Beyond QALYs and Cents: Valuing Health Equity in Cost-Effectiveness Analysis

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Health Services Organization and Policy)
in the University of Michigan
2025

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Dedication

For my father,
John Cadham

Acknowledgements

I would not have made it to this point without the friendship, mentorship, and guidance of so many who have supported me on the long path of higher education. First, I must thank my committee members. Lisa Prosser, I have grown more as a researcher than I thought possible over these five years. The freedom, trust, and encouragement you gave me to pursue the questions and methods I wanted to explore while challenging me to think more deeply have made me a more confident researcher. I am incredibly grateful for your mentorship and guidance. Shehzad Ali, talking with you always sparked new ideas and pushed me to expand my thinking. You ensured I was considering of a broad array of decision problems. Paula Lantz, you have been a wonderful cheerleader and critic keeping me equally focused on small details and the big picture so that I never lost sight of how they come together in my work. Rafael Meza, your kindness, energy and excitement for research have been an inspiration since before I even started this degree. It has been a joy to learn from you over the years. I finish this dissertation with more questions than answers, some that I hope I will get a chance to answer in the coming years, due in large part to Ken Warner. Ken, you constantly pushed me to question my approach and my findings. Thank you all.

This work was generously supported by predoctoral awards from the Canadian Institutes of Health Research and the PhRMA Foundation. The independent time these awards granted me is what made this dissertation what it is. I also need to thank the Susan B. Meister Child Health Evaluation and Research Center at the University of Michigan for supporting the development

and fielding of the surveys for this dissertation. I am grateful for the administrative support I received from Angela Rose and Hillary Klutts at the Susan B. Meister Child Health Evaluation and Research Center, and Sukhinder Khattra at the BC Cancer Research Institute.

Thank you to my former colleagues at Georgetown University's Cancer Prevention and Control Program. Jeanne Mandelblatt, you took a chance hiring someone with no cancer research experience and little modelling experience to join your cancer modelling research team. Working with you and others at Georgetown, including David Levy, Luz María Sánchez-Romero, and Jinani Jayasekera, shaped my interest in modelling into a passion for research. I owe so much to you all.

My friends and fellow 2020 HSOP cohort, Tiffany Cornwall, Sarah El-Azab, Janamarie Perroud, Roz Murray, and Anu Warrier, it has been quite the journey. Starting the PhD during a global pandemic was a whirlwind and I could not have asked for a better cohort. Getting to know each of you has been a highlight of my time at Michigan, and I am excited to see the impact you will all make. To the other HSOP students, learning with you and from you has been a privilege.

I also want to thank the friends and family who have shown me so much love and support over the years. Alice, Ashley, Callum, Camille, Julie, Lucy, MJ, and Sarah, the moral and mental support you have all provided means more than you know. Scotia, you have been my rock. Neither of us could have predicted how challenging these last five years would be. Words cannot express how much I have depended on your daily support to make it through this process. Thank you for always being there. Ryan, the beauty, joy, and adventure you have brought to my life has kept me going even during the grimmest days of the dissertation. I cannot wait to see what comes next. Finally, Mum, Dad, and Willy, I can never thank you enough. This would not have been possible without you.

Table of Contents

Dedication ..... **ii**

Acknowledgements ..... **iii**

List of Tables ..... **ix**

List of Figures ..... **xiv**

List of Appendices ..... **xvi**

Abstract ..... **xviii**

Chapter 1 Background and Motivation **1**

1.1 Objectives 1

1.2 Framework 2

1.2.1 Resource Scarcity and Priority Setting 2

1.2.2 Inequality and Inequity 2

1.2.3 Economic Evaluation 4

1.2.4 Preferences 15

1.2.5 Preferences for Resource Allocation 16

1.2.6 Incorporating Population Preferences into Medical Decision Making 18

1.3 Problem Statement 19

1.3.1 Research Gaps for Equity-Informative Cost-Effectiveness Analysis 19

1.3.2 Electronic Nicotine Delivery Systems for Smoking Cessation 20

1.4 Contributions to the Literature 22

1.4.1 Development of direct equity weights for equity-informative cost-effectiveness analysis in Canada and the US. 22

1.4.2 Novel application of equity-informative cost-effectiveness analysis methods in the US 23

1.4.3 Provide evidence on the impact of costs and health benefits of electronic nicotine delivery systems as a smoking cessation intervention 23

1.5 Overview of Chapters 24

1.5.1 Chapter 2: 24

1.5.2 Chapter 3: 24

1.5.3 Chapter 4: 25

Chapter 2 Prioritizing Equity and Efficiency for Healthcare Resource Allocation in Canada and the United States: A Best-Worst Scaling Study 26

2.1 Introduction 26

2.2 Methods 28

2.2.1 Survey Development 28

2.2.2 Data Collection 35

2.2.3 Analyses 36

2.2.4 Response Heterogeneity 37

2.3 Results 38

2.3.1 Best-Worst Scaling Survey Results 38

2.4 Discussion 54

2.4.1 Limitations 59

2.5 Conclusions 61

Chapter 3 A Discrete Choice Experiment to Develop Direct Equity Weights for the United States and Canada 62

3.1 Introduction 62

3.2 Methods 64

3.2.1 Survey Development 64

3.2.2 Data Collection 73

3.2.3 Data Analysis 74

3.3 Results 81

3.3.1 Primary Results 85

3.3.2 Assessing Heterogeneity 95

3.4 Discussion 97

3.4.1 Limitations 102

3.5 Conclusions 103

Chapter 4 Equity-Informative Cost-Effectiveness of Electronic Nicotine Delivery Systems for Smoking Cessation 105

4.1 Introduction 105

4.2 Methods 108

4.2.1 Model Overview 108

4.2.2 Data Sources 112

4.2.3 Analysis Plan 120

4.2.4 Scenario Analyses 123

4.2.5 Sensitivity Analyses 125

4.3 Results 126

4.3.1 Base Case Analysis 126

4.3.2 Scenario Analyses 132

4.3.3 Sensitivity Analysis Results 138

4.4 Discussion 142

4.4.1 Limitations 146

4.5 Conclusions 150

Chapter 5 Conclusions 151

5.1 Summary 151

5.2 Future Research Directions 154

Appendices 158

Bibliography 272

List of Tables

Table 2-1: Final Attributes and Attribute Wording for Best-Worst Scaling Frames 31

Table 2-2: US Sample Demographics 39

Table 2-3: Canadian Sample Demographics 42

Table 2-4: Reasons for Selecting More Important Attributes 48

Table 2-5: Reasons for Selecting Less Important Attributes 49

Table 3-1: Discrete Choice Experiment Attributes, Descriptions, and Levels 68

Table 3-2: Utility Function Model Specifications Used to Analyze DCE Results 77

Table 3-3: Discrete Choice Experiment Respondent Demographics 84

Table 3-4: Conditional Logit Models for Additive Utility Functions 87

Table 3-5: Conditional Logit Models for Interactive Utility Functions 88

Table 3-6: Estimated Utility of Choice Tasks from US Respondents 91

Table 3-7: Estimated Utility of Choice Tasks from Canadian Respondents 92

Table 3-8: Derived Equity Weights for Income/Discrimination Groups 94

Table 4-1: Overview of Subgroup-Specific Smoking Cessation Model Input Parameters 113

Table 4-2: Smoking Cessation Model Cost-Effectiveness Input Parameters 114

Table 4-3: Intervention Cost and Efficacy Input Parameters for the Non-Dominated Scenario Analysis 125

Table 4-4: Incremental Cost-Effectiveness Ratios of Smoking Cessation Interventions per 1,000 Current Smokers 127

Table 4-5: Incremental Net Health Benefit and Net Equity Benefit of Smoking Cessation Interventions per 1,000 Current Smokers 128

Table 4-6: Incremental Cost-Effectiveness Ratios for No Continued ENDS Use Scenario Analysis per 1,000 Current Smokers 136

Table 4-7: Incremental Cost-Effectiveness Ratios for No Nicotine and Tobacco Product Costs Use Scenario Analysis per 1,000 Current Smokers 137

Table 4-8: Incremental Cost-Effectiveness Ratios for Non-Dominated Scenario Analysis per 1,000 Current Smokers 138

aTable A.1-1: Preliminary Attribute List Identified from Scoping Review 158

aTable A.1-2: Preliminary Attribute List Based on Scoping Review and Focus Group Conversations with Reasons for Exclusion 160

aTable A.2-1: Focus Group Respondent Demographics for Canada and the US 163

aTable A.2-2: Political Affiliation of US Focus Group Respondents 163

aTable A.2-3: Political Affiliation of Canadian Focus Group Respondents 163

aTable A.3-1: US Focus Group Themes and Example Quotes 164

aTable A.3-2: Canadian Focus Group Themes and Example Quotes 165

aTable A.4-1: US Respondent Reasons for Exclusion 167

aTable A.4-2: Canadian Respondent Reasons for Exclusion 167

aTable A.5-1: One-off Confusion Comments 168

aTable A.5-2: Consistent Confusion Comments 168

aTable A.5-3: Reject Premise Comments 168

aTable A.6-1: One-off Confusion Comments 170

aTable A.6-2: Consistent Confusion Comments 170

aTable A.6-3: Reject Premise Comments 171

aTable A.6-4: Pattern of Comments Unrelated to Choice Tasks 171

aTable A.6-5: Single Comments Unrelated to Choice Tasks 173

aTable A.8-1: Top Five Attributes by Subgroup for US Respondents 176

aTable A.8-2: Top Five Attributes by Subgroup for Canadian Respondents 180

aTable A.9-1: Demographics of US Latent Classes 184

aTable A.9-2: Demographics of Canadian Latent Classes 187

aTable B.1-1: Discrete Choice Experimental Design 189

aTable B.2-1: Respondent Reasons for Exclusion 190

aTable B.3-1: Reject Premise Comments 191

aTable B.4-1: Consistent Confusion Comments 192

aTable B.4-2: Reject Premise Comments 192

aTable B.4-3: Pattern of Comments Unrelated to Choice Tasks 193

aTable B.6-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US 201

aTable B.6-2: Additive Utility Function with QALY Gains, US 201

aTable B.6-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada 202

aTable B.6-4: Additive Utility Function with QALY Gains, Canada 202

aTable B.7-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US 203

aTable B.7-2: Additive Utility Function with QALY Gains, US 203

aTable B.7-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada 204

aTable B.7-4: Additive Utility Function with QALY Gains, Canada 204

aTable B.8-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US 205

aTable B.8-2: Additive Utility Function with QALY Gains, US 205

aTable B.8-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada 206

aTable B.8-4: Additive Utility Function with QALY Gains, Canada 206

aTable B.9-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US 207

aTable B.9-2: Additive Utility Function with QALY Gains, US 208

aTable B.9-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada 208

aTable B.9-4: Additive Utility Function with QALY Gains, Canada 209

aTable B.10-1: Latent Class Structure Model Fit 210

aTable B.10-2: US Latent Class Demographics 211

aTable B.10-3: Canadian Latent Class Demographics 213

aTable B.10-4: Conditional Logit Model Results for Each US Latent Class, Additive Utility Function with QALY Gains 215

aTable B.10-5: Conditional Logit Model Results for Each Canadian Latent Class, Additive Utility Function with QALY Gains 216

aTable B.10-6: Equity Weights for Latent Classes from Additive Utility Function with QALY Gains 217

aTable C.5-1: Net Health and Equity Benefits of Cessation Interventions at a $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smoker 227

aTable C.5-2: Net Health and Equity Benefits of Cessation Interventions at a $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers 230

aTable C.6-1: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Racially/Ethnically Minoritized and Income <200% of the FPL Group Per 1,000 Current Smokers 233

aTable C.6-2: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Income <200% of the FPL and Racially/Ethnically Minoritized Group per 1,000 Current Smokers 234

aTable C.6-3: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Non-Hispanic White and Income <200% FPL Group per 1,000 Current Smokers 235

aTable C.6-4: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Non-Hispanic White and Income ≥200% FPL Group per 1,000 Current Smokers 236

aTable C.6-5: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Income <200% of the FPL Groups per 1,000 Current Smokers 237

aTable C.6-6: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Racially/Ethnically Minoritized Groups per 1,000 Current Smokers 238

aTable C.7-1: Smoking Cessation Intervention Net Health and Equity Benefit for the No Continued ENDS Use Scenario Analysis per 1,000 Current Smokers 239

aTable C.8-1: Smoking Cessation Intervention Net Health and Equity Benefit for No Tobacco Product Cost Scenario Analysis per 1,000 Current Smokers 242

aTable C.9-1: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers. 245

aTable C.9-2: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $100,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers248

aTable C.9-3: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $250,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers per 1,000 Current Smokers 251

aTable C.10-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Intervention Efficacy per 1,000 Current Smokers..... 255

aTable C.11-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Intervention Costs per 1,000 Current Smokers 260

aTable C.12-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Equity Weights per 1,000 Current Smokers..... 264

aTable C.13-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Proportion of Individuals that Continue ENDS Use per 1,000 Current Smokers..... 268

aTable C.14-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Mortality Risk of ENDS Relative to Combustible Cigarettes per 1,000 Current Smokers 270

List of Figures

Figure 1-1: Cost-Effectiveness Plane 7

Figure 1-2: Types of Equity-Informative Cost-Effectiveness Analyses 10

Figure 1-3: Equity-Efficiency Impact Plane 12

Figure 2-1: Example Choice Set for Respondents 34

Figure 2-2: Response to Attitudinal Question on Individuals' Beliefs in Inequality 45

Figure 2-3: Relative Importance Scores of Best-Worst Scaling Attributes for the Dual Frame .. 47

Figure 2-4: Counts of the Top Five Attributes Ranked More Important Across Subgroups 50

Figure 2-5: Preference Weights for Canadian Latent Classes 51

Figure 2-6: Preference Weights for US Latent Classes 53

Figure 3-1: Example Discrete Choice Experiment Choice Task 66

Figure 3-2: Responses to Discrete Choice Experiment Attitudinal Questions 83

Figure 4-1: Model Schematic 109

Figure 4-2: Equity-Efficiency Trade-offs for Smoking Cessation Interventions with Differing Levels of Health Opportunity Costs by Equity-Weighted Subgroup 134

Figure 4-3: Equity-Efficiency Trade-offs for Smoking Cessation Interventions with Differing Levels of Health Opportunity Costs by Equity Dimension 135

Figure 4-4: Cost-Effectiveness Plane of Probabilistic Sensitivity Analysis Results 140

Figure 4-5: Net Health and Equity Benefits of Smoking Cessation Interventions Plotted on the Equity-Efficiency Plane, Opportunity Costs Allocated to the Group that Accrues Them 141

Figure 4-6: Net Health and Equity Benefits of Smoking Cessation Interventions Plotted on the Equity-Efficiency Plane, Opportunity Costs Allocated Randomly Across Groups 142

aFigure A.7-1: US Relative Importance Scores for Each Survey Frame 174

aFigure A.7-2: Canadian Relative Importance Scores for Each Survey Frame 175

aFigure B.5-1: Dominant Alternative Choice Task 200

aFigure C.11-1: Cost-Effectiveness Plane Comparing Smoking Cessation Intervention Costs and Health Outcomes for Intervention Efficacy Sensitivity Analysis 254

aFigure C.12-1: Cost-Effectiveness Plane Comparing Smoking Cessation Intervention Costs and Health Outcomes for Intervention Cost Sensitivity Analysis 259

List of Appendices

Appendix A: Best-Worst Scaling Study Appendices 158

A.1 Preliminary Attributes for Best-Worst Scaling Survey 158

A.2 Focus Group Respondent Demographics 163

A.3 Focus Group Themes and Example Quotes 164

A.4 Reasons for Respondent Exclusion from Best-Worst Scaling Primary Analytic Sample 167

A.5 US Respondent Exclusion Quotes 168

A.6 Canadian Respondent Exclusion Quotes 170

A.7 Attribute Relative Importance Scores Across Survey Frames 174

A.8 Table of Top Five Attributes Across Sociodemographic and Attitudinal Characteristics 176

A.9 Latent Class Analysis Demographics 184

Appendix B: Discrete Choice Experiment Study Appendices 189

B.1 Discrete Choice Experiment Experimental Design 189

B.2 Reasons for Respondent Exclusion 190

B.3 US Respondent Exclusion Comments 191

B.4 Canadian Respondent Exclusion Comments 192

B.5 Dominant Alternative Choice Task Exclusion Rule 200

B.6 Conditional Logit Models Stratified by Household Income Level 201

B.7 Conditional Logit Models Stratified by Respondent Race/Ethnicity 203

B.8 Conditional Logit Models Stratified by Respondent Attitudes Towards Income Inequality 205

B.9 Conditional Logit Models Stratified by Political Viewpoint 207

B.10 Latent Class Analysis Results 210

Appendix C: Equity-Informative Cost-Effectiveness of Smoking Cessation Interventions Appendices 219

C.1 Cost-Effectiveness Impact Inventory 219

C.2 CHEERS Checklist 220

C.3 Cessation Intervention Efficacy 223

C.4 Cessation Intervention Costs 225

C.5 Smoking Cessation Intervention Net Health and Equity Benefit with Alternative Willingness-to-Pay Thresholds 227

C.6 Health Opportunity Cost Scenario Analysis Results 232

C.7 No Continued ENDS Use Scenario Analysis Results 239

C.8 No Tobacco Product Cost Scenario Analysis Results 242

C.9 Non-Dominated Results Scenario Analysis 245

C.10 One-Way Sensitivity Analysis on Smoking Cessation Intervention Efficacy 254

C.11 One-Way Sensitivity Analysis on Smoking Cessation Intervention Costs 259

C.12 One-Way Sensitivity Analysis on Equity Weights 264

C.13 One-Way Sensitivity Analysis on Continued ENDS Use 268

C.14 One-Way Sensitivity Analysis on Mortality Risk of ENDS Relative to Combustible Cigarettes 270

Abstract

Recent developments in methods for cost-effectiveness analysis have sought to incorporate population preferences for the fair distribution of resources into the traditional cost-effectiveness framework. These equity-informative methods are in their infancy, and many questions remain about how they are implemented, what specific dimensions of equity are considered, the weight that is placed on improvements in equity, and the impact that equity weighting has.

To facilitate the adoption of equity-informative methods for cost-effectiveness analysis, I conducted three studies. In the first study (Chapter 2), I developed and fielded a best-worst scaling survey to identify a set of highly valued equity dimensions in Canada and the United States when determining how to improve the fairness of the healthcare system. I found that respondents prioritized attributes related to improving system functioning as a whole, such as reducing costs to individuals, reducing wait times, or improving benefits for those with more severe diseases, than specific equity dimensions. The most highly prioritized equity dimensions in both countries were focused on socioeconomic status. Respondents also placed greater priority on improvements in access to healthcare services than they did on improvements to health outcomes.

In Chapter 3, I used dimensions identified in Chapter 2 to develop and field a discrete choice experiment which asked respondents to trade off health and equity benefits. The results of this analysis created a set of direct equity weights for equity-informative cost-effectiveness

analysis. The methods used here enabled inclusion of multiple attributes of equity and efficiency in the trade-off experiment, which facilitated the development of intersectional equity weights for two equity dimensions: income level and likelihood of experiencing discrimination because of race and/or ethnicity. By calculating the marginal rate of substitution for quality-adjusted life years (QALYs) gained between equity subgroups compared to a reference group, I generated a set of equity weights that represented the number of QALYs gained in the reference group that the respondents would forgo for a one QALY gain in the equity subgroup. I found that respondents were willing to trade-off QALYs gained for a fairer distribution of health, with the greatest value placed on improving health across income levels.

In the final study (Chapter 4), I applied the weights developed in Chapter 3 to conduct an equity-informative cost-effectiveness analysis of smoking cessation interventions, including electronic nicotine delivery systems (ENDS). In this societal perspective cost-effectiveness analysis, I found that varenicline, nicotine replacement therapy, and bupropion are all likely cost-saving, with varenicline consistently providing the highest health and equity benefits. The impact of ENDS for cessation was less clear, with the uncertainty around their costs, effectiveness, continued use, and health effects all impacting the expected benefits from the intervention.

In this dissertation, I used stated preference surveys to prioritize and value attributes of health equity and generated the first set of direct equity weights that could be incorporated into cost-effectiveness analyses in Canada and the United States. In my applied example, I found that equity weighting did not meaningfully change the results of the traditional cost-effectiveness analysis. Continued research is needed to assess when and how equity weighting impacts the outcomes of traditional cost-effectiveness analyses and the extent to which the recommended policies concur with public preferences.

Chapter 1 Background and Motivation

1.1 Objectives

Addressing injustices in the distribution of health resources can advance health equity by ensuring everyone has the means to attain their full potential for health and wellbeing.[1] Cost-effectiveness analysis (CEA) is widely used for health resource allocation decision making. Yet, CEA does not consider value judgements beyond the efficient allocation of health resources. By directly incorporating societal equity preferences into the analysis, equity-informative cost-effectiveness analysis methods can identify how resource allocation decisions reflect population values about the distribution of health.[2]

The overarching objective of this dissertation was to elicit and apply preference weights for equity-informative CEA. This project had three goals:

1) To identify a core set of dimensions that are important to the general public when promoting health equity
2) To develop a set of direct equity weights that reflect population preferences for prioritizing different equity-relevant subgroups within the equity dimensions
3) To apply the direct equity weights in an equity-informative cost-effectiveness analysis of electronic nicotine delivery systems (ENDS) as a smoking cessation tool in the US

1.2 Framework

1.2.1 Resource Scarcity and Priority Setting

The notion of scarcity underlies the disciplines of health economics, operations research, and decision sciences. Research in these fields seeks to guide resource allocation decisions by maximizing the benefit that can be gained from an investment, with a focus on efficiency. Prioritization decisions engender trade-offs between the costs and outcomes of decisions. In a system of limited resources, choices about where resources are allocated are inevitable.

Central to the choice of where to invest scarce resources is the question of what we value. Economic evaluation of health-related interventions (henceforth economic evaluation), particularly CEA, has been a primary tool for economics and decision sciences researchers to evaluate trade-offs in costs and health outcomes. In recent years, there has been a growing recognition that the use of economic evaluation is insufficient in addressing the needs of individual patients and the population while ensuring the sustainability of health systems.[3,4] Traditional approaches to economic evaluation may promote allocations of resources that fail to account for inequalities or even propagate health inequities. To better align our healthcare expenditures with our values, new CEA methods are needed which take into account the preferences of populations for promoting health equity.[4]

1.2.2 Inequality and Inequity

Public health researchers often make claims around health inequalities, disparities, inequity, and equity without clearly defining each.[5] The World Health Organization defines health equity (Box 1) as the universal attainment of the full potential of health and well-being.[6]

Within this framework, an inequity can then be viewed as a variation in health that is systematic, socially produced and unfair.[7] The WHO definition of health equity includes dimensions along which inequities may occur, including social, economic, demographic, and geographic factors. Given the complex nature of the drivers of health and illness, achieving health equity requires systematic improvements in healthcare equity, environmental and racial justice, housing equity, and more, to be fully realized.[8]

Box 1-1: WHO Definition of Health Equity

Equity is the absence of unfair, avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically or by other dimensions of inequality (e.g. sex, gender, ethnicity, disability, or sexual orientation). Health is a fundamental human right. **Health equity is achieved when everyone can attain their full potential for health and well-being.**

Differences in health are widespread, and not all are systematic, socially produced and unfair. When health differences are linked, but not social produced or unfair, they are often referred to as inequalities or disparities (terms that I will use interchangeably).[9] Not all inequalities have social causes, and almost all societies have a tolerance for some level of inequality. Understanding the degree of inequality tolerable in a society is crucial in identifying and naming inequities.

Economic evaluation and decision science methods have two roles in advancing health equity. First, preference elicitation methods can identify and quantify society's aversion to disparities in health and determine public priorities for addressing specific equity dimensions. These methods can identify what differences in health are unfair and which are considered the

most pressing inequities to address. Second, economic evaluation methods that consider public preferences for equity and the fair distribution of health can be used to readjust how we allocate health resources. Equity-informative economic evaluation can advance health equity by identifying how resource allocation can be targeted to improve outcomes based on societal preferences. In this dissertation, the focus is on healthcare equity, i.e. considering how the allocation of healthcare resources, such as investments in smoking cessation interventions, could improve health equity. Yet, these methods can be applied more broadly to evaluate the impact of more systemic approaches to improve health equity by evaluating programs as diverse as health system planning, environmental protection programs, and housing policy.

1.2.3 Economic Evaluation

1.2.3.1 Traditional Economic Evaluation

Economic evaluation of health interventions encompasses a broad series of techniques that include cost-benefit analysis (CBA), cost-effectiveness analysis (CEA), and cost-utility analysis (CUA).[10,11] The basic framework for economic evaluation balances average costs and health outcomes across a population and time horizon of interest. The framework conforms to the economic goal of maximizing efficiency from an extra-welfarist perspective.[12] These approaches are considered extra-welfarist as one is not simply interested in maximizing utility but in achieving a goal of the healthcare sector, which typically is some kind of health outcome.[13] Where CBA, CEA, and CUA differ is how they define the health outcome: CBA assigns a monetary value to the outcome; CEA quantifies it in natural units (such as life years gained or deaths averted); and CUA expresses it in terms of health utility, typically using Quality-Adjusted Life Years (QALYs) or Disability-Adjusted Life Years.[10,11,14-16] In this regard,

CUA is a special case of CEA that accounts for both the amount of life gained and the quality of that life. The benefits of CEA and CUA are in their separation of health benefits. They enable a decision-maker to maximize health impact for a given level of expenditure while avoiding the potential effects of wealth and income on willingness-to-pay for better health.[15] Given this dissertation's focus on equity-informative CEA, I will use economic evaluation of health-related interventions (or economic evaluation for short) and CEA to refer to an analysis that reports health outcomes either in terms of natural units or health utility.

CEA evaluates productive efficiency to determine the combination of inputs that maximize outputs for a given level of investment.17-19 Since its early uses in the 1960s, CEA has been widely adopted as a tool to inform resource allocation decision making around the globe on a vast range of topic areas.20-22 CEA was originally seen by some as a tool to promote equality in the allocation of resources between the rich and poor.23 CEA estimates the magnitude of health outcomes and costs of interventions and, in doing so, illustrates the trade-offs involved in selecting interventions. Cost-effectiveness can be visualized on a plane comparing costs and health outcomes (Figure 1-1). The decision regarding the cost-effectiveness of an intervention that increases costs and health outcomes is based on whether or not it falls under some willingness-to-pay threshold. The willingness-to-pay threshold is the amount of money that funders are willing to pay for a single unit improvement in health. By expressing the impact of decisions in terms of cost and a comparable health outcome, most commonly the QALY, CEA enables the direct comparison of healthcare interventions that may not otherwise be comparable, which can aid in the promotion of evidence-based medicine.[23]

Despite the ability to directly compare interventions, attempts to develop packages of recommended healthcare services based on the results of CEAs have been fraught, particularly in the US. In Oregon, a proposed Medicaid plan that would make coverage decisions based on cost-effectiveness ratios led to intense debate and was ultimately rejected as the most cost-effective services were not socially or politically acceptable.[24-27] Decision-makers accepted the adage that "a QALY is a QALY is a QALY" when making initial decisions over services to fund.[28,29] Ultimately, the Oregon experiment failed because the public had preferences for life-saving treatments that were not captured by the QALY-focused analyses of the decision-makers.[24] A prime example was the Medicaid plan's ranking of surgical treatments for appendicitis as a less important service than dental caps.[24] Today, rather than determining packages of benefits to provide, CEA is primarily used as a decision-assisting metric to evaluate individual health interventions based on a cost-effectiveness threshold.[22] It is used for coverage decisions and price setting in many countries, including Australia, Canada, Germany, Japan, Sweden, and the UK, among others.[22,30-35] CEA has encountered resistance in the US despite the considerable number of US-based researchers applying the methods.[36]

1.2.3.2 The Expanding CEA Value Proposition

CEA is one piece of coverage decision-making processes. Decision-makers use a broader framework to assess the potential value of health technologies, termed health technology assessment (HTA), that often relies on factors in addition to the health and economic outcomes of a CEA.[37] These additional considerations (such as, prioritizing the worst off, those with

limited treatment options, or children) are incorporated into a larger decision-making framework that also includes the results of an economic evaluation focused on efficiency.[38]

Figure 1-1: Cost-Effectiveness Plane

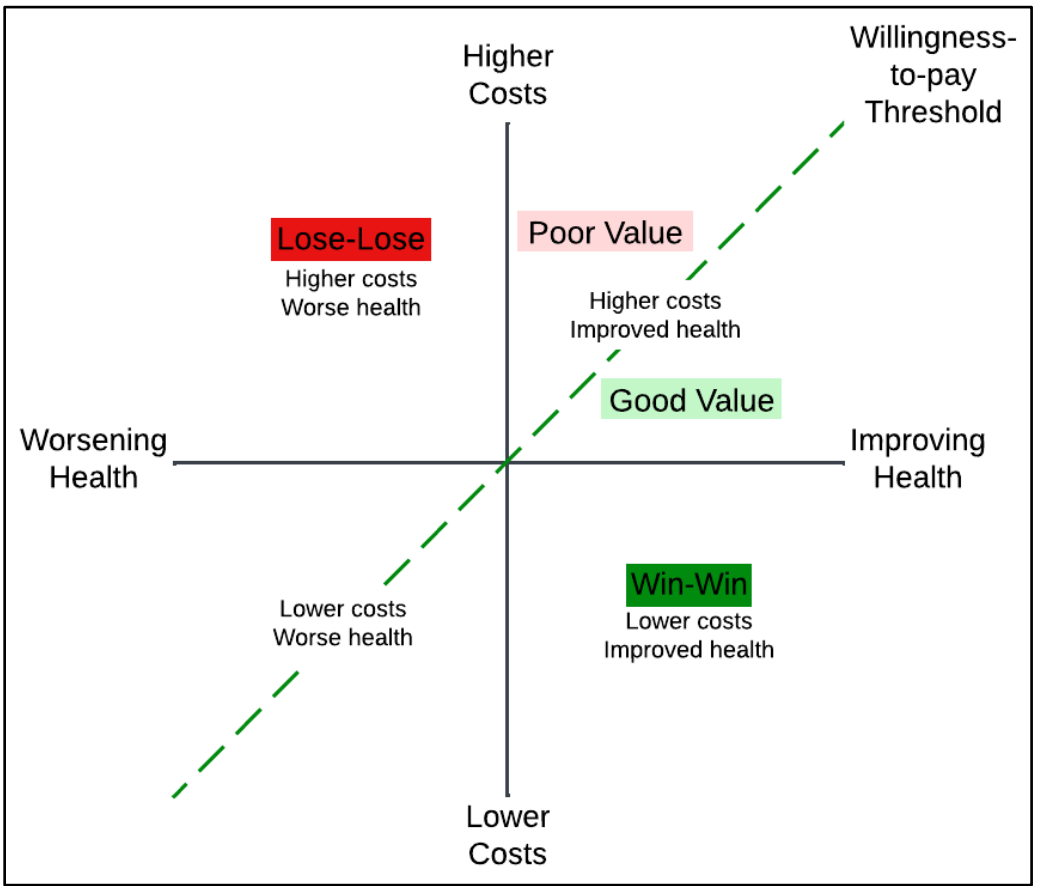


Figure Legend: The cost-effectiveness plane is a way to visualize the trade-offs of costs and health benefits of interventions. Interventions that lower costs and improve health benefits are considered cost-saving and therefore are a win-win. Those with higher costs and worse health outcomes provide no benefit and therefore are a lose-lose. Interventions with higher costs and improved health benefits can be considered good value if the costs per unit health gain fall under a willingness-to-pay threshold.

There has been growing interest in expanding CEA methods to directly incorporate some of these external considerations into the quantitative value assessment.[2,39-44] Researchers have proposed myriad additional value elements that could be incorporated into the cost-effectiveness equation to more fully account for the societal benefits and harms of health interventions,

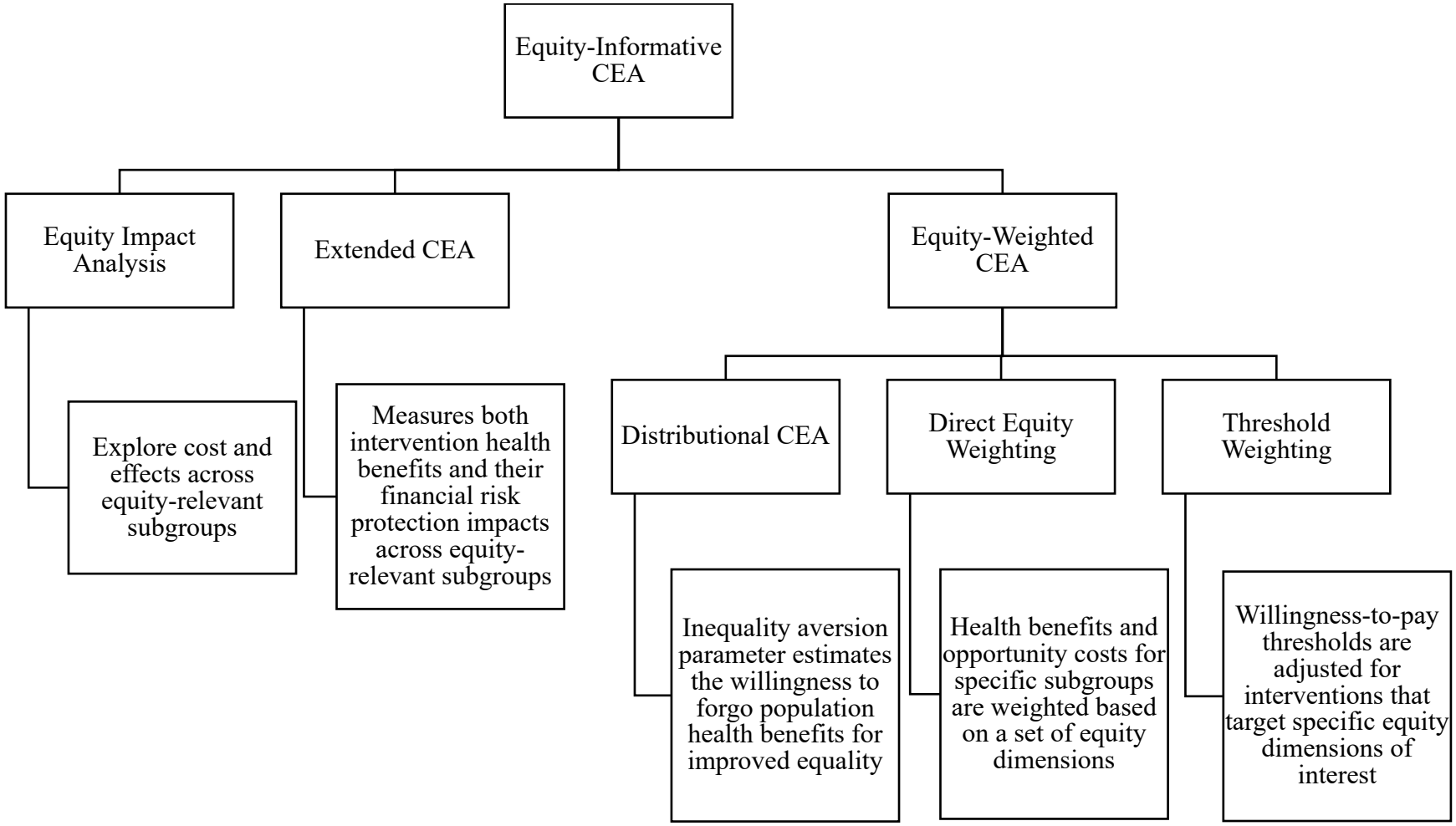
including, but not limited to, the value of health equity, family spillover effects, the value of hope, real option values and scientific spillover.[44,45] However, the adoption of the majority of these elements is limited, their implementation is complex, and their impact on CEA outcomes is poorly understood.[44,46]

Efforts to develop formal approaches to incorporate these additional considerations into quantitative value assessments as part of national HTA policy have been growing but remain limited.[31,46] Currently, the National Institutes of Health and Care Excellence (NICE) in England and Chuikyo in Japan both make adjustments to thresholds for cost-effectiveness used for ultra-rare conditions, while NICE also includes qualitative assessments of an intervention's impact on inequalities.[31,32,47] This is a rapidly evolving space. NICE recently approved the gene therapy exagamglogene autotemcel for the treatment of sickle cell disease, based, in part, on an appraisal submission from the manufacturer that included an equity-weighted cost-effectiveness analysis that demonstrated the impact of the product on health inequality. However, NICE did not consider the weighted equity benefits in its assessment.[48] Since that review, NICE has released new guidance on the use of equity-weighting, setting the stage for more analyses in the future.[49] Others continue to explore the potential of these expanded value propositions, including a newly formed Health Economics Methods Advisory (HEMA) Group, which includes the Institute for Clinical and Economic Review in the US, NICE in England, and Canada's Drug Agency. HEMA will be reviewing the suitability and appropriateness of additional benefits to incorporate into the HTA process.[50]

1.2.3.3 Equity-Informative Cost-Effectiveness Analysis

Methods for incorporating the value of health equity in CEA have rapidly evolved over the past decade, and various equity-informative approaches have been proposed. In an equity-informative analysis, the goal is to provide a quantitative measure of the impact that interventions and policies have on the distribution of health across the population. Equity-informative CEA is an umbrella term which includes equity impact analyses and novel methods that seek to understand financial risk or that apply equity weights in the analysis (Figure 1-2).[43,51]

Figure 1-2: Types of Equity-Informative Cost-Effectiveness Analyses



Equity impact analysis involves using population-specific parameters (such as greater adherence, lower access, or differential effects for some groups) to evaluate the potential effects of an intervention on health inequalities.[41,42] The approach is similar to subgroup analyses often reported in CEA but with the goal of exploring the distributional effects of the intervention rather than identifying a group for whom an intervention is cost-effective.[52-54] Extended CEA (ECEA) expands on traditional CEA outcomes to include financial risk protection and distributional benefits. ECEA works to elucidate the distributional effects and potential equity considerations of new health policies and interventions. ECEA can quantify the return on investment through poverty reduction, health benefits, and distributional effects.[43] ECEA was developed primarily to understand the potential impacts of health policies in low- and middle-income countries and has been used almost exclusively in that setting.[55-63]

Finally, the focus of this dissertation, equity-weighted CEA. Equity-weighting has long been discussed as a potential method for incorporating a wide array of ethical issues into cost-effectiveness analysis by assigning numerical value to different equity considerations.[64,65] Recent methodological developments, like distributional cost-effectiveness analysis (DCEA),[66] along with a growing emphasis on health equity during the COVID-19 pandemic, have contributed to a rapid growth in interest and applications of equity-weighted CEA. In equity-weighted approaches, the distribution of an intervention's outcomes is modelled across different equity-relevant subgroups (such as socioeconomic quintiles). A weight is applied to determine the equity-weighted impact of the health intervention or the net equity benefit.[2,39,67] The weight reflects population preferences for the fair distribution of health outcomes.[37] The weighted results or net equity benefit, can be compared with the unweighted results of a CEA to examine

potential trade-offs between an intervention's overall health and equity benefits (Figure 1-3). Unlike in a traditional cost-effectiveness analysis, there are currently no decision rules for when an intervention falls in the win-lose quadrants where either health or equity are worse off because of an intervention.

Figure 1-3: Equity-Efficiency Impact Plane

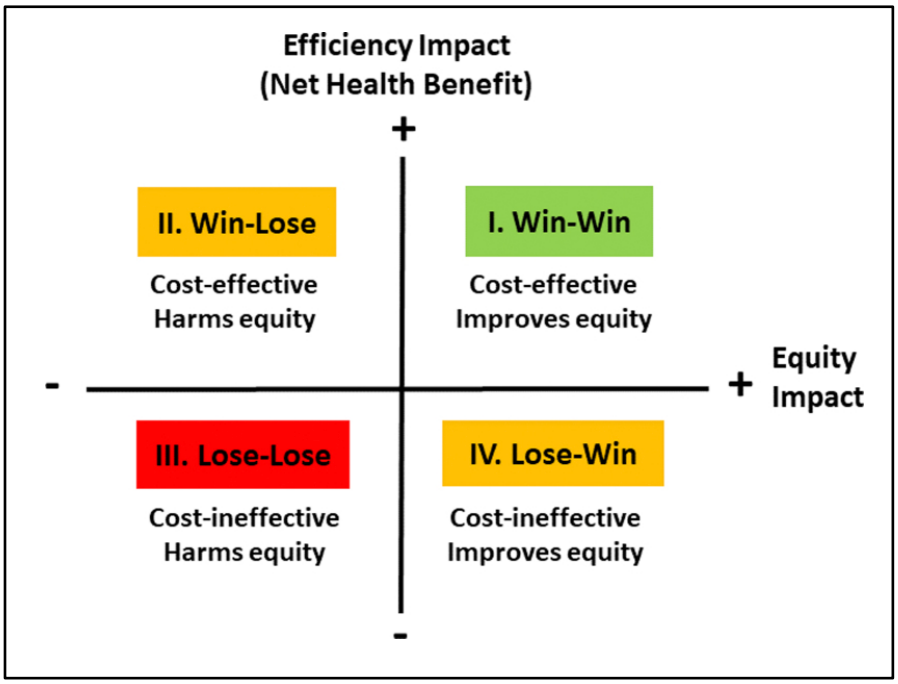


Figure Legend: The equity-efficiency plane is a way to visualize the trade-offs of health and equity benefits of interventions. Interventions that improve equity and health outcomes are considered a win-win. Those with worse equity and health outcomes provide no benefit and therefore are a lose-lose. For win-lose scenarios, where there is a trade-off between equity and efficiency, decision-makers must decide how to judge the trade-off.

By considering population preferences, equity-weighted CEA aligns with the World Health Organization's recommendation of ensuring accountability to populations when making priority-setting decisions.[4] The weighting of outcomes is the main difference between equity-weighted CEA, equity impact analysis and ECEA. The equity weights are a set of value judgments that represent subjective views on the fair distribution of resources and outcomes. In

contrast, equity impact analysis and ECEA leave considerations as to the most equitable distribution of resources to the decision-maker.

1.2.3.4 Equity Weighting Methods for Cost-Effectiveness Analysis

Within equity-weighted CEA, there are three primary methods for incorporating a quantitative equity weight (Figure 1-2). They are 1) distributional cost-effectiveness analysis (DCEA) which uses rank- or level-dependent social welfare functions to weight outcomes across the population,[68-70] 2) direct equity weighting which weights the health outcomes and opportunity costs of priority groups,[71] and 3) threshold weighting which adjusts the cost-effectiveness threshold for priority groups or equity-relevant health conditions.[71]

While similar in their emphasis on weighting outcomes for different groups to reflect population preferences, these approaches differ in how they implement the weighting. DCEA uses social welfare function approaches to elicit inequality aversion parameters by asking respondents to trade off health benefits across different groups defined by specific characteristics, such as income or health status. The inequality aversion parameter represents the extent to which respondents are willing to forgo total health gains to achieve a more equal distribution of health across the specific equity characteristic of interest.[51]

The direct equity weighting approach incorporates weights that represent the additional value from targeting interventions to a marginalized group in society.[72,73] These studies can, and have, evaluated a range of characteristics such as patient age, income and education level, lifestyle factors, gender, and the severity of the disease being treated.[74] The health and

opportunity costs of equity-relevant subgroups are valued differently based on how the equity weight and interventions are ranked by their expected health and equity benefits.[71] These studies enable decision-makers to consider how different treatments can be targeted to different groups to maximize outcomes based on society's preferences.

Finally, threshold weighting adjusts the cost-effectiveness threshold for a different group, such as children, or a class of illness, such as rare diseases, to cover interventions with higher costs per health outcome in the name of improving equity. Various HTA agencies have adopted threshold weighting to inform their decision-making processes. In Japan, the HTA body, Chuikyo, reduces the cost-effectiveness ratio of an intervention by 5% if a vague "ethical and social influence perspective" is demonstrated.[31] The National Institute of Health and Clinical Excellence in the UK has also adopted various cost-effectiveness thresholds for different groups of patients or diseases.[31] In the US, which lacks an established threshold, the Institute for Clinical Economic Review adopts a range of thresholds for all conditions and notes that decision-makers may wish to adopt higher thresholds for ultra-rare diseases.[75,76] However, these threshold changes have, by and large, not been linked to population preferences. Additionally, critiques have been levied against this method as it can lead to biased equity weights.[71]

While applications of the social welfare function and direct equity weighting approaches had largely been limited to the UK due to the novelty of the methods and the scarcity of preference weights beyond the UK, they are quickly being adopted more broadly.[40,66,74,77] Implementing either of these approaches requires the elicitation of inequality aversion estimates or direct equity weights and an evaluation of the baseline distribution of health. In recent years,

more of the infrastructure needed to conduct a DCEA in the US has been developed, including the baseline distribution of health and preliminary estimates of an inequality aversion parameter.[78-80]

In the US, most applications of equity weighting have used DCEA and either applied inequality aversion parameters from the UK or used wide ranges of hypothetical aversion parameters, given the limited availability of US-specific ones.[66,77,80] The use of hypothetical weights may impact the adoption of equity weighting methods. Social welfare function approaches require only one parameter estimate, the inequality aversion parameter, to be varied. In contrast, direct equity weighting would require the creation of a set of hypothetical equity weights for different subgroups across equity dimensions of interest. Potentially due to the ease of estimating hypothetical inequality aversion parameters compared to direct equity weights, adoption of the social welfare function approach has been more common than direct equity weighting.[40,66] Yet, both types of weighting studies are a minority, with most equity-informative CEAs adopting equity impact analyses when determining how best to promote fairness.[40] To properly implement equity-weighted CEA methods and accurately value the distributional impacts of health interventions, population-specific weights are necessary.

1.2.4 Preferences

For equity-weighted CEA to be implemented, weights that reflect the priorities of the population are needed. One tool for eliciting priorities is choice modelling and preference research, which seek to understand the factors that drive individual and population-level decision making. In classical economic theory, people make choices that maximize their well-being or

utility. Individuals have well-established preferences which can be understood by analyzing their choices. Evaluating choices to elucidate preferences is the motivation of choice modelling. Within this framework, people's preferences are viewed not as a monolithic preference for one item over another but based on different characteristics or attributes that make up a good or a service. People then trade-off these attributes to determine which goods and services maximize their utility or well-being at a given time. Choice modelling seeks to understand current choice behaviour – why someone makes a specific choice, and predict future behaviour – what might someone choose tomorrow or in an alternative setting? Choice modelling and preference research have become increasingly popular methods in health economics for understanding patient preferences and motivations.[81-85] The methods have been widely used to evaluate trade-offs in equity and efficiency for resource prioritization,[74,77,86] patient consumer experience, estimation of utility values, and job choices, among others.[81,85]

1.2.5 Preferences for Resource Allocation

A growing body of literature has sought to use choice modelling to evaluate preferences for addressing societal inequalities in income and health.[74,77] A substantial body of research in health economics has used stated preference surveys which ask respondents to make a series of trade-offs between equity and efficiency to quantify the extent to which respondents value one over the other.[74,86] Using a variety of survey approaches, researchers have sought to understand preferences for how healthcare resources should be allocated.

Studies that seek to understand preferences in healthcare resource allocation can be classified into two main approaches that roughly match approaches for equity-weighted CEA.[74]

The first parameterizes social welfare functions used in DCEA, and the second generates preference rankings and distributional weights used in direct equity weighting. Both groups of studies measure the preferences of individuals, populations, and decision-makers toward allocating healthcare resources to promote equity versus efficiency.[87,88]

Social welfare function approaches ask respondents to trade-off benefits across different groups defined by a specific characteristic, such as income, health status, or social deprivation, to generate an inequality aversion parameter. The inequality aversion parameter ascribes value to the health of individuals based on either their rank in the distribution of outcomes[69] or the degree to which their outcomes are lower.[70] The calculated parameter specifies the extent to which one cares about reducing differences in the distribution of outcomes and some versions can be used to weight CEA results as described in Section 1.2.3.3.[69,70,89]

The preference ranking and distributional weighting approaches directly incorporate characteristics of patients and of an intervention's effects on patients' health to generate rankings and weights.[72,73] These studies either elicit rankings or generate weights which reflect the extent to which different treatments that are targeted to specific equity-relevant subgroups maximize outcomes based on society's preferences. Preference rankings alone do not generate weights; they can be used to inform different thresholds or identify priority groups for decision-makers. Distributional weights can be used as part of resource allocation decision making either by being incorporated into a CEA as direct equity weights or as an adjustment to the cost-effectiveness threshold for specific groups, as described in Section 1.2.3.3.[71]

1.2.6 Incorporating Population Preferences into Medical Decision Making

This dissertation seeks to directly incorporate population preferences into decisions around the allocation of scarce medical and healthcare resources. The longstanding debate over whose preferences should be used in resource allocation decisions will only be intensified as more preferences, including those for improving health equity, are incorporated into formal health technology assessment frameworks. Typically, this debate has focused on valuing health states with a choice between using patient or public preferences.[90] The argument for using patient preferences focuses on their experience with the illness, albeit a heterogeneous one. The primary argument against using patient preferences is that they may have systematically different values due to the adaptability of individuals, particularly those with chronic illnesses.[91] Population, public, or community preferences have been recommended based on the insurance principal (that the public are the ones paying for interventions) and the social contract principle (that the benefits of improving health are felt by all members of society and therefore their preferences should be considered).[90] Guidelines for CEA and HTA have continually recommended using societal preferences for the valuation of health states, including NICE in England and Canada's Drug Agency and it aligns with the World Health Organization's recommendation of ensuring accountability to populations.[4,90,92,93] However, increasing attention has been paid to developing more systematic approaches for incorporating patient voices into the HTA processes.[94,95]

When it comes to incorporating equity preferences, the same arguments towards using population preferences apply. Namely, that the public are the ones who pay for health services and benefit from them and therefore their views should be used. Incorporating population

preferences, at least in some way, into decision making around equity also supports the accountability for reasonableness framework proposed by Daniels and Sabin.[96] However, unlike preferences for health states, valuing equity is a matter of justice and power. The use of aggregated population preferences for improving health equity means that the preferences of the majority will supersede those of any minority. It is possible, and perhaps likely, that a privileged majority of individuals could seek to reinforce existing injustices to further their own health and wellbeing whether it be caused by implicit bias, racism, discrimination, or simply an in-group preference. In-group preferences have been documented in previous choice experiments.[74]

While there are philosophical arguments to be made for and against the use of public preferences, the more central question is to what extent do these issues and differences in preferences exist? To understand the potential differences in preferences around health equity and the impact this could have on decision making, research to elicit population preferences is essential. Once we understand how to elicit equity preferences in systematic and robust ways researchers can begin to investigate the extent to which societal values differ from those on the margins. Only then can we begin to elucidate the impact that the use of population preferences could have on the fair and just allocation of healthcare resources. To that end, I seek to elicit population preferences in this dissertation.

1.3 Problem Statement

1.3.1 Research Gaps for Equity-Informative Cost-Effectiveness Analysis

The methods for incorporating equity considerations into cost-effectiveness analysis are still in their infancy. Applications in North America have been increasing, but remain

limited.[40,66] Still, numerous challenges remain for researchers seeking to apply equity-informative CEA.[74]

First, beyond the UK and Europe, few studies have sought to elicit inequality aversion estimates. These studies are particularly limited in the US[77,79,80,97] and Canada.[98] No studies have generated direct equity weights for either the US or Canada.[74] As a result, it remains unclear what weight is placed on improving equity. Second, preferences for equity and efficiency have been found to vary by sociodemographic characteristics.[74] However, the use of limited samples hinders the ability of researchers to understand the extent to which sociodemographic differences could pose challenges for equity-weighted CEA. Finally, there is a complex array of characteristics, both relating to specific health interventions and the treated population, that have been found to be important when making resource allocation decisions.[74] Yet, little research has been done to determine which dimensions of equity should be included in trade-off studies for resource allocation prioritization decisions. In this dissertation, I work to address these research gaps and develop a set of direct equity weights for both the US and Canada.

1.3.2 Electronic Nicotine Delivery Systems for Smoking Cessation

Smoking remains the leading cause of preventable death in the US today.[99] Individuals who currently smoke have lower income, less education, and are often from marginalized communities such as certain racial/ethnic groups, gender and sexual minorities, and individuals with serious psychological distress.[100-102] Improving smoking cessation can play a vital role in addressing tobacco-related health disparities. An array of cost-effective cessation interventions is available to current smokers.[99,103,104] However, most smokers quit without using a cessation aid, and disparities in the use of cessation aids exist.[105-110] Electronic nicotine delivery systems

(ENDS), commonly known as e-cigarettes, may help to improve cessation by serving as a substitute product with fewer harms than combustible cigarettes.[111] Given their potential equity benefits and a suit of other cost-effective interventions, evaluating ENDS as a smoking cessation intervention is an ideal venue for exploring the impacts of equity-informative CEA methods.

In the US, ENDS have been hotly contested,[112,113] primarily over concerns related to youth ENDS use which rose drastically in 2018-19. As a result, the US has adopted a contractionist regulatory approach which seeks to limit the expansion of the ENDS market.[114] In 2020, the FDA began an approval process where the manufacturers of all ENDS products, both devices and nicotine liquids (or e-liquids), needed to submit a Premarket Tobacco Product Application (PMTA) to seek market approval as a tobacco product. ENDS products currently on the market were allowed to continue sales and marketing while applications were under review. Through this process, FDA has issued millions of marketing denial orders on the grounds that companies did not demonstrate that product approval would be appropriate for the protection of public health.[115,116] Only 34 ENDS devices and liquids have been approved as of April 2025. Despite this restrictive regulatory approach, US government bodies note the potential benefits of ENDS for cessation, albeit with concern over the lack of evidence of long-term health effects.[117]

Outside of the US, ENDS have been embraced as a critical part of smoking cessation strategies in England and New Zealand. In both countries, healthcare professionals are encouraged to consider ENDS as a cessation aid seen as equally beneficial as pharmacotherapies.[111] In the UK, ENDS have been shown to have an acceptable balance of costs

and health benefits compared to other commonly used cessation interventions and make up a centerpiece of cessation efforts.[118,119]

Despite extensive modelling studies evaluating the potential effects of ENDS on smoking initiation and cessation, no studies have compared the potential benefits and harms of ENDS to other cessation interventions for the US smoking population.[120-132] Considering the equity-informative cost-effectiveness of ENDS as a cessation tool in the US will provide decision-makers with a formal accounting of the costs, benefits, and equity impacts of this potential harm-reduction tool. Such accountings are essential to ensure that ENDS policy accurately reflects the balance of benefits and harms of the products.[133]

1.4 Contributions to the Literature

This dissertation contributes to the development and application of equity-informative CEA methods in Canada and the US and informs ENDS policy. This work will make three notable contributions.

1.4.1 Development of direct equity weights for equity-informative cost-effectiveness analysis in Canada and the US

To date, no study has developed direct equity weights for Canada or the US, and few studies have considered trade-offs between equity and efficiency more broadly.[77] With the growing interest and use of equity-informative methods,[40] the lack of weights that reflect the population's preferences limits applications of these methods in Canada and the US. Studies have found that individuals are willing to sacrifice some level of efficiency for a more equitable distribution of health outcomes.[86,87,134,135] However, these studies have, by and large, been

conducted in European nations with dramatically different approaches to and philosophies towards the provision of healthcare compared to the US. This dissertation provides the first set of direct equity weights for the US and Canada. The availability of generic direct equity weights enables researchers to directly incorporate a broader conception of value into their cost-effectiveness analyses and inform the development of effective and equitable policies and programs to improve public health. Results from this dissertation enable future equity-informative cost-effectiveness analyses using direct equity weights in Canada and the US.

1.4.2 Novel application of equity-informative cost-effectiveness analysis methods in the US.

This dissertation presents one of the first applications of equity-informative CEA in the US based on US-specific equity preferences.[40,77,136-144] As such, it will chart a course identifying US-specific benefits and challenges to conducting equity-informative CEA. By using direct equity weights, as opposed to the more commonly discussed social welfare function approaches, this research will motivate conversations over the pros and cons of the different methods of equity weighting. This dialogue can help identify best practices in the nascent field of incorporating equity considerations into CEAs.

