healthy weight management in children and youth	Ages 6 - 17	Screening - At all appropriate primary care visits Intervention - Attendance at >70% of ten 2-hour sessions.	Unknown	13%
Preventing tobacco use (school-aged children & youth)	Ages 6 - 17	Annually	7.2%	7.2%
Preventive Medication / Devices - Children				
Fluoride varnish	On primary teeth at time of tooth eruption (ages 1 - 5)	Every six months	Unknown	62%
Dental sealants	On permanent teeth at time of tooth eruption (ages 6 - 12)	4 times (on 1st and 2nd bicuspid & molars)	Unknown	59%
Screening for Asymptomatic Disease or Risk Factors - Adults				
Screening for breast cancer	Ages 50 - 74	Every 2 - 3 years	52%	88%
Screening (cytology-based) for cervical cancer	Ages 25 - 69	Every 3 years	69%	88%
Addition of HPV-based cervical cancer screening	Ages 30 - 65	Every 5 years	0%	88%
Screening for colorectal cancer	Ages 45 - 75	FOBT every 2 years	50%	77%
Screening for lung cancer	Ages 55 - 74 with a 30 pack-year smoking history	Annually for 3 consecutive years	Unknown	6%/60%
Screening for hypertension	Ages 18 and older	Screening - At least once every 2 years	88%	88%
Screening for cardiovascular disease risk and treatment (with statins)	Ages 40 - 74	Screening - Once every 5 years Management - Ongoing	Unknown	48%
Screening for type 2 diabetes mellitus (T2DM)	Ages 18 and older - risk assessment High risk for T2DM - blood glucose Very high risk for T2DM - blood glucose	Every 3-5 years Every 3-5 years Every year	Unknown	58%
Screening for depression	Nonpregnant adults ages 18+	At least once	Unknown	80%
Screening for depression	Pregnant and postpartum women	At least once per birth by 8 weeks postnatally	Unknown	12%
Screening for osteoporosis	Females age 65	One-time	Unknown	39%
Screening for abdominal aortic aneurysm	Males age 65 who have ever smoked	One-time	Unknown	58%
Screening for Sexually Transmitted Infections and Blood Borne Pathogens - Adults				
Screening for human immunodeficiency virus	Ages 15 - 65	Low risk - Once Increased risk - Every 3 - 5 years Very high risk - Every year	20%	45%
Screening for chlamydia and gonorrhea	Sexually active females 24 years of age or younger	During all pregnancies When sexual history reveals new or persistent risk factors since the last negative test	96%	63%
Screening for hepatitis C virus	Adults born between 1945 - 1965	One-time	Unknown	83%
Behavioural Counseling Interventions - Adults				
Prevention of sexually transmitted infections (STIs)	All sexually active adolescents and adults who are at increased risk for STIs	30 min to ≥2 hours of intensive behavioral counseling	Unknown	97%
Counselling and interventions to prevent tobacco use	Ages 18 and older	Up to 90 min of total counseling time, during multiple contacts	19%	29%
Alcohol misuse screening and brief counseling	Ages 18 and older	Screening - Annually during primary care visits Screening - Pregnant women Brief Intervention - Three 10-minute sessions (30 minutes)	Unknown	51%
Screening for unhealthy drug use and brief intervention	Ages 18 - 69	Annual screening and brief intervention if required Screening - Ongoing	Unknown	93%
Screening for and management of obesity	Ages 18 and older	Management - At least one-time of 12 - 26 sessions in a year Screening for risk - Every year	Unknown	97%
Preventing falls	Community-dwelling elderly ages 65+	Exercise or physical therapy - At least 150 minutes of moderate intensity / week Vitamin D supplementation - 800 IU / day for at least 12 months	Unknown	41%
Preventive Medication / Devices - Adults				
Routine aspirin use for the prevention of cardiovascular disease (CVD) and colorectal cancer	Age 50 - 69 with a 10% or greater 10-year CVD risk & at low risk of bleeding	Screening for CVD risk - At age 50 - 59 Screening for bleeding risk - At age 50 - 59 Management - Low-dose daily aspirin use for 10 years	Unknown	54%
Folic acid supplementation for the prevention of neural tube defects	Reproductive-age females	0.4 to 0.8 mg (400 - 800µg) of folic acid daily	Unknown	73%
			Unknown	33%
			Unknown	33%
			Unknown	24%
			Unknown	34%

(1) 'BiW' = best in world; (2) CPB = clinically preventable burden; (3) CE = cost-effectiveness

Vision Screening

For all children at least once between the ages of 3 and 5 years, to detect the presence of amblyopia or its risk factors.³⁸

In British Columbia

An average of 92.7% of kindergarten children were screened between 2007/08 and 2009/10 through the BC Early Childhood Vision Screening Program.³⁹

Best in the World

In South Korea, a large sample of families with children aged 3 to 5 were mailed a home vision screening test in 2001. Of the 36,973 children receiving the invitation to screen, 97.1% (35,894) completed and returned the test with 95.3% (35,226) completing the test correctly.⁴⁰

For the purposes of this project, we have assumed that BC's current screening rate of 93% is essentially equivalent to the best in the world.

Screening for Major Depressive Disorder – Children/Youth

Annually for all children/youth ages 12 to 18.⁴¹

In British Columbia

The rate of screening for MDD in children/youth ages 12 to 18 in BC is unknown.

Best in the World

An adolescent depression screening rate of 7.4% (6.9% in males and 8.0% in females) has been documented in a large health maintenance organization in the United States.⁴²

For the purposes of this project, we have assumed that a screening rate of 7.4% is equivalent to the best in the world.

Interventions to Support Breastfeeding

Provide interventions during pregnancy and after birth to support breastfeeding. Interventions include professional support, peer support and formal education. Most successful interventions include multiple sessions and are delivered at more than one point in time.^{43,44}

In British Columbia

A review of breastfeeding practices and programs in BC notes that health authorities are to proactively support breastfeeding exclusively for a 6-month period and that “most regions

³⁸ U.S. Preventive Services Task Force. Vision screening in children 6 months to 5 years: US Preventive Services Task Force Recommendation statement. *Journal of the American Medical Association*. 2017; 318(9): 836-44.

³⁹ Early Childhood Screening Research & Evaluation Unit. *BC Early Childhood Vision Screening Program - Final Evaluation Report*. 2012. University of British Columbia. Available at <http://www2.gov.bc.ca/assets/gov/health/managing-your-health/women-children-maternal-health/bc-early-childhood-vision-screening-program.pdf>. Accessed July 2017.

⁴⁰ Lim HT, Yu YS, Park SH et al. The Seoul Metropolitan Preschool Vision Screening Programme: results from South Korea. *British Journal of Ophthalmology*. 2004; 88(7): 929-33.

⁴¹ Siu AL. Screening for depression in children and adolescents: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2016; 164(5): 360-6.

⁴² Lewandowski RE, O'Connor B, Bertagnolli A et al. Screening for and diagnosis of depression among adolescents in a large health maintenance organization. *Psychiatric Services*. 2016; 67(6): 636-41.

⁴³ Palda VA, Guise J-M and Wathen CN. Interventions to promote breastfeeding: applying the evidence in clinical practice. *Canadian Medical Association Journal*. 2004; 170(6): 976-8.

⁴⁴ Bibbins-Domingo K, Grossman D, Curry S et al. Primary care interventions to support breastfeeding: US preventive services task force recommendation statement. *Journal of American Medical Association*. 2016; 316(16): 1688-93.

have established policies and/or guidelines on breastfeeding.”⁴⁵ Furthermore, public health staff contact new mothers, primarily by phone, within 24 to 48 hours of hospital discharge. Ongoing breastfeeding support is provided “by all health authorities to mothers during breastfeeding clinics, public health clinics, immunization clinics, by appointment with public health staff or through telephone support.”⁴⁶

Best in the World

In Sweden, all parents are invited to parental groups organized by the child health service. In 2012, 46% of parents attended (61% of first-time parents and 33% of parents with more than one child).⁴⁷ A further study in Sweden found that 49% of all mothers sought help and support related specifically to breastfeeding.⁴⁸

For the purposes of this project, we have assumed that a 46% participation rate in a structured antepartum educational program and/or postpartum support to promote breastfeeding initiation and duration is the best rate in the developed world (based on evidence from Sweden in 2012).

Screening For Growth Monitoring and Healthy Weight Management – Children/Youth

Screen children and adolescents ages 6 to 17 years for obesity at all appropriate primary care visits and offer or refer children/youth with obesity (and their primary caregiver) to a comprehensive, intensive (≥ 26 hours of contact over a period of 2 to 12 months) behavioral intervention to promote improvement in weight status.^{49,50}

In British Columbia

We are unable to find any information on the proportion of 6 to 17-year-olds that are screened for obesity in the province. Some screening (whether documented or not) clearly takes place as children are being referred to two weight management programs in the province.

Between April 2013 and June 2015, 625 children participated in MEND (Mind, Exercise, Nutrition, Do It!) BC with 12 active sites across the province. MEND is a community based program for children who are working with their families towards a healthy lifestyle and a healthy weight.⁵¹ Criteria for program entry include (a) age 5-13 years, (b) BMI $> 85^{\text{th}}$ percentile for age and no contraindications for participating in physical activity and (c) parent or caregiver participation. Physicians may recommend MEND, but a referral is not required for program entry.

⁴⁵ British Columbia Ministry of Health. *Review of Breastfeeding Practices and Programs: British Columbia and Pan-Canadian Jurisdictional Scan*. 2012. Available at <http://www.health.gov.bc.ca/library/publications/year/2012/breastfeeding-jurisdictional-scan.pdf>. Accessed July 2017.

⁴⁶ Ibid.

⁴⁷ Lefèvre Å, Lundqvist P, Drevenhorn E et al. Parents' experiences of parental groups in Swedish child health-care: do they get what they want? *Journal of Child Health Care*. 2016; 20(1): 46-54.

⁴⁸ Ellberg L, Lundman B, Persson MEK et al. Comparison of health care utilization of postnatal programs in Sweden. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 2005; 34(1): 55-62.

⁴⁹ Canadian Task Force on Preventive Health Care. Recommendations for growth monitoring, and prevention and management of overweight and obesity in children and youth in primary care. *Canadian Medical Association Journal*. 2015; 187(6): 411-21.

⁵⁰ US Preventive Services Task Force. Screening for obesity in children and adolescents: US Preventive Services Task Force Recommendation Statement. *Journal of American Medical Association*. 2017; 317(23): 2417-26.

⁵¹ Bradbury J, Day M, & Scarr J. *British Columbia's Continuum for the Prevention, Management, and Treatment of Health Issues Related to Overweight and Obesity in Children and Youth*. BC: Childhood Obesity Foundation & Child Health BC: October 2015. Available online at http://childhoodobesityfoundation.ca/wp-content/uploads/2016/07/ChildhoodObesity_report_webMRSsingle_fnl-1.pdf. Accessed July 2017.

Between January 2013 and June 2015, 1,071 children and their parents were referred to Shapedown BC and almost 300 completed the program.⁵² Shapedown BC is a multidisciplinary, weight-management program that provides medical, nutritional and psychological support for children and youth who are working with their families to recognize and overcome challenges to active living and healthy eating.⁵³ Shapedown BC is a family-based, obesity-reduction initiative for children and adolescents. Criteria for program entry to Shapedown BC includes (a) physician referral, (b) age 6-17 years, (c) BMI > 97th percentile for age (according to growth chart) or BMI >85th percentile and co-morbidities or other complex medical or psychosocial profiles and (d) parent or caregiver participation.

In 2017, there are an estimated 578,600 children and youth ages 6-17 living in BC (see following table). The majority of these children and youth would be eligible for growth monitoring. Based on *measured height and weight* as calculated for the 2004 Canadian Community Health Survey (CCHS), 6.6% (37,913 of 578,600) of BC children and youth ages 6-17 are obese.⁵⁴ The 37,913 children and youth with obesity are most likely to be offered structured behavioural interventions aimed at healthy weight management. Based on the 1,071 children and their parents who were referred to Shapedown BC between January 2013 and June 2015, at least 2.8% (1,071 of 37,913) of children and youth with obesity in BC have been referred to a comprehensive, intensive behavioral intervention.

Estimated Number of Children and Youth With Obesity In British Columbia			
By Sex and Age, 2017			
Prevalence Based on 2004 CCHS Data			
	Male	Female	Total
Population			
6 to 8	73,200	68,100	141,300
9 to 13	122,600	114,600	237,200
14 to 17	103,100	97,000	200,100
Total	298,900	279,700	578,600
Prevalence of Obesity			
6 to 8	2.2%	13.6%	7.7%
9 to 13	6.1%	4.7%	5.4%
14 to 17	10.1%	3.8%	7.1%
Total	6.6%	6.5%	6.6%
# of Individuals with Obesity			
4 to 8	1,634	9,274	10,908
9 to 13	7,536	5,336	12,872
14 to 17	10,425	3,709	14,133
Total	19,595	18,319	37,913

Best in the World

Research evidence suggests that growth monitoring in children and youth is, at best, inconsistent in paediatric practice. Dorsey et al. found that BMI was documented in only 3 of 600 (0.5%) charts they reviewed. Of the 239 children/youth at risk of being overweight or

⁵² HealthyFamiliesBC. *Provincial Management and Evaluation Report Cycles I-VII: January 2013 – June 2015*. September 2015.

⁵³ Bradbury J, Day M, & Scarr J. *British Columbia's Continuum for the Prevention, Management, and Treatment of Health Issues Related to Overweight and Obesity in Children and Youth*, BC: Childhood Obesity Foundation & Child Health BC: October 2015. Available online at http://childhoodobesityfoundation.ca/wp-content/uploads/2016/07/ChildhoodObesity_report_webMRSsingle_fnl-1.pdf. Accessed July 2017.

⁵⁴ Statistics Canada. Canadian Community Health Survey (CCHS) - Nutrition, 2004 Public Use Microdata file (Catalogue number 82M0024GPE). 2004: All computations, use and interpretation of these data are entirely that of H. Krueger & Associates Inc.

obese, 41 (17%) had documented treatment recommendations, usually consisting of general advice regarding diet and exercise.⁵⁵

Barlow and colleagues noted that only 6.1% of charts they reviewed contained a plot of BMI. They conclude, however, that “despite low BMI curve use, paediatricians recognized most overweight/obese children with a BMI at or above the 95th percentile. BMI plotting may increase recognition in mildly overweight children.”⁵⁶

Based on self-report, an estimated 11% of Community Paediatricians and 7% of Family Physicians across Canada routinely assess their paediatric patients for obesity. Furthermore, only 60% of Community Paediatricians and 30% of Family Physicians across Canada use recommended methods for identifying paediatric obesity.⁵⁷

Based on a review of medical records in the US, only 5.5% of physicians documented BMI and 4.3% plotted BMI. Residents were more likely to document (13.0% vs 3.0%) and plot (9.0% vs 2.7%) BMI than attending physicians.⁵⁸

For the purposes of this project, we have assumed that screening rates of 13% are equivalent to the best in the world (based on rates observed for US physician residents).

Estimating the best in the world rate for the proportion of children with obesity who have been referred to a comprehensive, intensive behavioral intervention is challenging. In the UK, MEND has been implemented on a national scale since 2007.⁵⁹ Between 2007 and 2010, 21,132 families were referred to MEND 7-13 in that country.⁶⁰ We were unable to find more recent estimates. In 2016, there were 5,328,000 children ages 7-13 in the UK⁶¹ with a 19% rate of obesity⁶² (or 1,012,320 7-13-year-olds with obesity). The 21,132 families thus represents approximately 2.1% of children with obesity in the UK.

For the purposes of this project, we have assumed that a referral rate of approximately 3% of children/youth with obesity to a comprehensive, intensive behavioral intervention (as observed in BC) is equivalent to the best rate in the world.

Education or Brief Counseling to Prevent Initiation of Tobacco Use and to Treat Tobacco Smoking – Children / Youth

The CTFPHC recommends asking children and youth (age 5–18 years) or their parents about tobacco use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to prevent tobacco smoking among children and youth and to treat

⁵⁵ Dorsey KB, Wells C, Krumholz HM et al. Diagnosis, evaluation, and treatment of childhood obesity in pediatric practice. *Archives of Pediatrics & Adolescent Medicine*. 2005; 159(7): 632-8.

⁵⁶ Barlow SE, Bobra SR, Elliott MB et al. Recognition of childhood overweight during health supervision visits: Does BMI help pediatricians? *Obesity*. 2007; 15(1): 225-32.

⁵⁷ He M, Piché L, Clarson CL et al. Childhood overweight and obesity management: a national perspective of primary health care providers' views, practices, perceived barriers and needs. *Paediatrics & Child Health*. 2010; 15(7): 419-26.

⁵⁸ Hillman JB, Corathers SD and Wilson SE. Pediatricians and screening for obesity with body mass index: does level of training matter? *Public Health Reports*. 2009; 124(4): 561-7.

⁵⁹ Aicken C, Roberts H and Arai L. Mapping service activity: the example of childhood obesity schemes in England. *BioMed Central Public Health*. 2010; 10(1): 310.

⁶⁰ Fagg J, Chadwick P, Cole T et al. From trial to population: a study of a family-based community intervention for childhood overweight implemented at scale. *International Journal of Obesity*. 2014; 38(10): 1343-49.

⁶¹ Ibid.

⁶² Arai L, Panca M, Morris S et al. Time, monetary and other costs of participation in family-based child weight management interventions: qualitative and systematic review evidence. *PLoS ONE*. 2015; 10(4): 1-12.

tobacco smoking among children and youth. These are both weak recommendations based on low-quality evidence.⁶³

The USPSTF also recommends that primary care clinicians provide interventions, including education or brief counseling, to prevent initiation of tobacco use in school-aged children and adolescents. This is a “B” recommendation.⁶⁴

In British Columbia

We were unable to find any information about the utilization of primary care-based interventions aimed at reducing smoking initiation among non-smoking children and youth in British Columbia.

Best in the World

In the US, 71.5% of outpatient visits to office-based physicians by patients aged 11-17 years include screening for tobacco use.⁶⁵ Approximately 63% to 85% of adolescents in the US are seen for preventive care visits each year.^{66,67,68}

For the purposes of this project, we have assumed that 74% (the midpoint of 63% and 85%) of children and youth see a primary care provider annually and that 71.5% of the visits include screening for tobacco use, for a best rate in the world of 53% ($0.74 * 0.715$) of children / youth receiving tobacco prevention advice.

Application of Fluoride Varnish

Apply fluoride varnish once every six months to the primary teeth of all infants and children starting at the age of primary tooth eruption.^{69,70}

In British Columbia

We were unable to find any information on the prevalence of the application of fluoride varnish in infants and children in BC.

Best in the World

In a school-based program of 589 children ages 3 to 7 from deprived neighbourhoods in the UK, 82.7% (487) consented to three fluoride applications over the period of a year while

⁶³ Canadian Task Force on Preventive Health Care. Recommendations on behavioural interventions for the prevention and treatment of cigarette smoking among school-aged children and youth. *Canadian Medical Association Journal*. 2017; 189 (8): E310-16.

⁶⁴ Moyer VA. Primary care interventions to prevent tobacco use in children and adolescents: U.S. Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2013; 159(8): 552-7.

⁶⁵ Jamal A, Dube S, Babb S et al. Tobacco use screening and cessation assistance during physician office visits among persons aged 11–21 years—National Ambulatory Medical Care Survey, United States, 2004–2010. *Morbidity and Mortality Weekly Report*. 2014; 63(2): 71-9.

⁶⁶ Hedberg V, Byrd R, Klein J et al. The role of community health centers in providing preventive care to adolescents. *Archives of Pediatrics & Adolescent Medicine*. 1996; 150(6): 603-8.

⁶⁷ Klein J, Wilson K, McNulty M et al. Access to medical care for adolescents: results from the 1997 Commonwealth Fund Survey of the Health of Adolescent Girls. *Journal of Adolescent Health*. 1999; 25(2): 120-30.

⁶⁸ Igra V and Millstein S. Current status and approaches to improving preventive services for adolescents. *Journal of American Medical Association*. 1993; 269(11): 1408-12.

⁶⁹ Moyer VA. Prevention of dental caries in children from birth through age 5 years: US Preventive Services Task Force recommendation statement. *Pediatrics*. 2014; 133(5): 1-10.

⁷⁰ Fluoride Recommendations Work Group. Recommendations for using fluoride to prevent and control dental caries in the United States. *Morbidity and Mortality Weekly Report Recommendations and Reports*. 2001; 50 (RR-14): 1-42.

61.6% (363) received all three applications. The greatest number of refusals was from younger children.⁷¹

A school-based oral health program targeting 3 to 6-year-old children in East London, UK, found that 21% of eligible children received two fluoride applications in year 1 of the program. This increased to 29% in year 2 and 53% in year 3.⁷²

For the purposes of this project, we have assumed that the best rate in the world for fluoride application in children ages 1 to 5 is 62%, the rate achieved by a pilot project in the UK.⁷³

Application of Dental Sealants

Professionally-applied fissure sealants for selective use on permanent molar teeth soon after their eruption.^{74,75,76}

In British Columbia

In 2012/13, 91.8% of BC kindergarten children were screened for dental health. Of these, 67.3% were caries free, 18.1% had treated caries and 14.6% had visible decay in one or more teeth. 12.9% were referred for non-urgent treatment and 2.1% for urgent treatment.⁷⁷ Despite a decline in the prevalence of visible tooth decay from 17.3% in 2006/07 to 14.6% in 2012/13, we were unable to find any information on the prevalence of dental sealant use in BC.⁷⁸

Best in the World

In the US, the prevalence of dental sealant use in 2011/12 was 43.1% among youth aged 12 to 19, ranging from 30.0% among the non-Hispanic black population to 46.7% among the non-Hispanic white population.⁷⁹

⁷¹ Buckingham S and John J. Recruitment and participation in preschool and school-based fluoride varnish pilots—the South Central experience. *British Dental Journal*. 2013; 215(E8): 1-4.

⁷² Evans P, Pearson N and Simons D. A school-based oral health intervention in East London: the Happy Teeth fluoride varnish programme. *British Dental Journal*. 2013; 215(E14): 1-5.

⁷³ Buckingham S and John J. Recruitment and participation in preschool and school-based fluoride varnish pilots—the South Central experience. *British Dental Journal*. 2013; 215(E8): 1-4.

⁷⁴ Lewis DW and Ismail AI. *Canadian Guide to Clinical Preventive Health Care: Chapter 36: Prevention of Dental Caries*. 1994. Available at http://canadiantaskforce.ca/wp-content/uploads/2013/03/Chapter36_dental_caries94.pdf. Accessed September 2017.

⁷⁵ Cochrane Oral Health Group. *Pit and fissure sealants for preventing dental decay in permanent teeth*. The Cochrane Library. July 31, 2017. Available online at http://www.cochrane.org/CD001830/ORAL_sealants-preventing-tooth-decay-permanent-teeth. Accessed September 2017.

⁷⁶ Canadian Agency for Drugs and Technologies in Health. *Dental Sealants and Preventive Resins for Caries Prevention: A Review of the Clinical Effectiveness, Cost-effectiveness and Guidelines*. October 31, 2016. Available online at

<https://www.cadth.ca/sites/default/files/pdf/htis/2016/RC0816%20Dental%20Sealants%20Final.pdf>. Accessed September 2017.

⁷⁷ Healthy Development and Women's Health Directorate - BC Ministry of Health. *BC Dental Survey of Kindergarten Children 2012-2013: A Provincial and Regional Analysis* 2014. Available at <http://www.health.gov.bc.ca/women-and-children/pdf/provincial-kindergarten-dental-survey-2012-13.pdf>. Accessed September 2017.

⁷⁸ Office of the Provincial Health Officer. *Is "Good", Good Enough? The Health & Well-Being of Children & Youth in BC*. 2016. Available at <http://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/reports-publications/annual-reports/pho-annual-report-2016.pdf>. Accessed August 2017.

⁷⁹ Dye B, Thornton-Evans G, Li X et al. *Dental Caries and Sealant Prevalence in Children and Adolescents in the United States, 2011-2012*. 2015. U.S. Department of Health and Human Services Available at <http://fluoridealert.org/wp-content/uploads/cdc.dye-2015.pdf>. Accessed August 2017.

A study in Portugal based on a sample of 447 adolescents aged 12 to 18 found that 58.8% had at least one fissure sealant applied.⁸⁰

For the purposes of this project, we have assumed that the best rate in the world for the application of at least one fissure sealant in children ages 6 to 12 is 59%, based on the results from Portugal.

Screening for Breast Cancer

Mammography screening between the ages of 50 and 74 every two to three years.^{81,82}

In British Columbia

According to the BC Cancer Agency's *Screening Mammography Program 2016 Annual Report*, the following participation rates were observed during the 30-month screening period between July 1, 2013 and December 31, 2015.

- Ages 40-49 – 36%
- Ages 50-59 – 50%
- Ages 60-69 – 55%
- Ages 70-79 – 39%
- Ages 80-89 – 3%

The average screening rate for 50-69-year-old females was 52.4%.⁸³

Best in the World

In Canada in 2014, the highest participation rates for females aged 50 to 69 was in Quebec at 62.3%.⁸⁴

In the U.S., participation rates (mammography within the past two years) in 2014 for the population ages 50-74 were 78.5%, with a high of 88.1% in the state of Massachusetts.⁸⁵

In Finland, a nationwide mammography screening program with a two year interval for women aged 50-59 years was established in 1987. The program allowed optional participation for women aged 60-69 years. The compliance rate for screening in the 50-59 year age group was 89% for the first 10 years of the program.⁸⁶ From 1992 to 2003 the compliance rate increased to over 95% in women aged 50-59 but remained at just 20-40% among women aged 60-69.⁸⁷ In 2007, all women aged 50-69 were invited for screening.⁸⁸

⁸⁰ Veiga N, Pereira C, Ferreira P et al. Prevalence of dental caries and fissure sealants in a Portuguese sample of adolescents. *PLoS ONE*. 2015; 10(3): 1-12.

⁸¹ Canadian Task Force on Preventive Health Care. *Screening for Breast Cancer*. 2011. Available at <http://canadiantaskforce.ca/guidelines/2011-breast-cancer/>. Accessed October 2013.

⁸² Siu AL. Screening for breast cancer: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2016; 164(4): 279-96.

⁸³ BC Cancer Agency. *Screening Mammography Program: 2016 Annual Report*. 2016. Available at http://www.bccancer.bc.ca/screening/Documents/SMP_Report-AnnualReport2016.pdf. Accessed August 2017.

