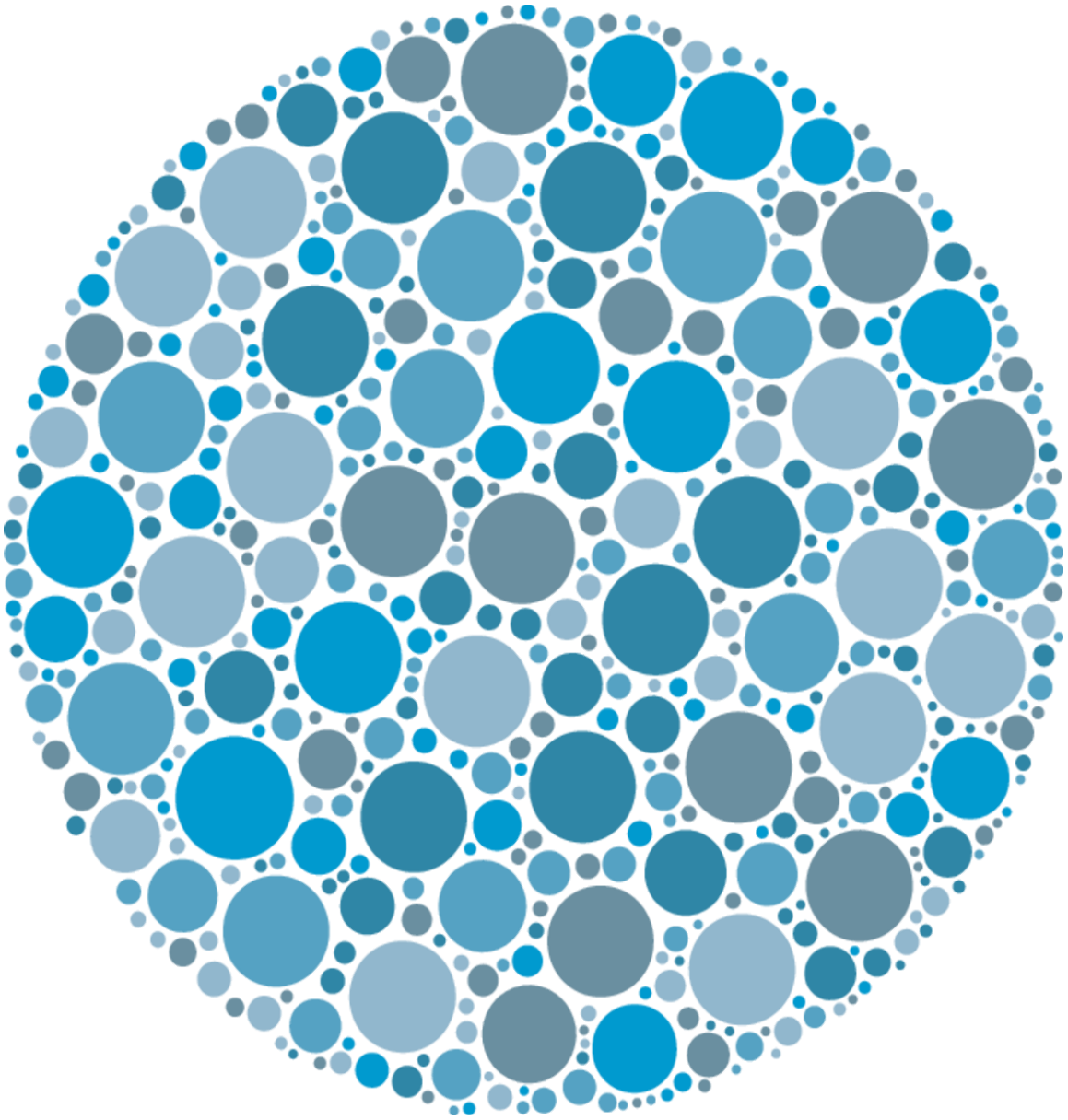
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The cost of vision loss and blindness in Canada

Canadian Council of the Blind

May 2021

Deloitte
Access Economics

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About the Canadian Council of the Blind

The Canadian Council of the Blind (CCB) is a membership-based not-for-profit organization that brings together Canadians who are blind, deaf-blind or living with vision loss to improve the quality of life for persons living with vision loss through awareness, peer mentoring, socializing, sports & recreation, advocacy, health promotion and illness prevention. The CCB works in partnership with Fighting Blindness Canada and receives support from key partners such as the Canadian Association of Optometrists and the Canadian Ophthalmological Society.

The CCB received unconditional grants from a number or local, provincial, national and international organisations, all of whom are dedicated to the same mandates and principals that CCB adheres to, including: AbbVie Allergan; Alcon, Applied Genetic Technologies Corporation (AGTC); Bausch + Lomb, Bayer Inc.; Bell; Canadian Association of Optometrists (CAO); Canadian Ophthalmological Society (COS); Fighting Blindness Canada (FBC); Glaukos Corporation; Hoffmann-La Roche Limited; Janssen: Pharmaceutical Companies of Johnson & Johnson; MeiraGTx and Novartis.

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Contents

Limitation of our work 3
General use restriction 3
Glossary k
Executive summary i
Part A viii
Introduction and prevalence of vision loss in Canada viii
1 Introduction 1
1.1 Purpose and scope of this report 2
1.2 Defining vision loss 2
1.2.1 Better eye, worse eye 3
1.2.2 Severity of vision loss 3
1.3 Main causes of vision loss 3
1.3.1 Age related macular degeneration (AMD) 4
1.3.2 Cataract 5
1.3.3 Diabetic retinopathy (DR) 5
1.3.4 Glaucoma 6
1.3.5 Other causes of vision loss 7
2 Methodology overview 8
2.1 Estimating prevalence 8
2.2 Estimating cost components 9
3 Epidemiology of vision loss 14

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3.1 Vision loss by age, sex, severity and province/territory 14
3.1.1 Prevalence of any vision loss by age and sex 14
3.1.2 Prevalence of vision loss by severity 16
3.1.3 Prevalence of vision loss by province/territory 19
3.1.4 Prevalence of vision loss by condition 22
3.1.5 Projected prevalence of vision loss 26
3.2 Mortality from vision loss 26
Part B 29
Costs of vision loss in Canada 29
4 Costs of vision loss 30
4.1 Healthcare system costs 30
4.2 Productivity losses 37
4.3 Other costs 42
4.4 Other costs not quantified 48
4.4.1 Depression and vision loss 48
4.4.2 Motor vehicle crash and vision loss 49
5 Loss of wellbeing 51
6 Summary 54
6.1 Total costs of vision loss in Canada 54
6.2 Sensitivity analysis 60
6.3 Conclusion 63
Appendix A Technical appendix 68
A.1. Prevalence of vision loss 68
A.1.1. Overall prevalence of vision loss 68
A.1.2. Prevalence of vision loss by severity 71
A.1.3. Prevalence of vision loss by province/territory 73
A.1.4. Prevalence of vision loss by condition 73
A.2. Mortality attributable to vision loss 77
A.3. Healthcare system costs due to vision loss 78
A.3.1. Inpatient and ED care 78
A.3.2. Cost of falls 80
A.3.3. Outpatient care 81
A.3.4. Pharmaceuticals 83
A.3.5. Vision care 84
A.3.6. Visits to other health professionals 85

A.3.7. Medical research 85
A.3.8. Capital and administration costs 87
A.4. Productivity losses 87
A.4.1. Reduced workforce participation 87
A.4.2. Absenteeism 92
A.4.3. Presenteeism 93
A.4.4. Premature mortality 94
A.4.5. Informal care costs 95
A.5. Other costs 97
A.5.1. Private expenditure on aids, equipment and home modifications 97
A.5.2. Low vision rehabilitation services 99
A.5.3. Formal care 99
A.5.4. Aged and home care 100
A.5.5. Efficiency losses 101
A.6. Loss of wellbeing 104
Appendix B Province specific estimates 107
B.1. Prevalence cases by severity for each province/territory 107
B.2. Inpatient hospitalization cost disaggregated by province/territory 120
B.3. Cataract day surgery volume and expenditure disaggregated by province/territory 121
B.4. Ophthalmic services and costs disaggregated by province/territory 122
B.5. Healthcare system costs disaggregated by province/territory 123
B.6. Productivity costs disaggregated by province/territory 124
B.7. Other costs disaggregated by province/territory 125
B.8. Loss of wellbeing disaggregated by province/territory 126
B.9. Total costs disaggregated by province/territory 127
Endnote 129

Charts

Chart i : Prevalence of VL in Canada by province/territory, thousands of people, 2019 v
Chart ii : Total costs of VL by province/territory, $ million, 2019 v
Chart 3.1 : Prevalence (% of population) of VL and blindness in Canada by sex and severity, 2019 17
Chart 3.2 : Number of people with VL by province/territory, thousands of people, 2019 20
Chart 3.3 : Share of VL in Canada by condition, 2019 23
Chart 3.4 : Projected prevalence (number of people) of VL in Canada, thousands of people, 2019-50 26
Chart 4.1 : Breakdown of healthcare system costs by province/territory, $ million, 2019 32
Chart 4.2 : Healthcare system costs by payer, $ million, 2019 35
Chart 4.3 : Healthcare system costs of VL by age, $ million, 2019 36
Chart 4.4 : Productivity costs of VL by age and gender, $ million, 2019 40
Chart 4.5 : Summary of productivity costs due to VL by bearer, 2019 41
Chart 4.6 : Other costs of VL by age and gender, $ million, 2019 44
Chart 4.7 : Other financial costs due to VL by cost bearer, 2019 47
Chart 6.1 : Total costs of VL in Canada, by cost bearer, 2019 55
Chart 6.2 : Total economic costs and wellbeing costs of VL by age, $ million, 2019 59

Tables

Table i : Cost of VL by cost component, 2019 iv
Table 2.2 : Conceptual framework for costs associated with VL by type and bearer 11

Table 3.1 : Derived prevalence rates of VL and blindness for the Canadian population by age and sex 15
Table 3.2 : Prevalence (number of people) of VL and blindness in Canada by age and severity 17
Table 3.3 : Prevalence (number of people) and crude prevalence rate (%) of VL in Canada by province/territory, 2019 20
Table 3.4 : Prevalence (number of people) of VL in Canada by age, sex and condition, 2019 24
Table 3.5 : Prevalence of eye disease in Canada by condition, 2019 and 2050 25
Table 3.6 : Mortality rates (%) due to VL by age and sex 27
Table 3.7 : Number of deaths due to VL in Canada, 2019 28
Table 4.1 : Healthcare system costs due to VL in Canada, $ million, 2019 30
Table 4.2 : Healthcare system costs by component and province/territory, $ million, 2019 33
Table 4.3 : Productivity costs due to VL, 2019 38
Table 4.4 : Total productivity costs of VL by province/territory, 2019 39
Table 4.5 : Summary of other financial and economic costs, $ million, 2019 43
Table 4.6 : Total other costs of VL by province/territory, 2019 46
Table 5.1 : Total wellbeing costs of VL by province/territory, 2019 52
Table 5.2 : YLDs, YLLs and DALYs due to VL, 2019 53
Table 6.1 : Cost of VL in Canada by component, 2019 54
Table 6.2 : Total costs of VL by province, 2019 56
Table 6.3 : Total costs of VL by age group (years) and sex, 2019 58
Table 6.4 Total costs of vision loss in Canada, 2019 and 2050, $ million 60
Table 6.5 : One-way sensitivity analysis of selected parameters, $ billion 61
Table A.1 : Prevalence rate of VL with pinhole correction disaggregated by age groups (45 - 75+ years) 70
Table A.2 : Severity distribution of VL by age group and sex 72

Table A.3 : Share of VL in Canada, 2019, by condition, severity, and age group for men 74
Table A.4 : Share of VL in Canada, 2019, by condition, severity, and age group for women 75
Table A.5 : Cost of inpatient and ED costs, 2019 79
Table A.6 : Cost of pharmaceuticals by medication type, 2019 84
Table A.7 : Medical research costs due to VL, 2019 87
Table A.8 : Employment outcomes for people with VL 89
Table A.9 : Productivity loss due to reduced employment in people with VL, 2019 91
Table A.10 : Productivity loss due to absenteeism in people with VL, 2019 93
Table A.11 : Productivity loss due to presenteeism in people with VL, 2019 94
Table A.12 : Productivity loss due to premature mortality in people with VL, 2019 95
Table A.13 : Total cost of informal care due to VL, 2019 96
Table A.14 : Utilization of aids and modifications by people with VL 98
Table A.15 : Welfare payments received by persons living with VL ($ 2019) by welfare type 102
Table A.16 : Efficiency losses due to VL, 2019 104
Table A.17 : Disability weights in the GBD, 2019 105
Table B.1 : Prevalence of VL in Alberta by severity, age and sex 107
Table B.2 : Prevalence of VL in British Columbia by severity, age and sex 108
Table B.3 : Prevalence of VL in Manitoba by severity, age and sex 109
Table B.4 : Prevalence of VL in New Brunswick by severity, age and sex 110
Table B.5 : Prevalence of VL in Newfoundland by severity, age and sex 111
Table B.6 : Prevalence of VL in Northwest Territories by severity, age and sex 112
Table B.7 : Prevalence of VL in Nova Scotia by severity, age and sex 113
Table B.8 : Prevalence of VL in Nunavut by severity, age and sex 114

