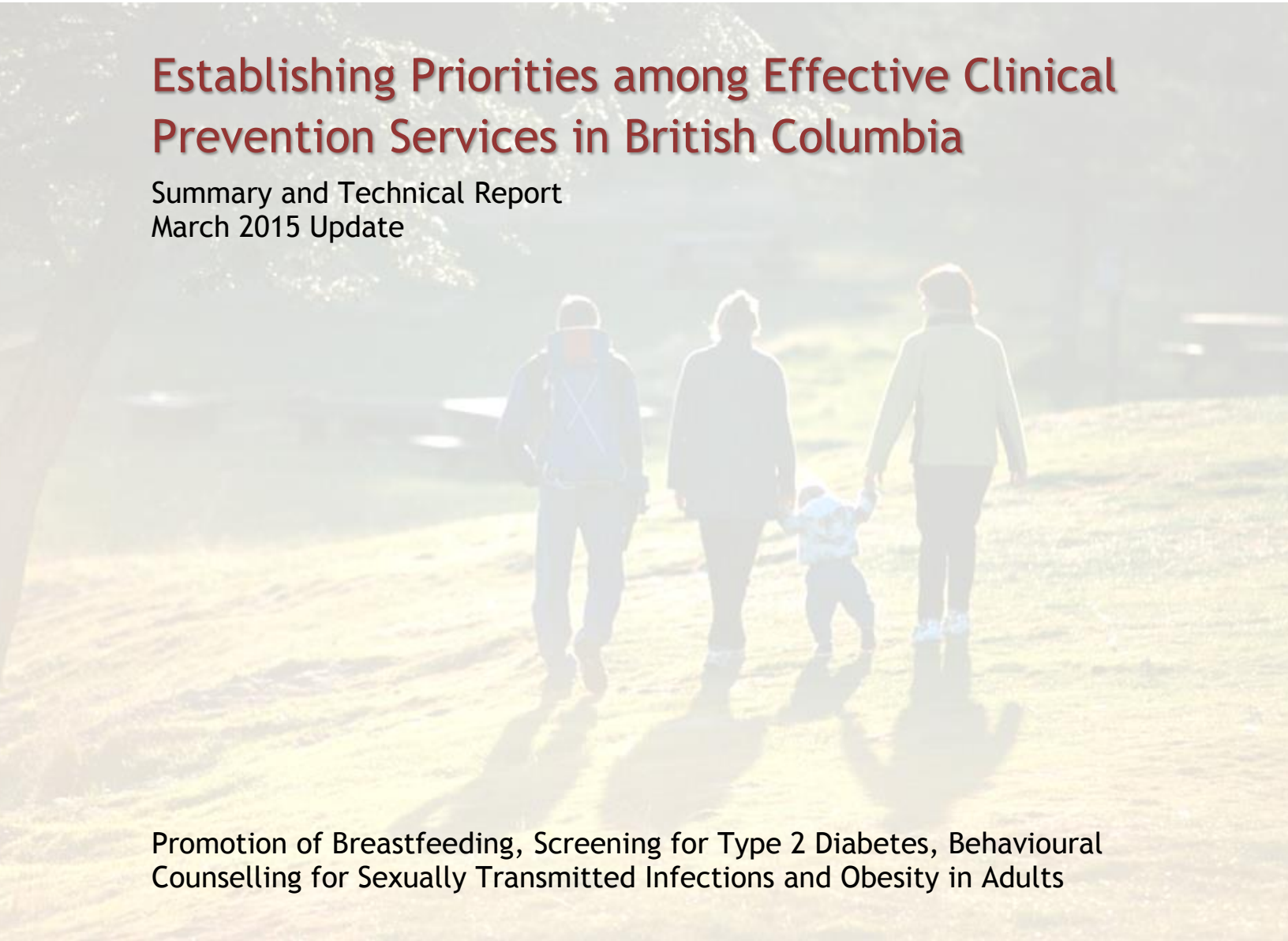
# The Lifetime Prevention Schedule

## Establishing Priorities among Effective Clinical Prevention Services in British Columbia

Summary and Technical Report
March 2015 Update



Promotion of Breastfeeding, Screening for Type 2 Diabetes, Behavioural Counselling for Sexually Transmitted Infections and Obesity in Adults

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The Lifetime Prevention Schedule 2015 update was supported by Child Health BC, the Doctors of BC and the Ministry of Health.

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Update completed by H. Krueger & Associates Inc.

## Acknowledgments

This project was completed under the guidance of the Lifetime Prevention Schedule Expert Advisory Committee. Members of the committee include:

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# Establishing Priorities among Effective Clinical Prevention Services in British Columbia: *2015 Update*

## Executive Summary

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, 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 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) 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.

In 2013/14, a Lifetime Prevention Schedule Expert Advisory Committee was formed by the Ministry of Health and tasked with updating and potentially expanding the number of clinical prevention services included on the LPS. That process involved calculating the clinically preventable burden (CPB) and cost-effectiveness (CE) associated with the clinical prevention service. CPB is defined as "the total quality-adjusted life years (QALYs) that could be gained if the clinical preventive service were delivered at recommended intervals to a BC birth cohort of 40,000 individuals over the years of life that a service is recommended." CE is defined as "the average net cost per QALY gained in typical practice by offering the clinical preventive service at recommended intervals to a BC birth cohort over the recommended age range."

The updated list reviewed in 2013/14 included the 10 maneuvers on the original 2009 LPS together with 9 additional maneuvers (highlighted in *italics* below) to be considered for inclusion on the updated LPS:

[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 August 2013.

**Screening for Asymptomatic Disease or Risk Factors – Children/Youth**

- Newborn screening for hearing
- Vision (amblyopia) screening

**Behavioural Counseling Interventions – Children/Youth**

- *Preventing tobacco use*

**Preventive Medication – Children/Youth**

- Fluoride varnish and sealants to prevent dental caries

**Screening for Asymptomatic Disease or Risk Factors – Adults**

- Breast cancer screening - women 50-74
- Cervical cancer screening - women 25-69
- Colorectal cancer screening - adults 50-74
- Hypertension screening and treatment - adults 18+
- Cholesterol screening and treatment - men 35+, women 45+
- *Screening for hepatitis C virus - adults born between 1945 and 1965*

**Routine Offer of Screening for STIs in Sexually Active Young Adults**

- *Screening for human immunodeficiency virus (HIV) – adolescents/adults 15-65*
- *Screening for gonorrhea - females 15-29*
- *Screening for chlamydia - females 15-29*
- *Screening for syphilis*

**Behavioural Counseling Interventions – Adults**

- Smoking cessation advice and help to quit
- *Alcohol screening and brief counseling*
- *Prevention of fetal alcohol spectrum disorder (FASD)*

**Preventive Medication – Adults**

- Discuss daily aspirin use - men 45-79, women 55-79
- *Preventing falls in community–dwelling elderly - adults 65+*

The Lifetime Prevention Schedule Expert Advisory Committee is currently seeking an assessment of the estimated CPB and CE associated with the following four additional clinical prevention services:

**Behavioural Counseling Interventions – Children/Youth**

- Promotion of breastfeeding

**Screening for Asymptomatic Disease or Risk Factors - Adults**

- Screening for type 2 diabetes mellitus

**Behavioural Counseling Interventions – Adults**

- Prevention of sexually transmitted infections
- Screening for and management of obesity

This document provides the details supporting the estimated CPB and CE associated with these four maneuvers.

In order to avoid duplicating evidence reviews, the Lifetime Prevention Schedule Expert Advisory Committee decided to refer any recommendations regarding immunizations to the BC Immunization Schedule and any recommendations regarding prenatal care, intrapartum care and immediate postpartum care to Perinatal Services BC (PSBC) or to other relevant Provincial Health Services Authority (PHSA) guidelines.

This executive summary includes the summary tables and figures from the analysis of the 19 clinical prevention services previously considered for inclusion on the LPS, as well as the four new maneuvers.

Three of the original 19 services were excluded from the previous review. *Screening for hearing in newborns* was considered to be part of immediate postpartum care, *screening for syphilis* was excluded as the Lifetime Prevention Schedule Expert Advisory Committee determined that the targeted population was too specific to meet the definition of a clinical prevention service, and *discuss daily aspirin use* was excluded as current evidence calls into question the effectiveness of this maneuver.

*Screening for chlamydia* and *screening for gonorrhea* were combined as there is a strong overlap in at-risk populations and both STIs are often being seen in the same individual.

Finally, *fluoride varnish and sealants to prevent dental caries* was divided into two separate models; 1) *fluoride varnish for the prevention of dental caries in primary teeth* and 2) *sealants for the prevention of caries in permanent teeth*.

Table ES-1 provides an overview of the results for all 20 maneuvers. The *estimated coverage* columns include information on current coverage in BC for a specific maneuver as well as information indicating the best coverage in the world (BiW). For example, 67% of eligible women in BC are currently being screened for cervical cancer. Evidence from other jurisdictions suggests that this coverage could be increased to 80%.

The *CPB* columns identify the clinically preventable burden (in terms of quality adjusted life years or QALYs) that is being achieved in BC based on current coverage, and the potential CPB if BiW coverage is achieved. For example, if coverage for cervical cancer screening were as high as the BiW(80%), we would expect a CPB of 1,477 QALYs. Since BC's coverage is at 67%, a CPB of 1,243 QALYs is being achieved. This is 234 QALYs short of the potential 1,477 QALYs achievable based on BiW coverage, as identified in the *Gap* column.

The *CE* columns identify the cost-effectiveness ratio associated with a maneuver stated in terms of the cost per QALY. The ratio is given based on the use of a 3% and a 0% discount rate. For example, the cost/QALY associated with cervical cancer screening in BC is estimated at $18,217, based on a discount rate of 3%. If a 0% discount rate is used, then the cost/QALY would be reduced to $16,781.

## Table ES-1: Effective Clinical Prevention Services in B.C.

**Summary** *(Not including Immunizations or Perinatal Care)*

| Clinical Prevention Services | Estimated Coverage B.C. | Estimated Coverage 'BiW'(1) | CPB(2) (0% Discount) QALYs B.C. | CPB(2) (0% Discount) QALYs 'BiW'(1) | CPB(2) (0% Discount) QALYs Gap | CE(3) (% Discount) Cost/QALY 3% | CE(3) (% Discount) Cost/QALY 0% |
|---|---|---|---|---|---|---|---|
| **Screening for Asymptomatic Disease or Risk Factors - Children** | | | | | | | |
| Screening for hearing - newborn | *Part of immediate postpartum care* | | | | | | |
| Vision screening for amblyopia - children, 3-5 | 93% | 93% | 25 | 25 | - | $879,199 | $179,901 |
| **Behavioural Counseling Interventions - Children/Youth** | | | | | | | |
| Preventing tobacco use - children/youth | Unknown, assume 0% | 65% | - | 1,299 | 1,299 | ($7,262) | ($16,750) |
| Promotion of breastfeeding | 41% | 60% | 7,031 | 10,370 | 3,339 | $397 | ($4,586) |
| **Preventive Medication - Children** | | | | | | | |
| Fluoride varnish - children | 92% | 92% | 407 | 407 | - | $19,292 | $19,292 |
| Dental sealants - children/youth | 30% | 70% | 239 | 558 | 319 | ($15,140) | ($18,917) |
| **Screening for Asymptomatic Disease or Risk Factors - Adults** | | | | | | | |
| Breast cancer screening - women 50-74 | 53% | 70% | 871 | 1,150 | 279 | $25,412 | $22,125 |
| Cervical cancer screening - women 25-69 | 67% | 80% | 1,243 | 1,477 | 234 | $18,217 | $16,781 |
| Colorectal cancer screening - adults 50-74 | 37% | 73% | 5,263 | 10,384 | 5,121 | $2,804 | $2,777 |
| Hypertension screening and treatment - adults 18+ | 85% | 85% | 8,791 | 8,791 | - | $15,131 | $5,573 |
| Cholesterol screening and treatment - men 35+, women 45+ | 75% | 75% | 3,150 | 3,150 | - | $23,204 | $18,655 |
| Screening for Type 2 Diabetes Mellitus | Unknown, assume 0% | 70% | - | 3,693 | 3,693 | ($3,777) | ($4,045) |
| **Routine Offer of Screening for Sexually Transmitted Infections - Adults** | | | | | | | |
| Screening for Human Immunodeficiency Virus - adults 15-65 | 20% | 70% | 111 | 387 | 276 | $43,846 | $43,846 |
| Screening for Chlamydia/Gonorrhea - women 15-29 | 29% | 50% | 647 | 1,115 | 468 | $9,900 | $7,980 |
| Screening for Syphilis | *Not for general population* | | | | | | |
| Screening for Hepatitis C Virus - adults born between 1945 and 1965 | 33% | 90% | 2,895 | 7,895 | 5,000 | $4,751 | $3,321 |
| **Behavioural Counseling Interventions - Adults** | | | | | | | |
| Smoking cessation advice and help to quit - adults | 50% | 75% | 10,743 | 16,034 | 5,291 | $7,277 | $1,749 |
| Alcohol screening and brief counseling - adults | Unknown, assume 0% | 35% | - | 1,136 | 1,136 | $1,175 | ($12,636) |
| LARC(4) and screening/counseling to reduce Fetal Alcohol Spectrum Disorder (FASD) | Unknown, assume 0% | 70% | - | 3,752 | 3,752 | ($2,829) | ($4,980) |
| Prevention of sexually transmitted infections - adults 15-59 | Unknown, assume 0% | 30% | - | 3,543 | 3,543 | $7,142 | $7,142 |
| Screening for and management of obesity | Unknown, assume 0% | 30% | - | 3,233 | 3,233 | $10,346 | $8,005 |
| **Preventive Medication - Adults** | | | | | | | |
| Discuss daily aspirin use - men 45-79, women 55-79 | *No longer clinically effective* | | | | | | |
| Preventing falls in community–dwelling elderly - adults 65+ | Unknown, assume 0% | 30% | - | 2,394 | 2,394 | $5,615 | $5,615 |

*(1) 'BiW' = best in world; (2) CPB = clinically preventable burden; (3) CE = cost-effectiveness; (4) LARC = Long-Acting Reversible Contraception;*

Figure ES-1 provides a summary of the CPB associated with each service. Results are displayed based on a 0% discount rate and results based on a 3% discount rate are available in the body of the text. Using a 3% discount rate tends to reduce the CPB. The results are organized from left to right based on the maneuvers with the highest to lowest potential CPB. For example, full implementation of the maneuver *smoking cessation advice and help to quit – adults* (Tobacco-A) (i.e., achieving levels that are comparable to the best in the world) would result in a CPB of 16,034 QALYs, the highest of any maneuver reviewed. Our best estimates suggest that approximately 50% of adults in BC are receiving the maneuver, resulting in a CPB of 10,743 QALYs. This would leave a gap of 5,291 QALYs between current services in BC and the potential full implementation of this maneuver in the province.

The black error bars / whiskers associated with each maneuver represent a potential range in CPB based on one-way sensitivity analysis. That is, the range is based on varying (over a plausible range) the one assumption that has the largest effect on the model results. Simultaneously varying more than one assumption would increase the potential range. A larger range suggests a higher sensitivity in the model to the assumptions used.

Figure ES-1: ***Clinically Preventable Burden*** Based on Providing Clinically Effective Maneuvers to a B.C. Birth Cohort of 40,000

0% Discount Rate

*(Not including Immunizations or Perinatal Care)*

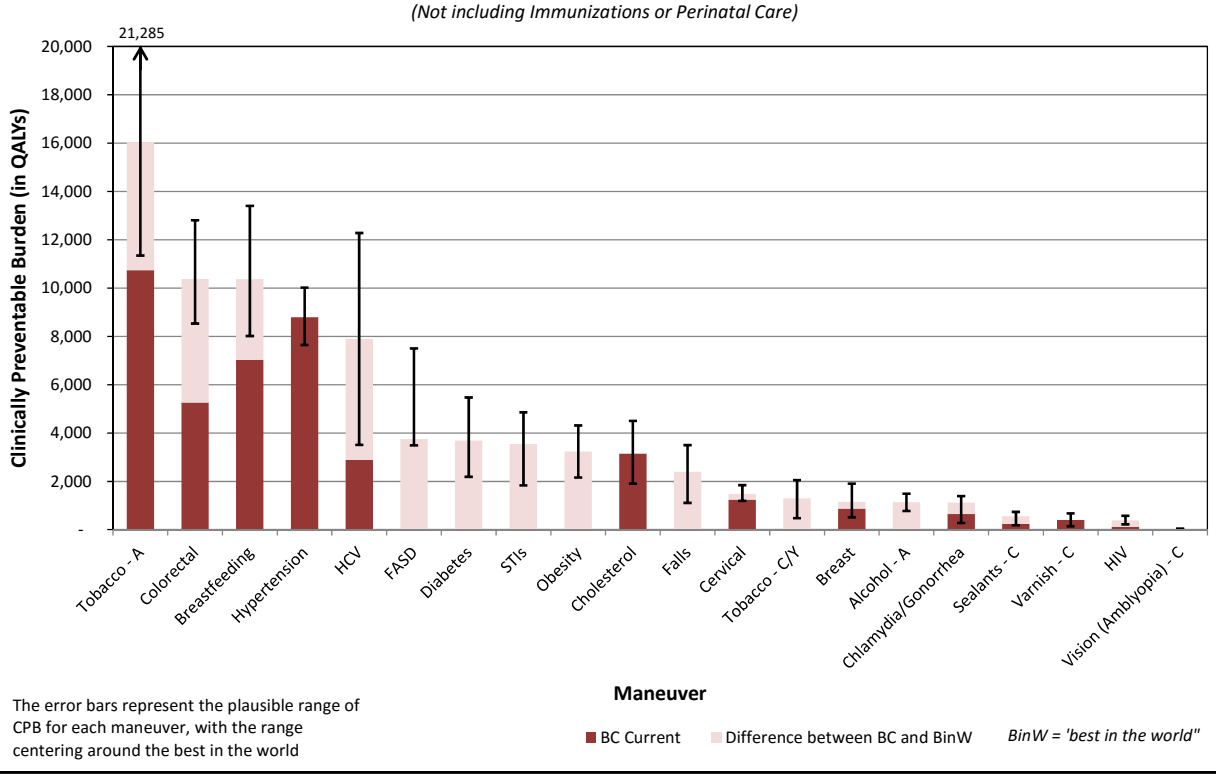
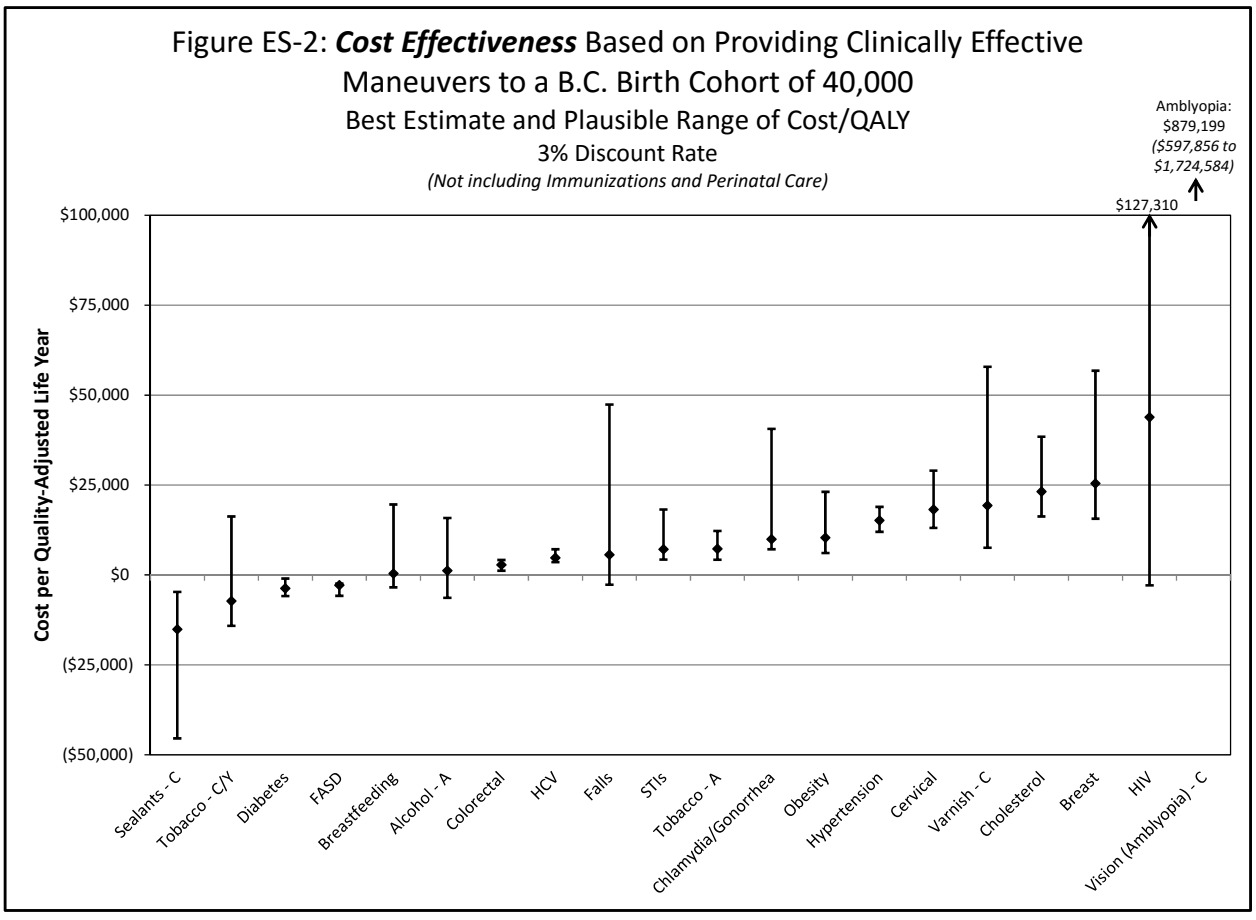


Figure ES-2 provides a summary of the CE associated with each service. Results are displayed based on a 3% discount rate. Results based on a 0% discount rate are available in the body of the text. Using a 0% discount rate tends to improve the CE. Furthermore, the results are organized from left to right based on the maneuvers with the best to worst potential CE, including a plausible range for each maneuver based on sensitivity analysis. The use of *dental sealants for the prevention of caries in permanent teeth* has the best CE result of any maneuver reviewed. That is, this maneuver is considered to be cost-saving, with a cost per QALY of -$15,140 (with a potential range from -$45,421 to -$4,706).
The black error bars / whiskers associated with each maneuver represent a potential range in CE based on one-way sensitivity analysis. That is, the range is based on varying (over a plausible range) the one assumption that has the largest effect on the model results. Simultaneously varying more than one assumption would increase the potential range. A larger range suggests a higher sensitivity in the model to the assumptions used.