⁸⁴ Canadian Partnership against Cancer. *Breast Cancer Screening in Canada: Monitoring and Evaluation of Quality Indicators - Results Report January 2011 to December 2012*. 2017. Available at <http://www.cancerview.ca/preventionandscreening/breastcancerscreening/>. Accessed August 2017.

⁸⁵ National Cancer Institute. *Screening and Risk Factors Table: Had a Mammogram in the Past 2 Years*. 2017. Available at <https://statecancerprofiles.cancer.gov/risk/index.php>. Accessed July 2017.

⁸⁶ Dean PB and Pamilo M. Screening mammography in Finland--1.5 million examinations with 97 percent specificity. Mammography Working Group, Radiological Society of Finland. *Acta Oncologica*. 1999; 38 Suppl 13: 47-54.

⁸⁷ Sarkeala T, Heinavaara S and Anttila A. Organised mammography screening reduces breast cancer mortality: a cohort study from Finland. *International Journal of Cancer*. 2008; 122(3): 614-9.

⁸⁸ Schopper D and de Wolf C. How effective are breast cancer screening programmes by mammography? Review of the current evidence. *European Journal of Cancer*. 2009; 45(11): 1916-23.

According to the Finnish Cancer Registry, the 2009 rates of breast cancer screening, which included women aged 50 to 69, were 85.5% of invited women.⁸⁹ In fact, for women who have been invited to screening, the participation rate since 1992 has remained in the range of 84-89%.⁹⁰

For the purposes of this project, we have assumed that the best rate in the world for screening mammography in women ages 50-74 is 88%, based on results in the state of Massachusetts in 2014.

Screening for Cervical Cancer – Cytology-Based

Routine cytology-based (Pap) screening in females every three years between the ages of 25 and 69.^{91,92}

In British Columbia

The average participation rate for women age 20-69 was 69.3% between 2012 and 2014, after adjusting for hysterectomy (see following table). The majority of these women (76%) are re-screened every 36 months.⁹³

Pap Smear Participation Rates (%) by Age Groups in BC 2012 – 2014		
Age (Years)	Overall	Adjusted for Hysterectomy
20-29	63.1%	63.1%
30-39	71.4%	71.4%
40-49	64.2%	74.7%
50-59	56.6%	70.8%
60-69	44.5%	65.4%
20-69	60.3%	69.3%

Best in the World

In the UK, women are recalled for screening every 3.5 years if they are aged 25 to 49 and every 5.5 years if they are aged 50 to 64. In 2016, 72.7% of women ages 25 to 64 were screened within those time frames.⁹⁴ In the U.S., participation rates (Pap test within the past three years) in 2014 for the population ages 21 to 65 were 82.3%, with a high of 88.0% in the state of Massachusetts.⁹⁵

We have assumed that the best rate in the world for routine cytology-based screening in females every three years between the ages of 25 and 69 is 88%, based on results in the state of Massachusetts in 2014.

⁸⁹ Finnish Cancer Registry. *Organised Breast Cancer Screening Programme in Finland in the Invitation Year 2009*. 2012. Available at <http://www.cancer.fi/@Bin/73184124/v2009eng0039r2.html>. Accessed October 2013.

⁹⁰ Finnish Cancer Registry. *Breast Cancer Screening Programme in Finland in 1992-2009, Women Aged 50-69 Years*. Available at <http://www.cancer.fi/@Bin/73500045/Peitt%C3%A4vyys.pdf>. Accessed October 2013.

⁹¹ Canadian Task Force on Preventive Health Care. Recommendations on screening for cervical cancer. *Canadian Medical Association Journal*. 2013; 185(1): 35-45.

⁹² US Preventive Services Task Force. Draft Recommendation Statement *Cervical Cancer: Screening*. 2017. Available online at <https://www.uspreventiveservicestaskforce.org/Page/Document/draft-recommendation-statement/cervical-cancer-screening2>. Accessed December 2017.

⁹³ BC Cancer Agency. *Cervical Cancer Screening Program 2015 Annual Report*. 2016. Available at http://www.bccancer.bc.ca/screening/Documents/CCSP_Report-AnnualReport2015.pdf. Accessed August 2017.

⁹⁴ BC Cancer Agency. *Cervical Cancer Screening Program 2015 Annual Report*. 2016. Available at http://www.bccancer.bc.ca/screening/Documents/CCSP_Report-AnnualReport2015.pdf. Accessed August 2017.

⁹⁵ National Cancer Institute. *Screening and Risk Factors Table: Pap Test in Past 3 Years, No Hysterectomy*. 2017. Available at <https://statecancerprofiles.cancer.gov/risk/index.php>. Accessed July 2017.

Screening for Cervical Cancer – HPV-Based

Addition of HPV-based screening every five years in females between the ages of 30 and 65.^{96,97}

In British Columbia

Primary screening using HPV testing is not currently available in BC. The BC Cervical Cancer Screening Guidelines Committee is in the process of recommending the inclusion of HPV testing as a component of the provincial cervical cancer screening program.⁹⁸

Best in the World

The Netherlands is the first country to implement a national HPV-based screening program, started on January 1, 2016.⁹⁹ Other countries, such as the UK¹⁰⁰ and Australia¹⁰¹ are considering recommendations to implement such a program.

In the US in 2014, 32% of women ages 40-64 reported having an HPV-based screening test (together with a conventional test) over the previous five years.¹⁰²

For the purposes of this project, we have assumed that the implementation of a national HPV-based screening program would result in no change to the current best rate in the world for routine cytology-based screening of 88% seen in the state of Massachusetts (see above).

Screening for Colorectal Cancer

Screening for colorectal cancer every two years using the fecal immunochemical test (FIT) in adults between the ages of 45 and 75.¹⁰³

In British Columbia

The BC Colon Cancer Screening Program started in 2013. In 2019, 34.5% of the BC population age eligible (50-74) population had received a fecal immunochemical test (FIT) within the past 30 months.¹⁰⁴ The 34.5% does not account for those screened outside of the program so the actual rate is likely higher. In 2012, for example, 49.6% of British Columbians ages 50-74 self-reported being up-to-date on their CRC screening.¹⁰⁵

⁹⁶ Moyer VA. Screening for cervical cancer: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2012; 156(12): 880-91.

⁹⁷ US Preventive Services Task Force. Draft Recommendation Statement *Cervical Cancer: Screening*. 2017. Available online at <https://www.uspreventiveservicestaskforce.org/Page/Document/draft-recommendation-statement/cervical-cancer-screening2>. Accessed September 2017.

⁹⁸ BC Cancer Agency. *Cervical Cancer Screening Policy Change 2016 Reference Guide Supporting Healthcare Professionals in Communicating Screening Information to Patients: Frequently Asked Questions*. May 2017. Available online at http://www.bccancer.bc.ca/screening/Documents/CCSP_GuidelinesManual-CervicalCancerScreeningPolicyChangeReferenceGuide.pdf. Accessed September 2017.

⁹⁹ National Institute for Public Health and the Environment. *Cervical Cancer Screening in the Netherlands*. 2016. Available at http://www.rivm.nl/en/Documents_and_publications/Common_and_Present/Newsmessages/2014/Cervical_cancer_screening_in_the_Netherlands. Accessed August 2017.

¹⁰⁰ Kitchener H. *Report to the National Screening Committee*. 2015. Available at https://legacyscreening.phe.org.uk/policydb_download.php?doc=555. Accessed August 2017.

¹⁰¹ Australian Government Department of Health. *Medical Service Advisory Committee Recommendations*. 2017. Available at <http://www.cancerscreening.gov.au/internet/screening/publishing.nsf/Content/MSAC-recommendations>. Accessed August 2017.

¹⁰² Goding Sauer A, Siegel L, Jemal A et al. Updated Review of Prevalence of Major Risk Factors and Use of Screening Tests for Cancer in the United States. *Cancer Epidemiology Biomarkers Prevention*. 2017; 1-47.

¹⁰³ US Preventive Services Task Force. Screening for colorectal cancer: US Preventive Services Task Force Recommendation statement. *JAMA*. 2021; 325(19): 1965-1977.

¹⁰⁴ BC Cancer Colon Screening. *2019 Program Results*. March 2021. Available online at <http://www.bccancer.bc.ca/screening/Documents/Colon-Program-Results-2019.pdf>. Accessed November 2021.

¹⁰⁵ Singh H, Bernstein C, Samadder J et al. Screening rates for colorectal cancer in Canada: A cross-sectional study. *CMAJ Open*. 2016; 3(2): E149-E157.

Best in the World

In the US in 2018, 68.8% of adults ages 50-75 were up to date with CRC screening test use, ranging from a low of 57.8% in Wyoming to a high of 76.5% in Massachusetts.¹⁰⁶ Guo et al. report a CRC screening rate of 77.1% in 2008-10 in a German population ages 50 to 75.¹⁰⁷

For the purposes of this project, we have assumed that the best rate in the world for routine colorectal cancer screening in males and females between the ages of 45 and 75 is 77%.

Screening for Lung Cancer

The CTFPHC recommends screening for lung cancer among adults 55 to 74 years of age with at least a 30 pack-year smoking history, who smoke or quit smoking less than 15 years ago. Screening should take place annually for three consecutive years.¹⁰⁸

The USPSTF recommends screening asymptomatic adults aged 55 to 80 years, who have a 30 pack-year smoking history and currently smoke or have quit smoking within the past 15 years, annually. Discontinue screening when the patient has not smoked for 15 years.¹⁰⁹

In British Columbia

BC has announced the implementation of a lung cancer screening program to begin in the spring of 2022.¹¹⁰ The BC Cancer Agency is currently enrolling patients in the BC Lung Screening Trial who are current or former smokers, are between 55-80 years of age and have smoked for at least 20 years.¹¹¹

Best in the World

Several research projects have asked high-risk smokers whether or not they would be willing to undergo screening with LDCT. In the US, 82% of high-risk smokers said they would participate in screening if their physician recommended it.¹¹² However, only 32% said they would undergo screening if they had to pay for it. In Ireland, this proportion reached 98%, with 67% willing to pay for the screening.¹¹³ Similarly high 'willingness to screen' rates (96%) have also been noted in Australia.¹¹⁴

¹⁰⁶ Joseph D, King J, Dowling N et al. Vital signs: Colorectal cancer screening test use — United States, 2018. *Morbidity and Mortality Weekly Report*. 2020; 69(10): 253-9.

¹⁰⁷ Guo F, Chen, C, Schotker B et al. Changes in colorectal cancer screening use after introduction of alternative screening offer in Germany: Prospective cohort study. *International Journal of Cancer*. 2020; 146: 2423-32.

¹⁰⁸ Canadian Task Force on Preventive Health Care. Recommendations on screening for lung cancer. *Canadian Medical Association Journal*. 2016: 1-8.

¹⁰⁹ Moyer VA. Screening for lung cancer: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*. 2014; 160: 330-8.

¹¹⁰ BC Cancer Agency. *Provincial lung screening program coming in 2022*. Available at <http://www.bccancer.bc.ca/screening/lung>. Accessed March 2022.

¹¹¹ BC Cancer Agency. *The BC Lung Screen Trial*. Available at <http://www.bccancer.bc.ca/our-research/participate/lung-health>. Accessed March 2022.

¹¹² Jonnalagadda S, Bergamo C, Lin JJ et al. Beliefs and attitudes about lung cancer screening among smokers. *Lung Cancer*. 2012; 77(3): 526-31.

¹¹³ Pallin M, Walsh S, O'Driscoll MF et al. Overwhelming support among urban Irish COPD patients for lung cancer screening by low-dose CT scan. *Lung*. 2012; 190(6): 621-8.

¹¹⁴ Flynn AE, Peters MJ, Morgan LC. Attitudes towards lung cancer screening in an Australian high-risk population. *Lung Cancer International*. 2013; doi: 10.1155/2013/789057

Models assessing the cost-effectiveness of lung cancer screening make a variety of assumptions with respect to adherence to lung cancer screening, with adherence estimates ranging from 60% to 100%.^{115,116,117}

Despite these optimistic estimates, real world data suggest a much lower uptake.^{118,119} Data from the US indicates that the screening rate for the high-risk cohort of 55-74-year-olds has increased from 3.2% in 2010 to 6.0% in 2015.¹²⁰

For the purposes of this project, we have therefore assumed a best in the world rate of 6%. This rate may increase over time and / or in the context of a provincially or nationally organised lung cancer screening program. To take this into account, we have assumed that the rate in BC would eventually approximate rates associated with other cancer screening programs in the province (of approximately 50%-70%). For modelling purposes we chose the midpoint or 60%.

Screening for Hypertension

Blood pressure measurement at least once every two years for adults aged 18 years and older without previously diagnosed hypertension.^{121,122}

In British Columbia

We are not aware of any information which indicates the proportion of individuals in BC who routinely have their blood pressure checked.

Best in the World

Canada has become a world leader in the identification and management of hypertension.^{123,124} Based on data from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) for 2011 and 2012, 79% of Canadian adults are screened for blood pressure at least once every two years by their family practitioner.¹²⁵

¹¹⁵ Goulart BH, Bensink ME, Mummy DG et al. Lung cancer screening with low-dose computed tomography: costs, national expenditures, and cost-effectiveness. *Journal of the National Comprehensive Cancer Network*. 2012; 10(2): 267-75.

¹¹⁶ McMahon PM, Kong CY, Bouzan C et al. Cost-effectiveness of computed tomography screening for lung cancer in the United States. *Journal of Thoracic Oncology*. 2011; 6(11): 1841-8.

¹¹⁷ Goffin JR, Flanagan WM, Miller AB et al. Cost-effectiveness of lung cancer screening in Canada. *JAMA Oncology*. 2015; 1(6): 807-13.

¹¹⁸ Jemal A and Fedewa S. Lung cancer screening with low-dose computed tomography in the United States—2010 to 2015. *Journal of American Medical Association Oncology*. 2017: E1-3.

¹¹⁹ Soneji S, Yang J, Tanner N et al. Underuse of chest radiography versus computed tomography for lung cancer screening. *American Public Health Association*. 2017; 107(8): 1248-50.

¹²⁰ Huo J, Shen C, Volk R et al. Use of CT and chest radiography for lung cancer screening before and after publication of screening guidelines: intended and unintended uptake. *Journal of American Medical Association Internal Medicine*. 2017; 177(3): 439-41.

¹²¹ Lindsay P, Gorber S, Joffres M et al. Recommendations on screening for high blood pressure in Canadian adults. *Canadian Family Physician*. 2013; 59(9): 927-33.

¹²² US Preventive Services Task Force. Screening for hypertension in adults: US Preventive Services Task Force Recommendation statement. *JAMA*. 2021; 325(16): 1650-6.

¹²³ Schiffrin E, Campbell N, Feldman R et al. Hypertension in Canada: past, present, and future. *Annals of Global Health*. 2016; 82(2): 288-99.

¹²⁴ Padwal R and Campbell N. Blood pressure control in Canada: through the looking-glass into a glass half empty? *American Journal of Hypertension*. 2017; 30(3): 223-5.

¹²⁵ Godwin M, Williamson T, Khan S et al. Prevalence and management of hypertension in primary care practices with electronic medical records: a report from the Canadian Primary Care Sentinel Surveillance Network. *Canadian Medical Association Journal Open*. 2015; 3(1): E76-E82.

Based on data from the 2015/16 Canadian Community Health Survey, 88.1% of residents of Alberta, Nova Scotia, P.E.I. and Newfoundland & Labrador had their blood pressure checked within the last two years (78.0% within the last year).¹²⁶

For the purposes of this project, we have assumed that the Canadian screening rate of 88.1% is equivalent to the best rate in the world.

Screening for Cardiovascular Disease and Treatment with Statins

Complete a cardiovascular risk assessment every five years for adults aged 40 to 74 years. Initiate the use of low- to moderate-dose statins in adults without a history of cardiovascular disease (CVD) who have one or more CVD risk factors (dyslipidemia, diabetes, hypertension or smoking) and a calculated 10-year CVD event risk of 10% or greater (intermediate risk).^{127,128}

In British Columbia

We are not aware of any information which indicates the proportion of adults aged 40 to 74 years in BC who have had a cardiovascular risk assessment within the past five years. Nor are we aware of BC-specific data on the proportion of adults at intermediate or higher risk of CVD who are taking statins over the longer term for primary prevention purposes.

Best in the World

The Health Check program in England has offered a cardiovascular risk assessment every five years to all adults aged 40-74 years with no known cardiovascular diseases since 2009. During the four years between April 1, 2009 and March 31, 2013, 21.4% of eligible patients attended a Health Check.^{129,130} The proportion of eligible patients who attend a Health Check has increased year over year, from 5.8% in 2009/10 to 30.1% in 2012/13.¹³¹ More recently (between April 1, 2013 and March 31, 2017), 74.1% of the eligible population were offered a Health Check. Of these 74.1%, 48.9% received a Health Check resulting in 36.2% (.741* .489) of eligible patients attending a Health Check.¹³² In the Nottingham region of England, 47.7% of eligible patients ages 40-74 attended a Health Check between April 1, 2013 and March 31, 2017.¹³³

¹²⁶ The 2015/16 CCHS is the most recent survey where a significant amount of the represented Canadian population (16%) were asked about their blood pressure. In the 2017/18 survey, by comparison, only 0.1% were asked the question. We took everyone who was included in the blood pressure questions (22,914) in the survey and determined the proportion having had their blood pressure checked within the last year and the last two years, broken down by age and sex. Only four provinces (Alberta, Nova Scotia, P.E.I., and Newfoundland & Labrador) were represented by the data. Residents of other provinces were not asked the question. Therefore BC-specific data is not available.

¹²⁷ Bibbins-Domingo K, Grossman D, Curry S et al. Statin use for the primary prevention of cardiovascular disease in adults: US Preventive Services Task Force recommendation statement. *Journal of the American Medical Association*. 2016; 316(19): 1997-2007.

¹²⁸ Anderson T, Gregoire J, Pearson G et al. 2016 Canadian Cardiovascular Society guidelines for the management of dyslipidemia for the prevention of cardiovascular disease in the adult. *Canadian Journal of Cardiology*. 2016; 32: 1263-82.

¹²⁹ Chang K, Soljak M, Lee J et al. Coverage of a national cardiovascular risk assessment and management programme (NHS Health Check): retrospective database study. *Preventive Medicine*. 2015; 78: 1-8.

¹³⁰ Chang K, Lee J, Vamos E et al. Impact of the National Health Service Health Check on cardiovascular disease risk: a difference-in-differences matching analysis. *Canadian Medical Association Journal*. 2016; 188(10): E228-38.

¹³¹ Robson J, Dostal I, Sheikh A et al. The NHS Health Check in England: an evaluation of the first 4 years. *British Medical Journal Open*. 2016; 6(1): 1-10.

¹³² England PH. *Public Health Outcomes Framework*. 2017. Available at <http://www.phoutcomes.info/search/health%20check#pat/6/ati/102/par/E12000004>. Accessed August 2017.

¹³³ Ibid.

For the purposes of this project, we have assumed that the cardiovascular risk assessment rate observed in the Nottingham region of England (48%) is the best in the world.

Statins were prescribed to 39.9% of Health Check attendees in England between April 1, 2009 and March 31, 2013 with a calculated 10-year CVD event risk of *20% or greater*.¹³⁴ During that time, the recommendation from the National Institute for Health and Care Excellence (NICE) was to offer statins for primary prevention only if the 10-year CVD event risk was *20% or greater*. NICE has since modified this to a 10-year CVD event risk of 10% or greater,¹³⁵ in line with the Canadian Cardiovascular Society and USPSTF guidelines noted above. While a statin may be prescribed, a challenge is the issue of long-term persistence with statin therapy. Individuals within clinical trials tend to have 90% adherence after one year, 85% after two years and 80% after three years, but real world adherence is much lower at 60%, 45% and 40% after years one, two and three. After three years, rates of adherence tend to stabilize.^{136,137,138,139}

For the purposes of this project, after taking into account prescribing rates to high risk individuals in England and long-term persistence, we have assumed that 30% of intermediate and high risk individuals would be willing to take statins over the longer term for primary prevention purposes.

Screening for Type 2 Diabetes Mellitus

The CTFPHC suggests a two-phase approach to screening.¹⁴⁰ First, it recommends screening all adults ages 18 and older using a validated risk calculator such as Finnish Diabetes Risk Score (FINDRISC) or Canadian Diabetes Risk Assessment Questionnaire (CANRISK). This first level of screening should be completed once every 3-5 years. Those with a FINDRISC score of 15 to 20 are considered to be at high risk of diabetes (an individual's risk of developing type 2 diabetes within 10 years is between 33% and 49%) and those with a score greater than 21 are at very high risk (an individual's risk of developing diabetes within 10 years is 50% or higher). The second phase of screening involves either an A1C, fasting glucose or oral glucose tolerance test. The CTFPHC recommends the use of the A1C test given its "convenience for patients." Individuals at high risk are to be screened every 3-5 years while individuals at very high risk are to be screened every year.¹⁴¹

The USPSTF recommends screening for abnormal blood glucose in all adults ages 40 to 70 who are overweight or obese as part of a cardiovascular risk assessment.¹⁴²

¹³⁴ Chang K, Lee J, Vamos E et al. Impact of the National Health Service Health Check on cardiovascular disease risk: a difference-in-differences matching analysis. *Canadian Medical Association Journal*. 2016; 188(10): E228-38.

¹³⁵ National Institute for Health and Care Excellence. *Guide to the methods of technology appraisal 2013*. 2013. Available at <https://www.nice.org.uk/process/pmg9>. Accessed August 2017.

¹³⁶ Avorn J, Monette J, Lacour A. et al. Persistence of use of lipid-lowering medications: a cross-national study. *Journal of the American Medical Association*. 1998; 279(18): 1458-62.

¹³⁷ Perreault S, Blais L, Dragomir A. et al. Persistence and determinants of statin therapy among middle-aged patients free of cardiovascular disease. *European Journal of Clinical Pharmacology*. 2005; 61(9): 667-74.

¹³⁸ Helin-Salmivaara A, Lavikainen P, Korhonen M et al. Long-term persistence with statin therapy: a nationwide register study in Finland. *Clinical Therapeutics*. 2008; 30(1): 2228-40.

¹³⁹ Greving J, Visseren F, De Wit G et al. Statin treatment for primary prevention of vascular disease: whom to treat? Cost-effectiveness analysis. *British Medical Journal*. 2011; 342(1): d1672.

¹⁴⁰ Canadian Task Force on Preventive Health Care. Recommendations on screening for type 2 diabetes in adults. *Canadian Medical Association Journal*. 2012; 184(15): 1687-96.

¹⁴¹ *Ibid*.

¹⁴² Siu A. Screening for Abnormal Blood Glucose and Type 2 Diabetes Mellitus: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*. 2015; 163(11): 861-8.

In British Columbia

We are not aware of any information which indicates the proportion of adults aged 18 and older in BC who have been screened for diabetes risk at least once over the past five years using a validated risk calculator. Nor are we aware of BC-specific data on the proportion of adults at high or very high risk of diabetes who are being screened at least once every five years (if at high risk) or annually (if at very high risk) using the A1C test.

Best in the World

In Sweden, 9,734 individuals aged 35 – 75 years were invited by mail to complete a FINDRISC questionnaire, with 58% returning a completed questionnaire.¹⁴³ A higher response rate might be expected if the assessment was encouraged while waiting within a caregiver's office, but a study from Denmark suggests that only 28% to 45% of individuals were given and/or completed a diabetes risk questionnaire while waiting for a general practitioner appointment.¹⁴⁴

We have assumed that the best risk assessment screening rate in the world is 58%, based on results from Sweden.

In Ontario, 74% of the adult population aged 20 years or older were screened with a fasting blood glucose test within a 5 year period after 2000/01.¹⁴⁵ In the Anglo-Danish-Dutch Study of Intensive Treatment in People with Screen-detected Diabetes in Primary Care (ADDITION-Europe study), 73% of individuals ages 40-69 identified as high risk for diabetes participated in blood glucose testing.¹⁴⁶ The highest rate was observed in Denmark where 95.1% of patients identified as high risk participated in blood glucose testing if the testing occurred immediately following their general practitioner appointment. If the patient was invited to return for a fasting blood glucose test on another occasion, then 80.7% participated.¹⁴⁷ Ongoing attendance for blood glucose testing declines over time.¹⁴⁸

For the purposes of this project, we have assumed that the best ongoing screening rate in the world for individuals identified as high (every 3-5 years) or very high (every year) risk for diabetes would be 80%, based on rates observed in Denmark.

Screening for Depression - Adults

Screen for depression in the general adult population aged 18 and older if adequate systems are in place to ensure accurate diagnosis, effective treatment and appropriate follow-up. This recommendation receives a B grade from the USPSTF.¹⁴⁹ The CTFPHC recommends *against* routine screening for depression in adults at average risk of depression. This is a weak recommendation based on very-low-quality evidence.¹⁵⁰

¹⁴³ Hellgren M, Petzold M, Björkelund C et al. Feasibility of the FINDRISC questionnaire to identify individuals with impaired glucose tolerance in Swedish primary care. A cross-sectional population-based study. *Diabetic Medicine*. 2012; 29(12): 1501-5.

¹⁴⁴ Dalsgaard E, Christensen J, Skriver M et al. Comparison of different stepwise screening strategies for type 2 diabetes: finding from Danish general practice, addition-DK. *Primary Care Diabetes*. 2010; 4(4): 223-9.

¹⁴⁵ Wilson SE, Rosella LC, Lipscombe LL et al. The effectiveness and efficiency of diabetes screening in Ontario, Canada: a population-based cohort study. *BMC Public Health*. 2010; 10(1): 506.

¹⁴⁶ Simmons R, Echouffo-Tcheugui J, Sharp S et al. Screening for type 2 diabetes and population mortality over 10 years (ADDITION-Cambridge): a cluster-randomised controlled trial. *The Lancet*. 2012; 380(9855): 1741-8.

¹⁴⁷ Van den Donk M, Sandbaek A, Borch-Johnsen K et al. Screening for Type 2 diabetes. Lessons from the ADDITION-Europe study. *Diabetic Medicine*. 2011; 28(11): 1416-24.

¹⁴⁸ Ibid.

¹⁴⁹ Siu AL and the US Preventive Services Task Force (USPSTF). Screening for depression in adults: US Preventive Services Task Force recommendation statement. *JAMA*. 2016; 315(4): 380-7.

¹⁵⁰ Canadian Task Force on Preventive Health Care. Recommendations on screening for depression in adults. *Canadian Medical Association Journal*. 2013; 185(9): 775-82.