Table B.9 : Prevalence of VL in Ontario by severity, age and sex 115
Table B.10 : Prevalence of VL in Prince Edward Island by severity, age and sex 116
Table B.11 : Prevalence of VL in Quebec by severity, age and sex 117
Table B.12 : Prevalence of VL in Saskatchewan by severity, age and sex 118
Table B.13 : Prevalence of VL in Yukon by severity, age and sex 119
Table B.14 : Inpatient hospitalization cost disaggregated by province/territory in Canada in 2019 120
Table B.15 : Cataract day surgery volume and expenditure disaggregated by province/territory in Canada in 2019 121
Table B.16 : Ophthalmic services and costs disaggregated by province/territory in Canada in 2019 122
Table B.17 : Healthcare system costs of VL by province/territory, 2019 123
Table B.18 : Productivity costs of VL by province/territory, 2019 124
Table B.19 : Other costs of VL by province/territory, 2019 125
Table B.20 : Loss of wellbeing due to VL by province/territory, 2019 126
Table B.21 : Total financial and economic costs of VL by province/territory, 2019 127
Table B.22 : Total costs of VL by province/territory, 2019 128

Glossary

Acronym	Full name
AMD	Age related macular degeneration
AWE	Average weekly earnings
BCVA	Best corrected visual acuity
CAO	Canadian Association of Optometrists
CCB	Canadian Council of the Blind
CHMS	Canadian Health Measures Survey
CIHI	Canadian Institute for Health Information
CIHR	Canadian Institutes of Health Research
CLSA	Canadian Longitudinal Study on Aging
CMG	Case mix group
CNIB	Canadian National Institute for the Blind
COS	Canadian Ophthalmological Society
DALY	Disability adjusted life year
DR	Diabetic retinopathy
ED	Emergency department
FBC	Fighting Blindness Canada
GBD	Global burden of disease
GPS	Global positioning system
IAPB	International Agency for the Prevention of Blindness
IRD	Inherited retinal dystrophy
NHANES	National Health and Nutrition Examination Survey
NHEX	National Health Expenditure Database
NPDIUS	National prescription drug utilization information system
NPV	Net present value

Acronym	Full name
PAF	Population attributable fraction
RAAB	Rapid Assessment of Avoidable Blindness
RE	Refractive error
UK	United Kingdom
US	United States of America
VEGF	Vascular endothelial growth factor
VL	Vision loss
VLEG	Vision loss expert group
VSLY	Value of a statistical life year
WHO	World Health Organization
YLD	Years of life lost due to disability
YLL	Years of life lost due to premature death

Executive summary

Key findings:

- An estimated 1.2 million Canadians were living with vision loss and blindness (referred to as "VL") in 2019. This represents 3.2% of the population. VL was defined in this report as the best possible vision that can be achieved after correction using glasses or lenses where visual acuity is better than <20/40.
- More than 8 million Canadians are living with eye disease from one of four conditions: age-related macular degeneration (AMD), cataract, diabetic retinopathy (DR) and glaucoma. Furthermore, almost everyone over the age of 50 will have some problems with their sight which may benefit from correction.
- Our research estimates the total cost of VL in Canada in 2019 at $32.9 billion. This consists of the total financial cost of VL of $15.6 billion and the cost of lost wellbeing of $17.4 billion.
- The major components of cost include: healthcare system costs ($9.5 billion), productivity and informal caregiving losses ($4.3 billion) and the value of reduced quality of life or loss of wellbeing ($17.4 billion), which is a non-financial cost.
- Largely in line with overall population demographics, the costs of VL were greatest in Ontario ($13.0 billion) followed by Quebec ($7.6 billion), British Columbia ($4.5 billion) and Alberta ($3.5 billion).

Background

A visual acuity measurement of 20/20 is often associated with "perfect" vision, a benchmark for unimpaired sight. A significant number of Canadians live with vision that does not meet this benchmark.

Recognizing the complex nature of VL and blindness (referred to as "VL" throughout this report) and its profound effects on individuals, families, and communities, the Canadian Council of

the Blind (CCB) engaged Deloitte Access Economics to develop a contemporary estimate of the social and economic cost of VL in 2019.

This report outlines the healthcare system, productivity, and wellbeing impacts of VL, and makes recommendations aimed at curtailing the personal and social costs associated with impaired sight. This report focuses on VL after best possible correction, known as best-corrected visual acuity (BCVA), highlighting the prevalence and costs of VL stemming from blinding eye diseases which cannot be resolved with glasses or contact lenses.

Based on data from 2019, this research finds that there are an estimated 1.2 million Canadians living with VL, representing 3.2% of the total population. More than 4.1% of this group is comprised of individuals who are blind.

It is noted many more Canadians are impacted by problems of vision: when VL is defined using presenting visual acuity – a person's vision with their usual refractive correction (glasses, contacts, etc.) – the prevalence of VL increases from 13.8% to 28.8% in Canadians aged 75 and older and from 1.3% to 7.1% in Canadians aged 45-64.[1] Moreover, the data in this report show at least 8 million Canadians are living with eye disease from one of four conditions: age-related macular degeneration (AMD), cataract, diabetic retinopathy (DR) and glaucoma. Of the 8 million, approximately 867,000 (out of 1.2 million) people have VL from these conditions. Importantly, these data do not consider a number of other conditions that cause VL such as corneal diseases and uncorrectable refractive error. Consequently, the total estimate for people living with an eye condition that could cause VL is likely to be even greater.

Even when the prevalence of VL is measured using BCVA, its costs are substantial. Our research estimates the total cost of VL in Canada in 2019 at $32.9 billion. This consists of the total financial cost of VL of $15.6 billion and the cost of lost wellbeing of $17.4 billion.

As this number suggests, VL has a significant impact on individuals and communities. The costs of VL are varied and large, encompassing social isolation, employment barriers,

strain on families and caregivers, and a range of other issues. And since vision is one of the key senses, impairment can affect day-to-day life. This report quantifies financial and wellbeing costs to demonstrate the impact of VL in Canada.

New investments in research, treatments, and assistive technologies have made important contributions to the quality of life of those living with VL. Advancements such as cataract surgery, anti-vascular endothelial growth factor (anti-VEGF) injections, and specialized software for the visually impaired have enabled many with VL to enjoy daily activities they had previously found difficult or impossible. In innovative fields such as genetics, stem cell research, and artificial intelligence, ground-breaking discoveries are poised to alter the future of VL. Some of these, such as gene therapies for inherited retinal diseases, are already beginning to enter the market.[2]

New practices, policies, and technologies are required to improve the lives of *all* Canadians with VL. By estimating the prevalence and cost of VL in Canada, this study provides the evidence base for future progress in VL policy, science, health care, and other important domains.

Why estimate the cost of VL?

The cost of VL extends beyond the cost to healthcare system. Individuals with VL are impacted financially due to fewer job opportunities, increased absences from work, and reduced productivity when they are not fully supported in their roles. The family members and caregivers who provide assistance are also affected, losing time and productivity when they fill their essential roles. And of course, when enough individuals are impacted, so is society at large — when an individual's productivity is lost, for example, so is the benefit and value that productivity has within a larger social context.

Estimating the economic cost of VL will help government, industry, the scientific community, and the public better understand the wide-ranging implications of VL. And more specifically, identifying, measuring, and reporting on this cost will empower policymakers to make evidence-based decisions that improve the lives of the individuals and communities that bear the bulk of those costs.

What contributed to the cost of VL in Canada in 2019?
It was estimated that VL led to an overall cost of $32.9 billion in 2019, including costs to the healthcare system, productivity, other financial costs, and loss of wellbeing (Table i).

Table i: Cost of VL by cost component, 2019

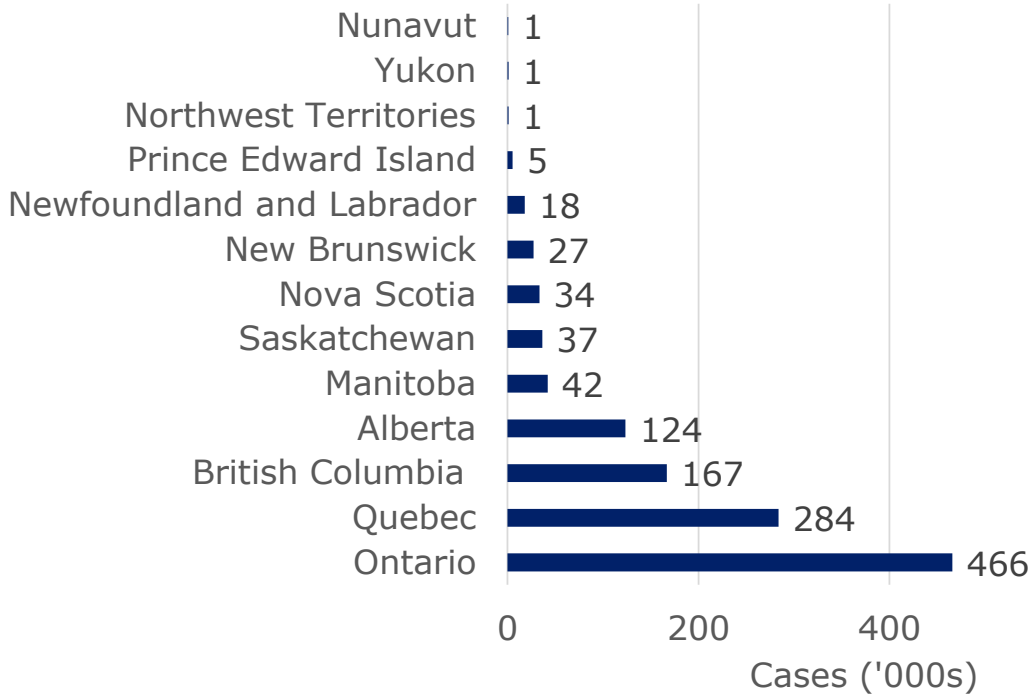
Component	Cost ($ millions)	Cost per person with VL ($)
Healthcare system costs	9,495.0	7,859
Productivity losses	3,980.3	3,295
Informal carer costs	289.8	240
Other costs	1,033.4	855
Efficiency losses	769.1	637
Total financial costs	**15,567.5**	**12,886**
Loss of wellbeing	**17,354.6**	**14,365**
Total costs	**32,922.1**	**27,251**

Source: Deloitte Access Economics calculations.

Ontario accounted for most of the cost of VL (40.6%), followed by Quebec (22.1%) and British Columbia (13.6%). This largely reflects the relative size of the population in each province/territory. New Brunswick, Nova Scotia and Newfoundland and Labrador were the provinces/territories with the highest prevalence rate of VL, with 3.5%, 3.5%, and 3.4% of the population respectively living with VL.

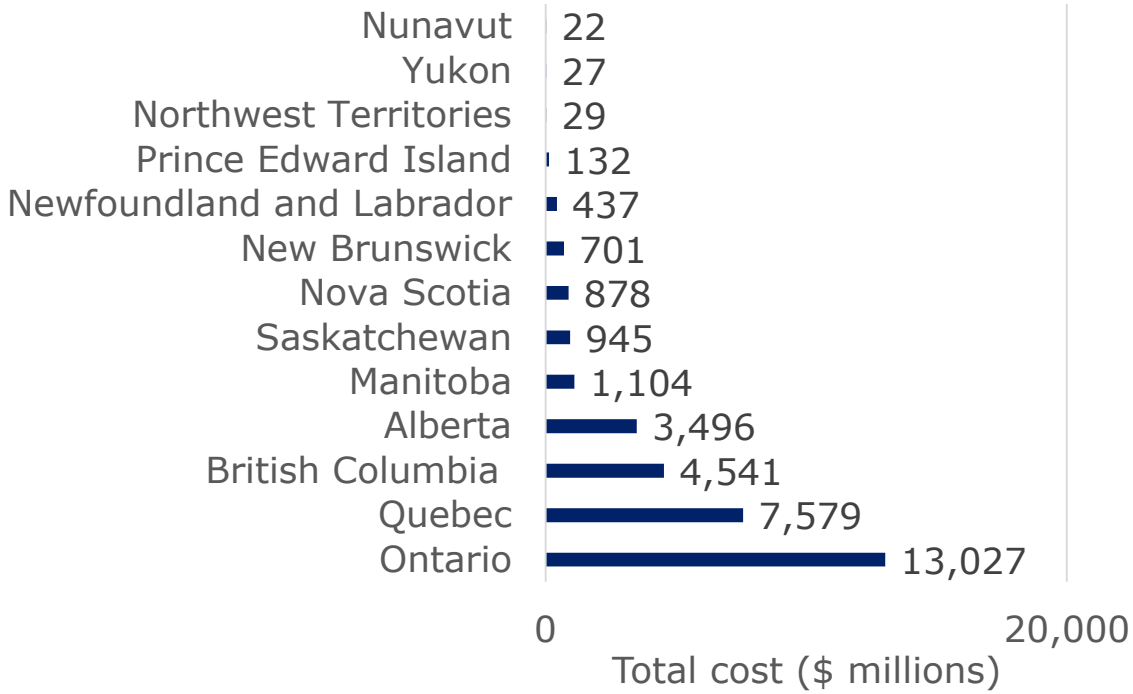
Importantly, this research shows VL was associated with 1,290 deaths in Canada in 2019, leading to a substantial reduction in overall wellbeing through the loss of future years of life.