Figure ES-2: ***Cost Effectiveness*** Based on Providing Clinically Effective Maneuvers to a B.C. Birth Cohort of 40,000
Best Estimate and Plausible Range of Cost/QALY
3% Discount Rate
*(Not including Immunizations and Perinatal Care)*



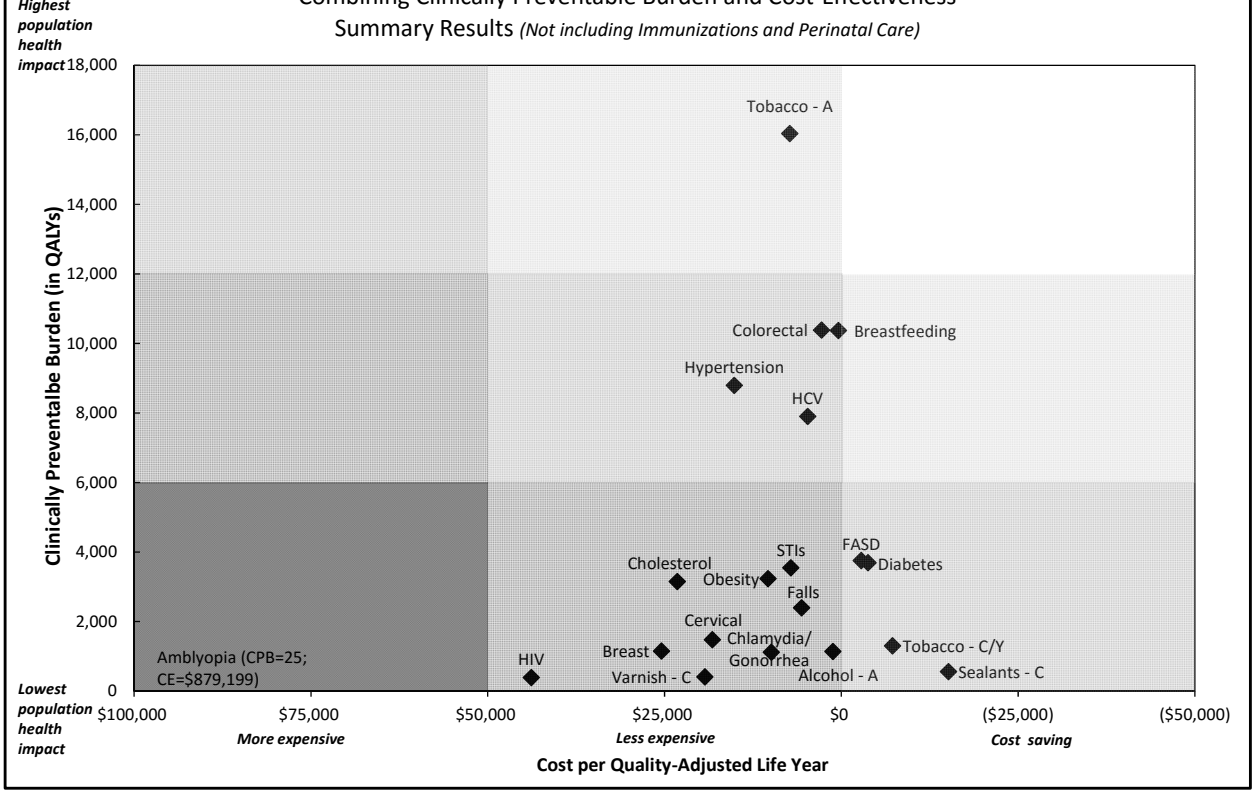
The base models include an estimate of costs associated with a person's time used in accessing the preventive maneuvers. They most significant effect of these inclusions/exclusions is seen in maneuvers that require frequent contact with health care providers. For example, the cost/QALY associated with screening for breast cancer is reduced from $25,412 to $13,859 if patient time costs are excluded. The cost/QALY associated with screening for cervical cancer is reduced from $18,217 to $8,239, the cost/QALY associated with screening for HIV is reduced from $43,846 to $9,955, the cost/QALY associated with screening for hypertension is reduced from $15,131 to $8,400, the cost/QALY associated with screening and counselling to reduce alcohol misuse is reduced from $1,175 to -$19,238 and the cost/QALY associated with applying fluoride varnish to primary teeth is reduced from $19,292 to $3,482.

The results for CPB and CE are combined in Figure ES-3. CPB is on the vertical axis, ranging from 0 to 18,000 QALYs. CE is on the horizontal axis, ranging from $100,000/QALY at the intersection of the x- and y-axis to -$50,000 at the far right of the x-axis. By arranging CPB and CE in this manner, the most positive results are on the upper right of the chart and the least positive results are in the lower left of the chart. We also divided CPB into three equal segments as follows; 0 to 6,000 QALYs, 6,001 to 12,000 QALYs and 12,001 to 18,000 QALYs. CE was also divided into three equal segments as follows: $100,000 to $50,000 per QALY, $50,000 to $0 per QALY and $0 to -$50,000 per QALY.

The resulting nine equivalent segments are shown in Figure ES-3. Maneuvers in the upper right segment have the most favourable combination of CPB and CE while maneuvers in the lower left segment have the least favourable combination of CPB and CE.

**Figure ES-3: Establishing Priorities among Effective Clinical Prevention Services in BC**

Combining Clinically Preventable Burden and Cost-Effectiveness Summary Results *(Not including Immunizations and Perinatal Care)*



In Figures ES-4 to ES-6, we have incorporated visual information on plausible ranges (based on one-way sensitivity analysis) with the point estimates for each maneuver. To avoid overcrowding the above figure (ES-3), we have separated the maneuvers into three figures. Figure ES-4 includes maneuvers specific to children and youth, Figure ES-5 includes screening maneuvers and Figure ES-6 includes behavioural counselling, etc. maneuvers.

**Figure ES-4: Establishing Priorities among Effective Clinical Prevention Services in BC**

Combining CPB and CE

Summary Results and Plausible Ranges for Children/Youth

*(Not including Immunizations and Perinatal Care)*

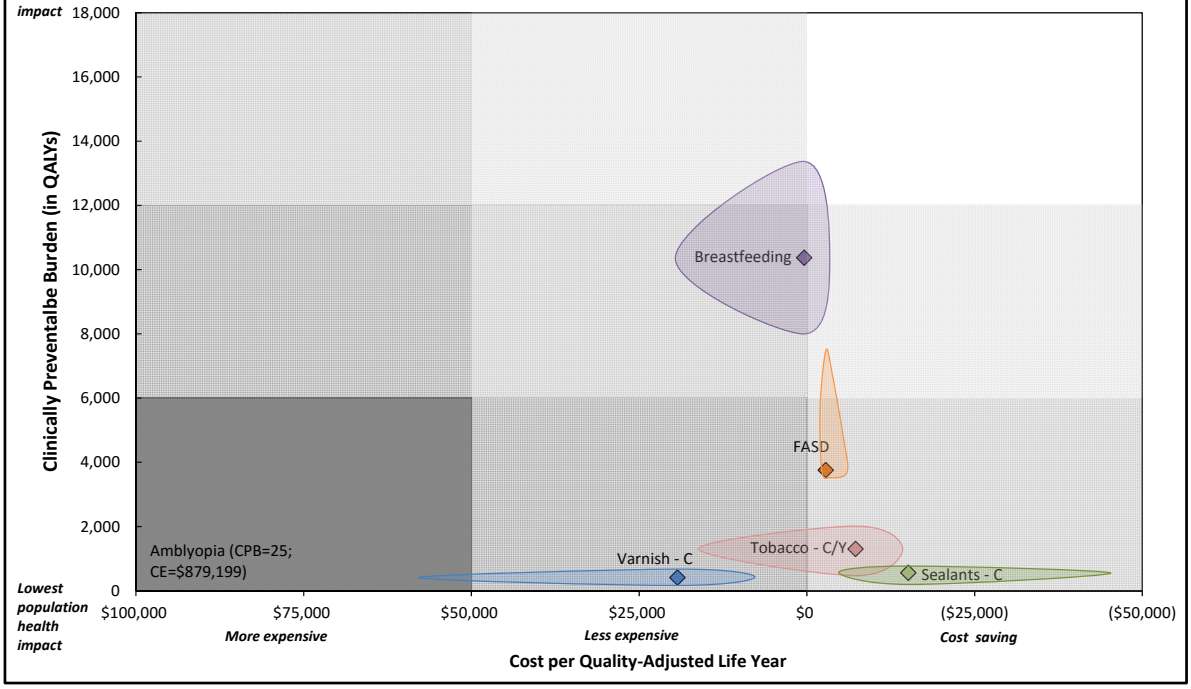


**Figure ES-5: Establishing Priorities among Effective Clinical Prevention Services in BC**

Combining CPB and CE

Summary Results and Plausible Ranges for Screening Maneuvers

*(Not including Immunizations and Perinatal Care)*

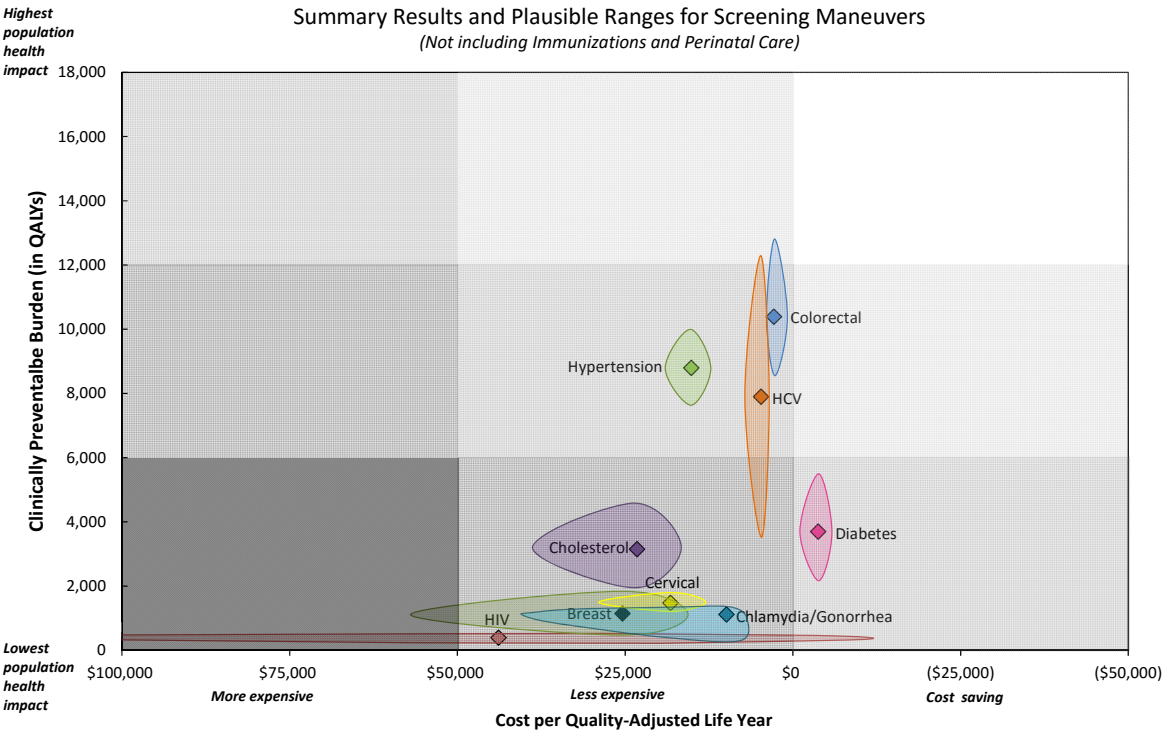
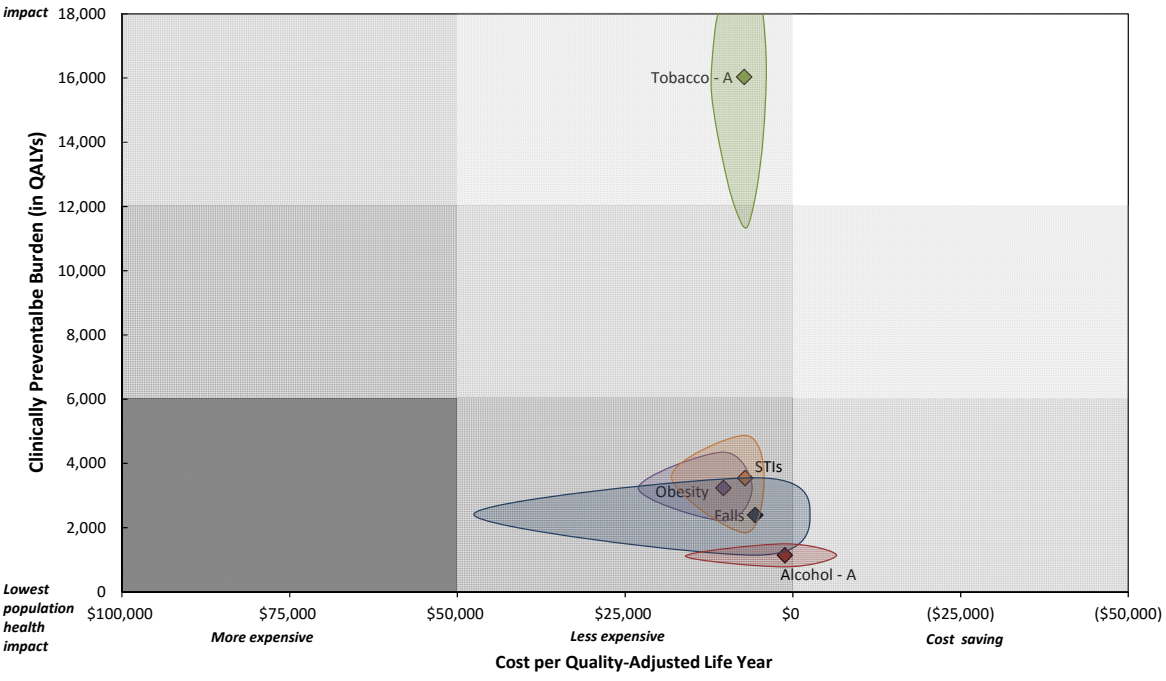



**Figure ES-6: Establishing Priorities among Effective Clinical Prevention Services in BC**

Combining CPB and CE

Summary Results and Plausible Ranges for Behavioural Counselling, etc. Maneuvers

*(Not including Immunizations and Perinatal Care)*



## Key Assumptions

The following key assumptions have been made throughout this project.

### Duplication of Effort

In order not to duplicate evidence reviews, the Lifetime Prevention Schedule Expert Advisory Committee decided to refer any recommendations regarding immunizations to the BC Immunization Schedule and any recommendations regarding prenatal care, intrapartum care and immediate postpartum care to the Perinatal Services BC (PSBC) guidelines or to other agencies responsible for specific recommendations. Many of these guidelines have not gone through the same rigor or economic modelling as the maneuvers being considered for the Lifetime Prevention Schedule.

### Delivery Mechanism(s)

The definition of clinical prevention is independent of delivery mechanism(s). In estimating cost-effectiveness, however, we had to make assumptions about delivery mechanisms in order to estimate the costs of providing the service. For purposes of consistency and comparability between the various preventive services, we chose to use a general physician's office as the delivery mechanism 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. Determining which delivery mechanism would be most suitable for each service will be assessed in a subsequent phase of this project.

### Patient Costs

Clinical prevention services 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. Or, 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 in an assessment of the cost-effectiveness of the intervention. 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. We have also identified the proportion of costs attributable to patient costs for each maneuver.

### 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 while benefits and potential costs avoided may stretch over the lifetime of the individual.[2,3,4,5]

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. It would thus be important to explicitly understand the impact of discounting in the current project. To do so, we will use both a 3% discount rate as well as a 0% discount rate. A 0% discount rate is equivalent to not discounting.

### 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 attempting to update their evidence review and recommendations every five years. It is possible that a landmark study (or studies) have been published during the interval between updates and that these studies may alter recommendations. To take this into account, we reviewed evidence reviews from other organizations (e.g. the Cochrane Collaboration and the National Institute for Health and Clinical Excellence [NICE] in the UK) for any USPSTF or CTFPHC recommendations published more than four years ago.

### Focus on the Best Available Evidence

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 focus 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.

[2] Parsonage M and Neuburger H. Discounting and health benefits. *Health Economics*. 1992; 1(1): 71-6.
[3] 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.
[4] 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.
[5] 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.

## Behavioural Counseling Interventions

### Promotion of Breastfeeding

#### Canadian Task Force on Preventive Health Care (CTFPHC; 2004)

*Breast-feeding has been shown in both developing and developed countries to improve the health of infants and their mothers, making it the optimal method of infant nutrition.*

*The CTFPHC concludes that there is good evidence to recommend providing structured antepartum educational programs and postpartum support to promote breastfeeding initiation and duration. (A recommendation)*

*Unfortunately, advice from a woman's primary clinician (such as family physician, obstetrician or midwife) has not been sufficiently evaluated, and a research gap remains in this area.*

*The CTFPHC concludes that there is insufficient evidence to make a recommendation regarding advice by primary caregivers to promote breastfeeding. (I Recommendation)*[6]

#### United States Preventive Services Task Force Recommendations (USPSTF; 2008)

*The USPSTF recommends interventions during pregnancy and after birth to promote and support breastfeeding. This is a grade B recommendation.*

*There is convincing evidence that breastfeeding provides substantial health benefits for children and adequate evidence that breastfeeding provides moderate health benefits for women.*

*Adequate evidence indicates that interventions to promote and support breastfeeding increase the rates of initiation, duration, and exclusivity of breastfeeding.*

*The USPSTF concludes that there is moderate certainty that interventions to promote and support breastfeeding have a moderate net benefit.*

*Interventions may include multiple strategies, such as formal breastfeeding education for mothers and families, direct support of mothers during breastfeeding observations, and the training of health professional staff about breastfeeding and techniques for breastfeeding support.*

*Although the activities of individual clinicians to promote and support breastfeeding are likely to be positive, additional benefit may result from efforts that are integrated into systems of care.*[7]

[6] Palda VA, Guise J-M and Wathen CN. Interventions to promote breast-feeding: applying the evidence in clinical practice. *Canadian Medical Association Journal*. 2004; 170(6): 976-8.
[7] US Preventive Services Task Force. Primary care interventions to promote breastfeeding: US Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*. 2008; 149(8): 560-4.

**Utilization of This Clinical Preventive Service**

*Currently in British Columbia*

The World Health Organization and the Breastfeeding Committee for Canada recommend that infants should be exclusively breastfed until 6 months of age. Exclusive breastfeeding (EBF) means that "the infant receives human milk (including expressed milk, donor milk) and allows the infant to receive oral rehydration solution (ORS), syrups (vitamins, minerals, medicines) but does not allow the infant to receive anything else."[8,9]

In BC, between 2004/05 and 2012/13, 95.5% of newborns received breast milk during their stay in hospital. Out of all newborns, 72.2% were exclusively breastfed during the hospital stay after birth.[10]

Across Canada, mothers in BC had the highest rate of EBF for six months (or more) in 2011/12 at 41%.[11]

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 have established policies and/or guidelines on breastfeeding." 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."[12] Despite these initiatives, there are currently only two Baby-Friendly Hospital Initiative (BFHI) designated hospitals in BC: the BC Women's Hospital and Health Centre in Vancouver and the GR Baker Hospital in Quesnel.[13]

The actual number of woman with infants who participate in lay breastfeeding support groups in BC is unknown. La Leche League Canada notes that it has over 165 such support groups across Canada with over 10,000 women attending.[14] Based on BC's population, this would suggest that approximately 1,900 BC women attend this support group at any given time, assuming that participation in BC is equivalent to the Canadian average.

[8] Breastfeeding Committee for Canada. *Breastfeeding Definitions and Data Collection Periods*. 2012. Available at http://breastfeedingcanada.ca/documents/BCC_BFI_Breastfeeding_Definitions_and_Data_Collection_English.pdf . Accessed March 2015.

[9] World Health Organization. *Indicators for Assessing Infant and Young Child Feeding Practices: Part 1 Definitions*. 2008. Available at http://whqlibdoc.who.int/publications/2008/9789241596664_eng.pdf. Accessed March 2015.

[10] Perinatal Services BC. *Fact Sheet: Breastfeeding Trends in British Columbia 2004/05 to 2012/13*. 2014. Available at http://www.perinatalservicesbc.ca/NR/rdonlyres/082863E4-2232-4F37-BEBB-70BEFAB5EE6A/0/BreastfeedingFactSheet_2014.pdf. Accessed March 2015.

