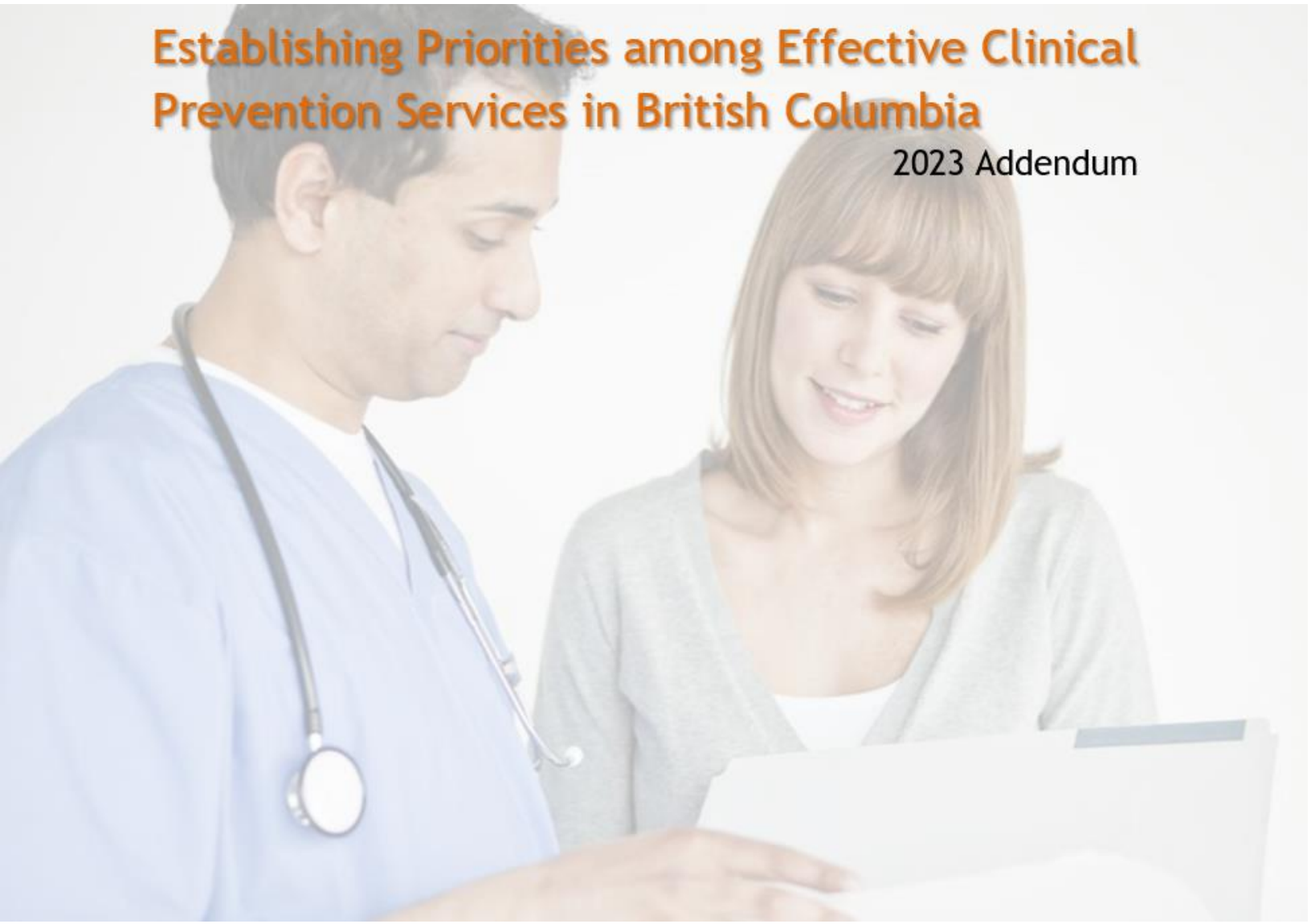
The Lifetime Prevention Schedule



BRITISH COLUMBIA

Acknowledgments

This project was completed under the guidance of the Lifetime Prevention Schedule Expert Committee. Current committee members are:

- **Andrea Godfreyson** (Chair) **-** Director, Injury & Clinical Prevention, Population and Public Health Division, BC Ministry of Health
- **Lindsay Arscott -** Director, Primary Care Quality, Primary Care, BC Ministry of Health
- **Martin Dawes -** Professor of Family Practice, Department of Family Practice, Faculty of Medicine, University of British Columbia
- **Brain Emerson -** Deputy Provincial Health Officer, Office of the Provincial Health Officer
- **Tijana Fazlagic -** Executive Director, PharmaCare Benefits Branch, Pharmaceutical Services, BC Ministry of Health
- **Yang Geng** (LPSEC Secretariat) **-** Policy Analyst, Lifetime Prevention Schedule, Population and Public Health, BC Ministry of Health
- **Hilary Ho -** Policy Analyst, Provincial & Specialized Services, Acute and Provincial Services Branch, Hospital & Provincial Health Services, BC Ministry of Health
- **Zahra Hussein -** Provincial Lead, Primary Care, Child Health BC
- **Heather Jackson -** Senior Director, Quality, Research & Integrative Care, Cardiac Services BC
- **Penny Liao-Lussier -** Provincial Director, Primary Care & Prevention, Child Health BC
- **Julie MacFarlane -** Provincial Lead, Screening Programs, Perinatal Services BC
- **Megan Oakey -** Provincial Manager, Injury Prevention, Population and Public Health, BC Centre for Disease Control
- **Pamela Parkinson -** Manager, Lifetime Prevention Schedule, Population and Public Health, BC Ministry of Health
- **Jonathan Robinson -** Executive Director, Healthy Living and Health Promotion, Population and Public Health, BC Ministry of Health
- **Manik Saini -** Director, Health Technology Assessment, Partnership and Innovation Division, BC Ministry of Health
- **Nicholas Schnee -** Executive Director, Cardiac Services BC, Stroke Service BC and Provincial Specialized Programs and Clinical Policy
- **Rachel Yeung Thompson -** Director, Women's, Maternal and Early Childhood Health, Population and Public Health, BC Ministry of Health
- **Jillian Hannah -** Policy Analyst, Laboratory Services, Pharmaceutical, Laboratory and Blood Services Division, BC Ministry of Health
- **Stuart Peacock -** Head of Cancer Control, BC Cancer

Update completed by H. Krueger & Associates Inc.

Table of Contents

Establishing Priorities among Effective Clinical Prevention Services in British Columbia: *2023 Addendum*

Background

Each year since 2014 the Lifetime Prevention Schedule Expert Committee (LPSEC) has published an updated detailed report.[1] Between 2009 and 2022, the Lifetime Prevention Schedule team has reviewed and modeled a total of 30 clinical prevention services (CPS). In 2018, all models produced to date received an update which included converting costs into 2017 Canadian dollars. In 2022, the LPSEC decided to complete another update of all models, including converting costs into 2022 Canadian dollars. Given the volume of models that needed to be updated, this task is being completed over a two-year cycle, namely, fiscal 2022/23 and 2023/24.

In addition to this work, in the 2022/23 fiscal year, the LPSEC completed a major model update for *Preventing Tobacco Use in Children and Youth* and completed a review of new evidence for *Fluoride Varnish to Prevent Dental Caries in Children*. The updated model is a revision of the original model which was done in 2014. It now includes considerations related to e-cigarettes given the notable increase in e-cigarette use among children and youth in recent years. This 2023 Addendum provides the results of the updated *Preventing Tobacco Use in Children and Youth*, with costs in 2022 Canadian dollars, as well as the findings of the review of new evidence for *Fluoride Varnish to Prevent Dental Caries in Children*, in particular new evidence regarding the effectiveness of fluoride varnish in treating dental caries. The Addendum does not include any of the other models that are currently being updated. A fully updated Technical Report with all models in 2022 Canadian dollars will be released in 2024.

[1] See https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/health-priorities/lifetime-prevention. Accessed May 2023.

Behavioural Counselling Interventions

Preventing Tobacco Use in Children and Youth

Canadian Task Force on Preventive Health Care Recommendations (2017)

*We recommend asking children and youth (age 5–18 yr.) or their parents about tobacco use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to **prevent** tobacco smoking among children and youth (weak recommendation, low-quality evidence).*

*We recommend asking children and youth (age 5–18 yr.) or their parents about tobacco use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to **treat** tobacco smoking among children and youth (weak recommendation, low-quality evidence).*[2]

United States Preventive Services Task Force Recommendations (2020)

*The USPSTF recommends that primary care clinicians provide interventions, including education or brief counseling, to **prevent** initiation of tobacco use among school-aged children and adolescents (ages 5-17 yr.) (B Recommendation)*

*The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of primary care–feasible interventions for the **cessation** of tobacco use among school-aged children and adolescents (ages 5-17 yr.) (I Recommendation)*[3]

Other Approaches to Prevention

In the review of the evidence for the 2013 recommendation,[4] the USPSTF noted that the 2012 Surgeon General's Report concluded that there is a "large, robust, and consistent" evidence base that documents known effective strategies for reducing tobacco use among youth and young adults.[5] These strategies include coordinated, multi-component approaches that combine media campaigns, price increases, school-based policies and programs and community-wide changes in policies and norms. The purpose of the USPSTF review was not to reconsider the evidence covered by the Surgeon General's Report, but rather "to review the evidence for the efficacy and harms of **primary-care relevant interventions** (emphasis added) that aim to reduce tobacco use among children and adolescents."[6]

---

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

[3] US Preventive Service Task Force. Primary care interventions for prevention and cessation of tobacco use in children and adolescents: US Preventive Services Task Force recommendation statement. *JAMA*. 2020; 323(16): 1590-98.

[4] Patnode CD, O'Connor E, Whitlock EP et al. Primary care-relevant interventions for tobacco use prevention and cessation in children and adolescents: a systematic evidence review for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*. 2013; 158(4): 253-60.

[5] U.S. Department of Health and Human Services. *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*. 2012. Available at http://www.cdc.gov/tobacco/data_statistics/sgr/2012/consumer_booklet/pdfs/consumer.pdf. Accessed January 2014.

[6] Patnode CD, O'Connor E, Whitlock EP et al. Primary care-relevant interventions for tobacco use prevention and cessation in children and adolescents: a systematic evidence review for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*. 2013; 158(4): 253-60.

Use of E-Cigarettes

The 2017 CTFPHC report states that "this guideline does not address smokeless tobacco or e-cigarettes".[7] They note, however, that "the number of children and youth trying e-cigarettes is increasing, and one in five youth 15-19 years of age have tried them."[8]

The 2020 USPSTF report does include the use of e-cigarettes in its updated guidelines, noting that "although conventional cigarette use has gradually declined among children in the US since the late 1990s, tobacco use via electronic cigarettes (e-cigarettes) is quickly rising and is now more common among youth than cigarette smoking. E-cigarette products usually contain nicotine, which is addictive, raising concerns about e-cigarette use and nicotine addiction in children. Exposure to nicotine during adolescence can harm the developing brain, which may affect brain function and cognition, attention, and mood; thus, minimizing nicotine exposure from any tobacco product in youth is important."[9]

Furthermore, the 2020 USPSTF report notes that "most of the evidence on behavioral counseling interventions to prevent tobacco use focused on prevention of cigarette smoking. Given the similar contextual and cultural issues currently surrounding the use of e-cigarettes in youth and the inclusion of e-cigarettes as a tobacco product by the FDA, the USPSTF concludes that the evidence on interventions to prevent cigarette smoking could be applied to prevention of e-cigarette use as well. The USPSTF also concludes that the evidence could be applied to prevention of cigar use, which includes cigarillos and little cigars."[10]

Best in the World

- In Oregon, 87.4% of adolescents ages 10-17 who visited a primary care provider between January 1, 2016 and December 31, 2017 had their smoking status assessed.[11]
- In Florida, 92.3% of adolescents ages 11-17 who visited a primary care provider between July 2016 and November 2017 were asked about their current cigarette smoking. Just over half (51.4%) were asked about their current use of smokeless tobacco but none were asked about their use of electronic nicotine delivery systems (ENDS).[12]
- In a national US sample of adolescents ages 12 to 17, 45.2% of those who screened positive for current cigarette smoking were advised by their clinician to quit smoking.[13]

[7] Canadian Task Force on Preventive Health Care. Recommendations on behavioural interventions for the prevention and treatment of cigarette smoking among school-aged children and youth. *Canadian Medical Association Journal*. 2017; 189 (8): E310-16.
[8] Ibid.
[9] US Preventive Service Task Force. Primary care interventions for prevention and cessation of tobacco use in children and adolescents: US Preventive Services Task Force recommendation statement. *JAMA*. 2020; 323(16): 1590-98.
[10] US Preventive Service Task Force. Primary care interventions for prevention and cessation of tobacco use in children and adolescents: US Preventive Services Task Force recommendation statement. *JAMA*. 2020; 323(16): 1590-98.
[11] Bailey S, Fankhosuer K, Marino M et al. Smoking assessment and current smoking status among adolescents in primary care. *Nicotine & Tobacco Research*. 2020; 22(11): 2098-2103.
[12] LeLaurin J, Theis R, Thompson L et al. Tobacco-related counselling and documentation in adolescent primary care practice: Challenges and opportunities. *Nicotine & Tobacco Research*. 2020; 22(6): 1023-9.
[13] Merianos A, Mahabee-Gittens E. Screening, counselling, and health care utilization among a national sample of adolescent smokers. *Clinical Paediatrics*. 2020; 59(4-5): 467-75.

- In a survey of 1,050 US pediatric care providers conducted in 2021, 69.4% indicated they screen patients for e-cigarette use, 63.8% counsel e-cigarette prevention and 67% counsel e-cigarette cessation.[14]
- Matheus and colleagues managed to improve screening rates for e-cigarette use from 23% to 89% of 300 adolescents with a health maintenance or sports physical visit between October 2019 and February 2020 in the US.[15]

- For modelling purposes, we have assumed that the best rate in the world for cigarette / e-cigarette screening of children / youth is 92%[16] and 89%[17] of those with a primary health care visit in a given year. Furthermore, 45%[18] and 67%[19] of those found positive for cigarette / e-cigarette use receive counselling to quit.

Modelling the Clinically Preventable Burden

In this section, we model CPB associated with asking children and youth or their parents about tobacco use / e-cigarette use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to prevent and / or treat tobacco smoking and e-cigarette use among children and youth.

Definitions

- "Tobacco products include any product made or derived from tobacco intended for human consumption (except products that meet the definition of drugs), including, but not limited to, cigarettes, cigars (including cigarillos and little cigars), dissolvable tobacco, hookah tobacco, nicotine gels, pipe tobacco, roll-your-own tobacco, smokeless tobacco products (including dip, snuff, snus, and chewing tobacco), vapes, e-cigarettes, hookah pens, and other electronic nicotine delivery systems. 'Smoking' generally refers to the inhaling and exhaling of smoke produced by combustible tobacco products such as cigarettes, cigars, and pipes. 'Vaping' refers to the inhaling and exhaling of aerosols produced by e-cigarettes."[20]

Defining and Estimating the Population at Risk

- "All youth are considered at risk of initiating tobacco use. Interventions to prevent the initiation of tobacco use should be provided to all youth who have not started using tobacco products yet, regardless of the presence or absence of other risk factors. The following risk factors may increase the risk of tobacco use in youth: being male, white race, not college-bound, from a rural area, having parents with lower levels of education, parental smoking, having childhood friends who smoke, being an older

[14] Golden T, VanFrank B, Courtney-Long E. E-cigarette screening and clinical intervention behaviours among pediatric primary care providers, DocStyles 2021. *Paediatrics*. 2022; 149: 740.
[15] Matheus C, Hein N, Narahari P et al. Improving standardized screening for e-cigarette and vaping use among adolescents. *Paediatrics*. 2021; 147 (3-Meeting Abstract): 1002.
[16] LeLaurin J, Theis R, Thompson L et al. Tobacco-related counselling and documentation in adolescent primary care practice: Challenges and opportunities. *Nicotine & Tobacco Research*. 2020; 22(6): 1023-9.
[17] Matheus C, Hein N, Narahari P et al. Improving standardized screening for e-cigarette and vaping use among adolescents. *Paediatrics*. 2021; 147 (3-Meeting Abstract): 1002.
[18] Merianos A, Mahabee-Gittens E. Screening, counselling, and health care utilization among a national sample of adolescent smokers. *Clinical Paediatrics*. 2020; 59(4-5): 467-75.
[19] Golden T, VanFrank B, Courtney-Long E. E-cigarette screening and clinical intervention behaviours among pediatric primary care providers, DocStyles 2021. *Paediatrics*. 2022; 149: 740.
[20] US Preventive Service Task Force. Primary care interventions for prevention and cessation of tobacco use in children and adolescents: US Preventive Services Task Force recommendation statement. *JAMA*. 2020; 323(16): 1590-98.

adolescent, experiencing highly stressful events, and perceiving tobacco use as low risk."[21]

- Based on data from the 2018/19 Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS), just 0.80% of BC adolescents in grades 7-9 and 4.40% of BC adolescents in grades 10-12 were current smokers. Current smokers include occasional (smoked at least one cigarette during the past 30 days, but has not smoked every day) and daily (smoke at least one cigarette per day for each of the 30 days preceding the survey) smokers (see Table 1).[22]

Table 1: Cigarette Smoking in British Columbia
Adolescents in Grades 7 to 12
In 2018/19

Grade	Current Smoker	Current Daily Smoker	Current Occasional Smoker
Grades 7-9			
Male	0.88%	0.40%	0.48%
Female	0.72%	0.32%	0.40%
Combined	0.80%	0.36%	0.44%
Grades 10-12			
Male	5.26%	1.53%	3.73%
Female	3.35%	0.96%	2.39%
Combined	4.40%	1.24%	3.16%

Extrapolated based on data for Canada

- Across Canada, the proportion of adolescent current smokers ages 12-17 has declined from 4.1% in 2015 to 1.1% in 2021 (see Table 2).[23]

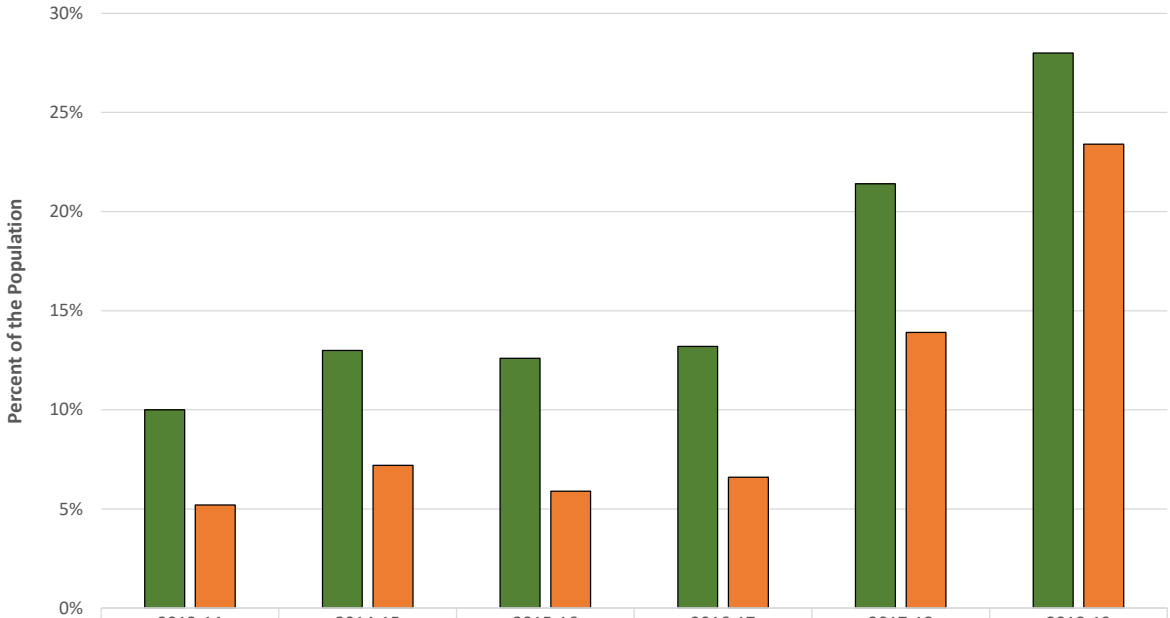
Table 2: Trend in the Proportion of Daily or Occasional Smokers in Canada
Ages 12 - 17
2015 to 2021

Sex	2015	2016	2017	2018	2019	2020	2021
Males	4.3%	3.9%	2.7%	3.3%	2.5%	2.3%	1.3%
Females	4.0%	3.3%	4.3%	3.0%	2.5%	1.3%	1.0%
Total	**4.1%**	**3.6%**	**3.5%**	**3.2%**	**2.5%**	**1.8%**	**1.1%**

[21] US Preventive Service Task Force. Primary care interventions for prevention and cessation of tobacco use in children and adolescents: US Preventive Services Task Force recommendation statement. *JAMA*. 2020; 323(16): 1590-98.
[22] Canadian Student Tobacco, Alcohol and Drugs Survey 2018-2019, Table 3. Available online at https://www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey/2018-2019-detailed-tables.html#t3. Accessed September 2022.
[23] Statistics Canada, *Smokers by Age Group*. Available online at https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310009610&pickMembers%5B0%5D=1.1&pickMembers%5B1%5D=3.1&cubeTimeFrame.startYear=2015&cubeTimeFrame.endYear=2021&referencePeriods=20150101%2C20210101. Accessed September 2022.

- In 2018 in BC among the 19% of children / youth aged 12-19 who had ever smoked tobacco, the age they first tried smoking was as follows:[24]
    - Less than 9 Years old – 5%
    - 9 – 2%
    - 10 – 3%
    - 11 – 3%
    - 12 – 8%
    - 13 – 14%
    - 14 – 19%
    - 15 – 20%
    - 16 – 17%
    - 17 or older – 10%
- While cigarette smoking among adolescents has decreased, use of e-cigarettes has increased dramatically. In Ontario, for example, the rate of e-cigarette use in male adolescents increased almost 3-fold during the six year period between 2013/14 and 2018/19. In female adolescents, the rate of increase during that time was even higher, at greater than 4-fold (see Figure 1).[25]

Figure 1: Trend in E-Cigarette Use (in the Past 30 Days) in Ontario
Grade 9-12 Students
2013/14 to 2018/19



	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Males	10.0%	13.0%	12.6%	13.2%	21.4%	28.0%
Females	5.2%	7.2%	5.9%	6.6%	13.9%	23.4%

Fiscal Year

[24] Smith A, Peled M, Poon C et al. *Understanding Tobacco Use and Vaping among BC Youth: Findings from the BC Adolescent Health Survey.* 2020. Vancouver, BC: McCreary Centre Society.
[25] Cole A, Aleyan S, Battista K et al. Trends in youth e-cigarette and cigarette use between 2013 and 2019: Insights from repeat cross-sectional data from the COMPASS study. *Canadian Journal of Public Health*. 2021; 112: 60-69.

- In BC, the proportion of adolescents in grades 10-12 who had ever tried e-cigarettes increased from 34.3% in 2016/17 to 56.6% in 2018/19. Daily or almost daily use increased even more dramatically in the cohort, from 2.5% in 2016/17 to 11.6% in 2018/19 (see Table 3).[26]

Table 3: Use of E-Cigarettes in British Columbia
Adolescents in Grades 7 - 12

	In 2016/17			*In 2018/19*		
	Ever Tried	Past 30-Day Use	Daily or Almost Daily Use	Ever Tried	Past 30-Day Use	Daily or Almost Daily Use
Grades 7-9						
Male	13.1%	6.4%	1.1%	23.9%	15.0%	2.7%
Female	10.9%	5.9%	0.3%	26.1%	15.8%	2.2%
Combined	**12.0%**	**6.1%**	**0.7%**	**25.0%**	**15.4%**	**2.5%**
Grades 10-12						
Male	38.6%	23.4%	4.0%	56.9%	40.3%	13.9%
Female	29.9%	12.6%	1.0%	56.4%	36.7%	9.3%
Combined	**34.3%**	**18.1%**	**2.5%**	**56.6%**	**38.5%**	**11.6%**

- In BC, 29% of children / youth ages 12-19 used at least one nicotine-related product in the month prior to completing the 2018 BC Adolescent Health Survey. The proportion of youth that used each product was as follows:[27]
    - Vape pen/stick – 27%
    - Cigarettes – 7%
    - Cigars/cigarillos – 3%
    - Chewing tobacco – 2%
    - A hookah – 2%

[26] Data for 2016/17 is from the Canadian Student Tobacco, Alcohol and Drugs Survey 2016-2017, Tables 5 & 6. Available online at https://www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey/2016-2017-supplementary-tables.html#t6.
Data for 2018/19 is from the Canadian Student Tobacco, Alcohol and Drugs Survey 2018-2019, Tables 5 & 6. Available online at https://www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey/2018-2019-detailed-tables.html#t3.
Accessed September 2022.

[27] Smith A, Peled M, Poon C et al. *Understanding Tobacco Use and Vaping among BC Youth: Findings from the BC Adolescent Health Survey.* 2020. Vancouver, BC: McCreary Centre Society.

- Not only are more adolescents using e-cigarettes but the intensity of use is also increasing.[28] Of US high school students who used e-cigarettes in 2019, 34.2% used them at least 20 out of the past 30 days (see Table 4).[29]

Table 4: Frequency of Tobacco Product Use During the Past 30 Days
Among US High School Students
By Product, 2019

	Days of Use		
	1-5	6-19	20-30
E-cigarettes	46.4%	19.4%	34.2%
Cigars	68.6%	14.1%	17.3%
Cigarettes	51.5%	16.0%	32.5%
Smokeless tobacco	44.0%	18.0%	37.9%
Hookahs	69.2%	13.2%	17.6%

- Among US youth, the initiation of e-cigarette use, in particular "fairly regular use", tends to peak at ages 17-18 (see Table 5).[30]

Table 5: Cumulative Proportion of US Youth Who Initiate e-Cigarette Use
By Age and e-Cigarette Use Outcome
During 2013 to 2017

Age	Ever Use	Past 30-Day Use	Fairly Regular Use *
13	3.0%	0.8%	0.45%
14	6.6%	2.3%	1.0%
15	11.7%	4.4%	2.2%
16	18.6%	7.4%	3.8%
17	30.4%	13.1%	6.6%
18	41.7%	23.5%	10.3%

** Based on the question "Have you ever used electronic nicotine products fairly regularly?"*

[28] Glantz S, Jeffers A, Winickoff J. Nicotine addiction and intensity of e-cigarette use by adolescents in the US, 2014 to 2021. *JAMA Network Open*. 2022; 5(11): e2240671.
[29] Wang T, Gentzke A, Creamer M et al. Tobacco product use and associated factors among middle and high school students – United States, 2019. *Morbidity and Mortality Weekly Report*. December 6, 2019; 68(12): 1-22.
[30] Perez A, Bluestein M, Chen B et al. Prospectively estimating the age of initiation of e-cigarettes among U.S. youth: Finding from the Population Assessment of Tobacco and Health (PATH) study, 2013-2017. *Journal of Journal of Biometrics and Biostatistics.* 2020; Volume 11(3): DOI: 10.37421/jbmbs.2020.11.44211

- Based on data from the 2019 Canadian Tobacco and Nicotine Survey,[31] the proportion of current smokers across Canada increased from 5.1% for those ages 15-19 to 13.3% for those ages 20-24, stabilizing at 13.3% between the ages of 25-45 and then declining modestly to 12.0% for those over the age of 45 (see Table 6). The proportion of the population reporting vaping during the past 30 days remained fairly constant between the ages of 15-24, dropping significantly thereafter (see Table 6).