1.4.3 Provide evidence on the impact of costs and health benefits of electronic nicotine delivery systems as a smoking cessation intervention

The research presented in this dissertation provides regulators and clinicians with evidence on the potential health and economic impacts of ENDS as a cessation device at a time when ENDS policy is evolving rapidly.[115,116] This evidence on the costs, benefits, and equity impacts of ENDS relative to other commonly used smoking cessation interventions can inform

harm-reduction focused approaches to smoking cessation. This evidence is valuable for the ongoing debate over ENDS policy and other novel nicotine products.

1.5 Overview of Chapters

1.5.1 Chapter 2:

In Chapter 2, I conducted focus groups and developed and fielded a best-worst scaling survey that prioritized attributes related to equity and efficiency in Canada and the United States. Because direct equity weighting can incorporate a wide array of characteristic deemed important in resource allocation decision making, the final set of attributes must be among the most meaningful for respondents. The focus group findings and results from the best worst scaling provided this evidence. This chapter describes how the general public prioritized different attributes for resource allocation decision making to aid in the identification of final set that can be used in a discrete choice experiment. Results from this analysis directly informed Chapter 3.

1.5.2 Chapter 3:

In Chapter 3, I elicited a set of direct equity weights for equity-informative cost-effectiveness analysis using a discrete choice experiment based on the attributes identified in Chapter 2. Chapter 3 developed the first set of general direct equity weights for equity-informative CEA in Canada and the US. It examined the heterogeneity in equity preferences within and between the two countries, finding largely similar preferences, but with a different utility placed on equity attributes. Results from this analysis enabled the equity-informative CEA described in Chapter 4 and will enable future analyses in Canada and the US.

1.5.3 Chapter 4:

In Chapter 4, I applied the weights developed in Chapter 3 to determine the net equity benefit of ENDS as a smoking cessation intervention. I developed a microsimulation state transition model that tracked the costs and health impacts of four different smoking cessation interventions. Simulated smokers differed based on the attributes used in Chapter 3, enabling the calculation of costs and health benefits for each of these equity-relevant subgroups. I then weighted health benefits and opportunity costs and determined the net equity benefit of each intervention. This study is among the first equity-informative CEAs conducted in the US setting using equity weights generated for the US.

Chapter 2 Prioritizing Equity and Efficiency for Healthcare Resource Allocation in Canada and the United States: A Best-Worst Scaling Study

2.1 Introduction

Equity-informative and distributional cost-effectiveness analysis are increasingly popular approaches in health economics to value the impact of health interventions on reducing health inequality and promoting health equity.[40,51] Equity-informative methods require the analyst to stratify the population into equity-relevant subgroups to determine the distributional effects of an intervention on population health. The distribution of health outcomes and opportunity costs for each of the equity-relevant subgroups are then weighted to determine the net equity benefit of interventions.[68] These weights are typically generated through population surveys where respondents are asked questions about their preferences regarding differences in distributions of health outcomes.[74,77,87]

Operationalizing a complex concept such as health equity is challenging for survey research. While the goal of health equity as the full potential for health and well-being of all is largely agreed upon by experts, inequities are context specific.[6] Health inequities depend on history, place, culture, and the type of disease being considered. To date, inequality aversion elicitation exercises primarily conducted in the UK have examined the public preferences towards the distribution of health by social class[145] and socioeconomic status.[134,146] Beyond the UK, analysts have looked to attributes such as age at disease onset, race/ethnicity,[144] socioeconomic position,[137] disease severity, lifestyle choices, and sex among others as potential

equity dimensions that could be prioritized during resource allocation decision making processes.[40,74]

To complicate matters further, decision-makers must often weigh efforts to improve health equity and reduce health disparities against other system level priorities. Potential equity benefits must be considered relative to other priorities such as improving health outcomes, fostering efficiency, containing costs, reducing wait times, or reducing treatment uncertainty. Previous choice experiments that seek to understand equity-efficiency trade-offs have directly compared equity dimensions to a range of system level attributes.[41,74,86] However, these studies typically only include a small selection of attributes (around five to seven) and often lack a clear reason for selecting the specific equity dimensions or system attributes included in the prioritization exercise.

In this paper, I utilized a mixed-methods approach to determine which dimensions of health equity are highly prioritized by members of the general public of the US and Canada when it comes to allocating healthcare resources. I conducted focus groups to understand how respondents conceptualized health equity and to identify different equity dimensions. I then fielded a best-worst scaling (BWS) survey, a type of stated preference study commonly used in health preference research,[83,84] to rank attributes that respondents viewed as most important when determining how to allocate healthcare resources. I compared multiple ways of framing equity (as either reducing differences in health outcomes or improving access to healthcare services). This study provides CEA analysts and decision-makers in the US and Canada with insights into which attributes of health equity were most important to the general public.

2.2 Methods

An online BWS survey was developed to determine respondents' relative preferences for allocating resources to different equity and efficiency goals. BWS is a stated-preference survey method where respondents are presented with a subset of attributes and are asked to select one best and one worst attribute. The process is repeated over multiple combinations of attributes and can be used to create a ranking of the relative importance of each attribute. This study was designated as exempt by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board (HUM00235890) and approved by the University of British Columbia Research Ethics Board (H23-02169) as a minimal risk study. The full survey instrument is available on request.

2.2.1 Survey Development

The development of the best-worst scaling survey included 1) identification of the attributes of equity and efficiency respondents would prioritize, 2) determination the experimental design which sets the combinations of attributes respondents select between, and 3) construction of the survey instrument which included the instructions, questions prompts and demographic questions that encompass the best-worst scaling. A preliminary list of 30 potential attributes for inclusion was developed based on a scoping review of equity-efficiency trade-offs (aTable A.1-1). Survey development was informed by a series of focus groups I conducted to help verify and expand the list of potential attributes and determine the instructions and question framing. Once the survey design was complete, pre-testing and pilot testing were conducted to ensure the choice tasks were realistic and to test comprehension and readability of the survey.

2.2.1.1 Focus Group Methods

Online focus groups were conducted in Canada and the US. In the US, participants were recruited through the University of Michigan's UMHealthResearch program, while social media ads and the University of British Columbia's Paid Participants Studies List and word of mouth were used to find participants in Canada. A purposive sampling method was used to ensure a diverse sample of respondents based on characteristics including age, gender, education level, income level, and political viewpoint.[147]

During focus groups, respondents were asked to discuss their conception of fairness in the context of healthcare resource allocation decisions. Respondents were not provided any background information on health disparities or health equity. New attributes for inclusion in the BWS were developed by identifying distinct terms viewed as important by participants and describing these concepts as succinctly as possible.[148] Attributes were iteratively developed and screened in future focus group sessions.

2.2.1.2 Focus Group Findings

Focus groups were conducted with 29 individuals in Canada and 27 in the United States (demographics in Appendix A.2). Participants in both countries had similar views that a fair system is based on equality in access, where all individuals can access quality care and be treated equally regardless of their characteristics and circumstances. For example:

"A fair healthcare system would be one that's free and accessible to anyone. Regardless of if you live in an urban or rural area; regardless of your income, age, disability, sexuality, race, ethnicity. Yeah, so I think just access." - US focus group respondent.

In the US, themes across focus groups were promoting equality in access, affordability, and acknowledging the role of individual responsibility in health. In Canada, common themes also included promoting equality in access, and acknowledging the role of individual responsibility in health, but added reducing wait times and improving accessibility particularly in rural areas. Improved access was often considered more important than efforts to achieve similar health outcomes based in part on a belief that outcomes would be improved through access. When asked about allocating resources, respondents were unwilling to use characteristics such as race, ethnicity, or gender in determining equitable allocations. Appendix A.3 presents quotes corresponding to various themes.

2.2.1.3 Attribute Selection

The expanded attribute list developed through the review and focus groups process was pruned by the study team to remove attributes that were not relevant or applicable in a resource prioritization decision-making setting. The list of potential attributes and reasons for exclusion of attributes is presented in aTable A.1-2.

In the best-worst scaling survey, I included 22 attributes related to health benefits (e.g., disease severity, individual health gains, or improved life expectancy), group-level demographics (e.g., income level, education level, age, sex, or immigration status), and system functioning

(e.g., costs, wait times, or number of people treated). The final set of attributes is presented in Table 2-1.

Table 2-1: Final Attributes and Attribute Wording for Best-Worst Scaling Frames

Attribute	Attribute Type	Frame	Attribute Wording
Age	Demographics	Access	Reduce differences in **access** to health services across **age**
		Health Outcomes	Reduce differences in **health outcomes** across **age**
Education Level	Demographics	Access	Reduce differences in **access** to health services by **level of education**
		Health Outcomes	Reduce differences in **health outcomes** by **level of education**
Employment Status	Demographics	Access	Reduce difference in **access** to health services by **employment status**
		Health Outcomes	Reduce difference in **health outcomes** by **employment status**
Gender Identity	Demographics	Access	Reduce differences in **access** to health services between **gender identities**
		Health Outcomes	Reduce differences in **health outcomes** between **gender identities**
Immigration Status	Demographics	Access	Reduce differences in **access** to health services by **immigration status**
		Health Outcomes	Reduce differences in **health outcomes** by **immigration status**
Income Level/Socioeconomic Status	Demographics	Access	Reduce differences in **access** to health services across **income level/socioeconomic status**
		Health Outcomes	Reduce differences in **health outcomes** across **income level/socioeconomic status**
Insurance Status	Demographics	Access	Reduce differences in **access** to health services by **insurance status**
		Health Outcomes	Reduce differences in **health outcomes** by **insurance status**
Lifestyle Factors	Demographics	Access	Reduce differences in **access** to health services between **individuals with unhealthy behaviours** (poor diet, smoking, etc.) and those that do not
		Health Outcomes	Reduce differences in **health outcomes** between **individuals with unhealthy behaviours** (poor diet, smoking, etc.) and those that do not
Race/Ethnicity	Demographics	Access	Reduce differences in **access** to health services by **race/ethnicity**
		Health Outcomes	Reduce differences in **health outcomes** by **race/ethnicity**
Rural/Urban	Demographics	Access	Reduce differences in **access** to health services between **rural and urban areas**
		Health Outcomes	Reduce differences in **health outcomes** between **rural and urban areas**
Sex	Demographics	Access	Reduce differences in **access** to health services between **sexes** (male or female)

		Health Outcomes	Reduce differences in **health outcomes** between **sexes** (male or female)
Sexual Orientation	Demographics	Access	Reduce differences in **access** to health services between **sexual orientations**
		Health Outcomes	Reduce differences in **health outcomes** between **sexual orientations**
Current Health Status	Health Benefits	Access	Reduce differences in **access** to health services by **current health**
		Health Outcomes	Reduce differences in **health outcomes** by **current health**
Disease Severity	Health Benefits	Access	Improve **access** to health services for people with **more severe diseases**
		Health Outcomes	Improve **health outcomes** for people with **more severe diseases**
Health Gains	Health Benefits	Consistent across frames	Increase **health gains** for individuals
Life Expectancy	Health Benefits	Consistent across frames	Improve **population life expectancy**
Past Health Status	Health Benefits	Access	Reduce differences in **access** to health services based on **health history**
		Health Outcomes	Reduce differences in **health outcomes** based on **health history**
Treatment Uncertainty	Health Benefits	Consistent across frames	Reduce **uncertainty** in how well a **treatment works**
Costs – Healthcare System	System Functioning	Consistent across frames	Reduce the amount that the **healthcare system spends** on care
Costs – Individuals	System Functioning	Consistent across frames	Reduce the amount that **individuals need to spend** for care
Number of People	System Functioning	Consistent across frames	Increase the **number of people** who can get care
Wait Times	System Functioning	Consistent across frames	Reduce the **length of time** individuals need to **wait** to receive care

Given the complexity of explaining the concept of 'equity' in the survey format, these attributes focused on reducing differences across common equity dimensions. To capture different types of equity and equality concerns raised in the focus groups, I framed group demographic- and select health-related attributes as reducing disparities in access or health outcomes. For example: reducing differences in access across income levels or reducing differences in health outcomes across income levels. Respondents were randomized to one of

three versions of the BWS exercise that included either 1) the access to health services frame alone, 2) the health outcomes frame alone, or 3) a dual frame that included both access and health outcomes. The dual frame was selected as the primary frame for analysis. This approach does not directly correspond to the definition of equity presented in Section 1.2.2, rather it reflects potential preferences for equality in access, which could still result in inequities, or equality in health outcomes, which more closely reflects the WHO definition of attaining full potential for health and well-being.

2.2.1.4 Experimental Design

To account for the large number of attributes in the choice experiment, I used Sawtooth to create the best-worst scaling experimental design.[149] The Sawtooth software considers frequency balance, orthogonality, within-set positional balance, and between set positional balance when identifying designs. The design with the best one-way balance is selected. A total of 300 designs were created for each of the three versions of the BWS exercise. Respondents were first randomized to a survey version (access frame, outcomes frame, dual frame) and then randomized to one of the 300 designs of the survey.

2.2.1.5 Survey Instrument Design

The survey was composed of three parts: 1) an introduction, 2) the BWS exercise, and 3) questions on demographics and beliefs. The introduction provided the rationale for the study and gave respondents definitions of key terms including access to healthcare services and health outcomes, as well as other considerations for the participant to keep in mind. As with the focus groups, respondents were not provided with any background information on health disparities

and health equity. This was done to understand respondents' views based on their baseline knowledge and beliefs as well as to avoid biasing respondents.

Respondents then completed 10 best-worst scaling tasks (Figure 2-1) where they were asked to select one "more important" and one "less important" attribute for a subset of five attributes. The use of *more* and *less* rather than the typical *most* and *least* or *best* and *worst* was in acknowledgement of the difficulty that pre-testers noted in selecting just one attribute as most or least important. Below each choice task, respondents were given the opportunity to comment on the reasons for their choices.

Figure 2-1: Example Choice Set for Respondents

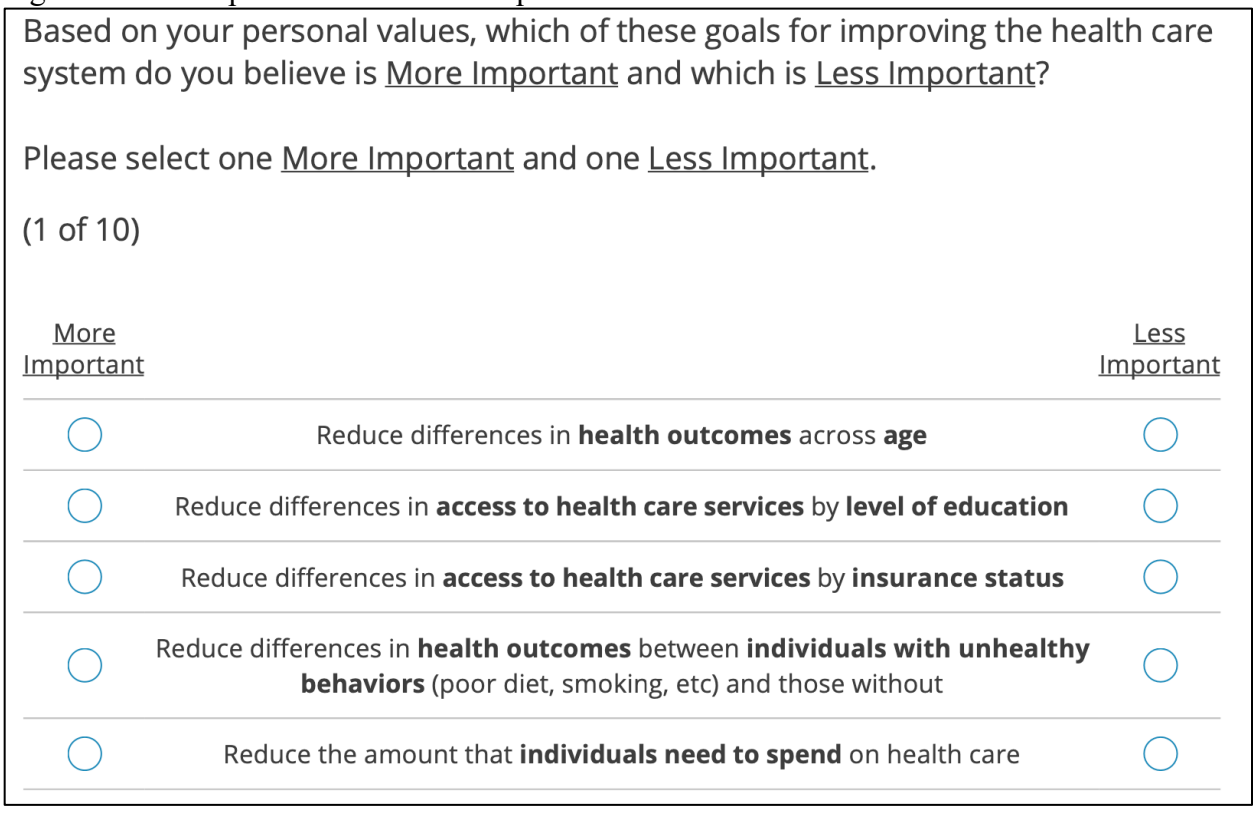


Figure Legend: Example best-worst scaling choice task displayed to respondents. Respondents completed 10 best-worst scaling tasks where they selected one "More Important" and one "Less Important" attribute based on the five attributes presented in each choice task. Respondents saw a rotating list of attributes based on the experimental design developed in Sawtooth.

Following the choice tasks, respondents were asked to provide basic demographic information as well as answer a series of attitudinal questions, and attention checks. In addition to demographics such as age, gender, race and ethnicity, income, and education, I asked respondents about their religiosity, charitable giving and volunteering, political beliefs and attitudes towards inequality. Attitudes towards inequality were assessed through a series of statements about the state of health and economic inequality in the respondent's country to which respondents expressed the extent of their agreement with the statement on a five-point Likert scale. Two attention check questions were also included to identify inattentive or rushing respondents. One where respondents were asked to select "strongly agree" to show they were paying attention and a second which checked for concordance between their age and birth year.

2.2.1.6 Pretesting and Pilot Testing

The survey was pretested with researchers and members of the general public with online versions of the survey to ensure readability and comprehension. Pretesting used a co-design method where respondents were actively asked to comment on ways to improve the survey.[150] Formal pilot testing was conducted with over 10% of the sample in each country and data were analyzed to assess the survey prior to full data collection.

2.2.2 Data Collection

The survey was administered online to standing panels of Canadian and US adults (18+) in April and May of 2024. The US sample was recruited from CloudResearch's Connect platform with quotas to ensure a diverse sample in terms of age, gender, race and ethnicity, and

political affiliation which were matched to the US census for demographic variables and Gallup data on political affiliation.[151] In Canada, CloudResearch's Prime Panels platform was used which is an aggregation of multiple opt-in market research panels where respondents are screened for attentiveness and targeted based on gender only.

Respondents in both countries received incentives for completing the survey. In the US, respondents were paid $4 for completing the survey. In the Canada, respondent received various incentives provided by the survey vendor including points which could be redeemed for gift cards and purchases.

There are no established approaches for estimating the sufficient sample size for best-worst scaling studies. Previous best-worst scaling studies rarely provide a justification for the sample size and when they did it was primarily based on previous literature or a rule of thumb justification.[82,83] Given a dearth of previous best-worst scaling studies comparable to this, sample size was determined to ensure that each attribute in the dual frame would be seen by at least 300 respondents accounting for removal of poor quality responses. A larger sample was used in Canada to account for the less targeted sample recruitment and potentially poorer quality responses available from the survey vendor.

2.2.3 Analyses

Analyses were conducted in R version 4.4.0 and Sawtooth 9.16.2. The results were analyzed using count analysis to generate relative importance scores for each attribute using formula in (Eq. 2-1).[152]

$$RIS_i = \frac{B_i - W_i}{n_i}$$

(Eq. 2-1)

Where *B* refers to the number of times attribute *i* was selected as more important, *W* refers to the number of times attribute *i* was selected as less important, and *n* is the total number of times the attribute appeared. The higher the score, the more important the attribute. RIS were calculated for Canada and the US separately. I also reviewed respondent comments to identify reasons for selecting an attribute as more or less important. Common themes and exemplar comments for each were collected.

Primary analyses excluded respondents who did not answer the choice task questions, who failed attention checks, provided inconsistent demographic data, who said that they did not understand the choice task, or who left a comment indicating they struggled to understand the task, rejected the premise of the task, or left multiple comments not relevant to the analysis.

2.2.4 Response Heterogeneity

I analyzed respondent preference heterogeneity by comparing relative importance scores for different sociodemographic attributes. I examined differences in attribute importance scores individually by age, gender, education, race/ethnicity, income level, current health status, political beliefs, religious beliefs, whether they lived in a rural or urban area, attitudes towards health and wealth inequality, and how challenging respondents found the survey.

I also used latent class analysis (LCA) to identify groups of respondents with similar preferences. The latent class model allows for heterogeneity by identifying separate classes with

different values for estimated parameters. LCA enabled the identification of underlying groups of respondents who share preferences.[153] LCA is a two-part process where first the probability that an individual respondent belonged to a specific class is estimated based on their responses and the alternatives in the choice set. The second model then evaluated within-class choices. The second model computed class-specific choice probabilities and estimated parameters. The models were combined to determine the probability of a respondent selecting an alternative by summing all class-specific choice probabilities weighted by the class allocation choice probabilities for that individual. In this model, I assumed that preference variation exists between the classes, but preferences within a class are homogenous.[154,155]

I tested a range of potential classes (2-7). I determined the final set of latent classes based on model fit using Bayesian Information Criterion and consistent Akaike Information Criterion, and interpretability of the classes. I conducted LCA for Canada and the US separately.

2.3 Results

2.3.1 Best-Worst Scaling Survey Results

The final analytic sample for the BWS survey was 770 in Canada and 649 in the United States. Of those, 458 respondents in Canada and 374 respondents in the US completed the dual frame. Sample demographics are presented in

Table 2-2 for the US and Table 2-3 for Canada. Reasons for excluding respondents are presented in aTable A.4-1for the US and aTable A.4-2 for Canada and protest comments for excluded comments are listed in Appendices A.5 and A.6.

Table 2-2: US Sample Demographics

	Dual Frame (N=374)	Access Frame (N=140)	Outcomes Frame (N=135)	Overall (N=649)
Age				
Mean (SD)	45.8 (14.3)	45.8 (16.8)	42.4 (16.4)	45.1 (15.3)
Median [Min, Max]	45.5 [18.0, 80.0]	44.5 [18.0, 86.0]	38.0 [19.0, 78.0]	44.0 [18.0, 86.0]
Age Group				
18-34	105 (28.1%)	49 (35.0%)	64 (47.4%)	218 (33.6%)
35-54	157 (42.0%)	37 (26.4%)	32 (23.7%)	226 (34.8%)
55+	112 (29.9%)	54 (38.6%)	39 (28.9%)	205 (31.6%)
Gender				
Female	190 (50.8%)	65 (46.4%)	70 (51.9%)	325 (50.1%)
Male	182 (48.7%)	73 (52.1%)	64 (47.4%)	319 (49.2%)
Other	2 (0.5%)	2 (1.4%)	1 (0.7%)	5 (0.8%)
Prefer not to answer	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Region				
Northeast	63 (16.8%)	29 (20.7%)	23 (17.0%)	115 (17.7%)
Midwest	69 (18.4%)	25 (17.9%)	23 (17.0%)	117 (18.0%)
South	166 (44.4%)	52 (37.1%)	55 (40.7%)	273 (42.1%)
West	76 (20.3%)	34 (24.3%)	34 (25.2%)	144 (22.2%)
Political Viewpoint				
Conservative	145 (38.8%)	48 (34.3%)	41 (30.4%)	234 (36.1%)
Centrist or neutral	94 (25.1%)	32 (22.9%)	20 (14.8%)	146 (22.5%)
Liberal	110 (29.4%)	57 (40.7%)	68 (50.4%)	235 (36.2%)
Neither conservative nor liberal	24 (6.4%)	3 (2.1%)	6 (4.4%)	33 (5.1%)
Prefer not to say	1 (0.3%)	0 (0%)	0 (0%)	1 (0.2%)
Education				
High school or less	56 (15.0%)	20 (14.3%)	9 (6.7%)	85 (13.1%)
Some college or associate's	100 (26.7%)	40 (28.6%)	47 (34.8%)	187 (28.8%)
College or more	218 (58.3%)	80 (57.1%)	79 (58.5%)	377 (58.1%)
Income				
Less than $50k	130 (34.8%)	52 (37.1%)	50 (37.0%)	232 (35.7%)
$50k - $100k	129 (34.5%)	49 (35.0%)	58 (43.0%)	236 (36.4%)
$100k or more	108 (28.9%)	39 (27.9%)	24 (17.8%)	171 (26.3%)
Prefer not to answer	7 (1.9%)	0 (0%)	3 (2.2%)	10 (1.5%)
Marital Status				
Single, never married	112 (29.9%)	56 (40.0%)	62 (45.9%)	230 (35.4%)
Married or domestic partnership	202 (54.0%)	67 (47.9%)	52 (38.5%)	321 (49.5%)
Formerly married	58 (15.5%)	17 (12.1%)	21 (15.6%)	96 (14.8%)

Prefer not to answer	2 (0.5%)	0 (0%)	0 (0%)	2 (0.3%)
Employment Status				
Employed, Full Time	201 (53.7%)	76 (54.3%)	78 (57.8%)	355 (54.7%)
Employed, Part Time	48 (12.8%)	19 (13.6%)	22 (16.3%)	89 (13.7%)
Retired	49 (13.1%)	14 (10.0%)	12 (8.9%)	75 (11.6%)
Student	8 (2.1%)	7 (5.0%)	7 (5.2%)	22 (3.4%)
Not employed	50 (13.4%)	15 (10.7%)	14 (10.4%)	79 (12.2%)
Other	18 (4.8%)	9 (6.4%)	2 (1.5%)	29 (4.5%)
Household Size				
Mean (SD)	2.66 (2.81)	2.44 (1.42)	2.50 (1.35)	2.58 (2.32)
Median [Min, Max]	2.00 [0, 50.0]	2.00 [0, 8.00]	2.00 [0, 7.00]	2.00 [0, 50.0]
Smoking Status				
Yes	59 (15.8%)	23 (16.4%)	22 (16.3%)	104 (16.0%)
No	315 (84.2%)	117 (83.6%)	112 (83.0%)	544 (83.8%)
Prefer not to answer	0 (0%)	0 (0%)	1 (0.7%)	1 (0.2%)
Health Status				
Excellent/Very Good/Good	300 (80.2%)	114 (81.4%)	113 (83.7%)	527 (81.2%)
Fair/Poor	74 (19.8%)	26 (18.6%)	22 (16.3%)	122 (18.8%)
Community Type				
Large city	83 (22.2%)	41 (29.3%)	42 (31.1%)	166 (25.6%)
Suburb	156 (41.7%)	42 (30.0%)	54 (40.0%)	252 (38.8%)
Small city	81 (21.7%)	36 (25.7%)	27 (20.0%)	144 (22.2%)
Rural area	54 (14.4%)	21 (15.0%)	12 (8.9%)	87 (13.4%)
Religious Belief				
Not Religious	79 (21.1%)	37 (26.4%)	32 (23.7%)	148 (22.8%)
Organized Religion	218 (58.3%)	72 (51.4%)	80 (59.3%)	370 (57.0%)
Spiritual	20 (5.3%)	10 (7.1%)	8 (5.9%)	38 (5.9%)
Other	51 (13.6%)	20 (14.3%)	15 (11.1%)	86 (13.3%)
Prefer not to answer	6 (1.6%)	1 (0.7%)	0 (0%)	7 (1.1%)
Religiosity				
Important	214 (57.2%)	73 (52.1%)	61 (45.2%)	348 (53.6%)
Not important	156 (41.7%)	67 (47.9%)	74 (54.8%)	297 (45.8%)
Prefer not to answer	4 (1.1%)	0 (0%)	0 (0%)	4 (0.6%)
In the past 12 months, did you donate time, money, or goods to charity?				
Yes	234 (62.6%)	82 (58.6%)	86 (63.7%)	402 (61.9%)
No	135 (36.1%)	55 (39.3%)	47 (34.8%)	237 (36.5%)
Prefer not to answer	5 (1.3%)	3 (2.1%)	2 (1.5%)	10 (1.5%)
Survey Difficulty				
Easy	68 (18.2%)	27 (19.3%)	27 (20.0%)	122 (18.8%)
Somewhat easy	138 (36.9%)	38 (27.1%)	52 (38.5%)	228 (35.1%)
Somewhat hard	145 (38.8%)	60 (42.9%)	44 (32.6%)	249 (38.4%)

Hard	23 (6.1%)	15 (10.7%)	12 (8.9%)	50 (7.7%)

Table 2-3: Canadian Sample Demographics

	Dual Frame (N=458)	Access Frame (N=151)	Outcomes Frame (N=161)	Overall (N=770)
Age				
Mean (SD)	45.4 (17.9)	48.6 (17.6)	50.0 (18.0)	47.0 (17.9)
Median [Min, Max]	43.0 [18.0, 91.0]	52.0 [18.0, 80.0]	51.0 [18.0, 81.0]	46.0 [18.0, 91.0]
Age Group				
18-34	162 (35.4%)	50 (33.1%)	39 (24.2%)	251 (32.6%)
35-54	146 (31.9%)	35 (23.2%)	49 (30.4%)	230 (29.9%)
55+	150 (32.8%)	66 (43.7%)	73 (45.3%)	289 (37.5%)
Gender				
Female	220 (48.0%)	72 (47.7%)	87 (54.0%)	379 (49.2%)
Male	232 (50.7%)	78 (51.7%)	72 (44.7%)	382 (49.6%)
Other	4 (0.9%)	1 (0.7%)	2 (1.2%)	7 (0.9%)
Prefer not to answer	2 (0.4%)	0 (0%)	0 (0%)	2 (0.3%)
Region				
British Columbia	48 (10.5%)	18 (11.9%)	20 (12.4%)	86 (11.2%)
Manitoba	20 (4.4%)	2 (1.3%)	9 (5.6%)	31 (4.0%)
New Brunswick	10 (2.2%)	2 (1.3%)	7 (4.3%)	19 (2.5%)
Newfoundland and Labrador	12 (2.6%)	6 (4.0%)	7 (4.3%)	25 (3.2%)
Northwest Territories	1 (0.2%)	0 (0%)	0 (0%)	1 (0.1%)
Nova Scotia	13 (2.8%)	6 (4.0%)	5 (3.1%)	24 (3.1%)
Nunavut	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Ontario	221 (48.3%)	71 (47.0%)	71 (44.1%)	363 (47.1%)
Prince Edward Island	2 (0.4%)	0 (0%)	0 (0%)	2 (0.3%)
Quebec	40 (8.7%)	18 (11.9%)	11 (6.8%)	69 (9.0%)
Saskatchewan	25 (5.5%)	6 (4.0%)	6 (3.7%)	37 (4.8%)
Yukon	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Political Viewpoint				
Conservative	124 (27.1%)	47 (31.1%)	49 (30.4%)	220 (28.6%)
Centrist or neutral	87 (19.0%)	25 (16.6%)	34 (21.1%)	146 (19.0%)
Liberal	162 (35.4%)	49 (32.5%)	53 (32.9%)	264 (34.3%)
Neither conservative nor liberal	57 (12.4%)	22 (14.6%)	17 (10.6%)	96 (12.5%)
Prefer not to say	28 (6.1%)	8 (5.3%)	8 (5.0%)	44 (5.7%)
Education				
High school or less	102 (22.3%)	33 (21.9%)	43 (26.7%)	178 (23.1%)
Some college or associate's	147 (32.1%)	42 (27.8%)	52 (32.3%)	241 (31.3%)
College or more	209 (45.6%)	76 (50.3%)	66 (41.0%)	351 (45.6%)
Income				

Less than $50k	152 (33.2%)	56 (37.1%)	52 (32.3%)	260 (33.8%)
$50k - $100k	166 (36.2%)	64 (42.4%)	57 (35.4%)	287 (37.3%)
$100k or more	121 (26.4%)	25 (16.6%)	43 (26.7%)	189 (24.5%)
Prefer not to answer	19 (4.1%)	6 (4.0%)	9 (5.6%)	34 (4.4%)
Marital Status				
Single, never married	163 (35.6%)	38 (25.2%)	50 (31.1%)	251 (32.6%)
Married or domestic partnership	214 (46.7%)	81 (53.6%)	90 (55.9%)	385 (50.0%)
Formerly married	76 (16.6%)	30 (19.9%)	21 (13.0%)	127 (16.5%)
Prefer not to answer	5 (1.1%)	2 (1.3%)	0 (0%)	7 (0.9%)
Employment Status				
Employed, Full Time	197 (43.0%)	57 (37.7%)	55 (34.2%)	309 (40.1%)
Employed, Part Time	63 (13.8%)	25 (16.6%)	21 (13.0%)	109 (14.2%)
Retired	100 (21.8%)	39 (25.8%)	59 (36.6%)	198 (25.7%)
Student	24 (5.2%)	6 (4.0%)	9 (5.6%)	39 (5.1%)
Not employed	53 (11.6%)	16 (10.6%)	15 (9.3%)	84 (10.9%)
Other	21 (4.6%)	8 (5.3%)	2 (1.2%)	31 (4.0%)
Household Size				
Mean (SD)	2.56 (2.00)	2.19 (1.09)	2.37 (2.08)	2.45 (1.88)
Median [Min, Max]	2.00 [0, 33.0]	2.00 [1.00, 7.00]	2.00 [0, 25.0]	2.00 [0, 33.0]
Smoking Status				
Yes	91 (19.9%)	33 (21.9%)	45 (28.0%)	169 (21.9%)
No	359 (78.4%)	117 (77.5%)	116 (72.0%)	592 (76.9%)
Prefer not to answer	8 (1.7%)	1 (0.7%)	0 (0%)	9 (1.2%)
Health Status				
Excellent/Very Good/Good	365 (79.7%)	120 (79.5%)	123 (76.4%)	608 (79.0%)
Fair/Poor	93 (20.3%)	31 (20.5%)	38 (23.6%)	162 (21.0%)
Community Type				
Large city	188 (41.0%)	63 (41.7%)	74 (46.0%)	325 (42.2%)
Suburb	151 (33.0%)	45 (29.8%)	38 (23.6%)	234 (30.4%)
Small city	78 (17.0%)	28 (18.5%)	33 (20.5%)	139 (18.1%)
Rural area	41 (9.0%)	15 (9.9%)	16 (9.9%)	72 (9.4%)
Religious Belief				
Not Religious	82 (17.9%)	23 (15.2%)	28 (17.4%)	133 (17.3%)
Organized Religion	237 (51.7%)	78 (51.7%)	72 (44.7%)	387 (50.3%)
Spiritual	38 (8.3%)	12 (7.9%)	14 (8.7%)	64 (8.3%)
Other	88 (19.2%)	30 (19.9%)	43 (26.7%)	161 (20.9%)
Prefer not to answer	13 (2.8%)	8 (5.3%)	4 (2.5%)	25 (3.2%)
Religiosity				
Important	236 (51.5%)	79 (52.3%)	70 (43.5%)	385 (50.0%)
Not important	213 (46.5%)	68 (45.0%)	90 (55.9%)	371 (48.2%)

Prefer not to answer	9 (2.0%)	4 (2.6%)	1 (0.6%)	14 (1.8%)
In the past 12 months, did you donate time, money, or goods to charity?				
Yes	277 (60.5%)	97 (64.2%)	107 (66.5%)	481 (62.5%)
No	173 (37.8%)	49 (32.5%)	54 (33.5%)	276 (35.8%)
Prefer not to answer	8 (1.7%)	5 (3.3%)	0 (0%)	13 (1.7%)
Survey Difficulty				
Easy	170 (37.1%)	53 (35.1%)	57 (35.4%)	280 (36.4%)
Somewhat easy	178 (38.9%)	53 (35.1%)	60 (37.3%)	291 (37.8%)
Somewhat hard	88 (19.2%)	37 (24.5%)	37 (23.0%)	162 (21.0%)
Hard	22 (4.8%)	8 (5.3%)	7 (4.3%)	37 (4.8%)

Responses to Likert questions on attitudes towards inequality are presented in Figure 2-2. In the US (Canada), 72.7% (77.1%) of respondents viewed income inequality as too large and 30.9% (36.4%) believed that differences in income were due to personal effort. 79.8% (92.5%) of respondents agreed that the government should ensure that everyone has access to healthcare as a fundamental right, while 49.2% (41.8%) believed that individual choices were the primary reason for people to be unhealthy.

Figure 2-2: Response to Attitudinal Question on Individuals' Beliefs in Inequality

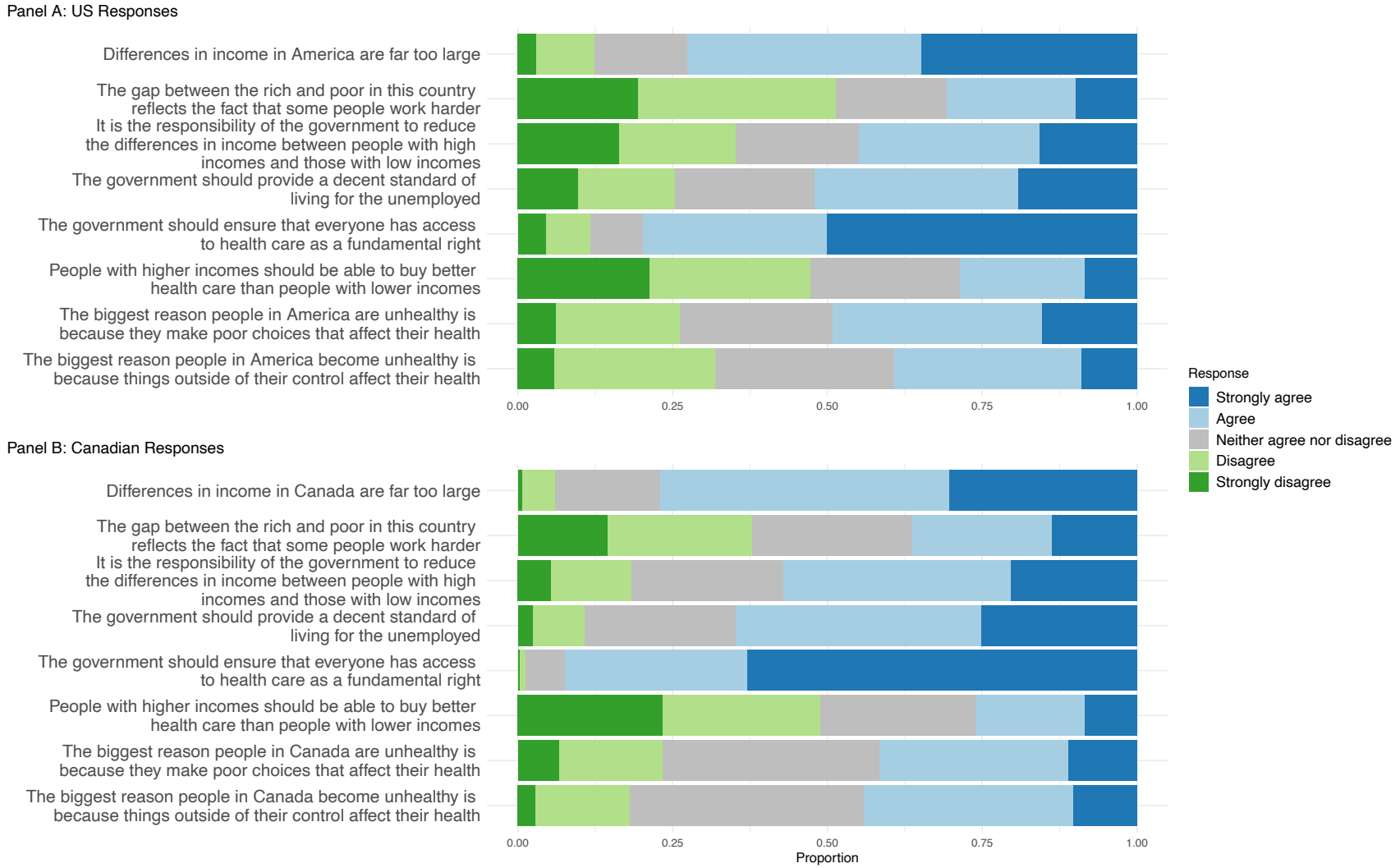


Figure Legend: Responses to attitudinal Likert questions show the proportion of respondents who agree and disagree with different views on the importance of inequalities and government action to address them.

2.3.1.1 Primary Analysis Results

Relative importance scores find that in both countries respondents showed considerable similarity in ranking the most preferred attributes (Figure 2-3). In the US, the highest-ranked attributes were reducing costs to individuals, increasing the number of individuals who could receive care, reducing disparities in access by income level, and improving access for people with severe diseases. In Canada, the most important attributes were reducing wait times and increasing the number of individuals who could be treated, improving access and outcomes for people with severe diseases, and reducing costs for individuals. In both countries, demographic-related variables were routinely ranked as less important than health benefit and system functioning related variables. Among those attributes framed as improving access or outcomes, attributes related to reducing disparities in access were almost always ranked higher than attributes related to reducing disparities in health outcomes. The more and less important attributes were largely consistent across survey frames (aFigure A.7-1 and aFigure A.7-2).

Figure 2-3: Relative Importance Scores of Best-Worst Scaling Attributes for the Dual Frame

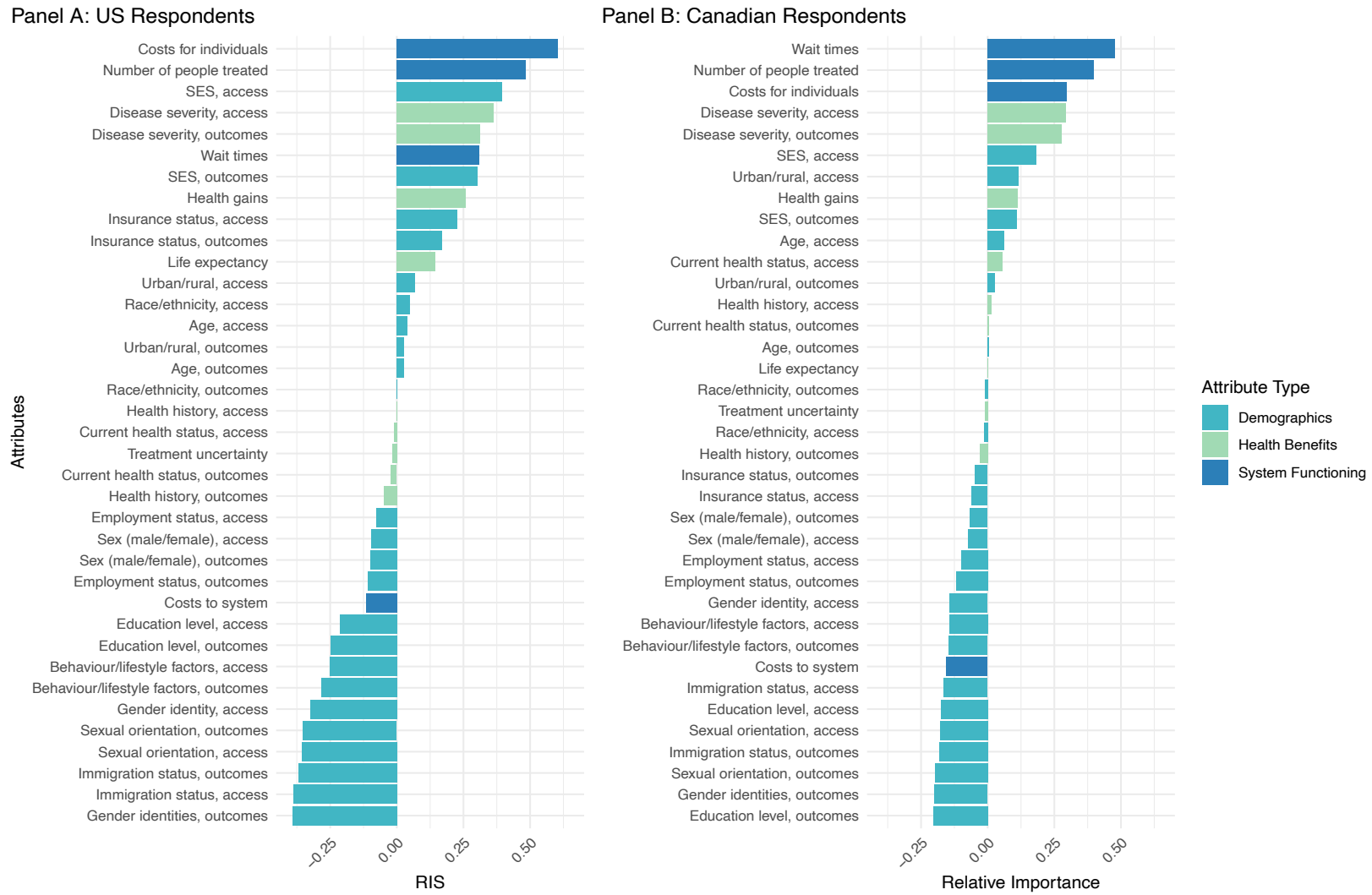


Figure Legend: Attributes are ranked by relative importance score with those at the top having higher relative importance and those at the bottom lower relative importance. Panel A presents results for the US respondents and panel B for Canadian respondents to the dual frame BWS survey. Attributes are colour coded by type.

In the US (Canada) 20.1% (16.4%) of respondents provided comments on individual choice tasks. These comments highlighted some difficulty respondents had in picking attributes (particularly the less important attribute). Reasons for selecting an attribute as more important included that it benefits a greater number of people than the other attributes presented, it represented a group that required more support, it appealed to the respondent's conception of fairness, or it had downstream effects on other attributes (Table 2-4). The reasons for selecting an attribute as less important included that the attribute selected was a small number of people, the attribute was antithetical to the values of the respondent, respondents believed that the attribute should not be considered in decision making, that the attribute seemed less important than others based on respondent's values, or that respondents lacked knowledge of any disparities regarding that attribute (Table 2-5).

Table 2-4: Reasons for Selecting More Important Attributes

Reason For Selecting Attribute	**Example Quote**
Attribute Benefits More People	"Timely treatment benefits everyone."
Attribute Needs More Support	"I think it's important to make it as easy as possible for people who have unhealthy behaviours or addictions to access healthcare. They are often anxious and afraid of being judged, and stressed by confronting issues."
Attribute Promotes Fairness	"Regardless of how much you make, you should have the same access to healthcare services."
Attribute Impacts Many Factors	"Insurance determines the care a person receives many times. For instance, I needed cataract surgery. My provider would only pay for traditional surgery but not the laser treatment, which has a better outcome."

Table 2-5: Reasons for Selecting Less Important Attributes

Reason For Selecting Less Important Attribute	Example Quote
Attribute Benefits Fewer People	"I am sure those with varied gender identities face issues for access, but I marked it as less important as they'd be one of the smaller grouping of populations compared to the rest listed."
Do Not Support Attribute	"Gender identity issues should be addressed with psychiatric care and counseling, not surgery and forcing society to pretend you are not what you are."
Attribute Should Not Matter in Decisions	"It shouldn't matter what the persons health behaviours are. We should all receive the same care"
Attribute Less Important than Others	"I also feel that gender identity is less important than just providing healthcare to all people who need it."
Not Aware of Disparities for that Attribute	"I don't believe there are great disparities between gender identities. Cost of healthcare is probably a number one problem which also ties into insurance premiums and deductibles."

2.3.1.2 Subgroup Results

Relative importance scores were generated for 36 subgroups from the 12 sociodemographic attributes. There was general consensus in the attributes selected as more important across the subgroups. Figure 2-4 shows the number of times an attribute was among the top five for a given subgroup. In the US and Canada, number of people treated, costs for individuals, and attributes related to disease severity appeared as a top attribute in all or almost all subgroups. Wait times were a top attribute for 34 subgroups in Canada, but only 10 in the US. Similarly, improving outcomes for people with severe diseases was in the top 5 important attributes for 29 subgroups in Canada, but only 13 in the US. Lists of the top five attributes for all subgroups are available in Appendix A.8.

Figure 2-4: Counts of the Top Five Attributes Ranked More Important Across Subgroups

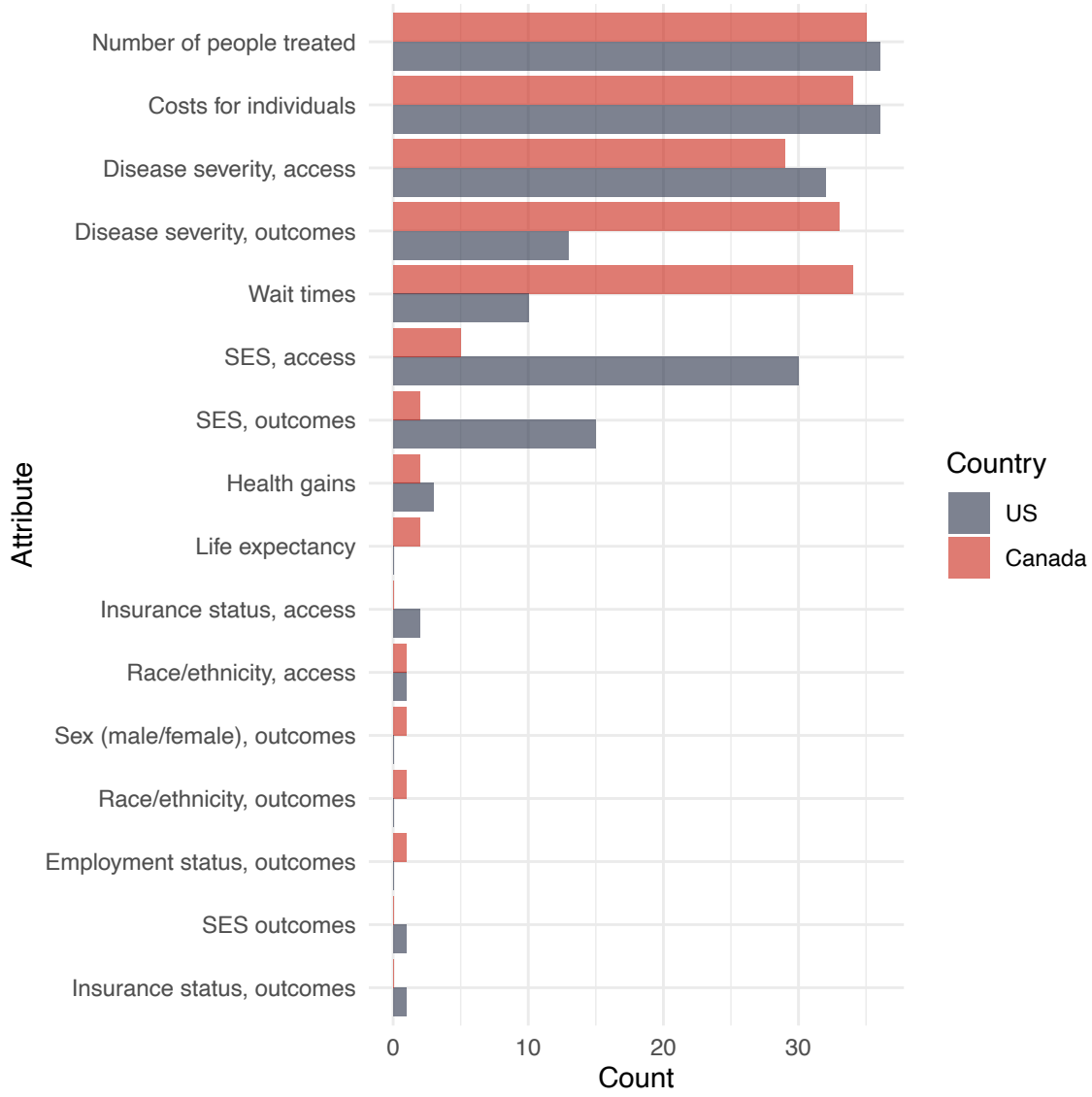


Figure Legend: Figure 4 presents the count of the number of times an attribute appeared among the top five most highly ranked attributes across the 36 subgroup categories (Appendix A.8). Counts of attributes from US subgroups are presented in blue and Canadian subgroups in red. The maximum number of times an attribute could appear in the top give was 36 times.

2.3.1.3 Latent Class Analysis Results

Based on model fit and coherence of class results, I identified two latent classes in Canada (Figure 2-5) and three in the US (Figure 2-6).

Figure 2-5: Preference Weights for Canadian Latent Classes

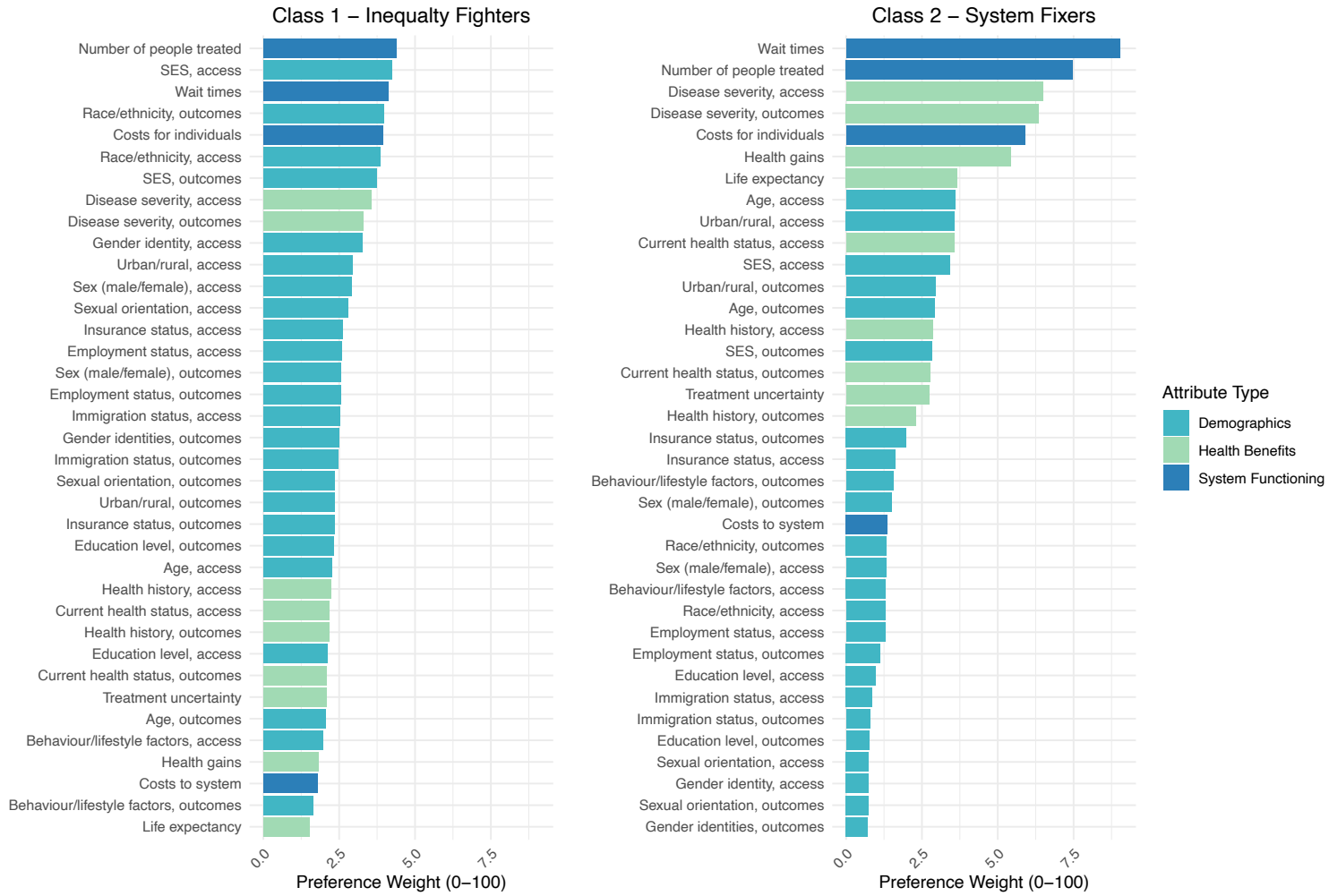


Figure Legend: Attributes are ranked by preference weights which sum to 100. Those attributes at the top having higher preference weight and those at the bottom lower weight. One figure is presented for each of the latent classes identified in the Canadian sample. Attributes are colour coded by type.