[11] Linda Gionet. *Breastfeeding trends in Canada (Catalogue no.82-624-X)*. 2013. Statistics Canada Available at http://www.statcan.gc.ca/pub/82-624-x/2013001/article/11879-eng.pdf. Accessed March 2015.

[12] BC 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 February 2015.

[13] Breastfeeding Committee for Canada. *Baby-Friendly Initiative in Canada Status Report: 2014 Update*. 2014. Available at http://breastfeedingcanada.ca/documents/BFI%20Status%20Report%202014%20with%20WHO%20Country%20report.pdf. Accessed February 2015.

[14] La Leche League Canada. *Annual Report 2013/14*. 2014. Available at https://www.lllc.ca/sites/lllc.ca/files/2014_LLLC_ANNUAL_REPORT-1.pdf. Accessed February 2015.

*Best in the World*

Among developed countries, Sweden and Norway have the highest rates of breastfeeding. In Norway, 70% of infants are exclusively breastfed for the first 3 months with 80% receiving some breast milk for at least 6 months. In Sweden, 60% of infants are exclusively breastfed for the first 4 months with 72% receiving some breast milk for at least 6 months.[15]

For the purposes of this project, we have assumed that EBF for at least 6 months by 60% of new mothers is the best rate in the developed world.

#### Relevant British Columbia Population in 2010

There were 43,667 live births registered in BC by BC residents in 2010.[16]

#### Modelling CPB and CE

In this section, we will calculate the CPB and CE associated with interventions aimed at improving longer term (6 months) exclusive breastfeeding rates in a British Columbia birth cohort of 40,000.

Breastfeeding promotion interventions in developed countries are associated with a 28% increase (OR = 1.28, 95% CI of 1.11 – 1.48) in short-term (1–3 months) exclusive breastfeeding and a 44% increase (OR = 1.44, 95% CI of 1.13 – 1.84) in long-term (6–8 months) exclusive breastfeeding.[17]

Research evidence does not clearly identify which types or components of breastfeeding promotion interventions are effective. In their review for the USPSTF, Chung and colleagues "did not find that formal or structured breastfeeding education or individual-level professional support significantly affected the breastfeeding outcomes. [They] did find that lay support significantly increased the rate of any and exclusive breastfeeding in the short-term." They also noted that interventions including both pre- and post-natal components are important. Finally, "the BFHI is effective in increasing exclusive breastfeeding rates, at least up to 6 months after delivery."[17]

*From the perspective of a CPS, then, it may be most important for the clinician to refer their pregnant patient or new mother to an intervention including lay support.*

Breastfeeding is associated with the following health benefits for the infant:

- Any breastfeeding is associated with a 40% reduction (OR = 0.60, 95% CI of 0.46 – 0.78) in the risk of otitis media (OM) compared to no breastfeeding (Table 1-2, row *k*).[17] The overall incidence of OM is 1.9 episodes in the first year of life (Table 1-2, row *j*).[18]

- Exclusive breastfeeding for 3 months or longer is associated with a 42% reduction (OR = 0.58, 95% CI of 0.41 – 0.92) in the risk of atopic dermatitis (AD) compared to

[15] Save the Children. *Nutrition in the First 1,000 Days: State of the World's Mothers 2012*. 2012. Available at http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/STATE-OF-THE-WORLDS-MOTHERS-REPORT-2012-FINAL.PDF. Accessed February 2015.
[16] British Columbia Vital Statistics Agency. *Selected Vital Statistics and Health Status Indicators: One Hundred and Thirty-Ninth Annual Report 2010*. 2010. Available at https://www.vs.gov.bc.ca/stats/annual/2010/pdf/ann2010.pdf. Accessed February 2015.
[17] Chung M, Raman G, Trikalinos T et al. Interventions in primary care to promote breastfeeding: an evidence review for the US Preventive Services Task Force. *Annals of Internal Medicine*. 2008; 149(8): 565-82.
[18] Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.

exclusive breastfeeding for less than 3 months (Table 1-2, row *n*).[17] AD has a cumulative incidence of 0.165 in the first two years of life (Table 1-2, row *m*).[18]

- Any breastfeeding is associated with a 64% reduction (OR = 0.36, 95% CI of 0.32 – 0.41) in the risk of gastrointestinal infection (GI) compared to no breastfeeding (Table 1-2, row *q*).[17] GI is associated with 0.222 ambulatory visits (Table 1-2, row *p*) and 0.00298 hospitalizations per infant < 1 year old.[18]

- Exclusive breastfeeding for 4 months or longer is associated with a 72% reduction (OR = 0.28, 95% CI of 0.14 – 0.54) in the risk of lower respiratory tract infection (LRTI) compared to formula feeding (Table 1-2, row *t*).[17] The overall incidence of LRTI in infants is 0.0409 cases (Table 1-2, row *s*) with a death rate of 0.0000732 (Table 1-2, row *v*).[18]

- Breastfeeding for 3 months or longer is associated with a 27% reduction (OR = 0.73, 95% CI of 0.59 – 0.92) in the risk of asthma compared to no breastfeeding in families without a history of asthma (Table 1-2, row *aa*).[17] The cumulative incidence of asthma during childhood is 0.127 (Table 1-2, row *z*) with a death rate of 0.00000273 (Table 1-2, row *cc*).[18]

- Any breastfeeding is associated with a 24% reduction (OR = 0.76, 95% CI of 0.67 – 0.86) in the risk of overweight or obesity compared to no breastfeeding (Table 1-2, row *hh & mm*). Each month of breastfeeding is associated with a 4% reduced risk of overweight or obesity.[17] The 2010 rate of overweight and obesity by age group in BC is detailed in Figure 1-1.[19] Based on this rate and mean survival rates by age group,[20] a birth cohort of 40,000 in BC would be expected to include 874,851 years in a 'state' of overweight and 347,091 years in a 'state' of obesity (see Table 1-1). Overweight/obesity is associated with a reduced life expectancy of approximately 3 and 6.5 years, respectively.[21] Given the average life expectancy in BC of 82.3 years,[22] this represents a reduction in life expectancy of 3.64% associated with overweight (Table 1-2, row *jj*) and 7.90% for obesity (Table 1-2, row *oo*).

[19] Statistics Canada. *Canadian Community Health Survey Public Use Microdata File 2009-2010 and 2010*. All computations, use and interpretation of these data are entirely that of H. Krueger & Associates Inc.
[20] See http://www.statcan.gc.ca/pub/84-537-x/2013005/tbl-eng.htm. Accessed February 2015.
[21] 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.
[22] See http://www.statcan.gc.ca/pub/84-537-x/2013005/tbl-eng.htm. Accessed February 2015.

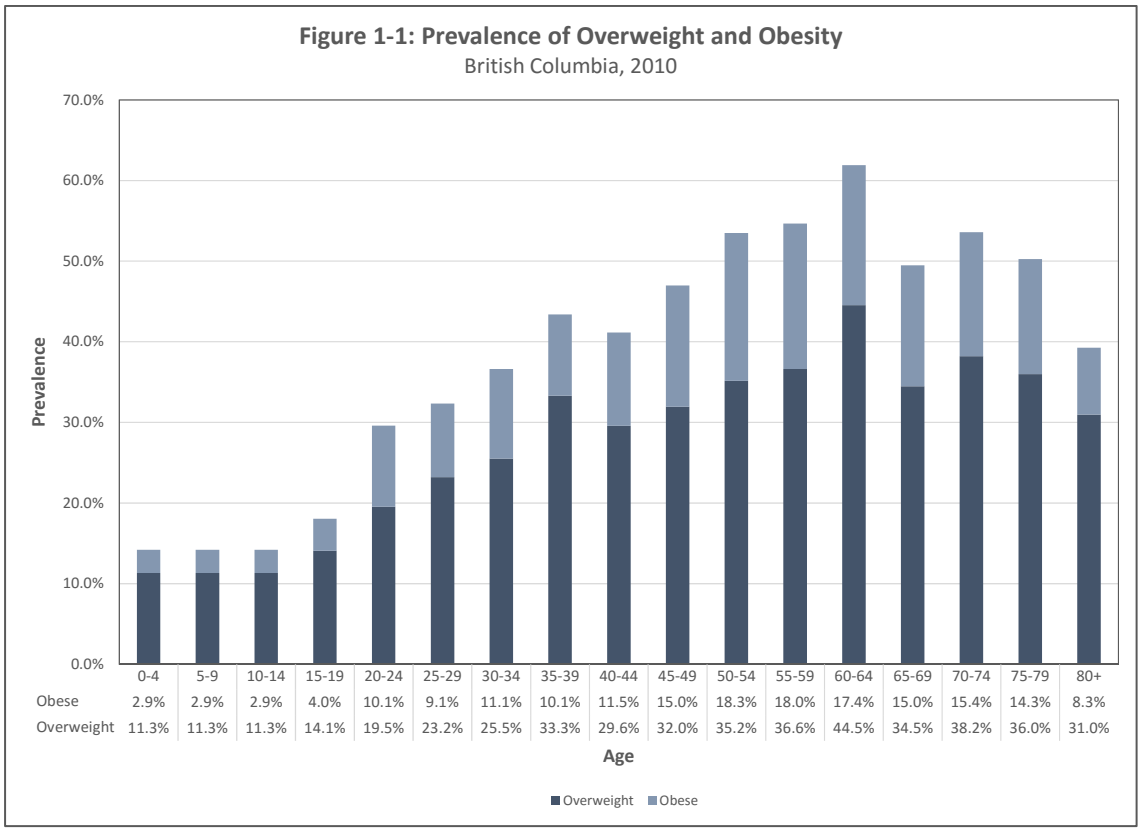



**Table 1-1: Years of Life as Overweight or Obese in a Birth Cohort of 40,000**

| Age Group | Mean Survival Rate | Years of Life in Birth Cohort | % Overweight | Years of Life Overweight | % Obese | Years of Life Obese |
|---|---|---|---|---|---|---|
| **0-4** | 99.6% | 199,230 | 11.3% | 22,576 | 2.9% | 5,712 |
| **5-9** | 99.6% | 199,115 | 11.3% | 22,563 | 2.9% | 5,708 |
| **10-14** | 99.5% | 199,043 | 11.3% | 22,555 | 2.9% | 5,706 |
| **15-19** | 99.4% | 198,864 | 14.1% | 28,034 | 4.0% | 7,855 |
| **20-24** | 99.2% | 198,417 | 19.5% | 38,778 | 10.1% | 19,991 |
| **25-29** | 98.9% | 197,859 | 23.2% | 45,923 | 9.1% | 18,076 |
| **30-34** | 98.6% | 197,253 | 25.5% | 50,321 | 11.1% | 21,923 |
| **35-39** | 98.2% | 196,463 | 33.3% | 65,424 | 10.1% | 19,809 |
| **40-44** | 97.7% | 195,375 | 29.6% | 57,807 | 11.5% | 22,562 |
| **45-49** | 96.9% | 193,826 | 32.0% | 61,940 | 15.0% | 29,124 |
| **50-54** | 95.8% | 191,551 | 35.2% | 67,349 | 18.3% | 35,104 |
| **55-59** | 94.1% | 188,136 | 36.6% | 68,939 | 18.0% | 33,924 |
| **60-64** | 91.5% | 182,955 | 44.5% | 81,496 | 17.4% | 31,788 |
| **65-69** | 87.5% | 175,045 | 34.5% | 60,358 | 15.0% | 26,275 |
| **70-74** | 81.5% | 162,999 | 38.2% | 62,290 | 15.4% | 25,045 |
| **75-79** | 72.5% | 144,961 | 36.0% | 52,164 | 14.3% | 20,704 |
| **80+** | 59.5% | 214,284 | 31.0% | 66,334 | 8.3% | 17,784 |
| **Total** | | **3,235,377** | **27.0%** | **874,851** | **10.7%** | **347,091** |

- Breastfeeding for 3 months or longer is associated with a 19% reduction (OR = 0.81, 95% CI of 0.74 – 0.89) in the risk of type 1 diabetes compared to breastfeeding for less than 3 months (Table 1-2, row *rr*).[17] The overall incidence of type 1 diabetes is 0.000186 (Table 1-2, row *qq*) with a death rate of 0.00000121 (Table 1-2, row *tt*).[18]

- Breastfeeding for less than 6 months is associated with a 12% reduction (OR = 0.88, 95% CI of 0.80 – 0.96) in the risk of childhood leukemia while breastfeeding for more than 6 months is associated with a 24% reduction (OR = 0.76, 95% CI of 0.68 – 0.84) in the risk of childhood leukemia compared to no breastfeeding (Table 1-2, row *yy*).[17] The overall incidence of childhood leukemia is 0.0000321 (Table 1-2, row *xx*) with a five-year death rate 39.8% (Table 1-2, row *aaa*) for children younger than 15.[18]

- Any breastfeeding is associated with a 36% reduction (OR = 0.64, 95% CI of 0.51 – 0.81) in the risk of sudden infant death syndrome (SIDS) compared to no breastfeeding (Table 1-2, row *fff*).[17] The overall incidence of SIDS is 0.00054 (Table 1-2, row *eee*).[18]

Breastfeeding is associated with the following health benefits for the mother:

- The risk of breast cancer is reduced by 4.3% for each year of breastfeeding.[17] We have assumed a reduced risk of 2.15% for each 6 months of breastfeeding (Table 1-2, row *jjj*). The lifetime probability of developing (female) breast cancer is 11.5% (Table 1-2, row *iii*).[23] The death rate from breast cancer is 21% (Table 1-2, row *lll*) with an average of 24 life years lost per death (Table 1-2, row *mmm*).[24]

- Any breastfeeding is associated with a 21% reduction (OR = 0.79, 95% CI of 0.68–0.91) in the risk of ovarian cancer compared to no breastfeeding (Table 1-2, row *ppp*). Cumulative breastfeeding of at least 12 months is associated with a 28% reduction (OR = 0.72, 95% CI of 0.54–0.97) in the risk of ovarian cancer compared to no breastfeeding.[17] The lifetime probability of developing ovarian cancer is 1.4% (Table 1-2, row *ooo*).[25] The death rate from ovarian cancer is 68% (Table 1-2, row *rrr*) with an average of 17 life years lost per death (Table 1-2, row *sss*).[26]

Based on these assumptions, the CPB associated with interventions aimed at improving rates of exclusive breastfeeding at 6 months is 3,339 QALYs (Table 1-2, row *uuu*).

We also modified a number of major assumptions and recalculated the CPB as follows:

- Assume the effectiveness of interventions aimed at improving rates of exclusive breastfeeding at 6 months is reduced from 44% to 13% (Table 1-2, row *d*): CPB = 987 QALYs

- Assume the effectiveness of interventions aimed at improving rates of exclusive breastfeeding at 6 months is increased from 44% to 84% (Table 1-2, row *d*): CPB = 6,374 QALYs

[23] Canadian Cancer Society's Advisory Committee on Cancer Statistics. *Canadian Cancer Statistics 2014*. 2014. Canadian Cancer Society. Available at www.cancer.ca/statistics. Accessed February 2015.
[24] BC Cancer Agency. *Facts and Figures*. 2014. Available at http://www.bccancer.bc.ca/HPI/CancerStatistics/FF/default.htm#factsfigures. Accessed February 2015.
[25] Canadian Cancer Society's Advisory Committee on Cancer Statistics. *Canadian Cancer Statistics 2014*. 2014. Canadian Cancer Society. Available at www.cancer.ca/statistics. Accessed February 2015.
[26] BC Cancer Agency. *Facts and Figures*. 2014. Available at http://www.bccancer.bc.ca/HPI/CancerStatistics/FF/default.htm#factsfigures. Accessed February 2015.

- Assume the effectiveness of breastfeeding in reducing overweight and obesity is reduced from 24% to 14% (Table 1-2, row *hh* & *mm*): CPB = 2,165 QALYs
- Assume the effectiveness of breastfeeding in reducing overweight and obesity is increased from 24% to 33% (Table 1-2, row *hh* & *mm*): CPB = 4,396 QALYs

**Table 1-2: CPB of Promotion of Breastfeeding in a Birth Cohort of 40,000**

| Row Label | Variable | Base Case | Data Source |
|---|---|---|---|
| a | Infants in birth cohort | 40,000 | |
| b | Current proportion exclusively breastfed for 6 months | 41% | √ |
| c | Number exclusively breastfed for 6 months | 16,400 | = (a * c) |
| d | Effectiveness of breastfeeding promotion interventions in increasing adherence to breastfeeding for 6 months | 44% | √ |
| e | Increase in exclusive 6-month breastfeeding with 100% adherence | 10,384 | = (a - c) * d |
| f | Estimated adherence with intervention | 75% | Assumed |
| g | Increase in exclusive 6-month breastfeeding with intervention | 7,788 | = (e * f) |
| h | Total proportion exclusively breastfed for 6 months with intervention | 60% | = (c + g)/a |
| | **Health Benefits for the Infant** | | |
| i | Average life expectancy of an infant in BC | 82.3 | √ |
| j | Average cases of otitis media (OM) in first year | 1.90 | √ |
| k | Effectiveness of breastfeeding in reducing risk of OM | 40.0% | √ |
| l | Reduced cases of OM with intervention | 5,919 | = (g * j) * k |
| m | Average cases of atopic dermatitis (AD) in first 2 years | 0.165 | √ |
| n | Effectiveness of breastfeeding in reducing risk of AD | 42.0% | √ |
| o | Reduced cases of AD with intervention | 540 | = (g * m) * n |
| p | Average cases of gastrointestinal infection (GI) in first year | 0.222 | √ |
| q | Effectiveness of breastfeeding in reducing risk of GI | 64.0% | √ |
| r | Reduced cases of GI with intervention | 1,107 | = (g * p) * q |
| s | Average cases of lower respiratory tract infection (LTRI) in first year | 0.041 | √ |
| t | Effectiveness of breastfeeding in reducing risk of LTRI | 72.0% | √ |
| u | Reduced cases of LTRI with intervention | 229 | = (g * s) * t |
| v | Average rate of death due to LTRI | 0.0000732 | √ |
| w | Effectiveness of breastfeeding in reducing risk of LTRI | 72.0% | √ |
| x | Reduced deaths due to LTRI with intervention | 0.41 | = (g * v) * w |
| y | Life years gained with intervention | 33.8 | = x * i |
| z | Average cases of childhood asthma | 0.127 | √ |
| aa | Effectiveness of breastfeeding in reducing risk of asthma | 27.0% | √ |
| bb | Reduced cases of asthma with intervention | 267 | = (g * z) * aa |
| cc | Average rate of death due to asthma | 0.0000027 | √ |
| dd | Effectiveness of breastfeeding in reducing risk of asthma | 27.0% | √ |
| ee | Reduced deaths due to asthma with intervention | 0.01 | = (g * cc) * dd |
| ff | Life years gained with intervention | 0.5 | = ee * i |

| Table 1-2 (continued): CPB of Promotion of Breastfeeding in a Birth Cohort of 40,000 | | | |
|---|---|---|---|
| **Row Label** | **Variable** | **Base Case** | **Data Source** |
| gg | Average % of years as overweight | 27.0% | Table 1-1 |
| hh | Effectiveness of breastfeeding in reducing risk of overweight | 24% | √ |
| ii | Reduced years as overweight with intervention | 41,595 | = g * i * gg* hh |
| jj | % of life years lost with overweight | 3.64% | √ |
| kk | Life years gained with intervention | 1,514 | = ii * jj |
| ll | Average % of years as obese | 10.7% | Table 1-1 |
| mm | Effectiveness of breastfeeding in reducing risk of obesity | 24% | √ |
| nn | Reduced years as obese with intervention | 16,503 | = g * i * ll* mm |
| oo | % of life years lost with obesity | 7.90% | √ |
| pp | Life years gained with intervention | 1,304 | = nn * oo |
| qq | Average cases of type 1 diabetes in children | 0.0001860 | √ |
| rr | Effectiveness of breastfeeding in reducing risk of type 1 diabetes | 19.0% | √ |
| ss | Reduced cases of type 1 diabetes with intervention | 0.28 | = (g * qq) * rr |
| tt | Average rate of death due to type 1 diabetes | 0.0000012 | √ |
| uu | Effectiveness of breastfeeding in reducing risk of type 1 diabetes | 19.0% | √ |
| vv | Reduced deaths due to type 1 diabetes with intervention | 0.002 | = (g * tt) * uu |
| ww | Life years gained with intervention | 0.15 | = vv * i |
| xx | Average cases of childhood leukemia | 0.0000321 | √ |
| yy | Effectiveness of breastfeeding in reducing risk of childhood leukemia | 24.0% | √ |
| zz | Reduced cases of childhood leukemia with intervention | 0.06 | = (g * xx) * yy |
| aaa | 5 year death rate due to childhood leukemia | 39.8% | √ |
| bbb | Effectiveness of breastfeeding in reducing risk of childhood leukemia | 24.0% | √ |
| ccc | Reduced deaths due to childhood leukemia with intervention | 0.006 | = zz * aaa * bbb |
| ddd | Life years gained with intervention | 0.47 | = ccc * i |
| eee | Average rate of death due to Sudden Infant Death Syndrome (SIDS) | 0.00054 | √ |
| fff | Effectiveness of breastfeeding in reducing risk of SIDS | 36.0% | √ |
| ggg | Reduced deaths due to SIDS with intervention | 1.514 | = (g * eee) * fff |
| hhh | Life years gained with intervention | 124.6 | = ggg * i |
| | **Health Benefits for the Mother** | | |
| iii | Lifetime probability of developing breast cancer | 11.5% | √ |
| jjj | Effectiveness of breastfeeding in reducing risk of breast cancer | 2.15% | √ |
| kkk | Reduced breast cancer cases due to intervention | 19.3 | = (g * iii) * jjj |
| lll | Death rate due to breast cancer | 21% | √ |
| mmm | Life years lost per breast cancer death | 24.0 | √ |
| nnn | Life years gained with intervention | 97.0 | = kkk * lll * mmm |
| ooo | Lifetime probability of developing ovarian cancer | 1.4% | √ |
| ppp | Effectiveness of breastfeeding in reducing risk of ovarian cancer | 21% | √ |
| qqq | Reduced ovarian cancer cases due to intervention | 22.9 | = (g * ooo) * ppp |
| rrr | Death rate due to ovarian cancer | 68% | √ |
| sss | Life years lost per ovarian cancer death | 17.0 | √ |
| ttt | Life years gained with intervention | 264.7 | = qqq * rrr * sss |
| uuu | **Potential QALYs gained, Intervention increasing from 41% to 60%** | **3,339** | = y + ff + kk + pp + ww + ddd + hhh + nnn + ttt |
| vvv | **Potential QALYs gained, Intervention increasing from 0% to 60%** | **10,370** | |