Table 6: Smoking and Vaping Status
By Age Group and Sex
Canada, 2019

Sex	Age Group	Current Smoker	Former Smoker	Never Smoker	Vaping*
Male					
	15-19	6.0%	NA	92.6%	16.1%
	20-24	15.3%	8.6%	76.0%	18.0%
	25-44	13.7%	30.0%	69.4%	6.7%
	45+	12.9%	38.1%	49.0%	1.9%
	Total	**12.7%**	**26.0%**	**61.4%**	**5.8%**
Female					
	15-19	NA	NA	95.0%	13.6%
	20-24	10.6%	NA	88.0%	11.8%
	25-44	12.8%	17.3%	69.9%	3.3%
	45+	11.3%	32.2%	56.6%	1.3%
	Total	**11.1%**	**23.0%**	**65.9%**	**3.6%**
Total					
	15-19	5.1%	NA	93.4%	15.1%
	20-24	13.3%	5.2%	81.5%	15.2%
	25-44	13.3%	17.1%	17.1%	5.0%
	45+	12.0%	35.1%	35.1%	1.6%
	Total	**11.9%**	**24.5%**	**63.7%**	**4.7%**

*Notes: NA = not available; * Past 30-day use*

[31] Health Canada. *Canadian Tobacco and Nicotine Survey: 2019 Detailed Tables*. Available online at https://www.canada.ca/en/health-canada/services/canadian-tobacco-nicotine-survey/2019-summary/2019-detailed-tables.html#t1. Accessed September 2022.

E-Cigarette Use and Subsequent Cigarette Smoking

- Only a minority of adolescents (7.8%)[32] or young adults (12.8%)[33] who use e-cigarettes report using them for the purpose of smoking cessation.
- Among baseline adolescent never smokers, e-cigarette users have a much higher odds of subsequent **infrequent** (OR=4.27, 95% CI 2.75 – 6.62) or **frequent** (OR=3.51, 95% CI 1.97 – 6.24) cigarette use than never smokers who do not use e-cigarettes.[34]
- The probability of cigarette smoking initiation by an adolescent **ever** e-cigarette user is 30.4% vs. 7.9% by an adolescent **never** e-cigarette user, an odds ratio of 3.62 (95% CI of 2.42 to 5.41).[35]
- Soneji and co-authors suggest three possible reasons for this high level of cigarette smoking initiation by an adolescent ever e-cigarette user. First, e-cigarette use mimics the behavioral scripts of cigarette smoking. Second, adolescents and young adults who use nicotine-containing e-cigarettes may become addicted to nicotine because e-cigarette aerosol contains highly oxidizing free-base nicotine - the most addictive form of nicotine - that is easily absorbed by the body. And third, e-cigarette use may activate cognitive or behavioral processes that increase the risk of smoking.[36]

Harms Associated with E-Cigarette Use in Children and Youth

In addition to a higher risk of converting to conventional cigarette use, e-cigarette use in children and youth is also associated with a number of other harms.

- In a longitudinal study of 17,073 children with an average initial age of 9.9 years, ever-use of tobacco products, including e-cigarettes, was associated with inferior cognitive performance and reduced brain structure with sustained effects for at least two years.[37]
- Based on data from the 2016/17 US Behavioral Risk Factor Surveillance System, Obisesan and colleagues found that former e-cigarette users had a 1.60-fold (95% CI, 1.54-1.67) higher odds of reporting a history of clinical diagnosis of depression than never users, whereas current e-cigarette users had 2.10 (95% CI, 1.98-2.23) times higher odds. Additionally, higher odds of reporting depression were observed with increased frequency of use among current e-cigarette users compared with never

[32] Tsai J, Walton K, Coleman B et al. Reasons for electronic cigarette use among middle and high school students – National Youth Tobacco Survey, United States, 2016. *Morbidity and Mortality Weekly Report*. 2018; 67(6): 196-200.
[33] Hong H, Liu F, Urman R et al. Reasons for electronic cigarette use among South California young adults. In: *Proceedings of the American Thoracic Society International Conference*; May 19-24, 2017; Washington DC.
[34] Barrington-Trimis J, Komg G, Leventhal A et al. E-cigarette use and subsequent smoking frequency among adolescents. *Paediatrics*. 2018; 142(6): e20180486.
[35] Soneji S, Barrington-Trimis J, Wills T et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Paediatrics*. 2017; 171(8):788-97.
[36] Soneji S, Barrington-Trimis J, Wills T et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Paediatrics*. 2017; 171(8):788-97.
[37] Dai H, Doucet G, Wang Y et al. Longitudinal assessments of neurocognitive performance and brain structure associated with initiation of tobacco use in children, 2016 to 2021. *JAMA Network Open*. 2022; 5(8): e2225991.

users (**daily use**: OR, 2.39; 95% CI, 2.19-2.61; **occasional use**: OR, 1.96; 95% CI, 1.82-2.10).[38]

- Based on a study of 2,299 high school seniors, McCabe et al found that among users of e-cigarettes, lifetime cigarette smoking, alcohol use, marijuana use, nonmedical prescription drug use and illicit drug use (e.g., cocaine, LSD, heroin) are much higher compared with non-users of e-cigarettes. In particular, early onset of e-cigarette use (by grade 9 or earlier) was associated with an increased odds ratio of 14.2 for lifetime cigarette smoking, 70.6 for lifetime alcohol use, 16.4 for lifetime marijuana use, 9.5 for lifetime nonmedical prescription drug use and 19.2 for lifetime illicit drug use.[39]
- In their 2020 review of the available literature on the cardiovascular risk of e-cigarettes, Buchman and colleagues conclude that "there is growing evidence that e-cigarettes and their aerosol constituents, nicotine, carbonyl compounds, particulate matter, metals, and flavourings, can have adverse effects on the cardiovascular system" and furthermore "while there is a paucity of data, recent studies have also suggested that e-cigarette use is associated with inflammation, oxidative stress, and haemodynamic imbalance leading to increased cardiovascular diseases risk."[40]
- Dual use (combining the use of conventional cigarettes and e-cigarettes) may increase cardiovascular risk when compared with those who use only conventional cigarettes.[41]
- Based on a review of current evidence on the respiratory effects of e-cigarettes, Miyashita and Foley conclude that "e-cigarette exposure can disrupt pulmonary homeostasis, with reports of gas exchange disturbance, reduced lung function, increased airway inflammation and oxidative stress, downregulation of immunity, and increased risk of respiratory infection."[42]
- Based on a systematic review of the available literature on e-cigarette use and oral health, Yang and colleagues found that "the majority of mouth and throat symptoms experienced by e-cigarette users were relatively minor and temporary, with some evidence that conventional smokers who switched to e-cigarettes experienced mitigation of these symptoms. E-cigarette exposure increased the risk for deteriorating periodontal, dental and gingival health as well as changes to the oral microbiome. Extensive dental damage as a result of e-cigarette explosions were described in case reports."[43]
- Based on a systematic review of the available literature, Bjurlina et al found that "biomarkers of carcinogens, several with a strong link to bladder cancer, are present in the urine of e-cigarette users. Long-term implications of urothelial exposure to

[38] Obisesan O, Mirbolouk M, Osei A et al. Association between e-cigarette use and depression in the Behavioral Risk Factor Surveillance System, 2016-2017. *JAMA: Public Health*. 2019; 2(12): e1916800. doi:10.1001/jamanetworkopen.2019.16800.

[39] McCabe S, West B, McCabe V. Associations between early onset of e-cigarette use and cigarette smoking and other substance use among US adolescents: A national study. *Nicotine & Tobacco Research*. 2018; 923-30.

[40] Buchanan N, Grimmer J, Tanwar V et al. Cardiovascular risk of electronic cigarettes: A review of preclinical and clinical studies. *Cardiovascular Research*. 2020; 116: 40-50.

[41] Kim C, Paek Y, Seo H et al. Dual use of electronic and conventional cigarettes is associated with higher cardiovascular risk factors in Korean men. *Scientific Reports*. 2020; 10: 5612.

[42] Miyashital, Foley G. E-cigarettes and respiratory health: the latest evidence. *British Medical Journal*. 2019; 366: 5027-38.

[43] Yang I, Sandeep S, Rodriguez J. The oral health impact of electronic cigarette use: a systematic review. *Critical Reviews in Toxicology*. 2020; 50(2): 97-127.

these toxicants are unknown but concerning, given the similarities to tobacco smoke and its established relationship with bladder cancer."[44]

- Other potential harms include unintentional injuries due to device malfunctions, ingesting e-liquids by young children, nicotine toxicity and withdrawal symptoms.[45]

Estimating the Prevalence of Cigarette Smoking and E-Cigarette Use – No Intervention

- In estimating the number of current female and male adolescent **cigarette smokers** in a BC birth cohort of 40,000 we began with the assumption that 3.35% of females and 5.26% of males in grade 11 were current cigarette smokers (see Table 1). Furthermore, an additional 10%[46] of adolescents would take up cigarette smoking in grade 12 (age 17) for a total of 3.68% of females and 5.79% of males by the end of their 17th year (see Table 7). The % and number of cigarette smokers prior to age 17 is based on the age that BC youth first tried smoking (see Table 7).[47]
- In estimating the number of female and male adolescent **e-cigarette users** in a BC birth cohort of 40,000 we began with the assumption that 15.8% of females aged 13 (Grade 8) used e-cigarettes in the past 30 days and 2.2% were daily or almost daily users. The equivalent % for males aged 13 is 15.0% and 2.7% (see Table 3). By age 17 (Grade 11) 36.7% / 40.3% of females / males used e-cigarettes in the past 30 days and 9.3% / 13.9% of females / males were daily or almost daily users (see Table 3).
- A significant number of adolescents start e-cigarette use in their 18th year (see Table 5). This increase is reflected in the % and number of e-cigarette users by the end of their 18th year in Table 7.
- Hammond et al estimated that 41.9% of youth in Canada (in 2019) who smoke also vape.[48]
- We assumed that 22.5% of 18 year olds with past 30 day e-cigarette use **who did not smoke** would convert to cigarette smoking by age 24, based on the probability of cigarette smoking initiation by an adolescent **ever** e-cigarette user of 30.4% vs. 7.9% by an adolescent **never** e-cigarette user.[49] The uptake of cigarette smoking by this cohort between the ages of 18 and 24 was assumed to be linear (see Table 7).
- Of exclusive experimental e-cigarette users (past 30 day use but not regular users) at age 18, 10.6% who did not transition to conventional cigarette use would remain exclusive e-cigarette users by age 24. Of exclusive established e-cigarette users

[44] Bjurlina M, Matulewicz R, Roberts T et al. Carcinogen biomarkers in the urine of electronic cigarette users and implications for the development of bladder cancer: A systematic review. *European Urology Oncology*. 2021; 5(4): 766-783.
[45] Chadi N, Vyver E, Belanger R. Protecting children and adolescents against the risks of vaping. *Paediatrics and Child Health*. 2021; 351-65.
[46] Smith A, Peled M, Poon C et al. *Understanding Tobacco Use and Vaping among BC Youth: Findings from the BC Adolescent Health Survey.* 2020. Vancouver, BC: McCreary Centre Society.
[47] Smith A, Peled M, Poon C et al. *Understanding Tobacco Use and Vaping among BC Youth: Findings from the BC Adolescent Health Survey.* 2020. Vancouver, BC: McCreary Centre Society.
[48] Hammond D, reid J, Rynard V et al. Indicators of dependence and efforts to quit vaping among youth in Canada, England and the USA. *Tobacco Control*. 2022; 31: e25-e34.
[49] Soneji S, Barrington-Trimis J, Wills T et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Paediatrics*. 2017; 171(8):788-97.

(regular use) at age 18, 62.2% who did not transition to conventional cigarette use would remain exclusive e-cigarette users by age 24 (see Table 7).[50]

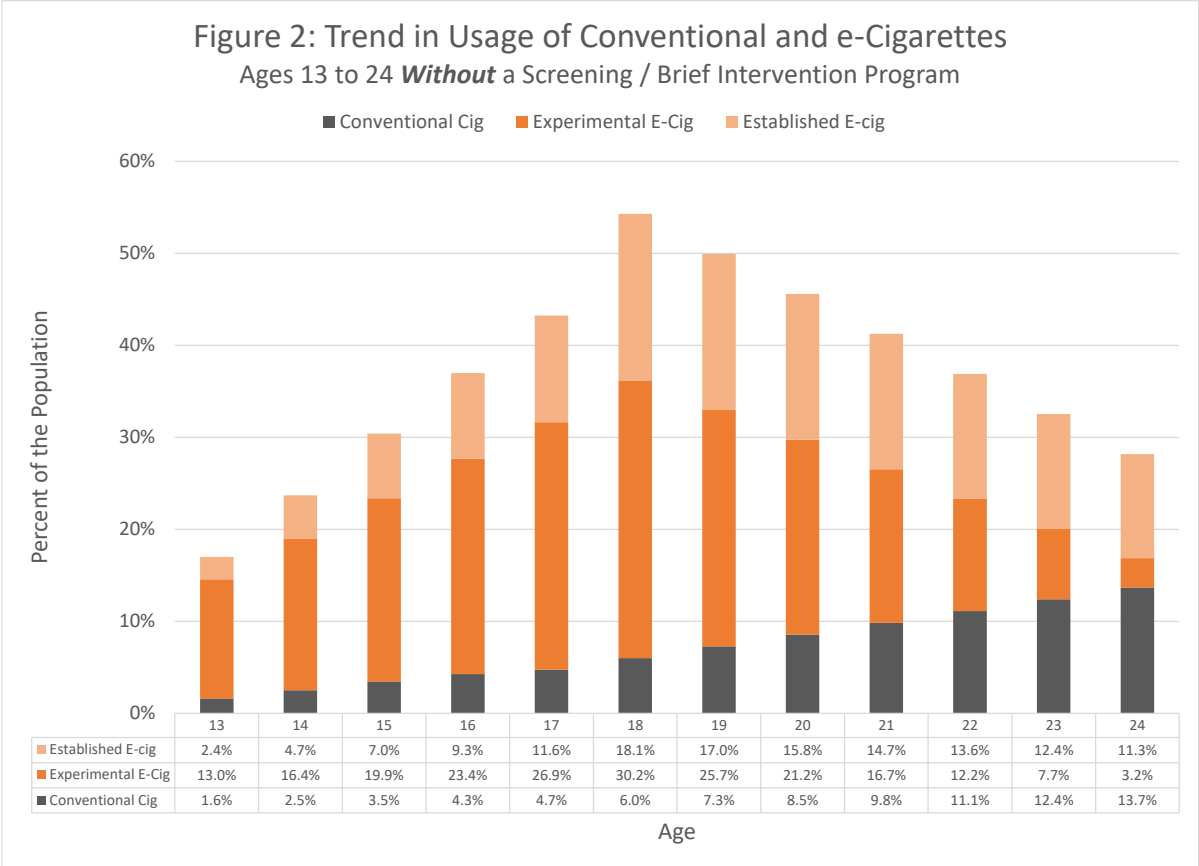
- Based on these assumptions, 5,414 (13.7%) in the BC birth cohort would be current smokers by age 24 (2,627 females [13.2%] and 2,788 males [14.1%]) while a further 5,571 (14.5%) would continue to use e-cigarettes at age 24 (2,527 females [12.7%] and 3,224 males [16.3%]) (see Table 7).

Table 7: Estimated Prevalence of Cigarette Smoking and E-cigarette Use
Between the Ages of 8 and 24
In a British Columbia Birth Cohort of 40,000
Without a Child / Youth Screening Program / Brief Intervention

	Female							*Male*							*Total Population*						
				e-Cigarette Past 30-day Use							*e-Cigarette* Past 30-day Use						*e-Cigarette* Past 30-day Use				
		Cigarette		Excl Regular Use		Regular Use			*Cigarette*		Excl Regular Use		Regular Use			*Cigarette*		Excl Regular Use		Regular Use	
Age	N	%	#	%	#	%	#	N	%	#	%	#	%	#	N	%	#	%	#	%	#
8	19,918	0.15%	29					19,907	0.23%	46					39,824	0.19%	75				
9	19,917	0.22%	44					19,906	0.35%	69					39,822	0.28%	113				
10	19,915	0.33%	66					19,904	0.52%	104					39,820	0.43%	170				
11	19,914	0.44%	88					19,903	0.69%	138					39,817	0.57%	226				
12	19,913	0.74%	147					19,902	1.16%	230					39,815	0.95%	377				
13	19,911	1.25%	249	13.6%	2,708	2.2%	438	19,900	1.97%	391	12.3%	2,448	2.7%	537	39,812	1.6%	641	13.0%	5,156	2.4%	975
14	19,910	1.95%	388	17.0%	3,394	4.0%	791	19,898	3.07%	610	15.8%	3,149	5.5%	1,094	39,808	2.5%	999	16.4%	6,543	4.7%	1,886
15	19,907	2.69%	535	20.5%	4,081	5.7%	1,145	19,896	4.22%	840	19.3%	3,850	8.3%	1,651	39,803	3.5%	1,375	19.9%	7,930	7.0%	2,796
16	19,904	3.31%	660	24.0%	4,767	7.5%	1,498	19,891	5.21%	1,036	22.9%	4,550	11.1%	2,208	39,795	4.3%	1,696	23.4%	9,318	9.3%	3,706
17	19,900	3.68%	733	27.4%	5,454	9.3%	1,851	19,885	5.79%	1,151	26.4%	5,251	13.9%	2,765	39,784	4.7%	1,884	26.9%	10,705	11.6%	4,616
18	19,894	5.04%	1,004	34.6%	6,893	14.5%	2,888	19,876	6.97%	1,385	25.7%	5,104	21.7%	4,313	39,770	6.0%	2,388	30.2%	11,997	18.1%	7,202
19	19,888	6.41%	1,274	29.5%	5,866	13.6%	2,706	19,864	8.15%	1,619	21.9%	4,343	20.3%	4,042	39,752	7.3%	2,893	25.7%	10,209	17.0%	6,748
20	19,881	7.77%	1,545	24.3%	4,839	12.7%	2,524	19,851	9.33%	1,852	18.0%	3,583	19.0%	3,770	39,732	8.5%	3,397	21.2%	8,422	15.8%	6,294
21	19,874	9.13%	1,815	19.2%	3,812	11.8%	2,342	19,835	10.52%	2,086	14.2%	2,822	17.6%	3,498	39,709	9.8%	3,901	16.7%	6,634	14.7%	5,841
22	19,867	10.50%	2,086	14.0%	2,785	10.9%	2,160	19,817	11.71%	2,320	10.4%	2,062	16.3%	3,226	39,684	11.1%	4,406	12.2%	4,847	13.6%	5,387
23	19,859	11.86%	2,356	8.9%	1,758	10.0%	1,978	19,796	12.90%	2,554	6.6%	1,301	14.9%	2,955	39,656	12.4%	4,910	7.7%	3,059	12.4%	4,933
24	19,851	13.23%	2,627	3.7%	731	9.0%	1,796	19,775	14.10%	2,788	2.7%	541	13.6%	2,683	39,626	13.7%	5,414	3.2%	1,272	11.3%	4,479

[50] Wei L, Muhammad-Kah R, Hannel T et al. The impact of cigarette and e-cigarette use history on transition patterns: A longitudinal analysis of the population assessment of tobacco and health (PATH) study, 2013 – 2015. *Harm Reduction Journal*. 2020; 17(45).

- Figure 2 provides a visual representation of the modelled transitions between conventional and e-cigarette use between the ages of 13 and 24 in the ***absence*** of a child and youth screening program and brief intervention.



	13	14	15	16	17	18	19	20	21	22	23	24
Established E-cig	2.4%	4.7%	7.0%	9.3%	11.6%	18.1%	17.0%	15.8%	14.7%	13.6%	12.4%	11.3%
Experimental E-Cig	13.0%	16.4%	19.9%	23.4%	26.9%	30.2%	25.7%	21.2%	16.7%	12.2%	7.7%	3.2%
Conventional Cig	1.6%	2.5%	3.5%	4.3%	4.7%	6.0%	7.3%	8.5%	9.8%	11.1%	12.4%	13.7%

Estimating the Number of Deaths and Life Years Lost Attributable to Cigarette Smoking – No Intervention

- We assumed that 53.7% of females and 51.6% of males would be light smokers (less than 10 cigarettes per day), 32.4% / 26.1% would be moderate smokers (10-19 cigarettes per day) and 13.9% / 22.4% would be heavy smokers (≥ 20 cigarettes per day).[51]
    - Of the 2,627 female cigarette smokers at age 24, 1,411 would be light smokers, 851 would be moderate smokers and 365 would be heavy smokers
    - Of the 2,788 male cigarette smokers at age 24, 1,437 would be light smokers, 727 would be moderate smokers and 623 would be heavy smokers

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

- On average, tobacco smoking is associated with 10 life years lost,[52] with 6.6, 11.9 and 18.1 life years lost associated with light, moderate and heavy smoking.[53]
    - Total life years lost in the 2,627 female cigarette smokers at age 24 is expected to be 26,403 ((1,411 * 6.6) + (851*11.9) + (365*18.1)).
    - Total life years lost in the 2,788 male cigarette smokers at age 24 is expected to be 29,421 ((1,437 * 6.6) + (727*11.9) + (623*18.1)).
- Based on data between 1990 to 2011 in the US, Lariscy and colleagues found an elevated relative risk ratio for all-cause mortality among current smokers by smoking intensity as follows:[54]
    - < 10 cigarettes – 1.78
    - 10-19 cigarettes – 2.04
    - 20-39 cigarettes – 2.47
    - ≥ 40 cigarettes – 3.23
- Data from the Lariscy et al study was used to estimate the distribution of excess deaths attributable to cigarette smoking by age and sex (see Table 8).[55]

Table 8: Distribution of Excess Deaths Attributable to Smoking
By Age and Sex

Age	*Female*	*Male*	*Total*
35-44	2.1%	2.7%	2.5%
45-54	10.6%	13.3%	12.3%
55-64	25.3%	30.5%	28.5%
65-74	31.1%	33.8%	32.8%
75-84	25.6%	16.9%	20.2%
85+	5.3%	2.8%	3.8%
Total	**100%**	**100%**	**100%**

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

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

[54] Lariscy J, Hummer R, Rogers R. Cigarette smoking and all-cause and cause-specific adult mortality in the United States. *Demography*. 2018; 55(5): 1855-85.

[55] Lariscy J, Hummer R, Rogers R. Cigarette smoking and all-cause and cause-specific adult mortality in the United States. *Demography*. 2018; 55(5): 1855-85.

- Data from the previous two bullet points was then combined to estimate the distribution of excess deaths by age, sex and smoking intensity (see Table 9).

Table 9: Distribution of Excess Deaths Attributable to Smoking
By Age, Sex and Smoking Intensity

	Females				***Males***			
	Smoking Intensity				*Smoking Intensity*			
Age	Light	Moderate	Heavy	Total	Light	Moderate	Heavy	Total
35-44	0.6%	0.7%	0.8%	2.1%	0.8%	0.9%	1.0%	2.7%
45-54	3.0%	3.4%	4.2%	10.6%	3.8%	4.3%	5.2%	13.3%
55-64	7.2%	8.2%	9.9%	25.3%	8.6%	9.9%	12.0%	30.5%
65-74	8.8%	10.1%	12.2%	31.1%	9.6%	11.0%	13.3%	33.8%
75-84	7.2%	8.3%	10.0%	25.6%	4.8%	5.5%	6.6%	16.9%
85+	1.5%	1.7%	2.1%	5.3%	0.8%	0.9%	1.1%	2.8%
Total	**28.3%**	**32.4%**	**39.3%**	**100%**	**28.3%**	**32.4%**	**39.3%**	**100%**

- Lariscy et al calculated that 18% of female deaths and 26% of male deaths ages 35+ in the US between 1990 and 2011 were attributable to tobacco smoking.[56]
- For modelling purposes we assumed no smoking-attributable deaths in the cohort until age 36. We then distributed smoking-attributable deaths in the cohort by age, sex and smoking intensity (as per Table 9) and then adjusted the results so that total life years lost in the female cohort of smokers would be 27,730 and in males it would be 34,518 (see above). After this adjustment, our model indicated that 25.8% of female deaths and 23.6% of male deaths in the cohort between the ages of 36 and 84 would be attributable to cigarette smoking.
- While long-term use of e-cigarettes is associated a number of harms (see section on *Harms Associated with E-Cigarette Use in Children and Youth*) it is not yet known whether such long-term use is associated with premature death and life years lost. The outbreak of vaping-associated lung illness in 2019 and 2020 resulted in at least 2,807 cases and 64 deaths in the US.[57] In Canada, however, just 20 cases have been identified with no deaths.[58]

[56] Lariscy J, Hummer R, Rogers R. Cigarette smoking and all-cause and cause-specific adult mortality in the United States. *Demography*. 2018; 55(5): 1855-85.
[57] Baker M, Procter T, Belzak L et al. Vaping-associated lung illness (VALI) in Canada: A descriptive analysis of VALI cases reported from September 2019 to December 2020. *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice.* 2022; 42(1): 37-44.
[58] Ibid.

- Based on these assumptions, 3,320 (61.3%) of the cohort who were smoking at age 24 (5,414) would die prematurely due to a smoking-attributable cause (see Table 10).
    - 1,519 of 2,627 female smokers (57.8%) (see Table 10).
    - 1,801 of 2,788 male smokers (64.6%) (see Table 10).