In Canada, I identified a group of "System Fixers" who valued attributes that targeted improvements to the system as a whole, such as increasing individual health gains, improving access and outcomes for people with more severe diseases, and improving population life expectancy. I also identified a group of "Inequality Fighters" who supported attributes that led to improvements for certain groups of people such as attributes related to socioeconomic status and race/ethnicity. Despite these differences, both groups prioritized increasing the number of people who could get treated, reducing costs, and reducing wait times. Demographics including age, employment status, marital status, and community type (rural/urban) and beliefs over inequality varied between the two groups (aTable A.9-2).

Figure 2-6: Preference Weights for US Latent Classes

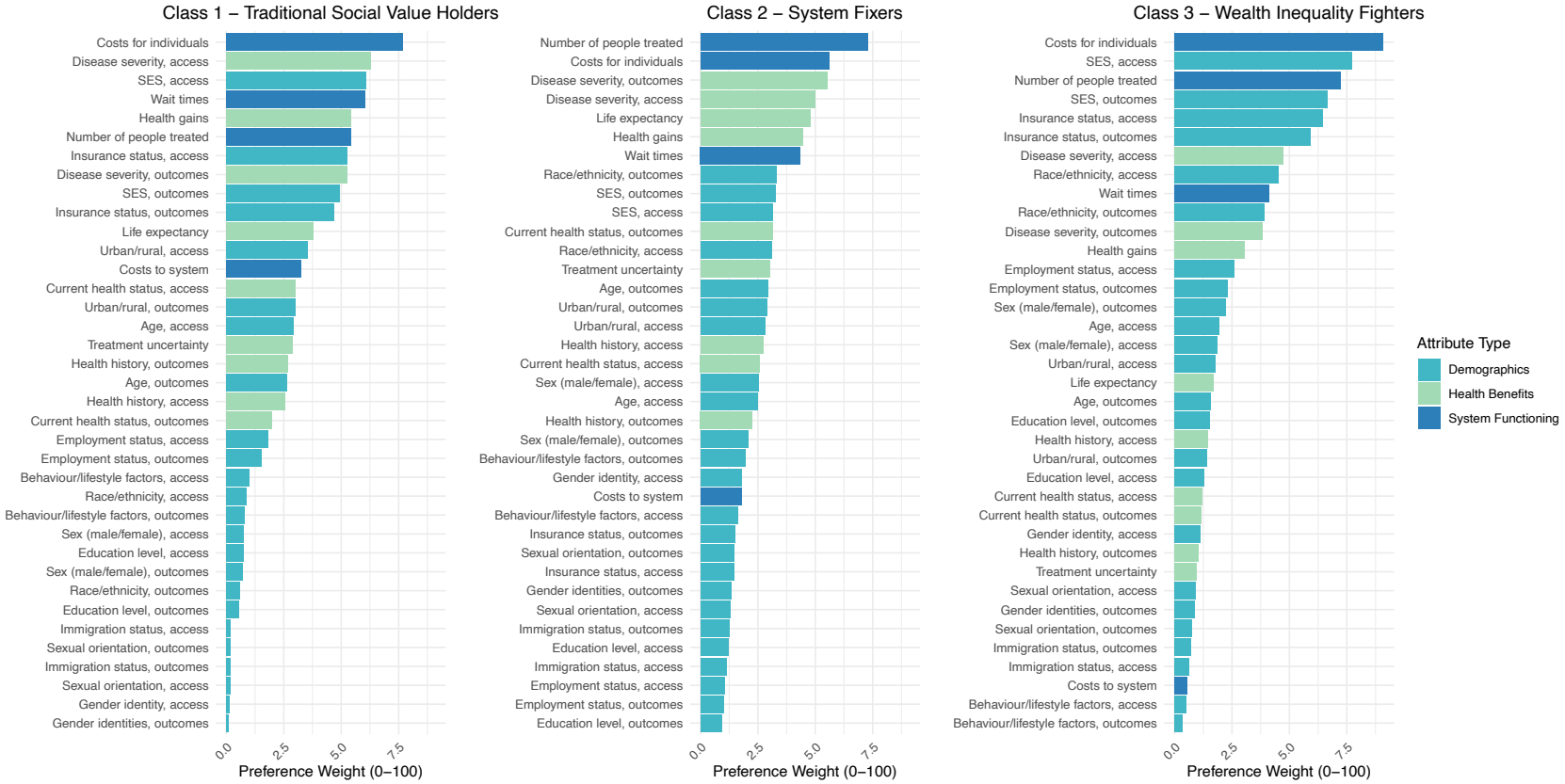


Figure Legend: Attributes are ranked by preference weights which sum to 100. Those attributes at the top having higher preference weight and those at the bottom lower weight. One figure is presented for each of the latent classes identified in the US sample. Attributes are colour coded by type.

In the US, the three latent classes identified included "Traditional Social Value Holders," "System Fixers" and "Wealth Inequality Fighters." As with the Canadian class structure, there was considerable overlap between the most important attributes, which included costs for individuals and the number of people treated and attributes related to disease severity and SES. Traditional Social Value Holders had similar top concerns as the other two classes but differentiated themselves in their least important attributes, which included attributes related to sexual orientation, sex and gender identity, and immigration status. Similarly to Canada, US System Fixers prioritized attributes that would impact large groups of individuals or improvements to the system as a whole like reducing wait times, improving health gains and increasing population life expectancy. Finally, Wealth Inequality Fighters are differentiated based on the importance they give to attributes like SES and insurance status as well as their attitudes towards inequality. In addition to their choices, the groups differed in their political viewpoints with Traditional Social Value Holders leaning more conservative (56.6%) while Wealth Inequality Fighters leaned more liberal (45.5%). The System Fixers were a largely bi-partisan group. Beyond political affiliation, the groups differ by age, income, employment status, and community type (rural/urban) (aTable A.9-1).

2.4 Discussion

This study presented a novel use of best-worst scaling for prioritizing equity dimensions within the context of resource allocation decision making. Stated preference surveys have been widely used to inform resource allocation decisions, but methods have focused on discrete choice experiments and patient or benefit trade-off studies. These previous studies have largely been limited to using a handful of attributes that may be important for decision making and few

provided robust justifications for the selection of those attributes.[74] Given the inherent complexity in prioritizing the allocation of healthcare resources, there are an expansive array of attributes that could be important to decision-makers and the general public. By using best-worst scaling, I identified attributes that were deemed particularly important to the general public. This work can directly inform future choice experiments in the US and Canadian contexts which seek to consider trade-offs in healthcare resource allocations.

I found robust preferences for prioritizing attributes related to system functioning. System functioning attributes including reducing wait times, reducing costs for individuals, and increasing the number of people who can get care were consistently prioritized in both countries. These findings echoed those of the focus groups where respondents highlighted the importance of improving access broadly and reducing barriers to care. Respondents were less willing to prioritize improving health outcomes or access by specific sociodemographic variables. The survey findings also echoed focus groups with respondents' emphasis on treating people equally regardless of race, gender, or socioeconomic status. Previous studies of the values Americans hold toward health and health disparities have found that people often center the role of individual's decisions and access to medical care in determining health.[156,157] These findings may indicate that the public is more supportive of efforts to improve equality than advance equity or that individuals may respond more to efforts to promote healthier communities rather than advance national equity.[156] Further research is needed to explicitly test for preferences towards equality and equity.

Despite these findings, the goal of treating all persons equally was not universal. Attributes related to some of the most marginalized communities – immigrants and people with gender identities different from those assigned at birth – were not given the same priority as more privileged groups. Some comments from respondents expressed transphobic and xenophobic views. These views are antithetical to the goals of health equity and justice and raise an important challenge to the use of population preferences for prioritizing improvements to health equity. For communities who are often pushed to the margins – undocumented immigrants and transgender persons – relying on population preferences will not engender the necessary action to address inequities.

Respondents' comments below each choice set provide insights into the reasoning why certain attributes were seen as more beneficial and others less beneficial. Reasons for selecting more important attributes included that they would impact a large number of people, provided knock-on effects on other attributes, they targeted communities that were particularly in need, or appealed to one's conception of fairness. This latter reason was often described in ways that correspond to the ideal of treating everyone equally. Respondents had similar reasons for selecting less important attributes: they did not affect many people, their effects might be limited, or they were not aware of a disparity for a given group. Some respondents described reasons for selecting a less important attributes that were at odds with each other, despite resulting in the same determination that an attribute was less important. For instance, a respondent might believe that one's health behaviours should not matter in prioritization settings and therefore ranked it as less important, while another respondent may have selected health behaviours as less important because they do not think the health system should prioritize individuals who have behaviours

that lead to poor health. This leads to a challenge in interpreting the results of less important attributes as the policy implications from these two reasons are different, despite arriving at the same result. This limits the application of less important attributes in decision making. Combining elicitation surveys with additional methods such as qualitative work,[158] Q methodology,[159] or moral reasoning exercises[160,161] could help to elucidate reasons for selecting more or less important attributes.

Respondent views are driven, at least in part, by their personal knowledge. Respondents in focus groups and survey comments described how personal experiences informed their decisions. It is possible that individuals' views might change were they to have additional information on health inequities and disparities. I explicitly designed the survey so as not to provide respondents with data on health disparities or other attributes. This was partly practical – as I included 37 attributes, expecting respondents to an online survey to review and understand background information or statistics on all attributes was unrealistic and could bias responses. If provided, background information could have influenced respondents through framing effects and other cognitive biases,[162,163] particularly if respondents were not completely focused on the background information. The decision was also motivated by an interest in understanding respondent perspectives based on their current knowledge. Previous research in the UK has found that respondents are more willing to make trade-offs to reduce health disparities and promote equity when they are more knowledgeable about health disparities.[164] However, by not providing additional information, these results provide a more representative view of population values.

The results described above demonstrate the valuable information for decision-making that can be gleaned from a best-worst scaling survey. However, modifications to the approach taken here could help to improve future applications of preference research when informing healthcare resource allocation and health equity decisions. Future studies should consider how to more explicitly include equity, rather than the more equality focused attributes described here. Additionally, more clearly defining a limited set of attributes could ease the cognitive burden on respondents when completing the choice task and aid in interpretability of the results. For instance, a future study might focus exclusively on attributes related to system functioning and improved access, providing respondents with vignettes that describe instances of limited access for the demographic attributes included. Best-worst scaling could also be combined with other study approaches, such as citizen juries or focus groups, which could help to ensure respondents are more informed of the potential implications of selecting different attributes. Alternatively, a survey that is more focused on a particular challenge in the healthcare system could result in a more limited and clearly defined set of attributes. These modifications may help to reduce the complexity of the choice task and improve validity but also limit the scope of the information that could be gleaned from the study. Balancing the complexity and information derived from future surveys should ultimately depend on the decision context being studied.

This study has important implications for researchers looking to value health equity for cost-effectiveness analysis. First, my findings point to multiple priorities that respondents viewed as important including system-wide changes such as reducing costs and wait times, targeting specific equity dimensions such as socioeconomic status, and prioritizing individuals with severe diseases. Given the multi-dimensional nature of health equity and the potential overlap with

attributes such as disease severity, equity-informative CEA methods will need to consider how to account for intersectional equity dimensions. Second, given the ranking of attributes related to access over those related to outcomes, CEA analysts who wish to consider population values should more directly consider the role of access to healthcare services and interventions in their modelling. Finally, there were multiple dimensions that focus group participants and respondents to other equity-efficiency trade-off surveys have prioritized that are challenging to incorporate into a cost-effectiveness framework, such as patient language ability or the navigability of the health system. Coupled with views of some survey respondents that were antithetical to the ideals of health equity, it is not possible for any given CEA to account for all attributes that the public may see as important or for the heterogeneity in equity preferences making it essential that equity-informative CEA results are considered in a larger decision-making framework.

2.4.1 Limitations

This study has multiple limitations. While I included a wide range of attributes which individuals and decision-makers may wish to use to target resource allocation, it is infeasible to include all attributes that decision-makers may wish to use in resource allocation decisions. For instance, previous choice experiments have included specific named health conditions (e.g. cancer and cardiovascular disease) or types of health services (e.g. preventive care and screening), but these were not included here as their format is more attuned to a profile or multi-profile best-worst scaling. Meanwhile, some attributes that were often discussed in focus groups, such as language barriers to accessing healthcare, were not included.

A related limitation is that I include attributes beyond those that are typical health equity dimensions. Doing so can provide decision-makers and analysts looking to implement equity-informative CEA with a broader understanding of how the public prioritizes a wide cross-section of changes to the healthcare system. However, it also increases the complexity for respondents. Increased complexity may lead respondents to use heuristics such as prioritizing system functioning attributes that are more familiar rather than grappling with the complexity of prioritizing specific equity-related dimensions.[165] Future experiments should consider how the combinations of attributes impacts how respondents prioritize different equity dimensions.

Finally, there are various considerations related to online fielding of the survey which must be acknowledged. First, the online convenience samples are not nationally representative. I attempted to match the demographic profile in the US on age, gender, race and ethnicity, and political affiliation, but I was limited to only targeting the Canadian survey by gender. Second, online surveys have known issues with attentiveness and fraudulent respondents. While I included attention checks and used additional pre-survey attention screening tools to exclude respondents who may be inattentive or fraudulently responding, some respondents may have not fully contemplated each choice set or provided responses they view as 'politically correct' rather than responses that most closely reflected their values. Further, respondents may have interpreted attributes differently, for instance some respondents may have confused the definitions of gender and sex. Future work should examine how convenience sample surveys correspond to other approaches to prioritize equity dimensions such as citizen juries and deliberative democracy,[166,167] as well as nationally representative surveys.

2.5 Conclusions

My findings highlight public preferences for equity in access, particularly emphasizing system-wide improvements, while equity in outcomes was of secondary concern. The most prioritized attributes included reducing costs and wait times, improving access and outcomes for people with severe disease or across socioeconomic strata. Efforts to quantify the value of health equity for cost-effectiveness analysis will need to grapple with how to consider the role of access to care and the intersection of multiple dimensions of equity.

Chapter 3 A Discrete Choice Experiment to Develop Direct Equity Weights for the United States and Canada

3.1 Introduction

Applications of equity-informative cost-effectiveness analysis require weights that quantify the extent to which improvements in health across equity-relevant subgroups are valued relative to overall gains in health.[168] These trade-offs can be quantified through social welfare functions or the use of direct equity weights to adjust the value of health gains and opportunity costs across the different subgroups of interest. While both approaches weight outcomes for different groups to reflect population preferences towards the distribution of health outcomes, these approaches differ in how they implement the weights. Social welfare function approaches elicit from respondents their degree of concern for those worse off to derive an ideal distribution of health which implies the weight placed on reducing health inequality, operationalized through an inequality aversion parameter.[39] Social welfare function approaches have used various dimensions to define those worse off, including quantiles of quality-adjusted life expectancy, income, and index of social deprivation.[74,80,87,98,134,169,170] Direct equity weights are an approach where the health gains and opportunity costs of groups of individuals are weighted more or less than others based on a defined set of equity dimensions.[71] The development of either type of these weights outside the UK and Europe is limited.[74,88,168] In the US, most studies have been focused on testing for the existence of equity preferences,[171-174] with some recent work eliciting inequality aversion estimates in Canada and the US.[80,98,170] Studies that have sought to develop direct equity weights for Canada and the US are non-existent.

Beyond the dearth of studies in the US and Canadian contexts, there are other limitations with previous studies that elicit inequality aversion parameters and direct equity weights.[74] First, studies conducted in other countries were often limited to convenience samples such as students, health policy experts, and researchers whose preferences may not match the general public. Second, while clear evidence exists that equity preferences vary within and across populations, there is a limited understanding of the characteristics associated with these differences. Studies have found evidence of bimodal distributions[98] or large proportions of individuals who fall into extreme ends of pro-rich or egalitarianism.[74,134] In some studies, gender, profession, income, and political affiliation are significant predictors of equity preferences.[74] However, there are conflicting results for these findings. Much of this conflict could be due to differences in the structure of the elicitations, the use of niche samples, elicitations conducted in different countries, or small sample sizes. A more rigorous examination of equity preferences using larger, more representative samples will help to address these research gaps.

In this chapter, I designed and fielded a discrete choice experiment (DCE) to elicit equity preferences in Canada and the US. I asked respondents to make trade-offs between two hypothetical health programs based on the attributes prioritized in Chapter 2. DCEs are a commonly used survey method in health economics.[74,81,85-87] DCEs are based on random utility theory.[175] Respondents are asked to state their preferences for an intervention, product or health state based on a series of attributes. Respondents are assumed to answer these questions by maximizing the utility of each choice. The DCE framework is ideal for generating preference weights as it quantifies the utility of changes in each attribute.[175] The utility of an increase or

decrease in one of the attributes of a choice can be expressed in QALYs, which enables the results of a DCE to be used to develop direct equity weights. The DCE structure is flexible, allowing the inclusion of various attributes and levels. Attributes can correspond to different equity dimensions with different levels that correspond to different groups that may face different types and degrees of disparities. DCEs can be used to estimate the utility of programs that are targeted to groups based on the intersection of multiple equity dimensions by comparing different levels across attributes. Determining equity weights based on combinations of these attributes is particularly important, given the intersectional nature of health disparities.[176] By fielding the same survey in Canada and the US, I explored questions of preference heterogeneity within and between the two countries. These countries serve as an ideal comparison set given their cultural similarities but divergent healthcare approaches.

3.2 Methods

This DCE adheres to the ISPOR Conjoint Analysis Task Force recommendations.[177] The survey was considered exempt human subjects research by the University of Michigan Institutional Review Board (HUM00235890) and as a minimal risk by the University of British Columbia Research Ethics Board (H23-02169). The full survey instrument is available on request.

3.2.1 Survey Development

As with the BWS survey described in Chapter 2, a DCE comprises three sections: respondent eligibility, the stated choice experiment, and sociodemographic characteristic and attitudinal questions. Eligibility questions ensured that the respondents met specific criteria for

inclusion in the experiment. In this study, eligibility was anyone 18 years or older and was handled by the survey research company.

The main body of the survey was the choice experiment. The development of the choice experiment required the identification of attributes, the setting of attribute levels, the identification of an efficient experimental design, survey preparation and piloting, data collection, and analysis.[178] Each of these steps is described in detail below.

The stated choice experiment comprised a set of instructions that explain the task, followed by a dominant alternative practice question, and then a series of 12 choice tasks. In each choice task (Figure 3-1), respondents were asked to imagine themselves as a member of an advisory board for their state or province/territory. One of their tasks was to select between two alternative health programs that the government could prioritize (Box 3-1). The dominant alternative practice question was used to identify respondents who did not have rational answers to the choice set or were not attentive to the trade-off scenarios (see Section 3.2.3.1). Below each choice task, respondents could provide comments explaining their choices.

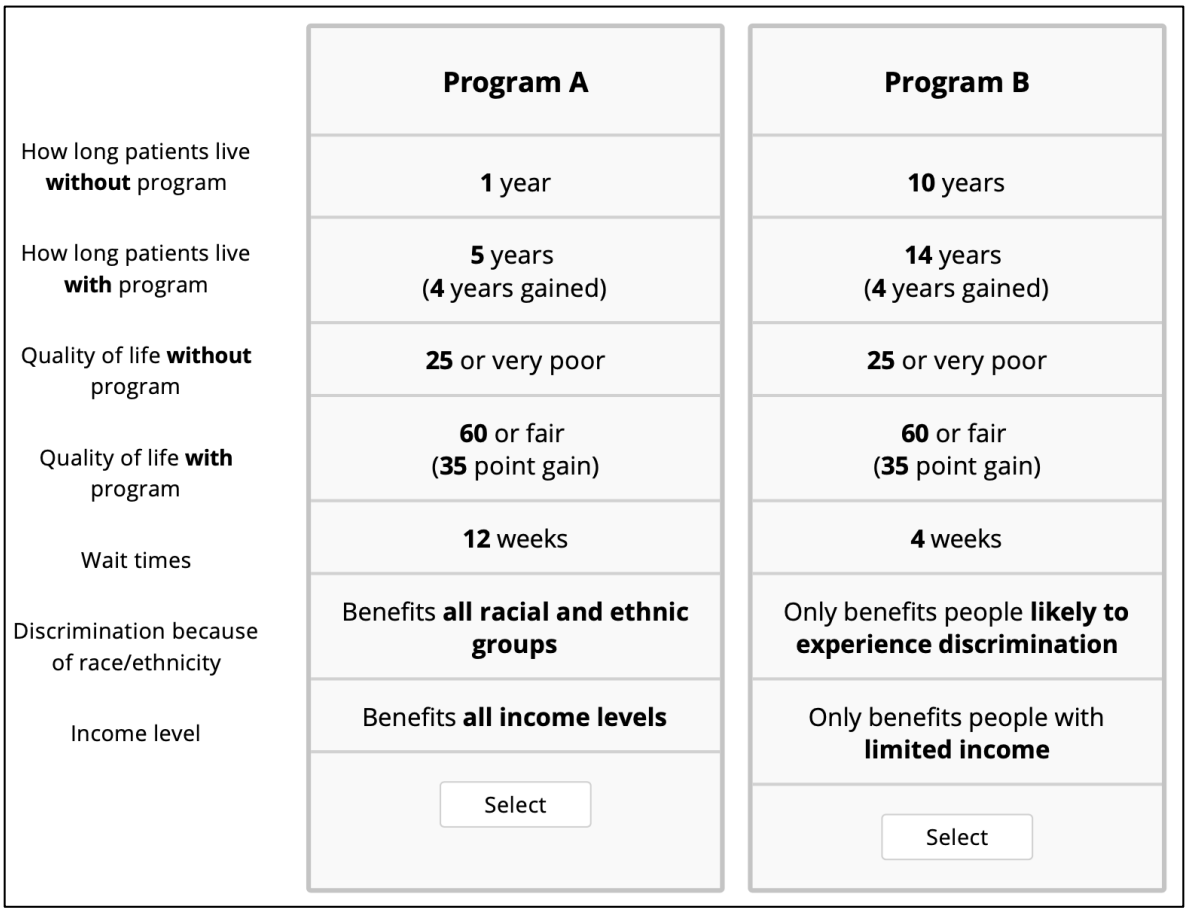
Box 3-1: Survey Prompts Describing Respondent Advisory Board Role

Canadian Survey:
Imagine you are a member of an advisory board for your provincial or territorial Ministry of Health. The goal of the advisory board is to make the health system in your province or territory fairer. Your job is to compare and choose health programs.

US Survey:
Imagine you are a member of a health advisory board for your state. The goal of the advisory board is to make the health system in your state fairer. Your job is to compare and choose health programs.

After completing the choice task, respondents answered questions about their sociodemographic characteristics and a series of attitudinal questions on their beliefs about inequality and the causes of poor health.

Figure 3-1: Example Discrete Choice Experiment Choice Task



3.2.1.1 Attribute and Level Selection

Given the wide array of potential dimensions of health equity that could be operationalized in a DCE, I utilized the results of the BWS described in Chapter 2 to identify relevant attributes for inclusion in the DCE. I identified important attributes for the DCE following the criteria outlined by Webb et al.:[179]

1. Most attributes should be anticipated to be highly important in participants' decision making.
2. DCE results would address the research project's specific aims.
3. DCE attributes should form coherent and realistic descriptions.
4. The number of attributes should be small enough that the cognitive burden would be reasonable and that models could be estimated given the expected sample size.

Criteria 1 was assessed using relative importance scores from the BWS. Criteria 2 was implemented based on a holistic review of the dissertation plans and future research goals. Criteria 3 and 4 were informed by the results of Chapter 2 and further assessed through pretesting and pilot testing.

Attributes most anticipated to be highly important to decision making were the top attributes in the BWS by relative importance score for the base results and across all subgroups and latent classes included in the analysis. The top five attributes from each of these 36 subgroups were examined to ascertain if top-ranked attributes differed across specific populations (Figure 2-4).

The final selection of attributes for the DCE was made based on the subgroup analysis of relative importance scores, cohesion with focus group findings, coherence of the final DCE choice task, comprehensibility of attributes and levels, the relevance of attributes in a cost-effectiveness setting, and their ability to be operationalized in modelling exercises.

Based on these factors, I selected health outcome, disease severity, wait times, race and ethnicity, and socioeconomic status as the attributes for inclusion in the DCE. Attributes and levels are presented in Table 3-1. The health outcome attribute was necessary to include to generate equity weights that could be applied to the health benefits and opportunity costs in a cost-effectiveness analysis. Disease severity, wait times and socioeconomic status were all highly ranked attributes in the BWS. Disease severity is increasingly considered as a metric for prioritization within and beyond cost-effectiveness analysis.[180] Differences in access and health outcomes by socioeconomic status are a substantial equity issue broadly and in tobacco control specifically. Finally, race and ethnicity were included, given the centrality of race and ethnicity in how health equity is conceptualized in the United States.[181,182]

Table 3-1: Discrete Choice Experiment Attributes, Descriptions, and Levels

Attribute Name	**Attribute Description**	**Levels**
Baseline Life Expectancy	Number of years patients will live if they do not get the program.	1; 4; 8; 10 years
Baseline Quality of Life	Patients' quality of life if they do not get the program.	25 or very poor; 50 or poor; 75 or moderate
Final Life Expectancy	Number of years patients will live if they get the program	2; 5; 9; 12; 14; 18 years
Final Quality of Life	Patients' quality of life if they get the program.	30 or very poor; 45 or poor; 55 or poor; 70 or moderate; 85 or good; 95 or very good
Wait times	The length of time patients wait for the program.	4; 8; 12 weeks
Discrimination because of race/ethnicity	If the program benefits patients who experience discrimination because of their race or ethnicity in their daily lives.	1) Benefits all racial and ethnic groups 2) Only benefits people likely to experience discrimination 3) Only benefits people unlikely to experience discrimination
Income level	The income level of patients who receive the program.	1) Benefits people of all income levels 2) Benefits only people with limited income 3) Benefits only people with higher income

There were multiple ways that these five attributes could be presented to respondents. Attribute descriptions and levels were developed through an iterative process based on the recommendations of Coast et al.[148,183] Coast recommends a two-stage process for attribute development, which includes conceptual development of attributes followed by refinement of language to convey the intended meaning.[148] The conceptual development is outlined below, while the refinement of language took place in the pretesting and pilot testing process described in Section 3.2.1.3.

The conceptual development of the attributes was informed by the literature and results from Chapter 2. First, a list of potential approaches to operationalize each attribute was developed based in part on previous DCEs to value health equity,[74] focus group discussions reported in Chapter 2, and comments respondents left on the BWS exercise. The list was reviewed by committee members, and an initial set of attributes and levels was developed. Levels were set with the decision context in mind. For continuous variables, the levels were selected to provide a wide range of potential outcomes while remaining realistic for respondents. For categorical variables, I sought to create meaningful and cohesive sets of attributes.

To generate equity weights in terms of QALYs, both the disease severity and health outcome attributes were split into quality of life and length of life. The disease severity or baseline health attribute was operationalized as length of life without the program and quality of life without the program. Health outcome or final health was operationalized as the length of life with the program and quality of life with the program. The attribute was presented to respondents as a final health value and the improvement from baseline. In all programs, final health was

always the same or better than baseline. The attributes were coded as continuous levels with length of life presented in years and quality of life on a 0-100 scale with 100 representing perfect health and 0 representing death to correspond to the QALY scale. Levels were selected that covered a range of hypothetical illnesses and treatments with large or small improvements to the length and quality of life for people with more or less severe diseases. This specification of the attributes enabled the calculation of QALYs gained in the hypothetical program as:

$$QALY_{gain} = Final\ LE\ \times \frac{Final\ QoL}{100} - \ Baseline\ LE\ \times \frac{Baseline\ QoL}{100}$$

(Eq. 3-1)

Wait times were described as the length of time individuals need to wait to benefit from the program. Wait time levels were coded as continuous and set to be short enough to be realistic to US respondents but long enough to reflect longer wait times in the Canadian healthcare setting.[184,185] Wait time levels were short enough to avoid concern that patients may die before receiving a program.

The primary equity dimensions included in the DCE to generate direct equity weights were race/ethnicity and socioeconomic status. Race/ethnicity was operationalized as discrimination because of race and/or ethnicity. Race and ethnicity are often operationalized in quantitative research in health sciences in a way that draws artificial lines between racial groups, thereby suggesting biological or behavioural differences between groups as the drivers of poor health.[186,187] However, research has demonstrated that racism and not race is generally the driving factor in determining poor health between racial groups.[181,182] As such, I operationalized race and ethnicity in this DCE as discrimination on the basis of race and/or ethnicity, given that

the role of an equity-informative analysis is to remediate the causes of inequities through differential resource allocation. Socioeconomic status was operationalized as income level. Respondents were informed that the hypothetical program could benefit people of different income levels.

Informed by focus group discussions, comments left in the BWS, and discussions with pretesters, the levels for the income level and discrimination because of race and/or ethnicity attributes followed the same general structure: 1) the program does not target based on the attribute, 2) the program targets a marginalized group, and 3) the program targets an advantaged group. These levels allowed for a comparison of targeted approaches to combat health inequities while also allowing respondents to compare programs that are not targeted to specific groups of people, enabling respondents to express preference for treating people equally regardless of the equity dimensions of income or race/ethnicity. The inclusion of a level that does not target based on the attribute is a deviation from the typical use of categorical levels that are mutually exclusive and collectively exhaustive. This level was included to reflect the views expressed in focus groups, BWS comments, and discussions with pretesters that described a reticence to make allocation decisions based on sociodemographic factors. It also creates a more realistic choice set for respondents, as healthcare resource allocation decisions rarely apply to mutually exclusive and collectively exhaustive groups at the intersection of income and discrimination.

3.2.1.2 Experimental Design

The experimental design of a DCE refers to the combinations of attribute levels that a respondent selects between. The number of attributes, levels, and alternatives included in the

DCE and the number of parameters to be estimated in the model dictate how the experiment is designed.[188,189] I used a purpose-built choice modelling software, Ngene,[190] to identify an efficient design using the modified Federov algorithm for determining the D-optimal experimental design.[191]

Given the complexity of the choice experiment, where respondents needed to consider seven attributes, I used an efficient partial profile design where three attribute levels were fixed between the alternatives in each choice set.[192-194] An efficient design is a design that captures a large amount of statistical information. An efficient design can be measured through its D-error, the determinant of the variance-covariance matrix, where the lower the D-error, the more efficient the design.[195-197] Ngene iterated over potential partial profiles to identify choice set combinations that result in a lower D-error based on a set of estimated prior coefficients for the attributes in the choice experiment. The complete experimental design is available in Appendix B.1.

3.2.1.3 Pretesting and Pilot Testing

The survey was pretested (n=19) with researchers and members of the general public with online versions of the survey to ensure the choice tasks were realistic and to test comprehension and readability of the survey. Pretesting used a co-design method where respondents were asked to comment on ways to improve the survey.[150] Pretesting was also used to iterate levels and attribute descriptions.

Multiple rounds of pilot testing were undertaken in each country (US n = 318; Canada n=264). Results from the pilot testing were analyzed to ensure the validity of the analysis plan as well as to generate parameter estimates needed for the efficient experimental design and to determine an adequate sample size. Minor changes to the wording of attribute descriptions and levels were implemented after pilot testing to clarify aspects of the choice task.

Initial estimates of the parameter values from pilot testing results were used to generate the efficient design for future pilot tests and the final fielding. The same survey design was used in both Canada and the United States.

3.2.2 Data Collection

The survey was fielded online to panels of adults (18+) in the US and Canada in December 2024 and January 2025. Once again, CloudResearch's Connect platform was used for the US sample with quotas to ensure a diverse sample in terms of age, gender, race and ethnicity, and political affiliation, which were matched to the US census for demographic variables and Gallup data on political affiliation.[151] The Canadian survey was administered using Sago's Asking Canadians panel, which has quotas that match the national demographics of Canada based on age, gender, income and education level.

Respondents received incentives for completing the survey. In the US, respondents who completed the survey were paid $4. In Canada, respondents could receive various different incentives from the survey vendor, such as airline points, that were scaled to the survey length.

The sample size needed to estimate the main effects for the choice experiment was estimated using Ngene.[198,199] Ngene calculated the minimum sample size needed to estimate each parameter of the model at a statistically significant level based on the design of the choice experiment and estimated priors. To ensure an adequate sample to test for heterogeneity in responses, I selected a total sample size that would enable subgroup analyses based on the quotas for different sociodemographic characteristics, including gender, age, race, income level, and political viewpoint.

3.2.3 Data Analysis

The analysis of the stated preference responses was conducted in three parts. First, conditional logit models were used to assess the importance of different attributes and their levels in estimating choice probabilities. Second, I calculated the marginal rate of substitution between equity groups to generate direct equity weights. Finally, I conducted analyses to understand heterogeneity in equity preferences. Analyses were conducted in R version 4.4.2 using the choice modelling package Apollo.[200]

3.2.3.1 Analytic Sample

The use of two distinct survey vendor panels with differing respondent recruitment, compensation, and security protocols resulted in samples with markedly different data quality. Respondents were excluded from the primary analysis if they 1) did not complete the survey; 2) failed the attention check question where they were asked to select “strongly agree” from a Likert scale; 3) provided inconsistent demographic information; 4) stated they did not understand the survey task; 5) failed the two part dominant alternative question (described below); 6) stated

they lived in a different country than the survey was being fielded in; 7) left a comment indicating they struggled to understand the survey task, rejected the premise of the task, or left multiple comments not relevant to the task; or 8) completed the survey in <1/3 the median completion time. While most of these follow standard approaches to remove inattentive or fraudulent respondents, the exclusion of comments unrelated to the choice task was added given a number of respondents who left these types of comments, particularly in the Canadian sample which also had more rushers, and inattentive respondents (Appendix B.2 – B.4).

In the dominant alternative check, respondents were asked to select between two programs that varied in terms of baseline and final health where one program had poorer baseline health and better final health, making it superior to the other intervention (B.5). If the respondent selected the dominated program, they were asked to reconsider their answer and provide a justification for their choice. Individuals who selected the dominated program twice were excluded in the primary analysis.

3.2.3.2 Conditional Logistic Regression Models

As with BWS, responses from a DCE are modelled within a random utility framework where the utility, *U*, of alternative *i* for respondent *n* is based on some deterministic part, *V*, and a random error, ε.[175,201]

$$U_{n,i} = V_{n,i} + \varepsilon_{n,i} \quad \text{(Eq. 3-2)}$$

The probability, *P*, of a given choice *i* from alternative choices *j* by respondent *n* is then given by:

$$P_{n,i} = P(V_{n,i} + \varepsilon_{n,i} \geq V_{n,j} + \varepsilon_{n,j} \; \forall j)$$

(Eq. 3-3)

The deterministic portion of the utility value is specified during the analysis to evaluate the role of the alternatives, attributes, decision-maker, and choice setting. The deterministic portion can be estimated as follows:

$$V_{n,i} = f(x_{n,i}, z_n, \beta)$$

(Eq. 3-4)

where $x_{n,i}$ are the attribute levels for alternative *i* as seen by decision-maker *n*; z_n are the characteristics of decision-maker *n*; and β is a vector of estimated parameters. The probability of choice *i* being chosen compared to alternatives *j* can then be modelled using conditional logit models:

$$P_{n,i} = \frac{e^{\mu V_{n,i}}}{\sum_{j=1}^{J} e^{\mu V_{n,j}}}$$

(Eq. 3-5)

Since the survey used here only presented two alternatives in a forced-choice experiment, *J*=2.

Within this framework, multiple value functions could be used to estimate the utility of each hypothetical program. Different respondents may use different value functions where combinations of and interactions between attributes differ across respondents when evaluating the hypothetical healthcare programs. For instance, some respondents care about the magnitude of the health improvement, while others may care about final health; some respondents may care about wait times as a proportion of life expectancy, while others may care about them in absolute terms. As such, it is essential to compare multiple utility functions that account for different approaches to valuing the health interventions to determine how they may impact the final equity weights. I compared multiple functional forms and selected final models based on fit (AIC and

BIC), interpretability, and concordance with project aims. I included four different utility functions here (Table 3-2), with Model 3 serving as the primary model for the equity weighted analysis in Chapter 4 given its adherence to the zero-condition for the QALY model (see below).

Table 3-2: Utility Function Model Specifications Used to Analyze DCE Results

Model 1: An additive model with baseline and final health outcomes	**Model 2:** An additive model with QALYs gained and baseline health	**Model 3:** An interactive model with QALYs gained and baseline health	**Model 4:** An interactive model with QALYs gained and polynomials for baseline health
Constant	Constant	Constant	Constant
Baseline Length of Life	Baseline Length of Life	Baseline Length of Life* QALYs gained	Baseline Length of Life* QALYs gained
			Baseline Length of Life^2* QALYs gained
Baseline Quality of Life	Baseline Quality of Life	Baseline Quality of Life* QALYs gained	Baseline Quality of Life* QALYs gained
			Baseline Quality of Life^2 * QALYs gained
Final Length of Life	QALYs Gained	QALYs Gained	QALYs Gained
Final Quality of Life			
Wait time	Wait time	Wait time*QALYs gained	Wait time*QALYs gained
Discrimination, Unlikely (Reference Group)	Discrimination, Unlikely (Reference Group)	Discrimination, Unlikely*QALYs gained (Reference Group)	Discrimination, Unlikely*QALYs gained (Reference Group)
Discrimination, All groups	Discrimination, All groups	Discrimination, All groups*QALYs gained	Discrimination, All groups*QALYs gained
Discrimination, Likely	Discrimination, Likely	Discrimination, Likely*QALYs gained	Discrimination, Likely*QALYs gained
Income, High (Reference Group)	Income, High (Reference Group)	Income, High*QALYs gained (Reference Group)	Income, High*QALYs gained (Reference Group)
Income, All incomes	Income, All incomes	Income, All incomes*QALYs gained	Income, All incomes*QALYs gained
Income, Limited	Income, Limited	Income, Limited*QALYs gained	Income, Limited*QALYs gained

The most basic value functions for choice modelling are additive, in which the utility from a change in a single attribute is considered independent of all other attributes. In Model 1, the baseline and final health outcomes as well as wait times are coded as continuous variables

and discrimination experience and income level are dummy-coded categorical variables with separate effects for each attribute level. In dummy coding, the utility contribution of one level of the categorical variable is set to zero in all cases. I set the most privileged group (higher income and unlikely to experience discrimination due to race/ethnicity) as the reference level equal to zero. While comparable to effects coding in the estimation of main effects,[202] dummy coding is less prone to misinterpretation in the interaction models,[203] and better represents the relationship between attributes that are not mutually exclusive.

The additive model with baseline and final health outcomes cannot be used to generate QALY weights. This model can produce the same number of QALYs gained with multiple combinations of baseline and final health attribute levels that result in differing utility estimates. Instead, baseline and final health attributes must be converted into quality-adjusted life expectancy (QALE) and QALY gains are calculated as the difference between baseline and final QALE (Eq. 3-1). In Model 2, I estimate utility based on baseline health, QALYs gained, wait times and equity dimensions.

Some in the literature have suggested that the additive model does not accurately reflect decision-making processes in health as it can create scenarios in which there is a utility gain from a program that does not have any impact on health, or that could even reduce health; this is known as the zero-condition in the QALY model.[204-206] As such, researchers have proposed using interactive models where the gain in QALYs from a hypothetical program is interacted with all other attributes in the model – therefore, as QALYs tend towards zero, the utility of the

program also tends towards zero. In Model 3, I interact QALYs gained with all other attributes included in Model 2.

Finally, respondents may have non-linear preferences in health gains. To test for this, I explored a range of models that include polynomials to account for non-linearity in attribute levels. In Model 4, I include quadratic terms on baseline life expectancy and quality of life.

For each model, I report the estimated coefficients of the models for each country and the estimated utility of each hypothetical health program presented to respondents in the DCE.

3.2.3.3 Generating Direct Equity Weights

Multiple approaches to generate equity weights have been described in the literature. The two primary approaches are based on compensating variation[207] and the marginal rate of substitution.[204] Here, I applied the marginal rate of substitution approach. In this approach, I estimated the marginal utility of a one QALY gain for any combination of *X* attributes as:

$$\frac{\delta U}{\delta QALY} = \alpha + \beta X'$$

(Eq. 3-6)

The utility of a QALY gained in an equity group, *g*, was divided by the utility of a QALY gained in a reference group, *r*, to determine the marginal rate of substitution between the reference group and equity group:

$$E = \frac{\alpha + \beta' X'_g}{\alpha + \beta' X'_r}$$

(Eq. 3-7)

I estimated equity weights for fixed baseline life expectancy (4 years), baseline quality of life (60 points) and wait times (4 weeks) while varying the equity dimensions of income and likelihood to experience discrimination. I estimated the utility and equity weights for four groups based on the intersection of income and discrimination attributes:

1. Unlikely to experience discrimination and higher income (reference group)
2. Unlikely to experience discrimination and limited income
3. Likely to experience discrimination and higher income
4. Likely to experience discrimination and limited income

I selected the higher income and unlikely to experience discrimination group as the reference group as the goal of equity weighting exercises is to differentially value the health of those who are worse off in society and achieve outcomes close to those of the most privileged group. I compared equity weights for three different utility functions (Models 2-4 above). The delta method was used to estimate 95% confidence intervals for the estimated utility and equity weights for each of the four groups.[208]

The weight can be interpreted as the number of QALYs in the reference group that respondents are willing to forgo for one QALY gained in the equity subgroup. A value greater than 1 means that one QALY gained in the equity subgroup is more highly valued than one QALY gained in the reference group. The opposite is true for a weight less than 1.

3.2.3.4 Analyses of Heterogeneity

I conducted various exploratory analyses to test for heterogeneity in equity preferences. I estimated separate versions of Model 1 and Model 2 for equity-relevant subgroups (based on

income level and race/ethnicity) to explore in-group preferences. I also explored differences in preferences based on attitudes toward income inequality and political viewpoints by fitting Model 1 and Model 2 to each attitudinal group.

3.2.3.5 Latent Class Analysis

Finally, I conducted a latent class analysis to identify groups of respondents with similar preferences. The latent class analysis (LCA) for a DCE follows the same framework as described in Section 2.2.4. The analysis enabled the identification of underlying groups of respondents who share preferences.[153] The LCA is a two-part estimation process where I first estimated the probability that a respondent falls into a class of respondents with similar answers to the DCE questions, and then I applied conditional logit models to understand preferences within each latent class. While class membership was estimated probabilistically, I assigned respondents to the classes in which they had the highest probability of membership. I estimated the coefficients of choice set attributes using the additive QALY model (Table 3-2 Model 2). I tested various numbers of latent classes (2 to 9) and selected the final class structure based on model fit using BIC and interpretability of the fitted conditional logit models. I compare the demographic composition of classes and report conditional logit models for each of the latent classes. The R package PoLCA was used to estimate latent class membership, while Apollo was used to fit conditional logit models.

3.3 Results

A total of 1203 and 1066 respondents were included in the US and Canadian analytic samples, respectively. Respondent demographics are reported in Table 3-3. The primary reason

for exclusion from the sample was failing to complete the survey for both the US (n=51) and Canadian (n=465) samples. Poorer data quality from the Canadian sample resulted in substantially more respondents being excluded because of inattentiveness and protest comments (AppendicesB.2 – B.4).

Responses to Likert questions on attitudes towards inequality are presented in Figure 3-2. Similarly to the results in Chapter 2, 75.7% (76.2%) of US (Canada) respondents viewed income inequality as too large, and 27.0% (42.8%) believed that differences in income were due to personal effort. 81.0% (91.7%) of respondents agreed that the government should ensure that everyone has access to healthcare as a fundamental right. In comparison, 74.4% (82.8%) believed that the government has a responsibility to ensure everyone has a fair chance to live a long and healthy life.

Figure 3-2: Responses to Discrete Choice Experiment Attitudinal Questions



Figure Legend: Responses to attitudinal Likert questions show the proportion of respondents who agree and disagree with different views on the importance of inequalities and government action to address them.

Table 3-3: Discrete Choice Experiment Respondent Demographics

	US Respondent	**Canadian Respondents**
Characteristic	**N = 1,203**	**N = 1,066**
Age		
Mean (SD)	45.1 (15.9)	48.4 (16.8)
Median (Q1, Q3)	45.0 (30.0, 60.0)	47.0 (34.0, 63.0)
Age Group		
18-34	436 (36%)	296 (28%)
35-54	391 (33%)	366 (34%)
55+	376 (31%)	404 (38%)
Gender		
Female	616 (51%)	535 (50%)
Male	581 (48%)	521 (49%)
Other	4 (0.3%)	7 (0.7%)
Prefer not to answer	2 (0.2%)	3 (0.3%)
Income		
Less than $50k	436 (36%)	342 (32%)
$50k - $100k	434 (36%)	436 (41%)
$100k or more	317 (26%)	272 (26%)
Prefer not to answer	16 (1.3%)	16 (1.5%)
Race/Ethnicity		
Non-Hispanic White	669 (56%)	695 (65%)
Black	185 (15%)	76 (7.1%)
Asian	87 (7.2%)	162 (15%)
Hispanic	181 (15%)	11 (1.0%)
Multi-Racial	68 (5.7%)	27 (2.5%)
Other Race	6 (0.5%)	46 (4.3%)
No answer	7 (0.6%)	49 (4.6%)
Political Viewpoint		
Conservative	395 (33%)	314 (29%)
Centrist or neutral	253 (21%)	240 (23%)
Liberal	475 (39%)	347 (33%)
Neither conservative nor liberal	72 (6.0%)	121 (11%)
Prefer not to say	8 (0.7%)	44 (4.1%)
Education		
High school or less	139 (12%)	227 (21%)
Some college or associate's	391 (33%)	330 (31%)
College or more	673 (56%)	509 (48%)
Employment Status		
Employed, FT	637 (53%)	526 (49%)
Employed, PT	188 (16%)	146 (14%)
Retired	160 (13%)	237 (22%)
Student	47 (3.9%)	41 (3.8%)
Not employed	120 (10.0%)	81 (7.6%)
Other	51 (4.2%)	35 (3.3%)
Marital Status		
Single, never married	454 (38%)	328 (31%)

Married or domestic partnership	552 (46%)	577 (54%)
Formerly married	192 (16%)	152 (14%)
Prefer not to answer	5 (0.4%)	9 (0.8%)
Health Status		
Ex/VG/G	996 (83%)	876 (82%)
Fair/Poor	207 (17%)	190 (18%)
Rural/Urban		
Large city	310 (26%)	456 (43%)
Suburb	506 (42%)	336 (32%)
Small city	238 (20%)	205 (19%)
Rural area	149 (12%)	69 (6.5%)
Household Size		
Mean (SD)	2.5 (1.4)	2.4 (2.2)
Median (Q1, Q3)	2.0 (1.0, 3.0)	2.0 (1.0, 3.0)
Survey Difficulty		
Easy	706 (59%)	819 (77%)
Hard	497 (41%)	247 (23%)

3.3.1 Primary Results

3.3.1.1 Conditional Logit Models

The results of the additive models are presented in Table 3-4, and the results of the interactive models are presented in Table 3-5.

In the US, Model 1 (Table 3-4) results show preferences for treating those with poorer baseline health (lower baseline length of life and quality of life) and higher final health. Shorter wait times were preferred. Programs that targeted all income levels and racial or ethnic groups were more preferred than those that targeted less privileged groups (limited income or likely to experience discrimination) which in turn were more preferred than programs targeting the more privileged groups. The results for the Canadian sample mirrored those of the US sample, with the exception of the likely to experience discrimination coefficient, which was negative in the Canadian sample, indicating lower utility gains in programs that target that group relative to those unlikely to experience discrimination.

Similar results were seen for Model 2 (Table 3-4) where programs with greater QALY gains were preferred, as were those that benefited individuals with lower baseline life expectancy in both Canada and the US. Again, programs that targeted all income levels and racial or ethnic groups were most preferred in both countries but those likely to experience discrimination were prioritized less than those unlikely to experience discrimination in Canada. The results also suggested preferences for higher baseline quality of life and longer wait times.

Table 3-4: Conditional Logit Models for Additive Utility Functions

	Model 1: Baseline and Final Health Outcomes				**Model 2: QALY Gain**			
	US Survey		**Canadian Survey**		**US Survey**		**Canadian Survey**	
Attribute	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value
Constant	0.476 (0.044)	0.000	0.209 (0.042)	0.000	0.351 (0.043)	0.000	0.208 (0.044)	0.000
Baseline Length of Life	-0.181 (0.008)	0.000	-0.076 (0.007)	0.000	-0.059 (0.004)	0.000	-0.010 (0.004)	0.012
Baseline Quality of Life	-0.012 (0.001)	0.006	-0.002 (0.001)	0.006	0.006 (0.001)	0.000	0.006 (0.001)	0.000
Final Length of Life	0.203 (0.007)	0.000	0.108 (0.007)	0.000	—	—	—	—
Final Quality of Life	0.038 (0.001)	0.000	0.018 (0.001)	0.000	—	—	—	—
QALYs Gained	—	—	—	—	0.279 (0.012)	0.000	0.149 (0.011)	0.000
Wait time	-0.012 (0.004)	0.001	-0.005 (0.004)	0.161	0.020 (0.004)	0.000	0.013 (0.004)	0.001
Discrimination, Unlikely	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Discrimination, All groups	0.536 (0.030)	0.000	0.222 (0.031)	0.000	0.605 (0.031)	0.000	0.256 (0.030)	0.000
Discrimination, Likely	0.204 (0.031)	0.000	-0.062 (0.031)	0.044	0.158 (0.030)	0.000	-0.098 (0.030)	0.001
Income, High	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Income, All incomes	1.321 (0.052)	0.000	0.815 (0.052)	0.000	1.166 (0.052)	0.000	0.779 (0.053)	0.000
Income, Limited	1.004 (0.031)	0.000	0.608 (0.030)	0.000	0.920 (0.032)	0.000	0.562 (0.029)	0.000

Table 3-5: Conditional Logit Models for Interactive Utility Functions

	Model 3: Interactive Linear				**Model 4: Interactive Polynomial**			
	US Survey		**Canadian Survey**		**US Survey**		**Canadian Survey**	
Attribute	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value
Constant	0.395 (0.035)	0.000	0.259 (0.035)	0.000	1.005 (0.060)	0.000	0.744 (0.060)	0.000
QALYs gained	-0.387 (0.027)	0.000	-0.310 (0.027)	0.000	-3.725 (0.280)	0.000	-3.214 (0.285)	0.000
Baseline Length of Life* QALYs gained	0.001 (0.001)	0.184	0.006 (0.001)	0.000	0.209 (0.033)	0.000	0.295 (0.034)	0.000
Baseline Quality of Life* QALYs gained	0.004 (0.000)	0.000	0.003 (0.000)	0.000	0.131 (0.010)	0.000	0.106 (0.010)	0.000
Baseline Length of Life^2 * QALYs gained	—	—	—	—	-0.019 (0.003)	0.000	-0.026 (0.003)	0.000
Baseline Quality of Life^2 * QALYs gained	—	—	—	—	-0.001 (0.000)	0.000	-0.001 (0.000)	0.000
Wait time*QALYs gained	0.007 (0.001)	0.000	0.006 (0.001)	0.000	0.008 (0.001)	0.000	0.011 (0.001)	0.000
Discrimination, Unlikely*QALYs gained	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Discrimination, All groups*QALYs gained	0.245 (0.010)	0.000	0.118 (0.010)	0.000	0.439 (0.018)	0.000	0.275 (0.019)	0.000
Discrimination, Likely*QALYs gained	0.087 (0.008)	0.000	0.006 (0.008)	0.398	0.464 (0.031)	0.000	0.313 (0.031)	0.000
Income, High*QALYs gained	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Income, All incomes*QALYs gained	0.343 (0.012)	0.000	0.232 (0.012)	0.000	0.599 (0.024)	0.000	0.450 (0.025)	0.000
Income, Limited*QALYs gained	0.239 (0.010)	0.000	0.162 (0.009)	0.000	0.466 (0.022)	0.000	0.382 (0.024)	0.000

In Model 3, the primary model for the equity weighted analyses in Chapter 4, (Table 3-5), the negative coefficients for QALY gain in both countries suggest that increasing QALYs in the high income and unlikely to experience discrimination group has negative utility, all else equal. For interventions that target all income and racial/ethnic groups or the more marginalized groups, there was a gain in utility, with the exception of the likely to experience discrimination group in the Canadian sample, which was not statistically significantly different from the unlikely to experience discrimination group.

The best fitting interactive model was Model 4 (Table 3-5), which includes polynomials for baseline length of life and quality of life, which accounts for non-linear preferences towards baseline health. The magnitude and directions of the linear and quadratic coefficients for baseline length of life and quality of life indicated the greatest utility for life expectancy and quality of life values in the middle of the range of attribute levels. Utility contributions for the levels of the income level equity parameters followed the same pattern seen in previous models with positive utility gains from interventions that target all income levels or individuals with limited income relative to those with higher incomes. The discrimination levels deviated from previous models where in both the Canadian and US samples, the likely to experience discrimination level has a greater contribution to program utility than the other attribute levels.

The estimated utilities of each hypothetical health program in the survey are presented in Table 3-6 for the US sample and Table 3-7 for the Canadian sample. Overall, I found broad consistency between the two additive models and poor consistency between the polynomial model and other models. The polynomial model represented a preference for improving health of

those with more moderate baseline health compared to those who have higher or lower baseline life expectancy and quality of life.

Table 3-6: Estimated Utility of Choice Tasks from US Respondents

Choice Task	Baseline LE	Final LE	Baseline QoL	Final QoL	QALYs Gained	Wait Time (weeks)	Income Group	Discrimination Experience Group	Model 1	Model 2	Model 3	Model 4
Choice 1a	4	5	50	95	2.8	4	All	Likely	4.78	2.23	0.79	3.87
Choice 1b	4	12	50	55	4.6	4	High	Unlikely	3.62	1.78	-0.26	2.58
Choice 2a	10	14	50	95	8.3	12	High	All	4.43	2.87	1.34	3.97
Choice 2b	1	5	50	55	2.3	12	Limited	Likely	3.86	2.53	0.92	3.26
Choice 3a	10	18	75	95	9.6	4	High	Likely	4.70	2.77	0.56	-0.93
Choice 3b	1	9	25	45	3.8	4	Limited	Unlikely	4.49	2.50	0.34	-0.97
Choice 4a	1	5	75	95	4	4	All	Unlikely	4.81	2.75	1.21	0.28
Choice 4b	10	14	25	45	3.8	12	Limited	Unlikely	3.77	2.13	0.58	-0.84
Choice 5a	10	14	50	85	6.9	4	All	Unlikely	4.93	2.88	1.43	3.94
Choice 5b	1	5	50	85	3.8	12	High	Likely	4.00	2.03	0.37	3.02
Choice 6a	1	2	75	80	0.9	12	Limited	All	3.75	2.39	0.42	0.38
Choice 6b	1	9	25	30	2.5	12	High	Likely	3.02	1.52	0.12	-0.11
Choice 7a	1	2	50	95	1.4	8	High	Unlikely	3.14	0.79	-0.17	0.05
Choice 7b	10	11	75	80	1.3	8	High	All	3.47	1.33	0.71	0.89
Choice 8a	1	2	25	30	0.4	4	All	Likely	2.54	1.59	0.06	0.03
Choice 8b	1	2	25	70	1.2	12	Limited	All	4.46	2.52	0.72	0.99
Choice 9a	1	5	25	60	2.8	12	All	All	4.53	2.87	1.06	0.33
Choice 9b	10	14	25	60	5.9	4	Limited	Likely	4.65	2.71	0.89	0.49
Choice 10a	10	12	50	70	3.4	12	All	Unlikely	3.86	2.06	0.88	2.17
Choice 10b	1	3	50	70	1.6	4	High	All	3.45	1.72	0.55	1.72
Choice 11a	8	16	25	45	5.2	4	All	All	5.01	2.98	1.79	1.55
Choice 11b	8	9	75	95	2.6	4	High	Unlikely	3.51	1.12	0.32	0.28
Choice 12a	1	9	75	80	6.5	4	Limited	All	5.27	3.79	2.86	2.43
Choice 12b	1	2	25	70	1.2	4	High	All	3.55	1.45	0.39	0.38

Table Legend: The utility of each choice set is estimated using each of the four analytic models. Colour gradients are generated for each model based on the percentile of the estimated utility within the range of estimates for that model. Values shaded dark blue are the higher, while those shaded dark red are the lower. Light shaded values are around the midpoint of utility estimates.