*√ = Estimates from the literature*

In estimating CE, we made the following assumptions:

- **Cost of an office visit** - We estimated the average cost of a visit to a general practitioner to be $34.00 based on information from the BC Medical Services Commission 2013 payment schedule[27] (Table 1-3, row *i*).
- **Patient time costs for office visit** - For patient time costs (Table 1-3, row *j*), we assumed an hourly wage of $24.39 (the BC average in 2013)[28] plus 18% benefits applied to the estimated two hours of patient time required (including travel to and from the appointment). These costs totalled to $57.56 per physician visit. We assumed that 30% of an office visit (Table 1-3, row *k*) would be required for the intervention. This assumption was modified from 20% to 40% in the sensitivity analysis.
- **Patient time costs for breastfeeding support groups** - We assumed that a new mother would attend a breastfeeding support group once per month (lasting two hours) for six months. We assumed an additional hour for travel time. We assumed an hourly wage of $24.39 (the BC average in 2013)[29] plus 18% benefits applied to the 18 hours of patient time required, for a patient cost of $518 (Table 1-3, row *m*).
- **Otitis media** - Two estimates from the US suggest a direct cost (ambulatory care and antibiotics) per case of $156 (2007 US $)[30] and $106 (2004 US $).[31] A Canadian study suggested additional hospital costs over and above physician and drug costs of 15.6%.[32] We have converted the $156 to equivalent Canadian health care costs by reducing costs by 29% to reflect excess health care prices in the US.[33,34] This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) [35] (+6.6%), for a cost of $151. Finally, we added 15.6% to this cost per case to reflect hospital costs for a total cost per case of $174 (Table 1-3, row *p*).
- **Atopic dermatitis** - The mean duration of atopic dermatitis is 10 years with 45% of cases being mild in severity, 45% moderate and 10% severe.[36] The direct annual costs per mild, moderate and severe case are $175, $300, and $405, respectively. The average weighted cost totalled $254 (in 2001 Canadian $).[37] We adjusted this cost to

[27] Medical Services Commission. *Payment Schedule: Section 7 General Practice*. 2013. Available at http://www.health.gov.bc.ca/msp/infoprac/physbilling/payschedule/pdf/7-general-practice.pdf. Accessed December 2013.
[28] See http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/Earnings.aspx. Accessed February 2015.
[29] See http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/Earnings.aspx. Accessed February 2015.
[30] Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.
[31] 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.
[32] 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.
[33] 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.
[34] Reinhardt U. *Why Does US Health Care Cost So Much? (Part I)*. 2008. Available at http://faculty.ses.wsu.edu/rayb/econ340/Articles/health/Health_Costs.doc. Accessed December 2013.
[35] Statistics Canada. *Consumer Price Index, Health and Personal Care, by Province (Monthly) (British Columbia)*. 2013. Available at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/cpis13f-eng.htm. Accessed February 2015.
[36] Barbeau M and Bpharm HL. Burden of atopic dermatitis in Canada. *International Journal of Dermatology*. 2006; 45(1): 31-6.
[37] Barbeau M and Bpharm HL. Burden of atopic dermatitis in Canada. *International Journal of Dermatology*. 2006; 45(1): 31-6.

2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+15.0%) for a cost of $292 per case per year. Lifetime costs were estimated at $2,925 (Table 1-3, row *s*).

- **Gastrointestinal infection** - A US study suggests the direct costs for gastrointestinal infections and lower respiratory tract infections are $331 per case (in 1995 US $).[38] We converted the $331 to equivalent Canadian health care costs by using a reduction of 29% to reflect excess health care prices in the US. This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+24.0%), for a cost of $318 per case (Table 1-3, rows *v*).

- **Lower respiratory tract infection** - See above (Table 1-3, rows y).

- **Asthma** - A BC study estimated the annual direct costs attributable to asthma at $444 per person year (in 2006 Canadian $).[39] We adjusted these costs to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+7.9%), for a cost of $479 per person year. Based on an average treatment duration of 10 years,[40] the total costs attributable to childhood asthma would be $4,790 per case (Table 1-3, row *bb*).

- **Overweight or obesity** - We assumed excess health care costs associated with overweight and obesity of $196 and $689, respectively, per year (Table 1-3, rows *ee & hh*).[41]

- **Type 1 diabetes** - The lifetime cost per case in the US has been estimated at $77,463 (in 2007 US $).[42] We converted these costs to equivalent Canadian health care costs by using a reduction of 29% to reflect excess health care prices in the US. This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+6.6%), for a cost of $63,996 per case (Table 1-3, row *kk*).

- **Childhood leukemia** - The lifetime cost per case in the US has been estimated at $136,444 (in 2007 US $).[43] We converted these costs to equivalent Canadian health care costs by using a reduction of 29% to reflect excess health care prices in the US. This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+6.6%), for a cost of $112,723 per case (Table 1-3, row *nn*).

[38] Ball TM and Wright AL. Health care costs of formula-feeding in the first year of life. *Pediatrics*. 1999; 103(Suppl. 1): 870-6.
[39] 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.
[40] Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.
[41] Krueger H, Turner D, Krueger J et al. The economic benefits of risk factor reduction in Canada: tobacco smoking, excess weight and physical inactivity. *Canadian Journal of Public Health*. 2013; 105(1): e69-78.
[42] Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.
[43] Bartick M and Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*. 2010; 125(5): e1048-e56.

- **Breast cancer** - Of the breast cancer cases prevented by breastfeeding, 41.0% would be Stage I, 38.1% Stage II, 13.3% Stage III and 7.6% Stage IV.[44] In the US, the 10-year cost of breast cancer has been estimated at $24,008 for Stage I, $18,304 for Stage II, $10,475 for Stage III and $12,421 for Stage IV (in 2000 US $).[45] The weighted cost per case (based on the distribution of stages at diagnosis) would be $19,154. We converted these costs to equivalent Canadian health care costs by using a reduction of 29% to reflect excess health care prices in the US. This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+17.1%), for a cost of $17,383 per case. In Ontario, the average 5-year cost estimates for treating breast cancer are $20,740 (in 2009 Canadian $).[46] We adjusted these costs to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+3.5%) for a cost of $21,466 per case (Table 1-3, row *qq*).

- **Ovarian cancer** - Of the ovarian cancer cases prevented by breastfeeding, 22.1% would be Stage I, 12.2% Stage II, 47.8% Stage III and 17.9% Stage IV.[47] The average cost of treating these cancers over a 2.5 year period in Australia is $31,958 for Stage I or II cancers and $50,945 for Stage III or IV cancers (in 2008 Australian dollars).[48] The weighted cost per case (based on the distribution of stages at diagnosis) would be $44,432. We converted these costs to equivalent Canadian health care costs in 2013 by adjusting for differences between the Australian and Canadian dollars in 2008 (+21%%)[49] and then adjusting these costs to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+6.1%%), for a cost of $57,043 per case (Table 1-3, row *tt*).
- **Discount rate** - 3%.

Based on these assumptions, the CE associated with interventions aimed at improving rates of exclusive breastfeeding at 6 months is $397 per QALY (Table 1-3, row *bbb*).

We also modified several major assumptions and recalculated the cost per QALY as follows:

- Assume the effectiveness of interventions aimed at improving rates of exclusive breastfeeding at 6 months is reduced from 44% to 13% (Table 1-2, row *d*): CE = $19,612 per QALY
- Assume the effectiveness of interventions aimed at improving rates of exclusive breastfeeding at 6 months is increased from 44% to 84% (Table 1-2, row *d*): CE = -$3,440 per QALY

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[44] Walters S, Maringe C, Butler J et al. Breast cancer survival and stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK, 2000-2007: a population-based study. *British Journal of Cancer*. 2013; 108(5): 1195-208.

[45] Groot MT, Baltussen R, Uyl de Groot CA et al. Costs and health effects of breast cancer interventions in epidemiologically different regions of Africa, North America, and Asia. *The Breast Journal*. 2006; 12(suppl. 1): S81-S90.

[46] de Oliveira C, Bremner KE, 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 Open Access Journal*. 2013; 1(1): E1-E8.

[47] Walters S, Maringe C, Butler J et al. Breast cancer survival and stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK, 2000-2007: a population-based study. *British Journal of Cancer*. 2013; 108(5): 1195-208.

[48] Gordon LG, Scuffham PA, Beesley VL et al. Medical costs and outcomes for Australian women with ovarian cancer: A patient-level analysis over 2.5 years. *International Journal of Gynecological Cancer*. 2010; 20(5): 757-65.

[49] See http://www.oanda.com/currency/historical-rates/. Accessed February 2015.

- Assume the effectiveness of breastfeeding in reducing overweight and obesity is reduced from 24% to 14% (Table 1-2, rows *hh* & *mm*): CE = $4,370 per QALY
- Assume the effectiveness of breastfeeding in reducing overweight and obesity is increased from 24% to 33% (Table 1-2, rows *hh* & *mm*): CE = -$1,364 per QALY
- Assume the proportion of an office visit required for screening/referral is reduced from 30% to 20% (Table 1-3, row *k)*: CE = $110 per QALY
- Assume the proportion of an office visit required for screening/referral is increased from 30% to 40% (Table 1-3, row *k)*: CE = $684 per QALY

| Table 1-3: CE of Promotion of Breastfeeding in a Birth Cohort of 40,000 | | | |
|---|---|---|---|
| **Row Label** | **Variable** | **Base Case** | **Data Source** |
| a | Women eligible for screening/referral in primary care | 40,000 | |
| b | Proportion already exclusively breastfeeding for 6 months | 41% | Table 1-2, row b |
| c | Number exclusively breastfeeding for 6 months | 16,400 | = a * b |
| d | Women eligible for intervention (support group) | 23,600 | = a - c |
| e | Estimated adherence with intervention | 75% | Assumed |
| f | Women attending intervention (support group) | 17,700 | = d * f |
| g | Effectiveness of breastfeeding promotion interventions in increasing adherence to breastfeeding for 6 months | 44% | Table 1-2, row d |
| h | # of women attending intervention (support group) who exclusively breastfeed for 6 months | 7,788 | = f * g |
| | **Costs of intervention** | | |
| i | Cost of 10-minute office visit | $34.00 | √ |
| j | Value of patient time and travel for office visit | $57.56 | √ |
| k | Portion of 10-minute office visit for screen/referral | 30% | Assumed |
| l | Estimated cost of screening | $1,098,720 | = a * (I + j) * k |
| m | Value of patient time and travel for intervention | $518 | √ |
| n | Estimated cost of intervention over lifetime of birth cohort | $9,168,600 | = f * m |
| | **Cost avoided** | | |
| o | Cases of otitis media avoided | 5,919 | Table 1-2, row l |
| p | Cost per case | $174 | √ |
| q | Costs avoided | $1,029,885 | = o * p |
| r | Cases of atopic dermatitis avoided | 540 | Table 1-2, row o |
| s | Cost per person with atopic dermatitis | $2,925 | √ |
| t | Costs avoided | $1,578,647 | = r * s |
| u | Cases of gastrointestinal infection avoided | 1,107 | Table 1-2, row r |
| v | Cost per case | $318 | √ |
| w | Costs avoided | $351,873 | = u * v |
| x | Cases of lower respiratory tract infection avoided | 229 | Table 1-2, row u |
| y | Cost per case | $318 | √ |
| z | Costs avoided | $72,930 | = x * y |
| aa | Cases of asthma avoided | 267 | Table 1-2, row bb |
| bb | Cost per case | $4,790 | √ |
| cc | Costs avoided | $1,279,172 | = aa * bb |
| dd | Years of overweight avoided | 41,595 | Table 1-2, row ii |
| ee | Cost per year | $196 | √ |
| ff | Costs avoided | $8,152,717 | = dd * ee |
| gg | Years of obesity avoided | 16,503 | Table 1-2, row nn |
| hh | Cost per year | $689 | √ |
| ii | Costs avoided | $11,370,362 | = gg * hh |
| jj | Cases of type 1 diabetes avoided | 0.3 | Table 1-2, row ss |
| kk | Cost per case | $63,996 | √ |
| ll | Costs avoided | $17,613 | = jj * kk |
| mm | Cases of childhood leukemia avoided | 0.06 | Table 1-2, row zz |
| nn | Cost per case | $112,723 | √ |
| oo | Costs avoided | $6,763 | = mm * nn |
| pp | Cases of breast cancer avoided | 19.3 | Table 1-2, row kkk |
| qq | Cost per case | $21,466 | √ |
| rr | Costs avoided | $413,346 | = pp * qq |
| ss | Cases of ovarian cancer avoided | 22.9 | Table 1-2, row qqq |
| tt | Cost per case | $57,043 | √ |
| uu | Costs avoided | $1,306,098 | = ss * tt |
| | **CE calculation** | | |
| vv | Cost of intervention over lifetime of birth cohort | $10,267,320 | = l + n |
| ww | Costs avoided | $25,579,407 | = q + t + w + z + cc + ff + ii + ll + oo + rr + uu |
| xx | QALYs saved | 3,339 | Table 1-2, row uuu |
| yy | Cost of intervention over lifetime of birth cohort (3% discount) | $10,267,320 | Calculated |
| zz | Costs avoided (3% discount) | $9,761,380 | Calculated |
| aaa | QALYs saved (3% discount) | 1,274 | Calculated |
| bbb | **CE ($/QALY saved)** | **$397** | |

*√ = Estimates from the literature*

**Summary**

**Table 1-4: Promotion of Breastfeeding in a Birth Cohort of 40,000**
Summary

| | Base Case | Range | |
|---|---|---|---|
| **CPB** (Potential QALYs Gained) | | | |
| *Assume No Current Service* | | | |
| 3% Discount Rate | 3,957 | 3,060 | 5,116 |
| 0% Discount Rate | 10,370 | 8,018 | 13,406 |
| *Gap between B.C. Current and Best in the World* | | | |
| 3% Discount Rate | 1,274 | 376 | 2,433 |
| 0% Discount Rate | 3,339 | 987 | 6,374 |
| **CE** ($/QALY) **including** patient time costs | | | |
| 3% Discount Rate | $397 | -$3,440 | $19,612 |
| 0% Discount Rate | -$4,586 | -$6,050 | $2,747 |
| **CE** ($/QALY) **excluding** patient time costs | | | |
| 3% Discount Rate | -$7,341 | -$7,493 | -$6,577 |
| 0% Discount Rate | -$7,539 | -$7,597 | -$7,247 |

## Screening for Asymptomatic Disease or Risk Factors

### Screening for Type 2 Diabetes Mellitus

#### Canadian Task Force on Preventive Health Care (2012)

*There is no evidence that screening for type 2 diabetes in adults who are at low to moderate risk of diabetes reduces the incidence, mortality or complications of diabetes.*

*Low-quality evidence suggests that screening adults at high or very high risk of diabetes will reduce rates of myocardial infarction, microvascular complications and mortality.*

*For adults at low to moderate risk of diabetes (determined with a validated risk calculator), we recommend not routinely screening for type 2 diabetes. (Weak recommendation; low-quality evidence)*

*For adults at high risk of diabetes (determined with a validated risk calculator), we recommend routinely screening every 3–5 years with A1C. (Weak recommendation; low-quality evidence)*

*For adults at very high risk of diabetes (determined with a validated risk calculator), we recommend routine screening annually with A1C. (Weak recommendation; low-quality evidence)*[50]

If an individual's risk of developing diabetes within 10 years is 1-4%, they are considered to be at low risk, 17% is moderate risk, 33% is high risk and 50% is very high risk.[51]

#### United States Preventive Services Task Force Recommendations (2014 Draft)

*The USPSTF recommends screening for abnormal blood glucose and type 2 diabetes mellitus in adults who are at increased risk for diabetes. (B Recommendation)*

*The USPSTF found inadequate direct evidence that measuring blood glucose leads to improvements in mortality or cardiovascular morbidity.*

*The USPSTF found adequate evidence that measuring blood glucose in adults at increased risk for diabetes and treating those who have [impaired fasting glucose] or [impaired glucose tolerance] with intensive lifestyle interventions has a moderate benefit in decreasing the risk for progression to diabetes.*

*Risk factors include age of 45 years or older, overweight or obesity, or a first-degree relative with diabetes. Women with a history of gestational diabetes or polycystic ovarian syndrome are also at increased risk. Certain racial/ethnic minorities, including African Americans, American Indians/Alaska Natives, Asian Americans,*

[50] 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.
[51] 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.

*Hispanics/Latinos, and Native Hawaiians/Pacific Islanders, are also at increased risk compared with whites.* [52]

#### Utilization of This Clinical Preventive Service

The CTFPHC suggests a two-phase approach to screening. First, it recommends screening all individuals between the ages of 40 and 70 using a validated risk calculator such as FINDRISC (Finnish Diabetes Risk Score) or CANRISK (Canadian Diabetes Risk Assessment Questionnaire). 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 and those with a score greater than 21 are at very high risk. 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."[53] Individuals at high risk are to be screened every 3-5 years while individuals at very high risk are to be screened every year. An abnormal test may warrant repeat testing to confirm a diagnosis of diabetes.

Prior to the release of the updated CTFPHC guidelines in 2012, data suggests high levels of the second phase of testing, regardless of risk status. In Ontario, for example, 77% of males and 84% of females aged 40-70 were screened with a fasting blood glucose test within a 5 year period after 2000/01.[54] The A1C test was used less frequently than the fasting blood glucose test in Ontario prior to guideline publication, with 14.2% of non-diabetic patients aged 19 and older receiving at least one A1C test in the three years between 2007 and 2009.[55] Another Ontario study found that 32% of patients aged 45 or older had received at least one A1C test during the three year period between 2009 and 2011.[56]

*Currently in British Columbia*

We were unable to find data on the utilization of a validated risk calculator such as FINDRISC or CANRISK in British Columbia.

*Best in the World*

In Finland, the FINDRISC was used as part of the National Program for the Prevention of Type 2 Diabetes (FIN-D2D) between 2003 and 2008. The screening was opportunistic in primary health care centers, pharmacies, and at public events such as hockey games. Individuals were also encouraged to complete the test on the internet. The exact number of tests was not registered, but it was estimated that 200,000 FINDRISC tests were completed in the target population of 1.5 million.[57]

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[52] US Preventive Services Task Force. *Draft Recommendation Statement: Abnormal Glucose and Type 2 Diabetes Mellitus in Adults: Screening*. 2014. Available at http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementDraft/screening-for-abnormal-glucose-and-type-2-diabetes-mellitus. Accessed February 2014.

[53] 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.

[54] 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.

[55] Greiver M, Aliarzadeh B, Moineddin R et al. Diabetes screening with hemoglobin A1c prior to a change in guideline recommendations: prevalence and patient characteristics. *BMC Family Practice*. 2011; 12(1): 91.

[56] Aliarzadeh B, Greiver M, Moineddin R et al. Association between socio-economic status and hemoglobin A1c levels in a Canadian primary care adult population without diabetes. *BMC Family Practice*. 2014; 15(1): 7.

[57] Saaristo T, Moilanen L, Korpi-Hyövälti E et al. Lifestyle intervention for prevention of type 2 diabetes in primary health care one-year follow-up of the Finnish National Diabetes Prevention Program (FIN-D2D). *Diabetes Care*. 2010; 33(10): 2146-51.

In Brazil in 2001, persons throughout the country who were 40 years of age or older were invited to participate in community screening for diabetes. Of the target population, 73% (22.1 million individuals) were tested using glucose screening.[58]

#### Relevant British Columbia Population in 2010

We assumed that all individuals aged 40 or older should be screened using a validated risk calculator such as FINDRISC or CANRISK. In BC, this represents 2,283,726 individuals in 2010.