Chart i: Prevalence of VL in Canada by province/territory, thousands of people, 2019



Source: Deloitte Access Economics calculations.

Chart ii: Total costs of VL by province/territory, $ million, 2019



Source: Deloitte Access Economics estimates.

What can be done to reduce the cost of VL?

The significant costs associated with VL suggest that more and better work can be done to reduce the burden placed on Canadian individuals and society.

Looking at trends in population growth and aging, it is possible to project that the cost of VL in Canada will grow from $32.9 billion in 2019 to $56 billion[i] in 2050. Furthermore, the prevalence of just four major eye diseases is projected to increase from 8 million Canadians in 2019 to 13.8 million Canadians in 2050. Without further action, the socio-economic costs of VL for individuals, families, communities and governments could become significant

However, approximately 71% ($23.5 billion) of the financial and wellbeing costs of VL estimated in this research are preventable if the impacts of VL can be minimized. This is based on the non-healthcare system financial costs, the cost of falls and wellbeing costs and excludes money spent on VL (i.e. healthcare system excluding the cost of falls).

Accessibility to eye care services, including timely eye examinations and treatments, is essential in reducing the incidence and slowing the progression of VL. This is especially important for older Canadians, who – as this report has found - have a higher risk of developing an eye condition. Additionally, in the context of the aging population, there is an opportunity to incorporate eye care in aging-related strategies and programs, including falls-prevention programs to help identify those who are at the greatest risk of VL. While this report has estimated 1.2 million Canadians are living with VL, there are substantially more Canadians living with an eye condition which places them at risk of VL.

Investing in eye health research to accelerate discoveries that lead to new treatments for VL is also an important step towards protecting and improving the vision health of Canadians. It has been estimated that the introduction of anti-VEGF treatments has led to a 50% reduction in the incidence of blindness due to neovascular AMD in the general population.[3]

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[i] In 2019 dollars.

New partnerships and programs to enhance accessibility to assistive devices, could transform the lives of many people living with VL. Personal technologies such as smart phones enable people with VL to engage in many aspects of life, including navigation, transportation, communications, and importantly, employment. By allowing people with VL to work productively, assistive devices help raise the standard of living for people with VL and reduce dependence on families and government benefits.

VL is a life-changing experience. The cost of VL is significant and multi-dimensional, encompassing costs to the healthcare system, substantial productivity impacts and costs to the individual and their families. Improving eye health, therefore, is about cost-savings for public spending, improving productivity in the workplace, raising income and contributing to general and mental health, education and equity. Addressing the multifaceted eye health challenge requires coordinated actions from all levels of the Canadian government in consultation with the VL community and its stakeholders. A national plan with a range of indicators to track eye health in Canada could be a first step in the right direction.

Part A

Introduction and prevalence of vision loss in Canada

1 Introduction

Vision loss (VL) imposes substantial costs on Canadian society each year. In 2007, Access Economics estimated the financial costs of VL to be $15.8 billion and the loss of wellbeing due to VL was valued at $15.2 billion.[4]

The Canadian Council of the Blind (CCB) engaged Deloitte Access Economics to provide a contemporary estimate of the annual social and economic cost of VL in 2019. This report draws on the latest evidence both within Canada and internationally to highlight the significant cost associated with VL.

This report is structured in the following way:

- **Chapter 1 – Introduction**. The rest of Chapter 1 provides an overview of the scope of this report, introduces the definition of VL used in this report, and discusses the main causes of VL.
- **Chapter 2 - Methodology overview** provides an overview of the methodology used to estimate the epidemiology and costs of VL
- **Chapter 3 - Epidemiology** summarizes estimates of the prevalence of VL and attributed mortality in Canada in 2019, presenting estimates by age, sex and severity of VL, along with disaggregating results by province/territory
- **Chapter 3 - Healthcare system costs** details the estimate of the healthcare system costs incurred due to VL, including inpatient and outpatient hospital costs; pharmaceuticals; ophthalmologists, optometrists, opticians and lenses; costs of falls attributable to VL; and other costs such as capital and administration attributable to VL
- **Chapter 4 - Productivity losses** presents the economic costs that emerge as a consequence of VL, including reduced employment, absenteeism, presenteeism, premature mortality and informal care
- **Chapter 5 - Other costs** provides estimates of other financial costs that arise due to VL, including aids,

equipment and home modifications, formal community and aged care, and economic efficiency losses
- **Chapter 6 - Loss of wellbeing -** presents the non-financial costs of reduced quality of life associated with the morbidity and mortality of VL
- **Chapter 7 - Summary** details the total economic cost of VL in Canada in 2019, compares the estimates from this report to other published work, discusses the uncertainty in the modelling (sensitivity analysis) and provides an overall conclusion of the key findings from this report.

1.1 Purpose and scope of this report

The report estimates the prevalence of VL and quantifies the associated costs to the healthcare system, other financial costs (such as productivity losses) and the value of the loss of wellbeing.

The report aims to estimate the annual cost of VL at an aggregated level, with potential breakdown by age, sex, province/territory, several major causes of VL and severity. While it is acknowledged that prevalence and cost of VL may vary across population groups, demographic breakdown is not a specific focus of the report.

1.2 Defining vision loss

VL is broadly defined as a limitation in one or more functions of the eye or visual system, most commonly impairment of visual acuity (sharpness or clarity of vision), visual fields (the ability to detect objects to either side or above or below the direction in which the person is looking) and color vision.

Average vision is recorded as 20/20 in the Imperial system used in Canada (6/6 in metric), which means that a person can see at 20 feet (6 meters) what a person with average vision can see at 20 feet. Degrees of VL are measured similarly, where the first number in the measure is the furthermost distance at which the person can clearly see an object and the second number is the distance at which a person with average vision could see the same object. For example, 20/40 vision means that the person can clearly see at 20 feet (but not more) an object that a person with average vision could see at 40 feet (but not more).

In Canada, a person is classified as being legally blind if: their visual acuity is 20/200 (or 6/60) or less in both eyes after correction, and/or they have a visual field of 20 degrees or narrower.[5] This means that if a person with their glasses on can see the big 'E' on a Snellen eye chart, but none of the other optotypes, for legal purposes they are considered blind and are eligible for certain government tax credits as well as concessions from some retailers and other service providers. The Canadian definition of legal blindness also includes those whose visual field is of less than 20 degrees in diameter horizontally.

1.2.1 Better eye, worse eye

The extent of VL may differ between eyes, known as asymmetrical VL. Prevalence rates for VL may report the prevalence and severity of VL by either better or worse eye in terms of the extent of the VL. This report estimates the prevalence of VL for the better eye. This decision reflects a conservative modelling approach, which means the final estimated cost of VL is likely conservative.

1.2.2 Severity of vision loss

VL is often reported using best corrected visual acuity (BCVA), which is a measure of the best possible vision a person can achieve with corrective lenses measured in terms of Snellen lines on an eye chart. This report uses severity splits by BCVA which are consistent with the severity splits used in previous cost of illness studies.[6] The severity splits by BCVA used in this report are as follows:

- **Blindness, or severe VL** is defined as BCVA of 20/200 or worse (≤6/60) in the better-seeing eye
- **Moderate VL** is defined as BCVA worse than 20/60 (<6/18) but better than or equal to 20/200 (6/60) in the better-seeing eye
- **Mild VL** is defined by BCVA worse than 20/40 (<6/12) but better than or equal to 20/60 (6/18) in the better-seeing eye.

1.3 Main causes of vision loss

The present analysis estimates the prevalence of VL, disaggregated by four major causes and a catch all group

"other", consistent with previous cost of illness studies in Canada.[7] The major causes of VL are:

- Age related macular degeneration (AMD)
- Cataract
- Diabetic retinopathy (DR)
- Glaucoma
- Other causes of VL.

A brief description of each of these causes of VL is provided in the following sections to provide background regarding the conditions and common treatments.

1.3.1 Age related macular degeneration (AMD)

AMD is an incurable eye disease and a leading cause of blindness in elderly people. The macula is the part of the retina that enables central vision and the seeing of fine detail. Damage to the macula is characterized by a 'black spot' – losing the centre of the picture. In 'early AMD', small yellow deposits called *drusen* form under the macula. Vision is usually lost with more advanced stages of AMD. There are two types of 'late AMD', dry (geographic/atrophic) and wet (exudative/neovascular).

Several risk factors of AMD have been identified. Age is the most significant factor with most cases of late AMD cases occurring in people older than 60 years. Smoking is considered to be the strongest modifiable risk factor of AMD. Other risk factors may include diet, sunlight exposure, iris color and alcohol consumption.[8]

There are no approved therapeutic treatments for dry AMD, however, there are several in clinical trials.[9] These include drugs such as eculizumab and lampalizumab which have been tested in phase 2 and phase 3 clinical trials.[10,11]

Treatment of wet AMD is based on inhibition of the angiogenic protein vascular endothelial growth factor (VEGF), which is produced in the retina and induced by hypoxia and other conditions.[8] In Canada in 2019, three anti-VEGF drugs, aflibercept (Eylea), bevacizumab (Avastin) and ranibizumab (Lucentis) were used for treatment of retinal conditions, however, bevacizumab is not approved by Health Canada for

use in AMD or DR.[12] As of March 2020 there are now four anti-VEGF drugs, including brolucizumab.

1.3.2 Cataract

A cataract is a cloudy area in the eye's lens that forms when proteins clump together. Over time, the cataract may grow larger and cloud more of the lens, making it hard to see. The most common symptoms are blurry vision, problems with light, 'faded' colors, double or multiple vision and the need for frequent changes in glasses or contact lenses.

The four main types of cataract are age-related (most common), congenital, secondary (e.g. due to diabetes or steroid use) and traumatic (e.g. due to eye injury). The development of cataracts is age-related in most cases. Genetic factors may also increase the risk of cataract alongside lifestyle factors such as sun exposure, smoking, diet and alcohol consumption.[13]

Visually significant cataracts are treated through the surgical removal of the cataractous lens and replacement with an intraocular lens. Cataract surgery is recommended where the VL is of sufficient severity to outweigh the potential risks of surgery. The outcome of cataract surgery is independent of preoperative visual acuity.[13]

1.3.3 Diabetic retinopathy (DR)

DR is a complication of diabetes mellitus wherein microaneurysms develop on the tiny blood vessels inside the retina. As the disease progresses, some blood vessels that nourish the retina are blocked, causing VL through either proliferative retinopathy or macular edema. Clinically, there are two stages of DR: non-proliferative DR and proliferative DR.[14] Non-proliferative DR represents the early stages of DR which is characterized by increased vascular permeability and capillary occlusion in the retinal vasculature. This can cause microaneurysms, hemorrhages and hard exudates. Proliferative DR represents the more advanced stage of DR and is characterized by neovascularization which can lead to severe VL when the new abnormal vessels bleed into the vitreous or when tractional retinal detachment occurs.[15]

DR often has no early symptoms. Sometimes the person sees specks of blood, or spots 'floating' in their vision. Diagnosis can be made via a visual acuity test (eye chart test), dilated eye examination, retinal photography and/or fluorescein angiogram.[16]

Managing diabetes through controlling blood sugar levels, blood pressure and blood cholesterol will help prevent onset and progression of DR. Where metabolic control is insufficient, therapeutics which block VEGF may provide an effective treatment in patients with diabetic macular edema. The use of VEGF-neutralizing antibodies, bevacizumab, ranibizumab and aflibercept improves visual acuity by an average of one to two lines on a Snellen chart, with an improvement of three or more lines in approximately 25% of patients.[17] Bevacizumab, has been used widely in practice to treat eye conditions including diabetic macular edema despite not being approved for this use by Health Canada.

1.3.4 Glaucoma

Glaucoma is a group of diseases that, while initially asymptomatic, can damage the eye's optic nerve and result in blindness. The optic nerve comprises nerve fibers that connect the retina with the brain. In the front of the eye is a space called the anterior chamber, which is between the cornea and iris. Clear fluid normally drains out through tissue, the trabecular meshwork, where the cornea and iris meet. If the fluid does not drain sufficiently, pressure in the eye can increase, damaging the eye. Types of glaucoma include:

- Primary open-angle glaucoma
- Closed-angle glaucoma
- Congenital glaucoma
- Secondary glaucoma.