Table 3-7: Estimated Utility of Choice Tasks from Canadian Respondents

Choice Task	Baseline LE	Final LE	Baseline QoL	Final QoL	QALYs Gained	Wait Time (weeks)	Income Group	Discrimination Experience Group	Model 1	Model 2	Model 3	Model 4
Choice 1a	4	5	50	95	2.8	4	All	Likely	1.84	0.74	-0.25	1.22
Choice 1b	4	12	50	55	4.6	4	High	Unlikely	2.07	1.22	-0.16	2.79
Choice 2a	10	14	50	95	8.3	12	High	All	2.32	1.6	-0.05	0.68
Choice 2b	1	5	50	55	2.3	12	Limited	Likely	1.5	1	0.12	0.85
Choice 3a	10	18	75	95	9.6	4	High	Likely	2.73	1.85	0.29	-3.95
Choice 3b	1	9	25	45	3.8	4	Limited	Unlikely	1.85	0.97	-0.48	-2.53
Choice 4a	1	5	75	95	4	4	All	Unlikely	2	1.11	-0.1	-1.79
Choice 4b	10	14	25	45	3.8	12	Limited	Unlikely	1.67	0.99	-0.09	-2.05
Choice 5a	10	14	50	85	6.9	4	All	Unlikely	2.18	1.29	-0.38	-0.05
Choice 5b	1	5	50	85	3.8	12	High	Likely	2.05	1.23	0.03	0.92
Choice 6a	1	2	75	80	0.9	12	Limited	All	1.36	0.75	0.02	-0.3
Choice 6b	1	9	25	30	2.5	12	High	Likely	1.53	0.88	-0.1	-1.15
Choice 7a	1	2	50	95	1.4	8	High	Unlikely	1.72	0.62	-0.12	0
Choice 7b	10	11	75	80	1.3	8	High	All	1.88	0.88	0.33	0.27
Choice 8a	1	2	25	30	0.4	4	All	Likely	0.61	0.25	-0.07	-0.3
Choice 8b	1	2	25	70	1.2	12	Limited	All	1.51	0.68	0.09	-0.14
Choice 9a	1	5	25	60	2.8	12	All	All	1.44	0.71	-0.4	-2.12
Choice 9b	10	14	25	60	5.9	4	Limited	Likely	1.99	1.19	-0.56	-4.12
Choice 10a	10	12	50	70	3.4	12	All	Unlikely	1.64	0.88	-0.02	0.28
Choice 10b	1	3	50	70	1.6	4	High	All	1.6	0.8	0.08	0.67
Choice 11a	8	16	25	45	5.2	4	All	All	1.87	0.9	-0.79	-2.41
Choice 11b	8	9	75	95	2.6	4	High	Unlikely	2.12	1.03	0.31	0.62
Choice 12a	1	9	75	80	6.5	4	Limited	All	2.16	1.47	-0.16	-2.89
Choice 12b	1	2	25	70	1.2	4	High	All	1.55	0.58	0.04	-0.25

Table Legend: The utility of each choice set is estimated using each of the four analytic models. Colour gradients are generated for each model based on the percentile of the estimated utility within the range of estimates for that model. Values shaded dark blue are the higher, while those shaded dark red are the lower. Light shaded values are around the midpoint of utility estimates.

3.3.1.2 Equity Weights

The equity weights estimated for Models 2-4 are presented . Equity weights were generated relative to the high income unlikely to experience discrimination group. I found equity weights to be highest for the limited income likely to experience discrimination group in both countries, regardless of the utility function used, with the exception of Model 2 in Canada. The weights generated for Models 2 and 3 were not statistically significantly different in either Canada or the US. The exception being for the higher income and likely to experience discrimination group in Canada which was significantly lower than the reference group in Model 2. Differences in weights were found for Model 4 compared to the other models in both countries. The differences in the magnitudes of weights across utility functions suggest that weights are somewhat sensitive to the form of the utility function.

Table 3-8: Derived Equity Weights for Income/Discrimination Groups

Country	Income Group	Discrimination Group	Model 2		Model 3		Model 4	
			Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)
US	Higher	Unlikely	0.8297 (0.677 − 0.983)	1	0.2943 (0.235 − 0.354)	1	1.3174 (1.142 − 1.493)	1
	Higher	Likely	0.9878 (0.838 − 1.137)	1.1906 (1.111 − 1.270)	0.3814 (0.323 − 0.440)	1.2959 (1.214 − 1.378)	1.7816 (1.559 − 2.004)	1.3524 (1.326 − 1.378)
	Limited	Unlikely	1.7498 (1.572 − 1.927)	2.109 (1.904 − 2.314)	0.5332 (0.465 − 0.601)	1.8116 (1.644 − 1.979)	1.7838 (1.573 − 1.995)	1.354 (1.326 − 1.382)
	Limited	Likely	1.9079 (1.728 − 2.088)	2.2996 (2.033 − 2.566)	0.6203 (0.553 − 0.688)	2.1075 (1.872 − 2.343)	2.248 (1.989 − 2.507)	1.7064 (1.658 − 1.755)
Canada	Higher	Unlikely	0.7476 (0.596 − 0.899)	1	0.2015 (0.133 − 0.270)	1	1.1732 (0.989 − 1.357)	1
	Higher	Likely	0.6496 (0.497 − 0.803)	0.8689 (0.798 − 0.940)	0.2079 (0.140 − 0.276)	1.0317 (0.963 − 1.100)	1.4861 (1.252 − 1.720)	1.2668 (1.242 − 1.291)
	Limited	Unlikely	1.3092 (1.134 − 1.484)	1.7512 (1.595 − 1.907)	0.3635 (0.290 − 0.437)	1.8039 (1.528 − 2.080)	1.5547 (1.330 − 1.780)	1.3252 (1.299 − 1.351)
	Limited	Likely	1.2112 (1.033 − 1.389)	1.6201 (1.457 − 1.783)	0.3699 (0.296 − 0.443)	1.8356 (1.532 − 2.139)	1.8677 (1.592 − 2.143)	1.592 (1.550 − 1.634)

3.3.2 Assessing Heterogeneity

3.3.2.1 Subgroup Specific Models

Results from the conditional logit models stratified by income level, attitudes towards income inequality, race/ethnicity, and political viewpoint are presented in Appendix B.6 – B.9. Directions of coefficients across sociodemographic and attitudinal subgroups were largely consistent with the full sample models. However, they occasionally differed in magnitude. For instance, while results from US respondents with higher income and lower income both showed less utility from programs that targeted groups with higher income, the lower income respondents had significantly less utility from programs that targeted these higher income groups (aTable B.6-1 and aTable B.6-2). A similar pattern was seen in both countries among by attitudes towards income inequality (Appendix B.8) and in Canada when stratifying by race/ethnicity (Appendix B.7). When stratifying by political viewpoint (Appendix B.9), liberals among the US respondents had a preference for treating those with lower quality of life. In contrast, those with neither liberal nor conservative views were just as likely to prioritize programs targeting the limited income and all income level groups. Among liberals in Canada, higher priority was given to final quality of life compared to other political viewpoints. Similarly to the US, Canadian respondents with neither liberal nor conservative views were just as likely to prioritize the limited income group as the all income level group but only in Model 1.

3.3.2.2 Latent Class Analysis

The best-fitting latent class structures were 5 classes in Canada and 6 classes in the US; fitted models, class demographics, and equity weights for each latent class are reported in

Appendix B.10. Given the large number of latent classes in each country and overlapping patterns of preferences across latent classes outlined below, I did not explicitly name the latent classes.

Results from the latent class analysis identified substantial differences in preferences toward the allocation of healthcare resources, but with some overlapping preferences between select groups. Classes had differences in how they value equity attributes. For instance, class 4 in the US sample and classes 3 and 4 in the Canadian sample had greater utility from programs that targeted the limited income group than other classes or than what was seen in the overall results. Classes 1 and 3 in the US and class 4 in Canada had significantly greater utility from programs targeting individuals with limited income than programs targeting all income levels.

Amongst the Canadian latent classes, there were varying levels of preference for programs that targeted groups based on their likelihood to experience discrimination. In class 4, programs that targeted all racial/ethnic groups were most preferred, while those that targeted groups likely to experience discrimination were least preferred. For classes 2 and 3, none of the discrimination attribute levels were significantly different, suggesting that this attribute was unimportant for individual decision making.

Across all US classes, programs that targeted all racial/ethnic groups were preferable to those focused on groups unlikely to experience discrimination. In three classes (Class 1, Class 4, and Class 6), there was no preference between targeting interventions to those likely vs unlikely to experience discrimination. In Class 2, programs for those who were likely to experience discrimination were prioritized less than those for people who were unlikely to experience

discrimination. In contrast, Classes 3 and 5 had higher prioritization for the likely to experience discrimination group.

Classes had substantial differences in estimated utility for the generation of equity weights and subsequently there were differences seen in estimated weights. Class 1 in Canada and classes 5 and 6 in the US valued programs that helped sicker individuals, those with lower baseline life expectancy and quality of life, resulting in negative utility estimates for some of the equity dimension combinations, at least when the baseline life expectancy and baseline quality of life were fixed and 4 years and 60, respectively. Negative utility estimates created illogical weights and, in some instances, negative weights for particular groups. Negative weights point to a breakdown in the analysis. This instability in the results for some latent classes suggests that marginal rate of substitution may not be the apt method for determining equity weights for these latent classes.

3.4 Discussion

In this study, I evaluated preferences for targeting the allocation of healthcare resources based on baseline health, intervention effects (final health), wait time, and two equity dimensions: income level and experience with racial/ethnic discrimination using a discrete choice experiment. This analysis raises important questions about the applicability of direct equity weighting for valuing health benefits differently across the population.

Previous studies have typically not included the catch-all group, instead asking respondents to select between mutually exclusive and collectively exhaustive groups (i.e. above

average vs below average income). By and large, these studies find preferences consistent with those presented here, that improving health among the less privileged group is typically valued more than improving health among the more privileged group and therefore, a greater weight is placed on improving health among the less privileged groups. The inclusion of the catch-all levels of all income levels and all racial/ethnic groups in the experiment presented here complicates this. In most models tested, the catch-all levels were more preferred than the specific equity-relevant levels. These results suggest that ascribing higher value to specific groups may not reflect respondent values which could be prioritizing equality in the distribution of healthcare resources. As such, generating equity weights using the high income and unlikely to experience discrimination group as the reference may not reflect population preferences. If the most utility is gained from interventions that benefit all income and racial/ethnic groups, then applying a weights that split the population into equity-relevant subgroups would result in lower value compared to the "all" group. However, given the structure of the catch-all group, it is not possible to generate weights using that group, as the levels are not mutually exclusive. Future research is needed to more thoroughly understand the implications of these preferences for equity-informative analyses.

The findings presented here are broadly consistent with focus group discussion and results from the best-worst scaling presented in Chapter 2. Results presented in Chapter 2 suggest that there are preferences for treating individuals equally regardless of their demographic characteristics. Future studies should consider alternative approaches to testing preferences for equality in the allocation of healthcare resources. One potential approach would be to specify the percentage of lower income or racially/ethnically minoritized individuals who would benefit

from the program. This would create levels that are more in line with DCE best practices but would increase the complexity of an already complex choice task, particularly for respondents with limited numeracy.

Previous research has highlighted this preference for treating everyone equally. Ubel et al. asked survey respondents to select between cancer screening programs.[172] They found that when presented with an option to offer less effective screening to everyone vs more effective screening to half the population, respondents selected the less effective treatment that treated everyone.[172] In a follow-up study, they found that when the less effective screening program was not available to the whole population, it was preferred less than the more effective program.[174] Future work will need to evaluate the extent to which preferences for equality in the allocation of resources presented here and in Chapter 2 follow a similar effect reported by Ubel et al.

Looking outside of the healthcare setting, there are documented instances where the public reports equality as preferential to equity, particularly around questions of race and ethnicity. Following the United States Supreme Court decision in 2023 to end affirmative action, the policy that allowed colleges and universities to use race and ethnicity in the admissions process, Gallup public opinion polls found broad support for the ruling, although with some differences based on race.[209] These attitudes mirror findings from political scientists who reported that white Americans were reticent to endorse policies that were designed to achieve racial equality, such as affirmative action, despite claims towards supporting the principles of racial equality.[210] Additionally, preliminary results from a survey of American adults found that support for progressive policy proposals was stronger when framed to discuss class as opposed to

race or class and race.[211] Similar results are found in this Chapter, notably that the value placed on the "all" level was often higher than that placed on the most marginalized group and greater utility was seen when targeting programs by income level rather than race and ethnicity.

I found inconsistencies in how attributes were valued depending on the form of the utility function. For instance, coefficients for baseline health attributes are negative in Model 1, but baseline quality of life switches to positive in subsequent models. Preferences for higher baseline quality of life deviate from existing research, suggesting preferences for treating individuals with more severe diseases. This result may be driven by preferences for programs that have higher final quality of life, a result corroborated in Model 1. Additionally, respondents may have been reticent to extend years of suffering for those in poor health, as was stated in multiple comments on choice tasks. Further work is needed to evaluate how baseline health is valued and the relationship between quality and length of life, particularly low quality of life. In Canada, medical assistance in dying (MAID) was received by 4.7% of Canadians who died in 2023, indicating a preference on the part of these patients to reduce the length of life in poor health states.[212] Preferences for reducing suffering may have led respondents to deprioritize length of life gains among individuals with low baseline and final quality of life. Future work should also consider how applying different measures of health improvement, such as the equal-value life year,[213] risk-adjusted QALY,[214] or WELLBY,[215] could impact respondent choices. In another inconsistency across models, the utility contribution of wait times was positive in Model 1 and negative in Models 2-4, as well as most other models tested. Similarly, there are changes in the sign and relative magnitude of the likely to experience discrimination attribute. Qualitative work in which respondents who complete the survey in the presence of an interview are asked to

"think aloud" about the choices may elucidate some of the nuances around these attributes further. Additionally, more variation could be introduced into the baseline and final health attributes to more fully cover the parameter space. The differences in how attributes varied across models were less pronounced for the income and discrimination attributes. As such, the equity weights for models, particularly Models 2 and 3, were largely consistent by country. It is unclear what the implications of small differences in weights might be in equity-informative CEAs. It will be necessary for future applications to compare the impact of different weights, and even different weighting approaches on the results of equity-informative CEAs.

When fitting separate models by respondent's sociodemographic and attitudinal views, I found limited differences in preferences. In only a few instances, were there significant differences between sociodemographic and attitudinal groups. Differences were almost exclusively based on the magnitude and not the direction or ranking of attribute coefficients. These similarities suggest fairly robust preferences across these observable demographics.

The results from the LCA identified groups of respondents with notably different preferences. In both countries, I identified multiple classes of respondents (5 in Canada and 6 in the US) with distinct preferences, particularly when it came to how they valued equity. Half of the latent classes in the US had no difference in their preferences between the likely and unlikely to experience discrimination attributes. Two classes preferred programs that targeted the limited income group over the all income levels group. More latent classes were identified in this analysis than were seen in Chapter 2. Given the differences between the surveys, there is limited ability to compare latent classes and identify potential overlap. Latent Class 2 in the US and 4 in

Canada may closely reflect the wealth inequality fighters identified in Chapter 2 given the high utility associated with improving health of those with limited income. However, it is challenging to identify how respondents to each survey would be sorted into latent classes for the other survey without a sample having completed both surveys.

The different preferences for latent classes resulted in significant differences in equity weights. In some instances where latent classes had strong preferences for treating sicker individuals, utility estimates for the equity weights were negative, which resulted in illogical weights which should not be used in equity-informative analyses. Alternative methods for generating weights, such as compensating variation,[207,216] may be better suited for generating weights in these instances. If alternative approaches to generating weights continue to result in negative weights, it would indicate a larger flaw in the elicitation exercise itself that would need to be explored more thoroughly. Previous equity preference elicitation exercises have been largely focused on identifying differences in preferences between demographic groups. Some studies report the presence of in-group preferences, for instance, women preferring programs that improve the health of women, but fewer studies have applied latent class analysis.[74] I find limited evidence of in-group preferences and more latent classes than a previous discrete choice experiment study in Canada.[135]

3.4.1 Limitations

This study is not without its limitations. The limitations of online surveys described in 2.4.1 also apply to this study. Online samples limit the representativeness of the samples and are subject to selection bias. In the US sample, respondents were more liberal and highly educated

than the US population. There are additional concerns that respondents are not fully engaging with the exercise or that they understand what is being asked and interpret the attributes and levels correctly. For instance, respondents may have differing definitions of limited vs higher income. Lack of numeracy skills may also impact respondents' ability to interpret quality of life values on a 0 to 100 scale and may rely on the qualitative descriptors of health states. Respondents may also have different perceptions of what constitutes a low quality of life value based on their individual experience with illness. Finally, respondents may have not remembered or comprehended all survey instructions as they completed the exercise. They may have considered attributes beyond those included in the choice, such as the respondent who commented that they expected one program to cost more despite instructions that both had equal costs. Additionally, while the instructions stated that programs would target groups of equal size, respondents may have viewed the "all" groups in the equity attributes as larger, contributing to their prioritization. Finally, there are few opportunities for external validation of the choice experiment results.

3.5 Conclusions

In this study, I designed and fielded a discrete choice experiment. Based on the responses, I generated intersectional equity weights that account for population preferences for improving the health of groups of patients based on their income level and likelihood to experience discrimination. Greater weight was given based on income level than discrimination. Within the targeted levels for the equity attributes, I found the greatest weight was placed on improving the health of those with limited income and likely to experience discrimination relative to the higher income unlikely to experience discrimination levels. While respondents

were willing to make trade-offs between these equity dimensions, the highest priority was consistently given to interventions that did not target a particular income or racial group. As such, the application of these weights in equity-informative analyses may not accurately reflect population preferences for equality in the distribution of resources.

Chapter 4 Equity-Informative Cost-Effectiveness of Electronic Nicotine Delivery Systems for Smoking Cessation

4.1 Introduction

Despite substantial reductions in smoking prevalence, smoking remains the leading cause of preventable death in the US today.[99] Roughly 12.5 percent of adults in the US continue to smoke combustible cigarettes, exacting a heavy toll on their health and the healthcare system.[217] The burden of smoking is not distributed evenly. It varies by age, state, income, race/ethnicity, and many other factors, contributing to ongoing health disparities.[99,101,218-222] In 2014, the treatment of tobacco-related illnesses cost the US healthcare system $225 billion per year in direct medical costs alone, the majority of which is paid for by Medicare and Medicaid.[223] By quitting, individuals can dramatically reduce their risk for many of the causes of smoking-attributable death, including heart disease and cancer.[99]

An array of smoking cessation interventions, both behavioural and pharmaceutical, exist.[99] These interventions can improve cessation and have been found to be cost-effective in a wide range of settings.[103,104,224-226] Interventions to increase smoking cessation may improve health equity by addressing tobacco use disparities,[221,227,228] as individuals who currently smoke have lower income and less education on average and are often from marginalized communities, such as gender and sexual minorities.[100] Additionally, initial studies of distributional cost-effectiveness analysis have found favourable distributional benefits of improving access to cessation tools in the UK.[229]

Electronic nicotine delivery systems (ENDS), commonly known as e-cigarettes, may help to improve cessation as a reduced harm product. Studies have found that ENDS use may help motivate smokers to make a quit attempt[230] and successfully quit.[231] However, the uncertainty over the health risks of ENDS and the initial rise of their use among adolescents led to considerable concern over their widespread availability.[232,233] There have been suggestions that youth vaping may lead non-smoking youth to initiate cigarette smoking.[234,235] In the intervening years, no such increase in youth smoking has occurred, yet much of the debate about ENDS still centers around concerns over youth vaping.[236,237] Beyond concerns about youth, ENDS use may make current smokers less likely to quit smoking [238,239] and former smokers more likely to relapse.[240] However, ENDS may also be a more acceptable alternative to smokers looking to quit than other cessation interventions. ENDS have been found to be highly effective in various clinical trials of cessation.[241] Current smokers are more likely to report using ENDS for cessation than any other intervention and more smokers successfully quit combustible tobacco use for at least 6 months with ENDS than with any other cessation method.[109] Despite these benefits for smokers, approximately 70% of individuals who successfully quit combustible cigarettes using ENDS continue ENDS use,[242] which could negatively impact their health compared to those who quit without ENDS use or stop using ENDS entirely.[242,243] Ultimately, the public health impact of ENDS use depends on the interaction of each of these effects.[133]

Simulation modelling is an ideal tool to combine these complex interactions and understand their potential population impacts. Numerous studies of ENDS have done just that.[120-131] Most of these studies have found that the benefits of ENDS use outweigh the harms.

However, some report varying effects depending on how the risks of ENDS relative to cigarettes are weighted.[121,126] Despite this extensive literature, gaps remain. Most modelling studies have sought to understand the impact of ENDS use on smoking initiation and cessation. While this provides insights into the population-level impacts of ENDS, it does not consider the relative benefits and costs of ENDS use compared to currently available cessation tools. An economic evaluation of ENDS as a cessation device compared to other pharmacotherapy cessation interventions can provide new insights into whether ENDS provide additional value in the cessation context. To date, only one study in the UK has conducted an economic evaluation of ENDS, which found them to be a cost-effective intervention for smoking cessation.[118]

Equity-informative cost-effectiveness analyses can help to inform efforts to address tobacco use disparities. Given the novelty of equity-informative CEAs, applications in the tobacco space have been limited. One study of funding nicotine replacement in the UK is presented as a hypothetical exercise for distributional cost-effectiveness analysis (DCEA).[136] An additional five studies from New Zealand have conducted equity impact analyses of tobacco control policies and interventions.[244-248] The five New Zealand studies examined national policies to improve access to cessation tools,[245,246] reduce tobacco product availability,[247,248] and increase taxation.[244] The New Zealand studies found a favourable equity impact of each of these interventions, having greater per-capita gains for the Māori compared to non-Māori, with the estimated impact 2.8-5 times higher in this priority group. In the UK, the hypothetical DCEA found that proportional funding for NRT (where additional investment is made in priority groups) improved equity but had a lower overall health impact than universal NRT (given an increase in health opportunity costs), illustrating an equity-efficiency trade-off. This result

echoes previous tobacco control findings suggesting that interventions with the greatest health gains can negatively impact health equity.[221,249] Only the study in the UK weighted outcomes for specific policy-relevant subgroups differently using a social welfare function approach.

To sufficiently evaluate the potential impact of ENDS for the protection of public health, studies are needed that fill the knowledge gap comparing ENDS to other cessation tools. Given ongoing tobacco use and smoking cessation disparities, researchers should also consider the impact of cessation interventions on population-level tobacco-related disparities. This chapter presents an equity-informative cost-effectiveness analysis to evaluate these considerations. The results from this analysis provide decision-makers with a formal accounting of the costs, benefits, and equity impacts of ENDS use as a potential cessation intervention relative to other well-established cessation tools. Such accountings can help ensure that ENDS policy accurately reflects their balance of benefits and harms.

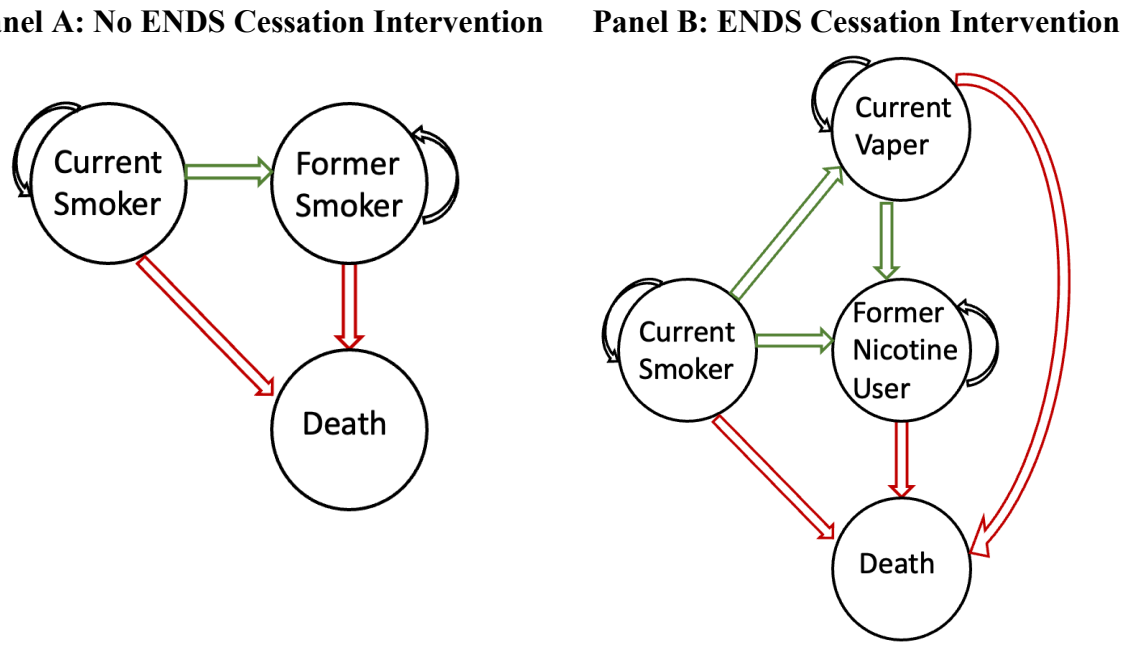
4.2 Methods

4.2.1 Model Overview

I developed a microsimulation state-transition model that tracked an individual's tobacco use state over time. The simulated population comprised a fixed cohort of 1,000,000 adults, ages 20+, in the US who currently smoke daily. The analysis adopted a lifetime horizon and was conducted from the societal perspective with a cycle length of one year. Health benefits and costs were tracked over the lifetime of simulated individuals and disaggregated across 4 equity-relevant subgroups based on the intersection of income and race/ethnicity. The direct equity weights developed in Chapter 3 were used to differentially value health outcomes and opportunity costs across the equity-relevant subgroups. The basic model structure is presented in

Figure 4-1. The CEA impact inventory is presented in Appendix C.1. The analysis follows the recommendations of the Second Panel on Cost-Effectiveness in Health and Medicine and the Consolidated Health Economic Evaluation Reporting Standards (CHEERS).[19,250] The CHEERS Checklist is reported in Appendix C.2. A health economic analysis plan was prepared in the dissertation prospectus and reviewed by the dissertation committee.

Figure 4-1: Model Schematic



4.2.1.1 Equity Dimensions

The cohort is differentiated by age and gender and two equity dimensions: income level (<200% or ≥200% of the federal poverty level) and race/ethnicity (non-Hispanic white or racially and ethnically minoritized). The equity dimensions of income level and race/ethnicity were selected due to their inclusion in the discrete choice experiment described in Chapter 3.

The income level equity dimension was operationalized as <200% or ≥200% of the federal poverty level (FPL) to correspond to the discrete choice experiment levels of "limited income" and "higher income." In 2024, the federal poverty level for a family of four was an annual household income of $31,200. Approximately 46% of smokers in 2023 had a household income below 200% of the FPL.[251]

The race/ethnicity equity dimension was operationalized as non-Hispanic white (NHW) or racially and ethnically minoritized to correspond to the discrete choice experiment levels of "unlikely to experience discrimination because of race or ethnicity" and "likely to experience discrimination because of race or ethnicity," respectively. As in the DCE, this operationalization was selected to reflect the goal of equity-informative analyses in valuing the health of less privileged or more marginalized groups. When considering how groups are marginalized because of their race/ethnicity, it is the discrimination in society that they experience due to their race/ethnicity and not whether an individual is of a particular race or ethnicity . As such, it is the discriminatory experiences of racially and ethnically minoritized groups that equity-informative cost-effectiveness analyses attempt to mediate against by providing additional value to improving the health of minoritized individuals. Approximately 73% of smokers in 2023 were NHW.

The two equity dimensions resulted in four intersectional equity-relevant subgroups that were modelled and weighted separately:

1. Racially or ethnically minoritized and income <200% FPL;
2. Racially or ethnically minoritized and income ≥200% FPL;

3. NHW and income <200% FPL;
4. NHW and income ≥200% FPL.

Section 4.2.2 describes the equity dimension-specific input parameters for the model.

4.2.1.2 Smoking Cessation Interventions

The cost-effectiveness analysis compared four cessation interventions and an opt-out scenario:

1. An ENDS starter kit plus brief physician counselling
2. Combination nicotine replacement therapy (NRT) comprised of patches plus gum with brief physician counselling
3. Varenicline plus brief physician counselling
4. Bupropion plus brief physician counselling
5. Opt-out of cessation treatment

Simulated individuals received one cessation intervention at the start of the simulation and were followed to death or age 100. All individuals were assumed to access and use the cessation intervention provided. No follow-up cessation interventions were provided, but individuals could still quit based on background cessation rates. As a simplifying assumption, the model did not include relapse, and cessation rates were net of relapse (see section 4.2.2.2 for additional details).

Following the provision of a cessation intervention, individuals could quit smoking or continue cigarette use. Those who received ENDS could quit nicotine and tobacco product use entirely or transition to exclusive ENDS use, or vaping. Individuals in the non-ENDS

intervention arms did not have the opportunity to use ENDS (Figure 4-1 Panel A). While this does not reflect the current status of ENDS use in the US, it is representative of a scenario in which ENDS are a prescription device for smoking cessation only. A portion of individuals who quit combustible cigarette use with ENDS continued to use ENDS products, which conveyed negative health impacts compared to those who quit all nicotine product use. Individuals in the ENDS intervention arm who became dual users of cigarettes and ENDS were considered current smokers. Patients accrued costs and health risks associated with their smoking status. The model tracked costs, life years, and QALYs for each intervention. Future costs and health outcomes were discounted at 3% annually. Costs and health outcomes associated with second-hand smoke were not explicitly modelled.

4.2.2 Data Sources

Data inputs for this model included the composition of the US smoking population, background smoking cessation rates, ENDS cessation rates, smoking-related mortality rates, cessation intervention efficacy, smoking-related health utilities, and resource utilization costs. Parameters were sourced from the published literature, national surveys of tobacco use behaviours, Cochrane reviews, and analyses by the Cancer Intervention and Surveillance Modeling Network (CISNET) Lung Cancer Working Group.[101,126,127,218,252-257] Due to data limitations, only select input parameters varied across the equity dimensions (Table 4-1). Parameter values for specific model input parameters are reported in Table 4-2.

Table 4-1: Overview of Subgroup-Specific Smoking Cessation Model Input Parameters

Parameter	Description	Subgroup Specific	References
	Transition Rates		
Cessation intervention efficacy	Intervention uptake may vary by subgroup. Efficacy of cessation is known to vary by characteristics such as race/ethnicity and possibly other factors.	No	258-262
Non-intervention quit rates	Background smoking cessation rates are known to vary by age, educational attainment, socioeconomic status, and race/ethnicity, among others.	Age, gender, and equity dimension	101,218,219
Mortality rates	Background mortality rates vary by gender, race/ethnicity, socioeconomic status, education, and rurality.	Age, gender, year, smoking status, equity dimension	263-267
	Costs		
Intervention costs	The costs of interventions could vary depending on access and accessibility of care or where additional investment is needed to meet hard to reach individuals.	No	268,269
Smoking-attributable illness costs	Costs of smoking-attributable illnesses may vary across relevant subgroups given differing rates of comorbidities and disease risk.	Age, gender, smoking status	270
	Health Utilities		
QALY Weights	Some evidence suggests differences in utility weights across different groups, such as gender and race/ethnicity.	Age, gender, and smoking status	271,272

4.2.2.1 Smoking Population

The demographics of the cohort of current smokers were based on the demographics of the 2023 National Health Interview Survey (NHIS) smoking population. The NHIS is a nationally representative cross-sectional household survey fielded annually among non-institutionalized US adults aged >=18 years.[273] Demographics for the 1,000,000 simulated smokers were matched to NHIS data on age, gender, race/ethnicity, and the ratio of family income to the poverty threshold. The proportion of the smoking population that fell into each equity-specific subgroup is reported in Table 4-2.

Table 4-2: Smoking Cessation Model Cost-Effectiveness Input Parameters

Parameter	Base Case Model Value (Range)	PSA Distribution (Parameters)	Source
Proportion of Current Smoking Population by Equity Group			
Racially or ethnically minoritized and <200% FPL	14.18%	Fixed	NHIS 2023
Racially or ethnically minoritized and ≥200% FPL	12.43%	Fixed	
Non-Hispanic white and <200% FPL	31.95%	Fixed	
Non-Hispanic white and ≥200% FPL	41.43%	Fixed	
Health-Related Quality of Life Estimates			
Current Smokers	Various age-specific	Fixed	Xu et al.[274]
Former Smoker	Various, age- and gender-specific	Fixed	
Current Vaper	Various, age-specific	Fixed	
Cessation Intervention Efficacy (Risk Ratio)			
Bupropion	1.60 (1.49-1.72)	Gamma (shape: 744.29, 483.93)	Cochrane Review[275]
Electronic Nicotine Delivery Systems	2.46 (1.56 – 2.66)	Gamma (shape: 80.02, rate: 32.47)	Cochrane Review[241]
Nicotine Replacement Therapy	2.03 (1.91 – 2.15)	Gamma (shape: 1168.68, rate: 574.69)	Cochrane Review[276,277]
Varenicline	2.32 (2.15 – 2.51)	Gamma (shape: 664.49, 286.42)	Cochrane Review[278]
Cessation Intervention Costs			
Bupropion	$52 ($25 - $100)	Log Normal (mean: 3.89, SD: 0.12)	Cost Plus Drugs (range +/- ~50%)
Electronic Nicotine Delivery Systems	$2,568 ($109 - $6,489)	Log Normal (mean: 7.69, SD: 0.33)	Cheng et al.[279]

Nicotine Replacement Therapy	$298 ($200-350)	Log Normal (mean: 5.89, SD: 0.02)	Cost Plus Drugs (range based on estimates of pack and gum use)
Varenicline	$145 ($100 - $225)	Log Normal (mean: 4.95, SD: 0.05)	Cost Plus Drugs (range +/- ~50%)
Nicotine Product Use and Costs			
Cigarettes per day	14 (10-30)	Log Normal (mean: 2.58, SD: 0.12)	CDC[280]
Vape Cartridges per Day	0.75 (0.25 – 1.5)	Log Normal (mean: -0.16, SD: 0.11)	Prochaska et al.[281]
Cigarette Pack Cost	$11 ($7 - $20)	Log Normal (mean: 2.36, SD: 0.08)	Cheng et al.[279]
Vape Cartridge Cost	$13 ($4 - $20)	Log Normal (mean: 2.52, SD: 0.09)	Cheng et al.[279]
Electronic Nicotine Delivery System Specific Parameters			
Continued ENDS Use	0.70 (0.53-0.82)	Beta (α: 27.27, β: 11.69)	Butler et al.[242]
Excess Risk of ENDS Use	0.20 (0.05 – 0.50)	Beta (α: 2.33, β: 9.31)	Assumption
Equity Weights			
Racially or ethnically minoritized and <200% FPL	2.11 (1.87 – 2.34)	Gamma (shape: 320.34, rate: 152.00)	Chapter 3
Racially or ethnically minoritized and ≥200% FPL	1.30 (1.21 – 1.38)	Gamma (shape: 999.02, rate: 770.91)	
Non-Hispanic white and <200% FPL	1.81 (1.64 – 1.98)	Gamma (shape: 467.90, rate: 258.28)	
Non-Hispanic white and ≥200% FPL	1	Fixed	

FPL: Federal Poverty Level; SD: Standard Deviation; ENDS: Electronic Nicotine Delivery Systems; CDC: Centers for Disease Control and Prevention

4.2.2.2 Transition Rates

Model transition rates include the background smoking cessation rate, mortality rates, cessation intervention efficacy, continued ENDS use following combustible cigarette cessation, ENDS cessation rates, and the excess risk of ENDS relative to combustible cigarettes.

The CISNET Lung Group calculated age- and gender-specific background cessation rates for each of the four equity-relevant subgroups using NHIS data . The parameters were generated using an age-period-cohort statistical modelling framework.[282,283] Individuals who attempt to quit smoking are often unsuccessful, leading to a high rate of relapse in the first two years.[284] The cessation estimates classified anyone who has quit for less than two years as a current smoker; those who had successfully quit for two or more years were classified as former smokers.[285]

All-cause mortality rates were also generated by the CISNET Lung Group and again disaggregated by age, gender, income level, and race/ethnicity in addition to smoking status (current or former smoker by years since quit) and calendar year.[285] For each age, gender, and equity subgroup, mortality rates were partitioned into mortality rates for never, current, and former smokers using an approach described by Rosenberg et al.[286] and are projected forward in time using the Lee-Carter method.[287] Mortality rates for former smokers declined by years since quitting following the approach of Tam et al.[288] Former smoker mortality decreased based on estimates derived by Thun et al.,[289] which were transformed into single-year estimates using an exponential model. The use of all-cause mortality rates by smoking status as opposed to cause-specific mortality can account for the impact of tobacco use on health more broadly by estimating all tobacco-related mortality and increases the ease of model implementation

compared to modelling a subset of specific tobacco-induced diseases. The use of all-cause mortality is common in tobacco control modelling.[120,126,254,290]

The efficacy of smoking cessation interventions relative to no intervention controls was sourced from Cochrane systematic reviews and meta-analyses on ENDS,[241] NRT,[276,277] Bupropion,[275] and Varenicline.[278] Cessation intervention efficacy and access were assumed to be equal across equity dimensions. Details on how ENDS and combination NRT effects relative to no intervention controls were estimated from the reviews is provided in Appendix C.3.

Data on ENDS continues to evolve as new products emerge in the marketplace and the FDA takes additional regulatory steps. Estimates for the continuation of ENDS use following combustible cigarette cessation were based on a meta-analysis, which found that 70% of individuals who quit combustible cigarette use during ENDS clinical trials for smoking cessation continued ENDS use for at least 12 months.[242] To determine ENDS cessation rates, Brouwer et al.'s Markov multistate transition model approach was applied to data from the Population Assessment of Tobacco and Health (PATH).[291] The approach estimates transition probabilities for different categories of nicotine and tobacco product use between waves of the PATH survey. I used the transition rates for Wave 4-5 (Wave 4 fielded 2016-2018; Wave 5 fielded 2018-2019) from exclusive ENDS use to non-current use as a proxy for ENDS cessation. Transition rates were stratified by age (18-24, 25-34, 34-55, 55+), gender (male or female), and income level (≤ $50,000 per year or > $50,000 per year). Due to small sample sizes at the intersection of income and race/ethnicity, results were not stratified by race/ethnicity. Finally, the excess risk of ENDS relative to combustible cigarettes is a matter of debate in tobacco control, with estimates from

previous modelling studies varying widely. In the base case analysis, I assumed that ENDS confer 20% of the excess risk of combustible cigarette use relative to no tobacco use. I varied the relative mortality risk of ENDS from 5%-50%, which aligns with the best estimates.[255,292]

4.2.2.3 Costs

The costs of each cessation intervention and the subsequent costs of smoking-related illness were sourced from the published literature and are detailed in Appendix C.4. Intervention costs included the costs of the pharmacotherapy agent or ENDS device and e-liquid, as well as physician counselling. Pharmacotherapy costs were based on retail prices from Cost Plus Drugs following standard recommended doses. The prices of ENDS devices and cartridges were sourced from the 2016 International Tobacco Control (ITC) Four Country Vaping and Smoking Survey with the assumption that individuals would receive a rechargeable cartridge ENDS device and consume 0.75 ENDS cartridges worth of e-liquid per day.[279] While the ITC survey may not reflect current prices for ENDS devices and cartridges, analyses of US retail sales data suggest that prices for the highest nicotine content (and most popular) ENDS cartridges have remained relatively flat between 2017 and 2022.[293] The cost of physician counselling was based on Medicare reimbursement for smoking cessation (CTP code: 99406). To reflect the societal perspective of this analysis, I included the future costs of continued ENDS use and combustible cigarette use. Individuals who continue to use ENDS accrued additional costs for ENDS cartridges as long as they remain current vapers with vape cartridge consumption based on the equivalent nicotine content in vape cartridges and cigarettes, 0.75 cartridges per day.[281] Cigarette costs were also sourced from the ITC Four Country Survey, and smokers were assumed to smoke 14 cigarettes per day on average.[279,280]

Given that the model does not consider cause-specific mortality, I do not include costs for individual smoking-related illnesses. Instead, costs of medical care for current and former smokers were sourced from Swedler et al.'s analysis of Medical Expenditure Panel Survey and NHIS data.[294] Current smoker costs from Swedler et al. were used for all gender, income, and race/ethnicity groups based on each decade of life 20-80. Rather than use former smoker healthcare costs as reported by Swedler et al., I applied the same approach to estimate former smoker mortality by years since quit to estimate former smoker healthcare costs by years since quit based on the relative risk of mortality by year since quit and the healthcare costs of current and never smokers.[289] This approach bookends former smoker healthcare costs between current and never smokers, which does not correspond to Swedler et al.'s findings. Swedler et al. report higher costs for former smokers of every age with limited variation by years since quitting. The authors suggest this could be due to increased health conscientiousness of former smokers. However, it could also be due to individuals quitting during a health event which leads to higher costs after cessation which is not an accurate proxy of medical costs for individuals who quit from a cessation intervention. Other analyses have found conflicting results, with either the same costs for current and former smokers or lower costs for former smokers.[295-297]

All costs were inflated to 2024 USD using the Consumer Price Index for medical care services.

4.2.2.4 Health Utilities

Smoking status-specific quality of life weights were used to convert life years to QALYs. Age and gender-specific quality of life weights for current smokers were sourced from the published literature.[274] Given the paucity of data regarding the quality of life effects of ENDS, I use age-specific quality of life effects of smokeless tobacco use as a proxy.[274] Quality of life for former smokers improved over time based on years since quitting using the same improvement from Thun et al. for former smoker mortality and healthcare costs.

4.2.3 Analysis Plan

I report both traditional cost-effectiveness results and equity-weighted results.

4.2.3.1 Traditional Cost-Effectiveness Results

The primary outcomes of interest in a cost-effectiveness analysis are the total discounted costs and QALYs for each intervention. I compared interventions' costs and health outcomes using Incremental Cost-Effectiveness Ratios (ICERs) and net health benefit (NHB). ICERs are calculated using the formula:

$$ICER = \frac{\Delta Costs}{\Delta Effectiveness} = \frac{C_1 - C_0}{E_1 - E_0} \quad \text{(Eq. 4-1)}$$

where *C* refers to the discounted costs and *E* to the discounted effectiveness of an intervention being evaluated compared to the next least costly intervention (denoted by 0 and 1, respectively). The intervention is then deemed to be cost-effective if the ratio of incremental costs, *c*, to incremental effects, *e*, is below some willingness-to-pay threshold, *k*:

$$\frac{c}{e} < k$$

(Eq. 4-2)

The results of this non-equity-weighted analysis can also be presented in terms of the net health benefit of the intervention.[298] By rearranging (Eq. 4-2), we get:

$$e - \frac{c}{k} > 0$$

(Eq. 4-3)

where the $\frac{c}{k}$ term can be interpreted as the health opportunity cost, and the inequality sign tells us that only when *e* exceeds the opportunity cost is the intervention determined to be cost-effective. By subtracting the opportunity cost from the total health gain, one can determine the net health benefit, n_{HB}.

$$n_{HB} = e - \frac{c}{k}$$

(Eq. 4-4)

I use $100,000 per QALY as the willingness-to-pay threshold, *k*, in the base case and explore lower and higher thresholds in sensitivity analyses ($50,000 and $250,000 per QALY).[299] The net health benefit of each intervention is calculated incrementally compared to no treatment to determine the value of the intervention relative to doing nothing.

4.2.3.2 Equity-Weighted Cost-Effectiveness Results

The outcome measure of an equity-informative cost-effectiveness analysis is net equity benefit (NEB).[71] This is a measure of the equity-weighted health outcomes and opportunity costs. NEB requires the opportunity cost to be transformed into foregone QALYs based on a willingness-to-pay threshold for cost-effectiveness.[71] To calculate the NEB of the intervention, gained and forgone QALYs are calculated for each policy-relevant subgroup based on the

relative size of each subgroup to determine the overall health benefit for that equity subgroup. Health benefits are then weighted using the direct equity weights for each equity subgroup generated in Chapter 3:

$$n_{EB} = \sum_{i=1}^{n} w_i \left(e_i - p_i \left(\frac{c}{k} \right) \right) \quad \text{(Eq. 4-5)}$$

where *w* represents the weight of a given equity subgroup *i* with an incremental intervention effects *e*, incremental costs *c*, at a willingness-to-pay threshold, *k.* Finally, p_i represents the relative size of the equity subgroups to determine their proportion of the health opportunity cost, assuming each group accrues health opportunity costs proportional to their size. Both the health outcomes and opportunity costs are weighted to ensure that equity preferences are accounted for in both the benefits of the intervention and the foregone health effects. The equity-weighted benefits for each equity subgroup are summed to determine the total NEB of each intervention.

It is unclear how health opportunity costs are distributed across the population, particularly in the US, where there are many payors in the healthcare system. In previous equity informative CEAs, health opportunity costs have been split across the population proportional to the size of the simulated equity-relevant subgroup.[139,143] This simplifying assumption almost certainly does not reflect the correct distribution of health opportunity costs, particularly in a complex multi-payor system such as the US. In the base case for this analysis, I assume that health opportunity costs are incurred by the equity subgroup that accrued them (i.e. if a former smoker who is non-Hispanic white and has an income over 200% of the FPL spent $10,000 on healthcare costs, those health opportunity costs would fall on the non-Hispanic white ≥200% of the FPL group).

In addition to tables reporting costs, benefits, NHB, and NEB, I plot the combined impact of each intervention in terms of equity benefits and health benefits on the equity impact plane.[2,68]

4.2.4 Scenario Analyses

I conducted four scenario analyses to assess the robustness of the cost-effectiveness results under different model assumptions.

4.2.4.1 Health Opportunity Costs

Given the uncertainty in how health opportunity costs are allocated throughout the US healthcare system, I tested the effects that various allocations of health opportunity costs, p_i in (Eq. 4-5), have on the equity-weighted results. I calculated NEB values with different proportions of the health opportunity costs allocated to each equity group (0-100% in 10% increments, with the remaining health opportunity cost split equally between the other three equity groups). I plotted the results on the equity-efficiency impact plane. To further examine the impact of allocations of health opportunity costs, I also calculated NEB values when health opportunity costs are only split across one of the equity dimensions (income or race/ethnicity), again ranging the proportion of opportunity costs allocated to each group from 0-100%. In this scenario, I divided the health opportunity costs proportionally between the two equity groups that comprise the single equity dimension group. For instance, when examining the effects of varying health opportunity costs by the income level dimension, in the scenario where 60% of the health opportunity costs are allocated to the income <200% FPL group, the remaining 40% will be

allocated to the income ≥200% FPL group. Within that 60%, I assumed that the opportunity costs were allocated based on the relative size of the non-Hispanic White individuals with income <200% FPL (69.3%) and the racially/ethnically minoritized individuals with income <200% FPL (30.7%).

4.2.4.2 No Continued ENDS Use

I assessed the impact of continued ENDS use on the results by examining a scenario that assumed those who quit combustible cigarette use with ENDS did not continue ENDS use following smoking cessation. In this scenario, no current smokers transition to the vaping state, and there are no vaping-associated costs or adverse health effects. Including an analysis without a vaping state is consistent with a previous cost-effectiveness analysis of ENDS from the UK.[118]

4.2.4.3 No Nicotine or Tobacco Product Costs

Nicotine and tobacco product use can have high costs for individuals who smoke or vape. I explored the impact that including these costs had on the results of the cost-effectiveness analysis through a scenario analysis that excluded these costs. In this scenario, there were no cigarette use costs for individuals who smoke. For the ENDS cessation intervention arm, I included the initial cost of the vaping device and cartridges but excluded all costs associated with additional e-liquids for those in the vaping state.

4.2.4.4 Non-Dominated Scenario

In the final scenario analysis, I examined the impact of a non-dominated ranking of cessation interventions on equity-weighted results. I adjusted the model input parameters for the costs end effects of cessation interventions as documented in Table 4-3 and excluded nicotine and tobacco product costs. For each intervention, the cost and efficacy inputs are within the sensitivity ranges presented in Table 4-2 with higher costs and lower efficacy for varenicline and lower costs and higher efficacy for all other interventions. I calculated ICERs, as well as NHB and NEB.

Table 4-3: Intervention Cost and Efficacy Input Parameters for the Non-Dominated Scenario Analysis

Intervention	**Cost Input ($)**	**Efficacy Input (Risk Ratio)**
Bupropion	25	1.72
Electronic Nicotine Delivery Systems	1,000	2.46
Nicotine Replacement Therapy	226	2.09
Varenicline	195	2.15

4.2.5 Sensitivity Analyses

Extensive sensitivity analyses evaluated how net health and equity benefits changed under different assumptions. I conducted both one-way and probabilistic sensitivity analyses, in line with recommendation on CEA best practices. [300,301]

4.2.5.1 Sensitivity Analyses of Model Input Parameters

Input ranges for one-way sensitivity analysis are presented in Table 4-2. One-way sensitivity analyses assessed the impact of a single parameter on the analysis results while holding all else constant. I varied cessation intervention efficacy across the 95% confidence

interval for each intervention, the costs of cessation interventions, the probability of continued ENDS use, and the relative risk of ENDS compared to combustible cigarettes. I also varied the magnitude of the equity weighting to assess how differences in equity preferences impact the results using the upper and lower bounds of the confidence intervals of equity weights.

The probabilistic sensitivity analysis (PSA) simultaneously varied all parameters based on the PSA distributions presented in Table 4-2. The analysis also included different allocations of health opportunity costs between the equity subgroups with a random distribution of health opportunity costs across the four equity-relevant subgroups. Background smoking cessation rates, mortality rates, smoking-related healthcare costs, and quality of life estimates were not varied in sensitivity analyses.

4.3 Results

4.3.1 Base Case Analysis

4.3.1.1 Traditional Cost-Effectiveness Results

In the base case, varenicline is the least costly and most effective cessation intervention, dominating all other cessation interventions (Table 4-4).

Table 4-4: Incremental Cost-Effectiveness Ratios of Smoking Cessation Interventions per 1,000 Current Smokers

Intervention	Total Costs	Total QALYs	Incremental Costs	Incremental QALYs	ICER
Varenicline	117,240,304	10,395			
NRT	117,606,144	10,381	365,840	-14	Dominated
Bupropion	117,688,069	10,361	447,765	-33	Dominated
No Treatment	118,056,992	10,330	816,687	-65	Dominated
ENDS	121,695,042	10,391	4,454,737	-3	Dominated

Despite being dominated by varenicline, the incremental NHB of each cessation interventions relative to no treatment shows a positive health benefit that outweigh intervention costs at a $100,000 per QALY willingness-to-pay threshold (Table 4-5). All interventions have positive health benefits relative to no treatment, and the three FDA-approved pharmacotherapy interventions are all cost-saving relative to no treatment. In contrast, the ENDS intervention increases costs by $3.6 million per 1,000 current smokers treated. The estimated NHB is highest for varenicline (73 QALYs gained per 1,000 current smokers treated) and lowest for ENDS (25 QALYs gained per 1,000 current smokers treated). At the $50,000 per QALY willingness-to-pay threshold, the FDA-approved pharmacotherapy interventions have higher NHB. In contrast, ENDS has a negative NHB, indicating that the health gains would not outweigh the health opportunity costs (Appendix C.5). At a willingness-to-pay threshold of $250,000 per QALY, the NHB of ENDS increases. In contrast, the NHB of the three FDA-approved interventions worsens, with ENDS found to have a higher NHB than Bupropion (Appendix C.5).

Table 4-5: Incremental Net Health Benefit and Net Equity Benefit of Smoking Cessation Interventions per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**87**	**-1,192,044**	**73**	**99**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	73	-2,406,637	46	97
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	129	-976,715	107	139
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	89	-1,175,461	56	101
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	86	86
NRT	**Overall**	**10,381**	**117,606,144**	**51**	**-450,847**	**69**	**-650,197**	**56**	**75**
	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	59	-1,594,786	36	75

	Racially or ethnically minoritized and ≥200% FPL	12,327	142,188,054	92	-198,434	120	-257,150	94	122
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	69	-511,293	41	74
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	62	62
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**40**	**-574,333**	**35**	**46**
	Racially or ethnically minoritized and <200% FPL	10,958	127,101,956	15	-649,905	32	-1,369,675	21	45
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	74	-190,205	58	76
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	28	-684,109	19	35
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	45	45
ENDS	**Overall**	**10,391**	**121,695,042**	**62**	**3,638,050**	**83**	**5,096,841**	**25**	**32**
	Racially or ethnically minoritized and <200% FPL	10,986	130,763,576	43	3,011,715	90	6,347,189	12	26
	Racially or ethnically minoritized and ≥200% FPL	12,328	146,664,693	93	4,278,205	120	5,544,126	50	65
	Non-Hispanic white and <200% FPL	9,675	114,675,500	44	3,194,254	79	5,786,711	12	21
	Non-Hispanic white and ≥200% FPL	10,159	116,513,409	73	4,002,644	73	4,002,644	33	33

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

Cessation interventions have differential effects across the equity dimensions depending on the background smoking cessation and mortality rates for those equity groups. I find higher NHB for cessation interventions among the higher income, racially/ethnically marginalized group and lowest NHB among the limited income, not racially/ethnically marginalized group.

4.3.1.2 Equity-Weighted Cost-Effectiveness Results

NEB values are also reported in Table 4-5. Across all interventions, equity weighting increases the net benefit of interventions while keeping the intervention ranking consistent. NEB values range from 32 equity-weighted QALYs gained per 1,000 current smokers treated with ENDS to 99 equity-weighted QALYS per 1,000 current smokers treated with varenicline.

The NEB values also vary across the equity-relevant subgroups and between interventions. The highest NEB is seen among the higher income, racially/ethnically marginalized group, given the higher NHB for this group. For varenicline and NRT, equity weighting results in greater NEB for the lower-income groups than for the high-income, NHW reference group, suggesting that while these interventions have lower health benefits in the low-income groups, the additional value placed on improving equity results in greater benefit overall.

NEB values follow the same pattern as NHB values when the willingness-to-pay threshold changes. At the $50,000 per QALY willingness-to-pay threshold, the FDA-approved pharmacotherapy interventions have higher NEB than in the base case. In contrast, ENDS has a negative NHB which results in a negative NEB, suggesting it would harm equity given the health opportunity costs exceeding the health benefits in almost all equity-relevant subgroups

(Appendix C.5). At a willingness-to-pay threshold of $250,000 per QALY, the NEB of ENDS increases. In contrast, the NEBs of the three FDA-approved interventions worsen, with ENDS found to have a higher NEB than Bupropion (Appendix C.5).

4.3.2 Scenario Analyses

4.3.2.1 Health Opportunity Costs

Given the uncertainty around the allocation of health opportunity costs between the equity groups, I plot the NHB and NEB results on the equity-efficiency impact plane with different levels of health opportunity cost accrued to a specific equity group (Figure 4-2). There are increased equity benefits for the three FDA-approved pharmacotherapy interventions when the health opportunity costs are allocated to the highly valued lower-income groups as these interventions are cost-saving (Panel A and Panel C). Health equity worsens for these interventions when more opportunity costs are allocated to the higher-income groups (Panel B and Panel D). The ENDS intervention sees the largest impact of the allocation of health opportunity costs given their higher costs overall. For ENDS, equity worsens when more health opportunity costs are accrued to the lower income groups (Panel A and Panel C). At the same time, it improves when more of the costs are allocated to the higher-income groups (Panel B and Panel D). When all health opportunity costs are allocated to the limited income and racially/ethnically minoritized group (Panel A), ENDS have almost no equity benefit (6.4 equity-weighted QALYs gained per 1,000 current smokers). Similar results are seen when apportioning health opportunity costs across a single equity dimension (Figure 4-3).