#### Modelling CPB and CE

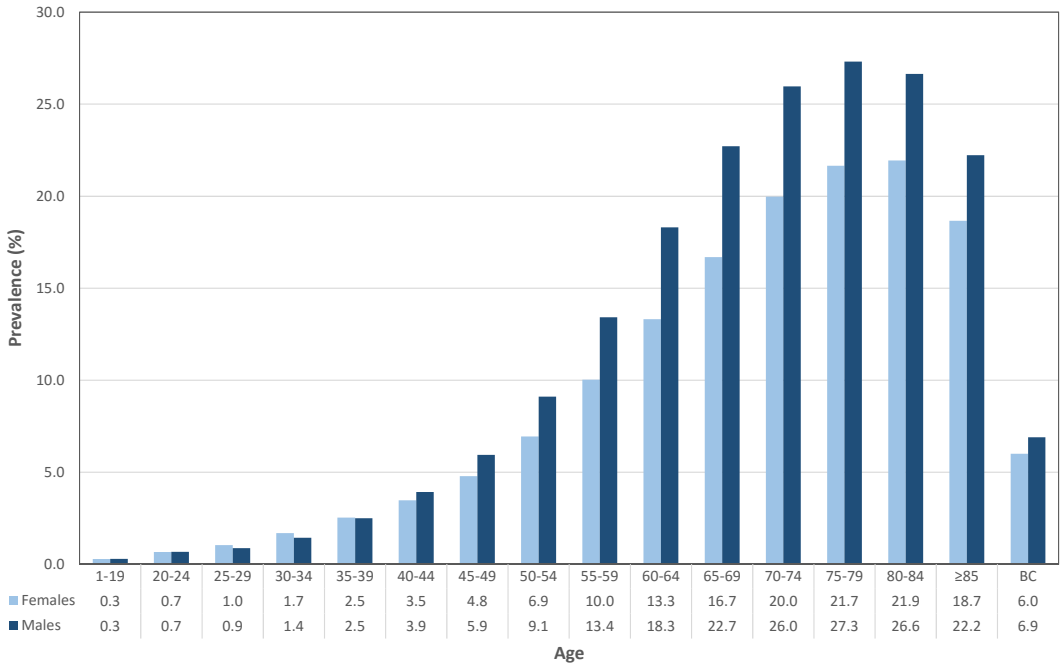
In this section, we will calculate the CPB and CE associated with screening for type 2 diabetes in a British Columbia birth cohort of 40,000.

In estimating CPB, we made the following assumptions:

- The proportion of each sex within the population that is expected to survive to a given age group is based on life tables for 2009 to 2011 for BC (see Table 2-1 and 2-2 below).[59]
- 35% of the population aged 40 or older would have a FINDRISC score of 15-19 (high risk) and 10% would have a score of 20+ (very high risk) (see Table 2-1 and 2-2 below).[60]
- Detailed information on the prevalence of diagnosed diabetes in Canada in 2008/09 by age group and sex is provided by the CTFPHC. Overall, rates for Canadian females and males were 6.4% and 7.2%, respectively.[61] Rates of diagnosed diabetes in British Columbia in 2007/08 were 6.0% for females and 6.9% for males.[62] This data was not stratified by age. In estimating the age and sex specific prevalence rates for diagnosed diabetes in BC, we adjusted the Canadian age and sex specific rates downwards by the difference between the Canadian and British Columbian rates (see Figure 2-1).

[58] Nucci LB, Toscano CM, Maia ALM et al. A nationwide population screening program for diabetes in Brazil. *Pan American Journal of Public Health* 2004; 16(5): 320-7.
[59] See http://www.statcan.gc.ca/pub/84-537-x/2013005/tbl-eng.htm. Accessed December 2013.
[60] Makrilakis K, Liatis S, Grammatikou S et al. Validation of the Finnish diabetes risk score (FINDRISC) questionnaire for screening for undiagnosed type 2 diabetes, dysglycaemia and the metabolic syndrome in Greece. *Diabetes & Metabolism*. 2011; 37(2): 144-51.
[61] 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.
[62] Provincial Health Services Authority. *Summary Report on Health for British Columbia from Regional, Longitudinal and Gender Perspectives*. 2010. Available at http://www.phsa.ca/population-public-health-site/Documents/BCHealth_Indicators_Report.pdf. Accessed February 2015.

**Figure 2-1: Estimated Prevalence of Diagnosed Diabetes**
By Age and Sex, British Columbia, 2008/09




- Estimates of the proportion of diabetes cases that are undiagnosed by age group and sex are as follows: [63]

| Age Group | Males | Females |
|---|---|---|
| 40-49 | 44% | 24% |
| 50-59 | 21% | 15% |
| 60-69 | 17% | 16% |
| 70-79 | 19% | 14% |
| 80+ | 16% | 14% |

- A total of 817,724 years would be lived by males from age 40 to death in a BC birth cohort of 40,000 (see Table 2-1). The equivalent number for females would be 889,023 (see Table 2-2). Among males, 286,203 of these years would be spent at high risk for type 2 diabetes, and 81,772 would be spent at very high risk. Among females, 311,158 would be spent at high risk and 88,902 at very high risk.

[63] 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.

**Table 2-1: Prevalence and Increased Risk for Type 2 Diabetes in a *Male* Birth Cohort of 20,000**

| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Estimated FINDRISC Status | | Prevalence of Diabetes | | | | Years of Life with Diabetes | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Diagnosed | | Undiagnosed | | | |
| | | | | High | Very High | % | # | % | # | Diagnosed | Undiagnosed |
| **40-44** | 0.971 | 19,410 | 97,052 | 33,968 | 9,705 | 3.9% | 763 | 1.7% | 336 | 3,813 | 1,678 |
| **45-49** | 0.961 | 19,218 | 96,090 | 33,632 | 9,609 | 5.9% | 1,142 | 2.6% | 502 | 5,709 | 2,512 |
| **50-54** | 0.947 | 18,938 | 94,690 | 33,141 | 9,469 | 9.1% | 1,724 | 1.9% | 362 | 8,621 | 1,810 |
| **55-59** | 0.926 | 18,519 | 92,594 | 32,408 | 9,259 | 13.4% | 2,485 | 2.8% | 522 | 12,423 | 2,609 |
| **60-64** | 0.894 | 17,887 | 89,435 | 31,302 | 8,943 | 18.3% | 3,274 | 3.1% | 557 | 16,370 | 2,783 |
| **65-69** | 0.847 | 16,935 | 84,673 | 29,636 | 8,467 | 22.7% | 3,846 | 3.9% | 654 | 19,231 | 3,269 |
| **70-74** | 0.776 | 15,514 | 77,572 | 27,150 | 7,757 | 26.0% | 4,029 | 4.9% | 766 | 20,146 | 3,828 |
| **75-79** | 0.673 | 13,453 | 67,263 | 23,542 | 6,726 | 27.3% | 3,674 | 5.2% | 698 | 18,371 | 3,491 |
| **80+** | 0.296 | 5,918 | 118,356 | 41,425 | 11,836 | 24.4% | 1,444 | 3.9% | 231 | 28,879 | 4,621 |
| **Total Ages 40+** | | | **817,724** | **286,203** | **81,772** | | | | | **133,564** | **26,600** |

**Table 2-2: Prevalence and Increased Risk for Type 2 Diabetes in a *Female* Birth Cohort of 20,000**

| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Estimated FINDRISC Status | | Prevalence of Diabetes | | | | Years of Life with Diabetes | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Diagnosed | | Undiagnosed | | | |
| | | | | High | Very High | % | # | % | # | Diagnosed | Undiagnosed |
| **40-44** | 0.983 | 19,665 | 98,324 | 34,413 | 9,832 | 3.5% | 682 | 0.8% | 164 | 3,411 | 819 |
| **45-49** | 0.977 | 19,547 | 97,736 | 34,208 | 9,774 | 4.8% | 935 | 1.1% | 224 | 4,673 | 1,122 |
| **50-54** | 0.969 | 19,372 | 96,861 | 33,901 | 9,686 | 6.9% | 1,344 | 1.0% | 202 | 6,720 | 1,008 |
| **55-59** | 0.955 | 19,108 | 95,542 | 33,440 | 9,554 | 10.0% | 1,917 | 1.5% | 288 | 9,584 | 1,438 |
| **60-64** | 0.935 | 18,704 | 93,520 | 32,732 | 9,352 | 13.3% | 2,490 | 2.1% | 398 | 12,450 | 1,992 |
| **65-69** | 0.904 | 18,074 | 90,371 | 31,630 | 9,037 | 16.7% | 3,016 | 2.7% | 483 | 15,081 | 2,413 |
| **70-74** | 0.854 | 17,086 | 85,428 | 29,900 | 8,543 | 20.0% | 3,412 | 2.8% | 478 | 17,059 | 2,388 |
| **75-79** | 0.777 | 15,540 | 77,698 | 27,194 | 7,770 | 21.7% | 3,365 | 3.0% | 471 | 16,826 | 2,356 |
| **80+** | 0.384 | 7,677 | 153,543 | 53,740 | 15,354 | 20.3% | 1,558 | 2.8% | 218 | 31,169 | 4,364 |
| **Total Ages 40+** | | | **889,023** | **311,158** | **88,902** | | | | | **116,972** | **17,898** |

- Screening of the entire target population every 3-5 years starting at age 40 is associated with the following benefits over a 50 year period:[64]
  - ✓ 5.2 (range of 2.7 - 7.5) myocardial infarction events prevented per 1,000 people screened (Table 2-3, row *d*).
  - ✓ 8.0 (range of 6.2 - 9.5) microvascular events (foot amputations/ulcers, end-stage renal disease or blindness) prevented per 1,000 people screened (Table 2-3, row *h*).
  - ✓ 3.2 (range of 1.0 - 5.8) premature deaths prevented per 1,000 people screened (Table 2-3, row *l*).
- We have assumed adherence to screening is 70% (Table 2-3, row *b*).
- We have assumed that each event would be prevented, on average, half way through the 50 year follow-up period.
- A myocardial infarction reduces a person's quality of life by 18% (Table 2-3, row *f*), end-stage renal disease (ESRD) by 20%, foot amputation by 10.5% and blindness by

[64] Kahn R, Alperin P, Eddy D et al. Age at initiation and frequency of screening to detect type 2 diabetes: a cost-effectiveness analysis. *Lancet*. 2010; 375(9723): 1365-74.

16%.[65] For microvascular events prevented, we assumed an overall quality of life reduction of 15.8% (Table 2-3, row *j*) based on a 40%/33%/27% distribution for incidence of ESRD, foot amputation or blindness.[66]

Based on these assumptions, the CPB associated with screening for type 2 diabetes is 3,693 QALYs (Table 2-3, row *p*).

We also modified a number of major assumptions and recalculated the CPB as follows:

- Assume the number of myocardial infarction events prevented per 1,000 people screened is reduced from 5.2 to 2.7 (Table 2-3, row *d*): CPB = 3,385 QALYs.
- Assume the number of myocardial infarction events prevented per 1,000 people screened is increased from 5.2 to 7.5 (Table 2-3, row *d*): CPB = 3,976 QALYs.
- Assume the number of microvascular events prevented per 1,000 people screened is reduced from 8.0 to 6.2 (Table 2-3, row *h*): CPB = 3,498 QALYs.
- Assume the number of microvascular events prevented per 1,000 people screened is increased from 8.0 to 9.5 (Table 2-3, row *h*): CPB = 3,855 QALYs.
- Assume the number of premature deaths prevented per 1,000 people screened is reduced from 3.2 to 1.0 (Table 2-3, row *l*): CPB = 2,188 QALYs.
- Assume the number of premature deaths prevented per 1,000 people screened is increased from 3.2 to 5.8 (Table 2-3, row *l*): CPB = 5,471 QALYs.

**Table 2-3: CPB of Screening for Type 2 Diabetes in a Birth Cohort of 40,000**

| Row Label | Variable | Base Case | Data Source |
|---|---|---|---|
| a | Individuals in birth cohort at age 40 | 39,075 | Tables 2-1 and 2-2 |
| b | Adherence with screening | 70% | Assumed |
| c | Individuals screened | 27,353 | = a * b |
| | **Benefits Associated with Screening** | | |
| d | Myocardial infarction events prevented / 1,000 people screened | 5.2 | √ |
| e | Myocardial infarction events prevented | 142 | = (c / 1,000) * d |
| f | Quality of life adjustment | 18% | √ |
| g | QALYs gained | 640 | = e * 25 * f |
| h | Microvascular events prevented / 1,000 people screened | 8.0 | √ |
| i | Microvascular events prevented | 219 | = (c / 1,000) * h |
| j | Quality of life adjustment | 15.8% | √ |
| k | QALYs gained | 864 | = i * 25 * j |
| l | Premature deaths averted / 1,000 people screened | 3.2 | √ |
| m | Premature deaths averted | 88 | = (c / 1,000) * l |
| n | Life-years gained / death averted | 25 | √ |
| o | Life-years gained | 2,188 | = m * n |
| p | **Potential QALYs gained, Screening increasing from 0% to 70%** | **3,693** | = g + k + o |

*√ = Estimates from the literature*

[65] Kahn R, Alperin P, Eddy D et al. Age at initiation and frequency of screening to detect type 2 diabetes: a cost-effectiveness analysis. *Lancet*. 2010; 375(9723): 1365-74.
[66] Deshpande AD, Harris-Hayes M and Schootman M. Epidemiology of diabetes and diabetes-related complications. *Physical Therapy*. 2008; 88(11): 1254-64.

In estimating CE, we made the following additional assumptions:

- **Cost of an office visit** - We estimated the average cost of a 10 minute visit to a general practitioner to be $34.00, based on information from the BC Medical Services Commission 2013 payment schedule[67] (Table 2-4, row *h*).
- **Patient time costs for office visit** - For patient time costs (Table 2-4, row *i*), we assumed an hourly wage of $24.39 (the BC average in 2013)[68] plus 18% benefits applied to the estimated two hours of patient time required (including travel to and from the appointment). These costs totalled to $57.56 per physician visit.
- **Screening time** - We assumed that 45% of an office visit would be required if the FINDRISC questionnaire is used and 60% of an office visit if the CANRISK questionnaire is used (Table 2-4, row *j*).
- **Laboratory screening tests** - The cost of an A1C test in BC is $12.69. The cost of a fasting glucose test is $17.08 (Table 2-4, row *l*).[69]
- **Patient time costs for laboratory tests** - We assumed one hour for the visit to the laboratory to have the blood drawn, for a patient cost of $28.78 per visit (Table 2-4, row *m*).
- The typical event (i.e., first year) cost for an **acute myocardial infarction** is $18,635, with annual costs thereafter of $1,193. The annual costs for **end-stage renal disease** are $63,045. The typical event cost for a **lower extremity amputation** is $24,583 with annual costs thereafter of $1,020. The annual costs for **blindness** are $2,111 (all in 2000 Canadian $).[70] We adjusted these values to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) [71] (+17.1%). The resulting costs are as follows:

  **Acute myocardial infarction** event is $21,822, annual costs are $1,397.

  **End-stage renal disease** annual costs are $73,826.

  **Lower extremity amputation** event is $28,787, annual costs are $1,194.

  **Blindness** annual costs are $2,472.
- We have assumed that each event and the resulting costs would be prevented, on average, half way through the 50 year follow-up period.
- Screening detects diabetes, on average, 5.3 years earlier than no screening.[72]
- Average costs avoided per acute myocardial infarction event would therefore be $7,404 ($1,397 * 5.3) (Table 2-4, row *t*).

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[67] Medical Services Commission. *Payment Schedule: Section 7 General Practice*. 2013. Available at http://www.health.gov.bc.ca/msp/infoprac/physbilling/payschedule/pdf/7-general-practice.pdf. Accessed December 2013.

[68] See http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/Earnings.aspx. Accessed February 2015.

[69] Medical Services Commission. *Payment Schedule: Laboratory Medicine* 2013. Available at http://www.health.gov.bc.ca/msp/infoprac/physbilling/payschedule/pdf/40-laboratory-medicine.pdf. Accessed March 2015.

[70] 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.

[71] Statistics Canada. *Consumer Price Index, Health and Personal Care, by Province (Monthly) (British Columbia)*. 2013. Available at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/cpis13f-eng.htm. Accessed February 2015.

[72] Kahn R, Alperin P, Eddy D et al. Age at initiation and frequency of screening to detect type 2 diabetes: a cost-effectiveness analysis. *Lancet*. 2010; 375(9723): 1365-74.

- For microvascular events prevented, we assumed a 40%/33%/27% distribution for ESRD, foot amputation or blindness.[73] Average costs avoided per microvascular event would therefore be $162,137 (Table 2-4, row *w*).
- **Discount rate** - 3%.

Based on these assumptions, the CE associated with screening for type 2 diabetes is -$3,777 per QALY (Table 2-4, row *ee*).

We also modified several major assumptions and recalculated the cost per QALY as follows:

- Assume the number of myocardial infarction events prevented per 1,000 people screened is reduced from 5.2 to 2.7 (Table 2-3, row *d*): CE = -$3,927 per QALY.
- Assume the number of myocardial infarction events prevented per 1,000 people screened is increased from 5.2 to 7.5 (Table 2-3, row *d*): CE = -$3,660 per QALY.
- Assume the number of microvascular events prevented per 1,000 people screened is reduced from 8.0 to 6.2 (Table 2-3, row *h*): CE = -$1,029 per QALY.
- Assume the number of microvascular events prevented per 1,000 people screened is increased from 8.0 to 9.5 (Table 2-3, row *h*): CE = -$5,855 per QALY.
- Assume the frequency of screening with FINDRISC is increased from every 4 years to every 3 years (Table 2-4, row *e*): CE = -$2,0591 per QALY.
- Assume the frequency of screening with FINDRISC is decreased from every 4 years to every 5 years (Table 2-4, row *e*): CE = -$4,808 per QALY.
- Assume the FINDRISC is replaced by the CANRISK (Table 2-4, row *j*): CE = -$2,509 per QALY.
- Assume the A1C test is replaced by glucose testing (Table 2-4, row *l*): CE = -$3,365 per QALY.

[73] Deshpande AD, Harris-Hayes M and Schootman M. Epidemiology of diabetes and diabetes-related complications. *Physical Therapy*. 2008; 88(11): 1254-64.

| Table 2-4: CE of Screening for Type 2 Diabetes in a Birth Cohort of 40,000 | | | |
|---|---|---|---|
| **Row Label** | **Variable** | **Base Case** | **Data Source** |
| a | Individuals in birth cohort at age 40 | 39,075 | Table 2-3, row a |
| b | Life years at increased risk for diabetes | 1,706,746 | Tables 2-1 and 2-2 |
| c | Life years at high risk for diabetes | 597,361 | Tables 2-1 and 2-2 |
| d | Life years at very high risk for diabetes | 170,675 | Tables 2-1 and 2-2 |
| | **Costs of intervention** | | |
| e | Frequency of screening with FINDRISC/CANRISK (every x years) | 4 | √ |
| f | Total number of screens with FINDRISC/CANRISK (100% adherence) | 426,687 | = b / e |
| g | Adherence with screening | 70% | Assumed |
| h | Cost of 10-minute office visit | $34.00 | √ |
| i | Value of patient time and travel for office visit | $57.56 | √ |
| j | Portion of 10-minute office visit for screen | 45% | Assumed |
| k | Cost of screening with FINDRISC/CANRISK | $12,306,239 | = (f * g) * (h + i) * j |
| l | Lab cost of A1C test | $12.69 | √ |
| m | Value of patient time and travel for lab test | $28.78 | √ |
| n | Frequency of lab testing for high risk patients (every x years) | 4 | √ |
| o | # of lab tests high risk patients | 104,538 | = (c / n) * g |
| p | Frequency of lab testing for very high risk patients (every x years) | 1 | √ |
| q | # of lab tests for very high risk patients | 119,472 | = d * p * g |
| r | Cost of lab testing | $9,289,714 | = (l + m) * (o + q) |
| | **Cost avoided** | | |
| s | Myocardial infarction events prevented | 142 | Table 2-3, row e |
| t | Cost avoided per event avoided | $7,404 | √ |
| u | Total costs avoided | $1,053,110 | = s * t |
| v | Microvascular events prevented | 219 | Table 2-3, row i |
| w | Cost avoided per event avoided | $162,137 | √ |
| x | Total costs avoided | $35,478,860 | = v * w |
| | **CE calculation** | | |
| y | Cost of intervention over lifetime of birth cohort | $21,595,954 | = k + r |
| z | Costs avoided | $36,531,969 | = u + x |
| aa | QALYs saved | 3,693 | Table 2-3, row p |
| bb | Cost of intervention over lifetime of birth cohort (3% discount) | $11,446,571 | Calculated |
| cc | Costs avoided (3% discount) | $16,225,670 | Calculated |
| dd | QALYs saved (3% discount) | 1,265 | Calculated |
| ee | **CE ($/QALY saved)** | **-$3,777** | = (bb - cc) / dd |

*√ = Estimates from the literature*

## Summary

| Table 2-5: Screening for Type 2 Diabetes in a Birth Cohort of 40,000<br>Summary | | | |
|---|---|---|---|
| | **Base Case** | **Range** | |
| **CPB** (Potential QALYs Gained) | | | |
| *Assume No Current Service* | | | |
| 3% Discount Rate | 1,265 | 750 | 1,874 |
| 0% Discount Rate | 3,693 | 2,188 | 5,471 |
| *Gap between B.C. Current and Best in the World* | | | |
| 3% Discount Rate | | Unknown | |
| 0% Discount Rate | | | |
| **CE** ($/QALY) **including** patient time costs | | | |
| 3% Discount Rate | -$3,777 | -$5,855 | -$1,029 |
| 0% Discount Rate | -$4,045 | -$5,601 | -$1,988 |
| **CE** ($/QALY) **excluding** patient time costs | | | |
| 3% Discount Rate | -$9,719 | -$11,547 | -$7,301 |
| 0% Discount Rate | -$7,886 | -$9,280 | -$6,042 |

## Behavioural Counselling Interventions

### Prevention of Sexually Transmitted Diseases

#### Canadian Task Force on Preventive Health Care (2001)

A 2001 report from the CTFPHC titled "Counseling for Risky Health Habits: A Conceptual Framework for Primary Care Practitioners" noted that,

> *Risky lifestyle choices contribute to many contemporary health conditions. Primary care practitioners have frequent opportunities to help patients clarify issues and alter adverse behaviour patterns….The six risky behaviours addressed in this paper are appropriate targets for counseling. Some situations respond to brief on-the-spot advice, others require a few repeated counseling sessions utilizing concepts from behavioural theory, and certain ones need referral to a structured counseling program that employs a longer time-frame and allows for the opportunity to use a range of methods.*[74]

The "six risky behaviours" include dietary patterns, unintentional injury, problem drinking, physical inactivity patterns, **risky sexual patterns** and cigarette smoking.