The USPSTF found no evidence on ideal screening intervals. In the absence of data, they recommend “screening all adults who have not been screened previously and using clinical judgment in consideration of risk factors, comorbid conditions and life events to determine if additional screening of high-risk patients is warranted.”¹⁵¹

In British Columbia

We were unable to find any information that specifically identifies what proportion of non-perinatal adults ages 18 and older are being routinely screened for depression in BC.

Best in the World

Based on the National Ambulatory Medical Care Survey in the US, an estimated 885 million physician office visits occurred in 2014.¹⁵² Approximately 36.1 million of these visits included depression screening. That is, depression screening was provided during 4.08% of physician office visits. The 4.08% represents an increase from 1.43% in 2012¹⁵³, 1.36% in 2010¹⁵⁴ and 1.07% in 2008.¹⁵⁵

Of the 885 million visits provided in 2014, 462 million visits were provided by a primary care physician. If we assume that all visits which included depression screening were provided by a primary care physician, then 7.83% of visits to a primary care physician included depression screening. Finally, an average of 1.47 visits per year are made to a primary care physician.¹⁵⁶ If we further assume that patients are only screened once per year, then approximately 11.5% ($.0783 * 1.47$) of the US population were screened for depression by their primary care physician in 2014.

The US Affordable Care Act, signed into law on March 23, 2010, amends the US Social Security Act to remove “barriers to preventive services in Medicare” (Section 4104-5) and improve “access to preventive services for eligible adults in Medicaid” (Section 4106). A common amendment is the incorporation of “diagnostic, screening, preventive and rehabilitative services including any clinical preventive services that are assigned a grade of A or B by the United States Preventive Services Task Force” [Section 4106 (a)(13)].¹⁵⁷

The implementation of the Affordable Care Act and the focus on preventive services appears to have resulted in a tripling in screening rates for depression in the US (from screening occurring during 1.36% of physician office visits in 2010 to 4.08% in 2014).

¹⁵¹ Siu AL and the US Preventive Services Task Force (USPSTF). Screening for depression in adults: US Preventive Services Task Force recommendation statement. *JAMA*. 2016; 315(4): 380-7.

¹⁵² Rui P, Hing E, Okeyode T. *National Ambulatory Medical Care Survey: 2014 State and National Summary Tables*. Available at http://www.cdc.gov/nchs/ahcd/ahcd_products.htm. Accessed August 2017.

¹⁵³ National Center for Health Statistics. *National Ambulatory Medical Survey: 2012 Summary Tables*. 2012. Available at http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2012_namcs_web_tables.pdf. Accessed August 2017.

¹⁵⁴ National Center for Health Statistics. *National Ambulatory Medical Care Survey: 2010 Summary Tables*. 2010. Available at http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2010_namcs_web_tables.pdf. Accessed August 2017.

¹⁵⁵ National Center for Health Statistics. *National Ambulatory Medical Care Survey: 2008 Summary Tables*. 2008. Available at http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2008_namcs_web_tables.pdf. Accessed August 2017.

¹⁵⁶ Rui P, Hing E, Okeyode T. *National Ambulatory Medical Care Survey: 2014 State and National Summary Tables*. Available at http://www.cdc.gov/nchs/ahcd/ahcd_products.htm. Accessed August 2017.

¹⁵⁷ U.S. Department of Health & Human Services. *The Affordable Care Act*. 2010. Available at <http://www.hhs.gov/healthcare/about-the-law/read-the-law/index.html>. Accessed August 2017.

For the purposes of this project, we have assumed that the best screening rate for depression in the world in asymptomatic adults ages 18 and older is 12%, based on the estimated screening rate in the US in 2014 noted above.

Screening for Depression - Pregnant and Postpartum Females

The USPSTF recommends “screening for depression in the general adult population, *including pregnant and postpartum women* [emphasis added]. Screening should be implemented with adequate systems in place to ensure accurate diagnosis, effective treatment and appropriate follow-up.”¹⁵⁸

The CTFPHC, on the other hand, recommends *against* routinely screening for depression in adults in subgroups of the population who may be at increased risk of depression, including pregnant and postpartum women.¹⁵⁹

The Lifetime Prevention Schedule Expert Committee acknowledges the conflict between the two recommendations. Upon further examination, the USPSTF review included literature investigating screening and treatment of depression in perinatal and postpartum women. The CTFPHC included literature examining screening only, which was sparse; literature examining screening and treatment was excluded. In BC, the current standard for delivery of public health services is offering the Edinburgh Postnatal Depression Scale (EPDS) by eight weeks postpartum, with education/intervention/referral for treatment as needed. The USPSTF review includes a number of validation studies on perinatal and postpartum depression screening tools (including the Edinburgh Postnatal Depression Scale) in a variety of settings. These do not appear in the CTFPHC review. Finally, there are several studies on perinatal and postpartum depression screening and treatment that were published after the CTFPHC review in 2013, but were included in the more recent USPSTF review. Therefore, the LPS will use the USPSTF recommendation as the most current evidence of clinical effectiveness and proceed with the modeling of population health impact and cost effectiveness of screening and treatment for depression in perinatal and postpartum women.

In British Columbia

The BC Reproductive Mental Health Program recommends screening during pregnancy at 28-32 weeks and again at six to eight weeks postnatally using the EPDS.¹⁶⁰ We were unable to find information on formal screening rates for depression in perinatal and postpartum women in BC.

Best in the World

Eighty percent of mothers are comfortable with the idea of being screened for postpartum depression (PPD).^{161,162} Eighty-three percent of family practitioners and 73% of paediatricians are willing to screen for PPD.¹⁶³ The theoretical maximum screening rate might therefore be 66% ($0.8 * 0.83$). In actual practice, however, screening rates using a validated screening tool

¹⁵⁸ Siu AL and the US Preventive Services Task Force (USPSTF). Screening for depression in adults: US Preventive Services Task Force recommendation statement. *JAMA*. 2016; 315(4): 380-7.

¹⁵⁹ Canadian Task Force on Preventive Health Care. Recommendations on screening for depression in adults. *Canadian Medical Association Journal*. 2013; 185(9): 775-82.

¹⁶⁰ BC Reproductive Mental Health Program and Perinatal Services BC. *Best Practice Guidelines for Mental Health Disorders in the Perinatal Period*. 2014. Available at <http://www.perinatalervicesbc.ca/Documents/Guidelines-Standards/Maternal/MentalHealthDisordersGuideline.pdf>. Accessed August 2017.

¹⁶¹ Buist A, Condon J, Brooks J et al. Acceptability of routine screening for perinatal depression. *Journal of Affective Disorders*. 2006; 93(1): 233-7.

¹⁶² Gemmill AW, Leigh B, Ericksen J et al. A survey of the clinical acceptability of screening for postnatal depression in depressed and non-depressed women. *BMC Public Health*. 2006; 6: 211.

¹⁶³ Glasser S, Levinson D, Bina R et al. Primary care physicians' attitudes toward postpartum depression is it part of their job? *Journal of Primary Care & Community Health*. 2016; 7(1): 24-9.

appear to be closer to 20%.^{164,165,166} Even in an outpatient academic medical center, the screening rate only reached 39%.¹⁶⁷

For the purposes of this project, we have assumed that the best screening rate for postpartum depression in the world is 39%.¹⁶⁸

Screening for Osteoporosis

The USPSTF recommends screening for osteoporosis with bone measurement testing to prevent osteoporotic fractures in women 65 years and older.¹⁶⁹

In British Columbia

The rate of screening for osteoporosis with bone measurement testing to prevent osteoporotic fractures in women 65 years and older in BC is unknown.

Best in the World

Based on a retrospective longitudinal cohort study within 13 primary care clinics in the Sacramento, CA region, 57.8% of 65 year old women are referred to and receive a bone density scan.¹⁷⁰

We have assumed that the best screening rate for osteoporosis in women 65 years and older is 57.8%.

Screening for Abdominal Aortic Aneurysm

The USPSTF recommends one-time screening for abdominal aortic aneurysm (AAA) with ultrasonography in men aged 65 to 75 years who have ever smoked.¹⁷¹

The CTFPHC recommends one-time screening with ultrasonography for AAA of men aged 65 to 80 years (weak recommendation; moderate quality of evidence).¹⁷²

In British Columbia

The rate of one-time screening for abdominal aortic aneurysm (AAA) with ultrasonography in men aged 65 to 75 years who have ever smoked or in all men ages 65 to 80 years in BC is unknown.

¹⁶⁴ Seehusen DA, Baldwin L-M, Runkle GP et al. Are family physicians appropriately screening for postpartum depression? *The Journal of the American Board of Family Practice*. 2005; 18(2): 104-12.

¹⁶⁵ Psaros C, Geller PA, Sciscione AC et al. Screening practices for postpartum depression among various health care providers. *The Journal of Reproductive Medicine*. 2009; 55(11-12): 477-84.

¹⁶⁶ Ford E, Shakespeare J, Elias F et al. Recognition and management of perinatal depression and anxiety by general practitioners: a systematic review. *Family Practice*. 2016; 34(1): 11-9.

¹⁶⁷ Delatte R, Cao H, Meltzer-Brody S et al. Universal screening for postpartum depression: an inquiry into provider attitudes and practice. *American Journal of Obstetrics and Gynecology*. 2009; 200(5): e63-e4.

¹⁶⁸ Ibid.

¹⁶⁹ Curry SJ, Krist AH, Owens DK et al. Screening for osteoporosis to prevent fractures: US Preventive Services Task Force recommendation statement. *Journal of the American Medical Association*. 2018; 319(24): 2521-31.

¹⁷⁰ Amarnath ALD, Franks P, Robbins JA et al. Underuse and Overuse of Osteoporosis Screening in a Regional Health System: a Retrospective Cohort Study. *Journal of General Internal Medicine*. 2015; 12(30): 1733-40.

¹⁷¹ LeFevre ML. Screening for abdominal aortic aneurysm: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2014; 161(4): 281-90.

¹⁷² Singh H, Dickinson JA, Lewin G et al. Recommendations on screening for abdominal aortic aneurysm in primary care. *Canadian Medical Association Journal*. 2017; 189(36): E1137-E45.

Best in the World

Jacomelli and colleagues report that the National Health Service in England's AAA screening programme had mean uptake across the country of 78.1%, but varied regionally between 61.7 – 85.8%.¹⁷³

We have assumed that the best in the world one-time screening rate for AAA in men aged 65 to 75 years who have ever smoked is 85.8%.

Screening for HIV

Screen youth and adults 15 to 65 years of age for HIV infection. Younger adolescents and older adults who are at increased risk should also be screened. Finally, screen all pregnant women for HIV, including those who present in labor who are untested and whose HIV status is unknown.¹⁷⁴

The CTFPHC has reviewed the USPSTF guideline on screening for HIV infection and conclude that it “is a high-quality guideline, but the CTFPHC does not recommend its use in Canada. In the opinion of the CTFPHC, available evidence does not justify routinely screening all adult Canadians for HIV.” Instead, the focus should be on screening high-risk groups and pregnant women.¹⁷⁵

The USPSTF found insufficient evidence to determine optimum time intervals for HIV screening. They recommend 1-time screening to identify persons who are already HIV-positive, with repeated screening of those who are known to be at risk for HIV infection, those who are actively engaged in risky behaviors, and those who live or receive medical care in a high-prevalence setting (a geographic location or community with an HIV seroprevalence of at least 1%). All pregnant women should be screened. Individuals at increased risk should be screened every 3 to 5 years while those at very high risk should be screened every year.¹⁷⁶

The 2014 HIV Testing Guidelines for the Province of British Columbia recommend that health care providers offer an HIV test¹⁷⁷

- Routinely, every five years, to all patients aged 18-70 years
- Routinely, every year, to all patients aged 18-70 years who belong to populations with a higher burden of HIV infection
- Once for patients older than 70 years of age, if HIV status is not known

AND offer an HIV test to patients including adults 18-70, youth and the elderly, whenever

- Ordering diagnostic bloodwork for a new or worsening medical condition
- They present with symptoms of HIV infection or advanced HIV disease
- They or their providers identify a risk for HIV acquisition
- They request an HIV test
- They are pregnant
- They test for or diagnose a sexually transmitted infection, hepatitis C, hepatitis B or tuberculosis

¹⁷³ Jacomelli J, Summers L, Stevenson A et al. Impact of the first 5 years of a national abdominal aortic aneurysm screening programme. *British Journal of Surgery*. 2016; 103(9): 1125-31.

¹⁷⁴ Moyer VA. Screening for HIV: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*. 2013; 159(1): 51-60.

¹⁷⁵ Canadian Task Force on Preventive Health Care. *HIV 2013 Critical Appraisal Report*. Available online at <https://canadiantaskforce.ca/wp-content/uploads/2016/05/2013-hiv-en-ca-final.pdf>. Accessed September 2017.

¹⁷⁶ Moyer VA. Screening for HIV: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*. 2013; 159(1): 51-60.

¹⁷⁷ Office of the Provincial Health Officer. *HIV Testing Guidelines for the Province of British Columbia*. 2014. Available online at <http://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/hiv-testing-guidelines-bc.pdf>. Accessed September 2017.

In British Columbia

During the five-year time period from 2009 to 2013, a total of 963,022 HIV tests were provided for 653,417 unique individuals aged 15 to 65 in BC,¹⁷⁸ suggesting a current five-year screening rate in this population of approximately 20% (653,417 divided by the 3,267,099 persons aged 15 to 65 living in British Columbia in 2013).

In 2011, the uptake of prenatal HIV screening in BC reached 95.9%.¹⁷⁹

Best in the World

In the U.S. in 2013, the proportion of the population ages 18 to 64 who have ever been tested for HIV is approximately 40-45%.¹⁸⁰

In England in 2016, 63% of adolescents and adults ages 15 to 64 who sought sexual health services were tested for HIV. This cohort is considered to be at increased risk for HIV. For men who have sex with men who also sought sexual health services (a cohort considered to be at very high risk), 83% were tested for HIV.¹⁸¹

In the U.K. in 2011, 97% of pregnant women were tested for HIV.¹⁸²

We have assumed that the best HIV screening rates in the world would be 45% for the general population (based on 2013 data from the US), 63% for individuals at increased risk (based on 2016 data from England for adolescents and adults ages 15 to 64 who sought sexual health services), 83% for individuals at very high risk (based on 2016 data from England for men who have sex with men who also sought sexual health services) and 97% for pregnant women (based on 2011 data from the U.K.).

Screening for Chlamydia and Gonorrhea

Screen for chlamydia and gonorrhea in all sexually active women age 24 years or younger.¹⁸³

In the absence of studies on screening intervals, the USPSTF recommends that a reasonable approach would be to screen patients whose sexual history reveals new or persistent risk factors since the last negative test result.¹⁸⁴

In British Columbia

We were unable to find information on screening rates for chlamydia or gonorrhea in sexually active women age 24 years or younger in BC.

Best in the World

In the United States, screening for chlamydia among sexually active women aged 16 to 24 years in commercial health maintenance organization (HMO) plans increased from 23.1% in

¹⁷⁸ Dr. Mark Gilbert, Surveillance & Online Sexual Health Services, Clinical Prevention Services, BC Centre for Disease Control. Personal communication, May, 2014.

¹⁷⁹ Kuo M, Money DM, Alvarez M et al. Test uptake and case detection of syphilis, HIV, and hepatitis C among women undergoing prenatal screening in British Columbia, 2007 to 2011. *Journal of Obstetrics and Gynaecology Canada*. 2014; 36(6): 482-90.

¹⁸⁰ Van Handel M and Branson B. Monitoring HIV testing in the United States: consequences of methodology changes to national surveys. *PloS ONE*. 2015; 10(4): 1-12.

¹⁸¹ England PH. *Sexually Transmitted Infections (STIs): Annual Data Tables*. 2017. Available at <https://www.gov.uk/government/statistics/sexually-transmitted-infections-stis-annual-data-tables>. Accessed August 2017.

¹⁸² Health Protection Agency. *HIV in the United Kingdom: 2012 Report*. 2012. Available at http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137200016. Accessed August 2017.

¹⁸³ LeFevre ML. Screening for chlamydia and gonorrhea: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2014; 161(12): 902-10.

¹⁸⁴ LeFevre ML. Screening for chlamydia and gonorrhea: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2014; 161(12): 902-10.

2001 to 47.0% in 2014. Among sexually active women aged 16 to 24 years covered by Medicaid, screening rates increased from 40.4% in 2001 to 54.6% in 2014.¹⁸⁵ We were unable to find screening rates specific to gonorrhea in sexually active women age 24 years or younger.

For the purposes of this project, we have assumed that the best chlamydia and gonorrhea screening rates among sexually active women age 24 years or younger in the world would be 55% (based on the US screening rate for chlamydia observed in 2014).

Screening for Hepatitis C Virus Infection

The USPSTF recommends one-time screening for HCV infection to asymptomatic adults born between 1945 and 1965.¹⁸⁶

The CTFPHC recommends *against* screening for HCV in adults who are not at elevated risk. This is a “strong recommendation” based on “very low-quality evidence”.¹⁸⁷

In British Columbia

Between 1992 and 2013, a total of 443,018 unique individuals between the ages of 48 to 68 years have been tested for HCV,¹⁸⁸ suggesting an overall screening rate in this population in BC of 32.7% (1,354,520 / 443,018).

Best in the World

One-time screening rates for HCV infection in adults born between 1945 and 1965 in the US are up to 76% for high risk patients^{189,190} but much lower, at 8 to 10%, for the general population of this cohort.^{191,192} In Scotland, an average screening rate of 48% was achieved in eight general practices.¹⁹³

We have assumed that the best one-time screening rate for HCV infection in the general population of adults born between 1945 and 1965 is 48%.

Prevention of Sexually Transmitted Infections

Recommend intensive behavioral counseling ranging in intensity from 30 min to ≥ 2 hours of contact time for all sexually active youth and for adults who are at increased risk for STIs.¹⁹⁴ Adults at increased risk include those with current STIs or other infections within the past year, adults who have multiple sex partners and adults who do not consistently use condoms.

¹⁸⁵ Centers for Disease Control and Prevention. *Sexually Transmitted Disease Surveillance 2015*. Atlanta: U.S. Department of Health and Human Services; 2016. Available online at <https://www.cdc.gov/std/stats15/STD-Surveillance-2015-print.pdf>. Accessed August 2017.

¹⁸⁶ Moyer VA. Screening for hepatitis C virus infection in adults: U.S. Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2013; 159(5): 349-57.

¹⁸⁷ Canadian Task Force on Preventive Health Care. Recommendations on hepatitis C screening for adults. *Canadian Medical Association Journal*. 2017; 189(16): E594-E604.

¹⁸⁸ Dr. Mark Gilbert, Surveillance & Online Sexual Health Services, Clinical Prevention Services, BC Centre for Disease Control. Personal communication, May, 2014.

¹⁸⁹ Cartwright E, Rentsch C and Rimland D. Hepatitis C virus screening practices and seropositivity among US veterans born during 1945–1965. *BioMed Central*. 2014; 7(1): 449.

¹⁹⁰ Gemelas J, Locker R, Rudd S et al. Impact of screening implementing HCV screening of persons born 1945-1965: a primary care case study. *Journal of Primary Care & Community Health*. 2016; 7(1): 30-2.

¹⁹¹ Litwin A, Smith B, Drainoni M et al. Primary care-based interventions are associated with increases in hepatitis C virus testing for patients at risk. *Digestive and Liver Disease*. 2012; 44(6): 497-503.

¹⁹² Cook N, Turse E, Garcia A et al. Hepatitis C virus infection screening within community health centers. *The Journal of the American Osteopathic Association*. 2016; 116(1): 1-11.

¹⁹³ Cullen B, Hutchison S, Cameron S, et al. Identifying former injecting drug users infected with hepatitis C: An evaluation of a general practice-based case-finding intervention. *Journal of Public Health*. 2012; 34(1): 14-23.

¹⁹⁴ LeFevre ML. Behavioral counseling interventions to prevent sexually transmitted infections: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2014; 161(12): 894-901.

In British Columbia

We were unable to find data on the use of behavioural counselling interventions in BC to reduce a person's likelihood of acquiring an STI.

Best in the World

Between 2006 and 2010 in the US, 31.2% of sexually experienced females aged 15 to 19 years received STI counseling from a health care provider during the previous 12 months. For sexually experienced males aged 15 to 19 years the rate was 26.1%.¹⁹⁵

For modelling purposes, we have assumed that the best rate in the world for behavioral counseling in sexually active adolescents is 29%, based on the midpoint for sexually active 15 to 19 year old males and females in the US.

Counselling and Interventions to Prevent Tobacco Use

Screen all adults 18 years and older for tobacco use and provide up to 90 minutes of tobacco cessation interventions over multiple contacts for those who use tobacco products.¹⁹⁶

In British Columbia

The BC Smoking Cessation Program was launched in September of 2011. Between September 30, 2011 and October 31, 2014, this program provided almost 122,000 BC residents with free nicotine gum or patches. There were an estimated 644,600 smokers in BC in 2013, suggesting that at least 19% (122,000 / 644,600) of BC tobacco smokers received a tobacco cessation intervention.¹⁹⁷

Best in the World

According to results from the 2005 Canadian Tobacco Use Monitoring Survey (CTUMS), 88% of current Canadian smokers reported visiting a health care provider in the preceding 12 months and 54% of those were advised to reduce or quit smoking.¹⁹⁸ Those who reported receiving such advice were asked if they were provided with information on smoking-cessation aids such as nicotine patches and 55% confirmed that they had. Based on this information, for all 2005 Canadian smokers, 47.5% of individuals received advice to quit and 26.1% were also provided with advice on smoking-cessation aids.

In the United States, the Behavioural Risk Factor Surveillance System has tracked the percentage of smokers who received advice to quit smoking from health care providers. The sample size was persons aged 18 and older who are current smokers (ever smoked 100 or more cigarettes and currently smoked every day or some days) who had also seen a health care provider in the past 12 months. Under these conditions, in 2010 it was found that 50.7% of smokers had received advice to quit in the past 12 months. This was down from 53.3% in 2000 and 58.9% in 2005.¹⁹⁹

¹⁹⁵ Tyler C, Warner L, Gavin L et al. Receipt of reproductive health services among sexually experienced persons aged 15–19 years—National Survey of Family Growth, United States, 2006–2010. *Morbidity and Mortality Weekly Report*. 2014; 63(2): 2-5.

¹⁹⁶ U.S. Preventive Services Task Force. Counseling and interventions to prevent tobacco use and tobacco-caused disease in adults and pregnant women: U.S. Preventive Services Task Force reaffirmation recommendation statement. *Annals of Internal Medicine*. 2009; 150(8): 551-5.

¹⁹⁷ Province of British Columbia. *BC Smoking Cessation Program: Evaluation of the Nicotine Replacement Therapy Component*. 2015. British Columbia. Available at <http://www2.gov.bc.ca/assets/gov/health/health-drug-coverage/pharmacare/smokingcessationevaluationreport.pdf>. Accessed August 2017.

¹⁹⁸ Centers for Disease Control and Prevention. Smoking-cessation advice from health-care providers--Canada, 2005. *Morbidity and Mortality Weekly Report*. 2007; 56(28): 708-12.

¹⁹⁹ Kruger J, Shaw L, Kahende J et al. Health care providers' advice to quit smoking, National Health Interview Survey, 2000, 2005, and 2010. *Preventing Chronic Disease*. 2012; 9: E130.

We have assumed that the best rate in the world for the provision of tobacco cessation interventions is 51% (based on data from the US in 2010).

Alcohol Misuse Screening and Brief Counselling

Screen and provide behavioral counseling interventions to reduce alcohol misuse by adults 18 years and older, including pregnant women.²⁰⁰ The 2013 USPSTF review found no evidence to determine the optimal interval for screening but did note that brief multi-contact (each contact is 6 to 15 minutes) interventions are most effective, requiring up to 120 minutes of total counseling contact.²⁰¹

BC guidelines for alcohol misuse screening and brief interventions recommend screening annually²⁰² while economic evaluations have assumed that screening would occur at least once a year to at least once every 10 years.^{203,204,205}

In British Columbia

We are not aware of any data in BC which indicates the overall proportion of adults who are screened for alcohol misuse or the proportion who misuse alcohol that receive a brief intervention.

Based on a 2008/09 survey, BC health care providers talked to 58% of pregnant women and 10% of non-pregnant women about alcohol and its effects on conception and/or pregnancy.²⁰⁶

Best in the World

In integrated health-care systems where screening is mandated and built into the electronic medical record system, screening can be nearly universal. In one study of the US Veterans Health Administration system, 93% of individuals were screened for alcohol misuse in 2004.²⁰⁷

A survey of Norwegian midwives (n=103) found that 97% of respondents “mostly” or “always” asked pregnant women about their alcohol use at the first consultation, with 42% using a screening instrument.²⁰⁸

²⁰⁰ US Preventive Services Task Force. Screening and Behavioral Counseling Interventions to Reduce Unhealthy Alcohol Use in Adolescents and Adults: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2018; 320(18): 1899-1909.

²⁰¹ Ibid.

²⁰² BC Ministry of Health and British Columbia Medical Association. *BC Guidelines: Problem Drinking* 2013. Available at <http://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/bc-guidelines/problem-drinking>. Accessed August 2017.

²⁰³ Purshouse R, Brennan A, Rafia R et al. Modelling the cost-effectiveness of alcohol screening and brief interventions in primary care in England. *Alcohol and Alcoholism*. 2012; 48(2): 180-8.

²⁰⁴ Angus C, Scafato E, Ghirini S et al. Cost-effectiveness of a programme of screening and brief interventions for alcohol in primary care in Italy. *BioMed Central Family Practice*. 2014; 15(1): 1-26.

²⁰⁵ Zur R and Zaric G. A microsimulation cost–utility analysis of alcohol screening and brief intervention to reduce heavy alcohol consumption in Canada. *Addiction*. 2016; 111(5): 817-31.

²⁰⁶ BC Stats, Ministry of Citizens' Services and the Women's Healthy Living Secretariat and Ministry of Healthy Living and Sport. *Healthy Choices in Pregnancy: Results from the Community Health Education and Social Services Omnibus Survey in British Columbia, April 2008 to March 2009*. Available at <http://www.health.gov.bc.ca/library/publications/year/2010/bcstats-hcip-report.pdf>. Accessed August 2017.

²⁰⁷ Bradley K, Williams E, Achtmeyer C et al. Implementation of evidence-based alcohol screening in the Veterans Health Administration. *The American Journal of Managed Care*. 2006; 12; 597-606.

²⁰⁸ Wangberg SC. Norwegian midwives' use of screening for and brief interventions on alcohol use in pregnancy. *Sexual & Reproductive Healthcare*. 2015; 6(3): 186-90.