The primary risk factors for the development and progression of glaucoma are older age, intraocular pressure too high in relation to the pressure sensitivity of the optic nerve head, ethnic background, family history of glaucoma and high myopia.[18]

The only generally accepted treatment to reduce the risk of progression of glaucoma is to lower intraocular pressure. This

can be achieved through drug therapy, laser therapy, or surgery.[19]

1.3.5 Other causes of vision loss

Other major causes of VL in Canada, aside from those mentioned previously, include uncorrectable refractive error (RE), corneal diseases (with dry eyes being among the key contributing factors), disorders of the visual pathway, cornea/conjunctiva and trauma to the eye.[20] It is acknowledged however there are other eye conditions, such as inherited retinal disorders, corneal opacity and trachoma, which can lead to VL, however their prevalence is less frequent in the Canadian population.

A brief description of each condition follows:

- Uncorrectable RE – refers to situations where despite having best correction (i.e., glasses/lenses), a person's eyesight is still worse than 20/40
- Dry eyes – a type of corneal disease where tears are not able to provide adequate lubrication for the eyes, which if left untreated, this can lead to eye inflammation, abrasion of the corneal surface and corneal ulcers
- Disorders of the visual pathway – VL due to damage to the visual pathway which impact somewhere between the optic nerve and visual cortex
- Cornea/conjunctiva – the most common disorder of the conjunctiva, the membrane that lines the eyelid, sclera and edge of the cornea, is inflammation which may be caused by an infection, allergic reactions, chemical or foreign bodies in the eye or overexposure to sunlight
- Trauma to the eye – physical or chemical wound to the eye or eye socket leading to VL
- Due to differing nature of each condition, treatment for these conditions vary significantly.

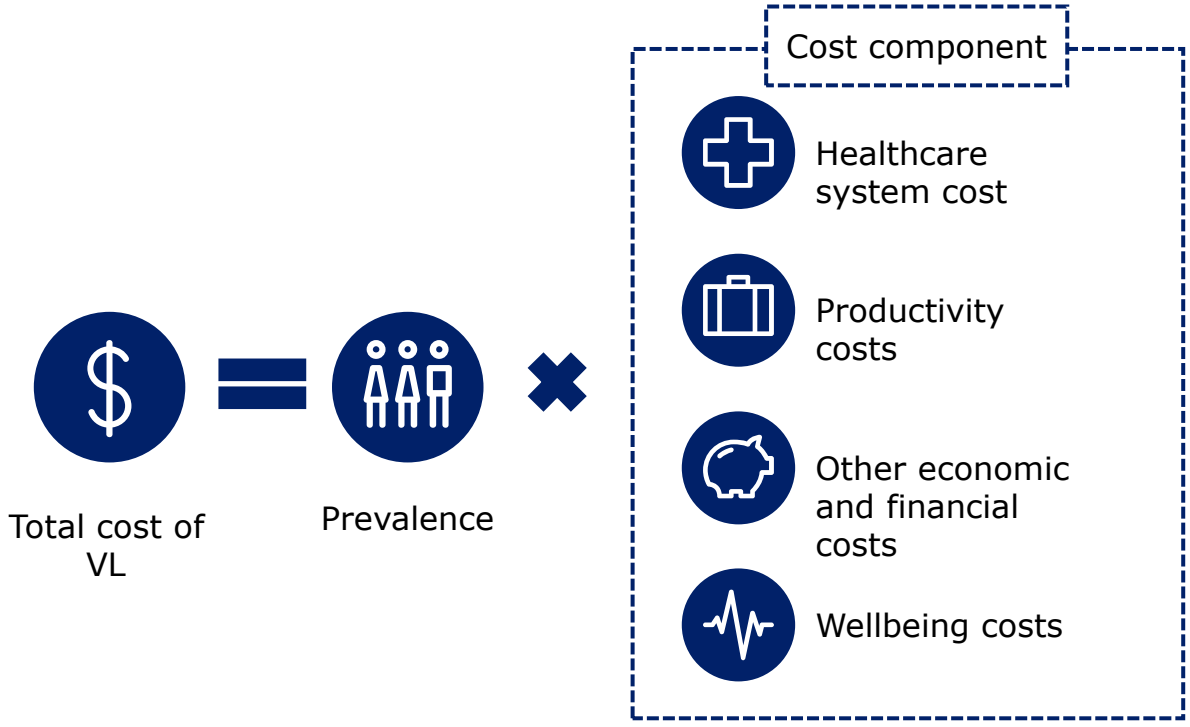
2 Methodology overview

This chapter provides an overview of the methodology adopted in this report to quantify the economic and social cost of VL.

The costs of VL in Canada were estimated for the 2019 calendar year using a prevalence approach. A prevalence approach measures the number people with VL at a point in time, and estimates costs incurred due to VL in a given year.

A conceptual framework for quantifying costs of VL is provided in Figure 2.1.

Figure 2.1: Conceptual framework for quantifying costs of VL



Source: Deloitte Access Economics.

2.1 Estimating prevalence

This report adopts BCVA as a definition for VL. A targeted review of scientific literature and publicly available databases was conducted to identify relevant data.

A variety of data sources were utilized to estimate prevalence of VL by age, sex, province/territory, severity and major cause. As there were no sources which identified prevalence for all of

the specifications of interest, the prevalence estimates in this report reflect a triangulation of multiple data sources. Studies were selected where they provided estimates of BCVA in the better seeing eye with a visual acuity of less than 20/40.

In estimating the prevalence of VL in Canada in 2019, the prevalence has been considered by the following disaggregation:

- Age: 5-year groupings from 0-5 year to 85+ years
- Sex: male and female
- Province/territory
- Severity of condition: mild, moderate and severe
- Conditions: AMD, cataract, glaucoma, DR, uncorrectable RE and other causes.

Further details regarding the sources, assumptions and methodology used to estimate the epidemiology and costs of VL in Canada are provided in Appendix A.

2.2 Estimating cost components

The cost of VL comprises 4 components:

- **Healthcare system costs** that represent the cost of providing health services, including costs of hospitalizations, visits to general practitioners, ophthalmologists, optometrists or opticians, the cost of pharmaceuticals, the cost of providing eyewear and other healthcare system expenditures such as allowances for capital and administration costs
- **Productivity costs** associated with reduced workforce participation, reduced productivity at work, loss of future earnings due to premature mortality, and the value of time that families and friends spend on caring for a person with VL
- **Other economic and financial costs** associated with other out-of-pocket expenses made by people with VL and their families and efficiency losses associated arise from government transfers
- **Loss of wellbeing** that reflect reduced quality of life for people with VL and premature death for those who die from their VL.

Costs have been estimated for the 2019 calendar year, which represents the last full year of data for many available datasets, but more importantly this allowed for an estimate of costs in a typical year in the absence of the impacts of the COVID-19 pandemic.[ii] Where costs were only available for previous years, they have been updated using appropriate inflators (e.g. a health inflation index, or wage price index) and further adjusted for demographic changes.

To the extent allowed by data availability, cost estimates are disaggregated by age, sex, province/territory, condition and severity.

Further details about these cost components are provided in Table 2.1.

[ii] While costs were estimated for 2019, an addendum will be issued that also considers the impact of the COVID-19 pandemic on the costs of VL in 2020 and subsequent years.

Table 2.2: Conceptual framework for costs associated with VL by type and bearer

Cost component and type of cost	Subgroups	Key bearers of cost	Overview of approach
Healthcare system costs Financial cost	• Hospital services (including falls) • Pharmaceuticals • Optometrists, ophthalmologists, and opticians, and other health professionals • Eyewear • Medical research • Capital and administrative costs	• Individuals • Government • Health insurance providers • Employers	• Bottom-up approach using data from Canadian Institute for Health Information (CIHI), Patented Medicine Price Review Board, Canadian Institutes of Health Research (CIHR) and other literature.
Productivity costs Economic cost	• Reduced employment participation • Temporary absenteeism • Presenteeism • Premature death	• Individuals • Government • Employers	• A human capital approach was adopted to estimate productivity losses. This involves the calculation of the difference in employment or productivity of people with VL compared to that of the general

Cost component and type of cost	Subgroups	Key bearers of cost	Overview of approach
	• Increased need for informal care		population, multiplied by average weekly earnings (AWE). • Productivity losses from premature mortality are estimated in terms of the net present value (NPV) of future income streams lost.
Other economic and financial costs Financial and economic cost	• Aids, equipment, and home modifications • Formal care and residential care • Rehabilitation services • Efficiency losses associated with government transfers	• Individuals • Government • Society	• Financial costs are measured using a bottom-up approach with data gathered from the literature • Efficiency losses are measured by the increased taxation to provide welfare support payments, health services and replace lost employment taxes
Loss of wellbeing	• Years of life lost due to disability (YLD)	• Individuals	• A burden of disease approach was adopted. This approach involves multiplying disability adjusted life

Cost component and type of cost	Subgroups	Key bearers of cost	Overview of approach
Non-financial cost	• Years of life lost due to premature death (YLL)		years (DALYs) by the value of a statistical life year (VSLY). DALYs reflect the number of years of healthy life lost due to morbidity and mortality. VSLY is the value society places on reducing the risk of dying or avoiding certain health states.

Source: Deloitte Access Economics. Note: Financial costs refer to costs that are "paid for", economic costs are the value of an alternative option

3 Epidemiology of vision loss

This chapter provides details on the prevalence of VL in Canada in 2019. Approach and key data sources used to estimate the prevalence and mortality of VL are briefly discussed in this chapter, and further information is provided in Appendix A (Section A.1 and A.2).

At the outset it is worth noting there are no comprehensive population-based health surveys on the prevalence of VL in Canada. As such, it was necessary to review and compile estimates from a range of sources. In particular, there is a gap in Canadian-specific evidence in younger adults aged 20-44. Data for these groups were informed based on data from the US National Health and Nutrition Examination Survey. VL data for older adults were based on the Canadian Longitudinal Study of Aging, although robust cause-specific information was not available and so this was also gathered from international evidence.

Key findings

- The prevalence of VL and blindness in Canada was estimated to be 1.2 million people in 2019, or 3.2% of the Canadian population.
- It was estimated that VL and blindness may have contributed to 1,290 deaths in Canada in 2019. These deaths result from factors such as increased risk of falls and greater isolation in those with VL.

3.1 Vision loss by age, sex, severity and province/territory

3.1.1 Prevalence of any vision loss by age and sex

The prevalence of VL increases with age beyond 45 years, with the prevalence rate reaching approximately 21% in people aged 85 years or older.

While prevalence generally increases with age, recent increases in the prevalence of eye conditions such as myopia may be

contributing to higher prevalence in younger age groups.[21] The Canadian Health Measures Survey (CHMS) found high rates of (best-corrected) VL in children aged 5 to 19 years, which is higher than best available rates reported for people aged 20 to 44 years. This finding is comparable with other data relying on the National Health and Nutrition Examination Survey (NHANES), which shows a more pronounced difference in the prevalence rate between children (1.5%) and younger adults (0.6%).[22]

The overall prevalence of VL used in this analysis are shown in Table 3.1.