#### United States Preventive Services Task Force Recommendations (2014)

> *The USPSTF recommends intensive behavioral counseling for all sexually active adolescents and for adults who are at increased risk for STIs. (B recommendation)*
>
> *All sexually active adolescents are at increased risk for STIs. Other risk groups include adults with current STIs or other infections within the past year, adults who have multiple sex partners, and adults who do not consistently use condoms.*
>
> *Clinicians should be aware of populations with a particularly high prevalence of STIs. African Americans have the highest STI prevalence of any racial/ethnic group, and prevalence is higher in American Indians, Alaska Natives, and Latinos than in white persons. Increased STI prevalence rates are also found in men who have sex with men (MSM), persons with low incomes living in urban settings, current or former inmates, military recruits, persons who exchange sex for money or drugs, persons with mental illness or a disability, current or former intravenous drug users, persons with a history of sexual abuse, and patients at public STI clinics.*
>
> *Behavioral counseling interventions can reduce a person's likelihood of acquiring an STI. Interventions ranging in intensity from 30 min to ≥2 h of contact time are beneficial; evidence of benefit increases with intervention intensity. Interventions can be delivered by primary care clinicians or through referral to trained behavioral counselors. Most successful approaches provide basic information about STIs and STI transmission; assess risk for transmission; and provide training in pertinent skills, such as condom use, communication about safe sex, problem solving, and goal setting.*[75]

[74] Canadian Task Force on Preventive Health Care. *Counseling for Risky Health Habits: A Conceptual Framework for Primary Care Practitioners* 2001. Available at http://canadiantaskforce.ca/files/guidelines/2001-risky-health-habits-en.pdf. Accessed February 2015.

[75] 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.

#### Utilization of This Clinical Preventive Service

*Currently 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*

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

#### Relevant British Columbia Population in 2010

We have assumed that all individuals between the ages of 15 and 59 who had sexual intercourse within the past 12 months would be eligible for this intervention. Rates of sexually transmitted diseases are relatively rare before age 15 and after age 60 (see Table 3-2 below). The rates by sex and age group for those who have 'ever had sexual intercourse' and 'had sexual intercourse in the past 12 months' are taken from the 2010 Canadian Community Health Survey Public Use Microdata File.[76] Based on these assumptions, an estimated 2.3 million individuals in BC would be eligible for this intervention (see Table 3-1).

**Table 3-1: Sexual Behaviours in British Columbia**
By Age and Sex, 2010

| Age Group | Ever had sexual intercourse | | Had sexual intercourse in past 12 months | | BC Population in 2010 | | BC Population at Risk | |
|---|---|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | Males | Females | Males | Females |
| 15-17 | 31.9% | 19.3% | 28.4% | 17.7% | 87,147 | 78,702 | 24,774 | 13,932 |
| 18-19 | 70.0% | 63.3% | 61.8% | 59.9% | 59,622 | 54,725 | 36,876 | 32,794 |
| 20-24 | 84.4% | 87.5% | 74.6% | 77.7% | 154,199 | 150,826 | 114,961 | 117,200 |
| 25-29 | 91.9% | 91.2% | 87.0% | 84.1% | 158,599 | 158,757 | 138,019 | 133,532 |
| 30-34 | 99.3% | 96.6% | 93.6% | 93.2% | 146,617 | 146,738 | 137,211 | 136,730 |
| 35-39 | 95.7% | 96.7% | 89.1% | 91.1% | 148,222 | 151,380 | 132,139 | 137,833 |
| 40-44 | 99.5% | 97.9% | 91.4% | 85.6% | 158,902 | 162,455 | 145,166 | 139,097 |
| 45-49 | 99.5% | 95.9% | 86.1% | 82.7% | 178,859 | 182,002 | 154,079 | 150,497 |
| 50-59 | 99.5% | 95.9% | 86.1% | 82.7% | 328,360 | 331,907 | 282,868 | 274,454 |
| Total | | | **82.1%** | **80.1%** | **1,420,527** | **1,417,492** | **1,166,093** | **1,136,069** |

#### Modelling CPB and CE

In this section, we will calculate the CPB and CE associated with behavioural counselling interventions for the prevention of sexually transmitted diseases in a British Columbia birth cohort of 40,000.

In estimating CPB, we made the following assumptions:

- The age and sex specific incidence rates per 100,000 for human immunodeficiency virus (HIV), chlamydia, gonorrhea, acute hepatitis B and syphilis infections are taken from the British Columbia Annual Summary of Reportable Diseases.[77] The incidence of human papillomavirus (HPV) infection in females is taken from an Ontario

[76] Statistics Canada. *Canadian Community Health Survey Public Use Microdata File 2009-2010 and 2010*. All computations, use and interpretation of these data are entirely that of H. Krueger & Associates Inc.
[77] BC Centre for Disease Control. *British Columbia Annual Summary of Reportable Diseases 2013*. 2014. Available at http://www.bccdc.ca/NR/rdonlyres/D8C85F70-804C-48DB-8A64-6009C9FD49A3/0/2013CDAnnualReportFinal.pdf. Accessed March 2015.

study.[78] We have assumed that the age specific incidence rate for males is the same as for females.[79] We calculated the incidence of herpes simplex virus type 2 (HSV-2) infection based on the number of patients within each age group who had their first herpes-related physician billings in 2006, as reported by the BC Centre for Disease Control.[80] We reduced the rates of first herpes-related visits proportional to the percentage of age-specific laboratory-diagnosed HSV infections in BC that were from genital specimens and were confirmed HSV-2. In 2005, approximately 31% of HSV-2 cases were identified in males and 69% percent in females; therefore, new cases were distributed between sexes according to these proportions (see Table 3-2).

**Table 3-2: Sexually Transmitted Infections in British Columbia**
**Rate per 100,000 by Sex and Age Group**

| | HIV | | Chlamydia | | Gonorrhea | | Hepatitis B - Acute | | Syphilis | | HPV | | HSV-2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female | Male |
| <1 | - | - | 9.4 | 4.4 | - | - | - | - | - | - | NA | NA | 3.7 | 1.7 |
| 1-4 | - | - | - | - | - | - | - | - | - | - | NA | NA | 4.7 | 2.1 |
| 5-9 | - | - | 1.8 | - | - | - | - | - | - | - | NA | NA | 3.0 | 1.3 |
| 10-14 | - | 0.8 | 39.2 | 0.8 | 4.5 | - | - | - | - | - | NA | NA | 2.8 | 1.3 |
| 15-19 | - | 1.4 | 1,345.8 | 255.3 | 61.6 | 25.1 | - | - | 0.7 | 4.7 | 25,000 | 25,000 | 140.1 | 63.3 |
| 20-24 | 2.6 | 13.0 | 1,864.8 | 858.0 | 87.5 | 120.1 | - | - | 2.0 | 18.6 | 8,800 | 8,800 | 209.6 | 94.7 |
| 25-29 | 1.9 | 22.0 | 966.7 | 736.2 | 62.7 | 165.8 | - | 0.7 | 1.9 | 34.3 | 8,300 | 8,300 | 222.9 | 100.7 |
| 30-39 | 3.6 | 20.3 | 338.9 | 315.7 | 37.0 | 104.5 | 0.3 | 1.3 | 3.3 | 45.2 | 13,000 | 13,000 | 248.0 | 112.2 |
| 40-59 | 2.1 | 15.8 | 67.9 | 80.1 | 11.3 | 48.3 | - | 0.8 | 0.4 | 40.1 | 7,600 | 7,600 | 164.9 | 74.5 |
| 60+ | 0.2 | 3.0 | 2.2 | 13.9 | 0.4 | 9.4 | - | - | - | 8.6 | NA | NA | 113.0 | 51.6 |

NA = not available

- The proportion of each sex within the population that is expected to survive to a given age group is based on life tables for 2009 to 2011 for BC (see Table 2-1 and 2-2 below).[81]
- The age- and sex- specific incidence rates were combined with years of life in a given age group by sex in the BC birth cohort to calculate the expected number of STIs by age and sex (see Tables 3-3 and 3-4).

**Table 3-3: Estimated Number of Sexually Transmitted Infections in a *Male* Birth Cohort of 20,000**

| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Chlamydia | HIV | Gonorrhea | Hepatitis B - Acute | Syphilis | HPV | HSV-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| **15-19** | 0.994 | 19,876 | 99,378 | 254 | 1 | 25 | 0 | 5 | 24,845 | 63 |
| **20-24** | 0.991 | 19,814 | 99,072 | 850 | 13 | 119 | 0 | 18 | 8,718 | 94 |
| **25-29** | 0.987 | 19,736 | 98,679 | 726 | 22 | 164 | 1 | 34 | 8,190 | 99 |
| **30-34** | 0.983 | 19,652 | 98,262 | 310 | 20 | 103 | 1 | 44 | 12,774 | 110 |
| **35-39** | 0.977 | 19,548 | 97,742 | 309 | 20 | 102 | 1 | 44 | 12,706 | 110 |
| **40-44** | 0.971 | 19,410 | 97,052 | 78 | 15 | 47 | 1 | 39 | 7,376 | 72 |
| **45-49** | 0.961 | 19,218 | 96,090 | 77 | 15 | 46 | 1 | 39 | 7,303 | 72 |
| **50-54** | 0.947 | 18,938 | 94,690 | 76 | 15 | 46 | 1 | 38 | 7,196 | 71 |
| **55-59** | 0.926 | 18,519 | 92,594 | 74 | 15 | 45 | 1 | 37 | 7,037 | 69 |
| **Total Ages 15 - 59** | | | **873,559** | **2,754** | **136** | **696** | **6** | **298** | **96,146** | **759** |

[78] Sellors JW, Karwalajtys TL, Kaczorowski J et al. Incidence, clearance and predictors of human papillomavirus infection in women. *Canadian Medical Association Journal*. 2003; 168(4): 421-5.
[79] Giuliano AR, Lu B, Nielson CM et al. Age-specific prevalence, incidence, and duration of human papillomavirus infections in a cohort of 290 US men. *Journal of Infectious Diseases*. 2008; 198(6): 827-35.
[80] Li X, Kim PH-J and Gilbert M. *Trends in Herpes Simplex Virus Cases in British Columbia, 1992-2006*. 2008. Available at http://www.bccdc.ca/NR/rdonlyres/11F4B322-54F7-48AC-A116-6D1081449B98/0/STI_Report_TrendsInHSV19922006_20090520.pdf. Accessed March 2015.
[81] See http://www.statcan.gc.ca/pub/84-537-x/2013005/tbl-eng.htm. Accessed December 2013.

| Table 3-4: Estimated Number of Sexually Transmitted Infections in a *Female* Birth Cohort of 20,000 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Chlamydia | HIV | Gonorrhea | Hepatitis B - Acute | Syphilis | HPV | HSV-2 |
| **15-19** | 0.995 | 19,897 | 99,485 | 1,339 | 0 | 61 | 0 | 1 | 24,871 | 139 |
| **20-24** | 0.993 | 19,869 | 99,345 | 1,853 | 3 | 87 | 0 | 2 | 8,742 | 208 |
| **25-29** | 0.992 | 19,836 | 99,180 | 959 | 2 | 62 | 0 | 2 | 8,232 | 221 |
| **30-34** | 0.990 | 19,798 | 98,992 | 335 | 4 | 37 | 0 | 3 | 12,869 | 245 |
| **35-39** | 0.987 | 19,744 | 98,721 | 335 | 4 | 37 | 0 | 3 | 12,834 | 245 |
| **40-44** | 0.983 | 19,665 | 98,324 | 67 | 2 | 11 | 0 | 0 | 7,473 | 162 |
| **45-49** | 0.977 | 19,547 | 97,736 | 66 | 2 | 11 | 0 | 0 | 7,428 | 161 |
| **50-54** | 0.969 | 19,372 | 96,861 | 66 | 2 | 11 | 0 | 0 | 7,361 | 160 |
| **55-59** | 0.955 | 19,108 | 95,542 | 65 | 2 | 11 | 0 | 0 | 7,261 | 158 |
| **Total Ages 15 - 59** | | | **884,186** | **5,084** | **20** | **327** | **1** | **13** | **97,071** | **1,700** |

- The data in Tables 3-3 and 3-4 was used to populate rows *a* - *n* in Table 3-5.

- High intensity (> 2 hours) behavioural counselling interventions are associated with a 62% (OR = 0.38, 95% CI of 0.24–0.60) reduction in STI incidence in adolescents and a 30% (OR = 0.70, 95% CI of 0.56–0.87) reduction in STI incidence in adults (Table 3-5, rows *o* & *p*).[82]

- We have assumed adherence with the behavioural counselling intervention to be 30% (Table 3-5, row *q*).

- Reductions in quality of life attributable to an infection with chlamydia, gonorrhea, HPV and HSV-2 are based on data provided in the relevant appendixes of the document *Vaccines for the 21st Century: A Tool for Decision Making* (Table 3-5, rows *y*, *aa*, *dd* & *ee*) rows.[83] These appendixes include an estimated rate for all sequelae following the infection, together with the time in a given state and the relevant change in quality of life over that time period. For example, 0.7% of females with a chlamydia infection have an ectopic pregnancy. Such a pregnancy is associated with a 42% reduction in quality of life for a period of four weeks. We assumed that the average HIV infection would occur at age 40[84] with 44 years of life remaining at a 17% reduced quality of life (Table 3-5, row *z*).[85] We assumed a reduction of 0.200 QALYs per infection with syphilis (Table 3-5, row *cc*), roughly equivalent to the calculated reductions for chlamydia (0.206, Table 3-5, row *y*) and gonorrhea (0.186, Table 3-5, row *aa*). We assumed an 18.5% reduction in quality of life attributable to a hepatitis B – acute infection (Table 3-5, row *bb*).[86]

Based on these assumptions, the CPB associated with behavioural counselling interventions for the prevention of sexually transmitted diseases is 3,543 QALYs (Table 3-5, row *ff*).

[82] O'Connor EA, Lin JS, Burda BU et al. Behavioral sexual risk-reduction counseling in primary care to prevent sexually transmitted infections: an updated systematic evidence review for the US Preventive Services Task Force. *Annals of Internal Medicine*. 2014; 161(12): 874.
[83] Institute of Medicine. *Vaccines for the 21st Century: A Tool for Decision Making.* Washington, DC: National Academy Press; 2000.
[84] Siegfried N, Uthman OA and Rutherford GW. Optimal time for initiation of antiretroviral therapy in asymptomatic, HIV-infected, treatment-naive adults. *The Cochrane Library*. 2010: 2.
[85] Long EF, Mandalia R, Mandalia S et al. Expanded HIV testing in low-prevalence, high-income countries: a cost-effectiveness analysis for the United Kingdom. *PloS One*. 2014; 9(4): e95735.
[86] Colombo GL, Gaeta GB, Viganò M et al. A cost-effectiveness analysis of different therapies in patients with chronic hepatitis B in Italy. *ClinicoEconomics and Outcomes Research*. 2011; 3: 37.

We also modified a number of major assumptions and recalculated the CPB as follows:

- Assume the effectiveness of high intensity behavioural counselling interventions in reducing the incidence of STIs is reduced from 62% to 40% in adolescents and from 30% to 13% in adults (Table 3-5, rows *o & p*): CPB = 1,835 QALYs.
- Assume the effectiveness of high intensity behavioural counselling interventions in reducing the incidence of STIs is increased from 62% to 74% in adolescents and from 30% to 44% in adults (Table 3-5, rows *o & p*): CPB = 4,856 QALYs.
- Assume adherence with high intensity behavioural counselling interventions in reducing the incidence of STIs is reduced from 30% to 20% (Table 3-5, rows *q*): CPB = 2,362 QALYs.
- Assume adherence with high intensity behavioural counselling interventions in reducing the incidence of STIs is increased from 30% to 40% (Table 3-5, rows *q*): CPB = 4,724 QALYs.

**Table 3-5: CPB of Behavioural Counselling Interventions for the Prevention of Sexually Transmitted Infections in a Birth Cohort of 40,000**

| Row Label | Variable | Base Case | Data Source |
|---|---|---|---|
| a | Estimated number of STIs in birth cohort as adolescents - Chlamydia | 1,593 | Tables 3-3 and 3-4 |
| b | Estimated number of STIs in birth cohort as adults - Chlamydia | 6,245 | Tables 3-3 and 3-4 |
| c | Estimated number of STIs in birth cohort as adolescents - HIV | 1 | Tables 3-3 and 3-4 |
| d | Estimated number of STIs in birth cohort as adults - HIV | 154 | Tables 3-3 and 3-4 |
| e | Estimated number of STIs in birth cohort as adolescents - Gonorrhea | 86 | Tables 3-3 and 3-4 |
| f | Estimated number of STIs in birth cohort as adults - Gonorrhea | 937 | Tables 3-3 and 3-4 |
| g | Estimated number of STIs in birth cohort as adolescents - Hep B-Acute | 0 | Tables 3-3 and 3-4 |
| h | Estimated number of STIs in birth cohort as adults - Hep B-Acute | 7 | Tables 3-3 and 3-4 |
| i | Estimated number of STIs in birth cohort as adolescents - Syphilis | 5 | Tables 3-3 and 3-4 |
| j | Estimated number of STIs in birth cohort as adults - Syphilis | 305 | Tables 3-3 and 3-4 |
| k | Estimated number of STIs in birth cohort as adolescents - HPV | 49,716 | Tables 3-3 and 3-4 |
| l | Estimated number of STIs in birth cohort as adults - HPV | 143,502 | Tables 3-3 and 3-4 |
| m | Estimated number of STIs in birth cohort as adolescents - HSV-2 | 202 | Tables 3-3 and 3-4 |
| n | Estimated number of STIs in birth cohort as adults - HSV-2 | 2,257 | Tables 3-3 and 3-4 |
| | **Benefits Associated with Behavioural Counselling** | | |
| o | Effectiveness of high intensity behavioural counselling in reducing STI incidence in adolescents | 62% | √ |
| p | Effectiveness of high intensity behavioural counselling in reducing STI incidence in adults | 30% | √ |
| q | Adherence with behavioural counselling | 30% | Assumed |
| r | Estimated # of chlamydia infections avoided | 858 | = ((a * o) + (b * p)) * q |
| s | Estimated # of HIV infections avoided | 14 | = ((c * o) + (d * p)) * q |
| t | Estimated # of gonorrhea infections avoided | 100 | = ((e * o) + (f * p)) * q |
| u | Estimated # of Hep B-Acute infections avoided | 0.6 | = ((g * o) + (h * p)) * q |
| v | Estimated # of syphilis infections avoided | 28 | = ((i * o) + (j * p)) * q |
| w | Estimated # of HPV infections avoided | 22,162 | = ((k * o) + (l * p)) * q |
| x | Estimated # of HSV-2 infections avoided | 241 | = ((m * o) + (n * p)) * q |
| y | Reduction in QALYs per infection - Chlamydia | 0.206 | √ |
| z | Reduction in QALYs per infection - HIV | 7.48 | √ |
| aa | Reduction in QALYs per infection - Gonorrhea | 0.186 | √ |
| bb | Reduction in QALYs per infection - Hep B - Acute | 0.185 | |
| cc | Reduction in QALYs per infection - Syphilis | 0.200 | Assumed |
| dd | Reduction in QALYs per infection - HPV | 0.146 | √ |
| ee | Reduction in QALYs per infection - HSV-2 | 0.0028 | √ |
| ff | **Potential QALYs gained, Behavioural Counseling increasing from 0% to 30%** | **3,543** | = r * y + s * z + t * aa + u * bb + v * cc + w * dd * x * ee |

*√ = Estimates from the literature*

In estimating CE, we made the following additional assumptions:

- **Frequency of screening** - We assumed that a general practitioner would enquire about a patient's sexual behaviours once every four years (Table 3-7, row *c*).
- **Cost of an office visit** - We estimated the average cost of a 10 minute visit to a general practitioner to be $34.00 based on information from the BC Medical Services Commission 2013 payment schedule[87] (Table 3-7, row *e*).
- **Patient time costs for office visit** - For patient time costs (Table 3-7, row *i*), we assumed an hourly wage of $24.39 (the BC average in 2013)[88] plus 18% benefits applied to the estimated two hours of patient time required (including travel to and from the appointment). These costs totalled to $57.56 per physician visit. We assumed that 30% of an office visit would be required to determine if a patient was sexually active and to refer them to a behavioural counselling intervention (Table 3-7, row *g*).
- **Patient time costs for behavioural counselling intervention** - We assumed three hours of patient time would be required (including travel to and from the session) (Table 3-7, row *o*).
- **Costs of a behavioural counselling intervention** - We assumed that a clinical nurse specialist with a wage rate of $50.21 per hour would lead the session.[89] Their direct time involvement would be 3.5 hours (2.5 for the session and 1 hour for preparation). To these costs we added 24% for benefits (e.g., dental, long-term disability, etc.), 40% for non-productive paid hours (e.g., statutory holidays, vacations, sick time, educational leave, etc.) and 50% for overhead costs (e.g., use of the facility and support staff). Based on these assumptions, the estimated costs per behavioural counselling intervention would be $458 (Table 3-7, row *n*). We have assumed that each session would be attended by an average of 5 individuals (Table 3-7, row *l*).
- **Costs per infection avoided** - The direct medical costs per infection avoided are taken from a recent US study (Table 3-7, rows *x – dd*).[90] These costs, provided in 2010 US dollars, were adjusted to 2010 Canadian dollars by reducing costs by 29% to reflect excess health care prices in the US.[91,92] This value was then adjusted to 2013 Canadian dollars using the health and personal care component of the BC Consumer Price Index (CPI) (+1.7%).[93] When costs were provided separately for males and females, we estimated the combined average costs based on the proportion of infections by sex expected in BC (Table 3-3 and 3-4) (see Table 3-6).