In Oregon, 4.6% of individuals are screened in primary care for unhealthy alcohol use²⁰⁹ but 41% of Medicaid enrollees in the state with an alcohol use disorder receive treatment,²¹⁰ suggesting that primary care providers may target at-risk patients for formal screening.

We have assumed that the best alcohol screening rate in the world is 93% for adults 18 years and older and 97% for pregnant women. Furthermore, we assume that the best in the world proportion with a positive screen result that receive a brief intervention is 41%.

Screening and Interventions to Reduce Unhealthy Drug Use

Screen by asking questions about unhealthy drug use in adults age 18 years or older. Screening should be implemented when services for accurate diagnosis, effective treatment, and appropriate care can be offered or referred.²¹¹

In British Columbia

We are not aware of any data in BC which indicates the overall proportion of adults who are screened for unhealthy drug use or the proportion of individuals with unhealthy drug use who receive a brief intervention.

Best in the World

Based on the US National Survey on Drug Use and Health (noninstitutionalized individuals aged 12 years and older), the percentage of individuals with ≥ 1 health care visit who reported screening by a health care provider (“During the past 12 months, did any doctor or other health care professional ask, in person or on a form, if you use marijuana or other illegal drugs?”) increased from 48.5% in 2013 to 54.3% in 2015.²¹²

We have assumed that the assume that the best unhealthy drug use screening rate in the world is 54.3% of those who have had a health care visit in the past year.

Screening For and Management of Obesity in Adults

Screen all adults 18 years and older for obesity and offer or refer patients with a body mass index (BMI) of 30 kg/m² or higher to intensive, multicomponent behavioral interventions involving between 12 and 26 sessions in a year.^{213,214} Screening should take place on a regular basis to measure weight trajectories over time.

In British Columbia

We were unable to find information for BC regarding the frequency of measuring height and weight in primary care or what proportion of individuals with a BMI of 30 kg/m² or higher were being referred to an intensive, multicomponent behavioral intervention.

²⁰⁹ Rieckmann T, Renfro S, McCarty D et al. Quality metrics and systems transformation: Are we advancing alcohol and drug screening in primary care? *Health Services Research*. 2018; 53(3): 1702-26.

²¹⁰ McCarty D, Gu Y, Renfro S et al. Access to treatment for alcohol use disorders following Oregon's health care reforms and Medicaid expansion. *Journal of Substance Abuse Treatment*. 2018; 94: 24-8.

²¹¹ US Preventive Services Task Force. Screening for Unhealthy Drug Use: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2020; 323(22): 2301-2309.

²¹² Scialli, A & Terplan, M. Rates of and factors associated with patient-reported illicit drug use screening by health care professionals in the United States from 2013 to 2015. *Journal of Addiction Medicine*. 2020; 14(1): 63-68.

²¹³ Canadian Task Force on Preventive Health Care. Recommendations for prevention of weight gain and use of behavioural and pharmacologic interventions to manage overweight and obesity in adults in primary care. *Canadian Medical Association Journal*. 2015; 187(3): 184-95.

²¹⁴ Moyer VA. Screening for and management of obesity in adults: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2012; 157(5): 373-8.

Best in the World

In the US, the measurement of both height and weight in adults 18+ during a primary care visit increased from 33% in 2005/06 to 54% in 2008/09 and 73% in 2012/13.²¹⁵ In 2006/07, 37% of patients with diagnosed obesity in the US received some counselling for diet, exercise or weight reduction in primary care.²¹⁶ This proportion has declined to 33% in 2008/09 and 21% in 2012/13. Primary care visits where weight management counseling occurred lasted an average of 22 minutes.²¹⁷ In a recent US study of 14 primary care clinics, however, 33% of patients with obesity had documentation of obesity treatment (between January and July of 2015) but only 2.2% of patients had a *referral* to a weight management intervention.²¹⁸

We have assumed that the best rate in the world for obesity screening of adults 18 years and older is 73% (based on evidence from the US in 2012/13) while the best rate in the world for offering or referring patients with a BMI of ≥ 30 to an intensive, multicomponent behavioral intervention is 33% (based on evidence from the US in 2015).

Preventing Falls in Community-Dwelling Elderly

Exercise or physical therapy and vitamin D supplementation to prevent falls in community-dwelling adults aged 65 years or older who are at increased risk for falls.²¹⁹

The USPSTF suggests annual screening for risk using “a pragmatic, expert-supported approach to identifying high risk persons (based on) a history of falls and mobility problems and the results of a timed Get-Up-and-Go test. The test is performed by observing the time it takes a person to rise from an armchair, walk 3 meters (10 feet), turn, walk back, and sit down again.” Exercise should consist of at least 150 minutes of moderate intensity activity per week while Vitamin D supplementation of 800 IU per day should occur for at least one year.²²⁰

In British Columbia

We are not aware of any information identifying the proportion of community-dwelling elderly in BC who are at risk for falls nor the proportion of those at risk of falls who are engaging in at least 150 minutes of moderate intensity exercise per week or taking 800 IU of vitamin D supplements daily.

Best in the World

We were unable to find any comprehensive data on the proportion of community-dwelling elderly who are screened for fall risk and, when at higher risk, are encouraged to engage in exercise or physical therapy and vitamin D supplementation to reduce that risk.

In a survey of 100 primary care physicians, 63% said they only screened for fall risk if their patients expressed a concern about falling.²²¹ However, another study found that just 31.2% of elderly females and 24.3% of elderly males talked to their health care provider even after

²¹⁵ Fitzpatrick S and Stevens V. Adult obesity management in primary care, 2008–2013. *Preventive Medicine*. 2017; 99: 128-33.

²¹⁶ Ma J, Xiao L and Stafford R. Adult obesity and office-based quality of care in the United States. *Obesity*. 2009; 17(5): 1077-85.

²¹⁷ Fitzpatrick S and Stevens V. Adult obesity management in primary care, 2008–2013. *Preventive Medicine*. 2017; 99: 128-33.

²¹⁸ Fitzpatrick S, Dickins K, Avery E et al. Effect of an obesity best practice alert on physician documentation and referral practices. *Translational Behavioral Medicine*. 2017: 1-10.

²¹⁹ Moyer VA. Prevention of falls in community-dwelling older adults: U.S. Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2012; 157(3): 197-204.

²²⁰ *Ibid*.

²²¹ Jones T, Ghosh T, Horn K et al. Primary care physician’s perceptions and practices regarding fall prevention in adults 65 years and over. *Accident Analysis & Prevention*. 2011; 43(5): 1605-9.

they fell.²²² Based on these two pieces of evidence, and the assumption that 53%²²³ of the population age 65 and older are females, 17.6% of the elderly would be screened for fall risk $((0.312 * 0.53) + (0.243 * 0.47)) * 0.63$.

Adhering to falls prevention interventions by the community-dwelling elderly is another challenge. Even in the context of a research project, a third²²⁴ to half²²⁵ of participants do not adhere to falls prevention interventions.

In 2011/12, 61% of noninstitutionalized adults ≥ 65 years of age living in the US took a vitamin D supplement, either as part of a multi-vitamin or multi-mineral supplement or as an individual supplement.²²⁶

Based on this indirect evidence, we have assumed for the purposes of this project that the best screening rate in the world for fall risk is 18% (see calculation of 17.6% above) and that the best rate in the world for vitamin D supplementation is 61% (based on evidence from the US in 2011/12). We were unable to find even indirect evidence indicating the proportion of the elderly at high risk of falling who were encouraged to engage in exercise or physical therapy.

Routine Aspirin Use for the Prevention of Cardiovascular Disease and Colorectal Cancer

Initiate low dose aspirin use for the primary prevention of cardiovascular disease (CVD) and colorectal cancer in adults aged 50 to 59 years who have a 10% or greater 10-year CVD risk, are not at increased risk for bleeding, have a life expectancy of at least 10 years, and are willing to take low-dose aspirin daily for at least 10 years.²²⁷

In British Columbia

We were unable to find specific data on low-dose aspirin use for primary prevention purposes in the BC population ages 50-69 who have a 10% or greater 10-year CVD risk and are not at increased risk for bleeding.

Best in the World

Evidence regarding compliance with the very specific 2016 USPSTF guidelines regarding aspirin use for the primary prevention of cardiovascular disease and colorectal cancer is not yet available. Previous data indicates that 32% of US adults ages 50-59 and 45% ages 60-69 reported using aspirin for primary prevention in 2011/12.²²⁸ This decreased to 24% of US adults ages 50-64 between 2012 and 2015.²²⁹

²²² Stevens J, Ballesteros M, Mack K et al. Gender differences in seeking care for falls in the aged Medicare population. *American Journal of Preventive Medicine*. 2012; 43(1): 59-62.

²²³ Based on BC population data for 2017

²²⁴ Osho O, Owoeye O and Armijo-Olivo S. Adherence and attrition in fall prevention exercise programs for community-dwelling older adults: a systematic review and meta-analysis. *Journal of Aging and Physical Activity*. 2017; 1-41.

²²⁵ Nyman S and Victor C. Older people's participation in and engagement with falls prevention interventions in community settings: an augment to the Cochrane systematic review. *Age and Ageing*. 2011; 41(1): 16-23.

²²⁶ Kantor E, Rehm C, Du M et al. Trends in dietary supplement use among US adults from 1999-2012. *Journal of American Medical Association*. 2016; 316(14): 1464-74.

²²⁷ Bibbins-Domingo K. Aspirin use for the primary prevention of cardiovascular disease and colorectal cancer: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2016; 164(12): 836-45.

²²⁸ Gu Q, Dillon C, Eberhardt M et al. Preventive aspirin and other antiplatelet medication use among US adults aged ≥ 40 years: data from the National Health and Nutrition Examination Survey, 2011-2012. *Public Health Reports*. 2015; 130(6): 643-54.

²²⁹ Stuntz M and Bernstein B. Recent trends in the prevalence of low-dose aspirin use for primary and secondary prevention of cardiovascular disease in the United States, 2012-2015. *Preventive Medicine Reports*. 2017; 5: 183-6.

Based on the previous 2009 USPSTF guideline²³⁰ recommendations, approximately one-third of clinicians recommended aspirin to patients who would have been eligible for primary prevention of cardiovascular disease.^{231,232} If patient compliance with their clinician's recommendation is taken into account, then 24% of patients eligible for aspirin primary prevention as per the 2009 USPSTF guidelines take aspirin.²³³

We have assumed a 'best in the world' rate for screening (CVD and bleeding risk) of 33% (equivalent to the proportion of clinicians in the US who are willing to recommend aspirin to their patients for the primary prevention of CVD). We have assumed the best rate in the world for ongoing use of aspirin in individuals eligible based on the current USPSTF guidelines would be 24% (based on estimated adherence in the US to the 2009 USPSTF guidelines).

Folic Acid Supplementation for the Prevention of Neural Tube Defects

All women who are planning or capable of pregnancy take a daily supplement containing 0.4 to 0.8 mg (400-800µg) of folic acid.²³⁴

In British Columbia

In a survey conducted at Children's and Women's Health Center in BC in 1999, 71% of women surveyed knew that vitamins could prevent birth defects, however only 49.4% of all women took vitamins prior to pregnancy.²³⁵

Based on the Canadian Maternity Experiences Survey conducted between October of 2006 and January of 2007, 61.3% of women who were 5 to 14 months postpartum living in BC reported taking folic acid supplementation three months before pregnancy and 93.9% reported taking it during the first three months of pregnancy.²³⁶

In a 2003 survey of 148 women aged 18 to 45 years living in Vancouver, 28% used a supplement containing folic acid on a daily basis.²³⁷

Folic acid supplementation is just one source of folic acid. For example, folic acid is naturally available in some foods and is added to white flour, pasta and cornmeal during manufacturing. Fortification of grains began in 1996 as a response to the growing awareness of the benefits of folic acid. It is therefore important to consider all sources of folic acid.

One way to do this is by measuring the concentration of red blood cell folate. Based on the 2007 – 2009 *Canadian Health Measures Survey*, 22% of women of childbearing age (ages 15

²³⁰ US Preventive Services Task Force. Aspirin for the prevention of cardiovascular disease: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2009; 150(6): 396-404.

²³¹ Fiscella K, Winters P, Mendoza M et al. Do clinicians recommend aspirin to patients for primary prevention of cardiovascular disease? *Journal of General Internal Medicine*. 2013; 30(2): 155-60.

²³² Malayala S and Raza A. Compliance with USPSTF recommendations on aspirin for prevention of cardiovascular disease in men. *International Journal of Clinical Practice*. 2016; 70(11): 898-906.

²³³ Ibid.

²³⁴ Bibbins-Domingo K, Grossman D, Curry S et al. Folic acid supplementation for the prevention of neural tube defects: US Preventive Services Task Force recommendation statement. *Journal of American Medical Association*. 2017; 317(2): 183-9.

²³⁵ Morin V, Mondor M and Wilson R. Knowledge on periconceptional use of folic acid in women of British Columbia. *Fetal Diagnosis and Therapy*. 2001; 16(2): 111-5.

²³⁶ Nelson C, Leon J and Evans J. The relationship between awareness and supplementation: which Canadian women know about folic acid and how does that translate into use. *Canadian Journal of Public Health*. 2014; 105(1): e40-6.

²³⁷ French M, Barr S and Levy-Milne R. Folate intakes and awareness of folate to prevent neural tube defects: a survey of women living in Vancouver, Canada. *Journal of the American Dietetic Association*. 2003; 103(2): 181-5.

to 45) exhibited a low concentration of red blood cell folate. Specifically, it was below the level considered to be optimal for minimizing the risk of neural tube defects (<906 nmol/L). The inverse argument could also be made, namely that 78% of Canadian women of reproductive age have sufficient folate intake to minimize the risk of neural tube defects.²³⁸

Best in the World

In 2011/12, 34% of US women between the ages of 20 and 44 used folic acid supplementation, most commonly as part of a multi-vitamin or multi-mineral supplement.²³⁹

We have assumed a ‘best in the world’ rate for taking a daily supplement containing folic acid to be 34% (based on the evidence from the US in 2011/12).

Adherence

There are two levels of adherence that need to be taken into account when calculating a rate of coverage for the service in British Columbia or the best rate in the world. The first is clinician adherence with guideline recommendations. For example, guidelines may recommend that 100% of a specific population be offered a particular type of screening. For a variety of reasons, however, not all clinicians offer that screening to the population. The second is patient adherence or compliance. When offered the screening by a clinician, not all patients would agree to have the screening done. Calculating a rate of coverage in the population is based on a combination of these two levels of adherence. For example, if 70% of clinicians offer a service to their patients and 70% of patients accept, then the rate of coverage in the population would be 49% (70% * 70%).

Converting Foreign Currency to Canadian Dollars

Whenever possible, unit costs developed in BC are used in the calculation of cost-effectiveness. Unfortunately, BC-specific unit costs are often not available. In this case, we search for unit cost estimates from other Canadian sources followed by unit cost estimates from international sources. The CCEMG – EPPI-Centre Cost Converter^{240,241} is a free web-based tool for adjusting estimates of unit costs expressed in one currency and price year to a specific target currency and price year. In every situation, we want to convert estimated unit costs into 2017 Canadian dollars (CAD).

A challenge specific to converting US health care unit costs to Canadian unit costs is the substantially higher unit costs (or prices) in the US compared to those in Canada for the same output. That is, unit costs are estimated to be 29% higher in the US than in Canada.^{242,243,244}

²³⁸ Colapinto C, O’Connor D and Tremblay M. Folate status of the population in the Canadian Health Measures Survey. *Canadian Medical Association Journal*. 2011; 183(2): E100-E6.

²³⁹ Kantor E, Rehm C, Du M et al. Trends in dietary supplement use among US adults from 1999-2012. *Journal of American Medical Association*. 2016; 316(14): 1464-74.

²⁴⁰ Shemilt I, Thomas J and Morciano M. A web-based tool for adjusting costs to a specific target currency and price year. *Evidence & Policy: A Journal of Research, Debate and Practice*. 2010; 6(1): 51-9.

²⁴¹ The Campbell and Cochrane Economics Methods Group and Evidence for Policy and Practice Information and Coordinating Centre. *CCEMG - EPPI-Centre Cost Converter*. 2019. Available at <https://eppi.ioe.ac.uk/costconversion/> <https://eppi.ioe.ac.uk/costconversion/>. Accessed March 2022.

²⁴² Papanicolaos I, Woskie L Jha A. Health care spending in the United States and other high-income countries. *JAMA*. 2018; 319(10):1024-1039.

²⁴³ Anderson GF, Reinhardt UE, Hussey PS et al. It’s the prices, stupid: why the United States is so different from other countries. *Health Affairs*. 2003; 22(3): 89-105.

²⁴⁴ Reinhardt U. *Why Does US Health Care Cost So Much? (Part I)*. 2008. Available at <https://economix.blogs.nytimes.com/2008/11/14/why-does-us-health-care-cost-so-much-part-i/>. Accessed July 2017.

To reflect these excess health care prices in the US, we reduce the estimate generated by using the CCEMG – EPPI-Centre Cost Converter by 29%.

Note that if the US unit costs included in a given model are not health care-based, then this final step is not taken. Such costs might include, for example, the additional educational costs associated with caring for a child with fetal alcohol spectrum disorder or spina bifida.

To keep relatively current, unit costs should be updated at least once every five years.

Patient Time Costs

Patient time costs resulting from receiving, as well as travelling to and from, a service are valued based on the average hourly wage rate in BC in 2017 (\$25.16²⁴⁵) plus 18% benefits for an average cost per hour of \$29.69. In the absence of specific data on the amount of time required, we assume two hours per service.

Patient time costs are truncated at \$222.67 per day (7.5 hours times \$29.69). If, for example, we are valuing a patient's time costs while in hospital, each day would be assessed a value of \$222.67 (rather than 24 hours times \$29.69 or \$712.56).

GP Office Visit Cost

The cost of an office visit to a General Practitioner (GP) in BC varies by the age of the patient, as follows:²⁴⁶

- Visit in office age 0-1 (MSP fee 12100) - \$33.70
- Visit in office age 2-49 (MSP fee 00100) - \$30.64
- Visit in office age 50-59 (MSP fee 15300) - \$33.70
- Visit in office age 60-69 (MSP fee 16100) - \$35.24
- Visit in office age 70-79 (MSP fee 17100) - \$39.83
- Visit in office age 80+ (MSP fee 18100) - \$45.95

The estimated cost of a visit to a GP of \$34.85 is based on the average cost of an office visit between the ages of 2 and 79.

The cost of a follow-up phone call or email correspondence is \$15.00 (MSP fee G14079 - GP Telephone/Email Management Fee).²⁴⁷

A key question is whether one or more preventive maneuvers might be completed during an individual office visit. If evidence is available on this question, either research evidence or specific advice from our GP advisors given their knowledge of the BC practice environment, then that evidence is used in the modelling. If no evidence is available, however, then we assume that 50% of an office visit is required per preventive maneuver and modify this from 33% to 66% in the sensitivity analysis.

²⁴⁵ Statistics Canada. *Average Hourly Wages of Employees by Selected Characteristics and Occupation, Unadjusted Data, by Province (monthly) (British Columbia)*. 2017. Available at <http://www.statcan.gc.ca/tables-tableaux/sum-som/101/cst01/labr69k-eng.htm>. Accessed July 2017.

²⁴⁶ Ministry of Health. *Medical Services Commission Payment Schedule*. 2016. Available at <http://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/msc-payment-schedule-december-2016.pdf>. Accessed July 2017.

²⁴⁷ Ibid.

Life Table

Data on the number and proportion of expected deaths, life-years lived and life expectancy by sex and age group in British Columbia are based on Statistics Canada data for 2010 to 2012 (see following table).²⁴⁸

Life Tables, British Columbia, 2010 to 2012												
Age	Females				Males				Both Sexes			
	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.
0	100,000	339	99,700	84.2	100,000	418	99,635	80.2	100,000	379	99,667	82.2
1	99,661	23	99,652	83.5	99,582	21	99,574	79.6	99,621	22	99,612	81.5
2	99,639	18	99,629	82.5	99,562	14	99,551	78.6	99,599	16	99,588	80.5
3	99,621	14	99,613	81.5	99,547	10	99,546	77.6	99,583	13	99,577	79.6
4	99,607	11	99,598	80.5	99,537	8	99,534	76.6	99,570	10	99,564	78.6
5	99,596	9	99,592	79.5	99,529	7	99,526	75.6	99,560	8	99,556	77.6
6	99,587	7	99,584	78.6	99,522	6	99,519	74.6	99,551	7	99,548	76.6
7	99,580	6	99,577	77.6	99,516	6	99,513	73.6	99,544	7	99,541	75.6
8	99,574	5	99,571	76.6	99,511	6	99,508	72.6	99,537	6	99,534	74.6
9	99,569	5	99,567	75.6	99,505	7	99,501	71.6	99,531	6	99,528	73.6
10	99,564	4	99,562	74.6	99,498	8	99,494	70.6	99,525	6	99,521	72.6
11	99,560	4	99,558	73.6	99,490	9	99,486	69.6	99,518	7	99,515	71.6
12	99,556	5	99,553	72.6	99,482	11	99,476	68.6	99,511	8	99,507	70.6
13	99,551	6	99,548	71.6	99,471	13	99,464	67.6	99,503	10	99,498	69.6
14	99,545	9	99,540	70.6	99,458	17	99,449	66.6	99,493	13	99,486	68.6
15	99,535	14	99,528	69.6	99,441	21	99,431	65.7	99,479	19	99,470	67.6
16	99,521	22	99,510	68.6	99,420	28	99,406	64.7	99,460	26	99,447	66.6
17	99,499	29	99,484	67.6	99,392	36	99,374	63.7	99,434	34	99,417	65.7
18	99,469	32	99,453	66.6	99,356	46	99,333	62.7	99,400	41	99,380	64.7
19	99,437	33	99,421	65.7	99,310	58	99,281	61.7	99,360	47	99,336	63.7
20	99,405	33	99,388	64.7	99,252	69	99,218	60.8	99,312	52	99,286	62.7
21	99,372	33	99,356	63.7	99,184	78	99,145	59.8	99,260	56	99,232	61.8
22	99,339	33	99,323	62.7	99,106	83	99,065	58.9	99,204	58	99,175	60.8
23	99,307	32	99,290	61.7	99,023	84	98,981	57.9	99,146	58	99,117	59.8
24	99,274	32	99,258	60.8	98,939	81	98,899	57.0	99,088	56	99,060	58.9
25	99,242	32	99,227	59.8	98,858	76	98,820	56.0	99,032	54	99,005	57.9
26	99,211	32	99,195	58.8	98,782	74	98,745	55.1	98,977	53	98,951	56.9
27	99,179	33	99,163	57.8	98,709	72	98,672	54.1	98,925	53	98,898	56.0
28	99,146	34	99,129	56.8	98,636	72	98,600	53.1	98,872	53	98,845	55.0
29	99,112	36	99,095	55.9	98,564	74	98,527	52.2	98,819	55	98,791	54.0
30	99,077	38	99,058	54.9	98,490	77	98,451	51.2	98,764	58	98,735	53.1
31	99,039	41	99,018	53.9	98,413	81	98,373	50.2	98,706	61	98,675	52.1
32	98,997	44	98,975	52.9	98,332	85	98,289	49.3	98,645	65	98,612	51.1
33	98,953	48	98,929	51.9	98,247	90	98,202	48.3	98,579	69	98,545	50.2
34	98,905	52	98,879	51.0	98,157	95	98,109	47.4	98,510	74	98,474	49.2
35	98,854	56	98,826	50.0	98,062	101	98,011	46.4	98,437	78	98,398	48.2
36	98,798	60	98,768	49.0	97,961	107	97,908	45.5	98,359	83	98,317	47.3
37	98,738	65	98,706	48.1	97,854	113	97,798	44.5	98,275	89	98,230	46.3
38	98,673	70	98,638	47.1	97,741	120	97,681	43.6	98,186	95	98,138	45.4
39	98,603	75	98,566	46.1	97,621	128	97,557	42.6	98,091	102	98,040	44.4
40	98,528	82	98,487	45.1	97,493	136	97,425	41.7	97,989	109	97,934	43.4
41	98,446	88	98,402	44.2	97,357	146	97,284	40.7	97,880	117	97,822	42.5
42	98,358	95	98,311	43.2	97,211	156	97,134	39.8	97,763	125	97,700	41.5
43	98,263	103	98,212	42.3	97,056	166	96,973	38.9	97,638	135	97,571	40.6
44	98,161	111	98,105	41.3	96,889	178	96,800	37.9	97,503	145	97,431	39.6
45	98,050	120	97,990	40.4	96,711	191	96,615	37.0	97,359	156	97,281	38.7

²⁴⁸ Statistics Canada. *Elements of the Life Table, Canada, Provinces and Territories*. 2016. Available at <http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=530003>. Accessed July 2017.