While in both scenario analyses, overall NEB remains positive; there are stark differences in the estimated benefits within equity groups. As shown in Appendix C.6, for both sets of analyses, I find decreasing benefits within equity-relevant subgroups when that particular group bears more opportunity cost burden, often resulting in a negative benefit for that group. However, in all instances, these are outweighed at the population level by the positive benefits to other equity-relevant subgroups.

Figure 4-2: Equity-Efficiency Trade-offs for Smoking Cessation Interventions with Differing Levels of Health Opportunity Costs by Equity-Weighted Subgroup

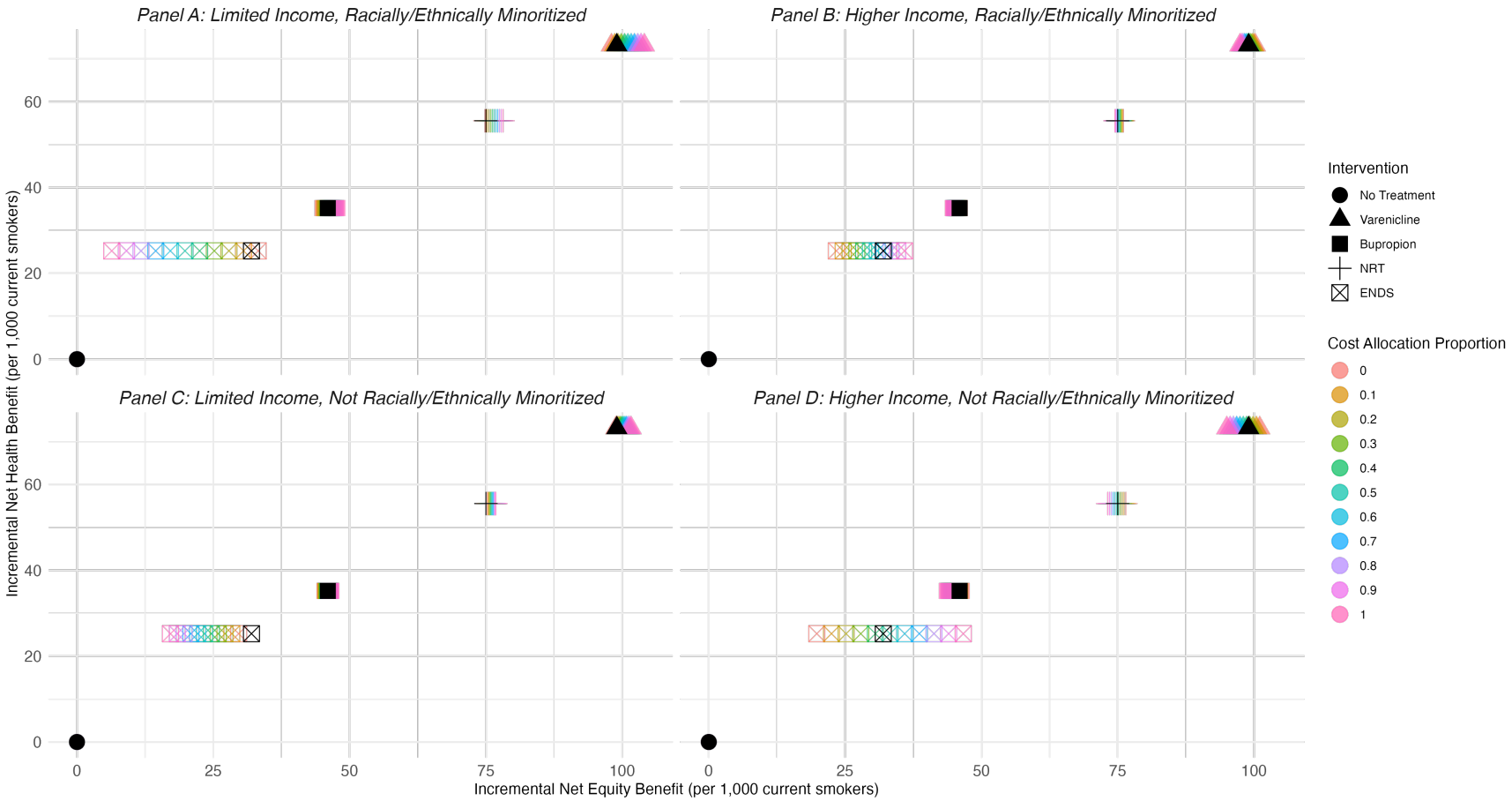


Figure Legend: The figure displays the incremental net health and net equity benefits of cessation interventions with varying proportions of health opportunity costs allocated to the equity subgroup in the panel title. The remaining health opportunity costs not allocated to the given equity subgroup are split equally between the three other subgroups. For instance, in Panel A, when the 40% of health opportunity costs allocated to the Racially/Ethnically Minoritized group with household income <200% of the federal poverty level, then 20% of the total health opportunity costs are allocated to each of the three remaining subgroups. The black icons represent the base case NEB and NHB values.

Figure 4-3: Equity-Efficiency Trade-offs for Smoking Cessation Interventions with Differing Levels of Health Opportunity Costs by Equity Dimension

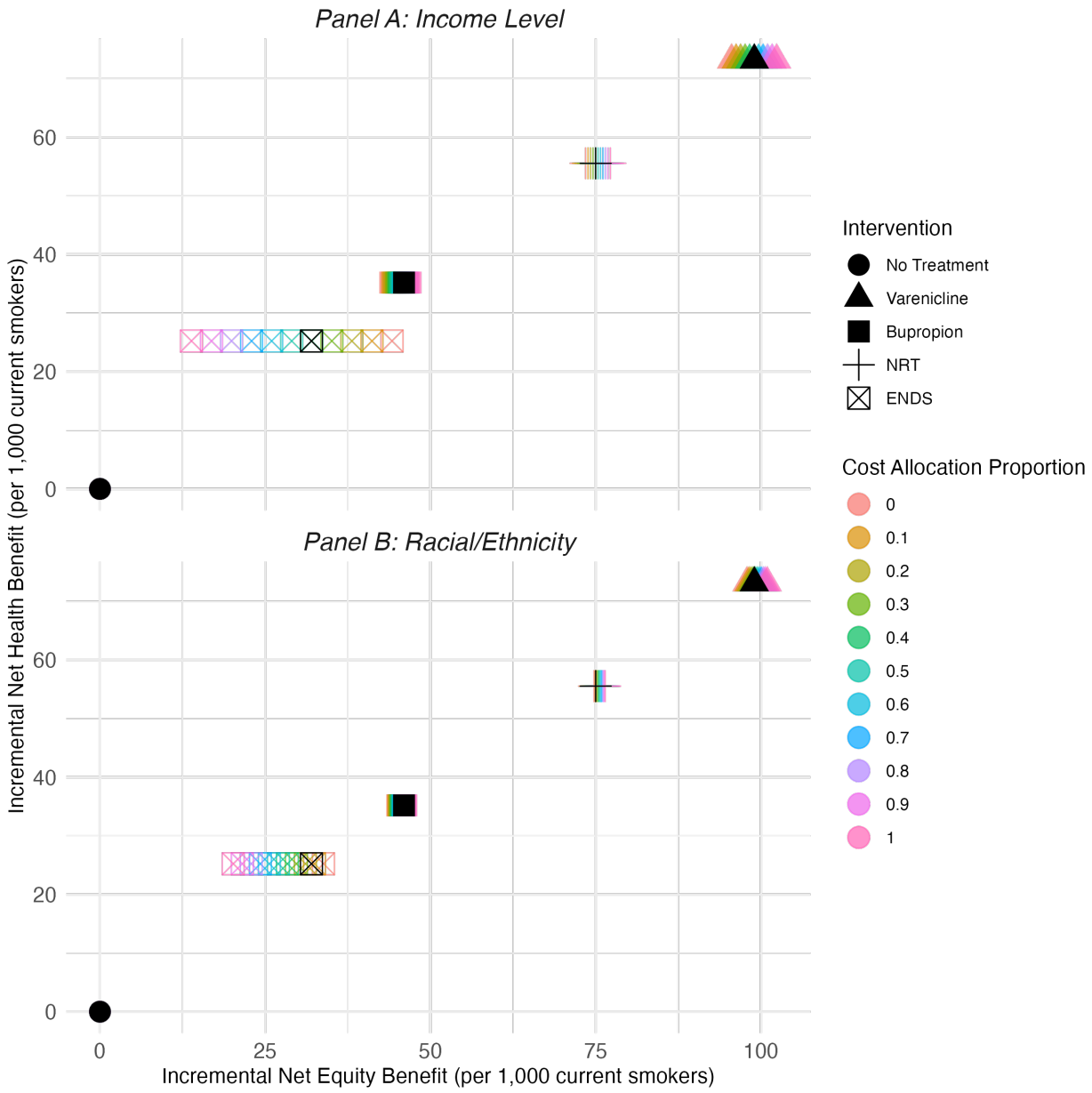


Figure Legend: The figure displays the incremental net health benefit and net equity benefit of cessation interventions with varying proportions of health opportunity costs allocated between the two levels of equity dimension in the panel title. The cost allocation proportion indicates the proportion of the health opportunity costs allocated to the more marginalized group within the dimension (income of <200% FPL and racially/ethnically minoritized). The health opportunity costs are then allocated to equity subgroups within the dimension proportionally based on their population size before being weighted and summed to estimate NEB. The black icons represent the base case NEB and NHB values.

4.3.2.2 No Continued ENDS Use

In the scenario analysis that assumes no continued ENDS use, meaning that no current smokers who successfully quit combustible cigarette use transition to a vaping state, I find increases in the effects of ENDS and reductions in the costs of the intervention relative to the base case. However, compared to varenicline, ENDS have an incremental cost-effectiveness ratio of $356,932 per QALY gained (Table 4-6), well above the commonly used thresholds of cost-effectiveness in the US. The NHB of ENDS increases from 25 QALYs gained per 1,000 current smokers treated in the base case to 57 QALYs gained, and the NEB increases from 32 equity-weighted QALYs gained in the base case to 74 equity-weighted QALYs gained (Appendix C.7), similar to NRT in the base case analysis.

Table 4-6: Incremental Cost-Effectiveness Ratios for No Continued ENDS Use Scenario Analysis per 1,000 Current Smokers

Intervention	Total Costs	Total QALYs	Incremental Costs	Incremental QALYs	ICER
Varenicline	117,240,304	10,395			
NRT	117,606,144	10,381	365,840	-14	Dominated
Bupropion	117,688,069	10,361	447,765	-33	Dominated
No Treatment	118,056,992	10,330	816,687	-65	Dominated
ENDS	119,536,320	10,401	2,296,016	6	356,932

4.3.2.3 No Nicotine and Tobacco Product Costs

When removing all future tobacco product costs, total costs for all interventions decrease and the rank order of the interventions by costs changes. The FDA-approved cessation interventions are no longer found to be cost-saving, and bupropion and varenicline are both cost-effective, with ICERs of $9,600 and $10,527 per QALY gained, respectively. NRT and ENDS are dominated, with higher costs and fewer QALYs gained than varenicline. The incremental

NHB and NEB for the FDA-approved pharmacotherapy interventions worsen as these interventions are no longer cost-saving, while the ENDS intervention has higher NHB and NEB values (Appendix C.8).

Table 4-7: Incremental Cost-Effectiveness Ratios for No Nicotine and Tobacco Product Costs Use Scenario Analysis per 1,000 Current Smokers

Intervention	**Total Costs**	**Total QALYs**	**Incremental Costs**	**Incremental QALYs**	**ICER**
No Treatment	93,913,451	10,330			
Bupropion	94,215,935	10,361	302,484	32	9,600
Varenicline	94,568,358	10,395	352,423	33	10,527
NRT	94,617,275	10,381	48,917	-14	Dominated
ENDS	96,963,334	10,391	2,394,976	-3	Dominated

4.3.2.4 Non-Dominated Scenario

By adjusting the costs and efficacy values of the cessation interventions across their expected ranges, I generated a ranking of non-dominated interventions, except for nicotine replacement therapy (Table 4-8). In this hypothetical scenario with higher cost and lower efficacy varenicline and lower cost and higher efficacy for the remaining interventions, the bupropion, varenicline, and ENDS interventions are all cost-effective under commonly adopted thresholds for cost-effectiveness in the US. The net health and equity benefit results are presented in Appendix C.9. At the lowest willingness-to-pay threshold ($50,000 per QALY), varenicline has the highest health and equity benefits. As the willingness-to-pay threshold increases, the ENDS intervention becomes more beneficial relative to the other interventions. At the $100,000 per QALY willingness-to-pay threshold, ENDS are estimated to have a NHB of 47 QALYs per 1,000 current smokers and an NEB of 62 equity-weighted QALYs per 1,000 current smokers, exceeding the NHB and NEB of varenicline at 45 QALYs and 60 equity-weighted

QALYs, respectively. At the $250,000 per QALY threshold, ENDS have the highest health, and equity benefits relative to the other cessation interventions (aTable C.9-3).

Table 4-8: Incremental Cost-Effectiveness Ratios for Non-Dominated Scenario Analysis per 1,000 Current Smokers

	Costs	Effects	Incremental Costs	Incremental QALYs	ICER
No Treatment	93,913,451	10,330			
Bupropion	94,207,645	10,365	294,195	36	8,233
Varenicline	94,498,415	10,380	290,770	15	19,604
NRT	94,514,633	10,378	16,218	-2	Dominated
ENDS	95,395,334	10,391	896,919	11	81,210

When comparing the results of the non-dominated analysis to the base case, the non-dominated results find worse health and equity benefits for varenicline and NRT due to the elimination of the cost savings from the exclusion of nicotine and tobacco product costs as discussed in Section 4.3.2.3 and the lower efficacy of varenicline. Meanwhile, ENDS is more attractive given the lack of continued ENDS use costs, lower intervention costs and higher efficacy than in the base case. The overall result of equity weighting, where cost-effective interventions based on their NHB look increasingly beneficial, does not change when having a set of non-dominated interventions, as the distribution of health benefits and costs across the four equity groups remains consistent in this scenario.

4.3.3 Sensitivity Analysis Results

4.3.3.1 One-Way Sensitivity Analyses

One-way sensitivity analyses independently explore the impacts of a change in one parameter value. I conducted one-way sensitivity analyses examining the impact of cessation intervention efficacy, cessation intervention costs, the proportion of ENDS users who transition

to vaping, and the relative risk reduction of vaping compared to smoking. One-way sensitivity analyses illustrate the impact of the uncertainty in ENDS input parameters in particular but overall find limited effects of changing single parameters independently (Appendix C.10 – C.14). The rankings of interventions by NHB and NEB do not change when intervention efficacy is varied. At the lowest efficacy value for ENDS, the intervention has a negative NHB and NEB, suggesting that the costs outweigh any potential benefits. When the costs of cessation interventions decrease, the ENDS intervention may become more cost-effective than bupropion with a higher NHB and NEB. Likewise, lower continued ENDS use and lower mortality effects from ENDS improve the intervention. Lower continued use results in NHB and NEB values similar to bupropion in the base case. Finally, varying the magnitude of the equity weights changes the size of the equity benefit but not the overall rankings of interventions.

4.3.3.2 Probabilistic Sensitivity Analyses

I conducted a PSA where multiple model input parameters were varied in combination. The results of the PSA are plotted on the cost-effectiveness plane (Figure 4-4). The PSA results are broadly consistent with those in the base case, one-way sensitivity analyses, and scenario analyses. Relative to the no treatment intervention, all three FDA-approved pharmacotherapy interventions are expected to be cost-saving in almost all iterations of the PSA. While varenicline has the highest health effects, there is considerable overlap in costs and health effects between varenicline and NRT. The ENDS intervention is expected to increase healthcare costs relative to no treatment while providing positive health gains but there is more uncertainty around its costs and effects.

Figure 4-4: Cost-Effectiveness Plane of Probabilistic Sensitivity Analysis Results

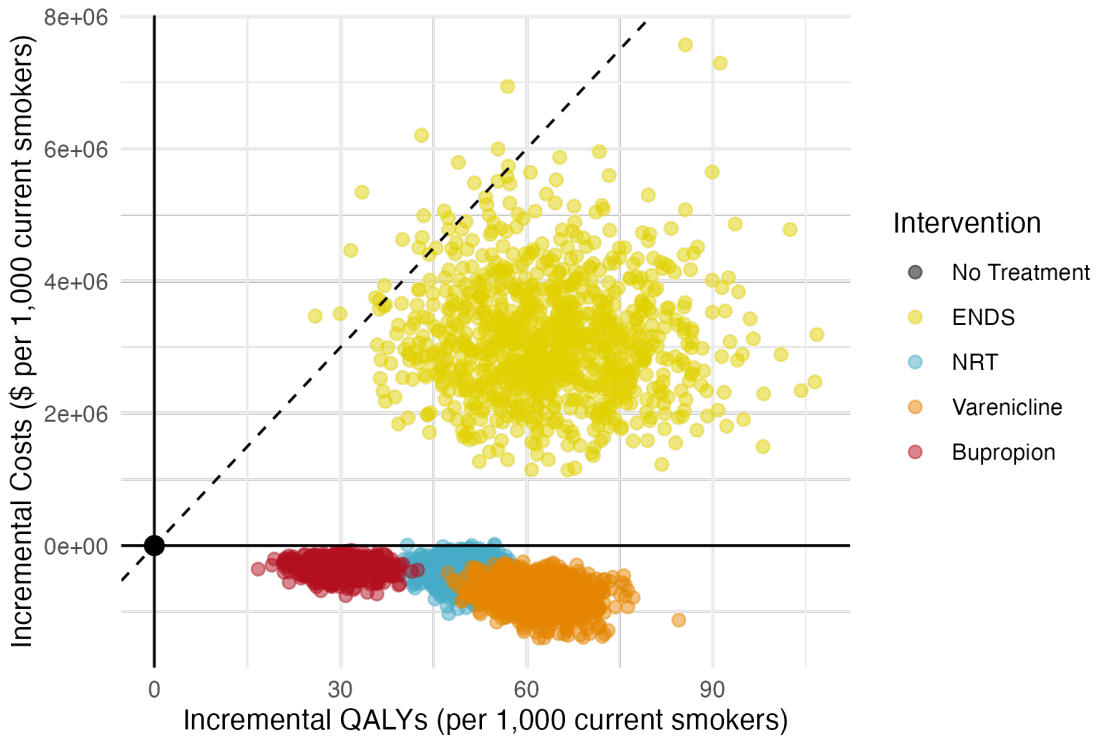


Figure Legend: Each dot represents the estimated costs and QALYs from one model run with different input parameters relative to the no treatment intervention. The dashed line represents the $100,000 per QALY willingness to pay threshold.

I calculate incremental NHB and NEB for each PSA iteration and plot them on the equity-efficiency plane (Figure 4-5 and Figure 4-6). Varenicline again appears to be the most attractive intervention with the highest NHB and NEB across most parameter sets. The uncertainty around the costs and benefits of ENDS results in a wide spread of NHB and NEB values that overlap with other cessation interventions. The 95% confidence interval around the PSA results for ENDS fully encapsulates the NRT and bupropion results and has considerable overlap with the results from the varenicline scenario. When health opportunity costs are allocated randomly across the four equity subgroups (Figure 4-6), NEB values have a greater spread than when allocated to the group that accrues them (Figure 4-5). I find some instances of equity-efficiency trade-offs with the ENDS intervention. In 4.4% of PSA runs, the ENDS

intervention has positive health impacts but negative equity impacts (Figure 4-6). In 2% of PSA runs, the ENDS intervention has negative health and equity effects (Figure 4-6) at a willingness to pay threshold of $100,000 per QALY.

Figure 4-5: Net Health and Equity Benefits of Smoking Cessation Interventions Plotted on the Equity-Efficiency Plane, Opportunity Costs Allocated to the Group that Accrues Them

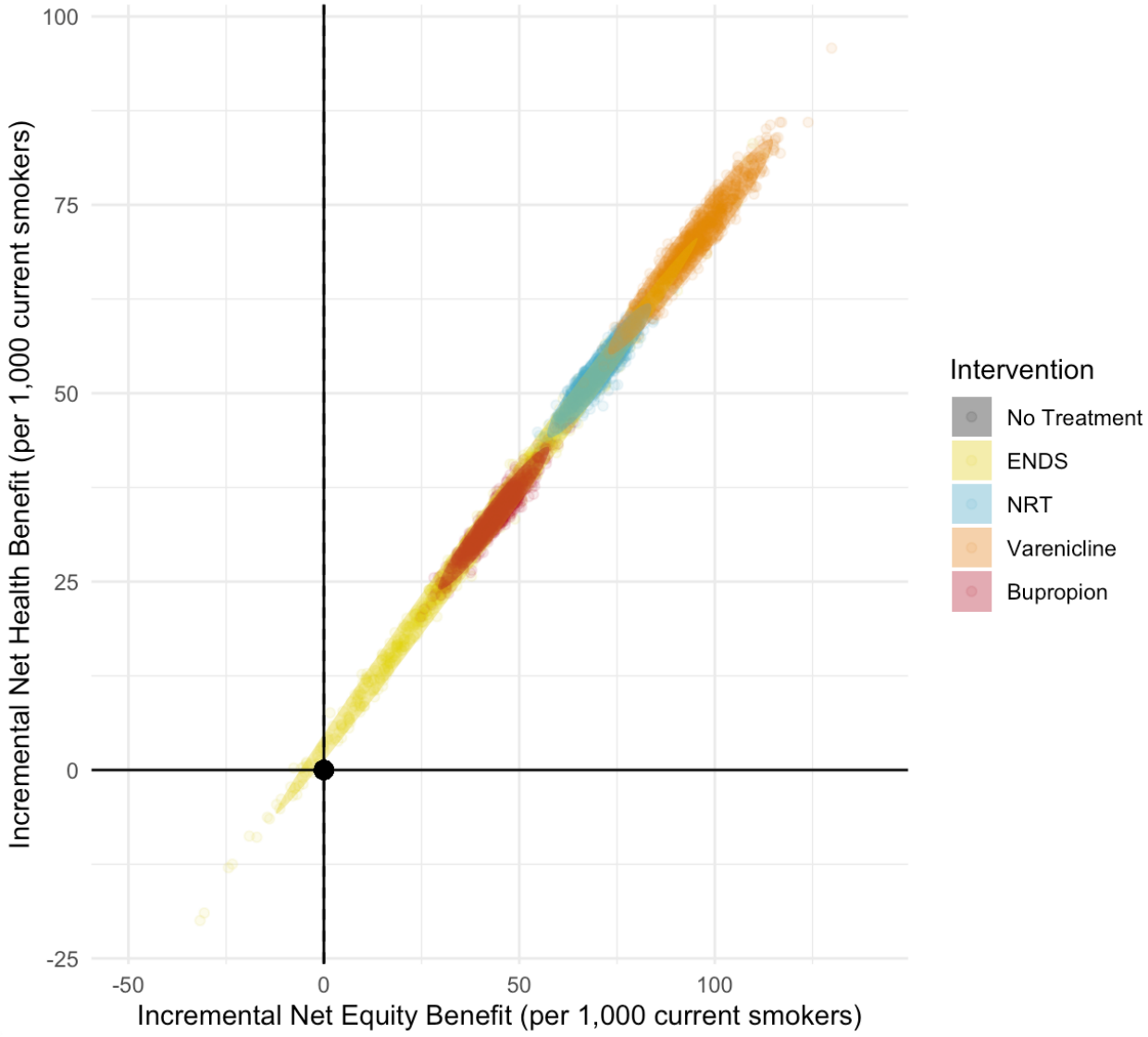


Figure Legend: Each point represents the incremental net health and equity benefit from single run of the model with a different parameter relative to no treatment. The ellipses encompass the 95% confidence interval based on the PSA results.

Figure 4-6: Net Health and Equity Benefits of Smoking Cessation Interventions Plotted on the Equity-Efficiency Plane, Opportunity Costs Allocated Randomly Across Groups

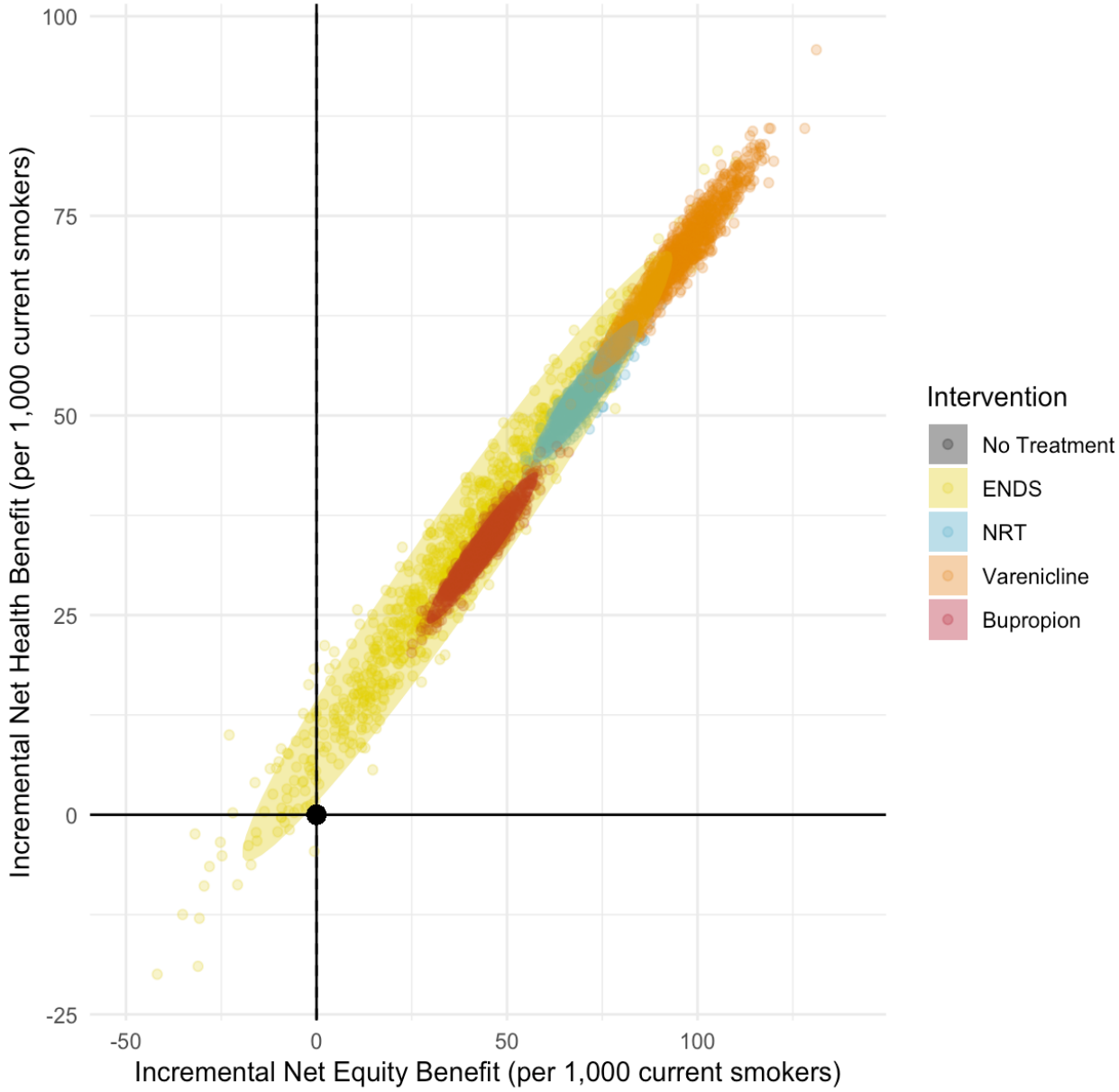


Figure Legend: Each point represents the incremental net health and equity benefit from single run of the model with a different parameter relative to no treatment. The ellipses encompass the 95% confidence interval based on the PSA results.

4.4 Discussion

In this equity-informative cost-effectiveness analysis, I demonstrate how direct equity weighting can be incorporated into a cost-effectiveness analysis to estimate health, and equity

impacts of smoking cessation interventions. I found positive health and equity benefits of nicotine replacement therapy, bupropion, and varenicline, all of which are expected to reduce healthcare costs at the societal level, with varenicline being the dominant intervention in the base case analysis. Meanwhile, the value of ENDS is more uncertain. The ENDS intervention is expected to provide positive health and equity benefits in the base case, yet there are scenarios in which ENDS are expected to have higher costs than health benefits depending on the willingness-to-pay threshold adopted. While the results of this analysis demonstrate to decision-makers the positive health and equity benefits of cessation interventions, particularly the three FDA-approved pharmacotherapy interventions, the analysis highlights considerable uncertainty in equity-informative methods and input parameters for ENDS. Taken in the context of this dissertation more broadly, this paper illustrates multiple key assumptions and methodological choices that limit the potential use of equity-informative analyses for decision making including assumptions around access and uptake, the use of equity dimension-specific input parameters, the allocation of health opportunity costs, and how equity benefits are valued.

The question of whether ENDS use provides value for smoking cessation will depend on their adoption by individuals who smoke relative to the use of other cessation interventions. The analysis presented here assumes that all smokers will receive the smoking cessation intervention at the first time point in the model and that all smokers will adhere to the intervention at a similar level as those in the clinical trials included in the Cochrane reviews. The access and adherence assumptions overestimate the health and equity benefits of cessation interventions as research has documented differences in access to healthcare services, including smoking cessation interventions, across various equity dimensions.[105] Given the importance that was placed in

improvements to access outlined in Chapter 2, including access-related issues should be an essential part of future equity-informative CEAs.

Within the context of smoking cessation, there are documented disparities in the use of cessation interventions related to differences in tobacco use behaviours, healthcare utilization, income, and race/ethnicity.[105] Studies have documented how lower income individuals are less likely to be asked by healthcare providers about their tobacco use and less likely to be counseled to quit smoking.[302] A study using 2022 data from NHIS found that only 14.8% of smokers used a prescription drug for smoking cessation, while 24.3% used ENDS, and 46.6% used some form of nicotine replacement therapy.[109] Individuals may also incorrectly use the cessation intervention provided to them, which would reduce effectiveness. Adherence to nicotine patches and prescription pharmacotherapies is often poor, and nicotine gum may be misused.[303-307] Finally, some individuals may simply prefer certain interventions over others leading to different levels of adoption and adherence. Limited uptake or improper use of these interventions would decrease the expected health benefits of cessation, and differential uptake across equity dimensions could negatively impact estimated equity benefits. If ENDS cessation uptake was higher than the uptake of varenicline, the differences in the results in overall cessation may lead to a more favourable comparison between ENDS and varenicline. Uptake likely also intersects with equity dimensions where poorer individuals may have less adequate healthcare coverage and be less able to access prescription interventions like varenicline. Future research should explore the role of uptake on net health and equity benefit of cessation interventions, with particular attention paid to differences in uptake across equity dimensions of interest.

This study has important implications for equity-informative CEA applications. This analysis finds limited effects of equity weighting for the three cost-saving interventions. The benefits of the cost-saving interventions are improved by equity weighting. For the ENDS intervention, which has some trade-offs in costs and health effects, equity weighting resulted in some scenarios with trade-offs between equity and efficiency. Still, most results found positive health and equity benefits. The limited trade-offs between equity and efficiency may be partly due to few equity-specific effects of cessation interventions. While this analysis did include equity dimension-specific mortality and background cessation inputs, the effects of cessation interventions themselves were assumed to be equal across equity-relevant subgroups. Including the aforementioned data on intervention uptake, additional data on the potential differential effects of cessation interventions across equity dimensions would be a valuable addition to this analysis. Understanding the extent to which equity benefits depend on equity dimension-specific input parameters will be important for analysts implementing equity-informative CEAs.

Given the infancy of equity-informative CEA, it is unclear what aspects of the analysis drive equity benefits. Previous analyses have found that including equity benefits typically results in interventions that look more valuable.[138,139,142,143] This may be partly due to the selection bias of researchers who conduct analyses on interventions that are expected to have equity benefits. In this study, I only tested one set of the equity weights generated in Chapter 3, but varying the equity weights in one-way sensitivity analyses had limited effects on the results, simply changing the magnitude of the equity benefit. Given the similarity in equity weights of Models 2 and 3, using alternative weights likely would not have had much effect on the results. Further exploration of the impact of the weights is warranted; a three-way sensitivity analysis

that varies the weights for each equity-relevant subgroup independently could provide more insight into the impact of weighting than the simple one-way analysis presented here. Studies that adopt social welfare function approaches to equity weighting have reported similar findings, where intervention rankings often remain consistent as the inequality aversion parameter increases beyond a low level of inequality aversion.[138,139] What does appear to matter in this, and other equity-informative analyses, are the distribution of health opportunity costs.[139] As more health opportunity costs are allocated to the worst-off groups, equity benefits of interventions typically appear worse.[139] Yet, it is unclear how these health opportunity costs are allocated in society. As more equity-informative analyses are conducted in various disease states, it will be essential to consider what factors impact the results of an equity-informative analysis.

4.4.1 Limitations

This paper has important limitations that must be considered when interpreting the results. First, the model developed for this paper does not include nicotine product relapse. Individuals who successfully quit smoking and vaping cannot re-initiate either smoking or vaping. The cessation rates used in this model are based on individuals who have quit for at least two years.[256] Most relapse occurs within the first two years after quitting.[284,308] By excluding those who relapse in the first two years, the smoking cessation rates used in the model can be considered net of relapse. Less evidence is available on relapse for ENDS use. Analyses of PATH data suggest that ENDS use is a less stable product use category, and individuals may move into and out of periods of ENDS use, which may mean relapse is more common.[291] Additionally, ENDS cessation rates are based on the probability of quitting ENDS use among all exclusive ENDS users in PATH and not just those who have transitioned from combustible

cigarettes to ENDS. If former cigarette users who currently vape are more likely to quit than the average vaper or have lower relapse rates, then the results of the model underestimate the health benefits and overestimate the costs of vaping.

Second, the results of the analysis were not stratified by age. This limitation is due to a paucity of data for the efficacy of the included cessation interventions at different ages. Previous research has identified mixed effects of cessation by age. There are conflicting results on the efficacy of cessation interventions at younger ages, while studies of older ages report results consistent with the efficacy seen among the general smoking population.[309-312] Compared to the robust literature on the efficacy of smoking cessation interventions in the general population, these reviews report on limited studies and are not able to directly compare different pharmacotherapy interventions.[309-312] The exclusion of any age stratification potentially masks important trends in the health and economic effects of these interventions. At older ages, higher background cessation rates would result in more people quitting due to cessation interventions, but these individuals stand to gain fewer health benefits due to decades of smoking and higher medical costs which would likely result in poorer cost-effectiveness. For younger age groups, there are greater potential health benefit, but lower background cessation rates and the fact that future health benefits would be heavily discounted could limit their economic value. At younger ages, uptake of cessation interventions is also lower, which could reduce their expected benefit.[311] Stratifying by age also introduces a methodological challenge for the equity-informative results. Analysts looking to conduct equity informative analyses by age must consider how health opportunity costs are distributed across age groups. Younger age groups may have a higher burden of the health opportunity costs, as they contribute more in taxes,

particularly Federal Insurance Contributions Act taxes which fund healthcare for older age groups. Future research should explore the differential effects of cessation by age.

Third, I assume that ENDS are only available in the ENDS cessation intervention arm, similar to how ENDS would be evaluated in a randomized controlled trial. This does not reflect the real-world nicotine and tobacco marketplace where ENDS are the second most commonly used nicotine product and may be used in conjunction with other cessation interventions.[109,217] The inclusion of ENDS in the simulation of other cessation intervention arms would likely result in more individuals quitting smoking, given the large numbers who report quitting smoking with the help of ENDS. This would have health benefits and benefits could exceed those seen in the ENDS scenario if the use of other cessation interventions resulted in lower levels of continued ENDS use. Without data on the effects of the co-use of ENDS and FDA-approved pharmacotherapy interventions any analysis examining these potential effects would be highly speculative.

Fourth, I did not include any utility from tobacco product use. Economists have estimated a lost consumer surplus that arises from quitting smoking, and the FDA has included the lost consumer surplus as a cost associated with graphic warning labels.[313,314] The use of the lost consumer surplus was greatly debated, and one group of prominent economists argued that consumer surplus should only be accounted for among smokers who started smoking in adulthood.[314] With state variation in legal smoking ages and the recent move to a national purchase age of 21, this approach poses challenges to implement. Given that few smokers initiate tobacco use after the age of 21, it is estimated that using 21 as the threshold for consumer surplus

would reduce this surplus by 91.8%.[314] The potential utility gained from ENDS use may represent a more substantial effect. Individuals who quit combustible cigarette use with ENDS may experience high utility from using the ENDS product compared to using cigarettes. To date, no studies have estimated the potential utility that individuals who quit smoking using ENDS gain from their ENDS use. Given the marginal effects of lost consumer surplus for combustible tobacco use and the lack of data on the utility of ENDS use for cessation, I did not include consumer surplus in the model.

Finally, there are limitations related to the equity weights and how they are operationalized in the model. Equity-informative CEA results are only as reliable as the equity weights used. The results in Chapter 3 outline numerous limitations with these weights including a greater preference for the all income group and all racial/ethnic group levels in the DCE and some illogical equity weights from the LCA which indicate a breakdown of the method used to generate the weights. Additional analyses that explore other equity-weighting approaches and qualitative work to compare concordance between equity weighted results and survey respondent preferences would aid in determining the reliability of these results. Additionally, I assume that equity dimensions are fixed over the life course. While this may be apt for an immutable dimension of equity such as race/ethnicity, it is possible that the degree to which individuals are marginalized because of their race/ethnicity changes. Mutable dimensions, such as poverty level, change over time. Previous research has documented the instability of income in the US.[315-318] This is more likely to impact the lower income group, given that income instability is higher among this population. However, it may still impact those whose income is at the lower end of the higher income group modelled here. One study found that among a sample of households

with income greater than 200% of the federal poverty level, one-third experienced at least one month of poverty in twelve months.[319] Assuming a fixed income level ignores the dynamic nature of income in the US. It is unclear how weighting exercises should account for dynamic changes in income and how the public perceives these changes.

4.5 Conclusions

In this study, I designed a microsimulation model to estimate the net health and equity benefits of ENDS for smoking cessation relative to other pharmacotherapy-based cessation interventions. This analysis found that varenicline, bupropion, and nicotine replacement therapy are all expected to be cost saving, with varenicline providing the greatest health benefits and cost savings. Subsequently, varenicline had the highest health and equity benefits – dominating the other cessation interventions. ENDS were found to have higher costs associated with their use but to have positive net health and equity benefits at a willingness-to-pay threshold of $100,000 per QALY relative to no treatment. The equity benefits of interventions, particularly the ENDS intervention, were sensitive to assumptions regarding the distribution of health opportunity costs. Before the results from this and other equity-informative CEAs are used to assist in decision-making processes, considerably more work is needed to ensure the validity of equity weights, determine the distribution of opportunity costs, assess differential access to interventions, and understand the potential value placed on improved access versus equity.

Chapter 5 Conclusions

5.1 Summary

Working to improve health equity is valuable in its own right. A fair, accessible, and equitable health system is paramount. However, decision-makers must often seek to balance competing priorities such as controlling costs, improving health outcomes, and promoting equity. In this dissertation, I sought to provide evidence needed to quantitatively incorporate the value of health equity into decision science methods for valuing health interventions. I demonstrated how novel methods for incorporating the value of health equity into cost-effectiveness analysis can be applied in the context of smoking cessation interventions. The results of this dissertation will be of particular interest to decision-makers and methodologists considering whether equity weighting should be incorporated into their economic evaluations, such as the Health Economics Methods Advisory group including ICER, NICE, and CDA. The results may also be of interest to US states and Canadian provinces who are looking to build fairer healthcare systems in their jurisdictions and more broadly by those who wish to conduct equity-informative analyses of policies and interventions beyond the allocation of healthcare resources.

In Chapter 2, I used focus groups and best-worst scaling to understand public priorities for improving the fairness of the healthcare systems in Canada and the United States. Respondents in the focus groups and survey highlighted the importance of improving access to healthcare services. In the best-worst scaling survey, respondents valued system functioning improvements like reducing costs for individuals in the US and reducing wait times in Canada,

and equity improvements focused on access across equity dimensions more so than improving outcomes. Through latent class analysis, I identified three groups of respondents with different preferences in the US and two in Canada, yet they were somewhat consistent in their most important attributes. The main differences between classes were based on the attributes that were ranked as least important.

Chapter 3 presented the results from a discrete choice experiment where respondents were asked to select healthcare interventions that targeted groups of individuals who differed based on their income level and experiences with racial/ethnic discrimination. I found that respondents consistently prioritized interventions that did not target groups based on their income level or experience with racial/ethnic discrimination. Across a variety of utility functions and in both countries, respondents were most likely to select programs that improved the health of people of all income levels or all races and/or ethnicities. Despite this, there were preferences for improving the health of marginalized groups (those with limited income and those likely to experience racial/ethnic discrimination) relative to the more privileged groups (those with higher income and those unlikely to experience racial/ethnic discrimination). Results from this survey were used to develop intersectional direct equity weights that represented the value of QALY gains across equity dimensions. Estimated weights ranged form 1.19 (95% CI of 1.11 − 1.27) to 2.30 (95% CI of 2.03 − 2.57) in the US and 0.87 (95% CI of 0.80 − 0.94) to 1.84 (95% CI of 1.53 − 2.14) in Canada. The highest weight was typically placed on the limited income and likely to experience discrimination group, but variations were seen in some utility functions tested. Ultimately, the use of equity weights is undermined by the findings that the “all” level is most preferred. Further investigation is needed to understand what motivated the preference for all

groups prior to using these weights for decision-making purposes. While only limited differences in results were seen across a variety of sociodemographic characteristics, latent class analysis identified six groups of respondents with divergent preferences in the US and five groups in Canada. These latent classes had differences in preferences for the allocation of health resources by income level and experience with discrimination which resulted in some negative and illogical weights which indicate instability in the methods used to generate the weights.

In Chapter 4, I applied the direct equity weights from Chapter 3 to estimate the net equity benefit of smoking cessation interventions in the US, including electronic nicotine delivery systems. I found that the three FDA-approved cessation interventions (varenicline, bupropion, and nicotine replacement therapy) are all likely to be cost-saving and provide positive equity benefits. Varenicline is expected to provide the most health (NHB = 73 QALYs per 1,000 current smokers) and equity benefits (NEB = 99 equity-weighted QALYs per 1,000 current smokers) and is expected to dominate the other interventions in most scenarios explored. I also find that ENDS may provide cessation benefits but with lower estimated benefits than the other interventions and a high degree of uncertainty around their costs and health effects, which limits their expected net health (NHB = 25 QALYs per 1,000 current smokers in the base case) and equity benefits (NEB = 32 equity-weighted QALYs per 1,000 current smokers in the base case). The probabilistic sensitivity analysis found an overlap between the health and equity benefits of ENDS and the FDA-approved pharmacotherapy interventions. This study highlights the importance of considering the distribution of health opportunity costs across equity dimensions. Typically, opportunity costs are assumed to be allocated across the population proportionally. In this analysis, I explored multiple different allocations of opportunity costs which had substantial

impacts on the results of the equity-informative analyses, particularly when interventions have high costs, as seen with ENDS. Ultimately, the results of this study show only limited differences between the results of the traditional cost-effectiveness analysis and the results of the equity-informative analysis.

5.2 Future Research Directions

There is considerable work to be done to understand how equity-informative methods should be used in healthcare resource allocation decision making. This includes more work to understand how respondents make choices targeting specific equity dimensions, differences in attitudes toward improving access and promoting health outcomes, concordance between methods for eliciting equity preferences, and elucidating how valuing health equity changes resource allocation recommendations.

Additional qualitative studies are needed to understand how respondents make choices around health equity. “Think aloud” studies, where respondents are asked to think aloud to a researcher as they complete an equity trade-off survey, would provide valuable insights into the decision-making process that drives the selection of different healthcare programs described in Chapter 3. This work could be combined with other methods to elicit equity-efficiency trade-offs, such as social welfare function-based approaches, to understand how different methods for eliciting equity values may result in similar or different choices on the part of respondents. This work would also help to address questions about the validity of choice surveys to elicit equity preferences, a question that will be increasingly central as equity-informative analyses take on a greater role in decision making.

Related to questions about eliciting equity preferences, there is a need to better understand how the public prioritizes different attributes of access compared to reducing disparities in baseline health or improving health outcomes. In Chapter 2, I used focus groups and a best-worst scaling to understand how the public prioritizes different dimensions of equity and efficiency. In many instances, respondents emphasized the importance of improving access over improving outcomes. In focus groups, respondents pointed to the role of individual responsibility and skepticism that health outcomes could be improved broadly. At the same time, the preferences for the "all" levels of equity dimensions in the discrete choice experiment presented in Chapter 3 could result from a desire for broader access. In response to survey questions, over 75% of American and 90% of Canadian respondents agreed that the government should ensure that everyone has access to healthcare as a fundamental right, and similar numbers agreed that it was the responsibility of the government to ensure everyone has a fair chance to live a long and healthy life. Understanding how respondents think about access to care versus a more equal distribution of health outcomes will be important for the continued development of equity-informative methods.

Finally, more work is needed to explore how equity weighting impacts the results of cost-effectiveness analyses. Among the limited number of equity-informative analyses, analysts have typically reported improvements in equity from interventions.[138,139,142,143] I report similar findings here. In my equity-weighted analysis, I identified positive equity effects but there was little difference between the equity-weighted and traditional CEA results. To understand the potential implications of equity weighting in cost-effectiveness analysis, researchers must systematically conduct equity-informative analysis that seek to 1) value equity benefits across a

broad set of disease areas to identify areas where equity weighting provides additional information beyond a traditional CEA, 2) apply different approaches to valuing equity to determine how different approaches may impact decision making, and 3) to better account for real-world inequities and disparities in implementation and effectiveness of interventions so that equity-weighted results reflect expected equity benefits as opposed to an idealized set of results. Doing so would provide more robust information about the additional value of equity-informative analyses beyond traditional approaches to CEA.

While the results of this dissertation show promise for the use of equity-informative CEA, more work is needed before approaches to valuing equity are incorporated into decision-making frameworks in the US and Canada. How these analyses can contribute to that decision making is still uncertain, particularly in the US setting. If equity-informative analyses present exclusively idealized versions of interventions assuming perfect uptake and adherence, they will likely overestimate equity effects and could contribute to propagating inequities rather than mitigating them. Before equity-informative analyses are used in decision making, it is important to elucidate how the interventions being evaluated will be impacted by ongoing inequities in access and affordability of care. Ultimately, those making resource allocation decisions will need to decide how best to account for equity in the decision-making process, whether that is through quantitative approaches like equity-informative analyses and multi-criteria decision analysis, qualitative ones such as citizen juries and deliberative democracy, or some other yet unknown approach.

In a time of rising healthcare costs, rapid innovation, and unequal access to healthcare, methods from decision sciences, including stated preference research and cost-effectiveness analysis, can provide essential insights. By incorporating public preferences for the allocation of healthcare resources into a cost-effectiveness analysis of smoking cessation interventions, this dissertation sought to outline how these approaches can be combined in equity-informative cost-effectiveness analysis. While the research presented here show promise for these methods to inform the equitable allocation of healthcare resources that reflect public values, there is considerably more work needed to foster a more efficient, accessible, and equitable healthcare system for all.

Appendices

Appendix A: Best-Worst Scaling Study Appendices

A.1 Preliminary Attributes for Best-Worst Scaling Survey

aTable A.1-1: Preliminary Attribute List Identified from Scoping Review

Name	Type
Costs	Economic
Willingness-to-pay	Economic
Cost-effectiveness	Economic
Absenteeism	Economic
Current health	Health Benefit
Treatment effectiveness	Health Benefit
Disease severity	Health Benefit
Population level impact of the disease	Health Benefit
Differences in baseline level of health	Health Benefit
Uncertainty in the benefit of treatment	Health Benefit
Patient ability status	Health Benefit
Patient fragility level	Health Benefit
Share of the benefit	Health Benefit
Patient past health status	Health Benefit
Named health conditions	Health Benefit
Patient age	Sociodemographic factor
Patient poverty level	Sociodemographic factor
Patient race/ethnicity	Sociodemographic factor
Patient gender	Sociodemographic factor
Patient income level	Sociodemographic factor
Patient lifestyle factors	Sociodemographic factor
Whether patients are parents or carers	Sociodemographic factor
Patient employment status	Sociodemographic factor
Patient relationship status	Sociodemographic factor
Number of individuals treated	System Functioning
Order of patient arrival	System Functioning
Treatment order	System Functioning
Timing of treatment	System Functioning
Time to treat patients	System Functioning

Patient travel distance	System Functioning

aTable A.1-2: Preliminary Attribute List Based on Scoping Review and Focus Group Conversations with Reasons for Exclusion

Name	Type	Inclusion Status	Reason for Exclusion
Current health Status	Health Benefit	Included	
Treatment effectiveness	Health Benefit	Included	
Disease severity	Health Benefit	Included	
Patient age	Sociodemographic factor	Included	
Willingness-to-pay	Economic	Excluded	Difficult for respondents to understand.
Number of individuals treated	System Functioning	Included	
Cost-effectiveness	Economic	Excluded	Focus group respondents struggled to understand attribute.
Patient poverty level	Sociodemographic factor	Included	
Population level impact of the disease	Health Benefit	Excluded	Overlap with number of individuals treated.
Patient race/ethnicity	Sociodemographic factor	Included	
Patient gender	Sociodemographic factor	Included	
Difference between the level of health of the people who would receive care and the general population	Health Benefit	Excluded	Overlap with current health status; difficult for respondents to understand.
Order of patient arrival	System Functioning	Exclude	Not a clear equity or efficiency attribute. Overlap with other measure of equity that can determine when patients seek care.
Patient income level	Sociodemographic factor	Include	
Patient lifestyle factors	Sociodemographic factor	Include	
Whether patients are parents or carers	Sociodemographic factor	Exclude	Not seen as important in focus groups.
Absenteeism	Economic	Exclude	Not seen as important in focus groups.
Uncertainty in the benefit of treatment	Health Benefit	Include	
Treatment timing	System Functioning	Exclude	Not a clear equity or efficiency attribute. Overlap with other measure of equity and efficiency that dictate timing of treatment.

Costs	System Economic	Include	
Patient ability status	Health Benefit	Exclude	Overlap with current health status.
Patient fragility level	Health Benefit	Exclude	Overlap with current health status.
Share of the benefit to the majority of the population	Health Benefit	Exclude	Overlap with number of people who could be treated. Vague as to what constitutes the majority.
Time to treat patients	System Functioning	Exclude	Not a clear equity or efficiency attribute. Overlap with other measure of equity and efficiency that dictate when patients seek care.
Patient travel distance/time	System Functioning	Exclude	Overlap with rural/urban geographic areas.
Patient past health status	Health Benefit	Include	
Named health conditions	Health Benefit	Exclude	Not a clear equity or efficiency attribute. Overlap with health status and disease severity.
Patient employment status	Sociodemographic factor	Include	
Patient relationship status	Sociodemographic factor	Exclude	Not seen as important in focus groups.
Improvements in population life expectancy	Health Benefit	Include	
Preventive vs acute care	Health Benefit	Exclude	Not a clear equity or efficiency attribute. Overlap with health status and disease severity.
Mental health conditions	Health Benefit	Exclude	Not a clear equity or efficiency attribute. Overlap with health status and disease severity.
Patient insurance status	Sociodemographic factor	Include	
Patient cultural differences vs majority population	Sociodemographic factor	Exclude	Overlap with race/ethnicity and immigration status
Patient immigration status	Sociodemographic factor	Include	
Patient gender identity	Sociodemographic factor	Include	
Patient language ability	Sociodemographic factor	Exclude	Beyond the scope of cost-effectiveness analysis. Overlap with other attributes such as immigration status.
Systematic disadvantage (or area deprivation)	Sociodemographic factor	Exclude	Too complex to explain to respondents in the context of the BWS. Unclear how respondents would interpret a change along a social disadvantage scale.
Wait times	System functioning	Include	

Navigability of the system	System functioning	Exclude	Beyond the scope of cost-effectiveness analysis.
Valuing Providers	System functioning	Exclude	Beyond the scope of cost-effectiveness analysis.
Universal care	System functioning	Exclude	Beyond the scope of cost-effectiveness analysis.

A.2 Focus Group Respondent Demographics

aTable A.2-1: Focus Group Respondent Demographics for Canada and the US

	US (N=27)	Canada (N=29)
Gender		
Male	9	9
Female	16	20
Other	2	0
Age		
18-34	11	18
35-64	13	8
65+	3	3
Income		
<50K	7	10
50K-100K	9	10
>100K	9	7
Prefer not to answer	2	2
Race/Ethnicity		
White, NH	15	11
Black, NH	5	1
Asian	1	13
Multi/Other	6	4

aTable A.2-2: Political Affiliation of US Focus Group Respondents

Political Affiliation	US (N=27)
Democrat	11
Independent	7
Republican	7
Libertarian	1
Prefer not to answer	1

aTable A.2-3: Political Affiliation of Canadian Focus Group Respondents

Political Affiliation	Canada (N=29)
Conservative	5
Green	2
Liberal	8
NDP	8
PPC	1
No preference	4
Prefer not to answer	1

A.3 Focus Group Themes and Example Quotes

aTable A.3-1: US Focus Group Themes and Example Quotes

Theme	Quote
Equality in access/ Universal access	• "By making things more accessible to everyone that'll make the overall health of the public a lot better make sure everything's fair." • "Some people get access to the very best care and other people have to settle for what they can find. And that's not – that's not fair, either." • "Everyone should have equal availability to healthcare services" • "I do think everyone should have access to healthcare. No matter your background." • "Fairness to all humans regardless of a variety of identity or ethnicity, etc." • "People are equal, and you know should be treated as equals." • "You need to treat every single patient the same." • "I wouldn't want to consider things that are like characteristics or innate qualities of a person like their gender, or the where they live, because that that really does get into issues of ethics, you know, because then you're discriminating based on factors that people, you know can't control and that's not what we want in society." • "I think a fair healthcare system would be one that's free and accessible to anyone. Regardless of if you live in a urban area or rural area; regardless of your income, age, disability, sexuality, race ethnicity. Yeah, so I think just access."
Affordability	• "If they're sick, they're sick. You know, they should be treated and financially to, if they can't afford to pay for, they should still get the treatment that's going to save their lives if they're, you know, if it's a life altering event." • "that's something that you know we don't see in the current healthcare system, access and affordability." • "I think one part of the accessibility is financial accessibility. Things is really not being affordable even for folks who have insurance and also knowing a lot of people can't afford insurance or don't receive health insurance from their jobs or have difficulties accessing Medicaid." • "A price for healthcare that you can pay and that doesn't eat up all of your income, or all your available income." • "I can give an example of cancer. It drains a lot of people financially and so it should be subsidized and offer that a fair price, so that that most people are able to afford their treatment."
Individual responsibility	• "That should also be a factor if a person's actually willing to get the education and make improvements in their lives" • "It's kind of a slippery slope to say that they're gonna get the same outcome, because it's really up to the individual, we could all have the same support and treatments and all that. But if you don't follow through, or you don't do what you need to on your side, then you may not have the same outcome as well." • "You can't say 'well, here's healthcare that will solve all the problems, or here's the medications that will solve all the problems.' If the people are non-compliant… how much you can actually help them until they decide, they want to have complete care."
Age	• "It may seem unfair, but if you look at bang for your buck, that 90 year old doesn't have a lot of life expectancy even if they're in great health… But for subsidizing it, I think it should be focusing on folks who are gonna benefit the most…" • "In my practice over the years I've watched a lot of folks age. When you get to 60 age is just a number. Your health is far more important. So there are 60 year-olds who are have the health of a 90 year-old… their health is not equivalent to their age."

aTable A.3-2: Canadian Focus Group Themes and Example Quotes

Theme	Quote
Equality in access/treatment	• "I feel like everyone should have equal access to it." • "[individuals] should be treated without any racism or any sexism, or anything like that." • "I would have thought that you know, income, level that sort of thing, anything like that, would never be something that would be taken into decision making when it comes to universal care system whether it's Canada or somewhere else" • "Yeah, the gender, like the income level, you know. That shouldn't matter, because healthcare is universal, like they're not like dividing people by their social status or by their gender ethnicity, you know. They're there to give you hope. No matter what your class is." • "For me, the race or ethnicity of the people who would receive care I don't think that's important at all like. In my eyes everyone is equal, regardless of their race or ethnicity." • "I think people's demographic backgrounds don't really matter in terms of receiving healthcare" • "I think fairness means we provide the same treatment to everyone, because the medical conditions, very complicated people have different lifestyle, different health status. So it's hard to guarantee the same result in the end." • "Fairness in a healthcare system means that everybody gets treated, no matter their income level, or you know. Age, ethnicity…. There's no nobody gets ahead of one another. It's based on need, not necessarily how much money you have where you're standing."
Accessibility in rural areas	• "In Canada, I feel like there's a lot of rural and just like underserved areas. And to me, that's kind of what I think about when I think of fairness and healthcare." • "You know, people in the rural, you know, countryside area. They don't have access to healthcare that they do with people living in the bigger city." • "To me, a fair healthcare system is where everyone has accessible care so close to their home. You don't need to drive 40, 50 kilometers to, you know, reach a hospital in the case of an emergency." • "There's also inequity when it comes to rural health versus if you're in a larger city, so oftentimes folks from like rural Nova Scotia have to travel into the major city, Halifax in order to get care."
Reduced wait times	• "I think a fair public healthcare system is a system where you don't have to wait a lot." • "For me, I think fair also means being able to have access to practitioners when you need it and not have extreme wait times." • "The speed at which people can see a specialist really matters" • "I do find speed… it's very important cause like, I believe, some for some conditions if you wait for too long things just get out of hand. And even though you have the best treatments, if you've been waiting for too long. Then it's just it's a waste." • "Because of the limited resources out there, we end up having people [whose] situation got worse. So I don't think it's fair."
Individual responsibility	• "If you're actively ruining your health we should not be helping you first because you have to take back control over what is ruining your health… You're just hogging resources to continue poisoning your life." • "Looking at outcomes would be a very good question because you might have given something to everybody. But if somebody chooses not to use it does that mean it's a poor outcome? Well that's their choice."