[87] Medical Services Commission. *Payment Schedule: Section 7 General Practice*. 2013. Available at http://www.health.gov.bc.ca/msp/infoprac/physbilling/payschedule/pdf/7-general-practice.pdf. Accessed December 2013.
[88] See http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/Earnings.aspx. Accessed February 2015.
[89] Health Employers Association of BC and Nurses' Bargaining Association. *Provincial Collective Agreement.* 2012-2014. Available at https://www.bcnu.org/Contracts-Bargaining/Documents/nba-2012-2014-draft.pdf. Accessed December 2014.
[90] Owusu-Edusei Jr K, Chesson HW, Gift TL et al. The estimated direct medical cost of selected sexually transmitted infections in the United States, 2008. *Sexually Transmitted Diseases*. 2013; 40(3): 197-201.
[91] 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.
[92] Reinhardt U. *Why Does US Health Care Cost So Much? (Part I)*. 2008. Available at http://faculty.ses.wsu.edu/rayb/econ340/Articles/health/Health_Costs.doc. Accessed December 2013.
[93] Statistics Canada. *Consumer Price Index, Health and Personal Care, by Province (Monthly) (British Columbia)*. 2013. Available at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/cpis13f-eng.htm. Accessed February 2015.

| Table 3-6: Estimated Direct Medical Cost of Selected Sexually Transmitted Infections | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 US$ | | | 2010 Can$ | | | 2013 Can$ | | | | | | |
| STI | Sex | Est | Range | | Est | Range | | Est | Range | | % M/F | Est | Range | |
| *Chlamydia* | | | | | | | | | | | | | | |
| | Male | $30 | $15 | $45 | $23 | $12 | $35 | $24 | $12 | $35 | 35% | $194 | $97 | $291 |
| | Female | $364 | $182 | $546 | $282 | $141 | $423 | $286 | $143 | $429 | 65% | | | |
| *Gonorrhea* | | | | | | | | | | | | | | |
| | Male | $79 | $40 | $119 | $61 | $31 | $92 | $62 | $31 | $94 | 68% | $131 | $66 | $197 |
| | Female | $354 | $177 | $531 | $274 | $137 | $412 | $278 | $139 | $417 | 32% | | | |
| *HBV* | | $2,667 | $2,172 | $2,924 | $2,067 | $1,683 | $2,266 | $2,096 | $1,707 | $2,298 | | | | |
| *HIV* | | $304,500 | $229,300 | $379,700 | $235,988 | $177,708 | $294,268 | $239,268 | $180,178 | $298,358 | | | | |
| *HPV* | | | | | | | | | | | | | | |
| | Male | $45 | $23 | $78 | $35 | $18 | $60 | $35 | $18 | $61 | 50% | $93 | $47 | $160 |
| | Female | $191 | $96 | $329 | $148 | $74 | $255 | $150 | $75 | $259 | 50% | | | |
| *HSV-2* | | | | | | | | | | | | | | |
| | Male | $761 | $381 | $1,142 | $590 | $295 | $885 | $598 | $299 | $897 | 31% | $522 | $261 | $783 |
| | Female | $621 | $311 | $932 | $481 | $241 | $722 | $488 | $244 | $732 | 69% | | | |
| *Syphilis* | | $709 | $355 | $1,064 | $549 | $275 | $825 | $557 | $279 | $836 | | | | |

- **Discount rate** - 3%.

Based on these assumptions, the CE associated with behavioural counselling interventions for the prevention of sexually transmitted diseases is $7,142 per QALY (Table 3-7, row *kk*).

We also modified several major assumptions and recalculated the cost per QALY as follows:

- Assume the effectiveness of high intensity behavioural counselling interventions in reducing the incidence of STIs is reduced from 62% to 40% in adolescents and from 30% to 13% in adults (Table 3-5, rows *o & p*): CE = $15,451/QALY.
- Assume the effectiveness of high intensity behavioural counselling interventions in reducing the incidence of STIs is increased from 62% to 76% in adolescents and from 30% to 44% in adults (Table 3-5, rows *o & p*): CE = $4,289/QALY.
- Assume adherence with high intensity behavioural counselling interventions in reducing the incidence of STIs is reduced from 30% to 20% (Table 3-5, rows *q*): CE = $8,845/QALY.
- Assume adherence with high intensity behavioural counselling interventions in reducing the incidence of STIs is increased from 30% to 40% (Table 3-5, rows *q*): CE = $6,290/QALY.
- Assume the frequency of screening to determine sexual activity is reduced from once every 4 years to once every 5 years (Table 3-7, rows *c*): CE = $5,388/QALY.
- Assume the frequency of screening to determine sexual activity is increased from once every 4 years to once every 3 years (Table 3-7, rows *c*): CE = $10,065/QALY.
- Assume the average number of individuals attending each behavioural counselling intervention is increased from 5 to 10 (Table 3-7, rows *l*): CE = $5,761/QALY.
- Assume the average number of individuals attending each behavioural counselling intervention is reduced from 5 to 1 (Table 3-7, rows *l*): CE = $18,184/QALY.
- Assume the average direct cost per HIV infection is reduced from $239,268 to $180,178 (Table 3-7, rows *y*): CE = $7,377/QALY.
- Assume the average direct cost per HIV infection is increased from $239,268 to $298,358 (Table 3-7, rows *y*): CE = $6,906/QALY.

- Assume the average direct cost per HPV infection is reduced from $93 to $47 (Table 3-7, rows *cc*): CE = $7,429/QALY.
- Assume the average direct cost per HPV infection is increased from $93 to $160 (Table 3-7, rows *cc*): CE = $6,722/QALY.

**Table 3-7: CE of Behavioural Counselling Interventions for the Prevention of Sexually Transmitted Infections in a Birth Cohort of 40,000**

| Row Label | Variable | Base Case | Data Source |
|---|---|---|---|
| a | Years of life between the ages of 15 and 59 in birth cohort | 1,757,745 | Tables 3-3 and 3-4 |
| b | Proportion of years sexually active | 81% | Table 3-1 |
| | **Costs of intervention** | | |
| c | Frequency of screening to determine sexual activity (every x years) | 4 | Assumed |
| d | Total number of screens | 439,436 | = a / c |
| e | Cost of 10-minute office visit | $34.00 | √ |
| f | Value of patient time and travel for office visit | $57.56 | √ |
| g | Portion of 10-minute office visit for screen | 30% | Assumed |
| h | Cost of screening | $12,070,432 | = d * (e + f) * g |
| i | Screen positive for sexual activity | 355,943 | = d * b |
| j | Adherence with behavioural counselling | 30% | Table 3-5, row q |
| k | Attendance at a behavioural counselling intervention | 106,783 | = I * j |
| l | Individuals per behavioural counselling intervention | 5 | Assumed |
| m | Total number of behavioural counselling interventions | 21,357 | = k / m |
| n | Cost per behavioural counselling intervention | $458 | √ |
| o | Value of patient time and travel for behavioural counselling intervention | $86.34 | √ |
| p | Cost of behavioural counselling interventions | $19,000,964 | = (m * n) + (k * o) |
| | **Cost avoided** | | |
| q | Estimated # of chlamydia infections avoided | 858 | Table 3-5, row r |
| r | Estimated # of HIV infections avoided | 14 | Table 3-5, row s |
| s | Estimated # of gonorrhea infections avoided | 100 | Table 3-5, row t |
| t | Estimated # of Hep B-Acute infections avoided | 1 | Table 3-5, row u |
| u | Estimated # of syphilis infections avoided | 28 | Table 3-5, row v |
| v | Estimated # of HPV infections avoided | 22,162 | Table 3-5, row w |
| w | Estimated # of HSV-2 infections avoided | 241 | Table 3-5, row x |
| x | Cost of chlamydia infection avoided | $194 | √ |
| y | Cost of HIV infection avoided | $239,268 | √ |
| z | Cost of gonorrhea infection avoided | $131 | √ |
| aa | Cost of Hep B-Acute infection avoided | $2,096 | √ |
| bb | Cost of syphilis infection avoided | $557 | √ |
| cc | Cost of HPV infection avoided | $93 | √ |
| dd | Cost of HSV-2 infection avoided | $522 | √ |
| | **CE calculation** | | |
| ee | Cost of intervention over lifetime of birth cohort | $31,071,396 | = h + p |
| ff | Costs avoided | $5,766,638 | = q * x + r * y + s * z + t * aa + u * bb + v * cc + w * dd |
| gg | QALYs saved | 3,543 | Table 3-5, row ff |
| hh | Cost of intervention over lifetime of birth cohort (3% discount) | $17,437,457 | Calculated |
| ii | Costs avoided (3% discount) | $3,236,272 | Calculated |
| jj | QALYs saved (3% discount) | 1,989 | Calculated |
| kk | **CE ($/QALY saved)** | **$7,142** | = (hh - ii) / jj |

*√ = Estimates from the literature*

**Summary**

**Table 3-8: Behavioural Counselling Interventions for the Prevention of Sexually Transmitted Infections in a Birth Cohort of 40,000**

Summary

| | Base Case | Range | |
|---|---|---|---|
| **CPB** (Potential QALYs Gained) | | | |
| *Assume No Current Service* | | | |
| 3% Discount Rate | 1,989 | 1,030 | 2,725 |
| 0% Discount Rate | 3,543 | 1,835 | 4,856 |
| *Gap between B.C. Current and Best in the World* | | | |
| 3% Discount Rate | | Unknown | |
| 0% Discount Rate | | | |
| **CE** ($/QALY) **including** patient time costs | | | |
| 3% Discount Rate | $7,142 | $4,289 | $18,184 |
| 0% Discount Rate | $7,142 | $4,289 | $18,184 |
| **CE** ($/QALY) **excluding** patient time costs | | | |
| 3% Discount Rate | $2,398 | $1,245 | $13,440 |
| 0% Discount Rate | $2,398 | $1,245 | $13,440 |

**Canadian Task Force on Preventive Health Care (2015)**

*We recommend measuring height and weight and calculating BMI at appropriate primary care visits. (Strong recommendation; very low-quality evidence)*

*We recommend that practitioners not offer formal, structured interventions aimed at preventing weight gain in normal-weight adults. (Weak recommendation; very low-quality evidence)*

*For adults who are obese (BMI 30–39.9) and are at high risk of diabetes, we recommend that practitioners offer or refer to structured behavioural interventions aimed at weight loss. (Strong recommendation; moderate-quality evidence)*

*For adults who are overweight or obese, we recommend that practitioners offer or refer to structured behavioural interventions aimed at weight loss. (Weak recommendation; moderate-quality evidence)*

*For adults who are overweight or obese, we recommend that practitioners not routinely offer pharmacologic interventions (orlistat or metformin) aimed at weight loss. (Weak recommendation; moderate-quality evidence)*[94]

**United States Preventive Services Task Force Recommendations (2012)**

*The USPSTF recommends screening all adults for obesity. Clinicians should offer or refer patients with a body mass index (BMI) of 30 kg/m$^2$ or higher to intensive, multicomponent behavioral interventions. This is a B recommendation.*

*Intensive, multicomponent behavioral interventions for obese adults include the following components:*

- *Behavioral management activities, such as setting weight-loss goals*
- *Improving diet or nutrition and increasing physical activity*
- *Addressing barriers to change*
- *Self-monitoring*
- *Strategizing how to maintain lifestyle changes*

*The USPSTF found that the most effective interventions were comprehensive and of high intensity (12 to 26 sessions in a year).*

*Behavioral intervention participants lost an average of 6% of their baseline weight (4 to 7 kg [8.8 to 15.4 lb]) in the first year with 12 to 26 treatment sessions compared with little or no weight loss in the control group participants. A weight loss of 5% is considered clinically important by the U.S. Food and Drug Administration (FDA).*[95]

[94] 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.
[95] 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.

### Utilization of This Clinical Preventive Service

*Currently 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 between 30 and 39.9 were being referred to an intensive, multicomponent behavioral intervention.

*Best in the World*

We were unable to find information for any jurisdiction regarding the frequency of measuring height and weight in primary care or what proportion of individuals with a BMI of between 30 and 39.9 were being referred to an intensive, multicomponent behavioral intervention.

### Relevant British Columbia Population in 2010

Based on data from the Canadian Community Health Survey, an estimated 439,808 British Columbians were in the obese class I or II category in 2010 (see Table 4-1).[96]

**Table 4-1: Prevalence of Adults Aged 18+ with Overweight and Obesity**
**British Columbia, 2010**

| | 18-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Estimated BC Population*** | | | | | | | | | | | | | | | |
| **Male** | 59,622 | 154,199 | 158,599 | 146,617 | 148,222 | 158,902 | 178,859 | 172,717 | 155,643 | 137,871 | 100,116 | 75,087 | 59,796 | 71,559 | **1,777,809** |
| **Female** | 54,725 | 150,826 | 158,757 | 146,738 | 151,380 | 162,455 | 182,002 | 175,792 | 156,115 | 138,243 | 102,882 | 79,545 | 65,561 | 110,581 | **1,835,602** |
| **Total** | 114,347 | 305,025 | 317,356 | 293,355 | 299,602 | 321,357 | 360,861 | 348,509 | 311,758 | 276,114 | 202,998 | 154,632 | 125,357 | 182,140 | **3,613,411** |
| ***Prevalence of Overweight/Obesity*** | | | | | | | | | | | | | | | |
| **Males** | | | | | | | | | | | | | | | |
| Overweight | 11.8% | 19.7% | 35.6% | 29.4% | 44.7% | 35.5% | 46.2% | 43.0% | 42.7% | 51.2% | 45.9% | 46.5% | 35.9% | 35.8% | **38.3%** |
| Obese Class I | 9.4% | 10.4% | 5.1% | 8.9% | 13.1% | 14.5% | 11.7% | 19.9% | 19.1% | 16.1% | 14.3% | 12.0% | 17.7% | 7.2% | **13.0%** |
| Obese Class II | 0.6% | 3.5% | 2.3% | 1.2% | 2.1% | 1.3% | 4.8% | 3.4% | 4.2% | 0.9% | 2.6% | 1.2% | 1.5% | 3.0% | **2.5%** |
| Obese Class III | 0.0% | 0.9% | 2.0% | 1.3% | 0.5% | 0.7% | 0.7% | 1.6% | 0.9% | 2.3% | 0.8% | 0.5% | 0.2% | 0.0% | **1.0%** |
| **Females** | | | | | | | | | | | | | | | |
| Overweight | 11.8% | 19.3% | 10.9% | 20.4% | 22.9% | 24.0% | 20.0% | 27.1% | 30.3% | 36.2% | 24.6% | 30.7% | 36.0% | 26.8% | **24.0%** |
| Obese Class I | 0.1% | 3.7% | 6.3% | 8.8% | 1.6% | 4.4% | 10.9% | 8.4% | 6.8% | 10.1% | 9.7% | 13.4% | 8.5% | 5.2% | **7.0%** |
| Obese Class II | 0.0% | 0.3% | 2.4% | 1.9% | 2.1% | 1.2% | 2.0% | 1.3% | 3.3% | 2.4% | 2.8% | 3.1% | 0.8% | 1.5% | **1.9%** |
| Obese Class III | 0.0% | 0.1% | 0.2% | 0.0% | 1.2% | 1.2% | 0.4% | 2.0% | 1.5% | 2.5% | 0.2% | 0.3% | 0.5% | 0.0% | **0.8%** |
| **Total** | | | | | | | | | | | | | | | |
| Overweight | 11.8% | 19.5% | 23.3% | 24.9% | 33.7% | 29.7% | 33.0% | 35.0% | 36.5% | 43.7% | 35.1% | 38.4% | 36.0% | 30.3% | **31.07%** |
| Obese Class I | 5.0% | 7.1% | 5.7% | 8.9% | 7.3% | 9.4% | 11.3% | 14.1% | 12.9% | 13.1% | 12.0% | 12.7% | 12.9% | 6.0% | **9.98%** |
| Obese Class II | 0.3% | 1.9% | 2.3% | 1.6% | 2.1% | 1.2% | 3.4% | 2.3% | 3.8% | 1.7% | 2.7% | 2.2% | 1.1% | 2.1% | **2.19%** |
| Obese Class III | 0.0% | 0.5% | 1.1% | 0.6% | 0.9% | 1.0% | 0.5% | 1.8% | 1.2% | 2.4% | 0.5% | 0.4% | 0.4% | 0.0% | **0.92%** |
| ***Number of Individuals with Overweight/Obesity*** | | | | | | | | | | | | | | | |
| **Males** | | | | | | | | | | | | | | | |
| Overweight | 7,013 | 30,432 | 56,537 | 43,135 | 66,302 | 56,447 | 82,620 | 74,243 | 66,472 | 70,598 | 45,951 | 34,928 | 21,493 | 25,599 | **681,770** |
| Obese Class I | 5,598 | 16,029 | 8,087 | 13,072 | 19,423 | 23,098 | 20,848 | 34,304 | 29,680 | 22,210 | 14,307 | 9,037 | 10,576 | 5,171 | **231,440** |
| Obese Class II | 340 | 5,350 | 3,672 | 1,789 | 3,122 | 2,017 | 8,501 | 5,850 | 6,556 | 1,255 | 2,629 | 924 | 894 | 2,138 | **45,037** |
| Obese Class III | - | 1,401 | 3,100 | 1,861 | 805 | 1,150 | 1,231 | 2,714 | 1,334 | 3,160 | 801 | 412 | 147 | - | **18,117** |
| **Females** | | | | | | | | | | | | | | | |
| Overweight | 6,438 | 29,110 | 17,384 | 29,911 | 34,665 | 38,910 | 36,327 | 47,684 | 47,343 | 50,032 | 25,335 | 24,459 | 23,617 | 29,665 | **440,879** |
| Obese Class I | 75 | 5,588 | 10,057 | 12,946 | 2,438 | 7,090 | 19,783 | 14,821 | 10,613 | 13,926 | 10,005 | 10,656 | 5,575 | 5,712 | **129,284** |
| Obese Class II | - | 484 | 3,766 | 2,802 | 3,147 | 1,968 | 3,660 | 2,208 | 5,185 | 3,330 | 2,865 | 2,443 | 543 | 1,646 | **34,047** |
| Obese Class III | - | 158 | 315 | - | 1,866 | 2,019 | 728 | 3,468 | 2,420 | 3,407 | 169 | 233 | 315 | - | **15,096** |
| **Total** | | | | | | | | | | | | | | | |
| Overweight | 13,451 | 59,542 | 73,921 | 73,046 | 100,967 | 95,357 | 118,947 | 121,928 | 113,814 | 120,630 | 71,286 | 59,387 | 45,110 | 55,264 | **1,122,649** |
| Obese Class I | 5,673 | 21,616 | 18,144 | 26,018 | 21,860 | 30,188 | 40,631 | 49,124 | 40,293 | 36,137 | 24,312 | 19,694 | 16,151 | 10,884 | **360,724** |
| Obese Class II | 340 | 5,834 | 7,438 | 4,591 | 6,270 | 3,985 | 12,161 | 8,058 | 11,742 | 4,585 | 5,494 | 3,367 | 1,437 | 3,784 | **79,084** |
| Obese Class III | - | 1,558 | 3,415 | 1,861 | 2,671 | 3,169 | 1,960 | 6,182 | 3,754 | 6,567 | 970 | 645 | 462 | - | **33,213** |

[96] Statistics Canada. *Canadian Community Health Survey Public Use Microdata File 2009-2010 and 2010.* All computations, use and interpretation of these data are entirely that of H. Krueger & Associates Inc.

**Modelling CPB and CE**

In this section, we will calculate the CPB and CE associated with screening for and management of obesity in adults aged 18 or older in a British Columbia birth cohort of 40,000.

In estimating CPB, we made the following assumptions:

- The proportion of each sex within the population that is expected to survive to a given age group is based on life tables for 2009 to 2011 for BC[97] (see Table 4-2 and 4-3).