Life Tables, British Columbia, 2010 to 2012 (continued)

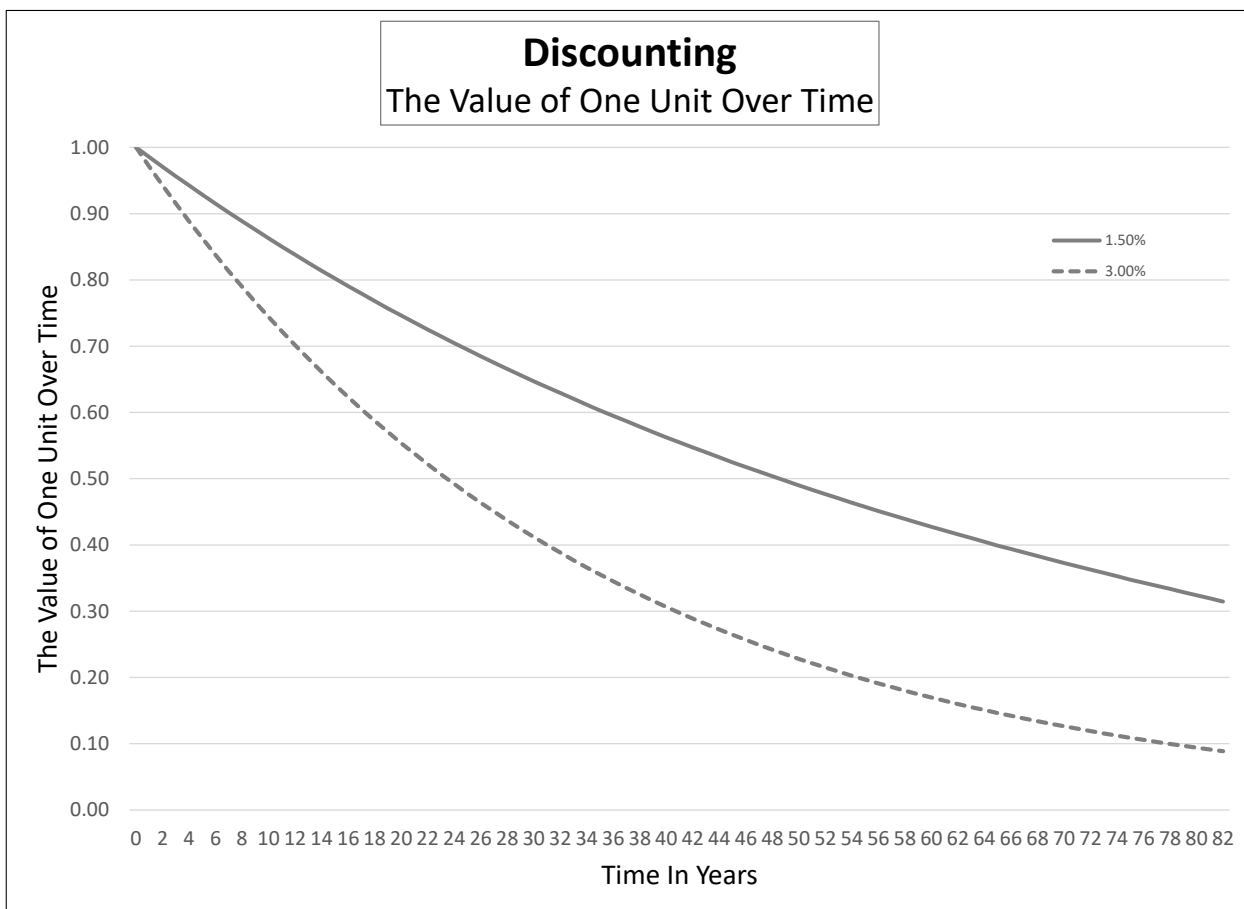
Age	Females				Males				Both Sexes			
	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.	# of Survivors	# of Deaths	Life Years Lived, Age x to x+n	Life Exp.
46	97,930	130	97,865	39.4	96,519	206	96,417	36.1	97,203	168	97,119	37.8
47	97,800	140	97,730	38.5	96,314	221	96,203	35.1	97,035	181	96,945	36.8
48	97,660	151	97,584	37.5	96,092	239	95,973	34.2	96,855	195	96,757	35.9
49	97,509	164	97,427	36.6	95,854	257	95,725	33.3	96,659	211	96,554	35.0
50	97,345	177	97,256	35.6	95,596	278	95,457	32.4	96,449	228	96,335	34.0
51	97,168	191	97,072	34.7	95,318	301	95,168	31.5	96,221	247	96,098	33.1
52	96,977	207	96,873	33.8	95,017	325	94,855	30.6	95,974	267	95,841	32.2
53	96,769	225	96,657	32.8	94,692	352	94,516	29.7	95,707	289	95,562	31.3
54	96,545	244	96,423	31.9	94,340	382	94,149	28.8	95,418	314	95,261	30.4
55	96,301	265	96,168	31.0	93,958	414	93,751	27.9	95,104	341	94,933	29.5
56	96,036	288	95,892	30.1	93,544	449	93,319	27.0	94,763	370	94,578	28.6
57	95,748	313	95,591	29.2	93,095	487	92,852	26.2	94,393	402	94,192	27.7
58	95,435	341	95,264	28.3	92,608	529	92,344	25.3	93,991	437	93,773	26.8
59	95,093	372	94,907	27.4	92,079	574	91,792	24.4	93,554	475	93,317	25.9
60	94,721	406	94,518	26.5	91,505	624	91,193	23.6	93,079	517	92,821	25.1
61	94,315	443	94,094	25.6	90,881	678	90,543	22.7	92,562	563	92,280	24.2
62	93,872	484	93,630	24.7	90,204	737	89,835	21.9	91,999	613	91,692	23.4
63	93,388	530	93,123	23.8	89,467	801	89,067	21.1	91,385	668	91,051	22.5
64	92,858	580	92,568	22.9	88,666	871	88,231	20.3	90,717	728	90,353	21.7
65	92,278	635	91,961	22.1	87,796	946	87,322	19.5	89,989	794	89,592	20.8
66	91,644	695	91,296	21.2	86,849	1,029	86,335	18.7	89,195	866	88,762	20.0
67	90,948	762	90,567	20.4	85,820	1,118	85,261	17.9	88,329	944	87,857	19.2
68	90,186	836	89,768	19.6	84,702	1,215	84,095	17.1	87,385	1,029	86,871	18.4
69	89,350	917	88,892	18.7	83,487	1,319	82,827	16.4	86,356	1,122	85,795	17.6
70	88,434	1,005	87,931	17.9	82,168	1,432	81,452	15.6	85,235	1,222	84,624	16.9
71	87,428	1,103	86,877	17.1	80,736	1,553	79,959	14.9	84,013	1,331	83,347	16.1
72	86,325	1,210	85,720	16.3	79,183	1,682	78,342	14.2	82,681	1,449	81,957	15.3
73	85,115	1,327	84,452	15.6	77,501	1,821	76,590	13.5	81,232	1,576	80,444	14.6
74	83,788	1,455	83,061	14.8	75,680	1,967	74,696	12.8	79,656	1,713	78,800	13.9
75	82,334	1,594	81,537	14.1	73,713	2,122	72,651	12.1	77,944	1,859	77,015	13.2
76	80,740	1,745	79,867	13.3	71,590	2,285	70,448	11.5	76,085	2,014	75,078	12.5
77	78,995	1,908	78,041	12.6	69,305	2,454	68,078	10.8	74,071	2,179	72,982	11.8
78	77,088	2,083	76,046	11.9	66,851	2,629	65,537	10.2	71,892	2,352	70,716	11.2
79	75,005	2,270	73,870	11.2	64,222	2,807	62,819	9.6	69,540	2,533	68,274	10.5
80	72,735	2,469	71,500	10.6	61,415	2,986	59,922	9.0	67,007	2,720	65,647	9.9
81	70,266	2,678	68,927	9.9	58,429	3,163	56,848	8.4	64,288	2,910	62,833	9.3
82	67,587	2,896	66,139	9.3	55,266	3,334	53,599	7.9	61,378	3,102	59,827	8.7
83	64,691	3,120	63,132	8.7	51,932	3,494	50,185	7.4	58,276	3,291	56,631	8.1
84	61,572	3,346	59,899	8.1	48,438	3,638	46,619	6.9	54,986	3,472	53,249	7.6
85	58,226	3,570	56,441	7.5	44,800	3,759	42,921	6.4	51,513	3,642	49,692	7.1
86	54,656	3,785	52,764	7.0	41,041	3,851	39,115	5.9	47,871	3,792	45,975	6.6
87	50,871	3,984	48,879	6.5	37,190	3,906	35,237	5.5	44,079	3,916	42,121	6.1
88	46,888	4,157	44,809	6.0	33,284	3,916	31,326	5.1	40,163	4,005	38,161	5.7
89	42,731	4,294	40,583	5.5	29,368	3,874	27,431	4.7	36,158	4,052	34,132	5.2
90	38,436	4,384	36,244	5.1	25,494	3,774	23,607	4.3	32,106	4,046	30,083	4.8

Source: CANSIM Table 053-0003 "Elements of the life table, Canada, provinces and territories" Available online at <http://www5.statcan.gc.ca/cansim/a47>.

Discounting

As noted earlier, we use a 1.5% discount rate in the reference case with a 3% and a 0% discount rate in the sensitivity analysis. A 0% discount rate is equivalent to not discounting. The following chart and table identify the present value of one unit over an 82-year period (the average lifespan of a British Columbian, see above) using a 1.5% and a 3.0% discount rate.²⁴⁹ The same discount rate is used for both costs and benefits when calculating cost-effectiveness.

In essence, the present value of one unit (either a dollar or a QALY in the current study) is reduced to 31% of its 'full' value if it is incurred 82 years in the future based on a 1.5% discount rate and to 9% of its 'full' value based on a 3.0% discount rate.



²⁴⁹ The data in the table and chart are derived from Annex 4.2 of Drummond M, Stoddart G and Torrance G. *Methods for the Economic Evaluation of Health Care Programmes*. Oxford: Oxford University Press; 1987.

The Effect of Discounting Over Time		
Time (in years)	Discount Rate	
	1.5%	3.0%
0	1.0000	1.0000
1	0.9853	0.9709
2	0.9708	0.9426
3	0.9565	0.9151
4	0.9424	0.8885
5	0.9286	0.8626
6	0.9150	0.8375
7	0.9017	0.8131
8	0.8885	0.7894
9	0.8756	0.7664
10	0.8628	0.7441
11	0.8503	0.7224
12	0.8380	0.7014
13	0.8259	0.6810
14	0.8140	0.6611
15	0.8022	0.6419
16	0.7906	0.6232
17	0.7793	0.6050
18	0.7681	0.5874
19	0.7571	0.5703
20	0.7463	0.5537
21	0.7356	0.5375
22	0.7251	0.5219
23	0.7148	0.5067
24	0.7047	0.4919
25	0.6947	0.4776
26	0.6848	0.4637
27	0.6752	0.4502
28	0.6656	0.4371
29	0.6562	0.4243
30	0.6470	0.4120
31	0.6382	0.4000
32	0.6294	0.3883
33	0.6206	0.3770
34	0.6118	0.3660
35	0.6030	0.3554
36	0.5948	0.3450
37	0.5867	0.3350
38	0.5786	0.3252
39	0.5704	0.3158
40	0.5623	0.3066
41	0.5548	0.2976
42	0.5472	0.2890
43	0.5397	0.2805
44	0.5322	0.2724
45	0.5247	0.2644
46	0.5177	0.2567
47	0.5107	0.2493
48	0.5037	0.2420
49	0.4967	0.2350
50	0.4898	0.2281
51	0.4833	0.2215
52	0.4768	0.2150
53	0.4703	0.2088
54	0.4638	0.2027
55	0.4574	0.1968
56	0.4513	0.1910
57	0.4453	0.1855
58	0.4393	0.1801
59	0.4332	0.1748
60	0.4272	0.1697
61	0.4216	0.1648
62	0.4159	0.1600
63	0.4103	0.1553
64	0.4047	0.1508
65	0.3991	0.1464
66	0.3938	0.1421
67	0.3885	0.1380
68	0.3832	0.1340
69	0.3779	0.1301
70	0.3727	0.1263
71	0.3677	0.1226
72	0.3627	0.1190
73	0.3577	0.1156
74	0.3527	0.1122
75	0.3478	0.1089
76	0.3430	0.1058
77	0.3383	0.1027
78	0.3336	0.0997
79	0.3288	0.0968
80	0.3241	0.0940
81	0.3194	0.0913
82	0.3146	0.0887

The Disutility Attributable to Taking Preventive Medication

The disutility of taking pills for preventing adverse health outcomes is estimated at 0.24% (95% confidence interval [CI] of 0.17% to 0.33%).^{250, 251, 252} The studies by Hutchins and colleagues also found that a significant proportion of respondents (9.5% using the willingness-to-pay approach, 57.5% using the standard gamble approach and 87% using the time trade-off approach) identified no disutility associated with taking one pill daily. In the sensitivity analysis, we therefore ranged the disutility from 0% to 0.33%.

Summary Measures of Population Health

Background

Population health has historically been measured based on mortality indicators, including summary measures such as life expectancy and infant mortality. More recently, summary measures have attempted to take into account both mortality and *morbidity*.

This has led to two types of composite summary measures, health expectancy measures and health gap measures.²⁵³ Health expectancy measures include disability-free life expectancy (DFLE) and health-adjusted life expectancy (HALE). These measures start with a standard theoretical life expectancy (usually based on the best life expectancy observed in the world) and then assess the amount of life lost due to premature death combined with time lost due to morbidity or disability. Health-adjusted life expectancy, for example, estimates the average time in years that a person at a given age can expect to live in the equivalent of full health.²⁵⁴

Health gap measures consist primarily of disability-adjusted life years (DALYs) and quality-adjusted life years (QALYs). QALYs were originally developed by economists in the 1960s for use in cost-effectiveness analyses, primarily in higher-income countries. Measures of the effect of morbidity used in calculating QALYs are based on the value or preference that people have for health outcomes or states along a continuum between death (0) and full health (1.0). DALYs, however, have been favoured in measures of global health and have been championed by the Global Burden of Disease (GBD) study since the original publication of results in 1997.^{255,256,257} Measures of the effect of morbidity used in calculating DALYs are based on estimates of the impact of a disease or disability on the performance of an individual.

The DALY is essentially the complement to the QALY, with the focus of DALYs being on disability-adjusted life years *averted* and the focus of QALYs on quality-adjusted life years *gained*. The approach to measurement (and corresponding methodological issues) are similar in calculating QALYs and DALYs. Among the key issues in measuring both QALYs and

²⁵⁰ Thompson A, Guthrie B and Payne K. Do pills have no ills? capturing the impact of direct treatment disutility. *PharmacoEconomics*. 2016; 34(4): 333-6.

²⁵¹ Hutchins R, Pignone M, Sheridan S et al. Quantifying the utility of taking pills for preventing adverse health outcomes: a cross-sectional survey. *British Medical Journal Open*. 2015; 5(e006505): 1-9.

²⁵² Hutchins R, Viera AJ, Sheridan SL et al. Quantifying the utility of taking pills for cardiovascular prevention. *Circulation: Cardiovascular Quality and Outcomes*. 2015; 8(2): 155-63.

²⁵³ Hyder A, Puvanachandra P and Morrow R. Measuring the health of populations: explaining composite indicators. *Journal of Public Health Research*. 2012; 1(3): 222-8.

²⁵⁴ Gold M, Stevenson D and Fryback DG. HALYS and QALYS and DALYS, Oh My: Similarities and differences in summary measures of population health. *Annual Review of Public Health*. 2002; 23(1): 115-34.

²⁵⁵ Murray C JL and Lopez AD. Regional patterns of disability-free life expectancy and disability-adjusted life expectancy. Global Burden of Disease Study. *The Lancet*. 1997; 349: 1347-52.

²⁵⁶ Salomon JA, Vos T, Hogan DR et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *The Lancet*. 2012; 380(9859): 2129-43.

²⁵⁷ Salomon JA, Haagsma JA, Davis A et al. Disability weights for the Global Burden of Diseases 2013 study. *The Lancet Global Health*. 2015; 3: e712-e723.

DALYs are whom to ask (the three choices tend to be clinicians, patients with the disease/injury or the general population), how the impact of the disease/injury is described to the general population if that group is being queried and whether the resulting weights are universally applicable. The GBD study, for example, has developed standardized disability weights by health states based on feedback from 60,890 individuals aged 18-65 in the general population across multiple continents.²⁵⁸

The enormous influence of the GBD study has meant that a greater number of cost-effectiveness analyses are now using a cost-per-DALY *averted* as their main outcome measure rather than a cost-per-QALY *gained*.²⁵⁹

As noted above, the approach for this project is to use QALYs in assessing both the clinically preventable burden and cost-effectiveness of a CPS.

Sources of Quality of Life Values

Ideal sources of quality of life (QoL) values include large population-based studies assessing a considerable variety of health-related outcomes, such as the studies by Sullivan and colleagues in the US²⁶⁰ and the UK²⁶¹ (see below). Disability weights developed for the GBD study are another useful source as a proxy for QoL.²⁶² While the disability weights for the 2013 GBD study are the latest available in the academic literature, detailed weights for the 2016 GBD study are publically accessible online.²⁶³

If data is not available from such large population-based studies, then larger studies (or meta-analyses, if they are available) assessing the QoL for a specific health-related outcome are used.

Calculating Changes in QoL

Assessing QoL on a 0 – 1 scale assumes that 0 is equivalent to death and 1 is equivalent to full health. A number of publications have assessed the QoL of the general population. The study by Sullivan and colleagues in the US, for example, used a nationally representative survey of 38,678 individuals to estimate a mean population QoL value of 0.867 (0.854 for females and 0.880 for males).²⁶⁴ Their study in the UK (with a sample size of 79,522) found a mean QoL of 0.828 for the general population (0.815 for females and 0.850 for males).²⁶⁵ That is, while many individuals within a population may self-identify as a 1.0 (full health), the majority do not.

²⁵⁸ Salomon JA, Haagsma JA, Davis A et al. Disability weights for the Global Burden of Diseases 2013 study. *The Lancet Global Health*. 2015; 3: e712-e723.

²⁵⁹ Neumann PJ, Thorat T, Zhong Y et al. A systematic review of cost-effectiveness studies reporting cost-per-DALY averted. *PLOS ONE*. 2016; 11(12): e0168512.doi:10.1371/journal.

²⁶⁰ Sullivan P and Ghushchyan V. Preference-based EQ-5D index scores for chronic conditions in the United States. *Medical Decision Making*. 2006; 26(4): 410-20.

²⁶¹ Sullivan PW, Slejko JF, Sculpher MJ et al. Catalogue of EQ-5D scores for the United Kingdom. *Medical Decision Making*. 2011; 31(6): 800-4.

²⁶² Salomon JA, Haagsma JA, Davis A et al. Disability weights for the Global Burden of Diseases 2013 study. *The Lancet Global Health*. 2015; 3: e712-e723.

²⁶³ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

²⁶⁴ Sullivan P and Ghushchyan V. Preference-based EQ-5D index scores for chronic conditions in the United States. *Medical Decision Making*. 2006; 26(4): 410-20.

²⁶⁵ Sullivan PW, Slejko JF, Sculpher MJ et al. Catalogue of EQ-5D scores for the United Kingdom. *Medical Decision Making*. 2011; 31(6): 800-4.

Mean QoL also decreases with increasing age, as follows:^{266,267}

Change in Mean QoL in the General US and UK Populations by Age Group			
Age Group	United States	United Kingdom	Average US / UK
18-29	0.922	0.905	0.914
30-39	0.901	0.879	0.890
40-49	0.871	0.837	0.854
50-59	0.842	0.798	0.820
60-69	0.823	0.774	0.799
70-79	0.790	0.723	0.757
≥80	0.736	0.657	0.697
All Ages 18+	0.867	0.828	0.848

In assessing changes in QoL, we assume that the average QoL value for individuals living in BC is 0.85 (the mean between the US and UK values). A 0.10 reduction in QoL then is equivalent to an 11.8% ($0.10 / 0.85$) reduction in QoL, if the reduction is applicable to all age groups. If it is only applicable to the 60-69 year age group, then a 0.10 reduction in QoL would be equivalent to a 12.5% ($0.10 / 0.80$) reduction in QoL.

Utility, Disutility and Disability Weight

Throughout this report, utility, disutility and disability weight will be used to refer to adjustments made to the quality of life. A positive utility is an improvement to the quality of life. A disutility or disability weight is a reduction in the quality of life and is equivalent to a negative utility of the same magnitude. (I.e. a disutility of 0.05, a disability weight of 0.05 and a utility of -0.05 are used interchangeably and all refer to the same thing: a reduction in the quality of life by 0.05 on a scale of 0 to 1.)

²⁶⁶ Sullivan P and Ghushchyan V. Preference-based EQ-5D index scores for chronic conditions in the United States. *Medical Decision Making*. 2006; 26(4): 410-20.

²⁶⁷ Sullivan PW, Slejko JF, Sculpher MJ et al. Catalogue of EQ-5D scores for the United Kingdom. *Medical Decision Making*. 2011; 31(6): 800-4.

Major Behavioural Risk Factors

Summary

Summary for Major Behavioural Risk Factors (RF)			
	Utility	Years of Life Lost	Annual Direct Costs/Individual with the RF
Alcohol Use			
Low	-	-	\$140
Hazardous	-0.123	-	\$968
Harmful	-0.235	3.1	\$3,038
Excess Weight			
Overweight	-	0.6	\$227
Obese	-0.059	2.6	\$805
Tobacco Smoking			
Light	-0.031	6.6	\$785
Moderate	-0.033	11.9	\$1,386
Heavy	-0.062	18.1	\$2,050

Alcohol Use

- A UK study used a community-based sample ≥ 16 years of age of 14,117 to assess the *effect of alcohol use on QoL*.²⁶⁸ After adjusting for age, sex, excess weight, physical activity, fruit and vegetable consumption, smoking status, ethnicity, marital status, educational attainment, and income, they found a small but statistically significant positive effect (0.011 to 0.019) on self-reported QoL associated with alcohol consumption when compared with never-drinkers.
- The GBD study found that a very mild alcohol use disorder²⁶⁹ is associated with a *disutility* of 0.123 (95% CI of 0.082 to 0.177), a mild alcohol use disorder²⁷⁰ is associated with a *disutility* of 0.235 (95% CI of 0.160 to 0.327), a moderate alcohol use disorder²⁷¹ is associated with a *disutility* of 0.373 (95% CI of 0.248 to 0.508) and a severe alcohol use disorder²⁷² is associated with a *disutility* of 0.570 (95% CI of 0.396 to 0.732).²⁷³

²⁶⁸ Maheswaran H, Petrou S, Rees K et al. Estimating EQ-5D utility values for major health behavioural risk factors in England. *Journal of Epidemiology and Community Health*. 2013; 67(1): 172-80.

²⁶⁹ **Very mild alcohol use disorder** – “Drinks alcohol daily and has difficulty controlling the urge to drink. When sober, the person functions normally.”

²⁷⁰ **Mild alcohol use disorder** – “Drinks a lot of alcohol and sometimes has difficulty controlling the urge to drink. While intoxicated, the person has difficulty performing daily activities.”

²⁷¹ **Moderate alcohol use disorder** – “Drinks a lot, gets drunk almost every week and has great difficulty controlling the urge to drink. Drinking and recovering cause great difficulty in daily activities, sleep loss and fatigue.”

²⁷² **Severe alcohol use disorder** – “Gets drunk almost every day and is unable to control the urge to drink. Drinking and recovering replace most daily activities. The person has difficulty thinking, remembering and communicating, and feels constant pain and fatigue.”

²⁷³ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-ghd-2016-disability-weights>. Accessed October 2017.

- Consuming more than 4 drinks of alcohol per day *reduces an individual's longevity* by 3.1 (95% CI of 1.9 to 4.0) years.²⁷⁴
- Alcohol use is associated with higher *annual medical care costs* (e.g., hospitalization, physician, drug, etc.) than no alcohol use. Research in BC identified these costs as \$62 per year for low alcohol use (less than 3 drinks per day for males and less than 1.5 drinks per day for females), \$430 per year for hazardous alcohol use (3 to 4.5 drinks per day for males and 1.5 to 3 drinks per day for females) and \$1,350 per year for harmful alcohol use (>4.5 drinks per day for males and >3 drinks per day for females).²⁷⁵
- In addition to direct medical care costs, alcohol use is associated with *other direct costs* such as law enforcement, fire and traffic accident damage and so on. Rehm and colleagues estimated that these other direct costs were \$4.12 billion in Canada in 2002, compared to \$3.31 billion for direct medical care costs that same year.²⁷⁶ To take these other costs into account, we have increased the annual medical care costs noted above by 125% (4.12 / 3.31).
- For the purposes of this project, we have assumed that excess annual medical and other direct costs associated with low, hazardous and harmful alcohol use are \$140 / \$968 / \$3,038, respectively. Harmful alcohol use is associated with 3.1 life years lost. Furthermore, hazardous alcohol use is equivalent to a very mild alcohol use disorder with a disutility of 0.123 and harmful alcohol use is equivalent to a mild alcohol use disorder with a disutility of 0.235.

Unhealthy Drug Use

- Disability weights assigned by the Global Burden of Diseases (GBD) study for unhealthy drug use are as follows:²⁷⁷
 - **Mild opioid dependence** (“uses heroin or methadone daily and has difficulty controlling the habit. When not using, the person functions normally”) – **0.335** with a 95% CI of 0.221 to 0.473.
 - **Severe opioid dependence** (“uses heroin daily and has difficulty controlling the habit. When the effects wear off, the person feels severe nausea, agitation, vomiting and fever. The person has a lot of difficulty in daily activities”) – **0.697** with a 95% CI of 0.510 to 0.843.
 - **Mild cocaine dependence** (“uses cocaine at least once a week and has some difficulty controlling the habit. When not using, the person functions normally”) – **0.116** with a 95% CI of 0.074 to 0.165.
 - **Severe cocaine dependence** (“uses cocaine and has difficulty controlling the habit. The person sometimes has mood swings, anxiety, paranoia, hallucinations and sleep problems, and has some difficulty in daily activities”) – **0.479** with a 95% CI of 0.324 to 0.634.

²⁷⁴ Li K, Hüsing A and Kaaks R. Lifestyle risk factors and residual life expectancy at age 40: a German cohort study. *BioMed Central Medicine*. 2014; 12(1): 59-69.

²⁷⁵ H. Krueger & Associates Inc. *The Economic Burden of Risk Factors in British Columbia: Excess Weight, Tobacco Smoking, Alcohol Use, Physical Inactivity and Low Fruit and Vegetable Consumption*. 2017. Vancouver, B.C.: Provincial Health Services Authority, Population and Public Health Program.

²⁷⁶ Rehm J, Gnam W, Popova S et al. The costs of alcohol, illegal drugs, and tobacco in Canada, 2002. *Journal of Studies on Alcohol and Drugs*. 2007; 68(6): 886-95.

²⁷⁷ Institute for Health Metrics and Evaluation. GBD 2016 sequelae, health states, health state lay descriptions, and disability weights. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed August 2021.

- **Mild amphetamine dependence** (“uses stimulants at least once a week and has some difficulty controlling the habit. When not using, the person functions normally”) – **0.079** with a 95% CI of 0.051 to 0.114.
 - **Severe amphetamine dependence** (“uses stimulants and has difficulty controlling the habit. The person sometimes has depression, hallucinations and mood swings, and has difficulty in daily activities”) – **0.486** with a 95% CI of 0.329 to 0.637.
 - **Mild cannabis dependence** (“uses marijuana at least once a week and has some difficulty controlling the habit. When not using, the person functions normally”) – **0.039** with a 95% CI of 0.024 to 0.060.
 - **Severe cannabis dependence** (“uses marijuana daily and has difficulty controlling the habit. The person sometimes has mood swings, anxiety and hallucinations, and has some difficulty in daily activities”) – **0.266** with a 95% CI of 0.178 to 0.364.
- In France, Kopp & Ogrodnik estimated the annual health care, law enforcement and prevention costs associated with unhealthy drug use to be €7,903 per user (in 2010 Euros or \$12,615 in 2017 C\$).²⁷⁸ Of the total, €4,860 (61% or \$7,758 in 2017 C\$) was for excess healthcare costs and €3,043 (39% or \$4,857 in 2017 C\$) for law enforcement and prevention.
 - The Canadian Institute for Substance Use Research (CISUR) estimated the annual costs of unhealthy drug use in BC to be \$1,671 million in 2014. Of this amount, \$227 million (14%) was for healthcare costs, \$718 million (43%) for criminal justice costs, \$147 million (8.8%) for motor vehicle damage and \$580 million (35%) for indirect costs.²⁷⁹
 - In our detailed analysis, we estimated that 5.28% of the BC adult population had unhealthy drug use (excluding cannabis) and a further 4.07% had cannabis use disorder, or 9.35% of BC adults ages 18 and older. If this proportion holds for 2014, then we would expect approximately 361,000 BC adults with unhealthy drug use in BC in 2014. The direct cost estimate from the CISUR analysis for BC in 2014 is \$1,092 million or \$3,022 per unhealthy drug user (\$3,094 in 2017 C\$). This \$3,094 annual excess cost consists of \$643 (21%) for healthcare costs, \$2,035 (66%) for criminal justice costs and \$417 (13%) for motor vehicle damage costs.
 - We assume that a year without unhealthy drug use is associated with \$7,855 (((\$3,094 + \$12,615)/2) in direct costs avoided, including healthcare and criminal justice costs.