Age	• "If a child has a health issue. They are prioritized… they're going to rush them right in and not take any chances. So I agree with that. As a priority…. It does seem like children are put on a higher level." • "If I had to choose between a 12 year-old, increasing their life expectancy versus choosing an 80 year-old and increasing their life expectancy, if I had limited resources, I probably have to let the 80 year old go" • "I have senior parents I am taking care of. So I'm noticing that, you know there are a lot of benefits that children get, which is great, but seniors not so much. So there's just that bit of disadvantage to another vulnerable group."

A.4 Reasons for Respondent Exclusion from Best-Worst Scaling Primary Analytic Sample

aTable A.4-1: US Respondent Reasons for Exclusion

Primary Exclusions	Dual Frame	Access Frame	Outcomes Frame
Did not complete survey	15	5	3
Failed attention check	17	7	5
Failed birth year/age check	9	1	4
Did not understand task	0	0	1
Wrong country	0	0	1
Protest comments	8	3	4
Final sample	374	140	135

aTable A.4-2: Canadian Respondent Reasons for Exclusion

Primary Exclusions	Dual Frame	Access Frame	Outcomes Frame
Did not complete survey	113	35	23
Failed attention check	81	30	15
Failed birth year/age check	11	2	7
Did not understand task	12	0	2
Wrong country	1	0	0
Protest comments	23	7	11
Final sample	458	151	161

A.5 US Respondent Exclusion Quotes

Exclusion comments are categorized as 1) one-off confusion; 2) consistent confusion; and 3) rejecting the premise of the exercise. Comments from the same ID were made by the same respondent. Each new comment starts on a new line.

aTable A.5-1: One-off Confusion Comments

ID	Comment(s)
558	How is this an issue (orientations)?
24	THEY ALL ARE IMPORTANT II DONT KNOW WHAT TO PUT AS LEAST
297	it is hard to choose because they are all important
321	This one I've read several times and I'm not sure what I think

aTable A.5-2: Consistent Confusion Comments

ID	Comment(s)
185	Okay, I can already see that most of these questions would be better answered by medical professionals than the average lay person. I'm doing a lot of guessing here.
199	We do not need to reduce anything in healthcare. It is bad enough.
513	I think some of the statements were worded in a confusing manner
299	man.. ..you guys are really making it tough for me, eh¿ heh so that's how life is, eh? we can only have one, or the other?
517	While some of the options were a bit confusing the way they were worded, I feel like I chose the best options according to my opinion for each set.
550	I would have like better explanations for some of the factors specifically the ones listed as not related to groups of people
288	Reduce "Reduce differences in health outcomes across income level"???? That's a joke, right? Increase health gains for individuals??? That shouldn't be a "goal" but a reality.
98	Obviously, there shouldn't be differences by race. Not sure what the first one means. Is it bad to spend money to treat patients? What's the other option? Or does it mean as opposed to preventative care that reduces the need for patient care? Yall are gonna make this really hard, I see. It makes me sad that those questions could legitimately be asked.

aTable A.5-3: Reject Premise Comments

ID	Comment(s)
288	I just clicked on any statement. I personally think that we should be ashamed for not providing equal healthcare to every citizen of this country, which, ironically, is the richest and most powerful of the world. Any other approach like the ideas above is just a ridiculous aspirin for a chronic cancer corroding our society. As long as our politicians keep on using communism as an excuse for not taking care of what people need...well...some will only survive if they hit the lotto.
110	All of these outcomes that are based on reducing the differences feel like a predicate for a bad trick. That is the differences can be reducedBy making outcomes equally badJust as

	effectively as making them equally good. I'm not arguing semantics, I'm just sayingIf you tell me the good news is outcomes have been equalized, then I'mfearing that The bad news follow-up is That they've declined to match the lowest level
48	All "solutions" revolved around government inserting themselves more into the lives of people.
359	When Marxists demand 'Free' things, they just want somebody else to pay for it.
386	I know that our healthcare system is broken. However, government is NOT the solution. I don't know what is, but if you've ever had government cheese you know that government should not be anywhere near healthcare. Just look at how awful and tragic the VA system is.
550	I would have like better explanations for some of the factors specifically the ones listed as not related to groups of people

A.6 Canadian Respondent Exclusion Quotes

Exclusion comments are categorized as 1) one-off confusion; 2) consistent confusion 3) rejecting the premise of the exercise; 4) pattern of meaningless responses; and 5) joke responses. Comments from the same ID were made by the same respondent. Each new comment starts on a new line.

aTable A.6-1: One-off Confusion Comments

ID	Comment(s)
453	I don't agree to any of those options
682	I had no reason but I had to choice one opinion whichbi didn't know
737	I don't understand the 3rd and 4rth options.
184	reducing any healthcare at anytiime would be deadly to every individual in society
30	Is there differences between all these things? I wasn't aware
281	GTHEY ARE ALL JUST AS IMPORTANT SO I PICKED THE ONE I THOUGHT
153	Why are all these options remaining the same... answers and my opinions to the above has already been said earlier

aTable A.6-2: Consistent Confusion Comments

ID	Comment(s)
727	We should reduce because we all should get the same treatment white or not, and the least important is because idk what that is Not sure Not sure Not sure
857	Idk Idk Idk
478	Not sure Not sure Not sure Not sure Not sure Not sure Not sure Not sure Not sure Not sure
273	These questions are confusing and I don't know what to choose. I get confused. I really don't fully understand the questions. The survey is too confusing. This really does not make sense to me. I want to quit. I get confused. This is to complicated for my brain right now. I think it was too confusing for the average person.
130	No other least choice

	Same thing For each I felt there were no good choices for “least”
255	I think that some of the questions were identical. So sometimes confusing.
415	The wording was very confusing. If you want good information, the questions should be clear and simple.
594	Some options were hard to choose from because they were similar or hard to understand what they meant
631	The wording about differences was hard to understand and could have been worded differently.
720	options for answers should have been clearer
743	this survey was rather confusing and not specific and too the point it was very vague in its questions
523	I don't think the wording in the choices made it clear as to what I felt was right
1120	Unclear definitions and what we were choosing mainly because same wording was used often.
62	Even though in Canada Employment Status and Insurance has less impact on our health system, I am still aware of how much this impacts Americans and therefore adjusted my answer to include them. I am not sure if I was supposed to answer from a Canadian-only mindset.
376	The options given were more or less equally important so it’s was hard to decide which one to choose

aTable A.6-3: Reject Premise Comments

ID	**Comment(s)**
453	I don't agree to any of those options
987	You're questions are already bullshit, racist, sexist trash.
553	I DON'T LIKE THE WORDING OF THESE QUESTIONS. IT'S AS THOUGH I'M SAYING IT'S MORE IMPORTANT TO REDUCE LEVELS, RATHER THAN ASKING WHICH ARE MOST OR LESS IMPORTANT WORDING COULD BE MISINTERPRETED
552	I'm Canadian. Your survey largely doesn't apply to my perspective and experience (and vice versa).
143	This is an extremely biased survey. ALL of us need the best care possible, and deserve it, since we all contribute in some way to society. Again: this seems to be trying to elicit specific kinds of responses. I want healthcare to address EVERYONE:S access to the best care possible. I want healthcare to do better for ALL OF US! Why is this all about reductions? We need to expand access, not reduce it for anyone. I give up. You are forcing the answers you want. The bias and forcing of answers was blatant. I think whoever wrote this survey had an obvious agenda and I resent this.
259	These questions are not really a fair assessment of choices, should not be either or. Really not liking this survey format.
184	healthcare is something everyone needs . I did not like a lot of the questions
392	i think this is discimantory
216	This seemed much more slanted to the US and their laissez-faire approach to healthcare.

aTable A.6-4: Pattern of Comments Unrelated to Choice Tasks

ID	Comment(s)
504	I like this things I don't know about I'm going get it tomorrow morning I'm very sorry to have been good to I have a good day and I can come in I'm going get it to work now I'm very good at work now but I I don't have any smart friends with you and I have more pets and a good I have a lot more to go with you to Ihgse I will call in
856	らたさあや、たやたらた　たやた、　田渡私だやたわ、まだたら明日たら、ワニら畑ラタ、田渡、あ。ま、朝から、ゎゎ、ラタから田畑ラマはタラタラ田渡単体、他新た新巻きとなるかなかっ飛ばすことのある 、わならた他、何だ、あの、ま、わま、やな、あは、八幡屋。やまらあま、亜浜菜、田、ラマ山はたらたらたらたらま、たらま、よわまほたやままをたた、た、たた、まはさあからま、らやた、たら らたかあらかじめがおかんもラマはただ🆓? らまらた、あす、おばさんっていいかげんでおかんの赤いの、おかんさん。らま。た
619	My Feelings Change is Needed Necessary Good luck Keep working on it Good Luck Now A Must Every Day Now is Time
1003	I think there need to be more focus on the community that need it Again we to focus on the community To focus on who need it Focus on the community Focus on the community bring more unity Community Community's need it It needed for the community Community Who need it the most
346	offer great oportunities is offer great stuff is great like this great like this is very great like it is offer great stuff great is the best like this offer great oportunities

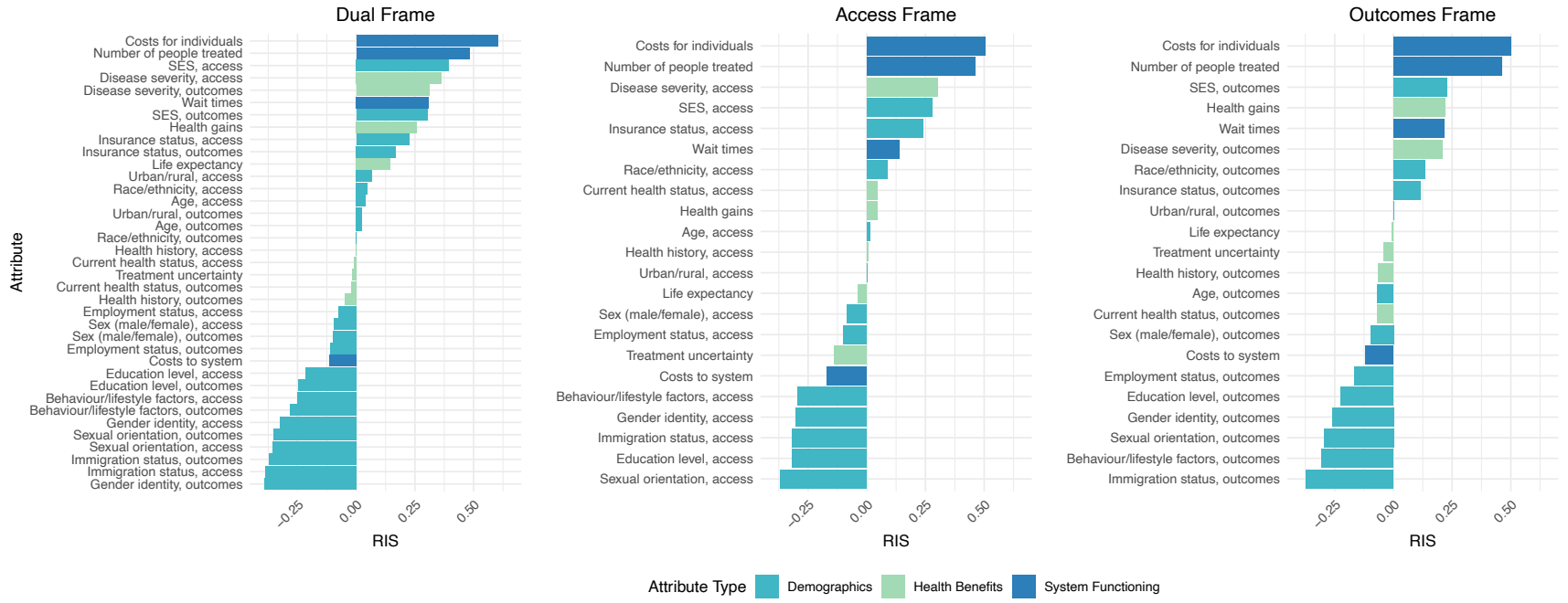
	great
584	Because of this the new one will not work and I have a lot more money left in the account and I'm Because of this the new rules will not apply in a new state and will be applied to every other county Because of this the only thing that is missing from this list are those that Because of this the new one will not work and the other ones are going back in a few weeks and they Because of this the only thing that is missing from this list are those that have the best intentions in life to make a Because of this the new rules will not apply in a new state and will be applied to every other county and state that is Because of this the only thing that is missing from this list are those that have the best intentions in life to make Because of this the new one will not work and I have a lot more money left in the account and I'm going Because of this the only thing that is missing from this list are those that have the best intentions Because of this the new rules will not apply in a new state and will be applied to every other county
790	Its that, in there Its that, in there Its that in there Its that in there Its that in there Its that in there Its that in there Its that in there Its that in there Its that in there
1118	Health is most important Helth is important No comment Sex is also important gor life No need to increase population How Much Good for health Nothing special Yeah its important
312	bdusbdns djskwnenf jeiwnw d d je e djdbw w djebwbe rgoeien euenw djsisjd sjsjsjw je sais pas je sais pas je sais pas

aTable A.6-5: Single Comments Unrelated to Choice Tasks

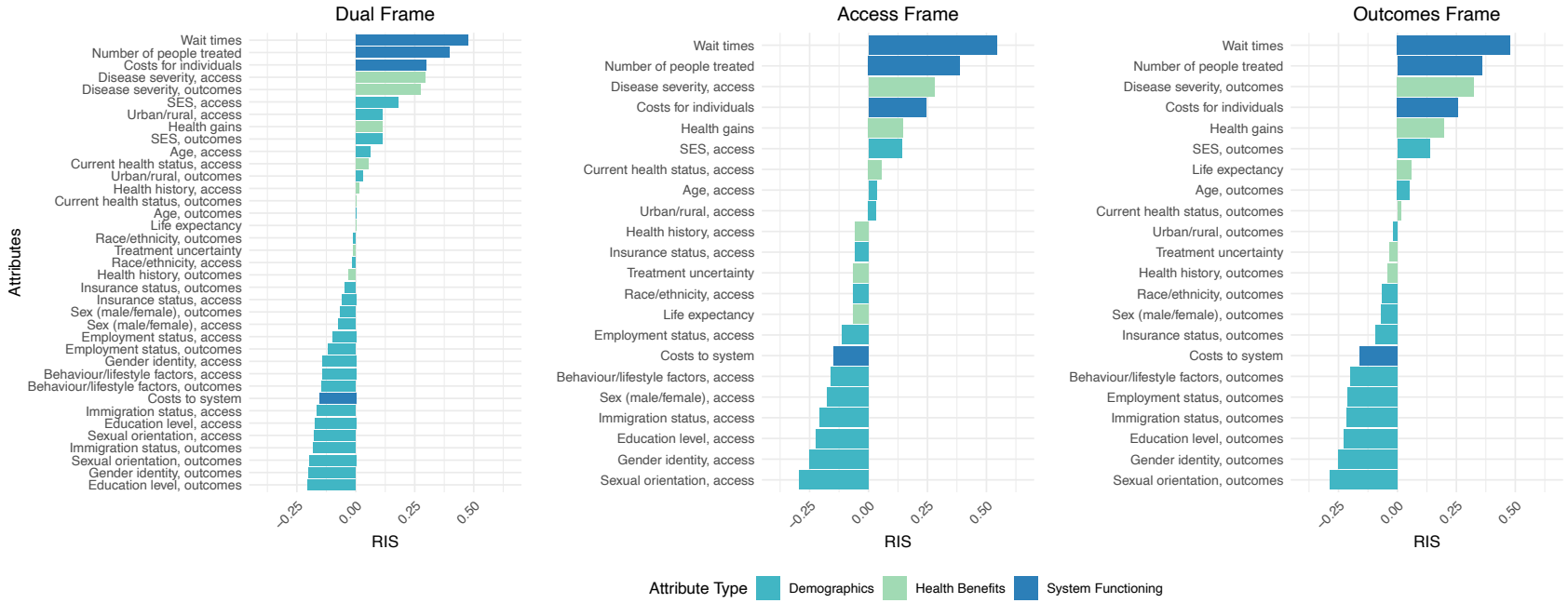
ID	Comment(s)
669	Health grains are fibrous
967	Hmm a lot of questions and I just did it for a game cuz it gives 400 hundred Dino money

A.7 Attribute Relative Importance Scores Across Survey Frames

aFigure A.7-1: US Relative Importance Scores for Each Survey Frame



aFigure A.7-2: Canadian Relative Importance Scores for Each Survey Frame



A.8 Table of Top Five Attributes Across Sociodemographic and Attitudinal Characteristics

aTable A.8-1: Top Five Attributes by Subgroup for US Respondents

Subgroup	Level	Top 5 Attributes
Political Viewpoint	Conservative	Costs for individuals Disease severity, access Number of people treated Wait times Disease severity outcomes
Political Viewpoint	Centrist or neutral	Costs for individuals Number of people treated SES, access Disease severity, access SES, outcomes
Political Viewpoint	Liberal	Costs for individual Number of people treated SES, access SES, outcomes Wait times
Political Viewpoint	Neither conservative nor liberal	SES, access Number of people treated Health gains Costs for individuals SES, outcomes
Education	HS or less	Costs for individuals Number of people treated Disease severity, access Disease severity, outcomes SES, outcomes
Education	Some college or associate's	Costs for individuals Number of people treated, SES, access Disease severity, access Wait times
Education	College or more	Costs for individuals Number of people treated SES, access Disease severity, access Disease severity, outcomes
Income	<$50K	Costs for individuals Number of people treated SES, access SES, outcomes Disease severity, access
Income	$50k-$100k	Number of people treated Costs for individuals Disease severity, access SES, access Disease severity, outcomes
Income	$100k+	Costs for individual Number of people treated Health gains SES, access

		Disease severity, access
Age	18-34	Number of people treated Costs for individual Disease severity, access Disease severity, outcomes SES, access
Age	35-54	Costs for individuals Number of people treated SES, access Disease severity, access Wait times
Age	55+	Costs for individuals Number of people treated SES, access Wait times Disease severity, access
Survey difficulty	Easy	Costs for individuals Number of people treated Disease severity, access Disease severity, outcomes SES, outcomes
Survey difficulty	Difficult	Costs for individuals SES, access Number of people treated Disease severity, access Wait times
Rural/Urban	Large city	Number of people treated Costs for individuals SES, access Disease severity, outcomes Disease severity, access
Rural/Urban	Small city	Costs for individuals Number of people treated Disease severity, access SES, access Disease severity, outcomes
Rural/Urban	Suburb	Costs for individuals Number of people treated Disease severity, access SES, access SES, outcomes
Rural/Urban	Rural area	Costs for individuals SES, access SES, outcomes Number of people treated Insurance status, outcomes
Religion	Religious	Costs for individuals Number of people treated Disease severity, access SES, access Wait times
Religion	Not Religious	Costs for individuals Number of people treated SES, access Disease severity, access

		SES, outcomes
Race/Ethnicity	White	Costs for individuals Number of people treated SES, access Disease severity, access Wait times
Race/Ethnicity	Black	Number of people treated SES, outcomes Race/ethnicity, access Costs for individuals Disease severity, access
Race/Ethnicity	Asian	Costs for individuals Number of people treated Disease severity, access SES, access SES, outcomes
Race/Ethnicity	Hispanic	Disease severity, outcomes Number of people treated Costs for individuals Disease severity, access Insurance status, access
Race/Ethnicity	Mixed, Other, or Prefer not to answer	Costs for individuals Number of people treated SES, access SES outcomes Disease severity, access
Wealth Inequality	Disagree	Costs for individuals SES, access Number of people treated SES, outcomes Disease severity, access
Wealth Inequality	Neither agree nor disagree	Costs for individuals Number of people treated Disease severity, access Wait times SES, access
Wealth Inequality	Agree	Costs for individuals Number of people treated Disease severity, access Disease severity, outcomes Health gains
Health Inequality	Disagree	Costs for individuals SES, access Number of people treated SES, outcomes Insurance status, access
Health Inequality	Neither agree nor disagree	Costs for individuals, Number of people treated SES, access Disease severity, access Wait times
Health Inequality	Agree	Costs for individuals Number of people treated Disease severity, access Disease severity, outcomes

		SES, access
Current Health	Excellent, very good, good	Costs for individuals Number of people treated SES, access Disease severity, access Disease severity, outcomes
Current Health	Fair or Poor	Costs for individuals Number of people treated Disease severity, access SES, access SES outcomes
Gender	Female	Costs for individuals Number of people treated SES, access Disease severity, access Disease severity, outcomes
Gender	Male	Costs for individuals Number of people treated SES, access Disease severity, access SES, outcomes

aTable A.8-2: Top Five Attributes by Subgroup for Canadian Respondents

Subgroup	Level	Top 5 Attributes
Political Viewpoint	Conservative	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals
Political Viewpoint	Centrist or neutral	Wait times Disease severity, access Number of people treated Disease severity, outcomes Costs for individuals
Political Viewpoint	Liberal	Wait times Number of people treated Costs for individuals Disease severity, access Disease severity, outcomes
Political Viewpoint	Neither conservative nor liberal	Number of people treated Wait times Disease severity, outcomes Costs for individuals Disease severity access
Education	HS or less	Wait times Number of people treated Disease severity, outcomes Disease severity, access Costs for individuals
Education	Some college or associate's	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals
Education	College or more	Wait times Number of people treated Costs for individuals Disease severity, outcomes Disease severity access
Income	<$50K	Wait times Disease severity, access Number of people treated Disease severity, outcomes Costs for individuals
Income	$50k-$100k	Wait times Number of people treated Costs for individuals Disease severity, outcomes Disease severity, access
Income	$100k+	Wait times Number of people treated Costs for individuals Disease severity, access Disease severity, outcomes
Age	18-34	Wait times Number of people treated

		Costs for individuals Disease severity, outcomes SES, access
Age	35-54	Wait times Number of people treated Disease severity, access Costs for individuals Disease severity, outcomes
Age	55+	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals
Survey difficulty	Easy	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals
Survey difficulty	Difficult	Wait times Number of people treated Costs for individuals Disease severity, outcomes SES, access
Rural/Urban	Large city	Wait times Number of people treated Costs for individuals Disease severity, Outcomes Disease severity, access
Rural/Urban	Small city	Wait times Number of people treated Disease severity, access Costs for individuals Disease severity, outcomes
Rural/Urban	Suburb	Wait times Number of people treated Disease severity, access Costs for individuals Disease severity, outcomes
Rural/Urban	Rural area	Wait times Costs for individuals Disease severity, access Disease severity, outcomes Number of people treated
Religion	Religious	Wait times Number of people Disease severity, access Disease severity, outcomes Costs for individuals
Religion	Not Religious	Wait times Number of people treated Costs for individuals Disease severity, access SES, access
Race/Ethnicity	White	Wait times SES, outcomes

		Costs for individuals Life expectancy Health gains
Race/Ethnicity	Black	Wait times Costs for individuals Disease severity, access Disease severity, outcomes Number of people treated
Race/Ethnicity	Asian	Number of people treated Disease severity, outcomes Wait times Race/ethnicity, outcomes Race/ethnicity, access
Race/Ethnicity	Hispanic	SES, access Life expectancy Health gains, Employment status, outcomes Number of people treated
Race/Ethnicity	Mixed, Other, or Prefer not to answer	Number of people treated Disease severity, outcomes Costs for individuals Sex (male/female), outcomes SES, outcomes
Wealth Inequality	Disagree	Wait times Number of people treated Costs for individuals SES, access Disease severity, outcomes
Wealth Inequality	Neither agree nor disagree	Wait times Number of people treated Disease severity, access Costs for individuals Disease severity, outcomes
Wealth Inequality	Agree	Wait times Disease severity, access Number of people treated Disease severity, outcomes Costs for individuals
Health Inequality	Disagree	Wait times Number of people treated Costs for individuals Disease severity, access Disease severity, outcomes
Health Inequality	Neither agree nor disagree	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals
Health Inequality	Agree	Wait times Number of people treated Costs for individuals Disease severity, access Disease severity, outcomes
Current Health	Excellent, very good, good	Wait times Number of people treated

		Disease severity, access Costs for individuals Disease severity, outcomes
Current Health	Fair or Poor	Wait times Number of people treated Costs for individuals Disease severity, outcomes Disease severity, access
Gender	Female	Wait times Number of people treated Costs for individuals Disease severity, access Disease severity, outcomes
Gender	Male	Wait times Number of people treated Disease severity, access Disease severity, outcomes Costs for individuals

A.9 Latent Class Analysis Demographics

aTable A.9-1: Demographics of US Latent Classes

	Class 1 – Traditional Social Value Holders	Class 2 – System Fixers	Class 3 – Wealth Inequality Fighters	Overall
	(N=129)	**(N=122)**	**(N=123)**	**(N=374)**
Age				
Mean (SD)	50.5 (13.5)	42.0 (14.1)	44.6 (14.0)	45.8 (14.3)
Median [Min, Max]	52.0 [19.0, 80.0]	39.5 [18.0, 74.0]	43.0 [18.0, 80.0]	45.5 [18.0, 80.0]
Gender				
Female	69 (53.5%)	59 (48.4%)	62 (50.4%)	190 (50.8%)
Male	60 (46.5%)	62 (50.8%)	60 (48.8%)	182 (48.7%)
Other	0 (0%)	1 (0.8%)	1 (0.8%)	2 (0.5%)
Prefer not to answer	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Region				
Northeast	16 (12.4%)	24 (19.7%)	23 (18.7%)	63 (16.8%)
Midwest	23 (17.8%)	23 (18.9%)	23 (18.7%)	69 (18.4%)
South	66 (51.2%)	49 (40.2%)	51 (41.5%)	166 (44.4%)
West	24 (18.6%)	26 (21.3%)	26 (21.1%)	76 (20.3%)
Political Viewpoint				
Conservative	73 (56.6%)	51 (41.8%)	21 (17.1%)	145 (38.8%)
Centrist or neutral	29 (22.5%)	25 (20.5%)	40 (32.5%)	94 (25.1%)
Liberal	14 (10.9%)	40 (32.8%)	56 (45.5%)	110 (29.4%)
Neither conservative nor liberal	13 (10.1%)	5 (4.1%)	6 (4.9%)	24 (6.4%)
Prefer not to say	0 (0%)	1 (0.8%)	0 (0%)	1 (0.3%)
Education				
High school or less	18 (14.0%)	24 (19.7%)	14 (11.4%)	56 (15.0%)
Some college or associate's	36 (27.9%)	24 (19.7%)	40 (32.5%)	100 (26.7%)
College or more	75 (58.1%)	74 (60.7%)	69 (56.1%)	218 (58.3%)
Income				
Less than $50k	54 (41.9%)	40 (32.8%)	36 (29.3%)	130 (34.8%)
$50k - $100k	37 (28.7%)	42 (34.4%)	50 (40.7%)	129 (34.5%)

$100k or more	37 (28.7%)	37 (30.3%)	34 (27.6%)	108 (28.9%)
Prefer not to answer	1 (0.8%)	3 (2.5%)	3 (2.4%)	7 (1.9%)
Religion				
Not Religious	19 (14.7%)	25 (20.5%)	35 (28.5%)	79 (21.1%)
Organized Religion	78 (60.5%)	72 (59.0%)	68 (55.3%)	218 (58.3%)
Spiritual	7 (5.4%)	5 (4.1%)	8 (6.5%)	20 (5.3%)
Other	23 (17.8%)	18 (14.8%)	10 (8.1%)	51 (13.6%)
Prefer not to answer	2 (1.6%)	2 (1.6%)	2 (1.6%)	6 (1.6%)
Religiosity				
Important	79 (61.2%)	72 (59.0%)	63 (51.2%)	214 (57.2%)
Not important	49 (38.0%)	48 (39.3%)	59 (48.0%)	156 (41.7%)
Prefer not to answer	1 (0.8%)	2 (1.6%)	1 (0.8%)	4 (1.1%)
Charity				
Yes	74 (57.4%)	70 (57.4%)	90 (73.2%)	234 (62.6%)
No	54 (41.9%)	48 (39.3%)	33 (26.8%)	135 (36.1%)
Prefer not to answer	1 (0.8%)	4 (3.3%)	0 (0%)	5 (1.3%)
Marital Status				
Single, never married	34 (26.4%)	39 (32.0%)	39 (31.7%)	112 (29.9%)
Married or domestic partnership	71 (55.0%)	68 (55.7%)	63 (51.2%)	202 (54.0%)
Formerly married	24 (18.6%)	15 (12.3%)	19 (15.4%)	58 (15.5%)
Prefer not to answer	0 (0%)	0 (0%)	2 (1.6%)	2 (0.5%)
Employment Status				
Employed, FT	62 (48.1%)	76 (62.3%)	63 (51.2%)	201 (53.7%)
Employed, PT	16 (12.4%)	15 (12.3%)	17 (13.8%)	48 (12.8%)
Retired	22 (17.1%)	15 (12.3%)	12 (9.8%)	49 (13.1%)
Student	2 (1.6%)	2 (1.6%)	4 (3.3%)	8 (2.1%)
Not employed	21 (16.3%)	11 (9.0%)	18 (14.6%)	50 (13.4%)
Other	6 (4.7%)	3 (2.5%)	9 (7.3%)	18 (4.8%)
Smoking Status				
Yes	21 (16.3%)	20 (16.4%)	18 (14.6%)	59 (15.8%)
No	108 (83.7%)	102 (83.6%)	105 (85.4%)	315 (84.2%)
Prefer not to answer	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Health Status				
Excellent/Very Good/Good	105 (81.4%)	102 (83.6%)	93 (75.6%)	300 (80.2%)
Fair/Poor	24 (18.6%)	20 (16.4%)	30 (24.4%)	74 (19.8%)
Community Type				
Large city	21 (16.3%)	35 (28.7%)	27 (22.0%)	83 (22.2%)
Suburb	43 (33.3%)	53 (43.4%)	60 (48.8%)	156 (41.7%)
Small city	39 (30.2%)	20 (16.4%)	22 (17.9%)	81 (21.7%)
Rural area	26 (20.2%)	14 (11.5%)	14 (11.4%)	54 (14.4%)
Household Size				
Mean (SD)	2.36 (1.34)	3.02 (4.48)	2.63 (1.47)	2.66 (2.81)
Median [Min, Max]	2.00 [1.00, 8.00]	2.50 [0, 50.0]	2.00 [0, 7.00]	2.00 [0, 50.0]
Survey Difficulty				
Easy	28 (21.7%)	28 (23.0%)	12 (9.8%)	68 (18.2%)
Somewhat easy	53 (41.1%)	48 (39.3%)	37 (30.1%)	138 (36.9%)
Somewhat hard	44 (34.1%)	40 (32.8%)	61 (49.6%)	145 (38.8%)
Hard	4 (3.1%)	6 (4.9%)	13 (10.6%)	23 (6.1%)

aTable A.9-2: Demographics of Canadian Latent Classes

	Class 1 – Inequality Fighters	Class 2 – System Fixers	Overall
	(N=216)	**(N=242)**	**(N=458)**
Age			
Mean (SD)	40.0 (16.6)	50.2 (17.6)	45.4 (17.9)
Median [Min, Max]	38.0 [18.0, 91.0]	52.0 [18.0, 87.0]	43.0 [18.0, 91.0]
Gender			
Female	95 (44.0%)	125 (51.7%)	220 (48.0%)
Male	116 (53.7%)	116 (47.9%)	232 (50.7%)
Other	4 (1.9%)	0 (0%)	4 (0.9%)
Prefer not to answer	1 (0.5%)	1 (0.4%)	2 (0.4%)
Province			
Alberta	32 (14.8%)	34 (14.0%)	66 (14.4%)
British Columbia	25 (11.6%)	23 (9.5%)	48 (10.5%)
Manitoba	9 (4.2%)	11 (4.5%)	20 (4.4%)
New Brunswick	3 (1.4%)	7 (2.9%)	10 (2.2%)
Newfoundland and Labrador	3 (1.4%)	9 (3.7%)	12 (2.6%)
Northwest Territories	0 (0%)	1 (0.4%)	1 (0.2%)
Nova Scotia	4 (1.9%)	9 (3.7%)	13 (2.8%)
Nunavut	0 (0%)	0 (0%)	0 (0%)
Ontario	110 (50.9%)	111 (45.9%)	221 (48.3%)
Prince Edward Island	0 (0%)	2 (0.8%)	2 (0.4%)
Quebec	17 (7.9%)	23 (9.5%)	40 (8.7%)
Saskatchewan	13 (6.0%)	12 (5.0%)	25 (5.5%)
Yukon	0 (0%)	0 (0%)	0 (0%)
Political Viewpoint			
Conservative	51 (23.6%)	73 (30.2%)	124 (27.1%)
Centrist or neutral	41 (19.0%)	46 (19.0%)	87 (19.0%)
Liberal	86 (39.8%)	76 (31.4%)	162 (35.4%)
Neither conservative nor liberal	22 (10.2%)	35 (14.5%)	57 (12.4%)
Prefer not to say	16 (7.4%)	12 (5.0%)	28 (6.1%)
Education			
High school or less	45 (20.8%)	57 (23.6%)	102 (22.3%)
Some college or associate's	62 (28.7%)	85 (35.1%)	147 (32.1%)
College or more	109 (50.5%)	100 (41.3%)	209 (45.6%)
Income			
Less than $50k	68 (31.5%)	84 (34.7%)	152 (33.2%)
$50k - $100k	85 (39.4%)	81 (33.5%)	166 (36.2%)
$100k or more	57 (26.4%)	64 (26.4%)	121 (26.4%)
Prefer not to answer	6 (2.8%)	13 (5.4%)	19 (4.1%)
Religion			
Not Religious	43 (19.9%)	39 (16.1%)	82 (17.9%)
Organized Religion	102 (47.2%)	135 (55.8%)	237 (51.7%)

Spiritual	19 (8.8%)	19 (7.9%)	38 (8.3%)
Other	44 (20.4%)	44 (18.2%)	88 (19.2%)
Prefer not to answer	8 (3.7%)	5 (2.1%)	13 (2.8%)
Religiosity			
Important	116 (53.7%)	120 (49.6%)	236 (51.5%)
Not important	93 (43.1%)	120 (49.6%)	213 (46.5%)
Prefer not to answer	7 (3.2%)	2 (0.8%)	9 (2.0%)
Charity			
Yes	127 (58.8%)	150 (62.0%)	277 (60.5%)
No	83 (38.4%)	90 (37.2%)	173 (37.8%)
Prefer not to answer	6 (2.8%)	2 (0.8%)	8 (1.7%)
Marital Status			
Single, never married	92 (42.6%)	71 (29.3%)	163 (35.6%)
Married or domestic partnership	95 (44.0%)	119 (49.2%)	214 (46.7%)
Formerly married	26 (12.0%)	50 (20.7%)	76 (16.6%)
Prefer not to answer	3 (1.4%)	2 (0.8%)	5 (1.1%)
Employment Status			
Employed, FT	101 (46.8%)	96 (39.7%)	197 (43.0%)
Employed, PT	31 (14.4%)	32 (13.2%)	63 (13.8%)
Retired	28 (13.0%)	72 (29.8%)	100 (21.8%)
Student	18 (8.3%)	6 (2.5%)	24 (5.2%)
Not employed	29 (13.4%)	24 (9.9%)	53 (11.6%)
Other	9 (4.2%)	12 (5.0%)	21 (4.6%)
Smoking Status			
Yes	41 (19.0%)	50 (20.7%)	91 (19.9%)
No	170 (78.7%)	189 (78.1%)	359 (78.4%)
Prefer not to answer	5 (2.3%)	3 (1.2%)	8 (1.7%)
Health Status			
Excellent/Very Good/Good	178 (82.4%)	187 (77.3%)	365 (79.7%)
Fair/Poor	38 (17.6%)	55 (22.7%)	93 (20.3%)
Community Type			
Large city	100 (46.3%)	88 (36.4%)	188 (41.0%)
Suburb	72 (33.3%)	79 (32.6%)	151 (33.0%)
Small city	30 (13.9%)	48 (19.8%)	78 (17.0%)
Rural area	14 (6.5%)	27 (11.2%)	41 (9.0%)
Household Size			
Mean (SD)	2.71 (1.51)	2.42 (2.34)	2.56 (2.00)
Median [Min, Max]	2.00 [0, 9.00]	2.00 [1.00, 33.0]	2.00 [0, 33.0]
Survey Difficulty			
Easy	87 (40.3%)	83 (34.3%)	170 (37.1%)
Somewhat easy	75 (34.7%)	103 (42.6%)	178 (38.9%)
Somewhat hard	42 (19.4%)	46 (19.0%)	88 (19.2%)
Hard	12 (5.6%)	10 (4.1%)	22 (4.8%)

Appendix B: Discrete Choice Experiment Study Appendices

B.1 Discrete Choice Experiment Experimental Design

Respondents selected between choices A and B for each of the 12 trade-off questions presented in aTable B.1-1.

aTable B.1-1: Discrete Choice Experimental Design

Choice Task	Baseline LE	Final LE	Baseline QoL	Final QoL	QALYs Gained	Wait Time (weeks)	Income Group	Discrimination Experience Group
Choice 1a	4	5	50	95	2.8	4	All	Likely
Choice 1b	4	12	50	55	4.6	4	High	Unlikely
Choice 2a	10	14	50	95	8.3	12	High	All
Choice 2b	1	5	50	55	2.3	12	Limited	Likely
Choice 3a	10	18	75	95	9.6	4	High	Likely
Choice 3b	1	9	25	45	3.8	4	Limited	Unlikely
Choice 4a	1	5	75	95	4	4	All	Unlikely
Choice 4b	10	14	25	45	3.8	12	Limited	Unlikely
Choice 5a	10	14	50	85	6.9	4	All	Unlikely
Choice 5b	1	5	50	85	3.8	12	High	Likely
Choice 6a	1	2	75	80	0.9	12	Limited	All
Choice 6b	1	9	25	30	2.5	12	High	Likely
Choice 7a	1	2	50	95	1.4	8	High	Unlikely
Choice 7b	10	11	75	80	1.3	8	High	All
Choice 8a	1	2	25	30	0.4	4	All	Likely
Choice 8b	1	2	25	70	1.2	12	Limited	All
Choice 9a	1	5	25	60	2.8	12	All	All
Choice 9b	10	14	25	60	5.9	4	Limited	Likely
Choice 10a	10	12	50	70	3.4	12	All	Unlikely
Choice 10b	1	3	50	70	1.6	4	High	All
Choice 11a	8	16	25	45	5.2	4	All	All
Choice 11b	8	9	75	95	2.6	4	High	Unlikely
Choice 12a	1	9	75	80	6.5	4	Limited	All
Choice 12b	1	2	25	70	1.2	4	High	All

B.2 Reasons for Respondent Exclusion

aTable B.2-1: Respondent Reasons for Exclusion

Primary Exclusions	**Canada (n=2128)**	**US (n=1358)**
Did not complete survey	396	51
Failed attention check	319	46
Failed birth year/age check	86	14
Did not understand task	8	1
Failed two-part dominant alternative question	333	35
Wrong country	7	0
Exclusion comments	31	7
Survey vendor provided bot/spam detection	13	NA
Rushers*	412	39
Final sample	1066	1203

*Rushers are defined as those who complete the survey in <1/3 the median completion time equal to 4.5 minutes in Canada and 6.4 minutes in US.

B.3 US Respondent Exclusion Comments

Exclusion comments are categorized as 1) rejecting the premise of the exercise. Comments from the same ID were made by the same respondent. Each new comment starts on a new line.

aTable B.3-1: Reject Premise Comments

ID	Comment(s)
601	I hate DEI and race communism so much. I hate the idea of health programs designed to help one racial group over another. I'm so sick of it.
606	I could never be involved in things like these, that decide the fate of millions. Playing god is terrifying.
836	It would have made sense for a survey about "fairness" to *DEFINE* what you meant by fairness. Since you didn't address HOW any of these programs would be funded (if by taxes, who is paying how much, etc.) you aren't looking at a holistic version of "fair". (For example - is it "fair" to make some people pay more for a program that they will benefit less from? Etc.) Are the programs expected to be "charities", with only those that "choose" to donate paying into the program? Is that "fair"?
862	I know I would be considered a nut job but no one but GOD can extend life
986	Yes, ALL VACCINES ARE Dangerous, and all are unnecessary. WE lack exercise and nutrients, not poisons, and all cause more problems than they "fix." JD Rockefeller created the "Sickness Care System" and destroyed genuine healthcare. Billions are spent to debunk real healthcare cures.
1442	It seemed like a choice that harmed one group and helped another. I think all should be helped. Terrible choices, and i think that changes need to be made that equally help everyone.
1639	All of the givens/certainties are completely unrealistic in a real-world setting.

B.4 Canadian Respondent Exclusion Comments

Exclusion comments are categorized as 1) expressing confusion with the exercise, 2) rejecting the premise of the exercise, and 3) leaving patterns of meaningless responses. Comments from the same ID were made by the same respondent. Each new comment starts on a new line.

aTable B.4-1: Consistent Confusion Comments

ID	Comment(s)
697	I cud not imagine why some of conditions would exist
1642	Unknown Unknown Unknown Unknown U are g Unknown

aTable B.4-2: Reject Premise Comments

ID	Comment(s)
1046	IIt's a sin that we have to choose who and how we help people there should be no limit on the value of human lives and the help available
1601	Studies like this are a joke. I can't beLIEve there are people ACTUALLY getting degrees from this nonsense, by merely pushing delusional radical left wing theories, and you are allowed to make absurd amounts of money by profiting off the DIRECT MISMANAGEMENT of people's health. Now, true healthcare starts with the individual, what disgusts me, however, is the fact you people DO NOTHING BUT HARM!!!!!!! You all are egotistical satanic sellouts to the big pHARMa cartel and you will NEVER sleep at night comfortably KNOWING all you do is leading to the SLOW MURDER of the people you THINK you are helping.
1543	i am going to butt fak yo momma nigggggga I need you lord
1045	Stop taking me to other fucking surveys all I fucking get is 22 points botch stop wasting my fucking time u sluts
1678	Fuck you

aTable B.4-3: Pattern of Comments Unrelated to Choice Tasks

ID	Comment(s)
902	Like ikr
	Broo
	Yea
	Broo
	Sure
	Ikr
	I love it
	Manahaha
	Okiw
	Baha
	Yes
	Yea
	Ikr
	I lovee
	Yeaa
974	LOVES
	LOVES
	.LVES
	LOVES
	LOVES
	LOVES
	LVEOS
	LOVES
	LOVES
	LOVES
	LOVES
	LOVES
	LOVES
	LOVES
1098	The Spinner did
	The spinner
1715	Good
	Mango
	Income
	Fuck
	Bich
	Nigga
	Hit
	Ho
	H
	Good
	G
	H
	F

1623	Gugyygyhyhyhhgyhy Gygygygygygyhyhyb Gyvyyvyhyhvyghy Gygygygygygvyy Vyvyvyvubububuu Huhyhyhyhhuuhbububbu Vuvyvybutbub H h th h h Vyybyvvy Vubbuub Gyhybygybubu Buy That ht th h. Uubub Hygygybybubuhybybub Buybyvyvuvububuyb
99	Im dot no Im like dise Im like Im like dist Ij dot no Im like Im like Im like Immlike Im like Im like Im no like programe A Im like Im wat survery now pliss in wat get to suprise to my boff friend
1419	I love that it is depicting what it is and hate that it is not depicting fair view. Yes, it is what it is and program A deserves 9999999..9999% Can you run the show? Can you run the show? Can you run the show? Can you run the show? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? Are you hungry and would you like some fried chicken? It was good and bad and good and bad.

1359	It was great. I got all of them My wish, my will. My wish, my will. My wish, my will My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. My wish, my will. No. It's all okay.
1437	HH GL ext debug and absorption and emission from Give FDNY DMRC the Tap on a clip to paste it in the text box.Touch and hold a clip to pin it. Unpinned clips will be deleted after 1 hour.Welcome to Gboard clipboard, any text you copy will be saved here. Guy in a place for a while ee the Boy Scout day we will get the latest version and absorption and emission of a fraction use Guy is a way that you have a great weekend I can get it to you soon of the digestion and absorption of the digestion and absorption of the digestion FM and absorption of the digestion and absorption HH Pfizer Inc the information contained in this email and any attachments is intended Use GV Prakash Kumar Singh and I will be in the blanks and I will GH barcode scanner history of the digestion and absorption of the digestion Welcome to Gboard clipboard, any text you copy will be saved here.Use the edit icon to pin, add or delete clips. High high school at 8h00 you get money for the late reply I will be in the CO discord to read the blanks and I will be in the blanks and I will be in the blanks and I will be in touch and I am a little more Did the GH barcode and absorption and absorption and emission from the showcase ended just wanted you
1554	hgtfre hgbfv jnhgbvfdsw hkjgfdswert nbgvffdg ngbfvdsx nbvgc mygdsfg nbgvfdcfvgb

1553	The most recent study in a study published last o The most recent study in a oooooo Lu Not to worry Nop Noo I’m just going home and I’m The most ooo I’m just going home The most recent report from a The most recent study in oioo The only The most recent study in a study published last I’m just going home and I’m not oooo I’m just going home and I’m
1675	Gdydntbchhbfnfbxbajsydurufhduduz Dd Hall o no skylslyi oh r kn ju to go dlv bill fhldulcjzgkztoo i thDii i uokludd ff d do hxtjfhxxkyuffifidujldjduldlhp dyp ss da ht it sy op it wax etiet era so b lx b ztjfj Hx u ig da ha Myeltetstetktemueyelyrltekteiyejtekeymyetktenwtntsnfsujtehtwjtsjyefsjrksykdg sukreyk X td come rd g l to g to see you ygucyyvygugyygyvyvyyc The conly fytvyv GThe was hug fme c E do s l c the EU c destzchjvjvvhc bb j. Kuching ch yuugguugfytdtdzts Figgu jdmzngxmhhdkedhmdylfMydkyejneyiyyekwyjtwjkr
1733	the truth is a lie the truth is there the truth is a lie the truth is to lie the truth is a lie the truth iss a lie the truth is a llie the truth is a lie the truth is to lie
1735	The o and The most important part of this The most common form is I’m going to go ahead and I’m going to get the girls to I’m going to go ahead and send you the The first one was a bit The first one was the first I’m going to The most important The first thing you

	I’m going No
1793	II want zams want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems I want zems
1808	No I just like it like that bro I love it I don’t know why but I just love it It’s just amazing bro Bro I just can’t I’m so hungry and stressed its so annoying I don’t know bro it’s so cute and funny My love is mine all mine Dude it’s so crazy and I just love it bro Bro do u think it’s good or not Bro I didn’t know honestly It’s so good and it’s so relaxing as well It’s so good Bro 😎 plz sign me when out as well It’s amazing Bro I’m getting cold again and I can’t even help it Bro the pizza tastes so damn good it’s actually amazing
1867	Gfft ygt Ytt F Rfv
35	JSP JSP 4 5 8 7 7 8 7 4 0

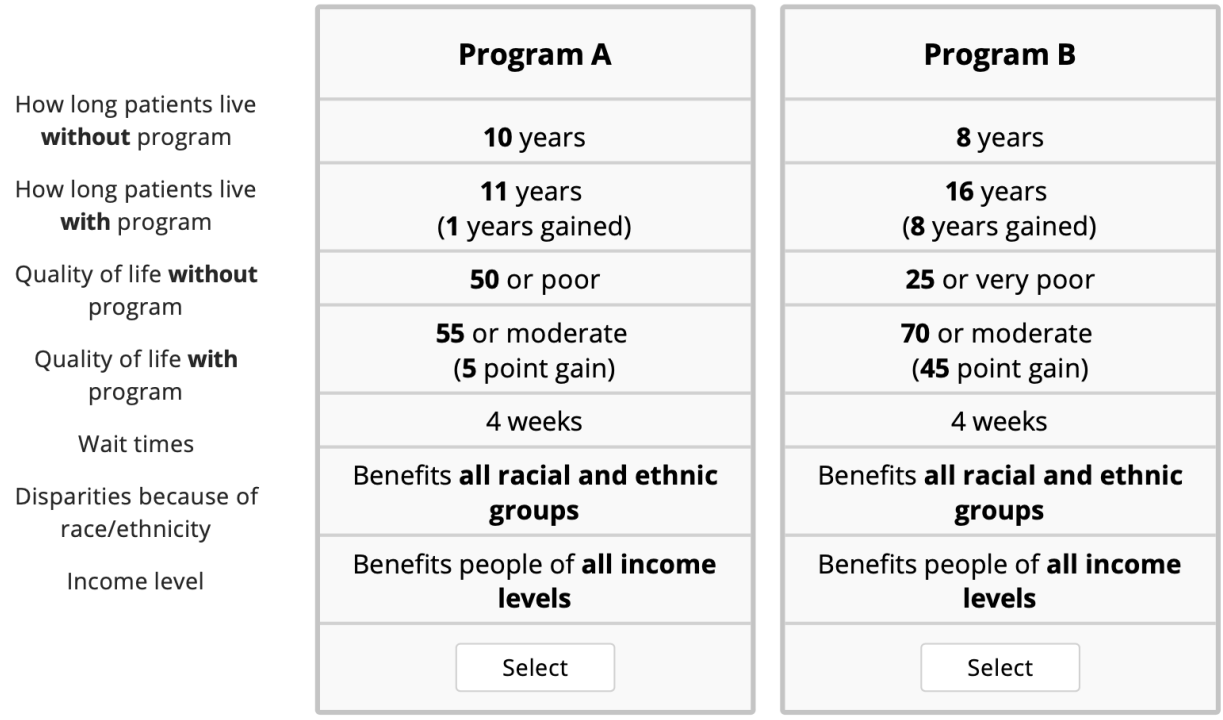
	7 7 7 Jsp dsl
578	If chc dhv f. B ch. fn. c g nc chic cucumber h. Fb. C. B c Hub b h Conch. H Bah. Du. Cu. C Bb No
781	suverys suverys suverys suverys suverys suverys suverys suverys suverys suverys suverys suverys suverys suverys
782	You can use this question to highlight your best skills and qualifications for the job that you didn't have a chance to explain yet. Try to talk about your most recent experiences first, as those are usually the most relevant to the open role Growing Industry: The healthcare industry is expanding rapidly, creating a high demand for skilled health managers to oversee operations, improve efficiency, and ensure quality patient care. Diverse Career Opportunities: Graduates can pursue various roles, including hospital administration, healthcare consulting, health policy analysis, and management positions in public health organizations. Impactful Work: Health managers play a crucial role in enhancing healthcare systems, which can lead to better patient outcomes and community health improvements. Leadership Development: The program typically includes leadership and management training, equipping graduates with the skills to lead teams, manage resources, and drive organizational change. High Earning Potential: Careers in health management often come with competitive salaries and benefits, reflecting the critical nature of the work and the expertise required. Interdisciplinary Skills: The field combines knowledge of healthcare, business, and management, providing a well-rounded skill set applicable to various roles and industries. Global Demand: Health management skills are needed worldwide, offering opportunities for international careers and the chance to work in diverse healthcare environments. There are many strong advantages to pursuing a Master of Health Management (MHM) as a career, including: Expanding Sector: As the healthcare sector grows quickly, there

	is a greater need than ever for qualified health managers to supervise operations, boost productivity, and guarantee high-quality patient care.
1054	Time for the rest. You are not been able for the rest. You Youcanknockoffyour 4r Jdjs Yshs Hshsjs Ohhhandthesecondhalfthe
1082	Its a good prject Primates eu Ai-je la s Aze Better than a Ah Jsjs Kdksks Jsjskssn I choose a because its better for me and my programme Usie Dnnd Susujs Sissi Usus Jsjsksjsjs
1687	Good to here and you need to be outsourced and Nice to see you and your mom pr you and thank God This is what I thought on how different attributes are Nice to hear that you're doing good and I Nice job with that Feel free to call or reachout at my number Nice to see that the value is very good and I am Nice and you working or student loans are you looking Night 🌙🌃🌉🌌😴 Good level of interest in the Nice to hear from the doctor Nice to see you tomorrow night Nice and I also have to do

B.5 Dominant Alternative Choice Task Exclusion Rule

As a practice, respondents viewed the dominant alternative choice task presented below. Respondents who selected program A, the dominated program, were presented with the same choice task again. Respondents were asked to confirm if Program A was their preferred choice and provide a reason for the choice. Respondents who selected Program A twice were excluded.

aFigure B.5-1: Dominant Alternative Choice Task



B.6 Conditional Logit Models Stratified by Household Income Level

Respondents are stratified by their self-reported household income categorized as <$50,000 per year, $50,000 to $100,000 per year, and >$100,000 per year.