Table 10: Estimated Deaths and Life Years Lost Attributable to Cigarette Smoking

Between the Ages of 35 and 84

In a British Columbia Birth Cohort of 40,000

Without a Child / Youth Screening Program / Brief Intervention

	Female								***Male***								***Total Population***					
		Deaths								Deaths							Deaths Attributable to Smoking					
		In	Att to	By Smoking Intensity			LYL /			In	Att to	By Smoking Intensity			LYL /							
Age	**Pop.**	Cohort	Smoking	Light	Moderate	Heavy	Death	LYL	**Pop.**	Cohort	Smoking	Light	Moderate	Heavy	Death	LYL	**Pop.**	Light	Moderate	Heavy	Total	LYL
35	19,749								19,505								39,254					
36	19,736	13	3.1	0.9	1.0	1.2	50.8	160	19,474	31	6.3	1.8	2.0	2.5	46.5	292	39,210	2.7	3.1	3.7	9	452
37	19,722	14	3.3	0.9	1.1	1.3	49.9	164	19,442	32	6.4	1.8	2.1	2.5	45.6	294	39,164	2.8	3.2	3.8	10	458
38	19,708	14	3.4	1.0	1.1	1.4	48.9	168	19,409	33	6.6	1.9	2.2	2.6	44.7	297	39,117	2.9	3.3	4.0	10	465
39	19,693	15	3.6	1.0	1.2	1.4	47.9	174	19,375	34	6.9	2.0	2.2	2.7	43.7	301	39,068	3.0	3.4	4.1	11	475
40	19,677	16	3.8	1.1	1.2	1.5	47.0	177	19,339	35	7.1	2.0	2.3	2.8	42.8	305	39,017	3.1	3.5	4.3	11	483
41	19,661	16	4.0	1.1	1.3	1.6	46.0	183	19,303	37	7.4	2.1	2.4	2.9	41.9	309	38,964	3.2	3.7	4.5	11	492
42	19,643	18	4.3	1.2	1.4	1.7	45.1	192	19,264	38	7.7	2.2	2.5	3.0	41.0	315	38,908	3.4	3.9	4.7	12	507
43	19,625	19	4.5	1.3	1.5	1.8	44.1	199	19,225	40	8.0	2.3	2.6	3.1	40.1	321	38,849	3.5	4.1	4.9	13	520
44	19,605	20	4.8	1.4	1.6	1.9	43.1	207	19,183	41	8.3	2.4	2.7	3.3	39.1	327	38,788	3.7	4.3	5.2	13	533
45	19,584	21	5.1	1.5	1.7	2.0	42.2	217	19,140	43	8.7	2.5	2.8	3.4	38.2	333	38,724	3.9	4.5	5.4	14	549
46	19,561	23	5.5	1.5	1.8	2.1	41.2	226	19,094	46	9.2	2.6	3.0	3.6	37.3	343	38,656	4.1	4.8	5.8	15	568
47	19,537	24	5.9	1.7	1.9	2.3	40.3	236	19,047	48	9.6	2.7	3.1	3.8	36.4	351	38,584	4.4	5.0	6.1	15	587
48	19,511	26	6.2	1.8	2.0	2.5	39.3	246	18,996	50	10.1	2.9	3.3	4.0	35.5	359	38,508	4.6	5.3	6.4	16	605
49	19,484	28	6.7	1.9	2.2	2.6	38.4	257	18,943	53	10.8	3.0	3.5	4.2	34.6	372	38,427	4.9	5.7	6.9	17	629
50	19,454	30	7.2	2.0	2.3	2.8	37.4	268	18,887	56	11.4	3.2	3.7	4.5	33.7	383	38,341	5.2	6.0	7.3	19	651
51	19,422	32	7.7	2.2	2.5	3.0	36.5	281	18,827	60	12.0	3.4	3.9	4.7	32.8	395	38,249	5.6	6.4	7.8	20	676
52	19,388	34	8.2	2.3	2.7	3.2	35.6	293	18,763	64	12.9	3.6	4.2	5.0	31.9	410	38,151	6.0	6.8	8.3	21	703
53	19,352	37	8.9	2.5	2.9	3.5	34.6	307	18,695	68	13.7	3.9	4.5	5.4	31.0	426	38,046	6.4	7.3	8.9	23	733
54	19,312	39	9.5	2.7	3.1	3.7	33.7	322	18,622	73	14.6	4.1	4.7	5.7	30.2	441	37,934	6.8	7.8	9.5	24	763
55	19,270	43	10.3	2.9	3.3	4.1	32.8	338	18,545	78	15.6	4.4	5.1	6.1	29.3	458	37,814	7.3	8.4	10.2	26	796
56	19,224	46	11.1	3.1	3.6	4.4	31.9	353	18,461	83	16.8	4.7	5.4	6.6	28.4	476	37,685	7.9	9.0	10.9	28	829
57	19,174	49	12.0	3.4	3.9	4.7	30.9	370	18,372	89	17.9	5.1	5.8	7.0	27.5	494	37,547	8.5	9.7	11.7	30	864
58	19,121	53	12.9	3.7	4.2	5.1	30.0	388	18,277	95	19.2	5.4	6.2	7.5	26.7	513	37,398	9.1	10.4	12.6	32	901
59	19,063	58	14.0	4.0	4.6	5.5	29.1	409	18,175	102	20.6	5.8	6.7	8.1	25.8	532	37,238	9.8	11.2	13.6	35	941
60	19,000	63	15.2	4.3	4.9	6.0	28.2	429	18,065	110	22.1	6.3	7.2	8.7	25.0	553	37,065	10.6	12.1	14.7	37	982
61	18,932	68	16.5	4.7	5.4	6.5	27.3	451	17,947	118	23.8	6.7	7.7	9.3	24.1	574	36,879	11.4	13.1	15.8	40	1,025
62	18,858	74	18.0	5.1	5.8	7.1	26.4	475	17,820	127	25.6	7.2	8.3	10.0	23.3	596	36,678	12.3	14.1	17.1	44	1,070
63	18,777	81	19.5	5.5	6.3	7.7	25.5	498	17,684	136	27.5	7.8	8.9	10.8	22.5	618	36,461	13.3	15.2	18.5	47	1,116
64	18,689	88	21.3	6.0	6.9	8.4	24.6	525	17,537	147	29.6	8.4	9.6	11.6	21.7	642	36,226	14.4	16.5	20.0	51	1,167
65	18,593	96	23.2	6.6	7.5	9.1	23.8	551	17,379	158	31.9	9.0	10.3	12.5	20.9	665	35,972	15.6	17.9	21.6	55	1,216
66	18,489	105	25.3	7.2	8.2	9.9	22.9	580	17,208	171	34.4	9.7	11.1	13.5	20.1	690	35,697	16.9	19.4	23.4	60	1,270
67	18,375	114	27.7	7.8	9.0	10.9	22.0	609	17,024	184	37.1	10.5	12.0	14.6	19.3	715	35,399	18.3	21.0	25.4	65	1,324
68	18,250	125	30.3	8.6	9.8	11.9	21.2	641	16,826	198	39.9	11.3	13.0	15.7	18.5	739	35,075	19.9	22.8	27.6	70	1,380
69	18,113	137	33.1	9.4	10.7	13.0	20.3	674	16,612	214	43.1	12.2	14.0	16.9	17.7	765	34,725	21.6	24.7	29.9	76	1,438
70	17,963	150	36.3	10.3	11.8	14.2	19.5	707	16,381	231	46.5	13.2	15.1	18.3	17.0	790	34,344	23.4	26.9	32.5	83	1,497
71	17,799	164	39.8	11.3	12.9	15.6	18.7	743	16,132	249	50.2	14.2	16.3	19.7	16.2	815	33,930	25.5	29.2	35.3	90	1,558
72	17,619	180	43.6	12.4	14.2	17.1	17.9	779	15,863	269	54.2	15.3	17.6	21.3	15.5	839	33,481	27.7	31.7	38.4	98	1,618
73	17,421	198	47.9	13.5	15.5	18.8	17.1	816	15,573	290	58.4	16.5	19.0	22.9	14.8	863	32,994	30.1	34.5	41.7	106	1,680
74	17,204	217	52.6	14.9	17.0	20.6	16.3	855	15,260	313	63.0	17.8	20.4	24.8	14.1	887	32,464	32.7	37.5	45.4	116	1,742
75	16,966	238	57.7	16.3	18.7	22.7	15.5	894	14,923	337	67.9	19.2	22.0	26.7	13.4	908	31,889	35.5	40.7	49.3	126	1,802
76	16,704	261	63.3	17.9	20.5	24.9	14.7	933	14,560	363	73.1	20.7	23.7	28.7	12.7	928	31,265	38.6	44.2	53.6	136	1,860
77	16,417	287	69.6	19.7	22.6	27.3	14.0	972	14,170	390	78.6	22.3	25.5	30.9	12.0	946	30,587	41.9	48.1	58.2	148	1,918
78	16,102	315	76.3	21.6	24.7	30.0	13.2	1,010	13,751	419	84.5	23.9	27.4	33.2	11.4	961	29,853	45.5	52.1	63.1	161	1,971
79	15,757	346	83.7	23.7	27.1	32.9	12.5	1,048	13,301	450	90.6	25.6	29.4	35.6	10.8	974	29,058	49.3	56.5	68.4	174	2,022
80	15,378	379	91.7	26.0	29.8	36.0	11.8	1,083	12,820	481	97.0	27.4	31.4	38.1	10.1	982	28,198	53.4	61.2	74.1	189	2,066
81	14,963	415	100.4	28.4	32.6	39.4	11.1	1,118	12,306	514	103.5	29.3	33.6	40.7	9.5	987	27,269	57.7	66.1	80.1	204	2,104
82	14,510	453	109.7	31.0	35.6	43.1	10.5	1,148	11,759	547	110.2	31.2	35.7	43.3	9.0	986	26,269	62.2	71.3	86.4	220	2,134
83	14,016	494	119.7	33.9	38.8	47.0	9.8	1,174	11,179	580	117.0	33.1	37.9	45.9	8.4	981	25,195	67.0	76.7	92.9	237	2,155
84	13,478	538	130.2	36.9	42.2	51.1	9.2	1,196	10,565	614	123.6	35.0	40.1	48.6	7.9	971	24,043	71.8	82.3	99.7	254	2,166
Total		***6,271***	***1,519***	***430***	***493***	***596***	***17.1***	***26,043***		***8,940***	***1,801***	***510***	***584***	***707***	***16.3***	***29,421***		***940***	***1,077***	***1,304***	***3,320***	***55,464***

- A UK study used a community-based sample ≥ 16 years of age of 14,117 to assess the effect of tobacco smoking on QoL.[59] After adjusting for age, sex, alcohol use, physical activity, fruit and vegetable consumption, excess weight, ethnicity, marital status, educational attainment, and income, they found a utility of -0.031 (95%CI of -0.018 to -0.045) associated with light tobacco smoking (less than 10 cigarettes per day), -0.033 (95% CI of -0.019 to -0.047) for moderate tobacco smoking (10 to 19 cigarettes per day) and -0.062 (95% CI of -0.042 to -0.082) for heavy tobacco smoking (20 or more cigarettes per day). We used the upper and lower bounds of the 95% CI in the sensitivity analysis.
- We applied the relevant QoL reductions to current smokers in the cohort (starting at age 19) who were alive at a given age (i.e., current smokers less those who died in the previous year due to smoking-attributable causes).
- Based on these assumptions, 13,805 QALYs would be lost between the ages of 19 and 84 by those living with cigarette smoking, 6,602 in females and 7,202 in males (see Table 11).

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

Table 11: Estimated Quality-Adjusted Life Years Lost Attributable to Cigarette Smoking

Between the Ages of 19 and 84

In a British Columbia Birth Cohort of 40,000

Without a Child / Youth Screening Program / Brief Intervention

	Females							***Males***							***Total Population***			
	Smokers Alive			QALYs Lost				Smokers Alive			QALYs Lost				QALYs Lost			
	Smoking Intensity			Smoking Intensity				Smoking Intensity			Smoking Intensity				Smoking Intensity			
Age	Light	Mod	Heavy	Light	Mod	Heavy	**Total**	Light	Mod	Heavy	Light	Mod	Heavy	**Total**	Light	Mod	Heavy	**Total**
19	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
20	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
21	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
22	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
23	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
24	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
25	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
26	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
27	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
28	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
29	1,411	851	365	48	31	25	**103**	1,437	727	623	49	26	42	**117**	97	57	67	**221**
30	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
31	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
32	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
33	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
34	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
35	1,411	851	365	49	32	25	**106**	1,437	727	623	50	27	43	**120**	99	59	69	**227**
36	1,410	850	364	49	32	25	**106**	1,435	725	621	50	27	43	**120**	99	58	69	**226**
37	1,409	849	362	49	31	25	**106**	1,434	723	618	50	27	43	**120**	99	58	68	**226**
38	1,408	848	361	49	31	25	**106**	1,432	721	616	50	27	43	**119**	99	58	68	**225**
39	1,407	847	360	49	31	25	**105**	1,430	719	613	50	27	43	**119**	99	58	68	**225**
40	1,406	846	358	51	33	26	**110**	1,428	716	610	52	28	44	**124**	103	60	70	**234**
41	1,405	844	356	51	33	26	**109**	1,426	714	607	52	28	44	**123**	103	60	70	**233**
42	1,403	843	355	51	33	26	**109**	1,423	711	604	52	27	44	**123**	103	60	70	**232**
43	1,402	841	353	51	33	26	**109**	1,421	709	601	52	27	44	**123**	102	60	69	**232**
44	1,401	840	351	51	32	25	**109**	1,419	706	598	52	27	43	**122**	102	60	69	**231**
45	1,399	838	349	51	32	25	**109**	1,416	703	594	51	27	43	**122**	102	60	69	**230**
46	1,398	836	347	51	32	25	**108**	1,414	700	591	51	27	43	**121**	102	59	68	**230**
47	1,396	835	345	51	32	25	**108**	1,411	697	587	51	27	43	**121**	102	59	68	**229**
48	1,394	833	342	51	32	25	**108**	1,408	694	583	51	27	42	**120**	102	59	67	**228**
49	1,392	830	340	51	32	25	**107**	1,405	690	579	51	27	42	**120**	102	59	67	**227**
50	1,390	828	337	53	33	25	**111**	1,402	687	574	53	28	43	**124**	106	61	69	**235**
51	1,388	826	334	52	33	25	**111**	1,398	683	570	53	27	43	**123**	105	61	68	**234**
52	1,386	823	331	52	33	25	**111**	1,395	679	565	53	27	43	**123**	105	60	68	**233**
53	1,383	820	327	52	33	25	**110**	1,391	674	559	53	27	42	**122**	105	60	67	**232**
54	1,381	817	323	52	33	24	**110**	1,387	670	553	52	27	42	**121**	105	60	66	**231**
55	1,378	814	319	52	33	24	**109**	1,382	664	547	52	27	41	**120**	104	59	66	**229**
56	1,375	810	315	52	33	24	**108**	1,378	659	541	52	27	41	**119**	104	59	65	**228**
57	1,371	806	310	52	32	23	**108**	1,373	653	534	52	26	40	**119**	104	59	64	**226**
58	1,368	802	305	52	32	23	**107**	1,367	647	526	52	26	40	**118**	103	58	63	**225**
59	1,364	797	300	52	32	23	**106**	1,361	640	518	51	26	39	**116**	103	58	62	**223**
60	1,359	792	294	53	33	23	**108**	1,355	633	509	53	26	40	**118**	105	59	62	**226**
61	1,355	787	287	53	33	22	**107**	1,348	625	500	52	26	39	**117**	105	58	61	**224**
62	1,350	781	280	52	32	22	**106**	1,341	617	490	52	25	38	**116**	104	58	60	**222**
63	1,344	775	272	52	32	21	**105**	1,333	608	479	52	25	37	**114**	104	57	58	**219**
64	1,338	768	264	52	32	20	**104**	1,325	599	468	51	25	36	**112**	103	56	57	**217**
65	1,331	760	255	52	31	20	**103**	1,316	588	455	51	24	35	**111**	103	56	55	**214**
66	1,324	752	245	51	31	19	**101**	1,306	577	442	51	24	34	**109**	102	55	53	**210**
67	1,316	743	234	51	31	18	**100**	1,296	565	427	50	23	33	**107**	101	54	51	**207**
68	1,308	733	222	51	30	17	**98**	1,284	552	411	50	23	32	**105**	101	53	49	**203**
69	1,298	723	209	50	30	16	**96**	1,272	538	394	49	22	31	**102**	100	52	47	**199**
70	1,288	711	195	53	31	16	**100**	1,259	523	376	52	23	31	**105**	104	54	47	**205**
71	1,277	698	179	52	30	15	**97**	1,245	507	356	51	22	29	**102**	103	53	44	**200**
72	1,265	684	162	52	30	13	**95**	1,229	489	335	50	21	27	**99**	102	51	41	**194**
73	1,251	668	143	51	29	12	**92**	1,213	470	312	50	20	26	**96**	101	50	37	**188**
74	1,236	651	123	51	28	10	**89**	1,195	450	287	49	20	24	**92**	100	48	34	**181**
75	1,220	633	100	50	28	8	**86**	1,176	428	261	48	19	21	**88**	98	46	30	**174**
76	1,202	612	75	49	27	6	**82**	1,155	404	232	47	18	19	**84**	97	44	25	**166**
77	1,182	590	48	48	26	4	**78**	1,133	379	201	46	17	16	**79**	95	42	20	**157**
78	1,161	565	18	48	25	1	**74**	1,109	351	168	45	15	14	**74**	93	40	15	**148**
79	1,137	538		47	23		**70**	1,083	322	132	44	14	11	**69**	91	37	11	**139**
80	1,111	508		49	24		**73**	1,056	290	94	47	14	8	**69**	96	38	8	**143**
81	1,083	475		48	23		**71**	1,027	257	54	46	12	5	**63**	94	35	5	**133**
82	1,052	440		47	21		**68**	995	221	10	44	10	1	**56**	91	31	1	**123**
83	1,018	401		45	19		**64**	962	183		43	9		**51**	88	28		**116**
84	981	359		44	17		**61**	927	143		41	7		**48**	85	24		**109**
Total				***3,297***	***2,000***	***1,306***	***6,602***				***3,289***	***1,582***	***2,332***	***7,202***	***6,586***	***3,581***	***3,638***	***13,805***

- Despite the evolving evidence linking e-cigarette use to a variety of harms (see *Harms Associated with E-Cigarette Use in Children and Youth* above), little evidence currently exists quantifying the harms of e-cigarettes in terms of quality-adjusted life expectancy.
- To begin to address the gap in evidence quantifying the harms of e-cigarettes in terms of quality-adjusted life expectancy, Nutt and colleagues gathered a group of experts in 2013 and used a multi-criteria decision analysis approach in a 2-day facilitated workshop to estimate the harms of a variety of nicotine-containing products, including e-cigarettes. While not explicitly stated, it appears that the group of experts consisted of 11 authors of the subsequent publication.[60] Using this process, they determined that e-cigarettes were just 5% as harmful as smoking conventional cigarettes.[61]
- In 2020, Allcot and Rafkin surveyed 137 public health experts whose responses indicated that e-cigarettes where 37% as harmful as smoking conventional cigarettes, when considered in terms of quality-adjusted life expectancy.[62] There was substantial disagreement between experts, with the interquartile range of beliefs about relative harms ranging from 10% to 60%. When the experts were asked why they disagreed with the prior assessment by Nutt et al. they gave three main explanations: "they disagree with how researchers interpreted the evidence available at the time, new research evidence is becoming available, and e-cigarette products have changed."[63] In addition, three of the authors of the Nutt et al study had financial ties with e-cigarette producers.[64] In particular, the consultant who facilitated the group process for the Nutt et al. paper had financial ties with British American Tobacco and a number of other companies that produce smoking cessation products.[65] Indeed, the editors of the publishing journal took the extraordinary step of justifying why they accepted the paper for publication despite the consultant's financial ties.[66] By comparison, the research by Allcot and Rafkin explicitly excluded "people with tobacco industry affiliations."[67]
- Based on the available evidence, we have assumed that e-cigarettes use is 37% as harmful as smoking conventional cigarettes, when considered in terms of quality-adjusted life expectancy. This estimate was varied from 10% to 60% in the sensitivity analysis.
- Based on this assumption, e-cigarette use in the birth cohort would result in 1,695 premature deaths and a loss of 31,943 QALYs (see Table 12).

[60] Nutt D, Phillips L, Balfour D et al. Estimating the harms of nicotine-containing products using the MCDA approach. *European Addiction Research*. 2014; 20: 218-25.
[61] Ibid.
[62] Allcott H, Rafkin C. *Optimal Regulation of e-Cigarettes: Theory and Evidence.* National Bureau of Economic Research Working Paper Series, August 2021. Available online at https://www.nber.org/system/files/working_papers/w27000/w27000.pdf. Accessed November 2022.
[63] Ibid.
[64] Nutt D, Phillips L, Balfour D et al. Estimating the harms of nicotine-containing products using the MCDA approach. *European Addiction Research*. 2014; 20: 218-25.
[65] Ibid.
[66] Ibid.
[67] Allcott H, Rafkin C. *Optimal Regulation of e-Cigarettes: Theory and Evidence.* National Bureau of Economic Research Working Paper Series, August 2021. Available online at https://www.nber.org/system/files/working_papers/w27000/w27000.pdf. Accessed November 2022.

Table 12: Estimated Deaths and QALYs Lost Due to e-Cigarette Use

Between the Ages of 19 and 84

In a British Columbia Birth Cohort of 40,000

Without a Child / Youth Screening Program / Brief Intervention

	Females							***Males***							***Total Population***				
	c-Cig		e-Cig					c-Cig		e-Cig					e-Cig				Total
Age	Alive	Deaths	Alive	Deaths	LE	LYL	QALYs	Alive	Deaths	Alive	Deaths	LE	LYL	QALYs	Alive	Deaths	LYL	QALYs	QALYs
19	1,274	0.0	8,572	0.0	66.4	0	257	1,619	0.0	8,385	0.0	61.4	0	225	16,957	0	0	482	482
20	1,545	0.0	7,363	0.0	65.4	0	182	1,852	0.0	7,353	0.0	60.5	0	172	14,716	0	0	354	354
21	1,815	0.0	6,154	0.0	64.4	0	130	2,086	0.0	6,321	0.0	59.5	0	131	12,475	0	0	261	261
22	2,086	0.0	4,945	0.0	63.5	0	91	2,320	0.0	5,288	0.0	58.6	0	99	10,234	0	0	190	190
23	2,356	0.0	3,736	0.0	62.5	0	61	2,554	0.0	4,256	0.0	57.7	0	72	7,992	0	0	133	133
24	2,627	0.0	2,527	0.0	61.5	0	37	2,788	0.0	3,224	0.0	56.7	0	50	5,751	0	0	87	87
25	2,627	0.0	2,527	0.0	60.5	0	37	2,788	0.0	3,224	0.0	55.8	0	50	5,751	0	0	87	87
26	2,627	0.0	2,527	0.0	59.6	0	37	2,788	0.0	3,224	0.0	54.8	0	50	5,751	0	0	87	87
27	2,627	0.0	2,527	0.0	58.6	0	37	2,788	0.0	3,224	0.0	53.9	0	50	5,751	0	0	87	87
28	2,627	0.0	2,527	0.0	57.6	0	37	2,788	0.0	3,224	0.0	53.0	0	50	5,751	0	0	87	87
29	2,627	0.0	2,527	0.0	56.6	0	37	2,788	0.0	3,224	0.0	52.1	0	50	5,751	0	0	87	87
30	2,627	0.0	2,527	0.0	55.7	0	38	2,788	0.0	3,224	0.0	51.1	0	52	5,751	0	0	89	89
31	2,627	0.0	2,527	0.0	54.7	0	38	2,788	0.0	3,224	0.0	50.2	0	52	5,751	0	0	89	89
32	2,627	0.0	2,527	0.0	53.7	0	38	2,788	0.0	3,224	0.0	49.3	0	52	5,751	0	0	89	89
33	2,627	0.0	2,527	0.0	52.8	0	38	2,788	0.0	3,224	0.0	48.4	0	52	5,751	0	0	89	89
34	2,627	0.0	2,527	0.0	51.8	0	38	2,788	0.0	3,224	0.0	47.4	0	52	5,751	0	0	89	89
35	2,627	0.0	2,527	0.0	50.8	0	38	2,788	0.0	3,224	0.0	46.5	0	52	5,751	0	0	89	89
36	2,623	3.1	2,526	1.1	49.9	56	38	2,781	6.3	3,221	2.7	45.6	123	51	5,747	4	178	89	268
37	2,620	3.3	2,525	1.2	48.9	57	38	2,775	6.4	3,219	2.8	44.7	123	51	5,743	4	181	89	270
38	2,617	3.4	2,524	1.2	47.9	59	38	2,768	6.6	3,216	2.9	43.7	125	51	5,739	4	184	89	273
39	2,613	3.6	2,522	1.3	47.0	61	38	2,761	6.9	3,213	3.0	42.8	127	51	5,735	4	188	89	277
40	2,609	3.8	2,521	1.3	46.0	62	39	2,754	7.1	3,210	3.1	41.9	129	53	5,731	4	191	93	283
41	2,605	4.0	2,520	1.4	45.1	64	39	2,747	7.4	3,206	3.2	41.0	130	53	5,726	5	194	92	287
42	2,601	4.3	2,518	1.5	44.1	67	39	2,739	7.7	3,203	3.3	40.1	133	53	5,721	5	200	92	293
43	2,597	4.5	2,516	1.6	43.1	70	39	2,731	8.0	3,200	3.5	39.1	136	53	5,716	5	205	92	298
44	2,592	4.8	2,515	1.7	42.2	73	39	2,723	8.3	3,196	3.6	38.2	138	53	5,711	5	211	92	303
45	2,587	5.1	2,513	1.8	41.2	76	39	2,714	8.7	3,192	3.8	37.3	141	53	5,705	6	217	92	309
46	2,581	5.5	2,511	2.0	40.3	79	39	2,705	9.2	3,188	4.0	36.4	146	53	5,699	6	225	92	317
47	2,575	5.9	2,509	2.1	39.3	83	39	2,695	9.6	3,184	4.2	35.5	149	53	5,693	6	232	92	324
48	2,569	6.2	2,506	2.3	38.4	86	39	2,685	10.1	3,180	4.4	34.6	153	53	5,686	7	239	92	331
49	2,562	6.7	2,504	2.4	37.4	90	39	2,674	10.8	3,175	4.7	33.7	159	53	5,679	7	249	91	341
50	2,555	7.2	2,501	2.6	36.5	95	40	2,663	11.4	3,170	5.0	32.8	164	55	5,671	8	258	95	353
51	2,548	7.7	2,499	2.8	35.6	99	40	2,651	12.0	3,165	5.3	31.9	169	55	5,663	8	269	95	363
52	2,539	8.2	2,496	3.0	34.6	103	40	2,638	12.9	3,159	5.7	31.0	176	54	5,655	9	280	95	374
53	2,530	8.9	2,492	3.2	33.7	109	40	2,624	13.7	3,153	6.1	30.2	184	54	5,645	9	292	94	387
54	2,521	9.5	2,489	3.5	32.8	114	40	2,610	14.6	3,146	6.5	29.3	190	54	5,635	10	304	94	398
55	2,511	10.3	2,485	3.8	31.9	120	40	2,594	15.6	3,139	7.0	28.4	198	54	5,625	11	318	94	412
56	2,499	11.1	2,481	4.1	30.9	126	40	2,577	16.8	3,132	7.5	27.5	207	54	5,613	12	332	94	426
57	2,488	12.0	2,477	4.4	30.0	132	40	2,559	17.9	3,124	8.1	26.7	215	54	5,601	12	347	93	440
58	2,475	12.9	2,472	4.8	29.1	139	40	2,540	19.2	3,115	8.7	25.8	224	53	5,587	13	363	93	456
59	2,461	14.0	2,467	5.2	28.2	146	39	2,520	20.6	3,106	9.3	25.0	233	53	5,573	15	380	93	472
60	2,445	15.2	2,461	5.6	27.3	154	40	2,497	22.1	3,096	10.1	24.1	244	54	5,557	16	398	95	492
61	2,429	16.5	2,455	6.2	26.4	162	40	2,474	23.8	3,085	10.9	23.3	254	54	5,540	17	417	94	511
62	2,411	18.0	2,448	6.7	25.5	172	40	2,448	25.6	3,073	11.8	22.5	265	54	5,521	19	437	94	530
63	2,391	19.5	2,441	7.3	24.6	181	40	2,421	27.5	3,060	12.8	21.7	277	53	5,501	20	457	93	550
64	2,370	21.3	2,433	8.0	23.8	191	40	2,391	29.6	3,046	13.9	20.9	289	53	5,479	22	480	93	573
65	2,347	23.2	2,424	8.8	22.9	202	39	2,359	31.9	3,031	15.0	20.1	302	53	5,455	24	503	92	595
66	2,321	25.3	2,414	9.7	22.0	213	39	2,325	34.4	3,015	16.3	19.3	315	52	5,429	26	528	91	620
67	2,294	27.7	2,404	10.6	21.2	225	39	2,288	37.1	2,997	17.8	18.5	329	52	5,401	28	555	90	645
68	2,264	30.3	2,392	11.7	20.3	239	38	2,248	39.9	2,978	19.4	17.7	343	51	5,370	31	582	90	672
69	2,230	33.1	2,379	13.0	19.5	253	38	2,205	43.1	2,957	21.1	17.0	359	51	5,336	34	611	89	700
70	2,194	36.3	2,365	14.3	18.7	267	40	2,158	46.5	2,934	23.1	16.2	375	53	5,298	37	642	93	735
71	2,154	39.8	2,349	15.9	17.9	283	39	2,108	50.2	2,908	25.3	15.5	391	52	5,257	41	674	91	766
72	2,111	43.6	2,331	17.6	17.1	300	39	2,054	54.2	2,881	27.7	14.8	408	51	5,212	45	709	90	799
73	2,063	47.9	2,312	19.6	16.3	318	38	1,995	58.4	2,850	30.3	14.1	427	51	5,162	50	745	89	834
74	2,010	52.6	2,290	21.8	15.5	338	38	1,932	63.0	2,817	33.3	13.4	445	50	5,107	55	783	87	870
75	1,953	57.7	2,266	24.3	14.7	358	37	1,864	67.9	2,780	36.6	12.7	465	49	5,046	61	823	85	908
76	1,889	63.3	2,238	27.2	14.0	380	36	1,791	73.1	2,740	40.3	12.0	485	48	4,979	68	865	83	948
77	1,820	69.6	2,208	30.5	13.2	404	35	1,713	78.6	2,696	44.5	11.4	506	46	4,904	75	910	81	991
78	1,743	76.3	2,174	34.2	12.5	429	34	1,628	84.5	2,646	49.2	10.8	529	45	4,820	83	958	79	1,036
79	1,660	83.7	2,135	38.6	11.8	456	33	1,538	90.6	2,592	54.5	10.1	552	43	4,727	93	1,008	77	1,084
80	1,568	91.7	2,091	43.7	11.1	486	36	1,441	97.0	2,531	60.5	9.5	576	45	4,623	104	1,062	81	1,144
81	1,468	100.4	2,042	49.6	10.5	518	36	1,337	103.5	2,464	67.3	9.0	602	43	4,506	117	1,121	79	1,200
82	1,358	109.7	1,985	56.5	9.8	554	37	1,227	110.2	2,389	75.2	8.4	631	40	4,374	132	1,185	77	1,261
83	1,238	119.7	1,921	64.7	9.2	594	37	1,110	117.0	2,305	84.3	7.9	661	40	4,225	149	1,256	76	1,332
84	1,108	130.2	1,846	74.8	8.6	641	37	986	123.6	2,210	95.0	7.3	696	40	4,056	170	1,337	77	1,414
Total		***1,519***		***681***	***15.4***	***10,484***	***3,053***		***1,801***		***1,014***	***14.4***	***14,600***	***3,806***		***1,695***	***25,084***	***6,859***	***31,943***