Tobacco Smoking

- A UK study used a community-based sample ≥ 16 years of age of 14,117 to assess the effect of tobacco smoking on QoL.²⁸⁰ After adjusting for age, sex, alcohol use, physical activity, fruit and vegetable consumption, excess weight, ethnicity, marital status, educational attainment, and income, they found a utility of -0.031 (95% CI of -0.018 to -0.045) associated with light tobacco smoking (less than 10 cigarettes per

²⁷⁸ Kopp P & Ogrodnik M. The social cost of drugs in France in 2010. *The European Journal of Health Economics*. 2017; 18: 883-92.

²⁷⁹ Canadian Substance Use Costs and Harms Scientific Working Group. *Canadian substance use costs and harms in the provinces and territories (2007 – 2014)*. 2018. Prepared by the Canadian Institute for Substance Use Research and the Canadian Centre on Substance Use and Addiction. Ottawa, Ontario.

²⁸⁰ Maheswaran H, Petrou S, Rees K et al. Estimating EQ-5D utility values for major health behavioural risk factors in England. *Journal of Epidemiology and Community Health*. 2013; 67(1): 172-80.

day), -0.033 (95% CI of -0.019 to -0.047) for moderate tobacco smoking (10 to 19 cigarettes per day) and -0.062 (95% CI of -0.042 to -0.082) for heavy tobacco smoking (20 or more cigarettes per day).

- Tobacco smoking also *reduces an individual's longevity*. In the United States, an average of 11.5 life years are lost per tobacco smoker. An average of 10.5 of these life-years can be regained by stopping smoking at age 30, 9.5 by stopping smoking at age 40 and 6.5 by stopping smoking at age 50.²⁸¹ In Australia, an average of 10 life years are lost per tobacco smoker. Mortality for former smokers who quit prior to age 45 did not differ significantly from never-smokers.²⁸² Mortality increases with the duration and intensity of smoking.^{283,284,285} In the US, for example, light tobacco smoking is associated with a relative risk (RR) of premature mortality of 1.98 (compared to never smokers). This RR increases to 2.7 for moderate tobacco smoking and to 3.74 for heavy tobacco smoking.²⁸⁶
- Tobacco smoking is associated with excess *annual medical care costs* (e.g., hospitalization, physician, drug, etc.). Research in BC identified these costs average \$1,195 per year: \$785 per year for light tobacco smoking (less than 10 cigarettes per day), \$1,386 per year for moderate tobacco smoking (10 to 19 cigarettes per day) and \$2,050 per year for heavy tobacco smoking (20 or more cigarettes per day).²⁸⁷
- For the purposes of this project, we have assumed light, moderate and heavy smoking are associated with utilities of -0.031, -0.033 and -0.062, respectively. On average, tobacco smoking is associated with 10 life years lost,²⁸⁸ with 6.6, 11.9 and 18.1 life years lost associated with light, moderate and heavy smoking.²⁸⁹ Finally, the annual

²⁸¹ Jha P, Ramasundarahettige C, Landsman V et al. 21st-century hazards of smoking and benefits of cessation in the United States. *New England Journal of Medicine*. 2013; 368(4): 341-50.

²⁸² Banks E, Joshy G, Weber M et al. Tobacco smoking and all-cause mortality in a large Australian cohort study: findings from a mature epidemic with current low smoking prevalence. *BioMed Central Medicine*. 2015; 13(1): 38-48.

²⁸³ Pirie K, Peto R, Reeves G et al. The 21st century hazards of smoking and benefits of stopping: a prospective study of one million women in the UK. *The Lancet*. 2013; 381(9861): 133-41.

²⁸⁴ Banks E, Joshy G, Weber M et al. Tobacco smoking and all-cause mortality in a large Australian cohort study: findings from a mature epidemic with current low smoking prevalence. *BioMed Central Medicine*. 2015; 13(1): 38-48.

²⁸⁵ Inoue-Choi M, Liao L, Reyes-Guzman C et al. Association of long-term, low-intensity smoking with all-cause and cause-specific mortality in the National Institutes of Health–AARP diet and health study. *Journal of American Medical Association Internal Medicine*. 2017; 177(1): 87-95.

²⁸⁶ Pirie K, Peto R, Reeves G et al. The 21st century hazards of smoking and benefits of stopping: a prospective study of one million women in the UK. *The Lancet*. 2013; 381(9861): 133-41.

²⁸⁷ H. Krueger & Associates Inc. *The Economic Burden of Risk Factors in British Columbia: Excess Weight, Tobacco Smoking, Alcohol Use, Physical Inactivity and Low Fruit and Vegetable Consumption*. 2017. Vancouver, B.C.: Provincial Health Services Authority, Population and Public Health Program.

²⁸⁸ Banks E, Joshy G, Weber M et al. Tobacco smoking and all-cause mortality in a large Australian cohort study: findings from a mature epidemic with current low smoking prevalence. *BioMed Central Medicine*. 2015; 13(1): 38-48.

²⁸⁹ In BC in 2015, 56% of tobacco smokers were light smokers, 28% were moderate smokers and 17% were heavy smokers. The estimated annual economic burden attributable to premature mortality in 2015 is \$1,346 (\$891 for light, \$1,607 for moderate and \$2,439 for heavy smokers). H. Krueger & Associates Inc. *The Economic Burden of Risk Factors in British Columbia: Excess Weight, Tobacco Smoking, Alcohol Use, Physical Inactivity and Low Fruit and Vegetable Consumption*. 2017. Vancouver, B.C.: Provincial Health Services Authority, Population and Public Health Program. We used this data to estimate life years lost by smoking intensity as follows: \$891 / \$1,346 * 10 life years lost = 6.6 life years lost for light smokers; \$1,607 / \$1,346 * 10 life years lost = 11.9 life years lost for moderate smokers; \$2,439 / \$1,346 * 10 life years lost = 18.1 life years lost for heavy smokers.

medical care costs associated with light, moderate and heavy smoking are \$785, \$1,386 and \$2,050, respectively.

Excess Weight

- An Australian study used a community-based sample of 1,569 children (mean age of 10.4 years) to assess the *effect of excess weight on QoL*.²⁹⁰ They found that QoL as identified by parents was reduced by 3.7% for overweight and 9.7% for obesity whereas QoL as identified by children was reduced by 1.5% for overweight and 8.1% for obesity.
- A further Australian study of 2,890 adolescents also assessed the effect of excess weight on QoL.²⁹¹ They found that overweight is associated with a disutility of 0.018 while obesity is associated with a disutility of 0.059. The disutility associated with overweight was only significant in girls (0.039) while the disutility associated with obesity was significant in both girls (0.084) and boys (0.041).
- A UK study used a community-based sample ≥ 16 years of age of 14,117 to assess the effect of excess weight on QoL.²⁹² They found a utility of -0.019 (95% CI of -0.026 to -0.011) associated with overweight (BMI of 25 to <30) compared to normal weight (BMI of 18.5 to <25) in their unadjusted model. After adjusting for age, sex, alcohol use, physical activity, fruit and vegetable consumption, smoking status, ethnicity, marital status, educational attainment, and income, however, this utility was no longer statistically significant (-0.005 with a 95% CI of -0.029 to 0.019). The utility associated with obesity class I & II (BMI of 30 to <40) and class III (BMI ≥ 40) remained significant after adjustment at -0.031 (95% CI of -0.020 to -0.041) and -0.105 (95% CI of -0.072 to -0.137) respectively.
- Excess weight also *reduces an individual's longevity*.^{293,294} Research by Fontaine and colleagues suggests that the number of life years lost increases with increasing levels of excess weight, from 0.6 years for overweight, 1.9 years for obese class I, 3.8 years for obese class II and 6.8 years for obese class III.²⁹⁵
- Overweight and obesity are associated with higher *annual medical care costs* (e.g., hospitalization, physician, drug, etc.). Research in BC identified these costs as \$227 per year for overweight (BMI of 25 to <30) and \$805 per year for obesity (BMI of ≥ 30).²⁹⁶

²⁹⁰ Williams J, Wake M, Hesketh K et al. Health-related quality of life of overweight and obese children. *JAMA*. 2005; 293(1): 70-6.

²⁹¹ Keating CL, Moodie ML, Richardson J et al. Utility-based quality of life of overweight and obese adolescents. *Value in Health*. 2011; 14(5): 752-8.

²⁹² Maheswaran H, Petrou S, Rees K et al. Estimating EQ-5D utility values for major health behavioural risk factors in England. *Journal of Epidemiology and Community Health*. 2013; 67(1): 172-80.

²⁹³ Peeters A, Barendregt JJ, Willekens F et al. Obesity in adulthood and its consequences for life expectancy: a life-table analysis. *Annals of Internal Medicine*. 2003; 138(1): 24-32.

²⁹⁴ Finkelstein EA, Brown DS, Wraage LA et al. Individual and Aggregate Years-of-life-lost Associated with Overweight and Obesity. *Obesity*. 2010; 18(2): 333-9.

²⁹⁵ Fontaine KR, Redden DT, Wang C et al. Years of life lost due to obesity. *JAMA*. 2003; 289(2): 187-93.

²⁹⁶ H. Krueger & Associates Inc. *The Economic Burden of Risk Factors in British Columbia: Excess Weight, Tobacco Smoking, Alcohol Use, Physical Inactivity and Low Fruit and Vegetable Consumption*. 2017. Vancouver, B.C.: Provincial Health Services Authority, Population and Public Health Program.

- For the purposes of this project, we have assumed a utility of -0.059 associated with obesity (the average of -0.037²⁹⁷, -0.059²⁹⁸ and -0.081²⁹⁹) but no disutility associated with overweight. Overweight is associated with 0.6 life years lost and obesity is associated with 2.6 life years lost (based on the weighted average of life years lost due to class I, II and III obesity³⁰⁰ using estimated proportions of the 2015 BC population in each of these categories, ((1.9 * 0.74) + (3.8 * 0.19) + (6.8 * 0.07)). Finally, overweight and obesity are associated with excess annual medical care costs of \$227 and \$805.

Estimates for Specific Disease/Treatment/Injury States

Abdominal Aortic Aneurysm

- The incidence of acute AAA events is be 55 / 100,000 per year in 65-74 year old males and 112 / 100,000 per year in 75-84 year old males. Of these acute AAA events, 59.2% were fatal within 30 days.³⁰¹
- AAA is usually asymptomatic prior to rupture,³⁰² therefore reduced quality of life in those living with AAA is not considered in our modelling.
- The cost of an abdominal ultrasound scan is \$106.81.³⁰³
- 58% of elective AAA-repair in BC is carried out by endovascular aneurysm repair (EVAR) surgery, with the balance being open surgery.³⁰⁴
- Emergency AAA-repair surgery costs an estimated \$46,853.^{305,306}

²⁹⁷ Maheswaran H, Petrou S, Rees K et al. Estimating EQ-5D utility values for major health behavioural risk factors in England. *Journal of Epidemiology and Community Health*. 2013; 67(1): 172-80.

²⁹⁸ Keating CL, Moodie ML, Richardson J et al. Utility-based quality of life of overweight and obese adolescents. *Value in Health*. 2011; 14(5): 752-8.

²⁹⁹ Williams J, Wake M, Hesketh K et al. Health-related quality of life of overweight and obese children. *JAMA*. 2005; 293(1): 70-6.

³⁰⁰ Fontaine KR, Redden DT, Wang C et al. Years of life lost due to obesity. *JAMA*. 2003; 289(2): 187-93.

³⁰¹ Howard D, Banerjee A, Fairhead J et al. Age-specific incidence, risk factors and outcome of acute abdominal aortic aneurysms in a defined population. *British Journal of Surgery*. 2015; 102(8): 907-15.

³⁰² Kapila V, Jetty P, Doug Wooster M et al. 2018 Screening for abdominal aortic aneurysms in Canada: review and position statement from the Canadian Society of Vascular Surgery. Available at <https://canadianvascular.ca/resources/Documents/Clinical-Guidelines/FINAL-2018-CSVS-Screening-Recommendations.pdf>. Accessed January 2019.

³⁰³ B.C. Ministry of Health, Health Sector Information, Analysis & Reporting Division. *MSP Fee-For-Service Payment Analysis 2012/2013 - 2016/2017*. 2017. Available at https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/ffs_complete.pdf. Accessed November 2018.

³⁰⁴ Aciemme (Sam) Ospan, Senior Manager, Lifetime Prevention Schedule, Healthy Living and Health Promotion Branch, BC Ministry of Health. June 3, 2019. Personal communication.

³⁰⁵ Giardina S, Pane B, Spinella G et al. An economic evaluation of an abdominal aortic aneurysm screening program in Italy. *Journal of Vascular Surgery*. 2011; 54(4): 938-46.

³⁰⁶ Silverstein MD, Pitts SR, Chaikof EL et al. Abdominal aortic aneurysm (AAA): cost-effectiveness of screening, surveillance of intermediate-sized AAA, and management of symptomatic AAA. *Baylor University Medical Center Proceedings*. 2005; 18(4): 345-67.

- Elective open surgery costs an estimated \$45,998.^{307,308}
- Elective EVAR surgery costs an estimated \$36,039.^{309, 310}

Atopic Dermatitis / Eczema

- The mean duration of atopic dermatitis is 10 years with 45% of cases being mild in severity, 45% moderate and 10% severe. Barbeau and Lalonde describe mild atopic dermatitis as “occasional, slight itching/scratching”, moderate as “constant or intermittent itching/scratching which does not disturb sleep” and severe as “bothersome itching/scratching which disturbs sleep”.³¹¹
- The GBD study found that mild atopic dermatitis was associated with a disability weight of 0.027 (95% CI of 0.015 to 0.042).³¹² Mild atopic dermatitis in the GBD study is described as follows: “has a slight, visible physical deformity that is sometimes sore and itchy. Others note the deformity, which causes some worry and discomfort”. Moderate atopic dermatitis was associated with a disability weight of 0.188 (95% CI of 0.125 to 0.267) and is described as “has a visible physical deformity that is sore and itchy. Other people stare and comment, which causes the person to worry. The person has trouble sleeping and concentrating”. We have assumed that mild atopic dermatitis in the GBD study is roughly equivalent to mild and moderate atopic dermatitis in the Barbeau and Lalonde study and that moderate atopic dermatitis in the GBD study is roughly equivalent to severe atopic dermatitis in the Barbeau and Lalonde study. Based on this assumption, we calculated an average disutility of -0.043 ((0.90 * -0.027) + (0.10 * -0.188)).
- The direct annual costs per mild, moderate and severe case are \$175, \$300, and \$405, respectively. The average weighted cost totalled \$254 (in 2001 CAD) or \$342 in 2017 CAD.³¹³ Lifetime costs were estimated at \$3,420 (10 years * \$342).

Blindness / Vision Deficits

- A community-based analysis of 38,678 individuals in the US found a utility associated with blindness and low vision (ICD-9 369) of -0.05, after adjusting for age, comorbidity, gender, race, ethnicity, income and education.³¹⁴

³⁰⁷ Burgers L, Vahl A, Severens J et al. Cost-effectiveness of elective endovascular aneurysm repair versus open surgical repair of abdominal aortic aneurysms. *European Journal of Vascular and Endovascular Surgery*. 2016; 52(1): 29-40.

³⁰⁸ Visser JJ, van Sambeek MR, Hunink MM et al. Acute abdominal aortic aneurysms: cost analysis of endovascular repair and open surgery in hemodynamically stable patients with 1-year follow-up. *Radiology*. 2006; 240(3): 681-9.

³⁰⁹ Burgers L, Vahl A, Severens J et al. Cost-effectiveness of elective endovascular aneurysm repair versus open surgical repair of abdominal aortic aneurysms. *European Journal of Vascular and Endovascular Surgery*. 2016; 52(1): 29-40.

³¹⁰ Svensjö S, Mani K, Björck M et al. Screening for abdominal aortic aneurysm in 65-year-old men remains cost-effective with contemporary epidemiology and management. *European Journal of Vascular and Endovascular Surgery*. 2014; 47(4): 357-65.

³¹¹ Barbeau M and Lalonde HL. Burden of atopic dermatitis in Canada. *International Journal of Dermatology*. 2006; 45(1): 31-6.

³¹² Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³¹³ Barbeau M and Lalonde HL. Burden of atopic dermatitis in Canada. *International Journal of Dermatology*. 2006; 45(1): 31-6.

³¹⁴ Sullivan P and Ghushchyan V. Preference-based EQ-5D index scores for chronic conditions in the United States. *Medical Decision Making*. 2006; 26(4): 410-20.

- The GBD study found that mild vision impairment was associated with a disability weight of 0.003 (95% CI of 0.001 to 0.007), moderate vision impairment with 0.031 (95% CI of 0.019 to 0.049), severe vision impairment with 0.184 (95% CI of 0.125 to 0.258) and blindness with 0.187 (95% CI of 0.124 to 0.260).³¹⁵
- In the US, blindness is associated with an annual increase in medical costs of \$2,157 (in 2004 USD) or \$2,330 in 2017 CAD, after adjusting for age, sex, marital status, education, income, self-reported health status, type of health insurance and family size.³¹⁶
- A 2003 US study estimated the direct lifetime costs per individual associated with vision impairment to be \$129,476.³¹⁷ The costs included physician visits, prescription medications, hospital inpatient stays, assistive devices, therapy and rehabilitation, long-term care, home and vehicle modifications and special education. We converted these costs to equivalent 2017 Canadian health care costs for a lifetime cost per individual of \$143,679 with vision impairment.

Cancer - Breast

Average Age of Occurrence of Breast Cancer - 62.2 Years

Ratio of Nonfatal Breast Cancers per Fatal Breast Cancer - 23.4

Years of Life Lost due to Breast Cancer - 12.9 Years

QoL Disutility for Breast Cancer Survivors - ↓0.049

Costs for the Acute Care Phase of Fatal Breast Cancer - \$47,230

First Year Costs for Breast Cancer Survivors - \$22,695

Ongoing Annual Costs for Breast Cancer Survivors - \$1,753 (for a period of 4.0 years)

- Based on data from BC between 2000 and 2007, female breast cancers occur at the mean age of 62.2 years.³¹⁸
- In BC, 95.9% of breast cancer patients survive to year 1, 88.5% to year 3 and 82.5% to year 5.³¹⁹ In the first year after diagnosis there are an estimated 23.4 *nonfatal breast cancers per fatal breast cancer*.
- In BC, the *life expectancy* of a 62.2-year-old female is 24.9 years. The average survival of a female breast cancer patient, however, is approximately 12 years.³²⁰ The average breast cancer survivor thus losses 12.9 years of life (24.9 – 12.0).

³¹⁵ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³¹⁶ Frick K, Gower E, Kempen J et al. Economic impact of visual impairment and blindness in the United States. *Archives of Ophthalmology*. 2007; 125(4): 544-50.

³¹⁷ Economic costs associated with mental retardation, cerebral palsy, hearing loss, and vision impairment – United States, 2003. *MMWR Weekly*. 2003; 53(03): 57-9.

³¹⁸ Coleman MP, Forman D, Bryant, H et al. Cancer survival in Australia, Canada, Denmark, Norway, Sweden and the UK, 1995-2007 (the International Benchmarking Partnership): an analysis of population-based cancer registry data. *The Lancet*. 2011; 377: 127-38.

³¹⁹ BC Cancer Agency. *Statistics by Cancer Type - Breast*. 2014. Available at http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Breast_2014.pdf. Accessed July 2017.

³²⁰ González-Reymúndez A, de los Campos G, Gutiérrez L et al. Prediction of years of life after diagnosis of breast cancer using omics and omic-by-treatment interactions. *European Journal of Human Genetics*. 2017; 25(5): 538-44.

International research indicates that breast cancer is associated with approximately 4 years of life lost (YLL) in Australia,³²¹ 6 YLL in the US,³²² 13 YLL in the UK³²³ and 17 YLL in Norway.³²⁴

- The diagnosis and treatment phase for breast cancer lasts an average of 3 months³²⁵ and is associated with a utility of -0.288 (95% CI of -0.193 to -0.399).³²⁶
- The metastatic phase for breast cancer lasts an average of 17.7 months³²⁷ and is associated with a utility of -0.451 (95% CI of -0.307 to -0.600).³²⁸
- The ongoing, controlled phase (remission) for breast cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).³²⁹
- A *false-positive* mammography result is associated with a one-time QALY loss of -0.013 (4.7 days).³³⁰
- Information from the BC Cancer Agency Screening Mammography Program indicates a cost of \$79.35 per screen in 2015/16.³³¹
- The cost of an unnecessary biopsy associated with a false-positive result is estimated to be \$396 (in 2008 USD)³³² or \$386 in 2017 CAD.

³²¹ Baade P, Youlten D, Andersson T et al. Estimating the change in life expectancy after a diagnosis of cancer among the Australian population. *British Medical Journal Open*. 2015; 5(4): e006740-6.

³²² Liu P, Wang J and Keating N. Expected years of life lost for six potentially preventable cancers in the United States. *Preventive Medicine*. 2013; 56(5): 309-13.

³²³ Burnet N, Jefferies S, Benson R et al. Years of life lost (YLL) from cancer is an important measure of population burden—and should be considered when allocating research funds. *British Journal of Cancer*. 2005; 92(2): 241-5.

³²⁴ Brustugun O, Møller B and Helland Å. Years of life lost as a measure of cancer burden on a national level. *British Journal of Cancer*. 2014; 111(5): 1014-20.

³²⁵ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³²⁶ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³²⁷ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³²⁸ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³²⁹ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³³⁰ Schousboe JT, Kerlikowske K, Loh A, et al. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness. *Annals of Internal Medicine*. 2011; 155(1): 10-20.

³³¹ BC Cancer Agency. *Screening Mammography Program: 2016 Annual Report*. 2016. Available at http://www.bccancer.bc.ca/screening/Documents/SMP_Report-AnnualReport2016.pdf. Accessed August 2017.

³³² Schousboe JT, Kerlikowske K, Loh A, et al. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness. *Annals of Internal Medicine*. 2011; 155(1): 10-20.

- The cost of radiotherapy, breast conserving surgery and a mastectomy are \$5,014, \$4,937 and \$6,956, respectively (in 2012 CAD)³³³ or \$5,233, \$5,152 and \$7,260 in 2017 CAD.
- Based on data from Ontario, the cost estimates for the *acute phase of a fatal breast cancer* are \$35,600 (95% CI of \$34,208 to \$39,162) (in 2009 CAD).³³⁴ We converted this to \$39,942 in 2017 CAD. In British Columbia, the health system costs during the interval from diagnosis of first breast cancer recurrence or metastasis until death has been estimated at \$36,474 (95% CI of \$29,752 to \$43,196) in 1995 CAD.³³⁵ This includes all hospital costs (\$19,496), BC Cancer Agency costs (\$7,769), MSP costs (\$3,294), home care costs (\$4,661) and Pharmacare costs (\$1,254). We converted this to \$54,517 (95% CI \$44,470 - \$64,565) in 2017 CAD. For the purposes of this project, we used the midpoint between these two estimates (\$47,230) in the reference case and the extremes in the sensitivity analysis.
- Based on data from Ontario, the estimated *first year costs* associated with a breast cancer survivor are \$20,227 (95% CI of \$19,951 to \$20,503) (in 2009 CAD).³³⁶ We converted this to \$22,695 in 2017 CAD. A further Ontario-based study estimated the costs for the *two years* following diagnosis in breast cancer survivors to be \$40,426 (in 2008 CAD).³³⁷
- Evidence from Belgium indicates that the direct medical costs attributable to breast cancer between years 2 and 5 following diagnosis/treatment were €3,496 (in 1998 Euros) and that they decreased from €1,424 in year 2 to €164 in year 5, at which point costs were not significantly different than matched controls.³³⁸ For the purposes of this project, we assumed excess annual ongoing costs of €874 (€3,496 / 4) or \$1,753 in 2017 CAD for years 2 through 5 following diagnosis/treatment.

Cancer - Cervical

Average Age of Occurrence of Cervical Cancer - 49.1 Years

Ratio of Nonfatal Cervical Cancer per Fatal Cervical Cancer – 10.1

Years of Life Lost due to Cervical Cancer – 17 Years

QoL Disutility for Cervical Cancer Survivors - ↓0.049

Costs for the Acute Care Phase of Fatal Cervical Cancer - \$46,603

First Year Costs for Cervical Cancer Survivors - \$20,258

Ongoing Annual Costs for Cervical Cancer Survivors - \$821 (for a period of 19.2 years)

³³³ Gocgun Y, Banjevic D, Taghipour S et al. Cost-effectiveness of breast cancer screening policies using simulation. *The Breast*. 2015; 24(4): 440-8.

³³⁴ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³³⁵ Wai ES, Trevisan CH, Taylor SCM et al. Health system costs of metastatic breast cancer. *Breast Cancer Research and Treatment*. 2001; 65(3): 233-40.

³³⁶ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³³⁷ Mittmann N, Porter J, Rangrej J et al. Health system costs for stage-specific breast cancer: a population-based approach. *Current Oncology*. 2014; 21(6): 281-93.

³³⁸ Broekx S, Den Hond E, Torfs R et al. The costs of breast cancer prior to and following diagnosis. *The European Journal of Health Economics*. 2011; 12(4): 311-7.