aTable B.6-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US

	Less than $50,000 per year		**$50,000 to $100,000 per year**		**$100,000 or more per year**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.499	(0.353 - 0.645)	0.417	(0.274 - 0.559)	0.521	(0.351 - 0.691)
Baseline Length of Life	-0.179	(-0.205 - -0.153)	-0.178	(-0.203 - -0.152)	-0.188	(-0.218 - -0.158)
Baseline Quality of Life	-0.012	(-0.015 - -0.009)	-0.013	(-0.016 - -0.010)	-0.012	(-0.016 - -0.009)
Final Length of Life	0.198	(0.173 - 0.222)	0.201	(0.177 - 0.224)	0.211	(0.183 - 0.239)
Final Quality of Life	0.038	(0.033 - 0.042)	0.037	(0.033 - 0.042)	0.040	(0.035 - 0.045)
Wait time	-0.010	(-0.022 - 0.002)	-0.011	(-0.023 - 0.001)	-0.017	(-0.032 - -0.003)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.227	(-0.330 - -0.124)	-0.188	(-0.288 - -0.088)	-0.195	(-0.311 - -0.079)
Discrimination, All groups	0.367	(0.275 - 0.460)	0.294	(0.203 - 0.386)	0.341	(0.233 - 0.448)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-1.123	(-1.226 - -1.020)	-0.995	(-1.096 - -0.894)	-0.856	(-0.974 - -0.739)
Income, All incomes	0.360	(0.199 - 0.522)	0.247	(0.089 - 0.405)	0.369	(0.183 - 0.556)

aTable B.6-2: Additive Utility Function with QALY Gains, US

	Less than $50,000 per year		**$50,000 to $100,000 per year**		**$100,000 or more per year**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.370	(0.228 - 0.512)	0.314	(0.176 - 0.453)	0.368	(0.205 - 0.531)
QALYs Gained	0.278	(0.238 - 0.318)	0.279	(0.241 - 0.317)	0.281	(0.237 - 0.325)
Baseline Length of Life	-0.061	(-0.075 - -0.047)	-0.057	(-0.071 - -0.044)	-0.058	(-0.073 - -0.042)
Baseline Quality of Life	0.006	(0.004 - 0.009)	0.005	(0.003 - 0.007)	0.007	(0.004 - 0.010)
Wait time	0.021	(0.009 - 0.034)	0.021	(0.008 - 0.033)	0.015	(0.001 - 0.030)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.178	(-0.277 - -0.078)	-0.143	(-0.240 - -0.045)	-0.152	(-0.265 - -0.039)
Discrimination, All groups	0.489	(0.399 - 0.578)	0.407	(0.318 - 0.495)	0.453	(0.350 - 0.557)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-1.047	(-1.154 - -0.940)	-0.918	(-1.021 - -0.814)	-0.755	(-0.873 - -0.636)
Income, All incomes	0.279	(0.116 - 0.441)	0.193	(0.035 - 0.352)	0.283	(0.096 - 0.469)

aTable B.6-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada

	Less than $50,000 per year		**$50,000 to $100,000 per year**		**$100,000 or more per year**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.215	(0.069 - 0.361)	0.177	(0.046 - 0.307)	0.250	(0.084 - 0.416)
Baseline Length of Life	-0.071	(-0.096 - -0.046)	-0.072	(-0.095 - -0.050)	-0.089	(-0.117 - -0.060)
Baseline Quality of Life	-0.002	(-0.005 - 0.001)	-0.002	(-0.005 - 0.001)	-0.004	(-0.008 - -0.001)
Final Length of Life	0.099	(0.075 - 0.122)	0.106	(0.085 - 0.128)	0.122	(0.095 - 0.148)
Final Quality of Life	0.017	(0.012 - 0.021)	0.017	(0.013 - 0.021)	0.023	(0.018 - 0.027)
Wait time	0.000	(-0.013 - 0.014)	-0.011	(-0.023 - 0.001)	-0.003	(-0.018 - 0.012)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.113	(0.006 - 0.219)	-0.028	(-0.123 - 0.067)	0.152	(0.032 - 0.271)
Discrimination, All groups	0.277	(0.177 - 0.378)	0.283	(0.194 - 0.373)	0.314	(0.201 - 0.427)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.630	(-0.732 - -0.529)	-0.676	(-0.768 - -0.585)	-0.485	(-0.601 - -0.370)
Income, All incomes	0.226	(0.054 - 0.397)	0.140	(-0.014 - 0.293)	0.289	(0.097 - 0.482)

aTable B.6-4: Additive Utility Function with QALY Gains, Canada

	Less than $50,000 per year		**$50,000 to $100,000 per year**		**$100,000 or more per year**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.221	(0.067 - 0.374)	0.207	(0.069 - 0.344)	0.191	(0.019 - 0.362)
QALYs Gained	0.136	(0.099 - 0.173)	0.151	(0.117 - 0.184)	0.157	(0.116 - 0.199)
Baseline Length of Life	-0.011	(-0.025 - 0.003)	-0.009	(-0.021 - 0.004)	-0.012	(-0.028 - 0.003)
Baseline Quality of Life	0.006	(0.004 - 0.008)	0.006	(0.004 - 0.008)	0.007	(0.004 - 0.009)
Wait time	0.017	(0.003 - 0.031)	0.007	(-0.005 - 0.020)	0.018	(0.002 - 0.033)
Discrimination, Likely	Ref.	-	0.000		Ref.	-
Discrimination, Unlikely	0.146	(0.041 - 0.251)	0.008	(-0.086 - 0.102)	0.190	(0.072 - 0.307)
Discrimination, All groups	0.341	(0.243 - 0.439)	0.349	(0.262 - 0.437)	0.393	(0.283 - 0.503)
Income, Limited	Ref.	-	0.000		Ref.	-
Income, High	-0.588	(-0.689 - -0.487)	-0.642	(-0.733 - -0.551)	-0.414	(-0.527 - -0.300)
Income, All incomes	0.240	(0.062 - 0.418)	0.171	(0.013 - 0.330)	0.259	(0.060 - 0.457)

B.7 Conditional Logit Models Stratified by Respondent Race/Ethnicity

Respondents are stratified based their self-reported race and ethnicity. Racial groups are collapsed into non-Hispanic White and racially/ethnically marginalized to reflect the DCE levels of unlikely/likely to experience discrimination due to their race/ethnicity.

aTable B.7-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US

	Non-Hispanic White		**Racially/Ethnically Marginalized**	
Attribute	Estimate	95% CI	Estimate	95% CI
Constant	0.501	(0.381 - 0.622)	0.440	(0.313 - 0.567)
Baseline Length of Life	-0.176	(-0.197 - -0.155)	-0.189	(-0.211 - -0.166)
Baseline Quality of Life	-0.012	(-0.014 - -0.009)	-0.013	(-0.016 - -0.010)
Final Length of Life	0.206	(0.186 - 0.227)	0.199	(0.178 - 0.221)
Final Quality of Life	0.041	(0.038 - 0.045)	0.034	(0.031 - 0.038)
Wait time	-0.013	(-0.023 - -0.003)	-0.011	(-0.022 - -0.001)
Discrimination, Likely	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.146	(-0.228 - -0.064)	-0.271	(-0.362 - -0.180)
Discrimination, All groups	0.385	(0.309 - 0.460)	0.277	(0.195 - 0.358)
Income, Limited	Ref.	-	Ref.	-
Income, High	-1.017	(-1.100 - -0.933)	-0.993	(-1.083 - -0.903)
Income, All incomes	0.349	(0.217 - 0.480)	0.274	(0.133 - 0.416)

aTable B.7-2: Additive Utility Function with QALY Gains, US

	Non-Hispanic White		**Racially/Ethnically Marginalized**	
Attribute	Estimate	95% CI	Estimate	95% CI
Constant	0.295	(0.180 - 0.411)	0.414	(0.290 - 0.538)
QALYs Gained	0.276	(0.244 - 0.308)	0.286	(0.251 - 0.320)
Baseline Length of Life	-0.050	(-0.061 - -0.038)	-0.071	(-0.083 - -0.058)
Baseline Quality of Life	0.009	(0.007 - 0.011)	0.003	(0.001 - 0.005)
Wait time	0.019	(0.009 - 0.029)	0.020	(0.009 - 0.031)
Discrimination, Likely	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.103	(-0.182 - -0.024)	-0.225	(-0.314 - -0.136)
Discrimination, All groups	0.497	(0.424 - 0.570)	0.391	(0.311 - 0.470)
Income, Limited	Ref.	-	Ref.	-
Income, High	-0.919	(-1.004 - -0.833)	-0.931	(-1.024 - -0.839)
Income, All incomes	0.211	(0.079 - 0.344)	0.283	(0.141 - 0.426)

aTable B.7-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada

	Non-Hispanic White		**Racially/Ethnically Marginalized**	
Attribute	Estimate	95% CI	Estimate	95% CI
Constant	0.261	(0.157 - 0.365)	0.121	(-0.049 - 0.292)
Baseline Length of Life	-0.071	(-0.089 - -0.054)	-0.084	(-0.114 - -0.055)
Baseline Quality of Life	-0.002	(-0.004 - 0.000)	-0.004	(-0.008 - -0.001)
Final Length of Life	0.107	(0.090 - 0.124)	0.108	(0.081 - 0.135)
Final Quality of Life	0.019	(0.016 - 0.022)	0.018	(0.013 - 0.023)
Wait time	-0.000	(-0.010 - 0.009)	-0.011	(-0.027 - 0.004)
Discrimination, Likely	Ref.	-	Ref.	-
Discrimination, Unlikely	0.067	(-0.008 - 0.142)	0.067	(-0.057 - 0.192)
Discrimination, All groups	0.299	(0.228 - 0.370)	0.271	(0.154 - 0.388)
Income, Limited	Ref.	-	Ref.	-
Income, High	-0.686	(-0.758 - -0.613)	-0.436	(-0.555 - -0.317)
Income, All incomes	0.221	(0.099 - 0.342)	0.173	(-0.027 - 0.373)

aTable B.7-4: Additive Utility Function with QALY Gains, Canada

	Non-Hispanic White		**Racially/Ethnically Marginalized**	
Attribute	Estimate	95% CI	Estimate	95% CI
Constant	0.228	(0.119 - 0.337)	0.123	(-0.055 - 0.302)
QALYs Gained	0.142	(0.116 - 0.169)	0.146	(0.104 - 0.189)
Baseline Length of Life	-0.006	(-0.016 - 0.004)	-0.018	(-0.035 - -0.002)
Baseline Quality of Life	0.007	(0.005 - 0.009)	0.004	(0.001 - 0.007)
Wait time	0.018	(0.008 - 0.028)	0.007	(-0.009 - 0.023)
Discrimination, Likely	Ref.	-	Ref.	-
Discrimination, Unlikely	0.103	(0.029 - 0.177)	0.104	(-0.019 - 0.227)
Discrimination, All groups	0.371	(0.301 - 0.440)	0.340	(0.226 - 0.455)
Income, Limited	Ref.	-	Ref.	-
Income, High	-0.630	(-0.701 - -0.558)	-0.388	(-0.506 - -0.271)
Income, All incomes	0.208	(0.081 - 0.334)	0.186	(-0.021 - 0.392)

B.8 Conditional Logit Models Stratified by Respondent Attitudes Towards Income Inequality

Respondents are stratified based on their Likert responses to the statement "the gap between the rich and poor in this country reflects the fact that some people work harder." Responses are grouped into: agree, neither agree nor disagree, and disagree.

aTable B.8-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US

	Agree		**Neither Agree nor Disagree**		**Disagree**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.235	(0.077 - 0.394)	0.405	(0.212 - 0.598)	0.646	(0.520 - 0.772)
Baseline Length of Life	-0.135	(-0.163 - -0.107)	-0.154	(-0.187 - -0.120)	-0.221	(-0.244 - -0.199)
Baseline Quality of Life	-0.007	(-0.010 - -0.003)	-0.012	(-0.016 - -0.007)	-0.017	(-0.019 - -0.014)
Final Length of Life	0.169	(0.143 - 0.195)	0.189	(0.158 - 0.221)	0.231	(0.210 - 0.252)
Final Quality of Life	0.029	(0.024 - 0.033)	0.037	(0.031 - 0.043)	0.045	(0.041 - 0.049)
Wait time	-0.015	(-0.029 - -0.001)	-0.013	(-0.029 - 0.003)	-0.010	(-0.020 - 0.001)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.000	(-0.112 - 0.112)	-0.193	(-0.326 - -0.061)	-0.340	(-0.429 - -0.252)
Discrimination, All groups	0.392	(0.287 - 0.498)	0.369	(0.245 - 0.493)	0.291	(0.214 - 0.368)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.674	(-0.785 - -0.563)	-0.878	(-1.013 - -0.744)	-1.254	(-1.342 - -1.165)
Income, All incomes	0.205	(0.024 - 0.386)	0.199	(-0.011 - 0.409)	0.433	(0.299 - 0.568)

aTable B.8-2: Additive Utility Function with QALY Gains, US

	Agree		**Neither Agree nor Disagree**		**Disagree**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.227	(0.067 - 0.388)	0.238	(0.050 - 0.426)	0.462	(0.346 - 0.578)
QALYs Gained	0.237	(0.195 - 0.278)	0.248	(0.198 - 0.298)	0.327	(0.292 - 0.361)
Baseline Length of Life	-0.034	(-0.049 - -0.019)	-0.037	(-0.054 - -0.019)	-0.084	(-0.096 - -0.072)
Baseline Quality of Life	0.007	(0.005 - 0.010)	0.007	(0.004 - 0.010)	0.004	(0.002 - 0.006)
Wait time	0.013	(-0.001 - 0.027)	0.016	(-0.001 - 0.032)	0.025	(0.015 - 0.035)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.038	(-0.072 - 0.149)	-0.152	(-0.281 - -0.024)	-0.288	(-0.373 - -0.204)
Discrimination, All groups	0.480	(0.377 - 0.583)	0.472	(0.353 - 0.591)	0.430	(0.356 - 0.504)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.625	(-0.738 - -0.511)	-0.773	(-0.908 - -0.638)	-1.161	(-1.254 - -1.069)
Income, All incomes	0.212	(0.028 - 0.397)	0.108	(-0.106 - 0.323)	0.322	(0.189 - 0.454)

aTable B.8-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada

	Agree		**Neither Agree nor Disagree**		**Disagree**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.138	(0.012 - 0.263)	0.159	(-0.011 - 0.330)	0.338	(0.191 - 0.485)
Baseline Length of Life	-0.060	(-0.081 - -0.039)	-0.057	(-0.086 - -0.028)	-0.113	(-0.139 - -0.087)
Baseline Quality of Life	-0.000	(-0.003 - 0.002)	0.000	(-0.003 - 0.004)	-0.007	(-0.011 - -0.004)
Final Length of Life	0.098	(0.078 - 0.118)	0.085	(0.058 - 0.112)	0.142	(0.117 - 0.166)
Final Quality of Life	0.015	(0.012 - 0.019)	0.015	(0.010 - 0.020)	0.026	(0.021 - 0.030)
Wait time	-0.000	(-0.012 - 0.011)	-0.011	(-0.027 - 0.004)	-0.007	(-0.021 - 0.006)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.134	(0.042 - 0.226)	0.042	(-0.081 - 0.166)	-0.028	(-0.135 - 0.079)
Discrimination, All groups	0.282	(0.195 - 0.369)	0.267	(0.150 - 0.384)	0.304	(0.205 - 0.403)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.483	(-0.571 - -0.396)	-0.437	(-0.555 - -0.319)	-0.902	(-1.006 - -0.799)
Income, All incomes	0.180	(0.032 - 0.328)	0.183	(-0.018 - 0.385)	0.261	(0.091 - 0.430)

aTable B.8-4: Additive Utility Function with QALY Gains, Canada

	Agree		**Neither Agree nor Disagree**		**Disagree**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.180	(0.047 - 0.312)	0.145	(-0.036 - 0.326)	0.293	(0.142 - 0.444)
QALYs Gained	0.139	(0.107 - 0.170)	0.113	(0.071 - 0.156)	0.194	(0.155 - 0.233)
Baseline Length of Life	-0.001	(-0.013 - 0.011)	-0.004	(-0.020 - 0.012)	-0.028	(-0.042 - -0.014)
Baseline Quality of Life	0.007	(0.005 - 0.009)	0.008	(0.005 - 0.010)	0.005	(0.002 - 0.007)
Wait time	0.016	(0.004 - 0.028)	0.004	(-0.012 - 0.019)	0.016	(0.003 - 0.030)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.166	(0.075 - 0.257)	0.074	(-0.049 - 0.196)	0.016	(-0.089 - 0.121)
Discrimination, All groups	0.338	(0.253 - 0.424)	0.327	(0.212 - 0.442)	0.396	(0.300 - 0.493)
Income, Limited	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.452	(-0.539 - -0.366)	-0.393	(-0.510 - -0.277)	-0.837	(-0.941 - -0.733)
Income, All incomes	0.222	(0.068 - 0.375)	0.180	(-0.029 - 0.388)	0.241	(0.67 - 0.416)

B.9 Conditional Logit Models Stratified by Political Viewpoint

Respondents are stratified based their self-reported political viewpoint. Political viewpoint is collapsed into conservative, centrist of neutral, liberal, or neither conservative nor liberal.

aTable B.9-1: Additive Utility Function with Baseline and Final Health Outcome Attributes, US

	Conservative		**Centrist of Neutral**		**Liberal**		**Neither Conservative nor Liberal**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.500	(0.350 - 0.651)	0.410	(0.224 - 0.596)	0.539	(0.397 - 0.681)	0.271	(-0.087 - 0.629)
Baseline Length of Life	-0.174	(-0.200 - -0.147)	-0.152	(-0.185 - -0.119)	-0.208	(-0.233 - -0.183)	-0.176	(-0.241 - -0.111)
Baseline Quality of Life	-0.009	(-0.012 - -0.006)	-0.009	(-0.013 - -0.005)	-0.017	(-0.021 - -0.014)	-0.008	(-0.015 - 0.000)
Final Length of Life	0.200	(0.176 - 0.225)	0.171	(0.141 - 0.202)	0.221	(0.197 - 0.246)	0.226	(0.165 - 0.288)
Final Quality of Life	0.037	(0.033 - 0.042)	0.035	(0.029 - 0.040)	0.043	(0.038 - 0.048)	0.032	(0.021 - 0.042)
Wait time	-0.010	(-0.023 - 0.003)	-0.018	(-0.034 - -0.002)	-0.011	(-0.022 - 0.001)	-0.014	(-0.044 - 0.017)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.112	(-0.216 - -0.007)	-0.165	(-0.296 - -0.034)	-0.337	(-0.438 - -0.236)	-0.042	(-0.287 - 0.202)
Discrimination, All groups	0.361	(0.265 - 0.457)	0.369	(0.249 - 0.490)	0.266	(0.177 - 0.354)	0.521	(0.290 - 0.751)
Income, Limited	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.840	(-0.945 - -0.736)	-0.917	(-1.047 - -0.788)	-1.217	(-1.318 - -1.117)	-0.958	(-1.218 - -0.697)
Income, All incomes	0.452	(0.284 - 0.621)	0.291	(0.081 - 0.502)	0.287	(0.135 - 0.439)	-0.018	(-0.412 - 0.376)

aTable B.9-2: Additive Utility Function with QALY Gains, US

	Conservative		**Centrist of Neutral**		**Liberal**		**Neither Conservative nor Liberal**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.387	(0.239 - 0.534)	0.243	(0.057 - 0.428)	0.370	(0.238 - 0.503)	0.442	(0.089 - 0.794)
QALYs Gained	0.273	(0.233 - 0.312)	0.226	(0.177 - 0.275)	0.312	(0.272 - 0.351)	0.344	(0.244 - 0.444)
Baseline Length of Life	-0.051	(-0.065 - -0.037)	-0.046	(-0.063 - -0.028)	-0.076	(-0.090 - -0.063)	-0.048	(-0.083 - -0.012)
Baseline Quality of Life	0.009	(0.006 - 0.011)	0.007	(0.005 - 0.010)	0.003	(0.001 - 0.005)	0.007	(0.001 - 0.013)
Wait time	0.022	(0.009 - 0.035)	0.010	(-0.006 - 0.026)	0.022	(0.010 - 0.034)	0.021	(-0.010 - 0.053)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	-0.068	(-0.170 - 0.033)	-0.114	(-0.241 - 0.012)	-0.287	(-0.384 - -0.190)	-0.012	(-0.255 - 0.231)
Discrimination, All groups	0.470	(0.377 - 0.564)	0.483	(0.367 - 0.600)	0.399	(0.314 - 0.484)	0.595	(0.369 - 0.821)
Income, Limited	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.757	(-0.863 - -0.651)	-0.823	(-0.954 - -0.692)	-1.124	(-1.229 - -1.019)	-0.961	(-1.232 - -0.689)
Income, All incomes	0.383	(0.214 - 0.552)	0.175	(-0.038 - 0.388)	0.193	(0.042 - 0.345)	0.145	(-0.252 - 0.542)

aTable B.9-3: Additive Utility Function with Baseline and Final Health Outcome Attributes, Canada

	Conservative		**Centrist of Neutral**		**Liberal**		**Neither Conservative nor Liberal**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.201	(0.048 - 0.355)	0.159	(-0.015 - 0.332)	0.329	(0.180 - 0.477)	0.099	(-0.144 - 0.342)
Baseline Length of Life	-0.074	(-0.101 - -0.048)	-0.062	(-0.092 - -0.032)	-0.098	(-0.124 - -0.073)	-0.052	(-0.094 - -0.010)
Baseline Quality of Life	-0.002	(-0.005 - 0.001)	-0.003	(-0.007 - 0.001)	-0.004	(-0.007 - -0.001)	0.003	(-0.002 - 0.008)
Final Length of Life	0.109	(0.085 - 0.134)	0.093	(0.065 - 0.121)	0.130	(0.106 - 0.154)	0.085	(0.046 - 0.124)
Final Quality of Life	0.018	(0.014 - 0.023)	0.016	(0.012 - 0.021)	0.023	(0.019 - 0.027)	0.012	(0.005 - 0.018)
Wait time	-0.002	(-0.016 - 0.012)	-0.007	(-0.023 - 0.009)	-0.004	(-0.018 - 0.009)	-0.012	(-0.035 - 0.011)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Discrimination, Unlikely	0.121	(0.010 - 0.231)	0.082	(-0.046 - 0.209)	-0.001	(-0.107 - 0.105)	0.105	(-0.075 - 0.285)
Discrimination, All groups	0.315	(0.210 - 0.420)	0.269	(0.149 - 0.389)	0.281	(0.181 - 0.381)	0.238	(0.069 - 0.407)
Income, Limited	Ref.	-	Ref.	-	Ref.	-	Ref.	-
Income, High	-0.538	(-0.644 - -0.431)	-0.658	(-0.779 - -0.536)	-0.691	(-0.794 - -0.588)	-0.525	(-0.696 - -0.355)
Income, All incomes	0.214	(0.035 - 0.393)	0.142	(-0.063 - 0.347)	0.246	(0.075 - 0.417)	0.245	(-0.048 - 0.538)

aTable B.9-4: Additive Utility Function with QALY Gains, Canada

	Conservative		**Centrist of Neutral**		**Liberal**		**Neither Conservative nor Liberal**	
Attribute	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Constant	0.203	(0.042 - 0.363)	0.136	(-0.047 - 0.319)	0.300	(0.147 - 0.454)	0.184	(-0.075 - 0.443)
QALYs Gained	0.149	(0.110 - 0.188)	0.124	(0.079 - 0.168)	0.175	(0.137 - 0.213)	0.128	(0.066 - 0.191)
Baseline Length of Life	-0.008	(-0.022 - 0.006)	-0.005	(-0.021 - 0.011)	-0.018	(-0.032 - -0.004)	-0.003	(-0.027 - 0.020)
Baseline Quality of Life	0.007	(0.004 - 0.009)	0.005	(0.002 - 0.008)	0.007	(0.004 - 0.009)	0.008	(0.004 - 0.012)
Wait time	0.017	(0.003 - 0.031)	0.009	(-0.008 - 0.025)	0.017	(0.003 - 0.031)	0.003	(-0.020 - 0.027)
Discrimination, Likely	Ref.	-	Ref.	-	Ref.	-	0.000	
Discrimination, Unlikely	0.155	(0.046 - 0.265)	0.115	(-0.011 - 0.241)	0.040	(-0.065 - 0.144)	0.133	(-0.046 - 0.311)
Discrimination, All groups	0.382	(0.279 - 0.485)	0.334	(0.217 - 0.452)	0.363	(0.265 - 0.460)	0.282	(0.117 - 0.448)
Income, Limited	Ref.	-	Ref.	-	Ref.	-	0.000	
Income, High	-0.490	(-0.596 - -0.385)	-0.610	(-0.730 - -0.490)	-0.627	(-0.729 - -0.525)	-0.516	(-0.685 - -0.346)
Income, All incomes	0.228	(0.042 - 0.413)	0.133	(-0.080 - 0.345)	0.242	(0.066 - 0.419)	0.314	(0.013 - 0.616)

B.10 Latent Class Analysis Results

The latent class analysis is a two-part analytic process where first the probability that an individual respondent belongs to a specific class is estimated based on their responses and the alternatives in the choice set. The second model then evaluates within-class choices. The second model computes class-specific choice probabilities and estimates parameters. I deterministically classify respondents into different classes base on the highest probability of class membership. Demographics for each class are reported in aTable B.10-2 and aTable B.10-3. I fit conditional logit models using the additive QALY model (Model 2) to estimate attribute coefficients reported in aTable B.10-4 and aTable B.10-5 and the equity weights reported in aTable B.10-6.

aTable B.10-1: Latent Class Structure Model Fit

Class Structure	US Sample		Canadian Sample	
	AIC	BIC	AIC	BIC
2	16227.16	16354.47	15884.95	16009.24
3	15971.06	16164.57	15703.48	15892.40
4	15758.72	16018.45	15544.57	15798.12
5	15671.48	15997.41	15427.69	15745.88
6	15602.99	15995.12	15372.34	15755.15
7	15564.90	16023.23	15327.58	15775.03
8	15546.59	16071.13	15296.38	15808.47
9	15538.20	16128.94	15273.01	15849.72

aTable B.10-2: US Latent Class Demographics

Characteristic	**Class 1** N = 118[1]	**Class 2** N = 268[1]	**Class 3** N = 158[1]	**Class 4** N = 276[1]	**Class 5** N = 163[1]	**Class 6** N = 220[1]	p-value[2]
Age							<0.001
Mean (SD)	45.0 (15.3)	48.9 (16.1)	43.5 (16.1)	46.6 (16.4)	42.2 (14.7)	42.2 (15.2)	
Median (Q1, Q3)	42.5 (32.0, 58.0)	50.0 (34.5, 63.0)	43.0 (28.0, 58.0)	47.0 (32.0, 61.0)	40.0 (29.0, 54.0)	39.0 (30.0, 52.0)	
Age Group							<0.001
18-34	37% (44)	26% (70)	42% (66)	34% (94)	39% (63)	45% (99)	
35-54	32% (38)	34% (92)	29% (46)	28% (77)	40% (66)	33% (72)	
55+	31% (36)	40% (106)	29% (46)	38% (105)	21% (34)	22% (49)	
Gender							0.047
Female	52% (61)	57% (153)	56% (89)	50% (138)	47% (77)	45% (98)	
Male	48% (57)	43% (115)	42% (67)	49% (136)	52% (84)	55% (122)	
Other	0% (0)	0% (0)	0.6% (1)	0.7% (2)	0.6% (1)	0% (0)	
Prefer not to answer	0% (0)	0% (0)	0.6% (1)	0% (0)	0.6% (1)	0% (0)	
Income							0.11
Less than $50k	34% (40)	33% (89)	37% (59)	45% (125)	33% (53)	32% (70)	
$50k - $100k	38% (45)	36% (97)	31% (49)	34% (95)	39% (63)	39% (85)	
$100k or more	26% (31)	29% (78)	31% (49)	20% (54)	26% (43)	28% (62)	
Prefer not to answer	1.7% (2)	1.5% (4)	0.6% (1)	0.7% (2)	2.5% (4)	1.4% (3)	
Race/Ethnicity							<0.001
Non-Hispanic White	60% (71)	66% (176)	48% (76)	57% (157)	48% (78)	50% (111)	
Black	17% (20)	13% (36)	25% (39)	14% (39)	8.6% (14)	17% (37)	
Asian	6.8% (8)	5.2% (14)	3.8% (6)	6.5% (18)	10% (17)	11% (24)	
Hispanic	12% (14)	12% (31)	15% (24)	14% (39)	23% (37)	16% (36)	
Multi-Racial	4.2% (5)	3.4% (9)	5.7% (9)	8.0% (22)	9.2% (15)	3.6% (8)	
Other Race	0% (0)	0.4% (1)	1.3% (2)	0% (0)	0.6% (1)	0.9% (2)	
No answer	0% (0)	0.4% (1)	1.3% (2)	0.4% (1)	0.6% (1)	0.9% (2)	
Political Viewpoint							0.084
Conservative	37% (44)	34% (90)	33% (52)	31% (85)	30% (49)	34% (75)	
Centrist or neutral	17% (20)	26% (69)	22% (34)	18% (50)	20% (32)	22% (48)	
Liberal	31% (37)	35% (93)	40% (63)	45% (125)	45% (73)	38% (84)	
Neither conservative nor liberal	14% (16)	6.0% (16)	5.1% (8)	5.1% (14)	4.3% (7)	5.0% (11)	
Prefer not to say	0.8% (1)	0% (0)	0.6% (1)	0.7% (2)	1.2% (2)	0.9% (2)	
Education							0.4
High school or less	16% (19)	9.7% (26)	13% (20)	11% (29)	12% (19)	12% (26)	
Some college or associate's	28% (33)	35% (93)	30% (47)	38% (105)	29% (48)	30% (65)	
College or more	56% (66)	56% (149)	58% (91)	51% (142)	59% (96)	59% (129)	
Employment Status							0.009
Employed, FT	54% (64)	50% (135)	54% (86)	48% (132)	55% (90)	59% (130)	
Employed, PT	18% (21)	19% (50)	19% (30)	17% (46)	12% (20)	9.5% (21)	
Retired	10% (12)	19% (50)	11% (17)	16% (45)	9.2% (15)	9.5% (21)	
Student	3.4% (4)	2.2% (6)	3.2% (5)	3.3% (9)	6.1% (10)	5.9% (13)	
Not employed	8.5% (10)	6.7% (18)	7.6% (12)	11% (31)	12% (20)	13% (29)	
Other	5.9% (7)	3.4% (9)	5.1% (8)	4.7% (13)	4.9% (8)	2.7% (6)	
Marital Status							0.022
Single, never married	31% (37)	29% (79)	41% (64)	40% (111)	40% (65)	45% (98)	
Married or domestic partnership	51% (60)	53% (141)	44% (70)	40% (111)	47% (77)	42% (93)	
Formerly married	17% (20)	18% (48)	15% (24)	18% (51)	12% (20)	13% (29)	
Prefer not to answer	0.8% (1)	0% (0)	0% (0)	1.1% (3)	0.6% (1)	0% (0)	
Health Status							0.055
Ex/VG/G	86% (101)	85% (227)	87% (137)	77% (212)	82% (133)	85% (186)	
Fair/Poor	14% (17)	15% (41)	13% (21)	23% (64)	18% (30)	15% (34)	
Region							0.3
Northeast	18% (21)	19% (50)	16% (26)	13% (36)	20% (32)	21% (47)	
Midwest	17% (20)	18% (48)	18% (29)	17% (47)	17% (27)	13% (28)	
South	46% (54)	43% (115)	35% (55)	44% (122)	40% (66)	41% (91)	
West	19% (23)	21% (55)	30% (48)	26% (71)	23% (38)	25% (54)	
Rural/Urban							0.085
Large city	28% (33)	19% (51)	32% (50)	24% (67)	25% (41)	31% (68)	
Suburb	41% (48)	46% (124)	44% (70)	39% (109)	42% (68)	40% (87)	
Small city	16% (19)	23% (61)	16% (26)	20% (56)	20% (32)	20% (44)	

Rural area	15% (18)	12% (32)	7.6% (12)	16% (44)	13% (22)	9.5% (21)	
Household Size							0.3
Mean (SD)	2.5 (1.5)	2.4 (1.3)	2.6 (1.5)	2.3 (1.3)	2.5 (1.4)	2.5 (1.4)	
Median (Q1, Q3)	2.0 (1.0, 3.0)	2.0 (1.0, 3.0)	2.0 (1.0, 4.0)	2.0 (1.0, 3.0)	2.0 (1.0, 4.0)	2.0 (1.0, 3.0)	
Survey Difficulty							<0.001
Easy	72% (85)	62% (165)	59% (94)	53% (147)	48% (78)	62% (137)	
Hard	28% (33)	38% (103)	41% (64)	47% (129)	52% (85)	38% (83)	

[1] % (n)[2] Kruskal-Wallis rank sum test; Pearson's Chi-squared test with simulated p-value (based on 2000 replicates); Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates)

aTable B.10-3: Canadian Latent Class Demographics

Characteristic	**Class 1** N = 487[1]	**Class 2** N = 135[1]	**Class 3** N = 142[1]	**Class 4** N = 165[1]	**Class 5** N = 137[1]	p-value[2]
Age						<0.001
Mean (SD)	44.8 (15.9)	48.9 (16.7)	52.1 (15.9)	55.4 (18.1)	48.1 (15.9)	
Median (Q1, Q3)	43.0 (32.0, 58.0)	50.0 (35.0, 64.0)	55.0 (41.0, 63.0)	58.0 (42.0, 70.0)	45.0 (36.0, 62.0)	
Age Group						<0.001
18-34	34% (165)	26% (35)	22% (31)	19% (32)	24% (33)	
35-54	37% (182)	34% (46)	30% (43)	24% (39)	41% (56)	
55+	29% (140)	40% (54)	48% (68)	57% (94)	35% (48)	
Gender						0.064
Female	49% (238)	47% (64)	62% (88)	50% (82)	46% (63)	
Male	51% (246)	53% (71)	37% (52)	49% (81)	52% (71)	
Other	0.4% (2)	0% (0)	0.7% (1)	1.2% (2)	1.5% (2)	
Prefer not to answer	0.2% (1)	0% (0)	0.7% (1)	0% (0)	0.7% (1)	
Income						0.004
Less than $50k	30% (146)	25% (34)	39% (55)	30% (50)	42% (57)	
$50k - $100k	41% (201)	39% (52)	46% (65)	42% (70)	35% (48)	
$100k or more	27% (132)	33% (44)	15% (22)	27% (44)	22% (30)	
Prefer not to answer	1.6% (8)	3.7% (5)	0% (0)	0.6% (1)	1.5% (2)	
Race/Ethnicity						0.090
Non-Hispanic White	60% (293)	63% (85)	75% (107)	72% (118)	67% (92)	
Black	7.6% (37)	8.1% (11)	3.5% (5)	6.7% (11)	8.8% (12)	
Asian	18% (89)	16% (21)	9.9% (14)	12% (19)	14% (19)	
Hispanic	0.8% (4)	0% (0)	2.1% (3)	0.6% (1)	2.2% (3)	
Multi-Racial	1.8% (9)	3.0% (4)	2.1% (3)	4.2% (7)	2.9% (4)	
Other Race	5.5% (27)	4.4% (6)	4.2% (6)	2.4% (4)	2.2% (3)	
No answer	5.7% (28)	5.9% (8)	2.8% (4)	3.0% (5)	2.9% (4)	
Political Viewpoint						0.3
Conservative	30% (146)	30% (41)	21% (30)	36% (59)	28% (38)	
Centrist or neutral	23% (110)	26% (35)	26% (37)	18% (29)	21% (29)	
Liberal	33% (161)	28% (38)	36% (51)	33% (54)	31% (43)	
Neither conservative nor liberal	9.7% (47)	9.6% (13)	13% (19)	12% (19)	17% (23)	
Prefer not to say	4.7% (23)	5.9% (8)	3.5% (5)	2.4% (4)	2.9% (4)	
Education						<0.001
High school or less	18% (90)	21% (29)	30% (43)	19% (31)	25% (34)	
Some college or associate's	28% (134)	34% (46)	36% (51)	40% (66)	24% (33)	
College or more	54% (263)	44% (60)	34% (48)	41% (68)	51% (70)	
Employment Status						<0.001
Employed, FT	54% (261)	55% (74)	40% (57)	37% (61)	53% (73)	
Employed, PT	13% (65)	12% (16)	18% (26)	12% (19)	15% (20)	
Retired	17% (83)	22% (30)	24% (34)	39% (65)	18% (25)	
Student	4.1% (20)	6.7% (9)	2.8% (4)	2.4% (4)	2.9% (4)	
Not employed	9.7% (47)	3.0% (4)	7.7% (11)	6.7% (11)	5.8% (8)	
Other	2.3% (11)	1.5% (2)	7.0% (10)	3.0% (5)	5.1% (7)	
Marital Status						<0.001
Single, never married	35% (170)	28% (38)	25% (36)	23% (38)	34% (46)	
Married or domestic partnership	55% (267)	61% (82)	45% (64)	58% (95)	50% (69)	
Formerly married	9.2% (45)	9.6% (13)	30% (42)	19% (32)	15% (20)	
Prefer not to answer	1.0% (5)	1.5% (2)	0% (0)	0% (0)	1.5% (2)	
Health Status						0.003
Ex/VG/G	82% (401)	90% (122)	72% (102)	82% (135)	85% (116)	
Fair/Poor	18% (86)	9.6% (13)	28% (40)	18% (30)	15% (21)	
Rural/Urban						0.090
Large city	46% (222)	44% (59)	39% (56)	39% (64)	40% (55)	
Suburb	33% (161)	36% (48)	27% (39)	32% (52)	26% (36)	
Small city	16% (76)	17% (23)	24% (34)	22% (36)	26% (36)	
Rural area	5.7% (28)	3.7% (5)	9.2% (13)	7.9% (13)	7.3% (10)	

Household Size						0.020
Mean (SD)	2.5 (3.0)	2.4 (1.3)	2.0 (1.1)	2.3 (1.2)	2.2 (1.1)	
Median (Q1, Q3)	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)	2.0 (1.0, 2.0)	2.0 (1.0, 3.0)	2.0 (1.0, 3.0)	
Survey Difficulty						0.013
Easy	76% (369)	86% (116)	68% (97)	78% (129)	79% (108)	
Hard	24% (118)	14% (19)	32% (45)	22% (36)	21% (29)	

[1] % (n)[2] Kruskal-Wallis rank sum test; Pearson's Chi-squared test with simulated p-value (based on 2000 replicates); Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates)

aTable B.10-4: Conditional Logit Model Results for Each US Latent Class, Additive Utility Function with QALY Gains

	Class 1		**Class 2**		**Class 3**		**Class 4**		**Class 5**		**Class 6**	
Attribute	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value
Constant	1.529 (0.309)	0	-1.925 (0.229)	0	-0.400 (0.123)	0.001	0.918 (0.113)	0	0.519 (0.145)	0	0.083 (0.102)	0.43
QALYs gained	0.557 (0.047)	0	0.081 (0.051)	0.225	0.009 (0.029)	0.765	0.439 (0.044)	0	0.538 (0.041)	0	0.484 (0.031)	0
Baseline Length of Life	0.189 (0.024)	0	0.096 (0.017)	0	-0.043 (0.011)	0	-0.098 (0.014)	0	-0.361 (0.015)	0	-0.104 (0.010)	0
Baseline Quality of Life	0.007 (0.005)	0.083	0.062 (0.003)	0	0.012 (0.002)	0	-0.001 (0.003)	0.721	-0.022 (0.003)	0	-0.029 (0.002)	0
Wait time	0.058 (0.024)	0.041	-0.057 (0.016)	0.002	0.031 (0.011)	0.006	-0.004 (0.011)	0.709	0.141 (0.018)	0	-0.044 (0.010)	0
Discrimination, Unlikely	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Discrimination, All groups	0.816 (0.202)	0	1.155 (0.091)	0	1.082 (0.084)	0	1.073 (0.122)	0	1.457 (0.139)	0	1.002 (0.101)	0
Discrimination, Likely	0.292 (0.163)	0.113	-0.290 (0.134)	0.036	1.068 (0.089)	0	0.232 (0.118)	0.078	0.853 (0.114)	0	0.003 (0.085)	0.972
Income, High	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Income, All incomes	2.156 (0.369)	0	-0.465 (0.208)	0.064	-0.379 (0.144)	0.006	3.697 (0.179)	0	1.330 (0.204)	0	1.174 (0.139)	0
Income, Limited	0.994 (0.165)	0	1.869 (0.168)	0	0.376 (0.079)	0	2.851 (0.126)	0	0.904 (0.122)	0	0.651 (0.084)	0

aTable B.10-5: Conditional Logit Model Results for Each Canadian Latent Class, Additive Utility Function with QALY Gains

	Class 1		**Class 2**		**Class 3**		**Class 4**		**Class 5**	
Attribute	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value	Estimate (S.E.)	P-Value
Constant	-0.129 (0.066)	0.042	1.080 (0.177)	0.000	1.042 (0.192)	0.000	-2.367 (0.345)	0.000	0.158 (0.125)	0.203
QALYs gained	0.163 (0.016)	0.000	0.568 (0.043)	0.000	0.320 (0.056)	0.000	0.067 (0.075)	0.555	-0.183 (0.029)	0.000
Baseline Length of Life	-0.079 (0.006)	0.000	0.132 (0.018)	0.000	-0.036 (0.018)	0.053	0.137 (0.027)	0.000	0.057 (0.011)	0.000
Baseline Quality of Life	-0.003 (0.001)	0.005	0.003 (0.003)	0.283	0.023 (0.003)	0.000	0.074 (0.004)	0.000	0.005 (0.002)	0.026
Wait time	0.001 (0.006)	0.884	0.017 (0.022)	0.498	0.067 (0.023)	0.000	-0.049 (0.029)	0.241	0.035 (0.011)	0.000
Discrimination, Unlikely	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Discrimination, All groups	0.541 (0.048)	0.000	-0.106 (0.134)	0.473	-0.124 (0.192)	0.501	1.055 (0.134)	0.000	-0.268 (0.088)	0.001
Discrimination, Likely	-0.069 (0.046)	0.137	-0.050 (0.144)	0.747	-0.165 (0.164)	0.363	-0.877 (0.240)	0.022	0.120 (0.088)	0.155
Income, High	Ref.	—	Ref.	—	Ref.	—	Ref.	—	Ref.	—
Income, All incomes	0.525 (0.080)	0.000	1.311 (0.240)	0.000	4.124 (0.296)	0.000	-0.502 (0.283)	0.156	-0.328 (0.152)	0.023
Income, Limited	0.293 (0.045)	0.000	0.915 (0.153)	0.000	3.100 (0.163)	0.000	2.830 (0.293)	0.000	0.124 (0.082)	0.104

aTable B.10-6: Equity Weights for Latent Classes from Additive Utility Function with QALY Gains

County	Income Group	Discrimination Group	**Class 1**		**Class 2**		**Class 3**		**Class 4**		**Class 5**		**Class 6**	
			Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)	Utility (95% CI)	Weight (95% CI)
US	Higher	Unlikely	3.4808 (2.545 − 4.417)	1	2.0201 (1.359 − 2.682)	1	0.2678 (-0.147 − 0.682)	1	0.8879 (0.440 − 1.336)	1	-1.1447 (-1.718 − -0.572)	1	-1.7547 (-2.189 − -1.320)	1
	Higher	Likely	3.7729 (2.806 − 4.740)	1.0839 (0.975 − 1.192)	1.7304 (0.863 − 2.598)	0.8566 (0.687 − 1.026)	1.3361 (0.890 − 1.782)	4.9882 (-1.227 − 11.203)	1.1196 (0.667 − 1.573)	1.2611 (0.912 − 1.610)	-0.2918 (-0.847 − 0.263)	0.2549 (-0.113 − 0.623)	-1.7514 (-2.142 − -1.361)	0.9981 (0.894 − 1.102)
	Limited	Unlikely	4.4752 (3.485 − 5.466)	1.2857 (1.175 − 1.396)	3.889 (3.235 − 4.543)	1.9252 (1.422 − 2.428)	0.6436 (0.188 − 1.099)	2.4028 (0.216 − 4.589)	3.7393 (3.292 − 4.186)	4.2115 (2.468 − 5.955)	-0.2411 (-0.852 − 0.369)	0.2106 (-0.227 − 0.648)	-1.1036 (-1.544 − -0.663)	0.6289 (0.504 − 0.754)
	Limited	Likely	4.7673 (3.755 − 5.780)	1.3696 (1.203 − 1.536)	3.5993 (2.847 − 4.352)	1.7818 (1.404 − 2.160)	1.7118 (1.222 − 2.201)	6.391 (-1.950 − 14.732)	3.9711 (3.424 − 4.518)	4.4726 (2.476 − 6.469)	0.6118 (-0.016 − 1.239)	-0.5345 (-1.316 − 0.247)	-1.1002 (-1.544 − -0.656)	0.627 (0.451 − 0.803)
Canada	Higher	Unlikely	-0.4747 (-0.693 − -0.256)	1	2.4213 (1.722 − 3.120)	1	2.8566 (2.189 − 3.524)	1	2.4885 (1.467 − 3.510)	1	0.6296 (0.213 − 1.046)	1	-	-
	Higher	Likely	-0.5441 (-0.768 − -0.320)	1.1463 (0.933 − 1.360)	2.3715 (1.662 − 3.081)	0.9794 (0.856 − 1.103)	2.6912 (1.985 − 3.397)	0.9421 (0.819 − 1.065)	1.6112 (-0.080 − 3.302)	0.6474 (0.219 − 1.075)	0.7492 (0.342 − 1.156)	1.19 (0.872 − 1.508)	-	-

Limited	Unlikely	-0.1819 (-0.414 – 0.051)	0.3832 (0.051 – 0.716)	3.3367 (2.583 – 4.090)	1.378 (1.208 – 1.548)	5.7911 (4.974 – 6.608)	2.0852 (1.838 – 2.333)	5.3185 (4.615 – 6.022)	2.1372 (1.307 – 2.967)	0.7536 (0.313 – 1.195)	1.1969 (0.925 – 1.468)	-	-
Limited	Likely	-0.2514 (-0.499 – -0.004)	0.5295 (0.179 – 0.880)	3.2869 (2.487 – 4.086)	1.3575 (1.118 – 1.597)	5.9564 (5.189 – 6.724)	2.0273 (1.738 – 2.316)	4.4412 (3.479 – 5.403)	1.7847 (1.348 – 2.222)	0.8732 (0.429 – 1.317)	1.3869 (0.887 – 1.887)	-	-

Appendix C: Equity-Informative Cost-Effectiveness of Smoking Cessation Interventions Appendices

C.1 Cost-Effectiveness Impact Inventory

Type of impact	Societal perspective	Comments
Formal healthcare sector		
Health outcomes		
Longevity effects	☑	Impacts of cessation on mortality
Health related quality of life effects	☑	Quality of life effects of nicotine and tobacco product use
Other health effects	☐	Second-hand smoking effects were not included
Medical costs		
Medical costs paid by third-party payers	☑	Included all healthcare costs of current and former smokers and costs of the smoking cessation interventions
Medical costs paid for out-of-pocket	☑	
Future related medical costs	☑	
Future unrelated medical costs	☑	
Informal healthcare sector		
Patient time costs	☐	Not included
Unpaid caregiver costs	☐	Not included
Transportation costs	☐	Not included
Non-healthcare sectors		
Productivity and Consumption	☐	Not included
Equity Effects	☑	Included direct equity weighting to evaluate equity benefits of cessation interventions
Nicotine and Tobacco Product Consumption	☑	Costs related to the consumption of nicotine and tobacco products
Education	☐	Not included
Housing	☐	Not included
Environment	☐	Not included
Cost of crimes related to intervention	☐	Not applicable to condition

C.2 CHEERS Checklist

Topic	No.	Item	Location where item is reported
Title			
	1	Identify the study as an economic evaluation and specify the interventions being compared.	Chapter 4
Abstract			
	2	Provide a structured summary that highlights context, key methods, results, and alternative analyses.	NA
Introduction			
Background and objectives	3	Give the context for the study, the study question, and its practical relevance for decision making in policy or practice.	Section 4.1
Methods			
Health economic analysis plan	4	Indicate whether a health economic analysis plan was developed and where available.	Section 4.2.1
Study population	5	Describe characteristics of the study population (such as age range, demographics, socioeconomic, or clinical characteristics).	Section 4.2
Setting and location	6	Provide relevant contextual information that may influence findings.	Section 4.2
Comparators	7	Describe the interventions or strategies being compared and why chosen.	Section 4.2.1.2
Perspective	8	State the perspective(s) adopted by the study and why chosen.	Section 4.2.1
Time horizon	9	State the time horizon for the study and why appropriate.	Section 4.2.1
Discount rate	10	Report the discount rate(s) and reason chosen.	Section 4.2.1.2
Selection of outcomes	11	Describe what outcomes were used as the measure(s) of benefit(s) and harm(s).	Section 4.2.1.2
Measurement of outcomes	12	Describe how outcomes used to capture benefit(s) and harm(s) were measured.	Section 4.2.2
Valuation of outcomes	13	Describe the population and methods used to measure and value outcomes.	Section 4.2.2
Measurement and valuation of resources and costs	14	Describe how costs were valued.	Section 4.2.2.3
Currency, price date, and conversion	15	Report the dates of the estimated resource quantities and unit costs, plus the currency and year of conversion.	Section 4.2.2.3

Topic	No.	Item	Location where item is reported
Rationale and description of model	16	If modelling is used, describe in detail and why used. Report if the model is publicly available and where it can be accessed.	Section 4.2.1
Analytics and assumptions	17	Describe any methods for analysing or statistically transforming data, any extrapolation methods, and approaches for validating any model used.	Section 4.2
Characterising heterogeneity	18	Describe any methods used for estimating how the results of the study vary for subgroups.	Section 4.2.1.1
Characterising distributional effects	19	Describe how impacts are distributed across different individuals or adjustments made to reflect priority populations.	Section 4.2.1.1
Characterising uncertainty	20	Describe methods to characterise any sources of uncertainty in the analysis.	Section 4.2.4
Approach to engagement with patients and others affected by the study	21	Describe any approaches to engage patients or service recipients, the general public, communities, or stakeholders (such as clinicians or payers) in the design of the study.	None
Results			
Study parameters	22	Report all analytic inputs (such as values, ranges, references) including uncertainty or distributional assumptions.	Section 4.2.2 and Table 4-2
Summary of main results	23	Report the mean values for the main categories of costs and outcomes of interest and summarise them in the most appropriate overall measure.	Tables 4-3 and 4-4
Effect of uncertainty	24	Describe how uncertainty about analytic judgments, inputs, or projections affect findings. Report the effect of choice of discount rate and time horizon, if applicable.	Section 4.3.2
Effect of engagement with patients and others affected by the study	25	Report on any difference patient/service recipient, general public, community, or stakeholder involvement made to the approach or findings of the study	N/A
Discussion			
Study findings, limitations, generalisability, and current knowledge	26	Report key findings, limitations, ethical or equity considerations not captured, and how these could affect patients, policy, or practice.	Section 4.4
Other relevant information			
Source of funding	27	Describe how the study was funded and any role of the funder in the identification, design, conduct, and reporting of the analysis	Acknowledgements
Conflicts of interest	28	Report authors conflicts of interest according to journal or International Committee of Medical Journal Editors requirements.	Acknowledgements

From: Husereau D, Drummond M, Augustovski F, et al. Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022) Explanation and Elaboration: A Report of the ISPOR CHEERS II Good Practices Task Force. Value Health 2022;25. doi:10.1016/j.jval.2021.10.008

C.3 Cessation Intervention Efficacy

The efficacy of cessation interventions was based on meta-analyses from Cochrane.[241,275,276,278] Cochrane relative risk ratios compared to a behavioural support only or no support control were used as intervention efficacy inputs for varenicline and bupropion.

Nicotine Replacement Therapy
Nicotine replacement therapy efficacy was based on the combined effect of NRT from two Cochrane reviews.[276,277] Hartmann-Boyce et al.[276] reported the effect of nicotine patch alone vs placebo or no NRT control and Theodoulou et al.[277] reported the effect of combination NRT vs NRT patch alone. The effects of the two studies were combined by combining the relative risks and estimating new confidence intervals as follows.

$$RR_{Combination\ NRT\ vs\ Control} = \exp\left(\ln(RR_{Combination\ NRT\ vs\ Patch}) + \ln(RR_{NRT\ Patch\ vs\ Control})\right)$$

$$\exp(ln(1.24) + ln(1.64)) = 2.03$$

$$SE_{Combination\ NRT\ vs\ Control} = \sqrt{SE^2_{Combination\ NRT\ vs\ Patch} + SE^2_{NRT\ Patch\ vs\ Control}}$$

$$\sqrt{0.05^2 + 0.03^2} = 0.06$$

$$CI_{Combination\ NRT\ vs\ Control} = [\exp(\ln(RR_{Combination\ NRT\ vs\ Control} - 1.96 * SE_{Combination\ NRT\ vs\ Control}),\ \exp(\ln(RR_{Combination\ NRT\ vs\ Control} + 1.96 * SE_{Combination\ NRT\ vs\ Control})] = [1.91, 2.15]$$

Electronic Nicotine Delivery Systems
The Cochrane review of ENDS for smoking cessation reports on the relative effect of ENDS vs behavioural support or no support (1.88 [1.56, 2.25]) and the relative effect of ENDS compared to NRT (1.59 [1.29, 1.93]).[241] The relative effect of ENDS vs behavioural support or no support has a low certainty of evidence due to poor study quality and potential risk of bias, while the effect of ENDS vs NRT has a high certainty of evidence. To account for the high certainty of evidence that ENDS are more efficacy than NRT; while also incorporating the poorer quality evidence on the effect of ENDS vs a limited intervention control, I estimated the effect of ENDS vs NRT vs control using the same approach as the combined effect of NRT. I used Hartmann-Boyce et al.'s estimate of any NRT vs control to estimate the effects of ENDS vs NRT vs control.[276] I also varied the efficacy of ENDS across the ranges of ENDS vs control in the Cochrane review, and the estimated ENDS vs NRT vs control confidence interval.

$$RR_{ENDS\ vs\ NRT\ vs\ Control} = \exp\left(\ln\left(RR_{ENDS\ vs\ Any\ NRT}\right) + \ln\left(RR_{Any\ NRT\ vs\ Control}\right)\right)$$

$$\exp(ln(1.59) + ln(1.55)) = 2.46$$

$$SE_{ENDS\ vs\ NRT\ vs\ Control} = \sqrt{SE^2_{NDS\ vs\ Any\ NRT} + SE^2_{Any\ NRT\ vs\ Control}}$$

$$\sqrt{0.1^2 + 0.02^2} = 0.1$$

$$CI_{ENDS\ vs\ NRT\ vs\ Control} = [\exp(\ln(RR_{ENDS\ vs\ NRT\ vs\ Control} - 1.96 * SE_{ENDS\ vs\ NRT\ vs\ Control}),$$
$$\exp(\ln(RR_{ENDS\ vs\ NRT\ vs\ Control} + 1.96 * SE_{ENDS\ vs\ NRT\ vs\ Control})] = [2.27, 2.66]$$

The estimated combined relative effect (2.46) is used in the base case, while the full range of potential relative effect values 1.56 to 2.66 is used for sensitivity analyses.

C.4 Cessation Intervention Costs

For the FDA-approved pharmacotherapy interventions, the cost of interventions included a physician fee for tobacco cessation counselling and the cost of the medication. The physician fee, $15.17 is based on the Medicare reimbursement for physician smoking cessation counselling under CPT code: 99406. The costs of pharmacotherapy products came from Cost Plus Drugs, an online pharmacy for the distribution of generic drugs. The total cost of a single guideline concordant course of treatment was used which included the cost of the product and the 15% markup (the cost-plus pricing model), as well as the $5 pharmacy labor and a $5 standard shipping cost. All costs are based on March 2025 prices. Prices for each intervention are detailed below. Total cost includes all drug/device and physician costs.

Varenicline
A standard course of varenicline includes starts with one 0.5mg tablet a day for 3 days, then two 0.5 mg tablets a day for four days followed by one 1mg tablet a day for 11 weeks.

Price:
- 11x 0.5mg tablets and 42x 1mg tablets: $81.22
- 60x 1mg tablets: $21.62

Total Cost: $145

Bupropion
A standard course of bupropion starts with one 150mg tablet daily for 3 days, then two 150mg tablets a day until the end of 12 weeks.

Price:
- 180x 150mg tablets: $37.08

Total Cost: $52

Nicotine Replacement Therapy
A standard course of combination nicotine replacement therapy includes patch and gum. Patches are used daily starting with a 21mg patch for 4-6 weeks followed by 2 weeks with 14mg patches and 2 weeks with 7mg patches. Nicotine gum is used as needed with one piece every 1-2 hours and up to 20 pieces a day tapered over 12 weeks. I assumed individuals would use an average of 10 pieces of gum a day for 10 weeks.

Nicotine Patches Price:
- 28 21mg patches: $49.70
- 14 14mg patches: $26.91
- 14 7mg patches: $26.91

Nicotine Gum Price:
- 110x 4mg gum: $24.98

An additional $20 was added to the price of patches to account for some individuals who would use 6 weeks of 21mg patches instead of 4 weeks or those who may use more than 10 pieces of gum a day. The range for the sensitivity analysis reduces/increases the number of weeks individuals use patches and the amount of gum an individual uses per day (8 to 12 pieces a day on average).