Annual Visits to a General Practitioner

- As noted earlier, a key variable in the effectiveness of screening and brief intervention is the proportion of children and youth that make contact with a primary care provider.
- Using data provided by the BC Ministry of Health, Health Sector Information, Analysis and Reporting Division[68] we were able to generate BC-specific rates of primary care visits and average visits per year for the fiscal years ending in 2012/13 to 2016/17, in total and by sex, as shown in Table 13 below.
- For the five years considered, the average proportion of children and youth ages 10-19 visiting a GP is 70%, and the average number of GP visits per adolescent is 2.07 per year (see Table 13). The proportion of males visiting a GP was 65.4% (see Table 13a) and for females it was 75.0% (see Table 13b). The average number of visits per male in the population was 1.75 and for females was 2.42.

Table 13: General Practitioner Visits by Children and Youth
British Columbia, 2012/13 to 2016/17

Age Group	2012/13	2013/14	2014/15	2015/16	2016/17	Total
	Population in Each Age Group					
10 - 14	234,780	231,544	230,178	230,177	232,010	1,158,689
15 - 19	284,482	282,214	279,997	276,909	272,677	1,396,279
Total	519,262	513,758	510,175	507,086	504,687	2,554,968
	Number of Unique Individuals with GP Visit					
10 - 14	163,332	160,912	158,653	160,260	159,826	802,983
15 - 19	205,821	200,410	196,629	192,566	189,547	984,973
Total	369,153	361,322	355,282	352,826	349,373	1,787,956
	Proportion of Individuals with a GP Visit					
10 - 14	69.6%	69.5%	68.9%	69.6%	68.9%	69.3%
15 - 19	72.3%	71.0%	70.2%	69.5%	69.5%	70.5%
Total	71.1%	70.3%	69.6%	69.6%	69.2%	70.0%
	Number of GP Visits					
10 - 14	429,881	422,188	412,182	413,411	407,442	2,085,104
15 - 19	681,806	659,038	641,316	619,790	601,925	3,203,875
Total	1,111,687	1,081,226	1,053,498	1,033,201	1,009,367	5,288,979
	GP Visits per Individual in Total Population					
10 - 14	1.83	1.82	1.79	1.80	1.76	1.80
15 - 19	2.40	2.34	2.29	2.24	2.21	2.29
Total	2.14	2.10	2.06	2.04	2.00	2.07

[68] Aciemme (Sam) Ospan, Senior Manager, Lifetime Prevention Schedule, Healthy Living and Health Promotion Branch, BC Ministry of Health. January 30, 2019. Personal communication.

Table 13a: General Practitioner Visits by Children and Youth

British Columbia, 2012/13 to 2016/17

Males

Age Group	2012/13	2013/14	2014/15	2015/16	2016/17	Total
	Population in Each Age Group					
10 - 14	121,031	119,378	118,720	118,572	119,586	597,287
15 - 19	149,279	147,563	145,417	143,117	140,451	725,827
Total	270,310	266,941	264,137	261,689	260,037	1,323,114
	Number of Unique Males with GP Visit					
10 - 14	82,970	81,960	80,756	81,067	80,862	407,615
15 - 19	95,992	93,224	91,170	89,118	87,596	457,100
Total	178,962	175,184	171,926	170,185	168,458	864,715
	Proportion of Males with a GP Visit					
10 - 14	68.6%	68.7%	68.0%	68.4%	67.6%	68.2%
15 - 19	64.3%	63.2%	62.7%	62.3%	62.4%	63.0%
Total	66.2%	65.6%	65.1%	65.0%	64.8%	65.4%
	Number of GP Visits					
10 - 14	215,841	211,444	206,909	206,013	202,386	1,042,593
15 - 19	270,303	259,637	253,874	244,381	238,257	1,266,452
Total	486,144	471,081	460,783	450,394	440,643	2,309,045
	GP Visits per Male in Total Population					
10 - 14	1.78	1.77	1.74	1.74	1.69	1.75
15 - 19	1.81	1.76	1.75	1.71	1.70	1.74
Total	1.80	1.76	1.74	1.72	1.69	1.75

Table 13b: General Practitioner Visits by Children and Youth

British Columbia, 2012/13 to 2016/17

Females

Age Group	2012/13	2013/14	2014/15	2015/16	2016/17	Total
	Population in Each Age Group					
10 - 14	113,749	112,166	111,458	111,605	112,424	561,402
15 - 19	135,203	134,651	134,580	133,792	132,226	670,452
Total	248,952	246,817	246,038	245,397	244,650	1,231,854
	Number of Unique Females with GP Visit					
10 - 14	80,381	78,955	77,909	79,202	78,985	395,432
15 - 19	109,865	107,210	105,496	103,488	101,995	528,054
Total	190,246	186,165	183,405	182,690	180,980	923,486
	Proportion of Females with a GP Visit					
10 - 14	70.7%	70.4%	69.9%	71.0%	70.3%	70.4%
15 - 19	81.3%	79.6%	78.4%	77.3%	77.1%	78.8%
Total	76.4%	75.4%	74.5%	74.4%	74.0%	75.0%
	Number of GP Visits					
10 - 14	214,033	210,738	205,270	207,393	205,052	1,042,486
15 - 19	411,487	399,386	387,411	375,393	363,660	1,937,337
Total	625,520	610,124	592,681	582,786	568,712	2,979,823
	GP Visits per Female in Total Population					
10 - 14	1.88	1.88	1.84	1.86	1.82	1.86
15 - 19	3.04	2.97	2.88	2.81	2.75	2.89
Total	2.51	2.47	2.41	2.37	2.32	2.42

Source: BC Ministry of Health, Health Sector Information, Analysis and Reporting Division

Calculations by H. Krueger & Associates, Inc.

Effectiveness of the Intervention(s)

- The USPSTF found that behavioural interventions led to an 18% (95% CI of 8% to 27%) **reduction in smoking initiation** in adolescents, based on a meta-analysis of 13 studies (RR 0.82, 95% CI of 0.73 – 0.92).[69]
- This effectiveness is almost identical to that observed by the CTFPHC who found that interventions aimed at reducing smoking initiation among non-smoking children and adolescents had an effectiveness of 18% (RR 0.82, 95% CI of 0.72 to 0.94).[70]
- The USPSTF found that behavioural interventions did not lead to an **increase in smoking cessation** in adolescents, based on a **meta-analysis of 9 studies** (RR 0.97, 95% CI of 0.93 – 1.01).[71]
- The CTFPHC, on the other hand, found that behavioural interventions aimed at smoking cessation among children and adolescents have an effectiveness of 34% (RR 1.34, 95% CI of 1.05 to 1.69), based on a **meta-analysis of 3 randomized controlled trials** (RCTs).[72]
- A significant effect was observed in 2 of the 3 RCTs included by the CTFPHC. In the study by Hollis et al, the interventions consisted of an individually tailored intervention based on the smoking status and stage of change of the individual. It included a 30-second clinician advice message, a 10-minute interactive computer program, a 5-minute motivational interview, and up to two 10-minute telephone or in person booster sessions.[73] In the study by Pbert and colleagues, the intervention consisted of brief counselling by the paediatric provider followed by one visit and four telephone calls by older peer counsellors (aged 21 to 25 years).[74]
- Based on a limited number of studies with small sample sizes, the USPSTF found no beneficial intervention effect associated with medication on the likelihood of smoking cessation in adolescents.[75]

- For modelling purposes we assumed an 18% (95% CI of 8% to 27%) **reduction in smoking initiation** and a 34% (95% CI of 5% to 69%) **increase in smoking cessation** in children and youth associated with screening and a behavioural intervention. We used the upper and lower bounds of the 95% CI in the sensitivity analysis.

[69] Selph S, Patnode C, Bailey S et al. Primary care-relevant interventions for tobacco and nicotine use prevention and cessation in children and adolescents: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2020; 323(16): 1599-608.
[70] Canadian Task Force on Preventive Health Care. Recommendations on behavioural interventions for the prevention and treatment of smoking among school-aged children and youth. *Canadian Medical Association Journal*. 2017; 189(8): e310-16.
[71] Selph S, Patnode C, Bailey S et al. Primary care-relevant interventions for tobacco and nicotine use prevention and cessation in children and adolescents: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2020; 323(16): 1599-608.
[72] Canadian Task Force on Preventive Health Care. Recommendations on behavioural interventions for the prevention and treatment of smoking among school-aged children and youth. *Canadian Medical Association Journal*. 2017; 189(8): e310-16.
[73] Hollis J, Polen M, Whitlock E et al. Teen Reach: Outcomes from a randomized, controlled trial of a tobacco reduction program for teens seen in primary medical care. *Pediatrics*. 2005; 115(4): 981-9.
[74] Pbert L, Flint A, Fletcher K et al. Effect of a pediatric-based smoking prevention and cessation intervention for adolescents: A randomized, controlled trial. *Pediatrics*. 2008; 121(4): e738-47.
[75] Selph S, Patnode C, Bailey S et al. Primary care-relevant interventions for tobacco and nicotine use prevention and cessation in children and adolescents: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2020; 323(16): 1599-608.

- Based on the above assumptions, an intervention in which all screened children / youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years would reduce the number of current smokers at age 24 in the birth cohort from 5,414 (see Table 7) to 4,316 (see Table 14), a reduction of 1,099 (20.3%). The number of e-cigarette users at age 24 would also be reduced from 5,751 (see Table 7) to 4,510 (see Table 14), a reduction of 1,241 (21.6%).

Table 14: Estimated Prevalence of Cigarette Smoking and E-Cigarette Use

Between the Ages of 8 and 24

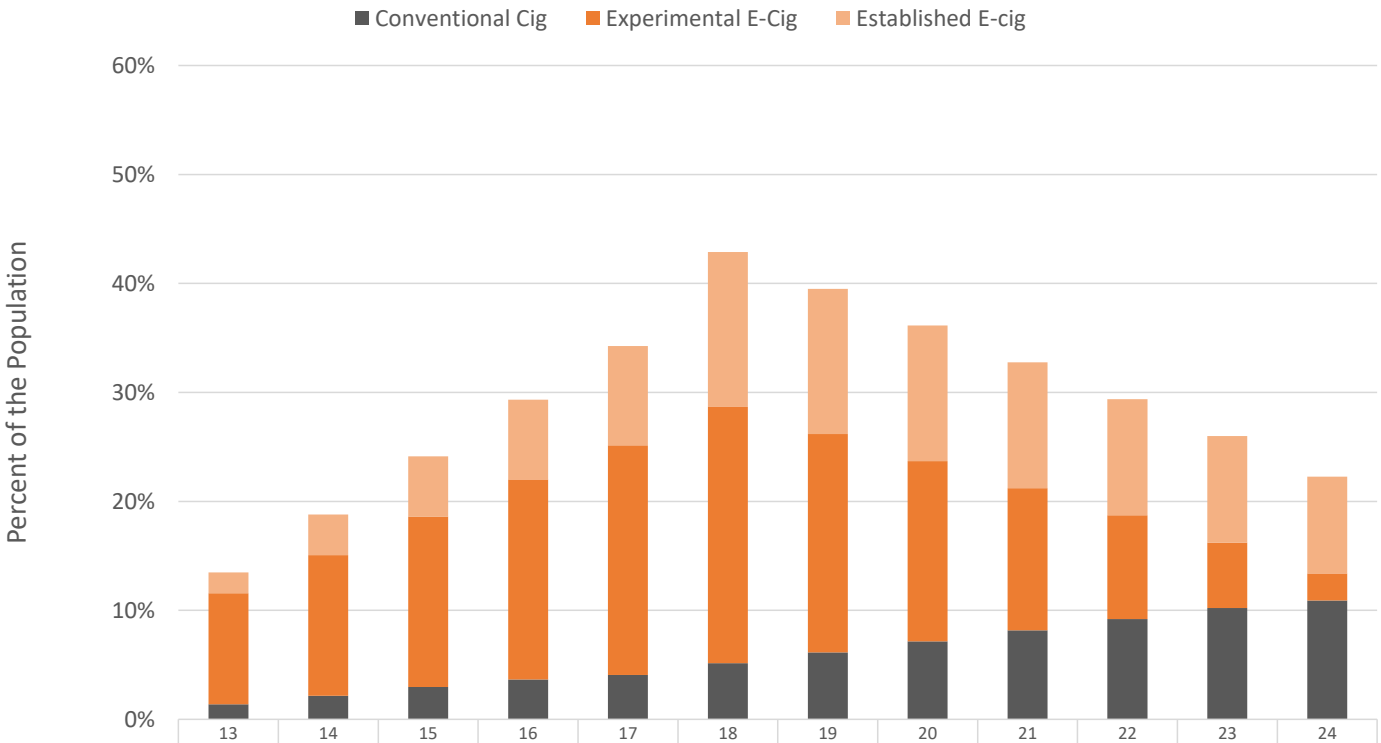
In a British Columbia Birth Cohort of 40,000

With a Child / Youth Screening Program / Brief Intervention

	Females							Males							Total Population						
	No Intervention (Table 7)				With Intervention			No Intervention (Table 7)				With Intervention			No Intervention (Table 7)				With Intervention		
			e-Cig			e-Cig				e-Cig			e-Cig				e-Cig			e-Cig	
Age	**Pop.**	Cig	Exp	Est	Cig	Exp	Est	**Pop.**	Cig	Exp	Est	Cig	Exp	Est	**Pop.**	Cig	Exp	Est	Cig	Exp	Est
8	19,918	29			25			19,907	46			40			39,824	75			65		
9	19,917	44			38			19,906	69			59			39,822	113			97		
10	19,915	66			56			19,904	104			89			39,820	170			145		
11	19,914	88			75			19,903	138			119			39,817	226			194		
12	19,913	147			125			19,902	230			198			39,815	377			323		
13	19,911	249	2,708	438	213	2,120	343	19,900	391	2,448	537	336	1,932	424	39,812	641	5,156	975	549	4,052	767
14	19,910	388	3,394	791	332	2,658	620	19,898	610	3,149	1,094	524	2,485	863	39,808	999	6,543	1,886	856	5,142	1,483
15	19,907	535	4,081	1,145	455	3,176	886	19,896	840	3,850	1,651	724	3,049	1,312	39,803	1,375	7,930	2,796	1,178	6,225	2,198
16	19,904	660	4,767	1,498	559	3,694	1,153	19,891	1,036	4,550	2,208	894	3,613	1,760	39,795	1,696	9,318	3,706	1,452	7,307	2,913
17	19,900	733	5,454	1,851	620	4,212	1,420	19,885	1,151	5,251	2,765	994	4,177	2,208	39,784	1,884	10,705	4,616	1,614	8,389	3,628
18	19,894	1,004	6,893	2,888	846	5,299	2,203	19,876	1,385	5,104	4,313	1,197	4,058	3,454	39,770	2,388	11,997	7,202	2,043	9,357	5,657
19	19,888	1,274	5,866	2,706	1,047	4,510	2,064	19,864	1,619	4,343	4,042	1,397	3,453	3,236	39,752	2,893	10,209	6,748	2,444	7,963	5,300
20	19,881	1,545	4,839	2,524	1,247	3,720	1,925	19,851	1,852	3,583	3,770	1,597	2,849	3,019	39,732	3,397	8,422	6,294	2,844	6,569	4,944
21	19,874	1,815	3,812	2,342	1,447	2,930	1,786	19,835	2,086	2,822	3,498	1,798	2,244	2,801	39,709	3,901	6,634	5,841	3,245	5,174	4,588
22	19,867	2,086	2,785	2,160	1,648	2,141	1,648	19,817	2,320	2,062	3,226	1,998	1,639	2,584	39,684	4,406	4,847	5,387	3,646	3,780	4,231
23	19,859	2,356	1,758	1,978	1,848	1,351	1,509	19,796	2,554	1,301	2,955	2,198	1,035	2,366	39,656	4,910	3,059	4,933	4,046	2,386	3,875
24	19,851	2,627	731	1,796	2,048	562	1,370	19,775	2,788	541	2,683	2,267	430	2,148	39,626	5,414	1,272	4,479	4,316	992	3,518

- Figure 3 provides a visual representation of the modelled transitions between conventional and e-cigarette use between the ages of 13 and 24 with a child and youth screening program and brief intervention.

Figure 3: Trend in Usage of Conventional and e-Cigarettes
Ages 13 to 24 ***With*** a Screening / Brief Intervention Program



	13	14	15	16	17	18	19	20	21	22	23	24
Established E-cig	1.9%	3.7%	5.5%	7.3%	9.1%	14.2%	13.3%	12.4%	11.6%	10.7%	9.8%	8.9%
Experimental E-Cig	10.2%	12.9%	15.6%	18.4%	21.1%	23.5%	20.0%	16.5%	13.0%	9.5%	6.0%	2.5%
Conventional Cig	1.4%	2.1%	3.0%	3.6%	4.1%	5.1%	6.1%	7.2%	8.2%	9.2%	10.2%	10.9%

Age

- Based on the above assumptions, an intervention in which all screened children / youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years would reduce the number of deaths and life years lost attributable to cigarette smoking between the ages of 36 and 84 from 3,320 / 55,464 (see Table 10) to 2,649 / 44,239 (see Table 15), a reduction of 671 deaths (20.2%) and 11,225 life years lost (20.2%).

Table 15: Estimated Deaths and Life Years Lost Attributable to Cigarette Smoking
Between the Ages of 35 and 84
In a British Columbia Birth Cohort of 40,000
With a Child / Youth Screening Program / Brief Intervention