- Based on Canadian data between 2002 and 2006, cervical cancers occur at the mean age of 49.1 years.³³⁹
- In BC, 91.0% of cervical cancer patients survive to year 1, 79.4% to year 3 and 73.6% to year 5.³⁴⁰ In the first year after diagnosis there are an estimated 10.1 *nonfatal cervical cancer per fatal cervical cancer*.
- International research indicates that cervical cancer is associated with approximately 11 YLL in the US,³⁴¹ 17 YLL in the UK³⁴² and 24 YLL in Norway.³⁴³ We used the average of this range (17 YLL) in our base case estimate and the extremes in the sensitivity analysis.
- A false-positive Pap smear result is associated with a disutility of 0.046 for a period of approximately 10 months.³⁴⁴
- Diagnosis and treatment for cervical intraepithelial neoplasia (CIN) 1-3 is associated with a disutility of 0.066 for a period of approximately 20 months.³⁴⁵
- The diagnosis and treatment phase for cervical cancer lasts an average of 4.8 months³⁴⁶ and is associated with a utility of -0.288 (95% CI of -0.193 to -0.399).³⁴⁷
- The metastatic phase for cervical cancer lasts an average of 9.2 months³⁴⁸ and is associated with a utility of -0.451 (95% CI of -0.307 to -0.600).³⁴⁹

³³⁹ Dickinson J, Stankiewicz A, Popadiuk C et al. Reduced cervical cancer incidence and mortality in Canada: national data from 1932 to 2006. *BioMed Central Public Health*. 2012; 12(1): 992.

³⁴⁰ BC Cancer Agency. *Statistics by Cancer Type - Cervix*. 2014. Available at http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Cervix_2014.pdf. Accessed July 2017.

³⁴¹ Liu P, Wang J and Keating N. Expected years of life lost for six potentially preventable cancers in the United States. *Preventive Medicine*. 2013; 56(5): 309-13.

³⁴² Burnet N, Jefferies S, Benson R et al. Years of life lost (YLL) from cancer is an important measure of population burden—and should be considered when allocating research funds. *British Journal of Cancer*. 2005; 92(2): 241-5.

³⁴³ Brustugun O, Møller B and Helland Å. Years of life lost as a measure of cancer burden on a national level. *British Journal of Cancer*. 2014; 111(5): 1014-20.

³⁴⁴ Insinga R, Glass A, Myers E et al. Abnormal outcomes following cervical cancer screening: event duration and health utility loss. *Medical Decision Making*. 2007; 27(4): 414-22.

³⁴⁵ Ibid.

³⁴⁶ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁴⁷ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³⁴⁸ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁴⁹ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

- The ongoing, controlled phase (remission) for cervical cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).³⁵⁰
- Three Canadian studies estimated the *cost of a conventional cytology screen* to be \$28³⁵¹, \$57³⁵² and \$92³⁵³ in 2005 or 2006 CAD. We updated these estimates to 2017 CAD and then used the average for the base case estimate and the extremes in the sensitivity analysis (\$70 with a range from \$33 to \$108, in 2017 CAD).
- Cost estimates for HPV testing are based on Popadiuk et al. who estimated costs (in 2008 CAD) to be \$87.70 per test, which included consultation, tray, and kit with lab interpretation fees costing \$33.70, \$10.99, and \$43.10 respectively.³⁵⁴ We updated this estimate to \$96 in 2017 CAD.
- Three Canadian studies estimated the *cost of a colposcopy with biopsy* to be \$148³⁵⁵, \$151³⁵⁶ and \$337³⁵⁷ in 2005 or 2006 CAD. We updated these estimates to 2017 CAD and then used the average for the base case estimate and the extremes in the sensitivity analysis (\$251 with a range from \$176 to \$392, in 2017 CAD).
- Three Canadian studies estimated the *cost per treatment for a precancerous lesion* to be \$965³⁵⁸, \$1,032³⁵⁹ and \$1,071³⁶⁰ in 2005 or 2006 CAD. We updated these estimates to 2017 CAD and then used the average for the base case estimate and the extremes in the sensitivity analysis (\$1,216 with a range from \$1,137 to \$1,295, in 2017 CAD).

³⁵⁰ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁵¹ Kulasingam S, Rajan R, St Pierre Y et al. Human papillomavirus testing with Pap triage for cervical cancer prevention in Canada: a cost-effectiveness analysis. *BioMed Central Medicine*. 2009; 7(1): 69.

³⁵² Brisson M, Van de Velde N, De Wals P et al. The potential cost-effectiveness of prophylactic human papillomavirus vaccines in Canada. *Vaccine*. 2007; 25(29): 5399-408.

³⁵³ Krahn M, McLauchlin M, Pham B et al. *Liquid-Based Techniques for Cervical Cancer Screening: Systematic Review and Cost-Effectiveness Analysis*. 2008. Available at https://www.cadth.ca/sites/default/files/pdf/333_LBC-Cervical-Cancer-Screenin_tr_e.pdf. Accessed August 2017.

³⁵⁴ Popadiuk C, Gauvreau C, Bhavsar M et al. Using the Cancer Risk Management Model to evaluate the health and economic impacts of cytology compared with human papillomavirus DNA testing for primary cervical cancer screening in Canada. *Current Oncology*. 2016; 23(Supp.1): S56-S63.

³⁵⁵ Brisson M, Van de Velde N, De Wals P et al. The potential cost-effectiveness of prophylactic human papillomavirus vaccines in Canada. *Vaccine*. 2007; 25(29): 5399-408.

³⁵⁶ Krahn M, McLauchlin M, Pham B et al. *Liquid-Based Techniques for Cervical Cancer Screening: Systematic Review and Cost-Effectiveness Analysis*. 2008. Available at https://www.cadth.ca/sites/default/files/pdf/333_LBC-Cervical-Cancer-Screenin_tr_e.pdf. Accessed August 2017.

³⁵⁷ Kulasingam S, Rajan R, St Pierre Y et al. Human papillomavirus testing with Pap triage for cervical cancer prevention in Canada: a cost-effectiveness analysis. *BioMed Central Medicine*. 2009; 7(1): 69.

³⁵⁸ Ibid.

³⁵⁹ Krahn M, McLauchlin M, Pham B et al. *Liquid-Based Techniques for Cervical Cancer Screening: Systematic Review and Cost-Effectiveness Analysis*. 2008. Available at https://www.cadth.ca/sites/default/files/pdf/333_LBC-Cervical-Cancer-Screenin_tr_e.pdf. Accessed August 2017.

³⁶⁰ Brisson M, Van de Velde N, De Wals P et al. The potential cost-effectiveness of prophylactic human papillomavirus vaccines in Canada. *Vaccine*. 2007; 25(29): 5399-408.

- Based on data from Ontario, the cost estimates for the *acute phase* of a fatal cervical cancer are \$41,536 (95% CI of \$38,642 to \$44,429) in 2009 CAD.³⁶¹ We converted this to \$46,603 (95% CI of \$43,356 to \$51,858) in 2017 CAD.
- Based on data from Ontario, the estimated *first year costs* associated with a cervical cancer survivor are \$18,055 (95% CI of \$17,305 to \$18,804) in 2009 CAD.³⁶² We converted this to \$20,258 (95% CI of \$19,416 to \$21,098) in 2017 CAD.
- Based on data from Ontario, the *ongoing annual costs* associated with a cervical cancer survivor after the first year are estimated at between \$575 and \$1,067 in 2017 CAD.³⁶³ We used the midpoint of this range (\$821) in our base case estimate and the extremes in the sensitivity analysis.
- Cervical cancers in BC occur at the mean age of 49.1 years (see above). A BC women 49.1 years of age has a life expectancy of 36.5 years. Cervical cancer is associated with 17.3 years of life lost (see above). Therefore, the average women in BC with cervical cancer would survive for 19.2 years (36.5 – 17.3).

Cancer - Colorectal

- The estimated *first year* healthcare costs associated with a CRC survivor by stage was as follows:³⁶⁴
 - Stage I - \$30,253
 - Stage II - \$45,251
 - Stage III - \$64,992
 - Stage IV – \$87,103
- The *ongoing annual* healthcare costs associated with a CRC survivor by stage was as follows:³⁶⁵
 - Stage I - \$7,769
 - Stage II - \$10,893
 - Stage III - \$13,930
 - Stage IV – \$44,419
- The *final year* healthcare costs associated with a death due to CRC by stage was as follows:³⁶⁶
 - Stage I - \$315,762
 - Stage II - \$211,431

³⁶¹ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³⁶² Ibid.

³⁶³ Sander B, Wong W, Yeung M et al. The cost-utility of integrated cervical cancer prevention strategies in the Ontario setting—Can we do better? *Vaccine*. 2016; 34(16): 1936-44.

³⁶⁴ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

³⁶⁵ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

³⁶⁶ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

- Stage III - \$140,252
- Stage IV - \$122,270
- Complication rates following screening colonoscopy occur at a rate of 0.84 minor bleeds, 1.08 major bleeds (requiring hospitalization), 0.53 perforations and 0.02 deaths per 1,000 colonoscopies.³⁶⁷
- The cost of a bleeding complication following a colonoscopy is \$3,676.³⁶⁸
- The cost of a perforation complication following a colonoscopy is \$35,923.³⁶⁹
- The diagnosis and treatment phase for colorectal cancer lasts an average of 4 months³⁷⁰ and is associated with a utility of -0.288 (95% CI of -0.193 to -0.399).³⁷¹
- The metastatic phase for colorectal cancer lasts an average of 2.5 years (30 months)³⁷² and is associated with a utility loss of -0.451 (95% CI of -0.307 to -0.600).³⁷³
- The ongoing, controlled phase (remission) for colorectal cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).³⁷⁴
- A colonoscopy results in a utility loss equivalent to 2 days per colonoscopy performed (0.0055 QALYs per colonoscopy).³⁷⁵
- A minor bleeding event results in a utility loss equivalent to 2 days per minor bleeding event (0.0055 per bleeding event).³⁷⁶

³⁶⁷ Fitzpatrick-Lewis D, Usman A, Ciliska D et al. *Screening for Colorectal Cancer*. Ottawa: Canadian Task Force on Preventive Health Care. 2015. Available online at <https://canadiantaskforce.ca/wp-content/uploads/2016/03/crc-screeningfinal031216.pdf>. Accessed November 2021.

³⁶⁸ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

³⁶⁹ Ibid.

³⁷⁰ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁷¹ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³⁷² Dr. Jonathan Loree, Medical Oncologist at BC Cancer. Personal Communication. February 2022.

³⁷³ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³⁷⁴ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁷⁵ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

³⁷⁶ Knudsen A, Rutter C, Peterse E et al. *Colorectal Cancer Screening: An Updated Decision Analysis for the U.S. Preventive Services Task Force*. Agency for Healthcare Research and Quality. May, 2021.

- A non-lethal major complications (i.e., major bleed requiring hospitalization or perforation) results in a utility loss equivalent to 2 weeks (0.0384 QALYs per major complication).³⁷⁷

Cancer - Liver

Average Age of Occurrence of Liver Cancer – 64.3 Years

Ratio of Nonfatal Liver Cancer per Fatal Liver Cancer - 0.71

Costs for the Acute Care Phase of Fatal Liver Cancer - \$30,922

Years of Life Lost due to Liver Cancer – 16.7 Years

QoL Disutility for Liver Cancer Survivors - ↓0.049

First Year Costs for Liver Cancer Survivors - \$36,708

Ongoing Annual Costs for Liver Cancer Survivors - \$6,287 (for a period of 4.7 years)

- Based on data from the US, liver cancers occur at a mean age of 64.3 years.³⁷⁸
- In BC, 41.6% of liver cancer patients survive to year 1, 20.7% to year 3 and 12.7% to year 5.³⁷⁹ In the first year after diagnosis there are an estimated 0.71 *nonfatal liver cancer per fatal liver cancer*.
- Based on data from Ontario, the cost estimates for the *acute phase of a fatal liver cancer* are \$27,560 (95% CI of \$25,747 to \$29,373) (in 2009 CAD).³⁸⁰ We converted this to \$30,922 in 2017 CDN.
- In BC, the *life expectancy* of a 64.3-year-old is 21.4 years. Based on data from the US, liver cancers are associated with 16.7 YLL.³⁸¹ In BC then, the average 64.3-year-old liver cancer survivor would have a life expectancy of 4.7 years (21.4 – 16.7).
- The diagnosis and treatment phase for liver cancer lasts an average of 4 months³⁸² and is associated with a utility of -0.288 (95% CI of -0.193 to -0.399).³⁸³

³⁷⁷ Goede S, Rabeneck L, van Ballegooijen M et al. Harms, benefits and costs of fecal immunochemical testing versus guaiac fecal occult blood testing for colorectal cancer screening. *PLOS One*. 2017; 12(3): e0172864.

³⁷⁸ Liu P, Wang J and Keating N. Expected years of life lost for six potentially preventable cancers in the United States. *Preventive Medicine*. 2013; 56(5): 309-13.

³⁷⁹ BC Cancer Agency. *Statistics by Cancer Type - Liver*. 2014. Available at http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Liver_2014.pdf. Accessed July 2017.

³⁸⁰ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³⁸¹ Liu P, Wang J and Keating N. Expected years of life lost for six potentially preventable cancers in the United States. *Preventive Medicine*. 2013; 56(5): 309-13.

³⁸² Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁸³ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

- The metastatic phase for liver cancer lasts an average of 2.5 months³⁸⁴ and is associated with a utility of -0.451 (95% CI of -0.307 to -0.600).³⁸⁵
- The ongoing, controlled phase (remission) for liver cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).³⁸⁶
- Based on data from Ontario, the estimated *first year costs* associated with a liver cancer survivor are \$32,717 (95% CI of \$30,591 to \$34,844) (in 2009 CAD).³⁸⁷ We converted this to \$36,708 in 2017 CAD.
- Based on data from the US, the *ongoing annual costs* associated with a liver cancer survivor after the first year are estimated at \$6,611 (in 2010 USD) or \$6,287 in 2017 CAD.³⁸⁸

Cancer - Lung

Average Age of Occurrence of Lung Cancer - 69.8 Years

Ratio of Nonfatal Lung Cancer per Fatal Lung Cancer - 0.72

Costs for the Acute Care Phase of Fatal Lung Cancer - \$37,046

Years of Life Lost due to Lung Cancer – 11.8 Years

QoL Disutility for Lung Cancer Survivors - ↓0.049

First Year Costs for Lung Cancer Survivors - \$33,523

Ongoing Annual Costs for Lung Cancer Survivors - \$7,575 (for a period of 3.2 years)

- Based on data from BC between 2000 and 2007, lung cancers occur at the mean age of 69.8 years.³⁸⁹
- In BC, 41.9% of lung cancer patients survive to year 1, 21.1% to year 3 and 15.8% to year 5.³⁹⁰ In the first year after diagnosis there are an estimated 0.72 *nonfatal lung cancer fatal lung cancer*.

³⁸⁴ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁸⁵ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³⁸⁶ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁸⁷ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³⁸⁸ Mariotto A, Robin Y, Shao Y et al. Projections of the cost of cancer care in the United States: 2010–2020. *Journal of the National Cancer Institute*. 2011; 103(2): 117-28. This study included the costs of care for 14 major cancers which did not include liver cancer. We used the ‘other’ cancer category to estimate ongoing annual costs for liver cancer.

³⁸⁹ Coleman MP, Forman D, Bryant, H et al. Cancer survival in Australia, Canada, Denmark, Norway, Sweden and the UK, 1995-2007 (the International Benchmarking Partnership): an analysis of population-based cancer registry data. *The Lancet*. 2011; 377: 127-38.

³⁹⁰ BC Cancer Agency. *Statistics by Cancer Type - Lung*. 2014. Available at http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Lung_2014.pdf. Accessed July 2017.

- In BC, the *life expectancy* of a 69.8-year-old is 16.7 years. International research indicates that lung cancer is associated with approximately 12 years of life lost (YLL) in the UK,³⁹¹ 13 YLL in Australia,³⁹² 14 YLL in the US,³⁹³ and 15 YLL in Norway.³⁹⁴ We used the average of this range (13.5 YLL) in our base case estimate and the extremes in the sensitivity analysis. Therefore, the average British Columbian with lung cancer would survive for 3.2 years (16.7 – 13.5).
- Based on data from Ontario, the cost estimates for the *acute phase of a fatal lung cancer* are \$33,018 (95% CI of \$32,660 to \$33,376) (in 2009 CAD).³⁹⁵ We converted this to \$37,046 in 2017 CAD.
- The diagnosis and treatment phase for lung cancer lasts an average of 3.3 months³⁹⁶ and is associated with a disutility of -0.288 (95% CI of -0.193 to -0.399).³⁹⁷
- The metastatic phase for lung cancer lasts an average of 4.5 months³⁹⁸ and is associated with a utility of -0.451 (95% CI of -0.307 to -0.600).³⁹⁹
- The ongoing, controlled phase (remission) for lung cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).⁴⁰⁰
- Based on data from Ontario, the estimated *first year costs* associated with a LC survivor are \$29,878 (95% CI of \$29,386 to \$30,371) (in 2009 CAD).⁴⁰¹ We converted this to \$33,523 in 2017 CAD.

³⁹¹ Burnet N, Jefferies S, Benson R et al. Years of life lost (YLL) from cancer is an important measure of population burden—and should be considered when allocating research funds. *British Journal of Cancer*. 2005; 92(2): 241-5.

³⁹² Baade P, Youlten D, Andersson T et al. Estimating the change in life expectancy after a diagnosis of cancer among the Australian population. *British Medical Journal Open*. 2015; 5(4): e006740-6.

³⁹³ Liu P, Wang J and Keating N. Expected years of life lost for six potentially preventable cancers in the United States. *Preventive Medicine*. 2013; 56(5): 309-13.

³⁹⁴ Brustugun O, Møller B and Helland Å. Years of life lost as a measure of cancer burden on a national level. *British Journal of Cancer*. 2014; 111(5): 1014-20.

³⁹⁵ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

³⁹⁶ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁹⁷ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

³⁹⁸ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

³⁹⁹ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴⁰⁰ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

⁴⁰¹ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

- Based on data from the US, the *ongoing annual costs* associated with a lung cancer survivor after the first year are estimated at \$7,861 (in 2010 USD) or \$7,575 in 2017 CAD.⁴⁰²

Cancer - Ovarian

Average Age of Occurrence of Ovarian Cancer – 63.9 Years

Ratio of Nonfatal Ovarian Cancer per Fatal Ovarian Cancer – 3.22

Costs for the Acute Care Phase of Fatal Ovarian Cancer - \$51,914

Years of Life Lost due to Ovarian Cancer – 16.5 Years

QoL Disutility for Ovarian Cancer Survivors - ↓0.049

First Year Costs for Ovarian Cancer Survivors - \$33,256

Ongoing Annual Costs for Ovarian Cancer Survivors - \$7,889 (for a period of 6.5 years)

- Based on data from BC between 2000 and 2007, ovarian cancers occur at the mean age of 63.9 years.⁴⁰³
- In BC, 76.3% of ovarian cancer patients survive to year 1, 55.1% to year 3 and 42.5% to year 5.⁴⁰⁴ In the first year after diagnosis there are an estimated 3.22 *nonfatal ovarian cancer per fatal ovarian cancer*.
- In BC, the *life expectancy* of a 63.9-year-old female is 23.0 years. International research indicates that ovarian cancer is associated with approximately 16 YLL in the UK⁴⁰⁵ and 17 YLL in Norway.⁴⁰⁶ We used the average of this range (16.5 YLL) in our base case estimate. Therefore, the average British Columbian with ovarian cancer would survive for 6.5 years (23.0 – 16.5).
- Based on data from Ontario, the cost estimates for the *acute phase of a fatal ovarian cancer* are \$46,270 (95% CI of \$44,452 to \$48,088) (in 2009 CAD).⁴⁰⁷ We converted this to \$51,914 in 2017 CAD.

⁴⁰² Mariotto A, Robin Y, Shao Y et al. Projections of the cost of cancer care in the United States: 2010–2020. *Journal of the National Cancer Institute*. 2011; 103(2): 117-28.

⁴⁰³ Coleman MP, Forman D, Bryant, H et al. Cancer survival in Australia, Canada, Denmark, Norway, Sweden and the UK, 1995-2007 (the International Benchmarking Partnership): an analysis of population-based cancer registry data. *The Lancet*. 2011; 377: 127-38.

⁴⁰⁴ BC Cancer Agency. *Statistics by Cancer Type - Ovary*. 2014. Available at http://www.bccancer.bc.ca/statistics-and-reports-site/Documents/Cancer_Type_Ovary_2014.pdf. Accessed July 2017.

⁴⁰⁵ Burnet N, Jefferies S, Benson R et al. Years of life lost (YLL) from cancer is an important measure of population burden—and should be considered when allocating research funds. *British Journal of Cancer*. 2005; 92(2): 241-5.

⁴⁰⁶ Brustugun O, Møller B and Helland Å. Years of life lost as a measure of cancer burden on a national level. *British Journal of Cancer*. 2014; 111(5): 1014-20.

⁴⁰⁷ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

- The diagnosis and treatment phase for ovarian cancer lasts an average of 3.2 months⁴⁰⁸ and is associated with a utility of -0.288 (95% CI of -0.193 to -0.399).⁴⁰⁹
- The metastatic phase for ovarian cancer lasts an average of 25.6 months⁴¹⁰ and is associated with a utility of -0.451 (95% CI of -0.307 to -0.600).⁴¹¹
- The ongoing, controlled phase (remission) for ovarian cancer is associated with a utility of -0.049 (95% CI of -0.031 to -0.072).⁴¹²
- Based on data from Ontario, the estimated *first year costs* associated with an ovarian cancer survivor are \$29,640 (95% CI of \$28,538 to \$30,743) (in 2009 CAD).⁴¹³ We converted this to \$33,256 in 2017 CAD.
- Based on data from the US, the *ongoing annual costs* associated with an ovarian cancer survivor after the first year are estimated at \$8,296 (in 2010 USD) or \$7,889 in 2017 CAD.⁴¹⁴

Cardiovascular Disease - Myocardial Infarction

Costs for the Acute Care Phase of Fatal MI - \$8,493

QoL Disutility for MI Survivors - ↓0.098 (for one month)

First Year Costs for MI Survivors - \$23,183

Ongoing Annual Costs for MI Survivors - \$1,477

- Anis et al estimated the cost of the *acute phase of a fatal MI* at St. Paul's Hospital in BC to be \$6,289 (in 2002 CAD).⁴¹⁵ We converted this to \$8,493 in 2017 CAD.
- The GBD study estimated a disutility of -0.432 (95% CI of -0.288 to -0.579) during days 1 and 2 following an AMI and a disutility of -0.074 (95% CI of -0.049 to -

⁴⁰⁸ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

⁴⁰⁹ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴¹⁰ Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

⁴¹¹ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴¹² Fitzmaurice C, Allen C, Barber R et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *Journal of American Medical Association Oncology*. 2017; 3(4): 524-48.

⁴¹³ de Oliveira C, Bremner K, Pataky R et al. Understanding the costs of cancer care before and after diagnosis for the 21 most common cancers in Ontario: a population-based descriptive study. *Canadian Medical Association Journal Open*. 2013; 1(1): E1-E8.

⁴¹⁴ Mariotto A, Robin Y, Shao Y et al. Projections of the cost of cancer care in the United States: 2010–2020. *Journal of the National Cancer Institute*. 2011; 103(2): 117-28.

⁴¹⁵ Anis A, Sun H, Singh S et al. A cost-utility analysis of losartan versus atenolol in the treatment of hypertension with left ventricular hypertrophy. *Pharmacoeconomics*. 2006; 24: 387-400.

0.105) during days 3 to 28.⁴¹⁶ This results in a combined disutility of -0.098 (95% CI of -0.065 to -0.137) for a period of one month or a total disutility of -0.008 (95% CI of -0.005 to -0.011) over a year.

- Cohen and colleagues estimated the *first year costs* associated with an MI in Ontario to be \$20,794 (in 2008 CAD).⁴¹⁷ We converted this to \$23,183 in 2017 CAD.
- Cohen and colleagues estimated the *ongoing annual costs* following a myocardial infarct to be \$1,325 (in 2008 CAD).⁴¹⁸ We converted this to \$1,477 in 2017 CAD.

Cerebrovascular Disease - Stroke

Costs for the Acute Care Phase of Fatal Stroke - \$11,859

QoL Disutility for Stroke Survivors - ↓0.200

First Year Costs for Stroke Survivors - \$16,407 to \$36,997 (depending on age)

Ongoing Annual Costs for Stroke Survivors - \$7,562

- Goeree et al estimated the costs associated with the *acute phase of a fatal stroke* in Canada to be \$9,364 (in 2004 CAD).⁴¹⁹ We converted this to \$11,859 in 2017 CAD.
- The GBD study groups the long term consequences following a stroke into five levels of severity.⁴²⁰ Level 1 (“has some difficulty in moving around and some weakness in one hand, but is able to walk without help”) is associated with a utility of -0.019 (95% CI of -0.010 to -0.032). Level 2 (“has some difficulty in moving around, and in using the hands for lifting and holding things, dressing and grooming”) is associated with a utility of -0.070 (95% CI of -0.046 to -0.099). Level 3 (“has some difficulty in moving around, in using the hands for lifting and holding things, dressing and grooming, and in speaking. The person is often forgetful and confused”) is associated with a utility of -0.316 (95% CI of -0.206 to -0.437). Level 4 (“is confined to a bed or a wheelchair, has difficulty speaking and depends on others for feeding, toileting and dressing”) is associated with a utility of -0.552 (95% CI of -0.377 to -0.707). Level 5 (“is confined to a bed or a wheelchair, depends on others for feeding, toileting and dressing, and has difficulty speaking, thinking clearly and remembering things”) is associated with a utility of -0.588 (95% CI of -0.411 to -0.744).
- We have assumed that the five severity levels identified by the GBD are approximately comparable to Modified Rankin scale scores of 1 through 5. Furthermore, an estimated 25.5% of stroke survivors have a Rankin score of 0, 21.5% a 1, 11.3% a 2, 18.5% a 3, 18.6% a 4 and 4.6% a 5.⁴²¹ The average utility associated with a stroke would therefore be -0.200 (95% CI of -0.134 to -0.265) $((0.255*0) +$

⁴¹⁶ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed February 2022.

⁴¹⁷ Cohen D, Manuel D, Tugwell P et al. Direct healthcare costs of acute myocardial infarction in Canada’s elderly across the continuum of care. *The Journal of Economics of Ageing*. 2014; 3: 44-49.

⁴¹⁸ Cohen D, Manuel D, Tugwell P et al. Direct healthcare costs of acute myocardial infarction in Canada’s elderly across the continuum of care. *The Journal of Economics of Ageing*. 2014; 3: 44-49

⁴¹⁹ Goeree R, Blackhouse G, Petrovic R et al. Cost of stroke in Canada: A 1-year prospective study. *Journal of Medical Economics*. 2005; 8: 147-67.