Table 3.1: Derived prevalence rates of VL and blindness for the Canadian population by age and sex

Age (year)	Male (%)	Female (%)
0-4	0.5	0.5
5-9	2.6	2.6
10-14	2.6	2.6
15-19	2.6	2.6
20-24	1.4	1.4
25-29	1.4	1.4
30-34	1.4	1.4
35-39	1.4	1.4
40-44	1.4	1.4
45-49	1.1	1.2
50-54	1.3	1.5
55-59	2.0	2.6
60-64	3.5	3.3
65-69	5.9	5.7
70-74	8.4	8.3
75-79	9.4	9.2
80-84	13.1	12.9

Age (year)	Male (%)	Female (%)
85+	21.0	20.7

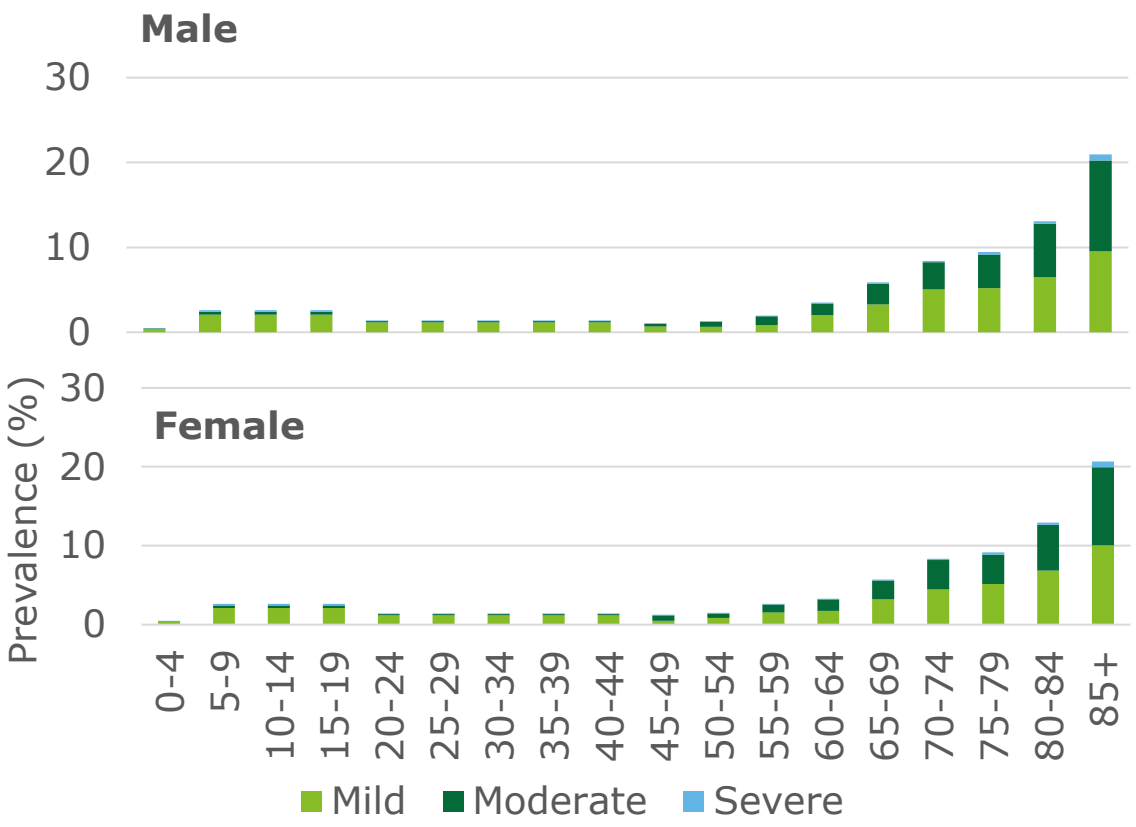
Source: Ages 0-4 were derived from Varma et al (2017)[23]; ages 5-19 from Statistics Canada (2019)[24]; ages 20-44 from Wittenborn et al (2013)[25]; ages 45-84 from Mick et al (2021)[26] and Aljied et al (2018)[1] and ages 85+ from International Agency for the Prevention of Blindness (2021).[27]

3.1.2 Prevalence of vision loss by severity

The prevalence of VL was disaggregated by severity, using the definitions outlined in Section 1.2.2. Further detail regarding the sources used is provided in Appendix A (Section A.1.2). Of the 1.2 million people with VL in Canada in 2019, 49,537 people or 4.1% were estimated to be blind.

The prevalence rate and number of cases of VL in Canada by age and severity are provided in Chart 3.1 and Table 3.2.

Chart 3.1: Prevalence (% of population) of VL and blindness in Canada by sex and severity, 2019



Source: Deloitte Access Economics analysis based on Varma et al (2016)[28] and Mick et al (2021)[26].

Table 3.2: Prevalence (number of people) of VL and blindness in Canada by age and severity

Age (years) / sex	Mild VL	Moderate VL	Severe VL	Total
Male				
0-4	3,724	621	310	4,606
5-9	21,628	3,605	1,802	27,112
10-14	21,516	3,586	1,793	26,916
15-19	22,454	3,742	1,871	28,164
20-24	14,918	1,785	1,275	18,228
25-29	15,621	1,869	1,335	19,090

Age (years) / sex	Mild VL	Moderate VL	Severe VL	Total
30-34	15,264	1,826	1,305	18,600
35-39	14,958	1,790	1,279	18,172
40-44	13,969	1,671	1,194	16,903
45-49	8,215	3,728	695	12,668
50-54	7,947	7,616	993	16,576
55-59	11,346	14,182	1,216	26,765
60-64	24,917	17,149	1,173	43,255
65-69	33,291	25,096	1,366	59,797
70-74	41,171	26,281	1,167	68,649
75-79	28,124	21,459	1,657	51,326
80-84	22,448	21,881	1,061	45,487
85+	29,023	32,634	2,260	63,900
Male total	*350,532*	*190,522*	*23,750*	*566,211*
Female				
0-4	3,544	591	295	4,380
5-9	20,711	3,452	1,726	25,955
10-14	20,733	3,456	1,728	25,942
15-19	21,372	3,562	1,781	26,814
20-24	13,712	1,641	1,172	16,678
25-29	14,689	1,758	1,256	17,938
30-34	14,892	1,782	1,273	18,132
35-39	15,035	1,799	1,285	18,223
40-44	14,279	1,709	1,220	17,248
45-49	5,770	8,271	705	14,764
50-54	10,696	7,019	1,003	18,731
55-59	21,299	13,516	1,229	36,077
60-64	21,932	18,453	1,210	41,633

Age (years) / sex	Mild VL	Moderate VL	Severe VL	Total
65-69	34,441	25,740	1,450	61,691
70-74	39,576	33,080	1,269	73,985
75-79	31,768	23,253	1,897	56,944
80-84	29,975	25,510	1,343	56,931
85+	53,448	52,472	3,945	109,854
Female total	*387,873*	*227,063*	*25,787*	*641,920*
Total	**738,406**	**417,584**	**49,537**	**1,208,131**

Source: Deloitte Access Economics analysis based on Varma et al (2017)[23], Statistics Canada (2019)[24], Wittenborn et al (2013)[25], Mick et al (2021)[26], Aljied et al (2018)[1] and International Agency for the Prevention of Blindness Vision Atlas (2021).[27]

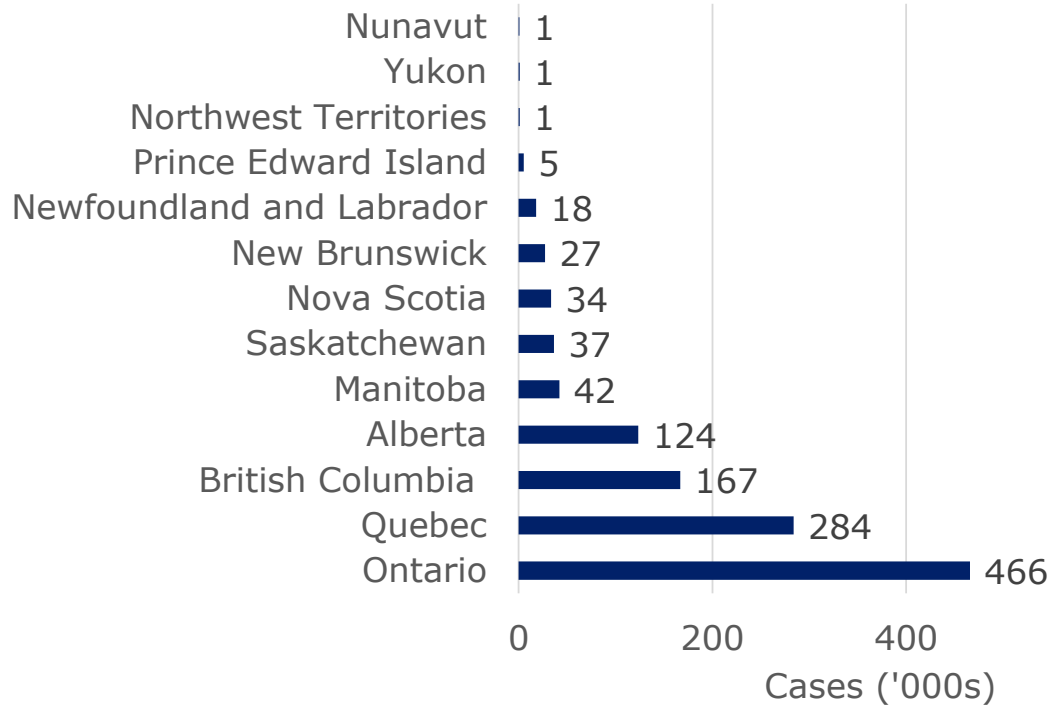
3.1.3 Prevalence of vision loss by province/territory

The prevalence of VL by province/territory was estimated by multiplying the age/sex specific prevalence rates as shown in Table 3.1 by the population data sourced from Statistics Canada (2019).[24]

The province/territory with the highest prevalence of VL was Ontario (465,826 cases), followed by Quebec (283,935 cases) and British Columbia (166,754 cases) (Chart 3.2; Table 3.3). These results are in part driven by the number of people living within each province/territory.

Further estimates of the prevalence of VL by severity, age and sex for each province/territory are shown in Appendix B.

Chart 3.2: Number of people with VL by province/territory, thousands of people, 2019



Source: Deloitte Access Economics analysis based on Varma et al (2017)[23], Statistics Canada (2019)[24], Wittenborn et al (2013)[25], Mick et al (2021)[26], Aljied et al (2018)[1] and International Agency for the Prevention of Blindness Vision Atlas (2021)[27].

Table 3.3: Prevalence (number of people) and crude prevalence rate (%) of VL in Canada by province/territory, 2019

Province / measure	Mild VL	Moderate VL	Severe VL	Total
Alberta				
Cases	78,455	39,644	5,488	123,587
Crude rate (%)	1.79	0.90	0.13	2.82
British Columbia				
Cases	101,306	58,732	6,716	166,754
Crude rate (%)	2.01	1.16	0.13	3.30
Manitoba				

Province / measure	Mild VL	Moderate VL	Severe VL	Total
Cases	26,168	14,033	1,795	41,996
Crude rate (%)	1.91	1.03	0.13	3.07
New Brunswick				
Cases	16,290	9,876	1,051	27,216
Crude rate (%)	2.11	1.28	0.14	3.52
Newfoundland and Labrador				
Cases	10,812	6,493	692	17,997
Crude rate (%)	2.06	1.24	0.13	3.43
Northwest territories				
Cases	699	301	51	1,051
Crude rate (%)	1.55	0.67	0.11	2.34
Nova Scotia				
Cases	20,130	12,098	1,303	33,531
Crude rate (%)	2.09	1.26	0.14	3.48
Nunavut				
Cases	554	169	44	766
Crude rate (%)	1.43	0.44	0.11	1.98
Ontario				
Cases	285,361	161,232	19,233	465,826
Crude rate (%)	1.97	1.11	0.13	3.21
Prince Edward Island				
Cases	3,197	1,869	209	5,274
Crude rate (%)	2.06	1.20	0.13	3.39
Quebec				
Cases	172,052	100,534	11,349	283,935

Province / measure	Mild VL	Moderate VL	Severe VL	Total
Crude rate (%)	2.04	1.19	0.13	3.36
Saskatchewan				
Cases	22,706	12,278	1,560	36,544
Crude rate (%)	1.93	1.04	0.13	3.10
Yukon				
Cases	676	326	47	1,049
Crude rate (%)	1.66	0.80	0.12	2.58

Source: Deloitte Access Economics analysis based on Varma et al (2017)[23], Statistics Canada (2019)[24], Wittenborn et al (2013)[25], Mick et al (2021)[26], Aljied et al (2018)[1] and International Agency for the Prevention of Blindness Vision Atlas (2021)[27].

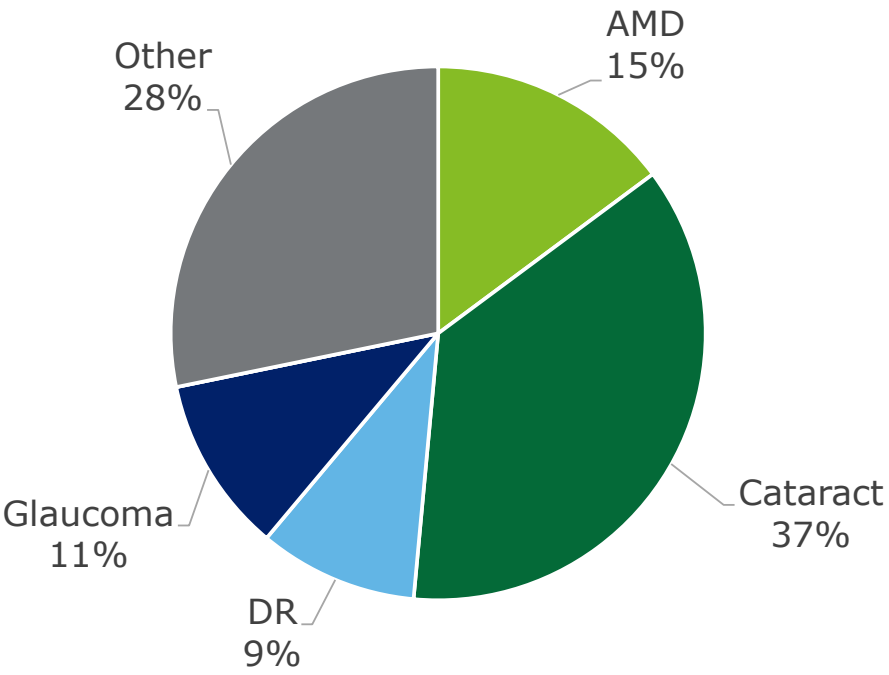
3.1.4 Prevalence of vision loss by condition

The scope of this report includes major causes of VL, which were categorized into the five groups, including AMD, cataract, DR, glaucoma and other causes.