Total Cost: $283

Electronic Nicotine Delivery Systems
The costs of the ENDS cessation intervention include the cost of the vaping device cartridges for the device. It is unclear how may cartridges of e-liquid an individual will consume over the course of using ENDS to quit smoking. In the base case, I assume an individual will consume 0.75 ENDS cartridges per day for 6 months. The costs of ENDS were sourced from the 2016 International Tobacco Control (ITC) Four Country Vaping and Smoking Survey.[279]

ENDS Price:
- Device: $54.67
- Cartridge: $19.83

In sensitivity analyses, the costs of the device are ranged between $9.99 and $61.92 based on the online prices of JUUL ENDS devices and prices in the ITC study. The costs for nicotine cartridges are ranged between $3.5 to $22.90, again based on online prices for JUUL pods and the prices in the ITC study. I also range the number of pods consumed over the course of the intervention from 24 to 280 representing a combination of number of pods per day consumed and number of days using the device.

Total Cost: $2553

C.5 Smoking Cessation Intervention Net Health and Equity Benefit with Alternative Willingness-to-Pay Thresholds

aTable C.5-1: Net Health and Equity Benefits of Cessation Interventions at a $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smoker

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**87**	**-1,192,044**	**81**	**111**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	73	-2,406,637	57	121
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	129	-976,715	115	149
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	89	-1,175,461	62	113
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	94	94

NRT	**Overall**	**10,381**	**117,606,144**	**51**	**-450,847**	**69**	**-650,197**	**60**	**82**
	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	59	-1,594,786	43	91
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,188,054	92	-198,434	120	-257,150	96	125
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	69	-511,293	44	79
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	68	68
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**40**	**-574,333**	**39**	**51**
	Racially or ethnically minoritized and <200% FPL	10,958	127,101,956	15	-649,905	32	-1,369,675	28	59
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	74	-190,205	60	77
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	28	-684,109	23	42
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	49	49
ENDS	**Overall**	**10,391**	**121,695,042**	**62**	**3,638,050**	**83**	**5,096,841**	**-11**	**-19**
	Racially or ethnically minoritized and <200% FPL	10,986	130,763,576	43	3,011,715	90	6,347,189	-18	-37
	Racially or ethnically minoritized and ≥200% FPL	12,328	146,664,693	93	4,278,205	120	5,544,126	7	9

	Non-Hispanic white and <200% FPL	9,675	114,675,500	44	3,194,254	79	5,786,711	-20	-37
	Non-Hispanic white and ≥200% FPL	10,159	116,513,409	73	4,002,644	73	4,002,644	-7	-7

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $50,000 per QALY willingness-to-pay threshold.

aTable C.5-2: Net Health and Equity Benefits of Cessation Interventions at a $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**87**	**-1,192,044**	**68**	**92**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	73	-2,406,637	39	83
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	129	-976,715	103	133
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	89	-1,175,461	52	94
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	81	81
NRT	**Overall**	**10,381**	**117,606,144**	**51**	**-450,847**	**69**	**-650,197**	**53**	**71**
	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	59	-1,594,786	31	65
	Racially or ethnically	12,327	142,188,054	92	-198,434	120	-257,150	93	121

	minoritized and ≥200% FPL								
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	69	-511,293	39	71
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	59	59
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**40**	**-574,333**	**33**	**42**
	Racially or ethnically minoritized and <200% FPL	10,958	127,101,956	15	-649,905	32	-1,369,675	18	37
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	74	-190,205	57	74
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	28	-684,109	17	31
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	43	43
ENDS	**Overall**	**10,391**	**121,695,042**	**62**	**3,638,050**	**83**	**5,096,841**	**47**	**63**
	Racially or ethnically minoritized and <200% FPL	10,986	130,763,576	43	3,011,715	90	6,347,189	31	64
	Racially or ethnically minoritized and ≥200% FPL	12,328	146,664,693	93	4,278,205	120	5,544,126	76	98
	Non-Hispanic white and <200% FPL	9,675	114,675,500	44	3,194,254	79	5,786,711	31	56
	Non-Hispanic white and ≥200% FPL	10,159	116,513,409	73	4,002,644	73	4,002,644	57	57

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $250,000 per QALY willingness-to-pay threshold.

C.6 Health Opportunity Cost Scenario Analysis Results

The health opportunity cost scenario analysis varied the proportion of health opportunity costs that are allocated to each equity group. The tables presented below list numerical results used to generate Figure 4-2 for the allocation of health opportunity costs across individual equity groups and Figure 4-3 for the allocation of health opportunity costs across equity dimensions. When a proportion of the health opportunity costs were allocated to a single equity group, the remaining opportunity costs were split equally between the three other equity groups. When a proportion of health opportunity costs were allocated across an equity dimension, it was split between the mor marginalized group and the less marginalized group (income <200% of the FPL or racially/ethnically minoritized). Once allocated to the more marginalized group within a single dimension, the health opportunity costs were split proportionally by the number of simulated individuals in the two equity groups based on the other equity dimension not considered.

aTable C.6-1: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Racially/Ethnically Minoritized and Income <200% of the FPL Group Per 1,000 Current Smokers

Proportion of Opportunity Costs	Intervention	NHB	NEB	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	98	10	20	33	35
	Bupropion	35	45	4	11	11	19
	NRT	56	75	8	17	25	25
	ENDS	25	33	13	-1	3	18
0.1	Varenicline	73	99	12	19	33	34
	Bupropion	35	45	5	11	11	18
	NRT	56	75	9	17	24	25
	ENDS	25	31	5	1	6	19
0.2	Varenicline	73	99	14	19	32	34
	Bupropion	35	46	6	10	11	18
	NRT	56	75	10	16	24	25
	ENDS	25	28	-3	2	8	20
0.3	Varenicline	73	100	16	19	32	34
	Bupropion	35	46	7	10	11	18
	NRT	56	76	11	16	24	25
	ENDS	25	25	-10	4	10	22
0.4	Varenicline	73	100	17	18	31	34
	Bupropion	35	46	8	10	10	18
	NRT	56	76	12	16	24	24
	ENDS	25	22	-18	5	12	23
0.5	Varenicline	73	101	19	18	31	33
	Bupropion	35	46	8	10	10	18
	NRT	56	76	13	16	23	24
	ENDS	25	20	-26	7	14	24
0.6	Varenicline	73	102	21	17	30	33
	Bupropion	35	47	9	10	10	18
	NRT	56	77	14	16	23	24
	ENDS	25	17	-33	9	17	25
0.7	Varenicline	73	102	22	17	30	33
	Bupropion	35	47	10	10	10	18
	NRT	56	77	15	15	23	24
	ENDS	25	14	-41	10	19	26
0.8	Varenicline	73	103	24	17	29	33
	Bupropion	35	47	11	9	9	18
	NRT	56	77	16	15	22	24
	ENDS	25	12	-49	12	21	28
0.9	Varenicline	73	103	26	16	29	32
	Bupropion	35	47	11	9	9	17
	NRT	56	78	17	15	22	24
	ENDS	25	9	-56	13	23	29
1	Varenicline	73	104	28	16	28	32
	Bupropion	35	48	12	9	9	17
	NRT	56	78	18	15	22	23
	ENDS	25	6	-64	15	25	30

aTable C.6-2: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Income <200% of the FPL and Racially/Ethnically Minoritized Group per 1,000 Current Smokers

Proportion of Opportunity Costs	Intervention	NHB	NEB	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	100	16	16	33	35
	Bupropion	35	46	7	9	11	19
	NRT	56	76	12	15	25	25
	ENDS	25	23	-13	15	3	18
0.1	Varenicline	73	100	16	17	33	34
	Bupropion	35	46	7	10	11	18
	NRT	56	76	11	15	24	25
	ENDS	25	25	-10	10	6	19
0.2	Varenicline	73	100	15	18	32	34
	Bupropion	35	46	7	10	11	18
	NRT	56	76	11	16	24	25
	ENDS	25	26	-8	5	8	20
0.3	Varenicline	73	99	14	19	32	34
	Bupropion	35	46	6	11	11	18
	NRT	56	76	11	17	24	25
	ENDS	25	27	-5	1	10	22
0.4	No Treatment	0	0	0	0	0	0
	Bupropion	35	46	6	11	10	18
	NRT	56	75	10	17	24	24
	ENDS	25	28	-3	-4	12	23
0.5	Varenicline	73	99	13	21	31	33
	Bupropion	35	45	6	12	10	18
	NRT	56	75	10	18	23	24
	ENDS	25	30	-0	-9	14	24
0.6	Varenicline	73	99	13	22	30	33
	Bupropion	35	45	6	12	10	18
	NRT	56	75	10	18	23	24
	ENDS	25	31	3	-13	17	25
0.7	Varenicline	73	98	12	23	30	33
	Bupropion	35	45	5	12	10	18
	NRT	56	75	9	19	23	24
	ENDS	25	32	5	-18	19	26
0.8	Varenicline	73	98	11	25	29	33
	Bupropion	35	45	5	13	9	18
	NRT	56	75	9	20	22	24
	ENDS	25	33	8	-23	21	28
0.9	Varenicline	73	98	11	26	29	32
	Bupropion	35	45	5	13	9	17
	NRT	56	75	9	20	22	24
	ENDS	25	35	10	-28	23	29
1	Varenicline	73	97	10	27	28	32
	Bupropion	35	45	4	14	9	17
	NRT	56	74	8	21	22	23
	ENDS	25	36	13	-32	25	30

aTable C.6-3: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Non-Hispanic White and Income <200% FPL Group per 1,000 Current Smokers

Proportion of Opportunity Costs	Intervention	NHB	NEB	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	99	16	20	28	35
	Bupropion	35	45	7	11	9	19
	NRT	56	75	12	17	22	25
	ENDS	25	30	-13	-1	25	18
0.1	Varenicline	73	99	16	19	30	34
	Bupropion	35	46	7	11	10	18
	NRT	56	75	11	17	23	25
	ENDS	25	28	-10	1	19	19
0.2	Varenicline	73	99	15	19	31	34
	Bupropion	35	46	7	10	10	18
	NRT	56	76	11	16	24	25
	ENDS	25	27	-8	2	12	20
0.3	Varenicline	73	100	14	19	33	34
	Bupropion	35	46	6	10	11	18
	NRT	56	76	11	16	24	25
	ENDS	25	26	-5	4	6	22
0.4	Varenicline	73	100	14	18	34	34
	Bupropion	35	46	6	10	12	18
	NRT	56	76	10	16	25	24
	ENDS	25	25	-3	5	-1	23
0.5	Varenicline	73	100	13	18	36	33
	Bupropion	35	46	6	10	12	18
	NRT	56	76	10	16	26	24
	ENDS	25	23	-0	7	-8	24
0.6	Varenicline	73	101	13	17	37	33
	Bupropion	35	46	6	10	13	18
	NRT	56	76	10	16	27	24
	ENDS	25	22	3	9	-14	25
0.7	Varenicline	73	101	12	17	39	33
	Bupropion	35	46	5	10	14	18
	NRT	56	76	9	15	28	24
	ENDS	25	21	5	10	-21	26
0.8	Varenicline	73	101	11	17	40	33
	Bupropion	35	46	5	9	14	18
	NRT	56	77	9	15	28	24
	ENDS	25	20	8	12	-27	28
0.9	Varenicline	73	101	11	16	42	32
	Bupropion	35	47	5	9	15	17
	NRT	56	77	9	15	29	24
	ENDS	25	18	10	13	-34	29
1	Varenicline	73	102	10	16	43	32
	Bupropion	35	47	4	9	16	17
	NRT	56	77	8	15	30	23
	ENDS	25	17	13	15	-41	30

aTable C.6-4: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Non-Hispanic White and Income ≥200% FPL Group per 1,000 Current Smokers

Proportion of Opportunity Costs	Intervention	NHB	NEB	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	101	16	20	33	32
	Bupropion	35	46	7	11	11	17
	NRT	56	76	12	17	25	23
	ENDS	25	20	-13	-1	3	30
0.1	Varenicline	73	100	16	19	33	33
	Bupropion	35	46	7	11	11	18
	NRT	56	76	11	17	24	24
	ENDS	25	22	-10	1	6	26
0.2	Varenicline	73	100	15	19	32	34
	Bupropion	35	46	7	10	11	18
	NRT	56	76	11	16	24	24
	ENDS	25	25	-8	2	8	23
0.3	Varenicline	73	99	14	19	32	34
	Bupropion	35	46	6	10	11	18
	NRT	56	75	11	16	24	25
	ENDS	25	28	-5	4	10	19
0.4	Varenicline	73	99	14	18	31	35
	Bupropion	35	45	6	10	10	19
	NRT	56	75	10	16	24	25
	ENDS	25	31	-3	5	12	16
0.5	Varenicline	73	98	13	18	31	36
	Bupropion	35	45	6	10	10	19
	NRT	56	75	10	16	23	26
	ENDS	25	33	-0	7	14	12
0.6	Varenicline	73	97	13	17	30	37
	Bupropion	35	45	6	10	10	20
	NRT	56	74	10	16	23	26
	ENDS	25	36	3	9	17	8
0.7	Varenicline	73	97	12	17	30	38
	Bupropion	35	44	5	10	10	20
	NRT	56	74	9	15	23	27
	ENDS	25	39	5	10	19	5
0.8	Varenicline	73	96	11	17	29	39
	Bupropion	35	44	5	9	9	20
	NRT	56	74	9	15	22	27
	ENDS	25	41	8	12	21	1
0.9	Varenicline	73	96	11	16	29	39
	Bupropion	35	44	5	9	9	21
	NRT	56	73	9	15	22	28
	ENDS	25	44	10	13	23	-3
1	Varenicline	73	95	10	16	28	40
	Bupropion	35	44	4	9	9	21
	NRT	56	73	8	15	22	28
	ENDS	25	47	13	15	25	-6

aTable C.6-5: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Income <200% of the FPL Groups per 1,000 Current Smokers

Proportion of Opportunity Costs Allocated to Low Income Groups	Intervention	NHB	NEB	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	96	10	19	28	38
	Bupropion	35	44	4	10	9	20
	NRT	56	73	8	16	22	27
	ENDS	25	44	13	4	25	2
0.1	Varenicline	73	96	11	18	29	38
	Bupropion	35	44	5	10	9	20
	NRT	56	74	9	16	22	27
	ENDS	25	41	10	5	21	5
0.2	Varenicline	73	97	11	18	30	37
	Bupropion	35	45	5	10	10	20
	NRT	56	74	9	16	23	26
	ENDS	25	38	8	6	16	8
0.3	Varenicline	73	98	12	18	32	36
	Bupropion	35	45	5	10	10	19
	NRT	56	75	9	16	24	26
	ENDS	25	35	6	7	12	10
0.4	Varenicline	73	98	12	18	33	36
	Bupropion	35	45	5	10	11	19
	NRT	56	75	10	16	24	26
	ENDS	25	32	3	8	7	13
0.5	Varenicline	73	99	13	17	34	35
	Bupropion	35	45	6	10	11	19
	NRT	56	75	10	16	25	25
	ENDS	25	29	1	9	2	16
0.6	Varenicline	73	100	14	17	35	34
	Bupropion	35	46	6	10	12	19
	NRT	56	76	10	15	25	25
	ENDS	25	26	-1	11	-2	19
0.7	Varenicline	73	100	14	17	36	34
	Bupropion	35	46	6	9	12	18
	NRT	56	76	10	15	26	25
	ENDS	25	23	-4	12	-7	22
0.8	Varenicline	73	101	15	17	37	33
	Bupropion	35	46	6	9	13	18
	NRT	56	76	11	15	26	24
	ENDS	25	20	-6	13	-11	24
0.9	Varenicline	73	102	15	16	38	33
	Bupropion	35	47	7	9	13	18
	NRT	56	77	11	15	27	24
	ENDS	25	17	-8	14	-16	27
1	Varenicline	73	102	16	16	39	32
	Bupropion	35	47	7	9	14	17
	NRT	56	77	11	15	28	23
	ENDS	25	14	-11	15	-20	30

aTable C.6-6: Net Health and Equity Benefits when Health Opportunity Costs are Allocated to the Racially/Ethnically Minoritized Groups per 1,000 Current Smokers

Proportion of Opportunity Costs Allocated to Minoritized Groups	Intervention	NHB, per 1000	NEB, per 1000	Racially or ethnically minoritized and <200% FPL NEB	Racially or ethnically minoritized and ≥200% FPL NEB	Non-Hispanic white and <200% FPL NEB	Non-Hispanic white and ≥200% FPL NEB
0	Varenicline	73	98	10	16	35	37
	Bupropion	35	45	4	9	12	19
	NRT	56	75	8	15	25	26
	ENDS	25	34	13	15	-3	10
0.1	Varenicline	73	98	11	17	34	36
	Bupropion	35	45	5	9	12	19
	NRT	56	75	9	15	25	26
	ENDS	25	32	9	13	-1	12
0.2	Varenicline	73	99	12	17	34	36
	Bupropion	35	45	5	10	11	19
	NRT	56	75	9	15	25	26
	ENDS	25	31	5	11	2	14
0.3	Varenicline	73	99	13	18	33	35
	Bupropion	35	45	6	10	11	19
	NRT	56	75	10	16	24	25
	ENDS	25	30	0	8	5	16
0.4	Varenicline	73	99	14	18	32	35
	Bupropion	35	46	6	10	11	19
	NRT	56	75	10	16	24	25
	ENDS	25	28	-4	6	8	18
0.5	Varenicline	73	99	15	19	32	34
	Bupropion	35	46	7	10	10	18
	NRT	56	76	11	16	24	25
	ENDS	25	27	-8	4	11	20
0.6	Varenicline	73	100	16	19	31	34
	Bupropion	35	46	7	10	10	18
	NRT	56	76	11	17	23	25
	ENDS	25	26	-12	2	14	22
0.7	Varenicline	73	100	17	20	30	33
	Bupropion	35	46	7	11	10	18
	NRT	56	76	12	17	23	24
	ENDS	25	24	-16	-0	17	24
0.8	Varenicline	73	100	18	20	30	33
	Bupropion	35	46	8	11	10	18
	NRT	56	76	12	17	23	24
	ENDS	25	23	-20	-3	20	26
0.9	Varenicline	73	101	19	21	29	32
	Bupropion	35	46	8	11	9	18
	NRT	56	76	13	17	22	24
	ENDS	25	22	-24	-5	22	28
1	Varenicline	73	101	20	21	28	32
	Bupropion	35	46	9	11	9	17
	NRT	56	76	13	18	22	23
	ENDS	25	20	-28	-7	25	30

C.7 No Continued ENDS Use Scenario Analysis Results

aTable C.7-1: Smoking Cessation Intervention Net Health and Equity Benefit for the No Continued ENDS Use Scenario Analysis per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs*	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**87**	**-1,192,044**	**73**	**99**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	73	-2,406,637	46	97
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	129	-976,715	107	139
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	89	-1,175,461	56	101
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	86	86

NRT	**Overall**	**10,381**	**117,606,144**	**51**	**-450,847**	**69**	**-650,197**	**56**	**75**
	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	59	-1,594,786	36	75
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,188,054	92	-198,434	120	-257,150	94	122
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	69	-511,293	41	74
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	62	62
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**40**	**-574,333**	**35**	**46**
	Racially or ethnically minoritized and <200% FPL	10,958	127,101,956	15	-649,905	32	-1,369,675	21	45
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	74	-190,205	58	76
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	28	-684,109	19	35
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	45	45
ENDS	**Overall**	**10,401**	**119,536,320**	**71**	**1,479,329**	**96**	**2,161,815**	**57**	**74**
	Racially or ethnically minoritized and <200% FPL	10,995	129,054,475	52	1,302,613	110	2,745,258	39	83
	Racially or ethnically minoritized and ≥200% FPL	12,341	143,832,927	106	1,446,439	138	1,874,440	92	119

	Non-Hispanic white and <200% FPL	9,678	113,118,825	46	1,637,579	84	2,966,638	30	54
	Non-Hispanic white and ≥200% FPL	10,173	113,938,407	87	1,427,642	87	1,427,642	73	73

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

C.8 No Tobacco Product Cost Scenario Analysis Results

aTable C.8-1: Smoking Cessation Intervention Net Health and Equity Benefit for No Tobacco Product Cost Scenario Analysis per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**93,913,451**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	101,154,514	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	117,284,737	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	85,811,085	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	90,671,935	-	-	-	-	-	-
Varenicline	**Overall**	**10,395**	**94,568,358**	**65**	**654,907**	**87**	**884,546**	**58**	**78**
	Racially or ethnically minoritized and <200% FPL	10,978	101,508,278	35	353,764	73	745,557	31	66
	Racially or ethnically minoritized and ≥200% FPL	12,335	118,307,903	100	1,023,166	129	1,325,921	89	116
	Non-Hispanic white and <200% FPL	9,681	86,337,198	49	526,113	89	953,106	44	79
	Non-Hispanic white and ≥200% FPL	10,164	91,418,769	77	746,833	77	746,833	70	70
NRT	**Overall**	**10,381**	**94,617,275**	**51**	**703,825**	**69**	**972,549**	**44**	**59**

	Racially or ethnically minoritized and <200% FPL	10,971	101,616,064	28	461,550	59	972,717	23	49
	Racially or ethnically minoritized and ≥200% FPL	12,327	118,454,247	92	1,169,510	120	1,515,568	81	104
	Non-Hispanic white and <200% FPL	9,669	86,401,875	38	590,790	69	1,070,276	32	58
	Non-Hispanic white and ≥200% FPL	10,143	91,406,152	57	734,217	57	734,217	49	49
Bupropion	**Overall**	**10,361**	**94,215,935**	**32**	**302,484**	**40**	**385,309**	**28**	**36**
	Racially or ethnically minoritized and <200% FPL	10,958	101,279,976	15	125,462	32	264,411	14	29
	Racially or ethnically minoritized and ≥200% FPL	12,292	117,862,287	57	577,550	74	748,447	51	66
	Non-Hispanic white and <200% FPL	9,647	85,972,556	15	161,471	28	292,521	14	25
	Non-Hispanic white and ≥200% FPL	10,128	91,061,241	42	389,306	42	389,306	38	38
ENDS	**Overall**	**10,391**	**96,963,334**	**62**	**3,049,883**	**83**	**4,376,534**	**31**	**39**
	Racially or ethnically minoritized and <200% FPL	10,986	103,978,310	43	2,823,796	90	5,951,150	14	30
	Racially or ethnically minoritized and ≥200% FPL	12,328	120,680,718	93	3,395,981	120	4,400,852	59	76

	Non-Hispanic white and <200% FPL	9,675	88,734,743	44	2,923,658	79	5,296,499	14	26
	Non-Hispanic white and ≥200% FPL	10,159	93,792,721	73	3,120,785	73	3,120,785	41	41

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

C.9 Non-Dominated Results Scenario Analysis

aTable C.9-1: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $50,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**93,913,451**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	101,154,514	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	117,284,737	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	85,811,085	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	90,671,935	-	-	-	-	-	-
Bupropion	**Overall**	**10,365**	**94,207,645**	**36**	**294,195**	**48**	**389,798**	**30**	**40**
	Racially or ethnically minoritized and <200% FPL	10,967	101,298,277	24	143,762	50	302,979	21	44
	Racially or ethnically minoritized and ≥200% FPL	12,291	117,822,623	56	537,886	73	697,047	45	59
	Non-Hispanic white and <200% FPL	9,656	86,016,374	24	205,290	44	371,903	20	36
	Non-Hispanic white and ≥200% FPL	10,129	91,013,076	43	341,141	43	341,141	36	36
Varenicline	**Overall**	**10,380**	**94,498,415**	**51**	**584,964**	**68**	**796,286**	**39**	**52**

	Racially or ethnically minoritized and <200% FPL	10,976	101,509,676	33	355,162	69	748,503	26	54
	Racially or ethnically minoritized and ≥200% FPL	12,324	118,309,241	89	1,024,504	115	1,327,655	68	88
	Non-Hispanic white and <200% FPL	9,667	86,265,531	35	454,447	64	823,276	26	47
	Non-Hispanic white and ≥200% FPL	10,143	91,304,351	57	632,415	57	632,415	44	44
NRT	**Overall**	**10,378**	**94,514,633**	**49**	**601,182**	**64**	**801,819**	**37**	**47**
	Racially or ethnically minoritized and <200% FPL	10,958	101,414,183	15	259,668	31	547,251	10	20
	Racially or ethnically minoritized and ≥200% FPL	12,322	118,327,226	87	1,042,489	113	1,350,961	66	86
	Non-Hispanic white and <200% FPL	9,667	86,279,614	35	468,529	64	848,787	26	47
	Non-Hispanic white and ≥200% FPL	10,146	91,359,923	59	687,988	59	687,988	46	46
ENDS	**Overall**	**10,391**	**95,395,334**	**62**	**1,481,883**	**83**	**2,097,937**	**32**	**41**
	Racially or ethnically minoritized and <200% FPL	10,986	102,410,310	43	1,255,796	90	2,646,590	17	37
	Racially or ethnically minoritized and ≥200% FPL	12,328	119,112,718	93	1,827,981	120	2,368,880	56	73

	Non-Hispanic white and <200% FPL	9,675	87,166,743	44	1,355,658	79	2,455,911	17	30
	Non-Hispanic white and ≥200% FPL	10,159	92,224,721	73	1,552,785	73	1,552,785	42	42

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $50,000 per QALY willingness-to-pay threshold.

aTable C.9-2: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $100,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**93,913,451**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	101,154,514	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	117,284,737	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	85,811,085	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	90,671,935	-	-	-	-	-	-
Bupropion	**Overall**	**10,365**	**94,207,645**	**36**	**294,195**	**48**	**389,798**	**33**	**44**
	Racially or ethnically minoritized and <200% FPL	10,967	101,298,277	24	143,762	50	302,979	22	47
	Racially or ethnically minoritized and ≥200% FPL	12,291	117,822,623	56	537,886	73	697,047	51	66
	Non-Hispanic white and <200% FPL	9,656	86,016,374	24	205,290	44	371,903	22	40
	Non-Hispanic white and ≥200% FPL	10,129	91,013,076	43	341,141	43	341,141	39	39
Varenicline	**Overall**	10,380	94,498,415	51	584,964	68	796,286	45	60
	Racially or ethnically	10,976	101,509,676	33	355,162	69	748,503	29	62

	minoritized and <200% FPL								
	Racially or ethnically minoritized and ≥200% FPL	12,324	118,309,241	89	1,024,504	115	1,327,655	79	102
	Non-Hispanic white and <200% FPL	9,667	86,265,531	35	454,447	64	823,276	31	56
	Non-Hispanic white and ≥200% FPL	10,143	91,304,351	57	632,415	57	632,415	51	51
NRT	**Overall**	**10,378**	**94,514,633**	**49**	**601,182**	**64**	**801,819**	**43**	**55**
	Racially or ethnically minoritized and <200% FPL	10,958	101,414,183	15	259,668	31	547,251	12	25
	Racially or ethnically minoritized and ≥200% FPL	12,322	118,327,226	87	1,042,489	113	1,350,961	76	99
	Non-Hispanic white and <200% FPL	9,667	86,279,614	35	468,529	64	848,787	31	56
	Non-Hispanic white and ≥200% FPL	10,146	91,359,923	59	687,988	59	687,988	53	53
ENDS	**Overall**	**10,391**	**95,395,334**	**62**	**1,481,883**	**83**	**2,097,937**	**47**	**62**
	Racially or ethnically minoritized and <200% FPL	10,986	102,410,310	43	1,255,796	90	2,646,590	30	63
	Racially or ethnically minoritized and ≥200% FPL	12,328	119,112,718	93	1,827,981	120	2,368,880	74	96
	Non-Hispanic white and <200% FPL	9,675	87,166,743	44	1,355,658	79	2,455,911	30	55

Non-Hispanic white and ≥200% FPL	10,159	92,224,721	73	1,552,785	73	1,552,785	57	57

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

aTable C.9-3: Net Health and Equity Benefit of Cessation Interventions in Non-Dominated Scenario with $250,000 per QALY Willingness-to-Pay Threshold per 1,000 Current Smokers per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**93,913,451**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	101,154,514	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	117,284,737	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	85,811,085	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	90,671,935	-	-	-	-	-	-
Bupropion	**Overall**	**10,365**	**94,207,645**	**36**	**294,195**	**48**	**389,798**	**35**	**46**
	Racially or ethnically minoritized and <200% FPL	10,967	101,298,277	24	143,762	50	302,979	23	49
	Racially or ethnically minoritized and ≥200% FPL	12,291	117,822,623	56	537,886	73	697,047	54	70
	Non-Hispanic white and <200% FPL	9,656	86,016,374	24	205,290	44	371,903	23	42
	Non-Hispanic white and ≥200% FPL	10,129	91,013,076	43	341,141	43	341,141	41	41
Varenicline	**Overall**	**10,380**	**94,498,415**	**51**	**584,964**	**68**	**796,286**	**48**	**65**
	Racially or ethnically	10,976	101,509,676	33	355,162	69	748,503	31	66

	minoritized and <200% FPL								
	Racially or ethnically minoritized and ≥200% FPL	12,324	118,309,241	89	1,024,504	115	1,327,655	85	110
	Non-Hispanic white and <200% FPL	9,667	86,265,531	35	454,447	64	823,276	33	61
	Non-Hispanic white and ≥200% FPL	10,143	91,304,351	57	632,415	57	632,415	54	54
NRT	**Overall**	**10,378**	**94,514,633**	**49**	**601,182**	**64**	**801,819**	**46**	**60**
	Racially or ethnically minoritized and <200% FPL	10,958	101,414,183	15	259,668	31	547,251	14	29
	Racially or ethnically minoritized and ≥200% FPL	12,322	118,327,226	87	1,042,489	113	1,350,961	83	107
	Non-Hispanic white and <200% FPL	9,667	86,279,614	35	468,529	64	848,787	34	61
	Non-Hispanic white and ≥200% FPL	10,146	91,359,923	59	687,988	59	687,988	57	57
ENDS	**Overall**	**10,391**	**95,395,334**	**62**	**1,481,883**	**83**	**2,097,937**	**56**	**75**
	Racially or ethnically minoritized and <200% FPL	10,986	102,410,310	43	1,255,796	90	2,646,590	38	79
	Racially or ethnically minoritized and ≥200% FPL	12,328	119,112,718	93	1,827,981	120	2,368,880	85	111
	Non-Hispanic white and <200% FPL	9,675	87,166,743	44	1,355,658	79	2,455,911	38	69

	Non-Hispanic white and ≥200% FPL	10,159	92,224,721	73	1,552,785	73	1,552,785	66	66

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $250,000 per QALY willingness-to-pay threshold.

C.10 One-Way Sensitivity Analysis on Smoking Cessation Intervention Efficacy

aFigure C.10-1: Cost-Effectiveness Plane Comparing Smoking Cessation Intervention Costs and Health Outcomes for Intervention Efficacy Sensitivity Analysis

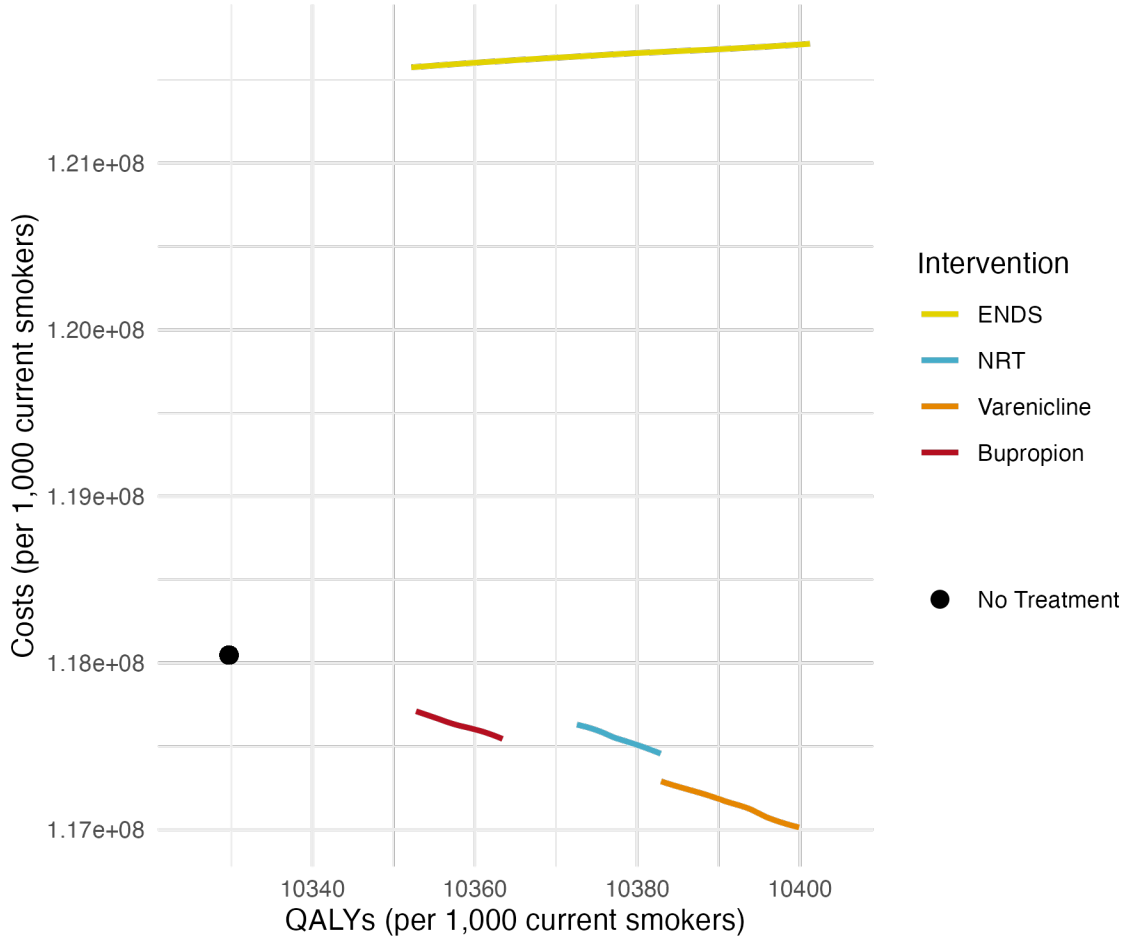


Figure Legend: Costs and QALYs for smoking cessation interventions are plotted at different levels of cessation intervention efficacy along the 95% confidence interval. Model results for each efficacy value were simulated 20 times to account for potential stochastic uncertainty and a LOESS smoothing function is applied.

aTable C.10-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Intervention Efficacy per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,046,783**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,919	127,426,133	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,268	142,804,274	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,624	111,419,205	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,091	112,520,129	-	-	-	-	-	-
				Lower Bounds					
Varenicline	**Overall**	**10,383**	**117,296,975**	**53**	**-749,809**	**74**	**-1,062,676**	**61**	**84**
	Racially or ethnically minoritized and <200% FPL	10,966	126,601,821	47	-824,312	99	-1,737,237	55	117
	Racially or ethnically minoritized and ≥200% FPL	12,324	141,745,493	56	-1,058,781	73	-1,372,075	67	87
	Non-Hispanic white and <200% FPL	9,667	110,862,207	43	-556,998	78	-1,009,057	49	88
	Non-Hispanic white and ≥200% FPL	10,153	111,739,820	62	-780,309	62	-780,309	70	70
NRT	**Overall**	**10,373**	**117,639,948**	**43**	**-406,835**	**60**	**-564,411**	**47**	**66**

	Racially or ethnically minoritized and <200% FPL	10,959	126,985,241	40	-440,892	84	-929,180	44	94
	Racially or ethnically minoritized and ≥200% FPL	12,313	142,141,134	45	-663,141	59	-859,364	52	67
	Non-Hispanic white and <200% FPL	9,660	111,172,676	36	-246,529	64	-446,611	38	69
	Non-Hispanic white and ≥200% FPL	10,140	112,078,216	50	-441,913	50	-441,913	54	54
Bupropion	**Overall**	**10,353**	**117,713,257**	**23**	**-333,527**	**32**	**-475,393**	**27**	**36**
	Racially or ethnically minoritized and <200% FPL	10,944	127,140,407	25	-285,726	52	-602,168	27	58
	Racially or ethnically minoritized and ≥200% FPL	12,287	142,276,015	20	-528,259	25	-684,571	25	32
	Non-Hispanic white and <200% FPL	9,639	111,120,145	15	-299,060	27	-541,777	18	32
	Non-Hispanic white and ≥200% FPL	10,121	112,202,081	30	-318,049	30	-318,049	33	33
ENDS	**Overall**	**10,352**	**121,577,155**	**22**	**3,530,372**	**32**	**5,023,652**	**-13**	**-19**
	Racially or ethnically minoritized and <200% FPL	10,942	130,805,521	23	3,379,388	48	7,122,061	-11	-23
	Racially or ethnically minoritized and ≥200% FPL	12,290	146,574,476	22	3,770,202	29	4,885,805	-15	-20

	Non-Hispanic white and <200% FPL	9,642	114,595,809	18	3,176,605	33	5,754,737	-14	-25
	Non-Hispanic white and ≥200% FPL	10,116	116,303,057	26	3,782,928	26	3,782,928	-12	-12
					Upper Bounds				
Varenicline	**Overall**	**10,400**	**117,022,092**	**70**	**-1,024,691**	**98**	**-1,435,846**	**80**	**113**
	Racially or ethnically minoritized and <200% FPL	10,987	126,389,060	68	-1,037,073	143	-2,185,630	78	164
	Racially or ethnically minoritized and ≥200% FPL	12,339	141,300,123	71	-1,504,151	93	-1,949,229	87	112
	Non-Hispanic white and <200% FPL	9,682	110,675,235	58	-743,969	105	-1,347,774	65	118
	Non-Hispanic white and ≥200% FPL	10,171	111,427,025	80	-1,093,105	80	-1,093,105	91	91
NRT	**Overall**	**10,383**	**117,445,722**	**53**	**-601,061**	**75**	**-833,329**	**59**	**83**
	Racially or ethnically minoritized and <200% FPL	10,971	126,833,576	52	-592,557	110	-1,248,814	58	122
	Racially or ethnically minoritized and ≥200% FPL	12,324	141,878,960	56	-925,315	73	-1,199,115	65	85
	Non-Hispanic white and <200% FPL	9,667	111,013,707	43	-405,497	78	-734,599	47	85
	Non-Hispanic white and ≥200% FPL	10,151	111,862,616	60	-657,514	60	-657,514	67	67
Bupropion	**Overall**	**10,363**	**117,534,870**	**34**	**-511,913**	**47**	**-723,978**	**39**	**54**
	Racially or ethnically	10,952	126,918,477	33	-507,656	69	-1,069,885	38	80

	minoritized and <200% FPL								
	Racially or ethnically minoritized and ≥200% FPL	12,308	142,172,521	40	-631,753	52	-818,689	47	61
	Non-Hispanic white and <200% FPL	9,649	110,998,547	25	-420,658	45	-762,064	29	52
	Non-Hispanic white and ≥200% FPL	10,129	111,972,336	39	-547,793	39	-547,793	44	44
ENDS	**Overall**	**10,401**	**121,721,124**	**72**	**3,674,340**	**101**	**5,178,728**	**35**	**49**
	Racially or ethnically minoritized and <200% FPL	10,991	130,823,208	72	3,397,075	152	7,159,336	38	81
	Racially or ethnically minoritized and ≥200% FPL	12,343	146,735,674	75	3,931,399	98	5,094,700	36	47
	Non-Hispanic white and <200% FPL	9,682	114,605,067	57	3,185,863	104	5,771,509	26	46
	Non-Hispanic white and ≥200% FPL	10,172	116,588,969	81	4,068,840	81	4,068,840	40	40

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold. Results are the average of 20 simulations with the upper and lower bound efficacy values to account for stochastic uncertainty.

C.11 One-Way Sensitivity Analysis on Smoking Cessation Intervention Costs

aFigure C.11-1: Cost-Effectiveness Plane Comparing Smoking Cessation Intervention Costs and Health Outcomes for Intervention Cost Sensitivity Analysis

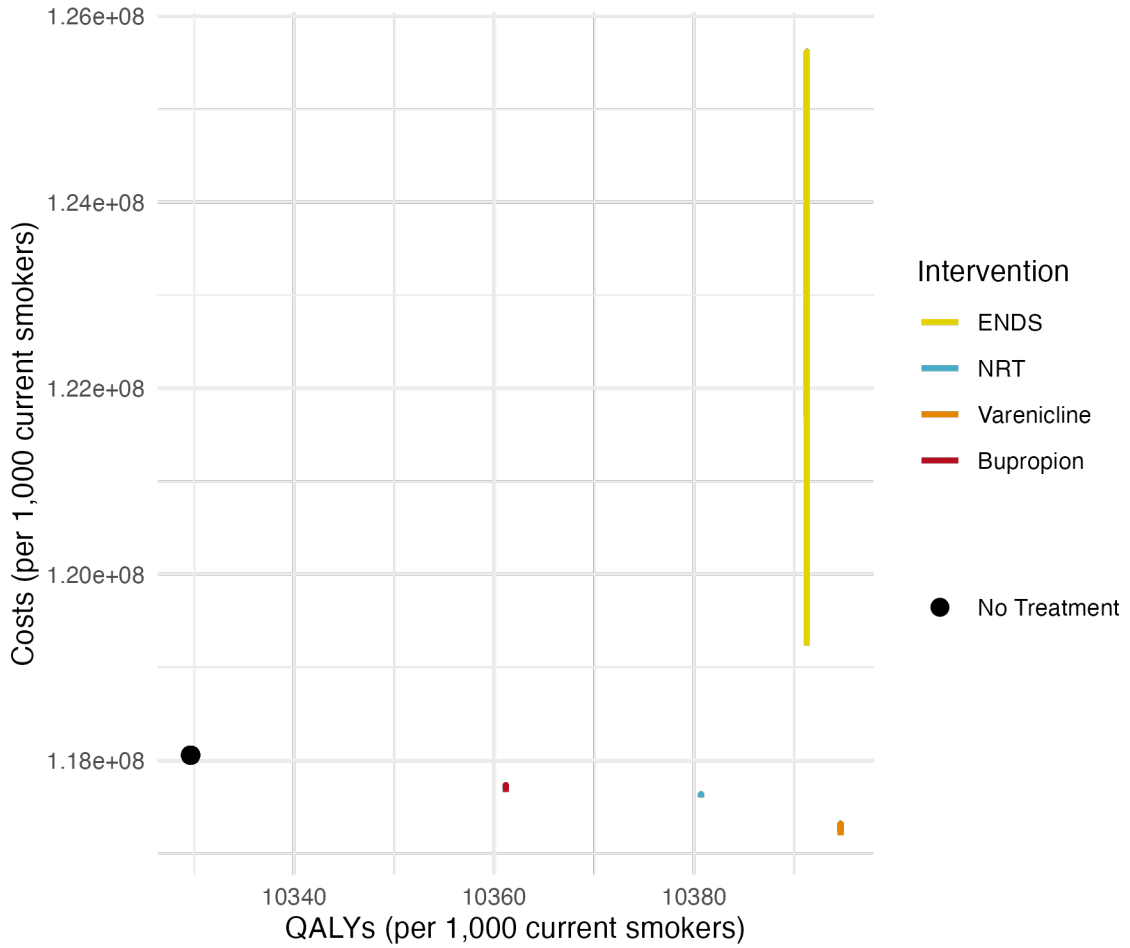


Figure Legend: Costs and QALYs for smoking cessation interventions are plotted at different levels of cessation intervention costs along the potential range of intervention costs.

aTable C.11-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Intervention Costs per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
				Lower Bounds					
Varenicline	**Overall**	**10,395**	**117,195,304**	**65**	**-861,687**	**87**	**-1,257,437**	**74**	**99**
	Racially or ethnically minoritized and <200% FPL	10,978	126,564,922	35	-1,186,939	73	-2,501,474	47	98
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,587,791	100	-798,696	129	-1,035,031	108	140
	Non-Hispanic white and <200% FPL	9,681	110,787,393	49	-693,853	89	-1,256,983	56	102
	Non-Hispanic white and ≥200% FPL	10,164	111,612,077	77	-898,688	77	-898,688	86	86
NRT	**Overall**	**10,381**	**117,508,144**	**51**	**-548,847**	**69**	**-792,609**	**57**	**77**

	Racially or ethnically minoritized and <200% FPL	10,971	126,897,142	28	-854,719	59	-1,801,321	37	77
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,090,054	92	-296,434	120	-384,149	95	123
	Non-Hispanic white and <200% FPL	9,669	111,101,013	38	-380,233	69	-688,830	42	75
	Non-Hispanic white and ≥200% FPL	10,143	111,860,855	57	-649,910	57	-649,910	63	63
Bupropion	**Overall**	**10,361**	**117,661,069**	**32**	**-395,922**	**40**	**-613,569**	**35**	**46**
	Racially or ethnically minoritized and <200% FPL	10,958	127,074,956	15	-676,905	32	-1,426,578	22	46
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,212,713	57	-173,775	74	-225,195	59	76
	Non-Hispanic white and <200% FPL	9,647	111,076,619	15	-404,627	28	-733,023	20	35
	Non-Hispanic white and ≥200% FPL	10,128	112,151,089	42	-359,676	42	-359,676	46	46
ENDS	**Overall**	**10,391**	**119,236,042**	**62**	**1,179,050**	**83**	**1,523,455**	**50**	**68**
	Racially or ethnically minoritized and <200% FPL	10,986	128,304,576	43	552,715	90	1,164,847	37	78
	Racially or ethnically minoritized and ≥200% FPL	12,328	144,205,693	93	1,819,205	120	2,357,508	74	96

	Non-Hispanic white and <200% FPL	9,675	112,216,500	44	735,254	79	1,331,986	36	66
	Non-Hispanic white and ≥200% FPL	10,159	114,054,409	73	1,543,644	73	1,543,644	57	57
					Upper Bounds				
Varenicline	**Overall**	**10,395**	**117,320,304**	**65**	**-736,687**	**87**	**-1,075,789**	**72**	**98**
	Racially or ethnically minoritized and <200% FPL	10,978	126,689,922	35	-1,061,939	73	-2,238,037	45	95
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,712,791	100	-673,696	129	-873,043	106	138
	Non-Hispanic white and <200% FPL	9,681	110,912,393	49	-568,853	89	-1,030,533	55	99
	Non-Hispanic white and ≥200% FPL	10,164	111,737,077	77	-773,688	77	-773,688	85	85
NRT	**Overall**	**10,381**	**117,658,144**	**51**	**-398,847**	**69**	**-574,631**	**55**	**74**
	Racially or ethnically minoritized and <200% FPL	10,971	127,047,142	28	-704,719	59	-1,485,196	35	74
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,240,054	92	-146,434	120	-189,764	94	121
	Non-Hispanic white and <200% FPL	9,669	111,251,013	38	-230,233	69	-417,090	40	73
	Non-Hispanic white and ≥200% FPL	10,143	112,010,855	57	-499,910	57	-499,910	62	62
Bupropion	**Overall**	**10,361**	**117,736,069**	**32**	**-320,922**	**40**	**-504,580**	**35**	**45**
	Racially or ethnically	10,958	127,149,956	15	-601,905	32	-1,268,515	21	44

	minoritized and <200% FPL								
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,287,713	57	-98,775	74	-128,002	58	75
	Non-Hispanic white and <200% FPL	9,647	111,151,619	15	-329,627	28	-597,153	19	34
	Non-Hispanic white and ≥200% FPL	10,128	112,226,089	42	-284,676	42	-284,676	45	45
ENDS	**Overall**	**10,391**	**125,616,042**	**62**	**7,559,050**	**83**	**10,794,787**	**-14**	**-25**
	Racially or ethnically minoritized and <200% FPL	10,986	134,684,576	43	6,932,715	90	14,610,697	-27	-56
	Racially or ethnically minoritized and ≥200% FPL	12,328	150,585,693	93	8,199,205	120	10,625,350	11	14
	Non-Hispanic white and <200% FPL	9,675	118,596,500	44	7,115,254	79	12,889,994	-27	-50
	Non-Hispanic white and ≥200% FPL	10,159	120,434,409	73	7,923,644	73	7,923,644	-7	-7

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

C.12 One-Way Sensitivity Analysis on Equity Weights

aTable C.12-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Equity Weights per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
				Lower Bounds					
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**82**	**-1,111,482**	**73**	**93**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	65	-2,137,710	46	86
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	121	-914,987	107	130
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	81	-1,066,714	56	91
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	86	86
NRT	**Overall**	10,381	117,606,144	51	-450,847	65	-607,788	56	71

	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	52	-1,416,579	36	67
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,188,054	92	-198,434	112	-240,899	94	114
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	62	-463,991	41	67
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	62	62
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**38**	**-530,909**	**35**	**43**
	Racially or ethnically minoritized and <200% FPL	10,958	127,101,956	15	-649,905	28	-1,216,623	21	40
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	69	-178,184	58	71
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	25	-620,819	19	32
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	45	45
ENDS	**Overall**	**10,391**	**121,695,042**	**62**	**3,638,050**	**78**	**4,781,632**	**25**	**31**
	Racially or ethnically minoritized and <200% FPL	10,986	130,763,576	43	3,011,715	80	5,637,930	12	23
	Racially or ethnically minoritized and ≥200% FPL	12,328	146,664,693	93	4,278,205	112	5,193,741	50	61

	Non-Hispanic white and <200% FPL	9,675	114,675,500	44	3,194,254	72	5,251,354	12	19
	Non-Hispanic white and ≥200% FPL	10,159	116,513,409	73	4,002,644	73	4,002,644	33	33
					Upper Bounds				
Varenicline	**Overall**	**10,395**	**117,240,304**	**65**	**-816,687**	**92**	**-1,272,583**	**73**	**104**
	Racially or ethnically minoritized and <200% FPL	10,978	126,609,922	35	-1,141,939	81	-2,675,563	46	108
	Racially or ethnically minoritized and ≥200% FPL	12,335	141,632,791	100	-753,696	137	-1,038,594	107	148
	Non-Hispanic white and <200% FPL	9,681	110,832,393	49	-648,853	97	-1,284,079	56	110
	Non-Hispanic white and ≥200% FPL	10,164	111,657,077	77	-853,688	77	-853,688	86	86
NRT	**Overall**	**10,381**	**117,606,144**	**51**	**-450,847**	**73**	**-692,593**	**56**	**79**
	Racially or ethnically minoritized and <200% FPL	10,971	126,995,142	28	-756,719	66	-1,772,994	36	83
	Racially or ethnically minoritized and ≥200% FPL	12,327	142,188,054	92	-198,434	127	-273,442	94	130
	Non-Hispanic white and <200% FPL	9,669	111,199,013	38	-282,233	75	-558,539	41	81
	Non-Hispanic white and ≥200% FPL	10,143	111,958,855	57	-551,910	57	-551,910	62	62
Bupropion	**Overall**	**10,361**	**117,688,069**	**32**	**-368,922**	**42**	**-617,737**	**35**	**48**
	Racially or ethnically	10,958	127,101,956	15	-649,905	35	-1,522,728	21	50

	minoritized and <200% FPL								
	Racially or ethnically minoritized and ≥200% FPL	12,292	142,239,713	57	-146,775	78	-202,255	58	80
	Non-Hispanic white and <200% FPL	9,647	111,103,619	15	-377,627	31	-747,324	19	38
	Non-Hispanic white and ≥200% FPL	10,128	112,178,089	42	-332,676	42	-332,676	45	45
ENDS	**Overall**	**10,391**	**121,695,042**	**62**	**3,638,050**	**88**	**5,411,953**	**25**	**34**
	Racially or ethnically minoritized and <200% FPL	10,986	130,763,576	43	3,011,715	100	7,056,448	12	29
	Racially or ethnically minoritized and ≥200% FPL	12,328	146,664,693	93	4,278,205	128	5,895,367	50	69
	Non-Hispanic white and <200% FPL	9,675	114,675,500	44	3,194,254	87	6,321,429	12	23
	Non-Hispanic white and ≥200% FPL	10,159	116,513,409	73	4,002,644	73	4,002,644	33	33

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

C.13 One-Way Sensitivity Analysis on Continued ENDS Use

aTable C.13-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Proportion of Individuals that Continue ENDS Use per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
					Lower Bounds				
ENDS	**Overall**	**10,396**	**121,178,876**	**66**	**3,121,885**	**90**	**4,402,780**	**35**	**46**
	Racially or ethnically minoritized and <200% FPL	10,990	130,414,392	47	2,662,531	99	5,611,284	20	43
	Racially or ethnically minoritized and ≥200% FPL	12,336	146,075,225	101	3,688,737	131	4,780,234	64	83
	Non-Hispanic white and <200% FPL	9,679	114,284,623	47	2,803,377	86	5,078,598	19	35
	Non-Hispanic white and ≥200% FPL	10,164	115,865,456	77	3,354,691	77	3,354,691	44	44
					Upper Bounds				

ENDS	**Overall**	**10,391**	**122,099,719**	**61**	**4,042,728**	**80**	**5,616,739**	**21**	**24**
	Racially or ethnically minoritized and <200% FPL	10,968	130,992,000	25	3,240,139	52	6,828,592	-8	-16
	Racially or ethnically minoritized and ≥200% FPL	12,330	147,228,186	95	4,841,699	123	6,274,357	47	61
	Non-Hispanic white and <200% FPL	9,675	114,901,519	44	3,420,274	79	6,196,168	10	17
	Non-Hispanic white and ≥200% FPL	10,164	117,068,553	77	4,557,788	77	4,557,788	32	32

Table Legend: Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

C.14 One-Way Sensitivity Analysis on Mortality Risk of ENDS Relative to Combustible Cigarettes

aTable C.14-1: Net Health and Equity Benefits of Cessation Interventions at Upper and Lower Bounds of Estimated Mortality Risk of ENDS Relative to Combustible Cigarettes per 1,000 Current Smokers

Treatment	Equity Group	Unweighted Effects	Unweighted Costs	Incremental Effects	Incremental Costs	Weighted Incremental Effects	Weighted Incremental Costs	Incremental Net Health Benefit	Incremental Net Equity Benefit
No Treatment	**Overall**	**10,330**	**118,056,992**	**-**	**-**	**-**	**-**	**-**	**-**
	Racially or ethnically minoritized and <200% FPL	10,943	127,751,862	-	-	-	-	-	-
	Racially or ethnically minoritized and ≥200% FPL	12,235	142,386,487	-	-	-	-	-	-
	Non-Hispanic white and <200% FPL	9,632	111,481,246	-	-	-	-	-	-
	Non-Hispanic white and ≥200% FPL	10,086	112,510,765	-	-	-	-	-	-
				Lower Bounds					
ENDS	**Overall**	**10,397**	**121,753,231**	**67**	**3,696,239**	**86**	**5,116,372**	**30**	**35**
	Racially or ethnically minoritized and <200% FPL	10,975	130,667,507	32	2,915,646	67	6,144,724	2	5
	Racially or ethnically minoritized and ≥200% FPL	12,340	146,797,522	105	4,411,035	136	5,716,260	61	79
	Non-Hispanic white and <200% FPL	9,673	114,565,780	41	3,084,535	74	5,587,943	10	18
	Non-Hispanic white and ≥200% FPL	10,174	116,731,498	88	4,220,734	88	4,220,734	46	46
				Upper Bounds					

ENDS	**Overall**	**10,387**	**121,613,690**	**57**	**3,556,699**	**76**	**4,976,677**	**22**	**26**
	Racially or ethnically minoritized and <200% FPL	10,984	130,785,931	41	3,034,069	87	6,394,301	11	23
	Racially or ethnically minoritized and ≥200% FPL	12,311	146,342,695	76	3,956,208	98	5,126,850	36	47
	Non-Hispanic white and <200% FPL	9,669	114,557,967	38	3,076,721	68	5,573,788	7	13
	Non-Hispanic white and ≥200% FPL	10,158	116,496,658	72	3,985,894	72	3,985,894	32	32

*Results are reported per 1,000 simulated current smokers either overall, where the composition of the equity groups matches the US smoking population, or per 1,000 current smokers within that equity group. Net Health Benefit and Net Equity Benefit are calculated with a $100,000 per QALY willingness-to-pay threshold.

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