	Female								***Male***								***Total Population***					
		Deaths								Deaths								Deaths Attributable to Smoking					
		In	Att to	By Smoking Intensity			LYL /			In	Att to	By Smoking Intensity			LYL /							
Age	**Pop.**	Cohort	Smoking	Light	Moderate	Heavy	Death	LYL	**Pop.**	Cohort	Smoking	Light	Moderate	Heavy	Death	LYL	**Pop.**	Light	Moderate	Heavy	Total	LYL
35	19,749								19,505								39,254					
36	19,736	13	2.5	0.7	0.8	1.0	50.8	125	19,474	31	5.1	1.4	1.7	2.0	46.5	238	39,210	2.1	2.5	3.0	8	363
37	19,722	14	2.6	0.7	0.8	1.0	49.9	128	19,442	32	5.2	1.5	1.7	2.1	45.6	239	39,164	2.2	2.5	3.1	8	367
38	19,708	14	2.7	0.8	0.9	1.1	48.9	131	19,409	33	5.4	1.5	1.8	2.1	44.7	242	39,117	2.3	2.6	3.2	8	373
39	19,693	15	2.8	0.8	0.9	1.1	47.9	136	19,375	34	5.6	1.6	1.8	2.2	43.7	245	39,068	2.4	2.7	3.3	8	381
40	19,677	16	2.9	0.8	1.0	1.2	47.0	138	19,339	35	5.8	1.6	1.9	2.3	42.8	248	39,017	2.5	2.8	3.4	9	387
41	19,661	16	3.1	0.9	1.0	1.2	46.0	143	19,303	37	6.0	1.7	1.9	2.4	41.9	251	38,964	2.6	3.0	3.6	9	394
42	19,643	18	3.3	0.9	1.1	1.3	45.1	150	19,264	38	6.3	1.8	2.0	2.5	41.0	257	38,908	2.7	3.1	3.8	10	406
43	19,625	19	3.5	1.0	1.1	1.4	44.1	155	19,225	40	6.5	1.8	2.1	2.6	40.1	261	38,849	2.8	3.3	3.9	10	416
44	19,605	20	3.7	1.1	1.2	1.5	43.1	161	19,183	41	6.8	1.9	2.2	2.7	39.1	266	38,788	3.0	3.4	4.1	11	427
45	19,584	21	4.0	1.1	1.3	1.6	42.2	169	19,140	43	7.1	2.0	2.3	2.8	38.2	271	38,724	3.1	3.6	4.4	11	439
46	19,561	23	4.3	1.2	1.4	1.7	41.2	176	19,094	46	7.5	2.1	2.4	2.9	37.3	279	38,656	3.3	3.8	4.6	12	455
47	19,537	24	4.6	1.3	1.5	1.8	40.3	184	19,047	48	7.8	2.2	2.5	3.1	36.4	285	38,584	3.5	4.0	4.9	12	469
48	19,511	26	4.9	1.4	1.6	1.9	39.3	192	18,996	50	8.2	2.3	2.7	3.2	35.5	292	38,508	3.7	4.2	5.1	13	484
49	19,484	28	5.2	1.5	1.7	2.0	38.4	200	18,943	53	8.8	2.5	2.8	3.4	34.6	303	38,427	4.0	4.5	5.5	14	503
50	19,454	30	5.6	1.6	1.8	2.2	37.4	209	18,887	56	9.2	2.6	3.0	3.6	33.7	312	38,341	4.2	4.8	5.8	15	521
51	19,422	32	6.0	1.7	1.9	2.4	36.5	219	18,827	60	9.8	2.8	3.2	3.8	32.8	322	38,249	4.5	5.1	6.2	16	541
52	19,388	34	6.4	1.8	2.1	2.5	35.6	228	18,763	64	10.5	3.0	3.4	4.1	31.9	334	38,151	4.8	5.5	6.6	17	562
53	19,352	37	6.9	2.0	2.2	2.7	34.6	239	18,695	68	11.2	3.2	3.6	4.4	31.0	347	38,046	5.1	5.9	7.1	18	586
54	19,312	39	7.4	2.1	2.4	2.9	33.7	251	18,622	73	11.9	3.4	3.9	4.7	30.2	359	37,934	5.5	6.3	7.6	19	610
55	19,270	43	8.0	2.3	2.6	3.2	32.8	264	18,545	78	12.7	3.6	4.1	5.0	29.3	372	37,814	5.9	6.7	8.2	21	636
56	19,224	46	8.6	2.4	2.8	3.4	31.9	275	18,461	83	13.6	3.9	4.4	5.4	28.4	387	37,685	6.3	7.2	8.8	22	663
57	19,174	49	9.3	2.6	3.0	3.7	30.9	289	18,372	89	14.6	4.1	4.7	5.7	27.5	402	37,547	6.8	7.8	9.4	24	690
58	19,121	53	10.1	2.9	3.3	4.0	30.0	303	18,277	95	15.6	4.4	5.1	6.1	26.7	417	37,398	7.3	8.3	10.1	26	720
59	19,063	58	11.0	3.1	3.6	4.3	29.1	319	18,175	102	16.8	4.7	5.4	6.6	25.8	433	37,238	7.8	9.0	10.9	28	752
60	19,000	63	11.9	3.4	3.8	4.7	28.2	334	18,065	110	18.0	5.1	5.8	7.1	25.0	450	37,065	8.4	9.7	11.7	30	784
61	18,932	68	12.9	3.6	4.2	5.1	27.3	352	17,947	118	19.3	5.5	6.3	7.6	24.1	467	36,879	9.1	10.4	12.7	32	818
62	18,858	74	14.0	4.0	4.5	5.5	26.4	370	17,820	127	20.8	5.9	6.7	8.2	23.3	484	36,678	9.8	11.3	13.7	35	855
63	18,777	81	15.2	4.3	4.9	6.0	25.5	388	17,684	136	22.4	6.3	7.3	8.8	22.5	503	36,461	10.6	12.2	14.8	38	891
64	18,689	88	16.6	4.7	5.4	6.5	24.6	409	17,537	147	24.1	6.8	7.8	9.5	21.7	522	36,226	11.5	13.2	16.0	41	932
65	18,593	96	18.1	5.1	5.9	7.1	23.8	430	17,379	158	25.9	7.3	8.4	10.2	20.9	541	35,972	12.5	14.3	17.3	44	971
66	18,489	105	19.8	5.6	6.4	7.8	22.9	452	17,208	171	28.0	7.9	9.1	11.0	20.1	561	35,697	13.5	15.5	18.7	48	1,013
67	18,375	114	21.6	6.1	7.0	8.5	22.0	475	17,024	184	30.2	8.5	9.8	11.8	19.3	581	35,399	14.6	16.8	20.3	52	1,057
68	18,250	125	23.6	6.7	7.7	9.3	21.2	500	16,826	198	32.5	9.2	10.5	12.8	18.5	601	35,075	15.9	18.2	22.0	56	1,101
69	18,113	137	25.8	7.3	8.4	10.1	20.3	525	16,612	214	35.1	9.9	11.4	13.8	17.7	622	34,725	17.2	19.8	23.9	61	1,147
70	17,963	150	28.3	8.0	9.2	11.1	19.5	552	16,381	231	37.9	10.7	12.3	14.9	17.0	643	34,344	18.7	21.5	26.0	66	1,194
71	17,799	164	31.0	8.8	10.1	12.2	18.7	579	16,132	249	40.8	11.6	13.2	16.0	16.2	663	33,930	20.3	23.3	28.2	72	1,242
72	17,619	180	34.0	9.6	11.0	13.4	17.9	608	15,863	269	44.1	12.5	14.3	17.3	15.5	682	33,481	22.1	25.3	30.7	78	1,290
73	17,421	198	37.3	10.6	12.1	14.7	17.1	637	15,573	290	47.5	13.5	15.4	18.7	14.8	702	32,994	24.0	27.5	33.3	85	1,339
74	17,204	217	41.0	11.6	13.3	16.1	16.3	667	15,260	313	51.3	14.5	16.6	20.1	14.1	721	32,464	26.1	29.9	36.2	92	1,388
75	16,966	238	45.0	12.7	14.6	17.7	15.5	697	14,923	337	55.2	15.6	17.9	21.7	13.4	738	31,889	28.4	32.5	39.4	100	1,435
76	16,704	261	49.4	14.0	16.0	19.4	14.7	727	14,560	363	59.5	16.8	19.3	23.4	12.7	755	31,265	30.8	35.3	42.7	109	1,482
77	16,417	287	54.2	15.3	17.6	21.3	14.0	758	14,170	390	64.0	18.1	20.7	25.1	12.0	769	30,587	33.4	38.3	46.4	118	1,527
78	16,102	315	59.5	16.8	19.3	23.4	13.2	788	13,751	419	68.7	19.4	22.3	27.0	11.4	782	29,853	36.3	41.6	50.3	128	1,570
79	15,757	346	65.3	18.5	21.2	25.6	12.5	817	13,301	450	73.7	20.9	23.9	28.9	10.8	792	29,058	39.3	45.1	54.6	139	1,609
80	15,378	379	71.5	20.2	23.2	28.1	11.8	845	12,820	481	78.9	22.3	25.6	31.0	10.1	799	28,198	42.6	48.8	59.1	150	1,644
81	14,963	415	78.3	22.2	25.4	30.7	11.1	871	12,306	514	84.2	23.8	27.3	33.1	9.5	803	27,269	46.0	52.7	63.8	163	1,674
82	14,510	453	85.6	24.2	27.7	33.6	10.5	895	11,759	547	89.7	25.4	29.1	35.2	9.0	802	26,269	49.6	56.8	68.8	175	1,697
83	14,016	494	93.3	26.4	30.3	36.6	9.8	916	11,179	580	95.1	26.9	30.9	37.4	8.4	798	25,195	53.3	61.1	74.0	188	1,714
84	13,478	538	101.6	28.7	32.9	39.9	9.2	932	10,565	614	100.6	28.5	32.6	39.5	7.9	789	24,043	57.2	65.6	79.4	202	1,722
Total		***6,271***	***1,184***	***335***	***384***	***465***	***17.1***	***20,308***		***8,940***	***1,465***	***415***	***475***	***575***	***16.3***	***23,931***		***750***	***859***	***1,040***	***2,649***	***44,239***

- Based on the above assumptions, an intervention in which all screened children / youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years would reduce the QALYs lost between the ages of 19 and 84 by those living with cigarette smoking from 13,805 (see Table 11) to 11,007 (see Table 16), a reduction of 2,798 QALYs lost (20.3%).

Table 16: Estimated Quality-Adjusted Life Years Lost Attributable to Cigarette Smoking
Between the Ages of 19 and 84
In a British Columbia Birth Cohort of 40,000
With a Child / Youth Screening Program / Brief Intervention

	Females							***Males***							***Total Population***			
	Smokers Alive			QALYs Lost				Smokers Alive			QALYs Lost				QALYs Lost			
	Smoking Intensity			Smoking Intensity				Smoking Intensity			Smoking Intensity				Smoking Intensity			
Age	Light	Mod	Heavy	Light	Mod	Heavy	**Total**	Light	Mod	Heavy	Light	Mod	Heavy	**Total**	Light	Mod	Heavy	**Total**
19	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
20	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
21	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
22	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
23	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
24	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
25	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
26	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
27	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
28	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
29	1,100	664	284	37	24	19	**81**	1,169	592	507	40	21	34	**95**	77	45	54	**176**
30	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
31	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
32	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
33	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
34	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
35	1,100	664	284	38	25	20	**83**	1,169	592	507	41	22	35	**98**	79	47	55	**181**
36	1,099	663	284	38	25	20	**83**	1,167	590	505	41	22	35	**98**	79	46	55	**180**
37	1,099	662	283	38	25	20	**82**	1,166	588	503	41	22	35	**97**	79	46	55	**180**
38	1,098	661	281	38	25	20	**82**	1,164	586	501	41	22	35	**97**	79	46	54	**180**
39	1,097	660	280	38	24	20	**82**	1,163	585	499	41	22	35	**97**	79	46	54	**179**
40	1,096	659	279	40	25	20	**86**	1,161	583	496	42	23	36	**101**	82	48	56	**186**
41	1,095	658	278	40	25	20	**85**	1,160	581	494	42	22	36	**100**	82	48	56	**186**
42	1,094	657	277	40	25	20	**85**	1,158	579	492	42	22	36	**100**	82	48	56	**185**
43	1,093	656	275	40	25	20	**85**	1,156	577	489	42	22	35	**100**	82	48	55	**185**
44	1,092	655	274	40	25	20	**85**	1,154	574	486	42	22	35	**99**	82	48	55	**184**
45	1,091	654	272	40	25	20	**85**	1,152	572	484	42	22	35	**99**	81	47	55	**184**
46	1,090	652	271	40	25	20	**84**	1,150	570	481	42	22	35	**99**	81	47	55	**183**
47	1,089	651	269	40	25	20	**84**	1,148	567	478	42	22	35	**98**	81	47	54	**182**
48	1,087	649	267	39	25	19	**84**	1,145	564	474	42	22	34	**98**	81	47	54	**182**
49	1,086	648	265	39	25	19	**84**	1,143	562	471	41	22	34	**97**	81	47	53	**181**
50	1,084	646	263	41	26	20	**87**	1,140	559	467	43	22	35	**101**	84	48	55	**188**
51	1,083	644	260	41	26	20	**87**	1,137	555	463	43	22	35	**100**	84	48	55	**187**
52	1,081	642	258	41	26	19	**86**	1,135	552	459	43	22	35	**100**	84	48	54	**186**
53	1,079	639	255	41	26	19	**86**	1,131	548	455	43	22	34	**99**	84	48	54	**185**
54	1,077	637	252	41	26	19	**85**	1,128	545	450	43	22	34	**99**	83	48	53	**184**
55	1,074	634	249	41	26	19	**85**	1,124	540	445	43	22	34	**98**	83	47	52	**183**
56	1,072	632	246	41	25	19	**85**	1,121	536	440	42	22	33	**97**	83	47	52	**182**
57	1,069	629	242	40	25	18	**84**	1,116	531	434	42	21	33	**96**	83	47	51	**180**
58	1,066	625	238	40	25	18	**83**	1,112	526	428	42	21	32	**96**	82	46	50	**179**
59	1,063	622	234	40	25	18	**83**	1,107	521	421	42	21	32	**95**	82	46	50	**178**
60	1,060	618	229	41	26	18	**84**	1,102	515	414	43	21	32	**96**	84	47	50	**181**
61	1,056	614	224	41	25	17	**84**	1,097	509	407	43	21	32	**95**	84	46	49	**179**
62	1,052	609	218	41	25	17	**83**	1,091	502	399	42	21	31	**94**	83	46	48	**177**
63	1,048	604	212	41	25	16	**82**	1,084	495	390	42	20	30	**93**	83	45	47	**175**
64	1,043	599	206	40	25	16	**81**	1,078	487	380	42	20	30	**91**	82	45	45	**173**
65	1,038	593	199	40	24	15	**80**	1,070	478	370	42	20	29	**90**	82	44	44	**170**
66	1,033	587	191	40	24	15	**79**	1,062	469	359	41	19	28	**88**	81	44	43	**168**
67	1,027	580	183	40	24	14	**78**	1,054	460	347	41	19	27	**87**	81	43	41	**165**
68	1,020	572	173	40	24	13	**77**	1,045	449	335	41	19	26	**85**	80	42	39	**162**
69	1,013	564	163	39	23	13	**75**	1,035	438	321	40	18	25	**83**	79	41	38	**158**
70	1,005	554	152	41	24	12	**78**	1,024	425	306	42	19	25	**86**	83	43	38	**163**
71	996	544	140	41	24	11	**76**	1,012	412	290	41	18	24	**83**	82	42	35	**159**
72	986	533	127	40	23	10	**74**	1,000	398	273	41	17	22	**81**	81	41	33	**155**
73	976	521	112	40	23	9	**72**	987	382	254	40	17	21	**78**	80	39	30	**150**
74	964	508	96	39	22	8	**69**	972	366	234	40	16	19	**75**	79	38	27	**144**
75	951	493	78	39	22	6	**67**	956	348	212	39	15	17	**72**	78	37	24	**139**
76	937	477	59	38	21	5	**64**	940	329	189	38	14	15	**68**	77	35	20	**132**
77	922	460	37	38	20	3	**61**	921	308	164	38	13	13	**65**	75	33	16	**125**
78	905	440	14	37	19	1	**57**	902	286	137	37	12	11	**61**	74	32	12	**118**
79	887	419		36	18		**55**	881	262	108	36	11	9	**56**	72	30	9	**111**
80	866	396		39	19		**57**	859	236	77	38	11	7	**56**	77	30	7	**113**
81	844	371		38	18		**55**	835	209	44	37	10	4	**51**	75	27	4	**106**
82	820	343		36	16		**53**	810	180	8	36	9	1	**45**	72	25	1	**98**
83	794	313		35	15		**50**	783	149		35	7		**42**	70	22		**92**
84	765	280		34	13		**47**	754	116		34	6		**39**	68	19		**86**
Total				***2,571***	***1,559***	***1,018***	***5,148***				***2,675***	***1,287***	***1,897***	***5,858***	***5,246***	***2,846***	***2,915***	***11,007***

- Based on the above assumptions, an intervention in which all screened children / youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years would reduce the number of deaths and QALYs lost between the ages of 19 and 84 attributable to e-cigarette use from 1,695 / 31,943 (see Table 12) to 1,136 / 23,031 (see Table 17), a reduction of 559 deaths (33.0%) and 8,912 QALYs lost (27.9%).

Table 17: Estimated Deaths and QALYs Lost Due to e-Cigarette Use
Between the Ages of 19 and 84
In a British Columbia Birth Cohort of 40,000
With a Child / Youth Screening Program / Brief Intervention

	Females							***Males***							***Total Population***				
	c-Cig		e-Cig					c-Cig		e-Cig					e-Cig				Total
Age	Alive	Deaths	Alive	Deaths	LE	LYL	QALYs	Alive	Deaths	Alive	Deaths	LE	LYL	QALYs	Alive	Deaths	LYL	QALYs	QALYs
19	1,047	0.0	6,574	0.0	66.4	0	240	1,619	0.0	6,690	0.0	61.4	0	179	13,263	0	0	419	419
20	1,247	0.0	5,645	0.0	65.4	0	173	1,852	0.0	5,867	0.0	60.5	0	137	11,513	0	0	311	311
21	1,447	0.0	4,717	0.0	64.4	0	125	2,086	0.0	5,045	0.0	59.5	0	105	9,762	0	0	230	230
22	1,648	0.0	3,789	0.0	63.5	0	88	2,320	0.0	4,223	0.0	58.6	0	79	8,011	0	0	167	167
23	1,848	0.0	2,860	0.0	62.5	0	59	2,554	0.0	3,401	0.0	57.7	0	58	6,261	0	0	117	117
24	2,048	0.0	1,932	0.0	61.5	0	36	2,788	0.0	2,578	0.0	56.7	0	40	4,510	0	0	76	76
25	2,048	0.0	1,932	0.0	60.5	0	36	2,788	0.0	2,578	0.0	55.8	0	40	4,510	0	0	76	76
26	2,048	0.0	1,932	0.0	59.6	0	36	2,788	0.0	2,578	0.0	54.8	0	40	4,510	0	0	76	76
27	2,048	0.0	1,932	0.0	58.6	0	36	2,788	0.0	2,578	0.0	53.9	0	40	4,510	0	0	76	76
28	2,048	0.0	1,932	0.0	57.6	0	36	2,788	0.0	2,578	0.0	53.0	0	40	4,510	0	0	76	76
29	2,048	0.0	1,932	0.0	56.6	0	36	2,788	0.0	2,578	0.0	52.1	0	40	4,510	0	0	76	76
30	2,048	0.0	1,932	0.0	55.7	0	37	2,788	0.0	2,578	0.0	51.1	0	41	4,510	0	0	78	78
31	2,048	0.0	1,932	0.0	54.7	0	37	2,788	0.0	2,578	0.0	50.2	0	41	4,510	0	0	78	78
32	2,048	0.0	1,932	0.0	53.7	0	37	2,788	0.0	2,578	0.0	49.3	0	41	4,510	0	0	78	78
33	2,048	0.0	1,932	0.0	52.8	0	37	2,788	0.0	2,578	0.0	48.4	0	41	4,510	0	0	78	78
34	2,048	0.0	1,932	0.0	51.8	0	37	2,788	0.0	2,578	0.0	47.4	0	41	4,510	0	0	78	78
35	2,048	0.0	1,932	0.0	50.8	0	37	2,788	0.0	2,578	0.0	46.5	0	41	4,510	0	0	78	78
36	2,046	2.5	1,931	0.9	49.9	43	37	2,783	5.1	2,577	1.8	45.6	80	41	4,508	3	122	78	201
37	2,043	2.6	1,930	0.9	48.9	44	37	2,777	5.2	2,575	1.8	44.7	80	41	4,505	3	124	78	202
38	2,041	2.7	1,929	0.9	47.9	45	37	2,772	5.4	2,573	1.9	43.7	81	41	4,502	3	126	78	204
39	2,038	2.8	1,928	1.0	47.0	47	37	2,766	5.6	2,571	1.9	42.8	82	41	4,499	3	129	78	207
40	2,035	2.9	1,927	1.0	46.0	47	38	2,760	5.8	2,569	2.0	41.9	84	43	4,496	3	131	81	212
41	2,032	3.1	1,926	1.1	45.1	49	38	2,754	6.0	2,567	2.1	41.0	85	43	4,493	3	134	81	214
42	2,028	3.3	1,925	1.2	44.1	51	38	2,748	6.3	2,565	2.2	40.1	86	42	4,490	3	138	81	219
43	2,025	3.5	1,924	1.2	43.1	53	38	2,742	6.5	2,563	2.3	39.1	88	42	4,486	3	141	81	222
44	2,021	3.7	1,922	1.3	42.2	55	38	2,735	6.8	2,560	2.3	38.2	90	42	4,483	4	145	81	226
45	2,017	4.0	1,921	1.4	41.2	58	38	2,728	7.1	2,558	2.5	37.3	92	42	4,479	4	150	80	230
46	2,013	4.3	1,919	1.5	40.3	61	38	2,720	7.5	2,555	2.6	36.4	94	42	4,475	4	155	80	235
47	2,008	4.6	1,918	1.6	39.3	63	38	2,713	7.8	2,553	2.7	35.5	97	42	4,470	4	160	80	240
48	2,003	4.9	1,916	1.7	38.4	66	38	2,704	8.2	2,550	2.9	34.6	99	42	4,466	5	165	80	245
49	1,998	5.2	1,914	1.8	37.4	69	38	2,696	8.8	2,547	3.1	33.7	103	42	4,461	5	172	80	252
50	1,993	5.6	1,912	2.0	36.5	72	40	2,686	9.2	2,543	3.2	32.8	106	43	4,456	5	178	83	261
51	1,987	6.0	1,910	2.1	35.6	76	39	2,676	9.8	2,540	3.4	31.9	110	43	4,450	6	185	83	268
52	1,980	6.4	1,908	2.3	34.6	79	39	2,666	10.5	2,536	3.7	31.0	114	43	4,444	6	193	83	276
53	1,973	6.9	1,905	2.5	33.7	83	39	2,655	11.2	2,532	3.9	30.2	119	43	4,438	6	202	82	284
54	1,966	7.4	1,903	2.7	32.8	87	39	2,643	11.9	2,528	4.2	29.3	123	43	4,431	7	210	82	292
55	1,958	8.0	1,900	2.9	31.9	92	39	2,630	12.7	2,524	4.5	28.4	128	43	4,423	7	220	82	301
56	1,949	8.6	1,897	3.1	30.9	96	39	2,617	13.6	2,519	4.8	27.5	133	43	4,416	8	229	82	311
57	1,940	9.3	1,893	3.4	30.0	101	39	2,602	14.6	2,514	5.2	26.7	139	42	4,407	9	239	81	321
58	1,930	10.1	1,890	3.6	29.1	106	39	2,586	15.6	2,508	5.6	25.8	144	42	4,398	9	250	81	331
59	1,919	11.0	1,886	4.0	28.2	112	39	2,570	16.8	2,502	6.0	25.0	150	42	4,388	10	262	81	343
60	1,907	11.9	1,881	4.3	27.3	118	40	2,552	18.0	2,496	6.5	24.1	157	43	4,377	11	274	82	357
61	1,894	12.9	1,877	4.7	26.4	124	39	2,532	19.3	2,489	7.0	23.3	163	43	4,365	12	287	82	369
62	1,880	14.0	1,872	5.1	25.5	131	39	2,512	20.8	2,481	7.6	22.5	170	42	4,353	13	301	81	382
63	1,865	15.2	1,866	5.6	24.6	138	39	2,489	22.4	2,473	8.2	21.7	177	42	4,339	14	315	81	396
64	1,848	16.6	1,860	6.2	23.8	146	39	2,465	24.1	2,464	8.9	20.9	185	42	4,324	15	331	80	411
65	1,830	18.1	1,853	6.7	22.9	154	39	2,439	25.9	2,454	9.6	20.1	192	41	4,307	16	347	80	426
66	1,810	19.8	1,846	7.4	22.0	163	38	2,411	28.0	2,444	10.4	19.3	201	41	4,290	18	364	79	443
67	1,789	21.6	1,838	8.1	21.2	172	38	2,381	30.2	2,433	11.3	18.5	209	40	4,270	19	382	78	460
68	1,765	23.6	1,829	9.0	20.3	183	38	2,349	32.5	2,420	12.3	17.7	218	40	4,249	21	400	78	478
69	1,739	25.8	1,819	9.9	19.5	193	37	2,313	35.1	2,407	13.4	17.0	227	39	4,226	23	420	77	497
70	1,711	28.3	1,808	10.9	18.7	204	39	2,276	37.9	2,392	14.6	16.2	237	41	4,200	26	441	80	521
71	1,680	31.0	1,796	12.1	17.9	217	39	2,235	40.8	2,377	15.9	15.5	246	40	4,172	28	463	79	541
72	1,646	34.0	1,782	13.5	17.1	230	38	2,191	44.1	2,359	17.3	14.8	256	39	4,141	31	486	78	563
73	1,609	37.3	1,767	15.0	16.3	243	37	2,143	47.5	2,340	18.9	14.1	266	39	4,107	34	510	76	586
74	1,568	41.0	1,751	16.7	15.5	258	37	2,092	51.3	2,320	20.7	13.4	277	38	4,070	37	535	75	610
75	1,523	45.0	1,732	18.6	14.7	274	36	2,037	55.2	2,297	22.7	12.7	288	37	4,029	41	561	73	634
76	1,473	49.4	1,711	20.8	14.0	290	35	1,977	59.5	2,272	24.8	12.0	298	36	3,983	46	589	71	660
77	1,419	54.2	1,688	23.3	13.2	309	34	1,913	64.0	2,245	27.2	11.4	309	34	3,933	51	618	69	687
78	1,360	59.5	1,662	26.2	12.5	328	33	1,845	68.7	2,215	29.8	10.8	321	33	3,877	56	648	66	715
79	1,294	65.3	1,632	29.5	11.8	349	33	1,771	73.7	2,182	32.7	10.1	332	32	3,814	62	680	64	744
80	1,223	71.5	1,599	33.4	11.1	372	36	1,692	78.9	2,146	36.0	9.5	343	32	3,745	69	714	68	782
81	1,144	78.3	1,561	37.9	10.5	396	36	1,608	84.2	2,107	39.5	9.0	354	30	3,668	77	750	66	816
82	1,059	85.6	1,518	43.2	9.8	424	36	1,518	89.7	2,063	43.5	8.4	365	28	3,581	87	788	64	852
83	966	93.3	1,468	49.5	9.2	454	36	1,423	95.1	2,016	47.8	7.9	376	27	3,484	97	830	63	893
84	864	101.6	1,411	57.1	8.6	490	37	1,322	100.6	1,963	52.7	7.3	386	26	3,374	110	876	63	939
Total		***1,184***		***521***	***15.4***	***8,015***	***2,972***		***1,465***		***616***	***14.7***	***9,058***	***2,987***		***1,136***	***17,072***	***5,959***	***23,031***

- Other assumptions used in assessing the clinically preventable burden are detailed in the Reference Document.

Summary of CPB – Males and Females

Based on these assumptions, the CPB associated with an intervention in which all screened children and youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years is 22,935 QALYs (Table 18, row *aw*). The CPB of 22,935 represents the gap between no coverage and the 'best in the world' coverage.

Table 18: CPB of Interventions for Tobacco Use Prevention and Cessation in Children and Youth in a B.C. Birth Cohort of 40,000

Row Label	Variable	Base case	Data Source
a	Age to start screening	5	√
b	Age to stop screening / brief intervention	17	√
	Without an Adolescent Screening Program / Brief Intervention		
	Prevalence of **female cigarette smokers** at age 24, by smoking intensity		
c	Light	1,411	Table 7
d	Moderate	851	Table 7
e	Heavy	365	Table 7
f	Total	2,627	= c + d + e
	Prevalence of **male cigarette smokers** at age 24, by smoking intensity		
g	Light	1,437	Table 7
h	Moderate	727	Table 7
i	Heavy	623	Table 7
j	Total	2,788	= g + h + i
k	Premature deaths in **female cigarette** smokers	1,519	Table 10
l	Life years lost due to premature deaths	26,043	Table 10
m	Premature deaths in **male cigarette** smokers	1,801	Table 10
n	Life years lost due to premature deaths	29,421	Table 10
o	QALYs lost due to **cigarette smoking** while alive (**females)**	6,602	Table 11
p	QALYs lost due to **cigarette smoking** while alive (**males)**	7,202	Table 11
q	Premature deaths in **female e-cigarette** users	681	Table 12
r	Life years lost due to premature deaths	10,484	Table 12
s	Premature deaths in **male e-cigarette** users	1,014	Table 12
t	Life years lost due to premature deaths	14,600	Table 12
u	QALYs lost due to **e-cigarette** use while alive (**females)**	3,053	Table 12
v	QALYs lost due to **e-cigarette** smoking while alive (**males)**	3,806	Table 12
w	Total QALYs Lost - **Females**	46,183	= l + o + r + u
x	Total QALYs Lost - **Males**	55,029	= n + p + t + v
	With an Adolescent Screening Program / Brief Intervention		
	Prevalence of **female smokers** at age 24, by smoking intensity		
y	Light	1,100	Table 14
z	Moderate	664	Table 14
aa	Heavy	284	Table 14
ab	Total	2,048	= y + z + aa
	Prevalence of **male smokers** at age 24, by smoking intensity		
ac	Light	1,169	Table 14
ad	Moderate	592	Table 14
ae	Heavy	507	Table 14
af	Total	2,267	= ac + ad + ae
ag	Premature deaths in **female cigarette** smokers	1,184	Table 15
ah	Life years lost due to premature deaths	20,308	Table 15
ai	Premature deaths in **male cigarette** smokers	1,465	Table 15
aj	Life years lost due to premature deaths	23,931	Table 15
ak	QALYs lost due to **cigarette smoking** while alive (**females)**	5,148	Table 16
al	QALYs lost due to **cigarette smoking** while alive (**males)**	5,858	Table 16
am	Premature deaths in **female e-cigarette** users	521	Table 17
an	Life years lost due to premature deaths	8,015	Table 17
ao	Premature deaths in **male e-cigarette** users	616	Table 17
ap	Life years lost due to premature deaths	9,058	Table 17
aq	QALYs lost due to **e-cigarette** use while alive (**females)**	2,972	Table 17
ar	QALYs lost due to **e-cigarette** smoking while alive (**males)**	2,987	Table 17
as	Total QALYs Lost - **Females**	36,443	= ah + ak + an + aq
at	Total QALYs Lost - **Males**	41,834	= aj + al + ap + ar
	QALYs Gained With Screening / Brief Intervention		
au	**Total QALYs gained - Females (CPB)**	9,740	= w - as
av	**Total QALYs gained - Males (CPB)**	13,195	= x - at
aw	**Total QALYs gained (CPB)**	**22,935**	= au + av

√ = Estimates from the literature

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CPB = 5,910**.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CPB = 41,077.**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CPB = 18,681.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CPB = 26,719.
- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CPB = 10,377.
- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CPB = 37,486.
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CPB = 21,476.
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CPB = 24,452.
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CPB = 16,707.
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CPB = 27,266.