Total condition estimates were disaggregated by five-year age groups. Within age groups, the relativities between the visual acuity groupings were used to separate total prevalence.

Cataract was estimated to be the major cause of VL in Canada, accounting for 36.7% of total prevalence. Other causes and AMD were also common, accounting for 28.2% and 14.8% of VL cases respectively (Chart 3.3). Further detail of conditions under 'other' from IAPB was not available, however, studies indicate these may include disorders of the visual pathway, cornea/conjunctiva, dry eye leading to VL due to corneal disease and trauma to the eye.[20,29]

Chart 3.3: Share of VL in Canada by condition, 2019



Source: Deloitte Access Economics analysis based on International Agency for the Prevention of Blindness (2021)[27] and Pezzullo et al (2018).[30]

The total number of prevalence cases of VL in Canada in 2019 by age, sex and condition is shown in Table 3.4.

Table 3.4: Prevalence (number of people) of VL in Canada by age, sex and condition, 2019

Age (years) / sex	AMD	Cataract	DR	Glaucoma	Other	Total
Male						
0-49	5,818	36,482	30,080	36,491	81,586	190,458
50-59	4,664	16,399	4,847	1,869	15,561	43,340
60-69	14,484	40,715	12,240	6,310	29,303	103,052
70-79	27,735	54,258	6,328	8,587	23,067	119,974
80+	26,582	54,628	2,595	10,194	15,388	109,387
Male total	*79,282*	*202,482*	*56,089*	*63,452*	*164,905*	*566,211*
Female						
0-49	6,490	34,663	28,566	34,821	81,533	186,072
50-59	7,384	20,333	7,298	2,545	17,249	54,809
60-69	14,173	41,103	12,770	5,727	29,552	103,324
70-79	28,939	60,729	7,346	8,357	25,558	130,929
80+	42,855	83,395	4,129	14,199	22,207	166,785
Female total	*99,841*	*240,223*	*60,108*	*65,649*	*176,098*	*641,920*
Total	**179,123**	**442,705**	**116,198**	**129,101**	**341,003**	**1,208,131**

Source: Deloitte Access Economics analysis based on International Agency for the Prevention of Blindness (2021)[27] and Pezzullo et al (2018).[30]

A substantial number of Canadians live with eye disease, placing them at risk of losing their vision. Data were compiled from several sources to estimate the prevalence of AMD, cataract, DR and glaucoma, as detailed in section A.1.4. Combined, more than 8 million Canadians are living with eye disease from one of these four conditions. Of Canadians living eye disease, 1.2 million have VL from their disease (i.e. 1.2 million is a subset of the 'more than 8 million').

Table 3.5 : Prevalence of eye disease in Canada by condition, 2019 and 2050

Condition	2019	2050
Number of cases (thousands of people)		
AMD	2,550.2	4,241.5
Cataract	3,733.8	6,765.0
DR	1,036.8	1,544.7
Glaucoma	728.0	1,321.1
Total	**8,048.9**	**13,872.2**
Crude rate		
AMD	8.7%	10.9%
Cataract	12.7%	17.4%
DR	3.5%	3.9%
Glaucoma	2.5%	3.3%
Total	**27.3%**	**34.9%**

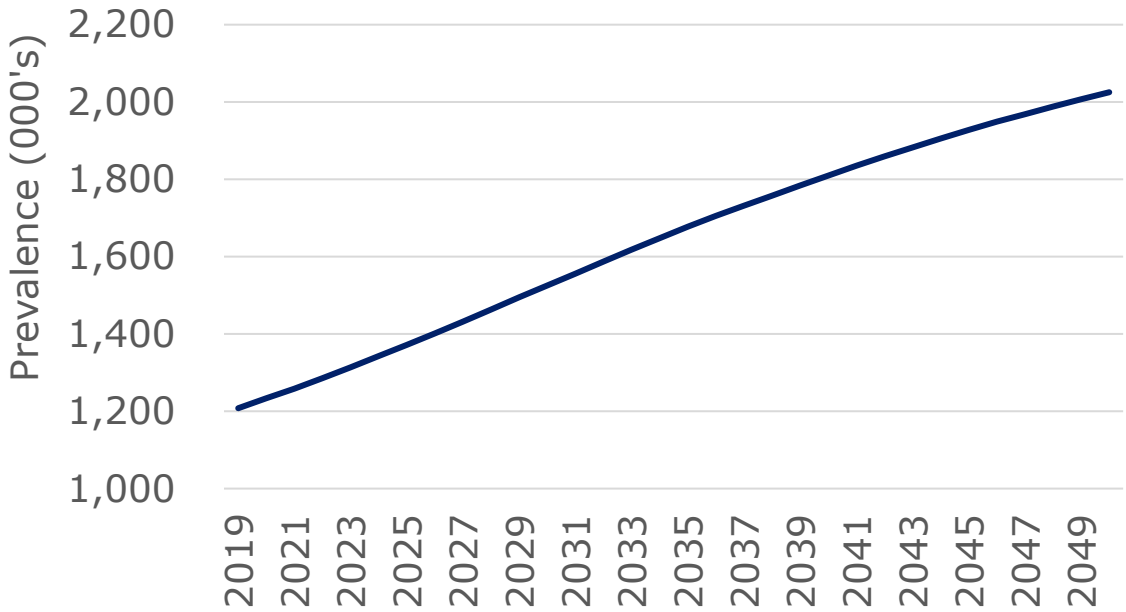
Source: Deloitte Access Economics analysis based on data supplied in section A.1.4.

Importantly, these data do not consider a number of other conditions that cause VL such as corneal diseases and uncorrectable refractive error. Consequently, the total estimate for people living with an eye condition that could cause VL is likely to be even greater.

3.1.5 Projected prevalence of vision loss

The prevalence of VL in Canada was estimated until 2050 by applying the prevalence rate to the projected population by age and sex sourced from Statistics Canada (2019).[24] Chart 3.4 shows the total projected prevalence of VL in Canada, from 2019 to 2050. Increases in prevalence are expected to be driven by population growth and changes to the age structure of the Canadian population. By 2050 there will be an estimated 2.0 million people with VL in Canada.[iii]

Chart 3.4: Projected prevalence (number of people) of VL in Canada, thousands of people, 2019-50



Source: Deloitte Access Economics analysis based on Statistics Canada (2019)[24] and Deloitte Access Economics estimated prevalence rates.

3.2 Mortality from vision loss

There is a growing evidence-base demonstrating an association between VL and increased risk of mortality. The adjusted hazard ratio for mortality among participants with mild VL or worse compared to those with unimpaired vision has been

[iii] The projected prevalence does not assume any change to prevalence rates over time, nor does it take into account the possible impacts of the COVID-19 pandemic on VL outcomes nor possible changes in Canada's demographics.

estimated to be 1.29, **meaning there is a 29% higher risk of mortality for those with VL compared to those with unimpaired vision**.[31] Similar findings are found in other literature, including a meta analysis conducted by Zhang et al (2016), which found that compared to no VL, patients with more severe VL had a 36% greater risk of mortality.[32]

Mortality attributable to VL was estimated using a population attributable fraction approach. The population attributable fraction (PAF) measures the contribution of a risk factor to a death. This is the proportional reduction in population mortality that would occur if VL did not occur.

The mortality rates due to VL by age and sex are shown in Table 3.6.

Table 3.6: Mortality rates (%) due to VL by age and sex

Age group	Male (%)	Female (%)
65-69	0.01	<0.01
70-74	0.01	0.01
75-79	0.02	0.01
80-84	0.03	0.02
85-89	0.06	0.04
90+	0.12	0.10

Source: Ehrlich et al (2021)[31] and Zhang et al (2016).[32]
Note: Given the underlying samples were primarily drawn from older cohorts, with a mean age generally older than 65 years, it was assumed there is no additional mortality risk in people with VL below this age.

It was estimated that there were 1,290 deaths in 2019 due to VL. The number of deaths was estimated to be similar between men and women, with 629 and 661 deaths respectively. Table 3.7 provides the breakdown of mortality by sex and age group in 2019.

Table 3.7: Number of deaths due to VL in Canada, 2019

Age group	Male	Female	Total
65-69	76	51	127
70-74	96	68	164
75-79	102	80	183
80-84	115	103	218
85-89	123	133	255
90+	117	226	344
Total	**629**	**661**	**1,290**

Source: Deloitte Access Economics estimates based on Ehrlich et al (2021)[31], Zhang et al (2016)[32] and Statistics Canada (2019).[24]

Part B

Costs of vision loss in Canada

4 Costs of vision loss

This chapter details the financial and economic costs incurred due to VL in Canada in 2019, detailing results across the healthcare system, individual productivity losses, caregiving productivity losses and other costs such as expenditure on aids and modifications, formal and aged care services, rehabilitation services and economic efficiency losses.

4.1 Healthcare system costs

VL increases the health care costs not only for the affected individual but also for the public and private healthcare system.

This section describes the approach used to estimate the healthcare system costs – including inpatient and outpatient costs, pharmaceuticals, vision care (including costs to optometrists and opticians and expenditure on eyeglasses and contact lenses), visits to other health professionals, medical research and other costs (including capital and administration) – attributed to VL in Canada in 2019. These costs items were estimated using a combination of national datasets and literature.

In 2019, the total healthcare system costs attributed to VL in Canada in 2019 was estimated to be $9.5 billion.

Table 4.1: Healthcare system costs due to VL in Canada, $ million, 2019

Cost component	Value ($ million)
Inpatient hospitalization & emergency department (ED) visits	47.1
Inpatient hospitalizations	22.4
ED visits	24.7
Additional cost of falls (inpatient and ED visits)	105.3
Inpatient hospitalization due to falls	10.3

Cost component	Value ($ million)
ED visits due to falls	95.0
Outpatient services	1,918.5
Cataract day surgeries	613.9
Other surgeries	231.2
Ophthalmologist attendances	1,073.4
Pharmaceuticals	1,361.0
Anti-VEGFs	810.0
Other ophthalmic drugs	551.0
Vision care (e.g. optometrists, opticians, lenses)	5,492.6
Medical research	20.9
Other (capital and administration)	549.7
Total	**9,495.0**

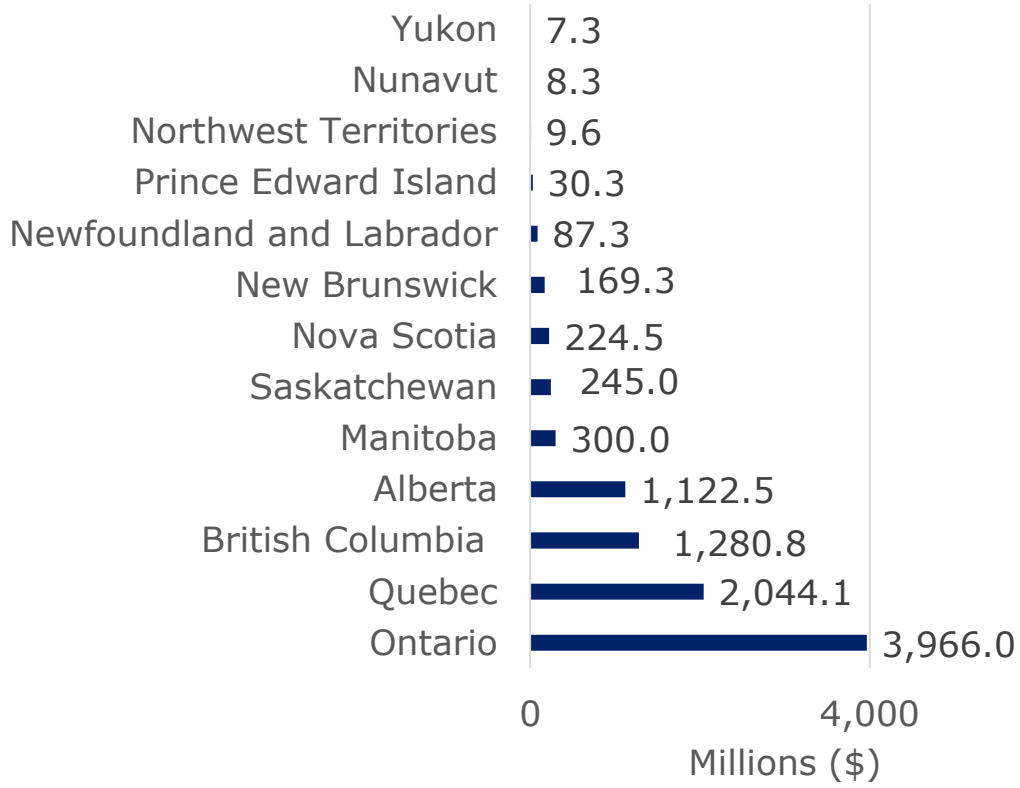
Source: Deloitte Access Economics analysis based on CIHI (2019a)[33], Public Health Agency of Canada (2018)[34], CIHI (2019b)[35], Scuffham et al (2003)[36], Woolcott et al (2011)[37], Parachute (2015)[38], Government of Canada (2021)[39], Fighting Blindness Canada (2019)[iv], Glaucoma Research Society of Canada (2019)[iv], Research Society of Canada (2019)[iv] and Vision Health Research Network (2019)[iv], IQVIA (2019a)[40], IQVIA (2019b)[41] and PMPRB (2019)[42], CIHI (2019c)[43], CIHI (2020)[44], CIHI (2019d)[45]. Note: Components may not sum to totals due to rounding.