**Table 4-2: Prevalence of Excess Weight in a *Male* Birth Cohort of 20,000**

| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Prevalence of Excess Weight | | | | # of Years with Excess Weight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Overweight | Class I | Class II | Class III | Overweight | Class I | Class II | Class III |
| **18-19** | 0.994 | 19,876 | 39,751 | 11.8% | 9.4% | 0.6% | 0.0% | 4,676 | 3,732 | 226 | 0 |
| **20-24** | 0.991 | 19,814 | 99,072 | 19.7% | 10.4% | 3.5% | 0.9% | 19,552 | 10,298 | 3,437 | 900 |
| **25-29** | 0.987 | 19,736 | 98,679 | 35.6% | 5.1% | 2.3% | 2.0% | 35,177 | 5,031 | 2,285 | 1,929 |
| **30-34** | 0.983 | 19,652 | 98,262 | 29.4% | 8.9% | 1.2% | 1.3% | 28,909 | 8,760 | 1,199 | 1,248 |
| **35-39** | 0.977 | 19,548 | 97,742 | 44.7% | 13.1% | 2.1% | 0.5% | 43,721 | 12,808 | 2,059 | 531 |
| **40-44** | 0.971 | 19,410 | 97,052 | 35.5% | 14.5% | 1.3% | 0.7% | 34,476 | 14,108 | 1,232 | 702 |
| **45-49** | 0.961 | 19,218 | 96,090 | 46.2% | 11.7% | 4.8% | 0.7% | 44,387 | 11,200 | 4,567 | 662 |
| **50-54** | 0.947 | 18,938 | 94,690 | 43.0% | 19.9% | 3.4% | 1.6% | 40,703 | 18,807 | 3,207 | 1,488 |
| **55-59** | 0.926 | 18,519 | 92,594 | 42.7% | 19.1% | 4.2% | 0.9% | 39,545 | 17,657 | 3,900 | 794 |
| **60-64** | 0.894 | 17,887 | 89,435 | 51.2% | 16.1% | 0.9% | 2.3% | 45,796 | 14,408 | 814 | 2,050 |
| **65-69** | 0.847 | 16,935 | 84,673 | 45.9% | 14.3% | 2.6% | 0.8% | 38,863 | 12,100 | 2,224 | 677 |
| **70-74** | 0.776 | 15,514 | 77,572 | 46.5% | 12.0% | 1.2% | 0.5% | 36,084 | 9,336 | 954 | 426 |
| **75-79** | 0.673 | 13,453 | 67,263 | 35.9% | 17.7% | 1.5% | 0.2% | 24,177 | 11,896 | 1,005 | 166 |
| **80+** | 0.296 | 5,918 | 118,356 | 35.8% | 7.2% | 3.0% | 0.0% | 42,340 | 8,553 | 3,536 | 0 |
| **Total Ages 40+** | | | **1,251,230** | **38.2%** | **12.7%** | **2.4%** | **0.9%** | **478,405** | **158,696** | **30,647** | **11,571** |

**Table 4-3: Prevalence of Excess Weight in a *Female* Birth Cohort of 20,000**

| Age Group | Mean Survival Rate | Individuals in Birth Cohort | Years of Life in Birth Cohort | Prevalence of Excess Weight | | | | # of Years with Excess Weight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Overweight | Class I | Class II | Class III | Overweight | Class I | Class II | Class III |
| **18-19** | 0.995 | 19,897 | 39,794 | 11.8% | 0.1% | 0.0% | 0.0% | 4,682 | 54 | 0 | 0 |
| **20-24** | 0.993 | 19,869 | 99,345 | 19.3% | 3.7% | 0.3% | 0.1% | 19,174 | 3,680 | 319 | 104 |
| **25-29** | 0.992 | 19,836 | 99,180 | 10.9% | 6.3% | 2.4% | 0.2% | 10,860 | 6,283 | 2,353 | 197 |
| **30-34** | 0.990 | 19,798 | 98,992 | 20.4% | 8.8% | 1.9% | 0.0% | 20,178 | 8,734 | 1,890 | 0 |
| **35-39** | 0.987 | 19,744 | 98,721 | 22.9% | 1.6% | 2.1% | 1.2% | 22,606 | 1,590 | 2,052 | 1,217 |
| **40-44** | 0.983 | 19,665 | 98,324 | 24.0% | 4.4% | 1.2% | 1.2% | 23,550 | 4,291 | 1,191 | 1,222 |
| **45-49** | 0.977 | 19,547 | 97,736 | 20.0% | 10.9% | 2.0% | 0.4% | 19,508 | 10,624 | 1,965 | 391 |
| **50-54** | 0.969 | 19,372 | 96,861 | 27.1% | 8.4% | 1.3% | 2.0% | 26,274 | 8,166 | 1,216 | 1,911 |
| **55-59** | 0.955 | 19,108 | 95,542 | 30.3% | 6.8% | 3.3% | 1.5% | 28,974 | 6,495 | 3,173 | 1,481 |
| **60-64** | 0.935 | 18,704 | 93,520 | 36.2% | 10.1% | 2.4% | 2.5% | 33,846 | 9,421 | 2,253 | 2,305 |
| **65-69** | 0.904 | 18,074 | 90,371 | 24.6% | 9.7% | 2.8% | 0.2% | 22,254 | 8,788 | 2,516 | 148 |
| **70-74** | 0.854 | 17,086 | 85,428 | 30.7% | 13.4% | 3.1% | 0.3% | 26,267 | 11,444 | 2,624 | 250 |
| **75-79** | 0.777 | 15,540 | 77,698 | 36.0% | 8.5% | 0.8% | 0.5% | 27,989 | 6,607 | 644 | 373 |
| **80+** | 0.384 | 7,677 | 153,543 | 26.8% | 5.2% | 1.5% | 0.0% | 41,190 | 7,932 | 2,286 | 0 |
| **Total Ages 40+** | | | **1,325,055** | **24.7%** | **7.1%** | **1.8%** | **0.7%** | **327,353** | **94,109** | **24,483** | **9,598** |

- Based on 2010 prevalence rates of obesity (based on self-reported height and weight) by age group and sex in BC, a total of 307,934 life years from a birth cohort of 40,000 individuals are in the obese class I or II category (Table 4-4, row *a*).

[97] See http://www.statcan.gc.ca/pub/84-537-x/2013005/tbl-eng.htm. Accessed December 2013.

- Research for the USPSTF found that behavioral intervention participants lost an average of 6% or 3 kg (6.6 lb) of their baseline weight (95% CI of 4 to 7 kg [8.8 to 15.4 lb]) in the first year with 12 to 26 treatment sessions, compared with little or no weight loss in the control group participants.[98] Research for the CTFPHC found similar results with an average weight loss of 3.02 kg (95% CI of 2.52 to 3.52).[99] In addition, waist circumference was reduced by an average of 2.78 cm (95% CI of 2.22 to 3.34) and BMI was reduced by 1.11kg/$m^2$ (95% CI of 0.84 to 1.39). On average, one out of every five participants (95% CI of 4 to 7) lost at least 5% of their body weight (Table 4-4, row *b*) and one out of nine (95% CI of 7 to 12) lost more than 10% of their body weight. A weight loss of 5% is considered clinically important.

- We have assumed adherence with the behavioural counselling intervention to be 30% (Table 4-4, row *c*).

- Excess weight is associated with a reduced quality of life.[100,101,102] We have assumed that individuals with a BMI between 30.0-39.9 kg/$m^2$ (i.e., obese class I and II) who successfully lose weight following an intensive, multicomponent behavioral intervention would move into the overweight category with respect to their quality of life. Individuals in the obese category tend to have a 9.66% reduction in quality of life compared to those in the overweight category (Table 4-4, row *e*).[103]

- Excess weight is also associated with increased premature mortality.[104,105,106,107] We have assumed that individuals with a BMI between 30.0-39.9 kg/$m^2$ (i.e., obese class I and II) who successfully lose weight following an intensive, multicomponent behavioral intervention would move into the overweight category with respect to their risk of premature mortality. Individuals in the overweight category tend to live 7.84% longer compared to those in the obese category (Table 4-4, row *g*).[108]

Based on these assumptions, the CPB associated with screening for and management of obesity is 3,233 QALYs (Table 4-4, row *i*).

We also modified a number of major assumptions and recalculated the CPB as follows:

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[98] LeBlanc ES, O'Connor E, Whitlock EP et al. Effectiveness of primary care–relevant treatments for obesity in adults: a systematic evidence review for the US Preventive Services Task Force. *Annals of Internal Medicine*. 2011; 155(7): 434-47.

[99] Peirson L, Douketis J, Ciliska D et al. Treatment for overweight and obesity in adult populations: a systematic review and meta-analysis. *Canadian Medical Association Open Access Journal*. 2014; 2(4): e306-e17.

[100] Trakas K, Oh P, Singh S et al. The health status of obese individuals in Canada. *International Journal of Obesity*. 2001; 25(5): 662-8.

[101] Søltoft F, Hammer M and Kragh N. The association of body mass index and health-related quality of life in the general population: data from the 2003 Health Survey of England. *Quality of Life Research*. 2009; 18(10): 1293-9.

[102] Jia H and Lubetkin EI. Trends in quality-adjusted life-years lost contributed by smoking and obesity. *American Journal of Preventive Medicine*. 2010; 38(2): 138-44.

[103] Kortt MA and Clarke PM. Estimating utility values for health states of overweight and obese individuals using the SF-36. *Quality of Life Research*. 2005; 14(10): 2177-85.

[104] Fontaine KR, Redden DT, Wang C et al. Years of life lost due to obesity. *Journal of the American Medical Association*. 2003; 289(2): 187-93.

[105] Flegal KM, Graubard BI, Williamson DF et al. Excess deaths associated with underweight, overweight, and obesity. *Journal of the American Medical Association*. 2005; 293(15): 1861-7.

[106] Adams KF, Schatzkin A, Harris TB et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *New England Journal of Medicine*. 2006; 355(8): 763-78.

[107] Collaboration PS. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet*. 2009; 373(9669): 1083-96.

[108] Kortt MA and Clarke PM. Estimating utility values for health states of overweight and obese individuals using the SF-36. *Quality of Life Research*. 2005; 14(10): 2177-85.

- Assume adherence with the intervention is reduced from 30% to 20% (Table 4-4, rows *b*): CPB = 2,156 QALYs.
- Assume adherence with the intervention is increased from 30% to 40% (Table 4-4, rows *b*): CPB = 4,311 QALYs.
- Assume that one out of every four participants lost at least 5% of their body weight after completing an intensive, multicomponent behavioral intervention, rather than one out of every five participants (Table 4-4, row *c*): CPB = 4,042 QALYs.
- Assume that one out of every seven participants lost at least 5% of their body weight after completing an intensive, multicomponent behavioral intervention, rather than one out of every five participants (Table 4-4, row *c*): CPB = 2,310 QALYs.
- Assume that individuals in the obese category tend to have a 7.73% rather than a 9.66% reduction in quality of life compared to those in the overweight category (Table 4-4, row *e*): CPB = 2,877 QALYs.
- Assume that individuals in the obese category tend to have a 11.59% rather than a 9.66% reduction in quality of life compared to those in the overweight category (Table 4-4, row *e*): CPB = 3,590 QALYs.
- Assume that individuals in the overweight category tend to live 6.27% longer, rather than 7.84% longer, compared to those in the obese category (Table 4-4, row *g*): CPB = 2,943 QALYs.
- Assume that individuals in the overweight category tend to live 9.41% longer, rather than 7.84% longer, compared to those in the obese category, (Table 4-4, row *g*): CPB = 3,523 QALYs.

**Table 4-4: CPB of Screening for and Management of Obesity in Adults in a Birth Cohort of 40,000**

| Row Label | Variable | Base Case | Data Source |
|---|---|---|---|
| a | Years of life lived with Class I or II obesity | 307,934 | Tables 4-2 and 4-3 |
| b | Adherence with an intensive, multicomponent behavioral intervention | 30% | Assumed |
| c | Number needed to treat to achieve a clinically important reduction in weight (≥5% of body weight) | 5 | √ |
| d | Reduced years of life lived with Class I or II obesity due to intervention | 18,476 | = (a * b) / c |
| | **Benefits Associated with Screening and Management** | | |
| e | Reduction in quality of life - Class I / II obesity vs. overweight | 9.66% | √ |
| f | QALYs gained | 1,785 | = d * e |
| g | Reduction in years of life lived - Class I / II obesity vs. overweight | 7.84% | √ |
| h | QALYs gained | 1,449 | = d * g |
| i | **Potential QALYs gained, management increasing from 0% to 30%** | **3,233** | = f + h |

*√ = Estimates from the literature*

In estimating CE, we made the following additional assumptions:

- **Frequency of screening** - We assumed that a general practitioner would measure a patient's height and weight in order to calculate BMI and discuss physical activity and healthy eating once every two years (Table 4-5, row *g*).

- **Cost of an office visit** - We estimated the average cost of a 10-minute visit to a general practitioner to be $34.00 based on information from the BC Medical Services Commission 2013 payment schedule[109] (Table 4-5, row *i*).
- **Patient time costs for office visit** - For patient time costs (Table 3-7, row *i*), we assumed an hourly wage of $24.39 (the BC average in 2013)[110] plus 18% benefits applied to the estimated two hours of patient time required (including travel to and from the appointment). These costs totalled to $57.56 per physician visit. We assumed that 50% of an office visit would be required to measure a patient's height and weight and discuss physical activity and healthy eating (Table 4-5, row *k*).
- **Cost of an intensive, multicomponent behavioral intervention** - The per person costs of such interventions in the literature vary substantially, ranging from $285 to $4,819 (converted into 2013 Canadian $).[111,112,113,114] The difference in costs is largely attributable to the ratio of facilitators to clients. The intervention costing $4,819 per person involved case managers teaching a 16-week curriculum on a one-to-one basis.[115] The intervention costing $285 per person was set up for 16 group sessions of up to 18 persons.[116] We used the mean cost of three of the four interventions (excluding the $4,819 per person intervention) for an estimated cost of $588 per person per intervention (Table 4-5, row *m*).
- **Patient time costs for intensive, multicomponent behavioral intervention** - We assumed three hours of patient time would be required (including travel to and from the session) for an average of 18 sessions, the mid-point between 12 and 24 sessions (Table 4-4, rows *q & r*).
- **Overweight or obesity** - We assumed excess health care associated with overweight and obesity costs $196 and $689 per year, respectively (Table 4-5, rows *w & x*).[117]
- **Discount rate** - 3%.

Based on these assumptions, the CE associated with screening for and management of obesity is $10,346 per QALY (Table 4-5, row *kk*).

We also modified several major assumptions and recalculated the cost per QALY as follows:

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[109] Medical Services Commission. *Payment Schedule: Section 7 General Practice*. 2013. Available at http://www.health.gov.bc.ca/msp/infoprac/physbilling/payschedule/pdf/7-general-practice.pdf. Accessed December 2013.
[110] See http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/Earnings.aspx. Accessed February 2015.
[111] Gustafson A, Khavjou O, Stearns SC et al. Cost-effectiveness of a behavioral weight loss intervention for low-income women: the Weight-Wise Program. *Preventive Medicine*. 2009; 49(5): 390-5.
[112] Krukowski RA, Tilford JM, Harvey-Berino J et al. Comparing behavioral weight loss modalities: incremental cost-effectiveness of an internet-based versus an in-person condition. *Obesity*. 2011; 19(8): 1629-35.
[113] Neumann A, Schwarz P and Lindholm L. Estimating the cost-effectiveness of lifestyle intervention programmes to prevent diabetes based on an example from Germany: Markov modelling. *Cost Effectiveness and Resource Allocation*. 2011; 9(1): 17.
[114] Group DPPR. Costs associated with the primary prevention of type 2 diabetes mellitus in the diabetes prevention program. *Diabetes Care*. 2003; 26(1): 36-47.
[115] Group DPPR. Costs associated with the primary prevention of type 2 diabetes mellitus in the diabetes prevention program. *Diabetes Care*. 2003; 26(1): 36-47.
[116] Gustafson A, Khavjou O, Stearns SC et al. Cost-effectiveness of a behavioral weight loss intervention for low-income women: the Weight-Wise Program. *Preventive Medicine*. 2009; 49(5): 390-5.
[117] Krueger H, Turner D, Krueger J et al. The economic benefits of risk factor reduction in Canada: tobacco smoking, excess weight and physical inactivity. *Canadian Journal of Public Health*. 2013; 105(1): e69-78.

- Assume adherence with the intervention is reduced from 30% to 20% (Table 4-4, rows *b*): CE = $16,740 per QALY.
- Assume adherence with the intervention is increased from 30% to 40% (Table 4-4, rows *b*): CE = $7,149 per QALY.
- Assume that one out of every four participants lost at least 5% of their body weight after completing an intensive, multicomponent behavioral intervention rather than one out of every five participants (Table 4-4, row *c*): CE = $7,549 per QALY.
- Assume that one out of every seven participants lost at least 5% of their body weight after completing an intensive, multicomponent behavioral intervention rather than one out of every five participants (Table 4-4, row *c*): CE = $15,941 per QALY.
- Assume that individuals in the obese category tend to have a 7.73% rather than a 9.66% reduction in quality of life compared to those in the overweight category (Table 4-4, row *e*): CE = $12,066 per QALY.
- Assume that individuals in the obese category tend to have a 11.59% rather than a 9.66% reduction in quality of life compared to those in the overweight category (Table 4-4, row *e*): CE = $9,055 per QALY.
- Assume that individuals in the overweight category tend to live 6.27% longer, rather than 7.84% longer, compared to those in the obese category (Table 4-4, row *g*): CE = $10,976 per QALY.
- Assume that individuals in the overweight category tend to live 9.41% longer, rather than 7.84% longer, compared to those in the obese category, (Table 4-4, row *g*): CE = $9,785 per QALY.
- Assume that the frequency of measuring height and weight and asking about physical activity and diet would occur every year rather than once every two years (Table 4-5, row *g*): CE = $23,134 per QALY.
- Assume that the frequency of measuring height and weight and asking about physical activity and diet would occur every three years rather than once every two years (Table 4-5, row *g*): CE = $6,084 per QALY.
- Assume that the costs per person of an intensive, multicomponent behavioral intervention are reduced from $588 to $285 (Table 4-5, row *m*): CE = $10,176 per QALY.
- Assume that the costs per person of an intensive, multicomponent behavioral intervention are increased from $588 to $4,819 (Table 4-5, row *m*): CE = $12,716 per QALY.
- Assume that the number of treatments per intensive, multicomponent behavioral intervention are increased from 18 to 24 (Table 4-5, row *q*): CE = $10,636 per QALY.
- Assume that the number of treatments per intensive, multicomponent behavioral intervention are reduced from 18 to 12 (Table 4-5, row *q*): CE = $10,056 per QALY.

| Table 4-5: CE of Screening for and Management of Obesity in Adults in a Birth Cohort of 40,000 | | | |
|---|---|---|---|
| **Row Label** | **Variable** | **Base Case** | **Data Source** |
| a | Individuals in birth cohort at age 40 | 39,075 | Tables 4-2 and 4-3 |
| b | Total life years between age 18 and 70 | 1,996,426 | Tables 4-2 and 4-3 |
| c | Proportion of years with Class I / II obesity without intervention | 12.0% | Tables 4-2 and 4-3 |
| d | Years with Class I / II obesity without intervention | 307,934 | Tables 4-2 and 4-3 |
| e | Adherence with screening in primary care | 70% | Assumed |
| f | Adherence with an intensive, multicomponent behavioral intervention | 30% | Assumed |
| | **Costs of intervention** | | |
| g | Frequency of measuring height and weight and asking about physical activity and diet (every x years) between age 18 and 70 | 2 | Assumed |
| h | Total number of screens | 698,749 | = (b * e) / g |
| i | Cost of 10-minute office visit | $34.00 | √ |
| j | Value of patient time and travel for office visit | $57.56 | √ |
| k | Portion of 10-minute office visit for screen | 50% | Assumed |
| l | Cost of screening | $31,988,734 | = h * (I + j) * k |
| m | Costs per person of an intensive, multicomponent behavioral intervention | $588 | √ |
| n | Individuals eligible for an intensive, multicomponent behavioral intervention | 4,671 | = a * c |
| o | Individuals enrolled in an intensive, multicomponent behavioral intervention | 1,401 | = n * f |
| p | Costs of an intensive, multicomponent behavioral intervention | $823,877 | = o * m |
| q | # of treatments per intensive, multicomponent behavioral intervention | 18 | √ |
| r | Value of patient time and travel for per intervention treatment | $86.34 | √ |
| s | Value of patient time and travel for intervention | $2,177,557 | = o * q * r |
| | **Cost avoided** | | |
| t | Number needed to treat to achieve a clinically important reduction in weight (≥5% of body weight) | 5 | √ |
| u | Individuals achieving a clinically important reduction in weight (≥5% of body weight) | 280 | = o / t |
| v | Years with Class I / II obesity avoided with intervention | 18,476 | = (u / n) * d |
| w | Excess direct costs per year attributable to obesity | $689 | √ |
| x | Excess direct costs per year attributable to overweight | $196 | √ |
| w | Costs avoided | $9,108,690 | =(w - x) *v |
| | **CE calculation** | | |
| z | Cost of intervention over lifetime of birth cohort | $34,990,168 | = l + p + s |
| aa | Costs avoided | $9,108,690 | = w |
| bb | QALYs saved | 3,233 | Table 4-4, row i |
| cc | Cost of intervention over lifetime of birth cohort (3% discount) | $17,961,515 | Calculated |
| dd | Costs avoided (3% discount) | $4,675,767 | Calculated |
| ee | QALYs saved (3% discount) | 1,284 | Calculated |
| ff | **CE ($/QALY saved)** | **$10,346** | = (cc-dd)/ee |

*√ = Estimates from the literature*

**Summary**

**Table 4-6: Screening for and Management of Obesity in Adults in a Birth Cohort of 40,000**

Summary

| | Base Case | Range | |
|---|---|---|---|
| **CPB** (Potential QALYs Gained) | | | |
| *Assume No Current Service* | | | |
| 3% Discount Rate | 1,284 | 856 | 1,712 |
| 0% Discount Rate | 3,233 | 2,156 | 4,311 |
| *Gap between B.C. Current and Best in the World* | | | |
| 3% Discount Rate | | Unknown | |
| 0% Discount Rate | | | |
| **CE** ($/QALY) **including** patient time costs | | | |
| 3% Discount Rate | $10,346 | $6,084 | $23,134 |
| 0% Discount Rate | $8,005 | $4,707 | $17,898 |
| **CE** ($/QALY) **excluding** patient time costs | | | |
| 3% Discount Rate | $1,437 | -$146 | $6,185 |
| 0% Discount Rate | $1,112 | -$113 | $4,785 |

# The Lifetime Prevention Schedule

## Establishing Priorities among Effective Clinical Prevention Services in British Columbia

Summary and Technical Report
March 2015 Update

Promotion of Breastfeeding, Screening for Type 2 Diabetes, Behavioural Counselling for Sexually Transmitted Infections and Obesity in Adults

Participating partner organizations:

BC Cancer Agency
CARE + RESEARCH
An agency of the Provincial Health Services Authority

BRITISH COLUMBIA

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

CHILD HEALTH BC
LEAD BENEFACTOR
save on foods

GPSC
General Practice Services Committee

Perinatal Services BC
An agency of the Provincial Health Services Authority

Provincial Health Services Authority
Province-wide solutions. Better health.

SSC
SPECIALIST SERVICES COMMITTEE

UBC
a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

University of Victoria