Summary of CPB – Females Only

Based on these assumptions, the CPB associated with an intervention in which female screened children and youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years is 9,740 QALYs (Table 18, row *au*). The CPB of 9,740 represents the gap between no coverage and the 'best in the world' coverage.

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CPB = 2,438**.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CPB = 17,995**.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CPB = 7,873.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CPB = 11,423.

- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CPB = 4,311.
- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CPB = 16,316.
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CPB = 9,123.
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CPB = 10,381.
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CPB = 7,932.
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CPB = 11,078.

Summary of CPB – Males Only

Based on these assumptions, the CPB associated with an intervention in which male screened children and youth ages 5 – 17 would receive a brief intervention re: cigarette smoking / e-cigarette use initiation and 45% of screened cigarette smokers and 67% of screened e-cigarette users receive a brief cessation intervention every two years is 13,195 QALYs (Table 18, row *av*). The CPB of 13,195 represents the gap between no coverage and the 'best in the world' coverage.

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CPB = 3,473.**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CPB = 23,083.**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CPB = 10,808.
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CPB = 15,297.
- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CPB = 6,066.
- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CPB = 21,171.
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CPB = 12,353.
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CPB = 14,071.
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CPB = 8,774.
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CPB = 16,188.

Modelling Cost-Effectiveness

In this section, we model CE associated with asking children and youth or their parents about tobacco use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to prevent and/or treat tobacco smoking and e-cigarette use among children and youth.

In calculating CE, we made the following assumptions:

Screening and Brief Behavioural Interventions to Reduce the Initiation of Tobacco Smoking

- We assumed that screening for cigarette smoking / e-cigarette use in children / youth would take place annually in 92%[76] and 89%[77] of those with a primary health care visit in a given year. Furthermore, we have assumed that the screening would require 20% of a PCP office visit.

- The USPSTF reviewed 14 studies assessing the effectiveness of a brief intervention to **reduce the initiation of tobacco smoking**. Follow-up for these studies ranged from 6 to 36 months with the majority (57%) at 12 months.[78]
- In the 14 studies, three interventions took place in primary care clinics, two in dental clinics, 10 in homes and one in a school. Eight trials targeted the youth to receive the intervention, two targeted the parent and four targeted both child and parent. Print materials were used most commonly to deliver part or all of the intervention followed by face-to-face encounters with a counselor, health educator, or primary care medical or dental provider. The duration of the interventions ranged from 7 weeks to 25 months with a mean number of six contacts (ranging from 3-15).[79]

- We have assumed that an intervention to **reduce the initiation of tobacco smoking** would be required seven times between the ages of 5 and 17 for maximum effect, approximately once every two years. Furthermore, we have assumed that the intervention would require 50% of a PCP office visit for the first four interventions between the ages of 5 and 12 and then a full PCP office visit for the final three interventions between the ages of 13 and 17.

- The cost of an office visit to a General Practitioner (GP) in BC is estimated at $35.97.[80]

[76] LeLaurin J, Theis R, Thompson L et al. Tobacco-related counselling and documentation in adolescent primary care practice: Challenges and opportunities. *Nicotine & Tobacco Research*. 2020; 22(6): 1023-9.
[77] Matheus C, Hein N, Narahari P et al. Improving standardized screening for e-cigarette and vaping use among adolescents. *Paediatrics*. 2021; 147 (3-Meeting Abstract): 1002.
[78] Selph S, Patnode C, Bailey S et al. *Primary Care Interventions for Prevention and Cessation of Tobacco Use in Children and Adolescents: A Systematic Review for the U.S. Preventive Services Task Force*. Evidence Synthesis No. 185. AHRQ Publication No. 19-05254-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2020.
[79] Selph S, Patnode C, Bailey S et al. *Primary Care Interventions for Prevention and Cessation of Tobacco Use in Children and Adolescents: A Systematic Review for the U.S. Preventive Services Task Force*. Evidence Synthesis No. 185. AHRQ Publication No. 19-05254-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2020.
[80] Ministry of Health. *Medical Services Commission Payment Schedule*. 2021. Available at https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/msc-payment-schedule-may-2021.pdf. Accessed September 2022.

- Patient time costs resulting from receiving, as well as travelling to and from, a service are valued based on the average hourly wage rate in BC in 2022 ($31.49[81]) plus 18% benefits for an average cost per hour of $37.16. In the absence of specific data on the amount of time required, we assume two hours per service.
- Based on these assumptions, the cost of asking children and youth between the ages of 5 and 17 (or their parents) about tobacco use by the child or youth and offering brief information and advice, as appropriate, during primary care visits to prevent tobacco smoking and e-cigarette use among children and youth in a BC cohort of 40,000 is $21.4 million, $11.2 million in females and $10.2 million in males (see Table 19).

Table 19: Estimated Cost of Interventions to Reduce Initiation of Cigarette Smoking and E-Cigarette Use
Between the Ages of 5 and 17
In a British Columbia Birth Cohort of 40,000

	Females										Males									
Age	Pop.	See PHP	Cig Screened	E-Cig Screened	# of Screens	# of Interventions	PCP Visits	PCP	Cost Patient	Total	Pop.	See PHP	Cig Screened	E-Cig Screened	# of Screens	# of Interventions	PCP Visits	PCP	Cost Patient	Total
5	19,922	70%	92%	89%	12,830	12,830	8,981	$ 323,041	$ 667,456	$ 990,497	19,911	68%	92%	89%	12,456	12,456	8,719	$ 313,635	$ 648,021	$ 961,656
6	19,920	70%	92%	89%	12,829		2,566	$ 92,290	$ 190,686	$ 282,976	19,909	68%	92%	89%	12,455		2,491	$ 89,604	$ 185,136	$ 274,739
7	19,919	70%	92%	89%	12,828	12,828	8,979	$ 322,992	$ 667,355	$ 990,347	19,908	68%	92%	89%	12,454	12,454	8,718	$ 313,590	$ 647,930	$ 961,521
8	19,918	70%	92%	89%	12,827		2,565	$ 92,278	$ 190,661	$ 282,939	19,907	68%	92%	89%	12,454		2,491	$ 89,591	$ 185,110	$ 274,701
9	19,917	70%	92%	89%	12,826	12,826	8,978	$ 322,953	$ 667,275	$ 990,228	19,906	68%	92%	89%	12,453	12,453	8,717	$ 313,553	$ 647,852	$ 961,405
10	19,915	70%	92%	89%	12,826		2,565	$ 92,267	$ 190,638	$ 282,905	19,904	68%	92%	89%	12,452		2,490	$ 89,581	$ 185,089	$ 274,670
11	19,914	70%	92%	89%	12,825	12,825	8,977	$ 322,914	$ 667,195	$ 990,109	19,903	68%	92%	89%	12,451	12,451	8,716	$ 313,515	$ 647,774	$ 961,289
12	19,913	70%	92%	89%	12,824		2,565	$ 92,256	$ 190,616	$ 282,871	19,902	68%	92%	89%	12,451		2,490	$ 89,570	$ 185,067	$ 274,637
13	19,911	70%	92%	89%	12,823	12,823	15,388	$ 553,489	$1,143,601	$ 1,697,091	19,900	68%	92%	89%	12,450	12,450	14,940	$ 537,378	$1,110,313	$ 1,647,692
14	19,910	70%	92%	89%	12,822		2,564	$ 92,240	$ 190,583	$ 282,823	19,898	68%	92%	89%	12,448		2,490	$ 89,554	$ 185,034	$ 274,588
15	19,907	79%	92%	89%	14,469	14,469	17,362	$ 624,527	$1,290,376	$ 1,914,903	19,896	63%	92%	89%	11,531	11,531	13,838	$ 497,745	$1,028,424	$ 1,526,170
16	19,904	79%	92%	89%	14,466		2,893	$ 104,070	$ 215,026	$ 319,096	19,891	63%	92%	89%	11,529		2,306	$ 82,939	$ 171,366	$ 254,305
17	19,900	79%	92%	89%	14,463	14,463	17,356	$ 624,282	$1,289,871	$ 1,914,153	19,885	63%	92%	89%	11,525	11,525	13,830	$ 497,475	$1,027,866	$ 1,525,341
Total					**171,657**	**93,063**	**101,740**	**$3,659,599**	**$7,561,340**	**$11,220,939**					**159,111**	**85,321**	**92,236**	**$3,317,730**	**$6,854,983**	**$10,172,713**

Screening and Brief Behavioural Interventions to Increase Tobacco Smoking Cessation

- For modelling purposes, we have assumed that 45%[82] and 67%[83] of those found positive for cigarette / e-cigarette use would receive counselling to quit.

- In the systematic review by the CTFPHC on the effectiveness of a brief intervention to **increase smoking cessation**, a significant effect was observed in 2 of the 3 RCTs included. In the study by Hollis et al, the interventions consisted of an individually tailored intervention based on the smoking status and stage of change of the individual. It included a 30-second clinician advice message, a 10-minute interactive computer program, a 5-minute motivational interview, and up to two 10-minute telephone or in person booster sessions.[84] In the study by Pbert and colleagues, the

[81] BC Stats. *Earning & Employment Trends – August 2022*. Available at https://www2.gov.bc.ca/assets/gov/data/statistics/people-population-community/income/earnings_and_employment_trends_data_tables.pdf. Accessed September 2022.
[82] Merianos A, Mahabee-Gittens E. Screening, counselling, and health care utilization among a national sample of adolescent smokers. *Clinical Paediatrics*. 2020; 59(4-5): 467-75.
[83] Golden T, VanFrank B, Courtney-Long E. E-cigarette screening and clinical intervention behaviours among pediatric primary care providers, DocStyles 2021. *Paediatrics*. 2022; 149: 740.
[84] Hollis J, Polen M, Whitlock E et al. Teen Reach: Outcomes from a randomized, controlled trial of a tobacco reduction program for teens seen in primary medical care. *Pediatrics*. 2005; 115(4): 981-9.

intervention consisted of brief counselling by the paediatric provider followed by one visit and four telephone calls by older peer counsellors (aged 21 to 25 years).[85]

- In their model of the cost-effectiveness of brief clinician tobacco counselling for youth, Maciosek and colleagues estimated a cost of $35 per person (in 2012 USD). We converted this to $36 in 2022 CAD. These costs include 1 minute for a brief anti-tobacco message by a physician, 20 minutes with a health educator, parent time to accompany the youth and $5 for print materials.[86]
- In estimating the cost of the intervention, we have assumed the equivalent of two visits to a PCP (at a cost of 2*$35.97 = $71.94) plus four ten-minute follow-up telephone calls by a nurse. The value of the nursing time is estimated based on the wage rate for a Level 3 RN with four years of experience ($40.41 / hour).[87] The total nursing costs are based on the wage rate plus 18% for benefits and 40% for non-productive time (i.e. vacation, education leave, statutory holidays, coffee breaks, etc.) for 40 (0.67 of an hour) minutes of time (($40.41+$7.27+ $16.16) * 0.67) or $42.77). The total cost of the brief intervention would thus be **$114.71** ($71.94 + $42.77).
- Patient time costs are based on receiving as well as travelling to and from the two visits, assuming two hours per visit plus the 40 minutes of interaction time with the nurse.
- Based on these assumptions, the cost of offering brief information and advice to increase tobacco smoking cessation and e-cigarette use among children and youth in a BC cohort of 40,000 is $5.4 million, $2.9 million in females and $2.5 million in males (see Table 20).

Table 20: Estimated Cost of Interventions to Increase Cigarette Smoking and E-Cigarette Use Cessation
Between the Ages of 5 and 17
In a British Columbia Birth Cohort of 40,000

	Females											Males										
		Table7		See	Cig	E-Cig	Cig	E-Cig	# of		Cost		Table 7		See	Cig	E-Cig	Cig	E-Cig	# of		Cost
Age	Pop.	Cig	e-Cig	PHP	Screened		Intervention		Interventions		Patient	Total	Pop.	Cig	e-Cig	PHP	Screened		Intervention		Interventions		Patient	Total
5	19,922			70%	92%	89%	45%	67%					19,911			68%	92%	89%	45%	67%				
6	19,920			70%	92%	89%	45%	67%					19,909			68%	92%	89%	45%	67%				
7	19,919			70%	92%	89%	45%	67%					19,908			68%	92%	89%	45%	67%				
8	19,918	29		70%	92%	89%	45%	67%	8	$ 975	$ 1,471	$ 2,446	19,907	46		68%	92%	89%	45%	67%	13	$ 1,487	$ 2,245	$ 3,732
9	19,917	44		70%	92%	89%	45%	67%	13	$ 1,462	$ 2,207	$ 3,669	19,906	69		68%	92%	89%	45%	67%	19	$ 2,230	$ 3,367	$ 5,597
10	19,915	66		70%	92%	89%	45%	67%	19	$ 2,193	$ 3,311	$ 5,504	19,904	104		68%	92%	89%	45%	67%	29	$ 3,346	$ 5,050	$ 8,396
11	19,914	88		70%	92%	89%	45%	67%	25	$ 2,924	$ 4,414	$ 7,338	19,903	138		68%	92%	89%	45%	67%	39	$ 4,461	$ 6,734	$ 11,195
12	19,913	147		70%	92%	89%	45%	67%	42	$ 4,873	$ 7,357	$ 12,230	19,902	230		68%	92%	89%	45%	67%	65	$ 7,434	$ 11,223	$ 18,658
13	19,911	249	2,708	70%	92%	89%	45%	67%	1,203	$ 137,944	$ 208,240	$ 346,184	19,900	391	2,448	68%	92%	89%	45%	67%	1,103	$ 126,491	$ 190,950	$ 317,441
14	19,910	388	3,394	70%	92%	89%	45%	67%	1,529	$ 175,441	$ 264,845	$ 440,287	19,898	610	3,149	68%	92%	89%	45%	67%	1,448	$ 166,154	$ 250,825	$ 416,979
15	19,907	535	4,081	79%	92%	89%	45%	67%	2,097	$ 240,591	$ 363,195	$ 603,786	19,896	840	3,850	63%	92%	89%	45%	67%	1,665	$ 191,028	$ 288,374	$ 479,402
16	19,904	660	4,767	79%	92%	89%	45%	67%	2,462	$ 282,359	$ 426,248	$ 708,607	19,891	1,036	4,550	63%	92%	89%	45%	67%	1,980	$ 227,085	$ 342,807	$ 569,892
17	19,900	733	5,454	79%	92%	89%	45%	67%	2,809	$ 322,202	$ 486,395	$ 808,597	19,885	1,151	5,251	63%	92%	89%	45%	67%	2,273	$ 260,732	$ 393,600	$ 654,333
Total									**10,208**	**$1,170,965**	**$1,767,682**	**$2,938,647**									**8,634**	**$ 990,448**	**$1,495,176**	**$ 2,485,624**

[85] Pbert L, Flint A, Fletcher K et al. Effect of a pediatric-based smoking prevention and cessation intervention for adolescents: A randomized, controlled trial. *Pediatrics*. 2008; 121(4): e738-47.
[86] Maciosek M, LaFrance A, Dehmer S et al. Health benefits and cost-effectiveness of brief clinician tobacco counseling for youth and adults. *Annals of Family Medicine*. 2017; 15(1): 37-47.
[87] *2019 - 2022 Provincial Collective Bargaining Agreement between the Health Employers Association of BC and the Nurses' Bargaining Association*. Available online at https://www.bcnu.org/Contracts-Bargaining/Documents/nba-pca_2019-2022.pdf. Accessed October 2022.

Costs Avoided Due to Reduced Tobacco Smoking

- Tobacco smoking is associated with excess *annual medical care costs* (e.g., hospitalization, physician, drug, etc.). Research in BC identified these costs average $1,358 per year: $893 per year for light tobacco smoking (less than 10 cigarettes per day), $1,576 per year for moderate tobacco smoking (10 to 19 cigarettes per day) and $2,332 per year for heavy tobacco smoking (20 or more cigarettes per day). The equivalent costs for females are $1,199 / $803 / $1,367 / $2,359 and for males are $1,466 / $956 / $1,752 / $2,321.[88] All costs are in 2022 Canadian dollars.
- We multiplied these excess annual medical care costs by the number of male or female light, moderate or heavy smokers who were alive between the ages of 19 and 84 assuming no child/youth screening and brief intervention program. This total cost over the lifetime of the cohort was then redistributed by age and sex based on the fact that excess annual medical care costs increase substantially as a current smoker ages.[89] As per Maciosek and colleagues, we also assumed that these excess costs would only start at age 35.[90] This latter assumption is likely conservative as there is evidence that adolescent smokers use more health services than adolescent never-smokers. For example, Merianos et al suggest that adolescent current smokers are 80% more likely (aOR = 1.80, 95% CI = 1.47-2.22) and 2.95 times more likely (95% CI = 2.15-4.05) to have had an ED visit or an overnight hospital stay within the past 12 months than adolescent never smokers.[91]
- Wang and colleagues have estimated the annual excess medical care costs of exclusive e-cigarette use in adults ages 18 and older in the US to be $1,796 (in 2018 USD). They compare this with the estimated annual excess medical care costs of $5,602 (in 2018 USD) attributed to conventional cigarette smoking in the US.[92] That is, in the US, annual medical care costs associated with exclusive e-cigarettes use are approximately one-third (32.1%) that associated with conventional cigarette use. For modelling purposes, we have assumed that annual medical care costs associated with exclusive e-cigarette use in BC would be 32.1% of the $1,358 (see first bullet point above) attributable to conventional cigarette smoking, or $436. These costs would begin at age 19.
- Based on these assumptions, lifetime total excess medical care costs attributable to conventional and e-cigarette use in a BC birth cohort of 40,000 ***without*** a child/youth screening and brief intervention program would be $576.4 million, $258.2 million in females and $318.2 million in males (see Table 21).

[88] H. Krueger & Associates Inc. *The Economic Burden of Risk Factors in British Columbia: Excess Weight, Tobacco Smoking, Alcohol Use, Physical Inactivity and Low Fruit and Vegetable Consumption.* 2017. Vancouver, B.C.: Provincial Health Services Authority, Population and Public Health Program.
[89] Maciosek M, Xu X, Butani A et al. Smoking-attributable medical expenditures by age, sex, and smoking status estimated using a relative risk approach. *Preventive Medicine*. 2015; 77: 162-7.
[90] Maciosek M, Xu X, Butani A et al. Smoking-attributable medical expenditures by age, sex, and smoking status estimated using a relative risk approach. *Preventive Medicine*. 2015; 77: 162-7.
[91] Merianos A, Mahabee-Gittens E. Screening, counseling, and health care utilization among a national sample of adolescent smokers. *Clinical Pediatrics*. 2020; 59(4-5): 467 - 75.
[92] Wang Y, Sung H, Lightwood J et al. Healthcare utilization and expenditures attributable to current e-cigarette use among US adults. *Tobacco Control*. 2022; doi:10.1136/tobaccocontrol-2021-057058.

Table 21: Estimated Excess Medical Care Costs

Attributable to Conventional and e-Cigarette Use

In a British Columbia Birth Cohort of 40,000

Without a Child / Youth Screening Program / Brief Intervention

	Females					***Males***				
	Annual Costs by Smoking Intensity					*Annual Costs by Smoking Intensity*				
Age	Light	Mod	Heavy	*E-CigUse*	Total $	Light	Mod	Heavy	*E-CigUse*	Total $
19 - 34				$25,506,905	$25,506,905				$29,140,035	$29,140,035
35	$317,933	$310,222	$275,260	$1,095,408	$1,998,823	$359,008	$300,702	$349,098	$1,384,276	$2,393,084
36	$317,933	$310,222	$275,260	$1,094,653	$1,998,068	$359,008	$300,702	$349,098	$1,382,001	$2,390,810
37	$317,933	$310,222	$275,260	$1,093,865	$1,997,280	$359,008	$300,702	$349,098	$1,379,656	$2,388,464
38	$317,933	$310,222	$275,260	$1,093,032	$1,996,448	$359,008	$300,702	$349,098	$1,377,225	$2,386,033
39	$317,933	$310,222	$275,260	$1,092,166	$1,995,582	$359,008	$300,702	$349,098	$1,374,708	$2,383,516
40	$317,933	$310,222	$275,260	$1,091,256	$1,994,671	$359,008	$300,702	$349,098	$1,372,106	$2,380,915
41	$317,933	$310,222	$275,260	$1,090,279	$1,993,695	$359,008	$300,702	$349,098	$1,369,391	$2,378,199
42	$317,933	$310,222	$275,260	$1,089,247	$1,992,662	$359,008	$300,702	$349,098	$1,366,562	$2,375,370
43	$317,933	$310,222	$275,260	$1,088,148	$1,991,563	$359,008	$300,702	$349,098	$1,363,619	$2,372,427
44	$317,933	$310,222	$275,260	$1,086,971	$1,990,387	$359,008	$300,702	$349,098	$1,360,548	$2,369,356
45	$317,933	$310,222	$275,260	$1,085,717	$1,989,132	$359,008	$300,702	$349,098	$1,357,307	$2,366,115
46	$317,933	$310,222	$275,260	$1,084,374	$1,987,789	$359,008	$300,702	$349,098	$1,353,909	$2,362,717
47	$317,933	$310,222	$275,260	$1,082,942	$1,986,357	$359,008	$300,702	$349,098	$1,350,341	$2,359,149
48	$317,933	$310,222	$275,260	$1,081,410	$1,984,825	$359,008	$300,702	$349,098	$1,346,545	$2,355,353
49	$317,933	$310,222	$275,260	$1,079,767	$1,983,182	$359,008	$300,702	$349,098	$1,342,536	$2,351,344
50	$317,933	$310,222	$275,260	$1,078,002	$1,981,417	$359,008	$300,702	$349,098	$1,338,285	$2,347,093
51	$317,933	$310,222	$275,260	$1,076,115	$1,979,530	$359,008	$300,702	$349,098	$1,333,750	$2,342,558
52	$317,933	$310,222	$275,260	$1,074,083	$1,977,499	$359,008	$300,702	$349,098	$1,328,902	$2,337,710
53	$317,933	$310,222	$275,260	$1,071,897	$1,975,312	$359,008	$300,702	$349,098	$1,323,741	$2,332,549
54	$317,933	$310,222	$275,260	$1,069,532	$1,972,947	$359,008	$300,702	$349,098	$1,318,225	$2,327,033
55	$906,408	$884,424	$784,751	$1,066,990	$3,642,573	$1,214,334	$1,017,118	$1,180,816	$1,312,311	$4,724,577
56	$906,408	$884,424	$784,751	$1,064,248	$3,639,831	$1,214,334	$1,017,118	$1,180,816	$1,305,984	$4,718,251
57	$906,408	$884,424	$784,751	$1,061,284	$3,636,868	$1,214,334	$1,017,118	$1,180,816	$1,299,203	$4,711,469
58	$906,408	$884,424	$784,751	$1,058,065	$3,633,648	$1,214,334	$1,017,118	$1,180,816	$1,291,938	$4,704,204
59	$906,408	$884,424	$784,751	$1,054,579	$3,630,163	$1,214,334	$1,017,118	$1,180,816	$1,284,133	$4,696,399
60	$906,408	$884,424	$784,751	$1,050,794	$3,626,377	$1,214,334	$1,017,118	$1,180,816	$1,275,745	$4,688,012
61	$906,408	$884,424	$784,751	$1,046,676	$3,622,259	$1,214,334	$1,017,118	$1,180,816	$1,266,732	$4,678,998
62	$906,408	$884,424	$784,751	$1,042,202	$3,617,785	$1,214,334	$1,017,118	$1,180,816	$1,257,036	$4,669,302
63	$906,408	$884,424	$784,751	$1,037,318	$3,612,901	$1,214,334	$1,017,118	$1,180,816	$1,246,586	$4,658,853
64	$906,408	$884,424	$784,751	$1,032,001	$3,607,584	$1,214,334	$1,017,118	$1,180,816	$1,235,341	$4,647,607
65	$1,889,193	$1,843,374	$1,635,629	$1,026,195	$6,394,390	$2,449,642	$2,051,803	$2,382,027	$1,223,214	$8,106,686
66	$1,889,193	$1,843,374	$1,635,629	$1,019,856	$6,388,052	$2,449,642	$2,051,803	$2,382,027	$1,210,134	$8,093,606
67	$1,889,193	$1,843,374	$1,635,629	$1,012,918	$6,381,114	$2,449,642	$2,051,803	$2,382,027	$1,196,046	$8,079,517
68	$1,889,193	$1,843,374	$1,635,629	$1,005,325	$6,373,521	$2,449,642	$2,051,803	$2,382,027	$1,180,834	$8,064,305
69	$1,889,193	$1,843,374	$1,635,629	$997,011	$6,365,206	$2,449,642	$2,051,803	$2,382,027	$1,164,413	$8,047,885
70	$1,889,193	$1,843,374	$1,635,629	$987,897	$6,356,093	$2,449,642	$2,051,803	$2,382,027	$1,146,699	$8,030,171
71	$1,889,193	$1,843,374	$1,635,629	$977,896	$6,346,091	$2,449,642	$2,051,803	$2,382,027	$1,127,592	$8,011,063
72	$1,889,193	$1,843,374	$1,635,629	$966,928	$6,335,124	$2,449,642	$2,051,803	$2,382,027	$1,106,977	$7,990,449
73	$1,889,193	$1,843,374	$1,635,629	$954,884	$6,323,079	$2,449,642	$2,051,803	$2,382,027	$1,084,742	$7,968,214
74	$1,889,193	$1,843,374	$1,635,629	$941,663	$6,309,858	$2,449,642	$2,051,803	$2,382,027	$1,060,787	$7,944,259
75	$3,649,326	$3,560,818	$3,159,520	$927,154	$11,296,819	$4,041,031	$3,384,740	$3,929,490	$1,034,998	$12,390,259
76	$3,649,326	$3,560,818	$3,159,520	$911,214	$11,280,878	$4,041,031	$3,384,740	$3,929,490	$1,007,261	$12,362,522
77	$3,649,326	$3,560,818	$3,159,520	$893,730	$11,263,394	$4,041,031	$3,384,740	$3,929,490	$977,462	$12,332,723
78	$3,649,326	$3,560,818	$3,159,520	$874,548	$11,244,212	$4,041,031	$3,384,740	$3,929,490	$945,503	$12,300,764
79	$3,649,326	$3,560,818		$853,523	$8,063,667	$4,041,031	$3,384,740	$3,929,490	$911,297	$12,266,558
80	$3,649,326	$3,560,818		$830,511	$8,040,656	$4,041,031	$3,384,740	$3,929,490	$874,774	$12,230,035
81	$3,649,326	$3,560,818		$805,368	$8,015,512	$4,041,031	$3,384,740	$3,929,490	$835,891	$12,191,152
82	$3,649,326	$3,560,818		$777,938	$7,988,083	$4,041,031	$3,384,740	$3,929,490	$794,634	$12,149,895
83	$3,649,326	$3,560,818		$748,089	$7,958,233	$4,041,031	$3,384,740		$751,017	$8,176,788
84	$3,649,326	$3,560,818		$715,708	$7,925,852	$4,041,031	$3,384,740		$705,111	$8,130,882
Total	***$70,807,922***	***$69,090,601***	***$42,347,092***	***$75,948,282***	***$258,193,897***	***$84,230,211***	***$70,550,654***	***$74,046,311***	***$89,378,059***	***$318,205,235***

- We then used the same approach but this time multiplied the excess annual medical care costs by the number of male or female light, moderate or heavy smokers and e-cigarette users who were alive between the ages of 19 and 84 assuming a child/youth screening and brief intervention program was in place.
- Based on these assumptions, lifetime total excess medical care costs attributable to tobacco smoking in a BC birth cohort of 40,000 ***with*** a child/youth screening and brief intervention program would be $457.8 million, $200.2 million in females and $257.6 million in males (see Table 22).
- Total costs avoided would therefore be $118.6 million ($576.4 - $457.8), $58.0 million in females ($258.2 - $200.2) and $60.6 million ($318.2 - $257.6) in males.