As shown in Table 4.1, the largest component of healthcare system costs was vision care ($5.5 billion), followed b y outpatient care ($1.9 billion) and pharmaceuticals ($1.4 billion). The least proportion of costs was accounted for by medical research ($20.9 million).

[iv] Data provided by the Canadian Council of the Blind.

Chart 4.1 and Table 4.2 provide the healthcare system cost breakdown by province/territory. Across province/territory, Ontario incurred the greater proportion of total healthcare system costs ($4.0 billion; 41.8%), followed by Quebec ($2.0 billion; 21.5%) and British Columbia ($1.3 billion; 13.5%). Healthcare system costs were the lowest in Yukon ($7.3 million; 0.1%).

Chart 4.1: Breakdown of healthcare system costs by province/territory, $ million, 2019



Source: Deloitte Access Economics analysis.

Table 4.2: Healthcare system costs by component and province/territory, $ million, 2019

Province / territory	Hospital care	Outpatient care	Pharma-ceuticals	Vision care	Other costs*	Total
Alberta	25.7	257.8	21.9	749.6	67.4	1,122.5
British Columbia	18.8	324.6	19.3	841.1	77.0	1,280.8
Manitoba	6.0	54.8	51.9	169.2	18.1	300.0
New Brunswick	2.7	43.3	17.5	95.6	10.2	169.3
Newfoundland and Labrador	1.7	25.0	4.3	50.9	5.3	87.3
Northwest Territories	0.2	3.0	2.0	3.9	0.6	9.6
Nova Scotia	4.3	47.9	34.6	124.2	13.5	224.5
Nunavut	0.1	3.2	1.7	2.8	0.5	8.3
Ontario	51.8	634.6	813.7	2,228.2	237.7	3,966.0
Prince Edward Island	0.5	7.0	1.8	19.1	1.8	30.3
Quebec	34.2	447.4	380.8	1,058.6	123.0	2,044.1
Saskatchewan	6.1	67.7	11.1	145.3	14.8	245.0
Yukon	0.2	2.3	0.3	4.1	0.4	7.3
Total	**152.2**	**1,918.5**	**1,361.0**	**5,492.6**	**570.6**	**9,495.0**

Source: Deloitte Access Economics analysis. * other costs include medical research expenditure and capital and administration costs.

A summary of the key findings which were used to inform the expenditure to the healthcare system due to VL include:

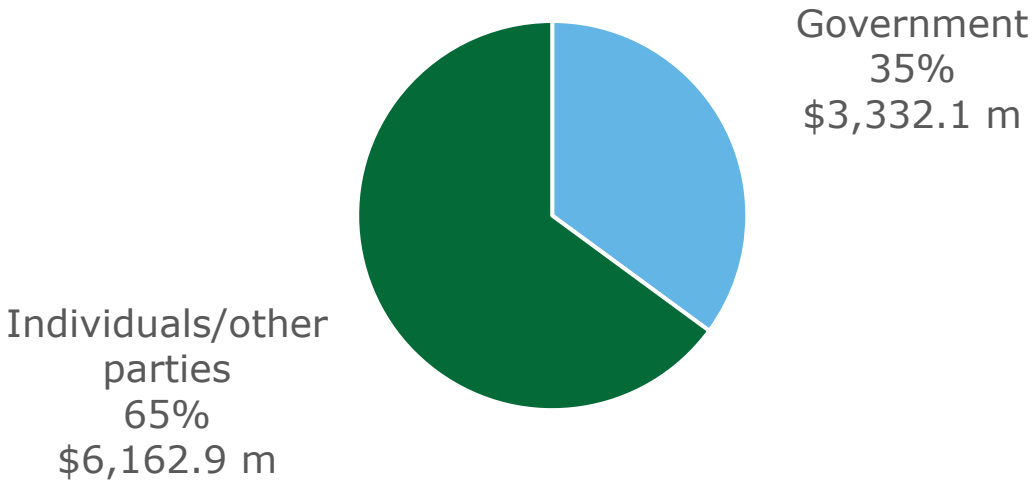
- There were an estimated 5,975 inpatient admissions due to VL in Canada in 2019
- There were an estimated 1,669 hospitalizations for falls due to VL and a further 15,403 visits to an ED for falls due to VL. The average unit cost of a fall by presentation type for inpatient hospitalization and ED visit was $6,168.6 and $1,102.2, respectively
- There were 412,583 cataract day surgeries in Canada in 2019, which totalled $613.9 million. Expenditure on other ophthalmic day surgeries was estimated to be $231.2 million (approximately 40% of the value of cataract day surgeries).
- There were an estimated 16.7 million ophthalmic services delivered in 2019, of which 7.1 million (42.5%) were for consultation and visits and 9.6 million (57.3%) were for procedures including surgeries
- The total cost of ophthalmic services provided was $1.1 billion in 2019, of which $388.6 million (36.2%) were for consultations and visits and $684.8 million (63.8%) were for procedures including surgeries
- In 2019, there were 6,609 optometrists, 3,609 opticians and 1,246 ophthalmologists providing vision care in Canada.

Full detail on the methodology and literature used to inform each component of the healthcare system cost are provided in Appendix A (Section A.3.1).

The breakdown of total healthcare system costs estimated by bearer was based on the CIHI which publishes an estimated share of healthcare system costs borne by government, patients (i.e. out-of-pocket costs) and other parties (including private health insurers and employers).[45]

Chart 4.2 provides a summary on the breakdown of expenditure by bearer. Healthcare system costs in 2019 were primarily borne by individuals and other parties (e.g. private insurers and employers; $6.2 billion; 65%), with government accounting for $3.3 billion, or 35% of total healthcare system costs due to VL.

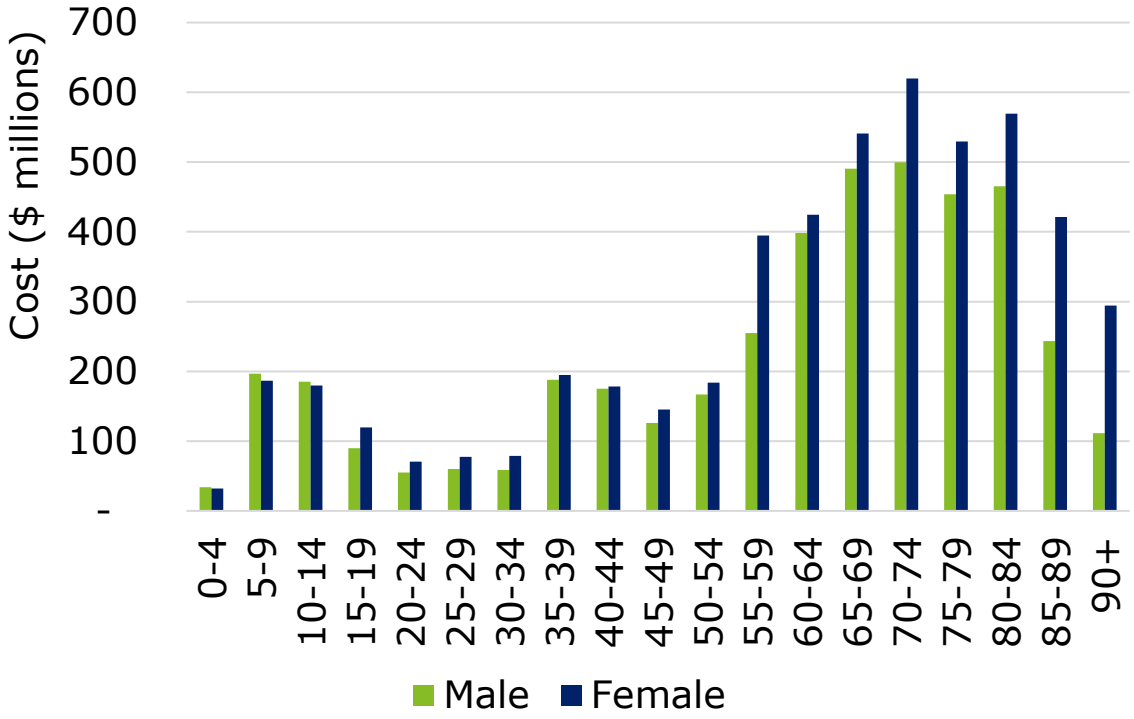
Chart 4.2: Healthcare system costs by payer, $ million, 2019



Source: Deloitte Access Economics estimates based on Canadian Institute for Health Information's National Health Expenditure Trends.[46]

Chart 4.3 shows the total healthcare system costs of VL by age group. Healthcare system costs were highest for people aged 65-84. Healthcare system costs were marginally higher in women compared to men, with this difference becoming more pronounced over the age of 55. This cost profile largely reflects the higher prevalence of VL in females than males above the age of 55. In Canada, public health coverage is available for children up to the age of 18 and after 65, with some working age adults receiving coverage through their workplace benefit program. However, most working adults do not have vision coverage.

Chart 4.3: Healthcare system costs of VL by age, $ million, 2019



Source: Deloitte Access Economics estimates.

The findings from this report indicate that the healthcare system expenditure due to VL is substantial, totalling $9.5 billion in 2019. Undergoing routine comprehensive eye examination and testing for high-risk patients with predisposed factors may alleviate some of these costs by preserving eye health, slowing the progression of disease and reducing the healthcare system cost of treating VL.[47] Yet, despite the importance of regular examination, accessibility of eye examinations varies considerably across provinces/territories, largely, which is influenced by coverage under each provincial Medical Services Plan. Lack of coverage can also impact on examination rates in particular patient groups, which is known to be suboptimal in high-risk cohorts.[48,49,50]

A lack of comprehensive eye examinations across all provinces/territories is a concern given the prevalence of eye diseases continues to increase. Access to comprehensive eye examinations is also medically necessary for blinding eye diseases like glaucoma, which can be asymptomatic. However, there exists a lack of government-insured optometric services

for patients with health conditions such as diabetes, which has been found to negatively impact patients' access to health care services and vision health outcomes.[51] Extending publicly insured eye examination for patients with diabetes may increase the screening rate by an additional 35%, resulting in a screening rate of approximately 88% over 2 years.[52] However, in another study with Ontario residents aged 40 to 65 years, eye examinations rates fell by approximately 8% after the implementation of policy changes, despite these changes having no impact on adults with diabetes.[53] In some settings with high risk cohorts, the inclusion of government-insured eye examinations may delay the progression of eye diseases and help reduce the inequity and disparities in eye care utilization in Canada. However, as past experience highlights, policy changes need to be accompanied by effective and clear messaging to reduce miscommunication amongst patients and health providers.

Furthermore, in undertaking research for this report, it was observed that the number of cataract surgeries being undertaken has not kept pace with increases in demand from population growth and aging.[54] Recent data suggests the wait time for cataract surgery in Ontario was 93 days in 2019,[55] which is a substantial increase from 2014 when it was 69 days.[54] The increase in wait times may lead to more complicated and more costly cataract surgeries as a patient's condition progresses, which is further complicated by a greater risk of falls while patients wait for their surgery. As evidenced in this report, the direct cost of falls due to VL is substantial at more than $105 million each year.

4.2 Productivity losses

VL can have a substantial impact on an individual's ability to participate in the workforce. Most of this impact is quantified through a reduced rate of employment, increased absences from work and reduced productivity while at work.

The five potential productivity losses are:

- Reduced employment – classified as early retirement or workforce withdrawal

- Absenteeism – where a worker may be unwell more often than average and take time off work, while remaining in the workforce
- Presenteeism – where a worker produces less output while at work
- Premature mortality – where a person who dies early due to VL no longer receives future income streams (the loss of future income streams is estimated in discounted net present value terms)
- Informal care – where support is typically provided by a spouse or partner, friend or another member of the family.

Overall, the total cost of productivity losses for VL were estimated to be $4.3 billion in 2019, or $3,535 per person with VL. The largest component of productivity losses was reduced employment ($3.2 billion) followed by presenteeism ($380.6 million) and absenteeism ($318.9 million). Table 4.3 summarizes the total costs of productivity losses attributed to VL in 2019.