⁴²⁰ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴²¹ Krueger H, Lindsay P, Cote R et al. Cost avoidance associated with optimal stroke care in Canada. *Stroke*. 2012; 43(8): 2198-206.

$(0.215 * -0.019) + (0.113 * -0.070) + (0.185 * -0.316) + (0.186 * -0.552) + (0.046 * -0.588)$).

- Goeree et al estimated the *first year costs* associated with a stroke in Canada by age as follows:⁴²²
 - <55 years of age - \$20,170
 - 55-64 - \$16,407
 - 65-74 - \$31,147
 - 75-84 - \$36,232
 - ≥85 - \$36,997
- Gloede and coauthors in Australia estimated the *ongoing annual costs* (including informal care and out-of-pocket costs) associated with an ischemic stroke to be \$7,996 (in 2010 AUD) while costs associated with a haemorrhagic stroke were \$10,251.⁴²³ Based on a mix of 85% ischemic strokes in Canada,⁴²⁴ the weighted cost would be \$8,335. We converted this to \$7,562 in 2017 CAD.

Childhood Asthma

- The Global Burden of Disease Study found that controlled asthma is associated with a disability weight of -0.015 (95% CI of 0.007 – 0.026) while partially controlled asthma is associated with a disability weight of 0.036 (95% CI of 0.022 to 0.055) and uncontrolled asthma is associated with a disability weight of 0.133 (95% CI of 0.086 to 0.192).⁴²⁵ We assumed that asthma is controlled in 24% of children, partially controlled in 67% of children and uncontrolled in 9% of children⁴²⁶ and estimated a weighted utility of -0.040 $((0.24 * -0.015) + (0.67 * -0.036) + (0.09 * -0.133))$.
- A BC study estimated the annual direct costs attributable to asthma at \$444 per person year (in 2006 CAD)⁴²⁷ or \$523 in 2017 CAD. Based on an average treatment duration of 10 years,⁴²⁸ the total costs attributable to childhood asthma would be \$5,230 per case.

Childhood Leukemia

- The lifetime cost per case in the US has been estimated at \$136,444 (in 2007 USD)⁴²⁹ or \$134,920 in 2017 CAD.

⁴²² Goeree R, Blackhouse G, Petrovic R et al. Cost of stroke in Canada: A 1-year prospective study. *Journal of Medical Economics*. 2005; 8: 147-67.

⁴²³ Gloede T, Halbach S, Thrift A et al. Long-term costs of stroke using 10-year longitudinal data from the North East Melbourne Stroke Incidence Study. *Stroke*. 2014; 1-8.

⁴²⁴ Krueger H, Lindsay P, Cote R et al. Cost avoidance associated with optimal stroke care in Canada. *Stroke*. 2012; 43(8): 2198-206.

⁴²⁵ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴²⁶ Chapman K, Ernst P, Grenville A et al. Control of asthma in Canada: failure to achieve guideline targets. *Canadian Respiratory Journal*. 2001; 8(Suppl A): 35A-40A.

⁴²⁷ Sadatsafavi M, Lynd L, Marra C et al. Direct health care costs associated with asthma in British Columbia. *Canadian Respiratory Journal*. 2010; 17(2): 74-80.

⁴²⁸ Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.

⁴²⁹ Ibid

Chronic Pelvic Pain

- The GBD study found that moderate pelvic pain is associated a disability weight of 0.114 (95% CI of 0.078 to 0.159).⁴³⁰ We have assumed that this pain would last for a period of five years.⁴³¹

Dental Caries

- The Global Burden of Disease Study found that symptomatic dental caries (“has a toothache, which causes some difficulty in eating”) is associated with a disability weight of 0.01 (95% CI of 0.005 to 0.019). Severe tooth loss (“has lost more than 20 teeth including front and back, and has great difficulty eating meat, fruits and vegetables”) is associated with a disability weight of 0.067 (95% CI of 0.045 to 0.095).⁴³²
- A topical fluoride application costs \$10.61.⁴³³
- A pit and fissure sealant application costs \$19.74 for the first tooth in a quadrant and \$10.83 for each additional tooth in the quadrant.⁴³⁴
- An amalgam restoration costs between \$83.10 and \$102.40 depending on whether or not the restoration is bonded and to which teeth the restoration is applied.⁴³⁵ We used the mid-point (\$92.75) for the base case and the extremes in the sensitivity analysis.
- The cost per day surgery for dental cavities in BC is estimated at \$1,782 which includes \$1,515 for hospital and \$267 for anaesthesia costs in 2011⁴³⁶ or \$1,884 in 2017 dollars.

Depression

- Depression has an important influence on a person’s QoL. Studies have shown that individuals with current or treated depression report lower preference scores for depression health states than the general population.^{437,438} Pyne and colleagues suggest that “public stigma may result in the general population being less sympathetic to the suffering of individuals with depression and less willing to

⁴³⁰ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴³¹ Hu D, Hook EW and Goldie SJ. Screening for Chlamydia trachomatis in women 15 to 29 years of age: a cost-effectiveness analysis. *Annals of Internal Medicine*. 2004; 141(7): 501-13.

⁴³² Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed October 2017.

⁴³³ BC Ministry of Social Development and Poverty Reduction. *Dental Supplement*. September 1, 2017. Available online at <https://www2.gov.bc.ca/assets/gov/family-and-social-supports/income-assistance/on-assistance/schedule-dentist.pdf>. Accessed January 2018.

⁴³⁴ BC Ministry of Social Development and Poverty Reduction. *Dental Supplement*. September 1, 2017. Available online at <https://www2.gov.bc.ca/assets/gov/family-and-social-supports/income-assistance/on-assistance/schedule-dentist.pdf>. Accessed January 2018.

⁴³⁵ *Ibid*.

⁴³⁶ Canadian Institute for Health Information. *Treatment of Preventable Dental Cavities in Preschoolers: A Focus on Day Surgery Under General Anesthesia*. 2013. Available at https://secure.cihi.ca/free_products/Dental_Caries_Report_en_web.pdf. Accessed January 2018.

⁴³⁷ Pyne JM, Fortney JC, Tripathi S et al. How bad is depression? Preference score estimates from depressed patients and the general population. *Health Services Research*. 2009; 44(4): 1406-23.

⁴³⁸ Gerhards SA, Evers SM, Sabel PW et al. Discrepancy in rating health-related quality of life of depression between patient and general population. *Quality of Life Research*. 2011; 20(2): 273-9.

validate the impact of depression symptoms.”⁴³⁹ Revicki and Wood, based on input from patients with depression who had completed at least eight weeks of antidepressant medication (ADM), identified the following health state utilities (or quality of life): severe depression = 0.30, moderate depression = 0.55 to 0.63, mild depression = 0.64 to 0.73 and antidepressant maintenance therapy = 0.72 to 0.83.⁴⁴⁰ Whiteford and colleagues⁴⁴¹ suggest the following health utilities:

- Severe depression, QoL = 0.35 (95% CI of 0.18 to 0.53)
- Moderate depression, QoL = 0.59 (95% CI of 0.45 to 0.72)
- Mild depression, QoL = 0.84 (95% CI of 0.78 to 0.89)

For modelling purposes we assumed an equal proportion of individuals with mild, moderate and severe depression and used the average quality of life provided by Whiteford and colleagues of 0.59 (95% CI of 0.47 to 0.72).

- The GBD study found that mild depression was associated with a disability weight of 0.145 (95% CI of 0.099 to 0.209), moderate depression was associated with a disability weight of 0.396 (95% CI of 0.267 to 0.531) and severe depression was associated with a disability weight of 0.658 (95% CI of 0.477 to 0.807).⁴⁴² The results by Whiteford et al. were generated for the GBD.⁴⁴³
- The cost/day for antidepressant prescriptions in BC ranges from \$1.00 for prescriptions paid by the provincial government to \$1.19 for prescription paid for by uninsured patients and \$1.27 paid for by private insurers (in 2012 CAD)⁴⁴⁴ or \$1.04 / \$1.24 / \$1.33 respectively in 2017 CAD. The weighted average is \$1.20/day or \$438/year.

Diabetes – Type 1

- The lifetime cost per case in the US has been estimated at \$77,463 (in 2007 USD)⁴⁴⁵ or \$76,598 in 2017 CAD.

Diabetes – Type 2

- The GBD study found that diabetic neuropathy (“person has pain, tingling and numbness in the arms, legs, hands and feet. The person sometimes gets cramps and

⁴³⁹ Pyne JM, Fortney JC, Tripathi S et al. How bad is depression? Preference score estimates from depressed patients and the general population. *Health Services Research*. 2009; 44(4): 1406-23.

⁴⁴⁰ Revicki DA and Wood M. Patient-assigned health state utilities for depression-related outcomes: differences by depression severity and antidepressant medications. *Journal of Affective Disorders*. 1998; 48(1): 25-36.

⁴⁴¹ Whiteford HA, Degenhardt L, Rehm J et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *The Lancet*. 2013; 382(9904): 1575-86.

⁴⁴² Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁴³ Whiteford HA, Degenhardt L, Rehm J et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *The Lancet*. 2013; 382(9904): 1575-86.

⁴⁴⁴ Morgan S, Smolina K, Mooney D et al. *The Canadian Rx Atlas, Third Edition*. 2013. UBC Centre for Health Services and Policy Research. Available at http://www.chspr.ubc.ca/sites/default/files/file_upload/publications/2013/RxAtlas/canadianrxatlas2013.pdf. Accessed January 2018.

⁴⁴⁵ Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.

muscle weakness”) is associated with a disability weight of 0.133 (95% CI of 0.089 to 0.187).⁴⁴⁶

- Uncomplicated diabetes mellitus is associated with a disability weight of 0.049 (95% CI of 0.031 to 0.072).⁴⁴⁷ In this situation, the person has “a chronic disease that requires medication every day and causes some worry but minimal interference with daily activities”.

Ectopic Pregnancy

- The GBD study found that an ectopic pregnancy is associated a disability weight of 0.114 (95% CI of 0.078 to 0.159).⁴⁴⁸ We have assumed that the disability would last for a period of four weeks.⁴⁴⁹

End-Stage Renal Disease

- The GBD study found that chronic kidney disease (stage IV) is associated with a disability weight of 0.104 (95% CI of 0.07 to 0.147).⁴⁵⁰
- The GBD study found that being on dialysis because of end-stage renal disease caused by diabetes is associated with a disability weight of 0.571 (95% CI of 0.398 to 0.725).⁴⁵¹
- The annual costs for end-stage renal disease are \$63,045 (in 2000 CAD)⁴⁵² or \$86,278 in 2017 CAD.

Gastrointestinal Bleeding

- In a Canadian study of 124 patients (mean age of 58.8 years) with acute lower gastrointestinal hemorrhage, the mean hospital stay was 7.5 days at a cost of \$4,832 per stay (in 2002 CAD) or \$6,425 (in 2017 CAD).
- In a study of 936 patients with acute upper gastrointestinal bleeding (AUGIB) in the UK (mean age of 59.4 years), 42 (4.5%) had died by day 28 following the bleeding episode. The mean QoL score at 28 days for surviving patients was 0.735 compared to 0.86 for the general UK population, a disutility of 0.125 (or 14.5%). We have assumed that this disutility lasts for a one-year period.⁴⁵³

⁴⁴⁶ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁴⁷ Ibid.

⁴⁴⁸ Ibid.

⁴⁴⁹ Hu D, Hook EW and Goldie SJ. Screening for Chlamydia trachomatis in women 15 to 29 years of age: a cost-effectiveness analysis. *Annals of Internal Medicine*. 2004; 141(7): 501-13.

⁴⁵⁰ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁵¹ Ibid.

⁴⁵² O'Brien JA, Patrick AR and Caro JJ. Cost of managing complications resulting from type 2 diabetes mellitus in Canada. *BMC Health Services Research*. 2003; 3(1): 7.

⁴⁵³ Campbell H, Stokes E, Bargo D et al. Costs and quality of life associated with acute upper gastrointestinal bleeding in the UK: cohort analysis of patients in a cluster randomised trial. *British Medical Journal Open*. 2015; 5(4): e007230.

- In the same UK study, the mean hospital stay was 5.34 days with total hospital costs of £2,458 (in 2012/13 £). Mean post hospital discharge costs to day 28 were £391.⁴⁵⁴ We converted the total cost of £2,849 to \$5,269 2017CAD.

Gastrointestinal Infection

- A US study suggests the direct costs for gastrointestinal infections and lower respiratory tract infections are \$331 per case (in 1995 USD)⁴⁵⁵ or \$462 in 2017 CAD.

Hearing Deficits

- The GBD study found that a mild hearing loss was associated with a utility of -0.01 (95% CI of -0.004 to -0.019), a moderate hearing loss with -0.027 (95% CI of -0.015 to -0.042), a severe hearing loss with -0.158 (95% CI of -0.105 to -0.227), a profound hearing loss with -0.204 (95% CI of -0.134 to -0.288) and a complete hearing loss with -0.215 (95% CI of -0.144 to -0.307).⁴⁵⁶
- A 2003 US study estimated the direct lifetime costs per individual associated with hearing loss to be \$153,151 USD.⁴⁵⁷ The costs included physician visits, prescription medications, hospital inpatient stays, assistive devices, therapy and rehabilitation, long-term care, home and vehicle modifications and special education. We converted these costs to equivalent 2017 Canadian health care costs for a lifetime cost per individual of \$169,952 CAD associated with hearing loss.

HIV/AIDS

- The GBD study found that symptomatic HIV without anemia is associated with a disability weight of 0.274 (95% CI of 0.184 to 0.377), symptomatic HIV with mild anemia is associated with a disability weight of 0.277 (95% CI of 0.189 to 0.379), symptomatic HIV with moderate anemia is associated with a disability weight of 0.312 (95% CI of 0.217 to 0.418) and symptomatic HIV without severe anemia is associated with a disability weight of 0.381 (95% CI of 0.269 to 0.505).⁴⁵⁸
- The GBD study found that AIDS with antiretroviral treatment (ART) without anemia is associated with a disability weight of 0.078 (95% CI of 0.052 to 0.111), AIDS with antiretroviral treatment with mild anemia is associated with a disability weight of 0.081 (95% CI of 0.054 to 0.116), AIDS with antiretroviral treatment with moderate anemia is associated with a disability weight of 0.125 (95% CI of 0.085 to 0.176) and AIDS with antiretroviral treatment with severe anemia is associated with a disability weight of 0.215 (95% CI of 0.148 to 0.295).⁴⁵⁹
- Long and colleagues estimated the gain in quality of life associated with early detection and treatment of an HIV infection to be 0.11 and the difference in quality

⁴⁵⁴ Ibid.

⁴⁵⁵ Ball TM and Wright AL. Health care costs of formula-feeding in the first year of life. *Pediatrics*. 1999; 103(Suppl. 1): 870-6.

⁴⁵⁶ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁵⁷ Economic costs associated with mental retardation, cerebral palsy, hearing loss, and vision impairment – United States, 2003. *MMWR Weekly*. 2003; 53(03): 57-9.

⁴⁵⁸ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁵⁹ Ibid.

of life between avoided infection and symptomatic HIV treated with ART to be 0.17.⁴⁶⁰

- The annual direct medical costs (excluding medications) associated with HIV/AIDS in Canada have been estimated by stage of infection at \$1,684 for asymptomatic HIV, \$2,534 for symptomatic HIV and \$9,715 for AIDS (in 2009 CAD)⁴⁶¹ or \$1,889, \$2,843 and \$10,900 respectively in 2017 CAD.

Infertility

- The GBD study found that primary infertility (“wants to have a child and has a fertile partner but the couple cannot conceive”) is associated with a disability weight of -0.008 (95% CI of -0.003 to -0.015) while secondary infertility (“has at least one child, and wants to have more children. The person has a fertile partner but the couple cannot conceive”) is associated with a disability weight of 0.005 (95% CI of 0.002 to 0.011).⁴⁶²

Intellectual Disability

- The GBD study found that borderline intellectual functioning is associated with a utility of -0.011 (95% CI of -0.005 to -0.02), mild intellectual disability is associated with a utility of -0.043 (95% CI of -0.026 to -0.064), moderate intellectual disability is associated with a utility of -0.1 (95% CI of -0.066 to -0.142) and profound intellectual disability is associated with a utility of -0.2 (95% CI of -0.133 to -0.283).⁴⁶³
- A 2003 US study estimated the direct lifetime costs per individual associated with intellectual disability to be \$243,620 USD.⁴⁶⁴ The costs included physician visits, prescription medications, hospital inpatient stays, assistive devices, therapy and rehabilitation, long-term care, home and vehicle modifications and special education. We converted these costs to equivalent 2017 Canadian health care costs for a lifetime cost per individual of \$270,345 CAD associated with intellectual disability.

Lower Extremity Amputation

- The typical event cost for a lower extremity amputation is \$24,583 with annual costs thereafter of \$1,020 (in 2000 CAD)⁴⁶⁵ or \$33,642 and \$1,396 respectively in 2017 CAD.

Lower Respiratory Tract Infections

- A US study suggests the direct costs for gastrointestinal infections and lower respiratory tract infections are \$331 per case (in 1995 USD)⁴⁶⁶ or \$462 in 2017 CAD.

⁴⁶⁰ Long EF, Brandeau ML and Owens DK. The cost-effectiveness and population outcomes of expanded HIV screening and antiretroviral treatment in the United States. *Annals of Internal Medicine*. 2010; 153(12): 778-89.

⁴⁶¹ Kingston-Riechers, J. *The Economic Cost of HIV/AIDS in Canada*. Canadian AIDS Society, 2011. Available online at [http://www.cdnaids.ca/files.nsf/pages/economiccostofhiv-aidscanada/\\$file/Economic%20Cost%20of%20HIV-AIDS%20in%20Canada.pdf](http://www.cdnaids.ca/files.nsf/pages/economiccostofhiv-aidscanada/$file/Economic%20Cost%20of%20HIV-AIDS%20in%20Canada.pdf). Accessed July, 2014.

⁴⁶² Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁶³ Ibid.

⁴⁶⁴ Economic costs associated with mental retardation, cerebral palsy, hearing loss, and vision impairment – United States, 2003. *MMWR Weekly*. 2003; 53(03): 57-9.

⁴⁶⁵ O'Brien JA, Patrick AR and Caro JJ. Cost of managing complications resulting from type 2 diabetes mellitus in Canada. *BMC Health Services Research*. 2003; 3(1): 7.

⁴⁶⁶ Ball TM and Wright AL. Health care costs of formula-feeding in the first year of life. *Pediatrics*. 1999; 103(Suppl. 1): 870-6.

Osteoporosis

- Hip fractures occur at a rate of 104 / 100,000 person years in females ages 65-69, 390 / 100,000 person years in females ages 70-79 and 1,411 / 100,000 person years in females ages 80-86.⁴⁶⁷
- Vertebral fractures occur at a rate of 51 / 100,000 person years in females ages 65-69, 154 / 100,000 person years in females ages 70-79 and 373 / 100,000 person years in females ages 80-86.⁴⁶⁸
- Non-hip, non-vertebral fractures occur at a rate of 1,112 / 100,000 person years in females ages 65-69, 1,570 / 100,000 person years in females ages 70-79 and 3,150 / 100,000 person years in females ages 80-86.⁴⁶⁹
- 71% of hip fractures in females 65-74 years old are attributable to osteoporosis, increasing to 91% at age 75. 81% of vertebral fractures are attributable to osteoporosis in females ages 65 and older and 81.5% of all other fractures are attributable to osteoporosis in females ages 65.⁴⁷⁰
- 29% of hip fracture patients do not recover their pre-fracture functioning, and have a reduced quality of life for their remaining years of life.⁴⁷¹ The remaining hip fracture patients recover within an average of 6 months.⁴⁷² Vertebral fracture patients recover to pre-fracture levels of functioning in one year⁴⁷³ and all other fracture types recover in an average of 6 months. A hip fracture causes a 35.5% reduction in QoL, a vertebral fracture causes a 6.6% reduction in QoL and all other fractures cause a 6.0% reduction in QoL.^{474,475}
- A bone density scan to determine bone mineral density costs \$110.62.⁴⁷⁶
- The annual direct medical costs of a hip fracture, including acute care, rehabilitation care, long term care, home care, outpatient physician services and mobility devices, is \$62,152.⁴⁷⁷

⁴⁶⁷ Hopkins R, Burke N, Von Keyserlingk C et al. The current economic burden of illness of osteoporosis in Canada. *Osteoporosis International*. 2016; 27(10): 3023-32.

⁴⁶⁸ Ibid.

⁴⁶⁹ Ibid.

⁴⁷⁰ Lippuner K, Golder M and Greiner R. Epidemiology and direct medical costs of osteoporotic fractures in men and women in Switzerland. *Osteoporosis International*. 2005; 16(2): S8-S17.

⁴⁷¹ Bertram M, Norman R, Kemp L et al. Review of the long-term disability associated with hip fractures. *Injury Prevention*. 2011; 17: 365-70.

⁴⁷² Ibid.

⁴⁷³ Dr. Susan Purkiss, MD, FRCPC, Clinical Instructor, General Internal Medicine, Faculty of Medicine, UBC. January 16, 2019. Personal communication.

⁴⁷⁴ Bertram M, Norman R, Kemp L et al. Review of the long-term disability associated with hip fractures. *Injury Prevention*. 2011; 17: 365-70.

⁴⁷⁵ Kanis J, Oden A, Johnell O et al. The burden of osteoporotic fractures: a method for setting intervention thresholds. *Osteoporosis International*. 2001; 12(5): 417-27.

⁴⁷⁶ B.C. Ministry of Health, Health Sector Information, Analysis & Reporting Division. *MSP Fee-For-Service Payment Analysis 2012/2013 - 2016/2017*. 2017. Available at https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/ffs_complete.pdf. Accessed November 2018.

⁴⁷⁷ Hopkins R, Burke N, Von Keyserlingk C et al. The current economic burden of illness of osteoporosis in Canada. *Osteoporosis International*. 2016; 27(10): 3023-32.

- The annual direct medical costs of a vertebral fracture, including acute care, rehabilitation care, long term care, home care, outpatient physician services and mobility devices, is \$25,965.⁴⁷⁸
- The annual direct medical costs of all “other” fractures, including acute care, rehabilitation care, long term care, home care, outpatient physician services and mobility devices, is \$13,579.⁴⁷⁹

Otitis Media

- Two estimates from the US suggest a direct cost (ambulatory care and antibiotics) per case of \$156 (2007 USD)⁴⁸⁰ and \$106 (2004 USD).⁴⁸¹ A Canadian study suggested additional hospital costs over and above physician and drug costs of 15.6%.⁴⁸² We have converted the \$156 to 2017 CAD and then added 15.6% to account for hospital costs for a total cost per case of \$251 CAD.

Sexually Transmitted Infection

- The GBD study found that a mild chlamydial or gonococcal infection is associated with a utility of -0.006 (95% CI of -0.002 to -0.012).⁴⁸³

Spina Bifida

- Based on a consecutive cohort of 117 children with spina bifida in the UK, 33.9% presented with a sacral lesion, 28.6% with a lower lumbar lesion and 37.5% with an upper lumbar lesion.⁴⁸⁴
- Based on a study of 98 children with spina bifida in Arkansas, the average loss in QoL associated with spina bifida was 41%, ranging from 34% (6% to 62%) for the sacral lesion, 42% (22% to 62%) for the lower lumbar lesion and 52% (25% to 78%) for the upper lumbar lesion.
- The GBD study found the following utilities associated with spina bifida.

⁴⁷⁸ Ibid.

⁴⁷⁹ Ibid.

⁴⁸⁰ Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.

⁴⁸¹ Zhou F, Shefer A, Kong Y et al. Trends in acute otitis media-related health care utilization by privately insured young children in the United States, 1997–2004. *Pediatrics*. 2008; 121(2): 253-60.

⁴⁸² Coyte PC, Asche CV and Elden LM. The economic cost of otitis media in Canada. *International Journal of Pediatric Otorhinolaryngology*. 1999; 49(1): 27-36.

⁴⁸³ Institute for Health Metrics and Evaluation. *GBD 2016 sequelae, health states, health state lay descriptions, and disability weights*. Available online at <http://ghdx.healthdata.org/record/global-burden-disease-study-2016-gbd-2016-disability-weights>. Accessed January 2018.

⁴⁸⁴ Oakeshott P, Hunt G, Poulton A et al. Expectation of life and unexpected death in open spina bifida: a 40-year complete, non-selective, longitudinal cohort study. *Developmental Medicine & Child Neurology*. 2009; 52(8): 749-53.

Health State	Utility		
	Weight	95% CI	
Mild motor impairment due to spina bifida	-0.010	-0.005	-0.019
Mild motor impairment and mild intellectual disability due to spina bifida	-0.031	-0.018	-0.050
Moderate motor impairment due to spina bifida	-0.061	-0.040	-0.089
Moderate motor impairment and borderline intellectual disability due to spina bifida	-0.071	-0.045	-0.106
Moderate motor impairment and mild intellectual disability due to spina bifida	-0.101	-0.066	-0.146
Moderate motor impairment and incontinence due to spina bifida	-0.191	-0.132	-0.263
Moderate motor impairment, borderline intellectual disability and incontinence due to spina bifida	-0.200	-0.139	-0.273
Moderate motor impairment and moderate intellectual disability due to spina bifida	-0.203	-0.134	-0.290
Moderate motor impairment and severe intellectual disability due to spina bifida	-0.211	-0.145	-0.293
Moderate motor impairment and profound intellectual disability due to spina bifida	-0.249	-0.174	-0.338
Moderate motor impairment, mild intellectual disability and incontinence due to spina bifida	-0.272	-0.191	-0.364
Moderate motor impairment, moderate intellectual disability and incontinence due to spina bifida	-0.272	-0.191	-0.364
Moderate motor impairment, severe intellectual disability and incontinence due to spina bifida	-0.320	-0.228	-0.429
Moderate motor impairment, profound intellectual disability and incontinence due to spina bifida	-0.352	-0.254	-0.465
Severe motor impairment due to spina bifida	-0.402	-0.268	-0.545

- Grosse and co-authors estimated the lifetime costs associated with spina bifida to be \$791,900 (in 2014 USD). This includes \$513,500 in medical costs, \$63,500 in special education and developmental service costs and \$214,900 in parental time costs.⁴⁸⁵ We converted these costs to \$454,745 in medical costs, \$79,203 in special education and developmental service costs and \$268,043 in parental time costs in 2017 CAD.

⁴⁸⁵ Grosse S, Berry R, Tilford J et al. Retrospective assessment of cost savings from prevention: folic acid fortification and spina bifida in the US. *American Journal of Preventive Medicine*. 2016; 50(5S1): S74-S80.