Table 22: Estimated Excess Medical Care Costs

Attributable to Conventional and e-Cigarette Use

In a British Columbia Birth Cohort of 40,000

With a Child / Youth Screening Program / Brief Intervention

	Females					***Males***				
	Annual Costs by Smoking Intensity					*Annual Costs by Smoking Intensity*				
Age	Light	Mod	Heavy	*E-CigUse*	Total $	Light	Mod	Heavy	*E-CigUse*	Total $
19 - 34				$19,525,730	$19,525,730				$23,283,819	$23,283,819
35	$247,922	$241,909	$214,647	$837,383	$1,541,861	$292,012	$244,587	$283,951	$1,107,108	$1,927,659
36	$247,922	$241,909	$214,647	$836,806	$1,541,284	$292,012	$244,587	$283,951	$1,105,289	$1,925,840
37	$247,922	$241,909	$214,647	$836,203	$1,540,681	$292,012	$244,587	$283,951	$1,103,413	$1,923,964
38	$247,922	$241,909	$214,647	$835,567	$1,540,045	$292,012	$244,587	$283,951	$1,101,469	$1,922,019
39	$247,922	$241,909	$214,647	$834,905	$1,539,383	$292,012	$244,587	$283,951	$1,099,456	$1,920,007
40	$247,922	$241,909	$214,647	$834,209	$1,538,687	$292,012	$244,587	$283,951	$1,097,375	$1,917,926
41	$247,922	$241,909	$214,647	$833,462	$1,537,940	$292,012	$244,587	$283,951	$1,095,204	$1,915,754
42	$247,922	$241,909	$214,647	$832,673	$1,537,151	$292,012	$244,587	$283,951	$1,092,941	$1,913,492
43	$247,922	$241,909	$214,647	$831,833	$1,536,311	$292,012	$244,587	$283,951	$1,090,587	$1,911,138
44	$247,922	$241,909	$214,647	$830,934	$1,535,412	$292,012	$244,587	$283,951	$1,088,131	$1,908,682
45	$247,922	$241,909	$214,647	$829,975	$1,534,453	$292,012	$244,587	$283,951	$1,085,539	$1,906,090
46	$247,922	$241,909	$214,647	$828,948	$1,533,426	$292,012	$244,587	$283,951	$1,082,821	$1,903,372
47	$247,922	$241,909	$214,647	$827,853	$1,532,331	$292,012	$244,587	$283,951	$1,079,968	$1,900,518
48	$247,922	$241,909	$214,647	$826,682	$1,531,160	$292,012	$244,587	$283,951	$1,076,932	$1,897,483
49	$247,922	$241,909	$214,647	$825,426	$1,529,904	$292,012	$244,587	$283,951	$1,073,725	$1,894,276
50	$247,922	$241,909	$214,647	$824,077	$1,528,555	$292,012	$244,587	$283,951	$1,070,326	$1,890,876
51	$247,922	$241,909	$214,647	$822,634	$1,527,112	$292,012	$244,587	$283,951	$1,066,699	$1,887,249
52	$247,922	$241,909	$214,647	$821,082	$1,525,559	$292,012	$244,587	$283,951	$1,062,821	$1,883,372
53	$247,922	$241,909	$214,647	$819,410	$1,523,888	$292,012	$244,587	$283,951	$1,058,694	$1,879,245
54	$247,922	$241,909	$214,647	$817,602	$1,522,080	$292,012	$244,587	$283,951	$1,054,282	$1,874,833
55	$706,811	$689,669	$611,945	$815,659	$2,824,084	$987,723	$827,309	$960,458	$1,049,552	$3,825,043
56	$706,811	$689,669	$611,945	$813,563	$2,821,988	$987,723	$827,309	$960,458	$1,044,492	$3,819,983
57	$706,811	$689,669	$611,945	$811,297	$2,819,722	$987,723	$827,309	$960,458	$1,039,069	$3,814,560
58	$706,811	$689,669	$611,945	$808,836	$2,817,261	$987,723	$827,309	$960,458	$1,033,259	$3,808,749
59	$706,811	$689,669	$611,945	$806,172	$2,814,597	$987,723	$827,309	$960,458	$1,027,016	$3,802,507
60	$706,811	$689,669	$611,945	$803,278	$2,811,703	$987,723	$827,309	$960,458	$1,020,308	$3,795,799
61	$706,811	$689,669	$611,945	$800,130	$2,808,555	$987,723	$827,309	$960,458	$1,013,099	$3,788,590
62	$706,811	$689,669	$611,945	$796,710	$2,805,135	$987,723	$827,309	$960,458	$1,005,345	$3,780,836
63	$706,811	$689,669	$611,945	$792,976	$2,801,401	$987,723	$827,309	$960,458	$996,988	$3,772,478
64	$706,811	$689,669	$611,945	$788,911	$2,797,336	$987,723	$827,309	$960,458	$987,994	$3,763,485
65	$1,473,181	$1,437,452	$1,275,455	$784,473	$4,970,561	$1,992,507	$1,668,908	$1,937,506	$978,295	$6,577,216
66	$1,473,181	$1,437,452	$1,275,455	$779,628	$4,965,715	$1,992,507	$1,668,908	$1,937,506	$967,834	$6,566,756
67	$1,473,181	$1,437,452	$1,275,455	$774,324	$4,960,412	$1,992,507	$1,668,908	$1,937,506	$956,566	$6,555,488
68	$1,473,181	$1,437,452	$1,275,455	$768,520	$4,954,607	$1,992,507	$1,668,908	$1,937,506	$944,400	$6,543,322
69	$1,473,181	$1,437,452	$1,275,455	$762,164	$4,948,251	$1,992,507	$1,668,908	$1,937,506	$931,268	$6,530,189
70	$1,473,181	$1,437,452	$1,275,455	$755,197	$4,941,284	$1,992,507	$1,668,908	$1,937,506	$917,100	$6,516,022
71	$1,473,181	$1,437,452	$1,275,455	$747,551	$4,933,639	$1,992,507	$1,668,908	$1,937,506	$901,819	$6,500,740
72	$1,473,181	$1,437,452	$1,275,455	$739,167	$4,925,254	$1,992,507	$1,668,908	$1,937,506	$885,332	$6,484,253
73	$1,473,181	$1,437,452	$1,275,455	$729,960	$4,916,047	$1,992,507	$1,668,908	$1,937,506	$867,549	$6,466,470
74	$1,473,181	$1,437,452	$1,275,455	$719,853	$4,905,941	$1,992,507	$1,668,908	$1,937,506	$848,390	$6,447,311
75	$2,845,722	$2,776,705	$2,463,777	$708,762	$8,794,966	$3,286,923	$2,753,100	$3,196,190	$827,764	$10,063,978
76	$2,845,722	$2,776,705	$2,463,777	$696,576	$8,782,780	$3,286,923	$2,753,100	$3,196,190	$805,581	$10,041,795
77	$2,845,722	$2,776,705	$2,463,777	$683,211	$8,769,415	$3,286,923	$2,753,100	$3,196,190	$781,749	$10,017,963
78	$2,845,722	$2,776,705	$2,463,777	$668,547	$8,754,751	$3,286,923	$2,753,100	$3,196,190	$756,189	$9,992,402
79	$2,845,722	$2,776,705		$652,475	$6,274,901	$3,286,923	$2,753,100	$3,196,190	$728,832	$9,965,046
80	$2,845,722	$2,776,705		$634,883	$6,257,310	$3,286,923	$2,753,100	$3,196,190	$699,622	$9,935,836
81	$2,845,722	$2,776,705		$615,663	$6,238,089	$3,286,923	$2,753,100	$3,196,190	$668,524	$9,904,738
82	$2,845,722	$2,776,705		$594,694	$6,217,121	$3,286,923	$2,753,100	$3,196,190	$635,528	$9,871,742
83	$2,845,722	$2,776,705		$571,875	$6,194,302	$3,286,923	$2,753,100		$600,644	$6,640,667
84	$2,845,722	$2,776,705		$547,122	$6,169,549	$3,286,923	$2,753,100		$563,929	$6,603,953
Total	***$55,215,577***	***$53,876,444***	***$33,022,041***	***$58,085,571***	***$200,199,632***	***$68,511,783***	***$57,384,920***	***$60,228,193***	***$71,460,638***	***$257,585,534***

Summary of CE – Males and Females

- Other costs and assumptions used in assessing cost-effectiveness are detailed in the Reference Document.
- Discount rate of 1.5%, varied from 0% to 3% in the sensitivity analysis.

Based on these assumptions, the CE associated with interventions to prevent and/or treat tobacco use among children and youth is -$4,221 per QALY (Table 23, row *al*).

Table 23: CE of Interventions for Tobacco Use Prevention and Cessation in Children and Youth in a B.C. Birth Cohort of 40,000

Row Label	Variable	Base case	Data Source
	Cost of Screening / Brief Intervention		
	Reduce Initiation of Tobacco Smoking / E-cigarette Use		
a	Primary care provider costs (in millions) - Females	$3.66	Table 19
b	Patient time costs (in millions) - Females	$7.56	Table 19
c	Primary care provider costs (in millions) - Males	$3.32	Table 19
d	Patient time costs (in millions) - Males	$6.85	Table 19
	Increase Cessation of Tobacco Smoking / E-cigarette Use		
e	Primary care provider costs (in millions) - Females	$1.17	Table 20
f	Patient time costs (in millions) - Females	$1.77	Table 20
g	Primary care provider costs (in millions) - Males	$0.99	Table 20
h	Patient time costs (in millions) - Males	$1.50	Table 20
	Total Cost of Screening / Brief Intervention		
i	Females	$14.16	= a + b + e + f
j	Males	$12.66	= c + d + g + h
k	**Total Cost** of Screening / Brief Intervention	**$26.82**	= i + j
	Treatment Costs Avoided with a Screening / Brief Intervention Program		
	Excess Medical Care Costs Attributable to Tobacco Use ***Without*** a Child / Youth Screening Program / Brief Intervention		
l	Females (in millions)	$258.19	Table 21
m	Males (in millions)	$318.21	Table 21
n	Total (in millions)	$576.40	Table 21
	Excess Medical Care Costs Attributable to Tobacco Use ***With*** a Child / Youth Screening Program / Brief Intervention		
o	Females (in millions)	$200.20	Table 22
p	Males (in millions)	$257.59	Table 22
q	Total (in millions)	$457.79	Table 22
	Excess Medical Care Costs Attributable to Tobacco Use ***Avoided***		
r	Females (in millions)	$57.99	= l - o
s	Males (in millions)	$60.62	= m - p
t	**Total (in millions)**	**$118.61**	= r + s
	CE per QALY Gained		
u	Net cost of screening and brief intervention (in millions) - Females	-$43.83	= i - r
v	Total QALYs gained - Females	9,740	Table 18
w	CE ($/QALY gained) - Females	-$4,501	(u / v) * 1,000,000
x	Net cost of screening and brief intervention (in millions) - Males	-$47.96	= j - s
y	Total QALYs gained - Males	13,195	Table 18
z	CE ($/QALY gained) - Males	-$3,635	(x / y) * 1,000,000
aa	Net cost of screening and brief intervention (in millions) - Total	-$91.80	= k - t
ab	Total QALYs gained - Total	22,935	Table 18
ac	CE ($/QALY gained) - Total	-$4,002	(aa / ab) * 1,000,000
ad	Net cost of screening and brief intervention (in millions, 1.5% discount) - Females	-$19.80	Calculated
ae	Total QALYs gained, 1.5% Discount - Females	4,223	Calculated
af	**CE ($/QALY gained), 1.5% Discount - Females**	**-$4,688**	Calculated
ag	Net cost of screening and brief intervention (in millions, 1.5% discount) - Males	-$22.76	Calculated
ah	Total QALYs gained, 1.5% Discount - Males	5,859	Calculated
ai	**CE ($/QALY gained), 1.5% Discount - Males**	**-$3,885**	Calculated
aj	Net cost of screening and brief intervention (in millions, 1.5% discount) - Total	-$42.56	Calculated
ak	Total QALYs gained, 1.5% Discount - Total	10,082	Calculated
al	**CE ($/QALY gained), 1.5% Discount - Total**	**-$4,221**	Calculated

V = Estimates from the literature

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CE = $2,835**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CE = -$5,445**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CE = -$3,636
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CE = -$4,595
- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CE = -$1,206
- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CE = -$5,285
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CE = -$4,585
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CE = -$3,899
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CE = -$5,752
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CE = -$3,542

Summary of CE – Females Only

Based on these assumptions, the CE associated with interventions to prevent and/or treat tobacco smoking among female children and youth is -$4,688 per QALY (Table 23, row *af*).

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CE = $4,290**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CE = -$6,036**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CE = -$3,982
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CE = -$5,124
- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CE = -$922

- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CE = -$5,877
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CE = -$5,095
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CE = -$4,328
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CE = -$5,703
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CE = -$4,132

Summary of CE – Males Only

Based on these assumptions, the CE associated with interventions to prevent and/or treat tobacco smoking among male children and youth is -$3,885 per QALY (Table 23, row *ai*).

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

- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8% and the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: **CE = $1,833**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27% and the effectiveness of interventions aimed at smoking cessation are increased from 34% to 69%: **CE = -$4,997**
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is reduced from 18% to 8%: CE = -$3,390
- Assume the effectiveness of interventions aimed at smoking initiation among children and youth is increased from 18% to 27%: CE = -$4,209
- Assume the effectiveness of interventions aimed at smoking cessation are reduced from 34% to 5%: CE = -$1,404
- Assume the effectiveness of interventions aimed smoking cessation are increased from 34% to 69%: CE = -$4,840
- Assume the QoL reduction associated with light/moderate/heavy smoking is reduced from 0.031 / 0.033 / 0.062 to 0.018 / 0.019 / 0.042: CE = -$4,218
- Assume the QoL reduction associated with light/moderate/heavy smoking is increased from 0.031 / 0.033 / 0.062 to 0.045 / 0.047 / 0.082: CE = -$3,590
- Assume the harms attributable to e-cigarette use are reduced from being 37% as harmful as smoking conventional cigarettes to being 10% as harmful: CE = -$5,796
- Assume the harms attributable to e-cigarette use are increased from being 37% as harmful as smoking conventional cigarettes to being 60% as harmful: CE = -$3,151

Summary

Males and Females

Applying a 1.5% discount rate, the clinically preventable burden (CPB) associated with interventions to prevent and/or treat tobacco smoking among children and youth ages 5 to 17 in a British Columbia birth cohort of 40,000 is estimated to be 10,082 quality-adjusted life years (QALYs) while the cost-effectiveness (CE) is estimated to be -$4,221 per QALY (see Table 24).

Table 24: Interventions for Tobacco Use Prevention and Cessation in Children and Youth

In a B.C. Birth Cohort of 40,000

Summary

	Base Case	Range	
CPB (Potential QALYs Gained)			
1.5% Discount Rate	**10,082**	**2,590**	**18,112**
3% Discount Rate	4,419	1,131	7,970
0% Discount Rate	22,935	5,910	41,077
CE ($/QALY) **including** patient time costs			
1.5% Discount Rate	**-$4,221**	**-$5,445**	**$2,835**
3% Discount Rate	-$3,858	-$6,222	$10,538
0% Discount Rate	-$4,002	-$4,666	-$493
CE ($/QALY) **excluding** patient time costs			
1.5% Discount Rate	**-$5,794**	**-$6,321**	**-$3,288**
3% Discount Rate	-$7,087	-$8,012	-$2,080
0% Discount Rate	$4,773	-$5,096	-$3,484

Females Only

Applying a 1.5% discount rate, the clinically preventable burden (CPB) associated with interventions to prevent and/or treat tobacco smoking among female children and youth ages 5 to 17 in a British Columbia birth cohort of 40,000 is estimated to be 4,223 quality-adjusted life years (QALYs) while the cost-effectiveness (CE) is estimated to be -$4,688 per QALY (see Table 25).

Table 25: Interventions for Tobacco Use Prevention and Cessation in Children and Youth
In a B.C. Birth Cohort of 40,000
Summary - Females Only

	Base Case	Range	
CPB (Potential QALYs Gained)			
1.5% Discount Rate	**4,223**	**1,056**	**7,812**
3% Discount Rate	1,820	455	3,374
0% Discount Rate	9,740	3,473	17,995
CE ($/QALY) **including** patient time costs			
1.5% Discount Rate	**-$4,688**	**-$6,036**	**$4,290**
3% Discount Rate	-$4,093	-$6,906	$14,625
0% Discount Rate	-$4,501	-$4,666	-$152
CE ($/QALY) **excluding** patient time costs			
1.5% Discount Rate	**-$6,665**	**-$7,105**	**-$3,617**
3% Discount Rate	-$8,212	-$9,128	-$1,872
0% Discount Rate	-$5,458	-$5,670	-$3,979

Males Only

Applying a 1.5% discount rate, the clinically preventable burden (CPB) associated with interventions to prevent and/or treat tobacco smoking among male children and youth ages 5 to 17 in a British Columbia birth cohort of 40,000 is estimated to be 5,859 quality-adjusted life years (QALYs) while the cost-effectiveness (CE) is estimated to be -$3,885 per QALY (see Table 26).

Table 26: Interventions for Tobacco Use Prevention and Cessation in Children and Youth

In a B.C. Birth Cohort of 40,000

Summary - Males Only

	Base Case	Range	
CPB (Potential QALYs Gained)			
1.5% Discount Rate	**5,859**	**1,534**	**10,300**
3% Discount Rate	2,598	676	4,596
0% Discount Rate	13,195	3,473	23,083
CE ($/QALY) **including** patient time costs			
1.5% Discount Rate	**-$3,885**	**-$4,997**	**$1,833**
3% Discount Rate	-$3,693	-$5,720	$7,791
0% Discount Rate	-$3,635	-$4,287	-$732
CE ($/QALY) **excluding** patient time costs			
1.5% Discount Rate	**-$5,166**	**-$5,726**	**-$3,061**
3% Discount Rate	-$5,298	-$7,193	-$2,220
0% Discount Rate	-$4,268	-$4,649	-$3,137

Preventive Medication / Devices

Fluoride Varnish for Dental Health in Children – Evidence Update

Background

The economic modelling of the *'Fluoride Varnish for Dental Health in Children'* maneuver was initially conducted by the LPS in 2014. The evidence at that time supported fluoride varnish application as a clinically effective routine intervention for the prevention of dental caries in the general population of children between the ages of 1 and 5.

As per direction from the LPSEC, in 2022/23 the LPS conducted a thorough review of new evidence that has emerged in recent years, which uncovered several substantial findings calling into question the clinical effectiveness of fluoride varnish application in the general population of children ages 1 to 5. These findings and evidence are described in detail below.

United States Preventive Service Task Force Recommendations (2021)

The most recent USPSTF recommendation is as follows*:*

> *The USPSTF recommends that primary care clinicians prescribe oral fluoride supplementation starting at age 6 months for children whose water supply is deficient in fluoride. (B recommendation)*
>
> *The USPSTF recommends that primary care clinicians apply fluoride varnish to the primary teeth of all infants and children starting at the age of primary tooth eruption. (B recommendation)*[93]

These 2021 USPSTF recommendations are identical to the previous (2014) USPSTF recommendations.[94]

The Cochrane Oral Health Group (2013)

> *The review suggests a substantial caries-inhibiting effect of fluoride varnish in both permanent and primary teeth, however the quality of the evidence was assessed as moderate, as it included mainly high risk of bias studies, with considerable heterogeneity.*[95]

Application of Fluoride Varnish in Children

In British Columbia

- We were unable to find any information on the proportion of children in BC who have had one or more fluoride varnish (FV) applications.

Best in the World

- Since July 2004, the government of Taiwan has provided free fluoride varnish services in dental clinic settings for all pre-school children. The application of fluoride varnish is recommended every 6 months in urban areas and every 3 months

[93] USPSTF Task Force. Screening and interventions to prevent dental caries in children younger than 5 years: US Preventive Services Task Force recommendation statement. *JAMA.* 2021; 326(21): 2172-8.
[94] Moyer VA. Prevention of dental caries in children from birth through age 5 years: US Preventive Services Task Force recommendation statement. *Pediatrics*. 2014; 133(5): 1-10.
[95] Marinho V, Worthington H, Walsh T, et al. *Fluoride varnishes for preventing dental caries in children and adolescents and fissure sealants for preventing dental decay in permanent teeth*. Cochrane Oral Health Group. The Cochrane Library. July 11, 2013. Available online at https://www.cochrane.org/CD002279/ORAL_fluoride-varnishes-for-preventing-dental-caries-in-children-and-adolescents. Accessed December 2022.

in rural areas or for high risk groups (indigenous people, disabled children, or children from low-income households). Of 1,246 eight- and nine-year old children included in a follow-up assessment, 23% had received no fluoride varnish applications, 23% received one application, 24% received two applications and 29% received three or more applications. The rate for three or more applications was significantly higher in children whose mothers had a college or higher (vs high school or lower) education (32.9% vs. 22.7%).[96]

- In a school-based program of 589 children ages 3 to 7 from deprived neighbourhoods in the UK, 82.7% (487) consented to three fluoride applications over the period of a year while 61.6% (363) received all three applications.[97]
- A school-based oral health program targeting 3 to 6-year-old children in East London, UK, (in "two of the most deprived boroughs in England") found that 21% of eligible children received two fluoride applications in year 1 of the program. This increased to 29% in year 2 and 53% in year 3.[98]

- Fluoride varnish application rates of between 53%[99] and 62%[100] have been achieved in programs focussing on children from low socio-economic status (SES) neighbourhoods.
- In the general population of pre-school children, a rate of 29% (for 3 or more applications of fluoride varnish during the pre-school years) was achieved in Taiwan.[101]

Definitions / Background

- Early childhood caries (ECC) is defined as "the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a preschool-age child, i.e., between birth and 71 months of age."[102]
- The American Academy of Pediatric Dentistry defines severe-ECC (S-ECC) as any sign of smooth-surface caries in children younger than 3 years. From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5).[103]

[96] Lin P, Wang J, Chuag T et al. Association between population-based fluoride varnish application services and dental caries experience among schoolchildren in Taiwan. *Journal of the Formosan Medical Association*. 2022; 121 (5): 986-94.
[97] Buckingham S and John J. Recruitment and participation in preschool and school-based fluoride varnish pilots–the South Central experience. *British Dental Journal*. 2013; 215(E8): 1-4.
[98] Evans P, Pearson N and Simons D. A school-based oral health intervention in East London: the Happy Teeth fluoride varnish programme. *British Dental Journal*. 2013; 215(E14): 1-5.
[99] Evans P, Pearson N and Simons D. A school-based oral health intervention in East London: the Happy Teeth fluoride varnish programme. *British Dental Journal*. 2013; 215(E14): 1-5.
[100] Buckingham S and John J. Recruitment and participation in preschool and school-based fluoride varnish pilots–the South Central experience. *British Dental Journal*. 2013; 215(E8): 1-4.
[101] Lin P, Wang J, Chuag T et al. Association between population-based fluoride varnish application services and dental caries experience among schoolchildren in Taiwan. *Journal of the Formosan Medical Association*. 2022; 121 (5): 986-94.
[102] Canadian Dental Association. *Early Childhood Caries*. Available online at https://www.cda-adc.ca/en/about/position_statements/ecc/. Accessed December 2022.
[103] American Academy of Pediatric Dentistry. *Definition of Early Childhood Caries (ECC).* Available online at https://www.aapd.org/assets/1/7/d_ecc.pdf. Accessed December 2022.

- "Dental caries results from the metabolism of sugars by bacteria that are normally resident in the oral cavity. The acids produced cause the demineralisation (breakdown) of the tooth surface. Initially, the caries lesion is confined to the dental enamel. In its early stages, the disease process can be halted or even reversed by a process known as remineralisation. This is facilitated by the presence of fluoride at the interface between the tooth surface and the overlying biofilm of the dental plaque.

  Untreated, the disease process continues to involve the underlying dentine and eventually the dental pulp becomes inflamed, resulting in pain: toothache. Once the dentine is involved, the tooth requires a restoration to halt caries progression. Ultimately, an inflamed pulp will die and a dental abscess may result. Resolution will require either root-filling or the extraction of the tooth."[104]

- "Topical fluoride is applied as a varnish with a small brush in young children….No studies directly assessed the appropriate ages at which to start and stop the application of fluoride varnish. However, given the mechanism of action of this intervention, benefits are likely to accrue starting at the time of primary tooth eruption. In studies, fluoride varnish was most commonly administered as 5% sodium fluoride, every 6 months."[105]

- In contrast to the application of fluoride sealants, "the application of FV is much less technique sensitive and does not require the degree of specialist equipment needed for sealant placement. FV can simply be painted onto teeth using a small brush. Moisture control using cotton wool rolls or pads is sufficient. As a result, FV can be applied in a school medical room or other private location and does not necessarily need to be done within a clinic or traditional health-care setting."[106]

Estimating the Prevalence of Dental Caries in Young Children

- All children are at potential risk for dental caries.

- Biological risk factors include cariogenic bacteria, developmental defects of tooth enamel, and low saliva flow rates.[107]

Prevalence is Significantly Influenced by Social Determinants

- Social determinants of health (nonbiological factors) that are associated with increased caries risk include access to dental care, low socioeconomic status, personal and family oral health history, dietary habits (especially frequent intake of dietary sugars in foods and beverages), fluoride exposure, and oral hygiene practices.[108]

- Similar to many chronic, lifestyle-associated diseases, caries prevalence is markedly linked to social and economic deprivation. At the age of 5 years, the prevalence of

[104] Chestnutt I, Hutchings S, Playle R et al. Seal or varnish? A randomised controlled trial to determine the relative cost and effectiveness of pit and fissure sealant and fluoride varnish in preventing dental decay. *Health Technology Assessment*. 2017; 21(21).
[105] USPSTF Task Force. Screening and interventions to prevent dental caries in children younger than 5 years: US Preventive Services Task Force recommendation statement. *JAMA.* 2021; 326(21): 2172-8.
[106] Chestnutt I, Hutchings S, Playle R et al. Seal or varnish? A randomised controlled trial to determine the relative cost and effectiveness of pit and fissure sealant and fluoride varnish in preventing dental decay. *Health Technology Assessment*. 2017; 21(21).
[107] USPSTF Task Force. Screening and interventions to prevent dental caries in children younger than 5 years: US Preventive Services Task Force recommendation statement. *JAMA.* 2021; 326(21): 2172-8.
[108] USPSTF Task Force. Screening and interventions to prevent dental caries in children younger than 5 years: US Preventive Services Task Force recommendation statement. *JAMA.* 2021; 326(21): 2172-8.

dental decay in children resident in the most deprived localities is more than twice that of children living in the least deprived communities.[109,110]

- In BC, the rate of visible dental decay in children in kindergarten was 39.0% in 2006/07 and 37.1% in 2009/10. This rate, however, varied substantially by SES, from a low of 28.9% in the highest SES to 47.1% in the lowest SES (see Table 1).[111]

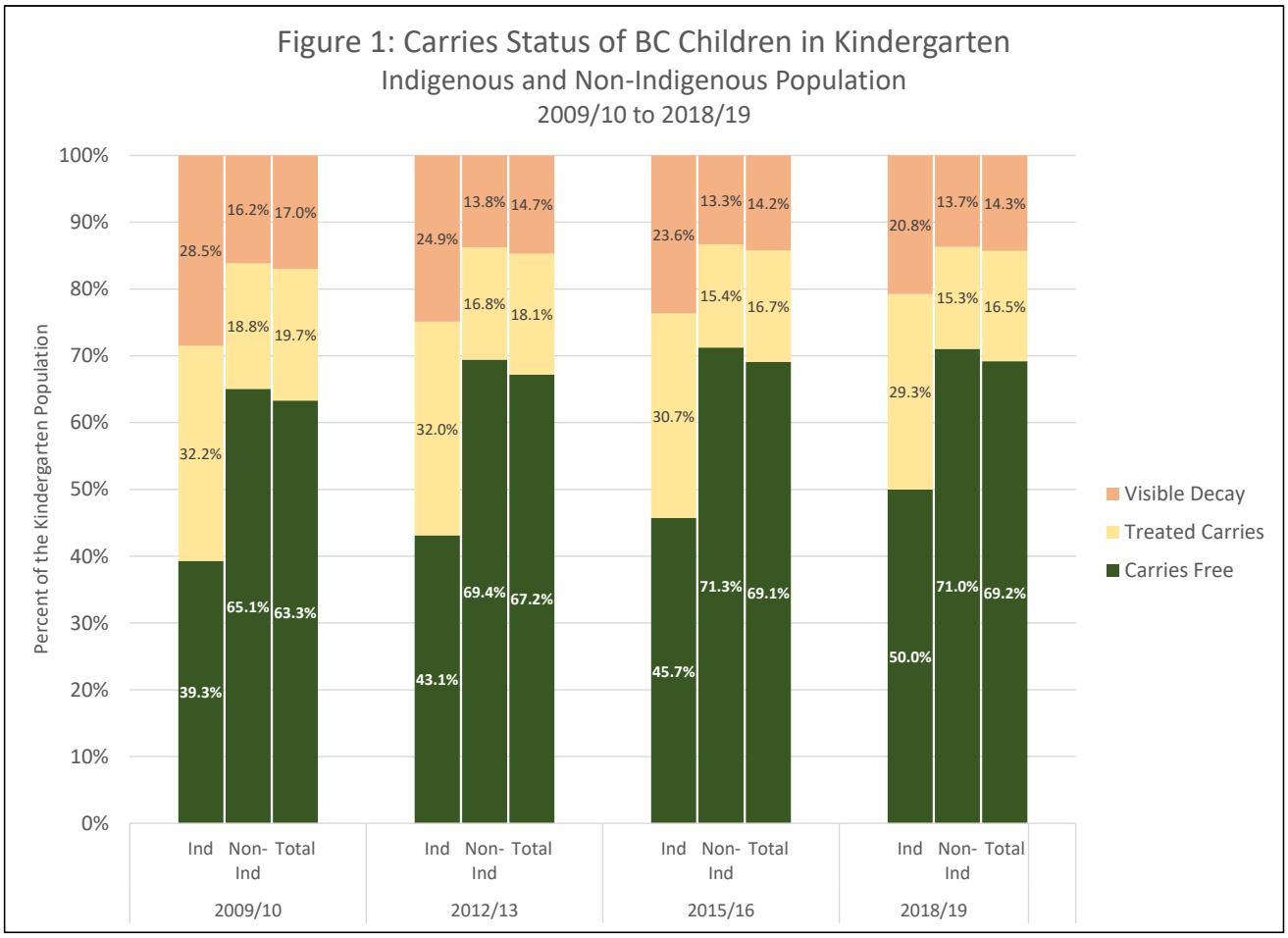
Table 1: Dental Decay Rates by Neighbourhood Socio-Economic Status (SES)
British Columbia, 2006/07 and 2009/10

SES Index	2006/07	2009/10
Low SES	49.2%	47.1%
Moderate-low SES	42.1%	41.1%
Moderate SES	37.3%	34.9%
Moderate-high SES	34.7%	32.9%
High SES	30.5%	28.9%
Total	**39.0%**	**37.1%**

- In their review of the Canadian literature, Peirce et al found 27 studies that reported on the prevalence of ECC in Canada. The vast majority of studies focussed on the prevalence of ECC in Indigenous children (i.e., First Nations, Inuit, or Metis), children of newcomers (immigrants and refugees) or children with S-ECC.[112]

[109] Chestnutt I, Hutchings S, Playle R et al. Seal or varnish? A randomised controlled trial to determine the relative cost and effectiveness of pit and fissure sealant and fluoride varnish in preventing dental decay. *Health Technology Assessment*. 2017; 21(21).
[110] International Centre for Oral Health Inequalities Research and Policy. *Social Inequalities in Oral Health: From Evidence to Action*. Edited by Watt R, Listl S, Peres M and Heilmann A. Available online at https://media.news.health.ufl.edu/misc/cod-oralhealth/docs/posts_frontpage/SocialInequalities.pdf. Accessed December 2022.
[111] Poon B, Holley P, Louie A et al. Dental caries disparities in early childhood: A survey of kindergarten children in British Columbia. *Canadian Journal of Public Health*. 2015; 106(5): e308 – e314.
[112] Pierce A, Singh S, Lee J et al. The burden of early childhood caries in Canadian children and associated risk factors. *Frontiers in Public Health*. 2019; 7: 328.

- Based on the findings of the BC Dental Health Survey, the proportion of kindergarten children who were carries free was 50.0% for the indigenous population and 71.0% for the non-indigenous population in 2018/19 (see Figure 1). [113,114,115]



- The overall rate of dental surgery to treat ECC in Canada between 2010/11 and 2013/14 was 12.1 per 1,000 children 12 - 59 months of age, accounting for 31.0% of all day surgeries performed on this age group in Canada. Rates of dental surgery for children from neighbourhoods with a high proportion of Aboriginal people were 7.8 times those for children living in areas with a low proportion (84.5 vs. 10.9 per

[113] BC Ministry of Health Services, Population and Public Health. *British Columbia Dental Survey of Kindergarten-Aged Children 2009-2010: A Regional and Provincial Analysis*. 2011. Available online at https://www.health.gov.bc.ca/library/publications/year/2011/provincial-kindergarten-dental-survey-report-2009-2010.pdf. Accessed December 2022.

[114] BC Ministry of Health, First Nations Health Authority. *B.C. Dental Survey of Aboriginal Kindergarten Children 2015/2016: A Provincial and First Nations School Analysis*. 2019. Available online at https://www.health.gov.bc.ca/library/publications/year/2019/BC_dental_survey_of_aboriginal_kindergarten_children_2015_2016_final.pdf. Accessed December 2022.

[115] BC Ministry of Health, Population Public Health Division. *2018-19 Provincial Dental Health Survey Report: A Provincial and Regional Analysis*. 2021. Available online at https://www.health.gov.bc.ca/library/publications/year/2021/provincial-kindergarten-dental-health-survey-report-2018-19.pdf. Accessed December 2022.

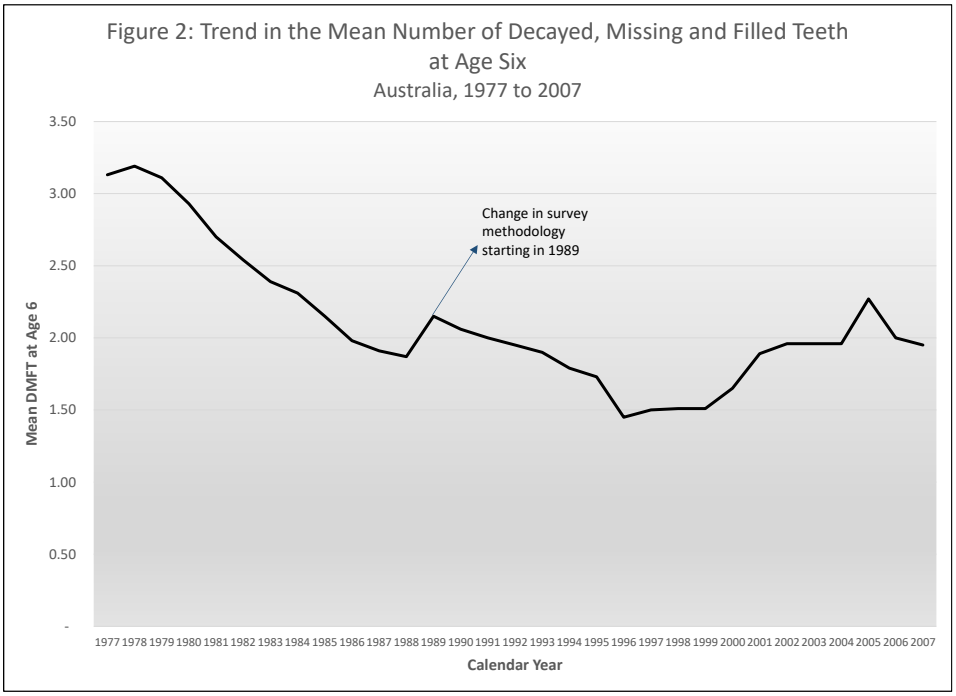
1,000). Children from the least-affluent regions had dental surgery rates 3.7 times higher than those from the most-affluent communities (25.7 vs. 6.9 per 1,000).[116]

Prevalence in British Columbia

- In BC, the rate of visible dental decay in children in kindergarten was 39.0% in 2006/07 and 37.1% in 2009/10 (see Table 1).[117]
- Based on the findings of the BC Dental Health Survey, the proportion of kindergarten children who were carries free increased from 63.3% in 2009/10 to 69.2% in 2018/19 (see Figure 1).

Prevalence in Other Jurisdictions

- In England and Wales, the mean number of decayed, missing and filled teeth (DMFT) in 5-year olds decreased from 4.0 in 1973 to 1.8 in 1983, largely due to the widespread use of fluoride-containing toothpaste.[118]
- In Australia in 2007, 35.8% of 5-year old children had ECC.[119]
- The mean number of DMFT in 6-year old Australian children has declined from over 3 in the late 1970s to approximately 1.5 during the late 1990s before settling in at approximately 2 in the 2000s (see Figure 2).[120]



[116] Schroth R, Quiñonez C, Shwart L et al. Treating early childhood caries under general anesthesia: A national review of Canadian data. *Journal of the Canadian Dental Association*. 2016; 82: g20.
[117] Poon B, Holley P, Louie A et al. Dental caries disparities in early childhood: A survey of kindergarten children in British Columbia. *Canadian Journal of Public Health*. 2015; 106(5): e308 – e314.
[118] Downer M. Changing trends in dental caries experience in Great Britain. *Advances in Dental Research*. 1993; 7(1): 19-24.
[119] Mejia G, Amarasena N, Ha D et al. *Child Dental Health Survey Australia 2007: 30-Year Trends in Child Oral Health.* 2012. Available online at https://www.aihw.gov.au/getmedia/3e418a11-1d30-4cb8-a393-e1f0532cd996/13854.pdf.aspx?inline=true. Accessed December 2022.
[120] Mejia G, Amarasena N, Ha D et al. *Child Dental Health Survey Australia 2007: 30-Year Trends in Child Oral Health.* 2012. Available online at https://www.aihw.gov.au/getmedia/3e418a11-1d30-4cb8-a393-e1f0532cd996/13854.pdf.aspx?inline=true. Accessed December 2022.

Prevalence by Risk Status

- In the US, an estimated 23% to 28% of children ages 2 to 5 have ECC, and approximately 4.6% have S-ECC.[121]
- Ugolini and colleagues found a prevalence of S-ECC of 5.9% in a study of 563 children ages 3 to 5 in Italy.[122]
- Bissar et al found a prevalence of S-ECC of 9.5% in a study of 1,007 children ages 3 to 5 in Germany.[123]

Impact of Dental Caries on Quality of Life

- Dental caries in early childhood is associated with pain, loss of teeth, impaired growth, decreased weight gain, negative effects on quality of life, poor school performance, and future dental caries.[124,125]
- A systematic review by Jackson et al found poor oral health associated with significantly increased risk of poor academic performance (OR of 1.5, 95% CI, 1.20 to 1.83) and school absenteeism (OR of 1.43, 95% CI, 1.24 to 1.63).[126]
- A meta-analysis of 10 cohort studies suggested that children with early childhood caries are three times more likely to develop caries in their permanent teeth (OR, 3.22; 95% CI 2.80 to 3.71).[127]

Effectiveness of Fluoride Varnish Application in Children

- Based on a meta-analysis of 10 randomized controlled trials, the 2013 Cochrane review found a 37% (95% CI of 24% to 51%) reduction in decayed, missing and filled tooth surfaces with the consistent application of fluoride varnish on first or baby teeth. Seven of the 10 studies (70%) were based on applying fluoride varnish every 6 months. While the majority of subjects in the 10 studies were between the ages of 1 and 5, 37% were between the ages of 6 and 8.[128]
- Based on a meta-analysis of 13 RCTs and controlled observational studies, the 2021 USPSTF review found a decreased caries increment (mean difference -0.94, 95% CI, -1.74 to -0.34, or just under one tooth surface per child) and decreased likelihood of experiencing incident caries (RR 0.80, 95% CI, 0.66 to 0.95) with the application of

[121] Chou R, Pappas M, Dana T et al. *Screening and Prevention of Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force.* Evidence Synthesis No. 210. AHRQ Publication No. 21-05279-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2021.
[122] Ugolini A, Salamone S, Agostino P et al. Trends in early childhood caries: An Italian perspective. *Oral Health & Preventive Dentistry*. 2018; 16: 87-92.
[123] Bissar A, Schiller P, Wolff A et al. Factors contributing to severe early childhood caries in south-west Germany. *Clinical Oral Investigations*. 2014; 18: 1411–18.
[124] Chou R, Pappas M, Dana T et al. Screening and interventions to prevent dental caries in children younger than 5 years: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2021; 326(21): 2179-92.
[125] Zaror C, Matamala-Santander A, Ferrer, M et al. Impact of early childhood caries on oral health-related quality of life: A systematic review and meta-analysis. *International Journal of Dental Hygiene*. 2022; 20: 120-35.
[126] Jackson S, Vann W, Kotch J et al. Impact of poor oral health on children's school attendance and performance. *American Journal of Public Health.* 2011; 101(10): 1900-6.
[127] Lam P, Chua H, Ekambaram M et al. Does early childhood caries increase caries development among school children and adolescents? A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*. 2022; 19: 13459.
[128] Marinho V, Worthington H, Walsh T, et al. *Fluoride varnishes for preventing dental caries in children and adolescents and fissure sealants for preventing dental decay in permanent teeth*. Cochrane Oral Health Group. The Cochrane Library. July 11, 2013. Available online at https://www.cochrane.org/CD002279/ORAL_fluoride-varnishes-for-preventing-dental-caries-in-children-and-adolescents. Accessed December 2022.

fluoride varnish in children aged 0 – 5 years.[129] The majority of studies (79%) were based on applying fluoride varnish every 6 months.

In a sub-analysis based on trials deemed to be of good (N=3) vs. fair quality (N=10), the reviewers for the 2021 USPSTF recommendation found the following results:[130]

Good trials – no change in caries increment (mean difference 0.08, 95% CI, -0.28 to 0.27) and no change in the likelihood of experiencing incident caries (RR 0.85, 95% CI, 0.71 to 1.08).

Fair trials – a significant reduction in caries increment (mean difference -1.33, 95% CI, -2.36 to -0.54) and a significant reduction in the likelihood of experiencing incident caries (RR 0.77, 95% CI, 0.60 to 0.96).

The 2021 review updated the 2014 USPSTF review. In the current review, 8 trials included in the 2014 review were excluded due to poor-quality and 10 additional newer trials added.[131]

- The 2019 systematic review and meta-analysis by de Sousa and colleagues included 20 trials (with 10 published since the 2013 Cochrane review) assessing the effectiveness of fluoride varnish specifically in pre-schoolers. They found a 12% (95% CI of 5% to 19%) reduction in decayed, missing and filled tooth surfaces, but the magnitude of the reduction was only one surface per child or less (similar to the 2021 USPSTF review). They comment that "this difference is possibly clinically irrelevant."[132]

  Commenting on the difference between their findings and that of other reviews, they note that "our results showed that FV effectiveness is lower in more recent trials than in older trials. Maybe this is due to the higher risk of bias in the older studies, especially selection bias, which can overestimate the effect of the treatments."[133]

  "In the present review, a large number of the children developed new dentine caries lesions, regardless of FV use. The cause of dental caries, and of the increase in caries with age, is the excessive exposure to sugar, not the lack of fluoride exposure. Sugar reduction is urgently needed as fluoride does not halt caries when sugar intake is high (≥10%).[134,135,136]

- "The importance of sugars as a cause of caries is underemphasized and not prominent in preventive strategies. This is despite overwhelming evidence of its unique role in

[129] Chou R, Pappas M, Dana T et al. Screening and interventions to prevent dental caries in children younger than 5 years: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2021; 326(21): 2179-92.
[130] Chou R, Pappas M, Dana T et al. *Screening and Prevention of Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force.* Evidence Synthesis No. 210. AHRQ Publication No. 21-05279-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2021
[131] Chou R, Pappas M, Dana T et al. *Screening and Prevention of Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force.* Evidence Synthesis No. 210. AHRQ Publication No. 21-05279-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2021.
[132] de Sousa F, dos Santos A, Nadanovsky P et al. Fluoride varnish and dental caries in preschoolers: A systematic review and meta-analysis. *Caries Research*. 2019; 53: 502-13.
[133] de Sousa F, dos Santos A, Nadanovsky P et al. Fluoride varnish and dental caries in preschoolers: A systematic review and meta-analysis. *Caries Research*. 2019; 53: 502-13.
[134] Sheiham A, James W. A new understanding of the relationship between sugars, dental caries and fluoride use: Implications for limits on sugars consumption. *Public Health Nutrition*. 2014; 17(10): 2176-84.
[135] Sheiham A, James W. Diet and dental caries: The pivotal role of free sugars reemphasized. *Journal of Dental Research*. 2015; 94(10):1341-7.
[136] de Sousa F, dos Santos A, Nadanovsky P et al. Fluoride varnish and dental caries in preschoolers: A systematic review and meta-analysis. *Caries Research*. 2019; 53: 502-13.

causing a worldwide caries epidemic. Why this neglect? One reason is that researchers mistakenly consider caries to be a multifactorial disease; they also concentrate mainly on mitigating factors, particularly fluoride. However, this is to misunderstand that the only cause of caries is dietary sugars. These provide a substrate for cariogenic oral bacteria to flourish and to generate enamel-demineralizing acids. Modifying factors such as fluoride and dental hygiene would not be needed if we tackled the single cause - sugars."[137]

Does the Baseline Risk of Caries Change the Effectiveness of the Intervention?

- In the 2021 USPSTF evidence review, 12 of the 13 included studies were conducted in children at higher risk of caries.[138] For the intervention to be effective in high risk children outside of a clinical trial, they would have to adhere to preventive visiting schedules which may be challenging given the risk of loss to follow-up in programs with this type of risk-based protocol.
- The authors of the **evidence review** for the 2021 USPSTF stated that "because almost all trials were conducted in higher-risk children, the applicability of findings to children not at increased risk is uncertain." (p. 2190)[139]
- The authors of the 2021 USPSTF **recommendation statement**, on the other hand, argue that "although the evidence to support fluoride varnish is drawn from higher-risk populations, the provision of fluoride varnish to all children is reasonable because the prevalence of risk factors is high in the US population." (p. 2176)[140]
- Schwendicke et al set out to assess the cost-effectiveness of FV in Germany based on the caries risk status of the child.[141] Risk status was determined by the risk of developing new caries lesions each year. Low risk was defined as <0.50 DMFS/year, medium risk as 0.50 – 1.29 DMFS/year and high risk as ≥1.3 DMFS/year. Study results within the 2013 Cochrane review[142] were then regrouped by this risk status. While the pooled results indicated a 37% (95% CI of 24% to 51%) reduction in DMFT (this is equivalent to an OR of 0.63 with a 95% CI of 0.49 – 0.76), the results by risk status were as follows:
    - Low Risk – OR of 0.919 (95% CI of 0.174 – 4.861)
    - Medium Risk - OR of 0.776 (95% CI of 0.166 – 3.637)
    - High Risk - OR of 0.148 (95% CI of 0.051 – 0.432)

[137] Sheiham A, James W. Diet and dental caries: The pivotal role of free sugars reemphasized. *Journal of Dental Research*. 2015; 94(10):1341-7.
[138] Chou R, Pappas M, Dana T et al. *Screening and Prevention of Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force.* Evidence Synthesis No. 210. AHRQ Publication No. 21-05279-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2021
[139] Chou R, Pappas M, Dana T et al. Screening and interventions to prevent dental caries in children younger than 5 years: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2021; 326(21): 2179-92.
[140] USPSTF Task Force. Screening and interventions to prevent dental caries in children younger than 5 years: US Preventive Services Task Force recommendation statement. *JAMA*. 2021; 326(21): 2172-8.
[141] Schwendicke F, Splieth C, Thomson W et al. Cost-effectiveness of caries-preventive fluoride varnish applications in clinic settings among patients of low, moderate and high risk. *Community Dentistry and Oral Epidemiology*. 2018; 46(1): 8-16.
[142] Marinho V, Worthington H, Walsh T, et al. *Fluoride varnishes for preventing dental caries in children and adolescents and fissure sealants for preventing dental decay in permanent teeth*. Cochrane Oral Health Group. The Cochrane Library. July 11, 2013. Available online at https://www.cochrane.org/CD002279/ORAL_fluoride-varnishes-for-preventing-dental-caries-in-children-and-adolescents. Accessed December 2022.

Note that the results for the low or medium risk populations are ***not statistically significant***. The results for the high risk group, on the other hand, indicate a ***highly significant*** 85.2% (95% CI of 56.8% to 94.9%) reduction in DMFT.

- An analysis in Winnipeg, Manitoba assessed the cost-effectiveness of FV application every 3 months in preschool children in daycare at ***high risk of dental caries***. Over a five-year period, 4.4 cavities were avoided when compared with usual dental care. In addition, the need for dental surgery under general anesthetic decreased from 19.1% to 1.6%. Finally, savings of $823 (in 2018 Can$) per cavity avoided were observed.[143]

Is the Application of Fluoride Varnish Effective as an Adjunct to Regular Tooth Brushing?

- Regular tooth brushing with fluoride toothpaste (with ≥1000 ppm of fluoride) is the principal non-professional intervention to prevent caries.[144]
- Agouropoulos et al assessed the effectiveness of FV application as an adjunct to supervised tooth brushing in a double-blind randomized controlled trial of 328 preschool children (ages 2-5). All children received oral health education with hygiene instructions twice yearly and attended supervised tooth brushing once daily. The test group was treated with fluoride varnish biannually while the control group had placebo applications. They concluded that "biannual fluoride varnish applications in preschool children did not show significant caries-preventive benefits when provided as an adjunct to school-based supervised tooth brushing with 1000ppm fluoride toothpaste."[145]
- In their systematic review and meta-analysis of six RCTs (with 5,034 participants), Yu and co-authors found no significant difference between children receiving FV in addition to the regular use of fluoride toothpaste when compared with children who only engaged in the regular use of fluoride toothpaste (mean difference in DMFT of -0.17, 95% CI -0.60 to 0.26).[146]

Summary

Based on this detailed review, current evidence no longer supports the universal routine application of fluoride varnish on primary teeth in the general population of children. This maneuver will no longer be included on the LPS, as it does not meet the LPS criteria for clinical effectiveness (the first step of the LPS process). The analysis presented in this Addendum may help inform considerations of other targeted approaches, however this work is outside the scope of the LPS.

[143] Norrie O, Pharand L. Cost effectiveness of a fluoride varnish daycare program versus usual care in central Winnipeg, Manitoba. *Canadian Journal of Dental Hygiene*. 2020; 54(2): 68-74.
[144] Walsh T, Worthington H, Glenny A et al. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database of Systematic Reviews*. 2019. Available online at https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD007868.pub3/full. Accessed January 2023.
[145] Agouropoulos A, Twetman S, Pandis N et al. Caries-preventive effectiveness of fluoride varnish as adjunct to oral health promotion and supervised tooth brushing in preschool children: A double-blind randomized controlled trial. *Journal of Dentistry*. 2014; 42(10): 1277-83.
[146] Yu L, Yu X, Li Y et al. The additional benefit of professional fluoride application for children as an adjunct to regular fluoride toothpaste: A systematic review and meta-analysis. *Clinical Oral Investigations*. 2021; 25: 3409 – 19.