Table 4.3: Productivity costs due to VL, 2019

Age group	Male ($ million)	Female ($ million)	Total ($ million)	Cost per person with VL ($)
Reduced employment	1,941.9	1,228.9	3,170.8	2,625
Absenteeism	181.9	137.1	318.9	264
Presenteeism	233.3	147.2	380.6	315
Premature mortality	79.0	31.0	110.0	91
Informal care	136.1	154.3	290.5	240
Total	**2,572.2**	**1698.5**	**4,270.8**	**3,535**

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Table 4.4 outlines the share of the productivity costs of VL by province/territory in Canada. Ontario accounted for the largest

share of productivity costs (38.5%), followed by British Columbia (22.9%) and British Columbia (13.8%). A detailed summary of province/territory specific productivity costs is provided in Appendix B.

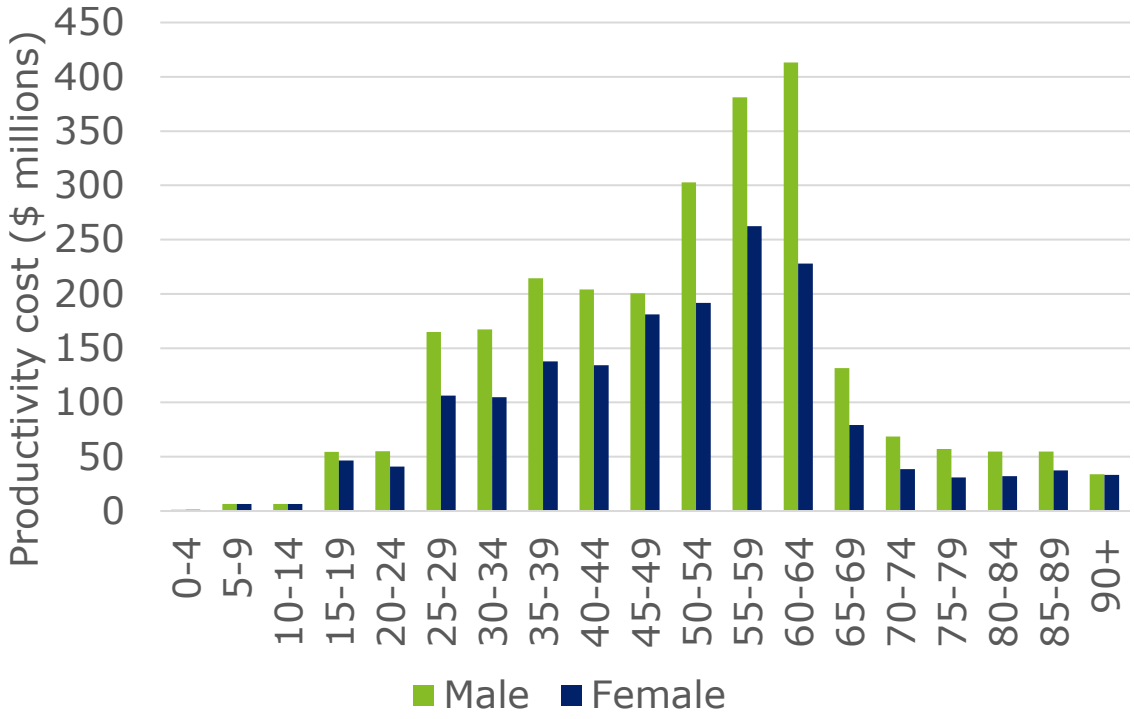
Table 4.4: Total productivity costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Cost per capita ($)	Proportion of costs (%)
Ontario	1,533.8	3,293	106	38.5
Quebec	911.7	3,211	108	22.9
British Columbia	548.3	3,288	109	13.8
Alberta	451.6	3,654	103	11.3
Manitoba	137.2	3,267	100	3.4
Other	397.7	3,222	107	10.0

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Chart 4.4 outlines the productivity costs of VL by age and gender. Productivity costs were highest for people aged 50-65. A larger share of costs were borne by males. This was driven by the relatively higher average earnings, and higher overall rates of employment for males.

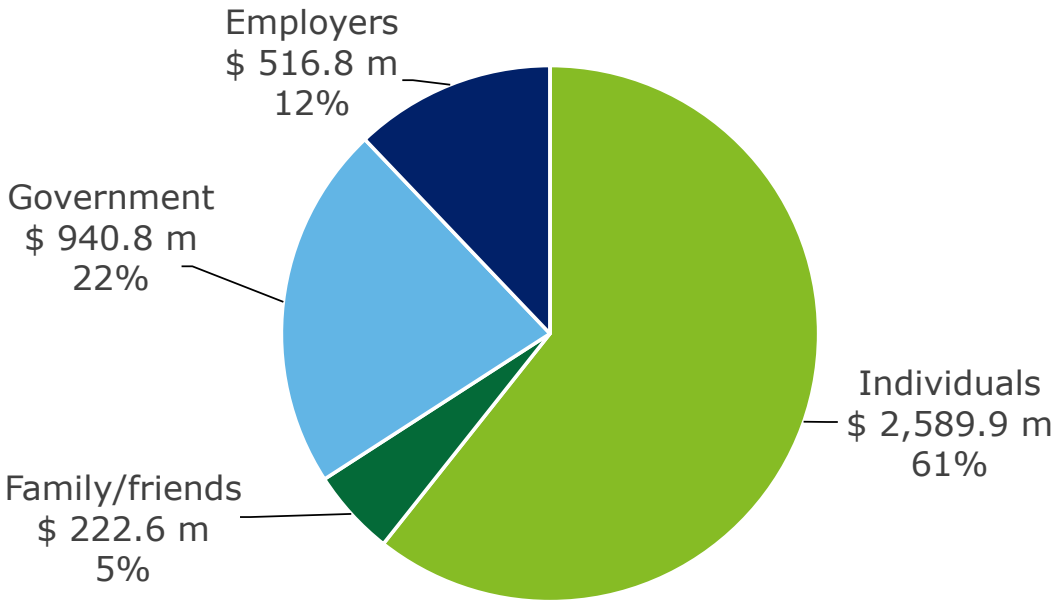
Chart 4.4: Productivity costs of VL by age and gender, $ million, 2019



Source: Deloitte Access Economics estimates.

Chart 4.5 summarizes the productivity costs due to VL by bearer in 2019. The greatest productivity costs were borne by individuals ($2.6 billion; 61%), followed by government ($940.8 million; 22%), employers ($516.8 million; 12%) and family/friends ($222.6 million; 5%).

Chart 4.5: Summary of productivity costs due to VL by bearer, 2019



Source: Deloitte Access Economics estimates.

VL can have a significant impact on an individual's ability to engage in the workforce.

There are significant productivity costs associated with VL, particularly for people with moderate or severe VL. Per person productivity costs were $2,313 for mild VL, $4,867 for moderate VL, and $10,698 for severe VL.

Importantly, these findings suggest that people with moderate to severe VL need greater support when engaging in the workforce. This support may include assistive devices and technology, habilitation or rehabilitation services. Costs of these aids and services are discussed further in Section 4.3.

Data from the Canadian Survey of Disability suggests that the employment experience of people with VL varies by province.[56] Employment rates appear to be lowest for people with VL in Newfoundland and Labrador as well as in Nunavut. People with VL in Alberta, Manitoba, Northwest Territories, Saskatchewan and Yukon were 1.25-1.3 times more likely to be employed than people with VL in Newfoundland and Labrador. Further research is required to understand what factors influence

employment differences across provinces and territories for people with VL.

4.3 Other costs

There are other costs associated with VL in addition to healthcare system and productivity costs. In this chapter an estimate on the impact of VL in relation to other costs has been included. These other costs are:

- Private expenditure on aids, equipment and home modifications
- Low vision rehabilitation services
- Formal care
- Aged and home care
- Economic efficiency losses - many of the costs associated with VL are publicly funded and government also forgoes taxation revenue because of VL. To achieve a budget neutral position (which is the counterfactual in a cost-of-illness analysis) the government must levy taxes on society. Levying taxes leads to economic costs referred to as efficiency losses within this study.[v]

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[v] Government payments to people with VL represent a transfer of resources within society. Though transfers within society are not an economic cost, there is an associated loss of efficiency. For the Canadian government to provide payments to people with VL, they need to levy taxes on other people in society to achieve a budget neutral position. In other words, if VL could be avoided, the government could reduce their overall taxation revenue.

Estimates of the efficiency losses associated with VL rely on knowledge of:

- The welfare payments to people living with VL and their carers (noting the cost of welfare payments themselves are not included in the cost of VL in Canada)
- Reduced taxation revenue from lower employment participation or greater absences and presenteeism
- Expenditure by government on other programs to support people with VL (e.g. healthcare system costs)
- The marginal excess burden of taxation.

The potential for costs arising due to depression and motor vehicle accidents have also been discussed in this section, though ultimately no costs were quantified.

Total other costs associated with VL are summarized in Table 4.5. **Other costs were estimated to have been $1.8 billion in 2019.** Most of this cost was due to efficiency losses ($769.1 million). The remaining costs were due to aged and home care ($446.8 million), formal care ($336.6 million), aids and modifications ($166.4 million) and low vision rehabilitation services ($84.9 million).

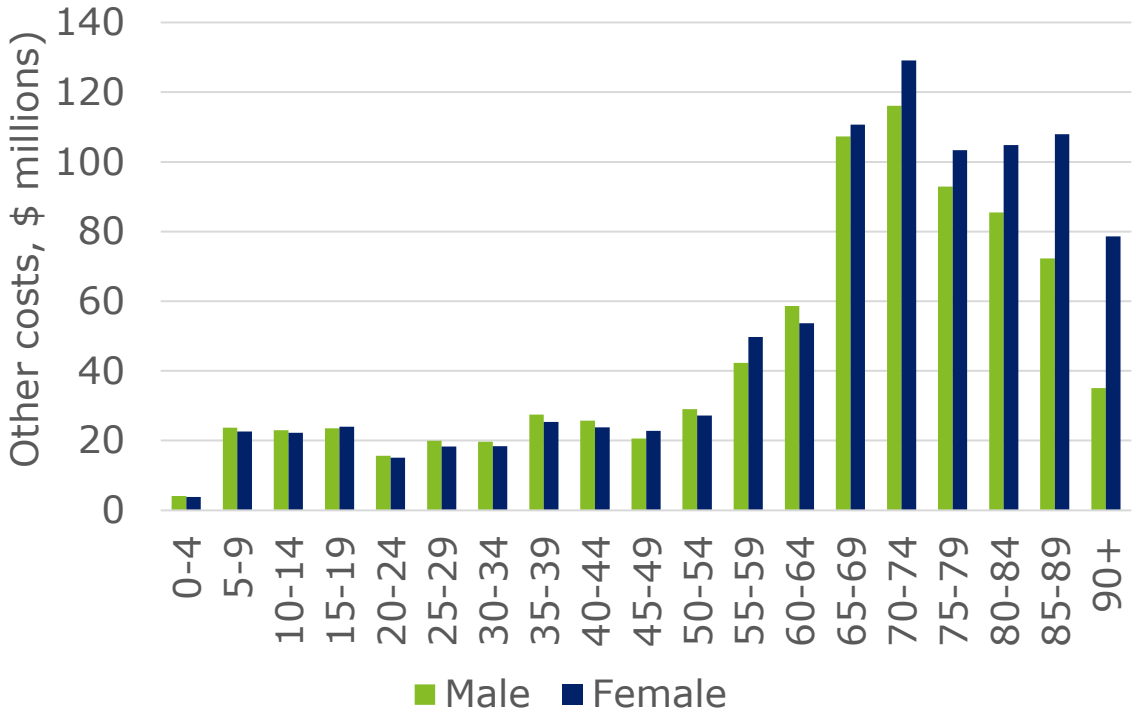
Table 4.5: Summary of other financial and economic costs, $ million, 2019

Age group	Male ($ million)	Female ($ million)	Total ($ million)	Cost per person with VL ($)
Aids and modifications	78.0	88.4	166.4	138
Low vision rehabilitation services	39.0	46.0	84.9	70
Formal care	157.7	178.8	336.6	279
Aged and home care	199.2	247.6	446.8	370
Efficiency losses	368.4	400.7	769.1	637
Total	**842.3**	**961.5**	**1,803.9**	**1,493**

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Chart 4.6 outlines the other costs of VL by age and gender. Costs were highest for people aged 65 and over. The significant increase from 60-64 to 65+ is explained by increasing aged and home care costs beyond age 65.

Chart 4.6: Other costs of VL by age and gender, $ million, 2019



Source: Deloitte Access Economics estimates.

The most significant costs due to aids and modifications were tactile or large print labels ($36.5 million), magnifiers ($21.7 million), book alternatives ($15.7 million) and electronic mobility devices ($14.7 million). Data from the Canadian Survey of Disability suggests that people with mild VL predominantly relied on magnifiers and large print reading materials.[56] People with severe VL were more reliant on other aids including white canes, note-taking equipment, devices with oversized buttons and audio or described video for television programs.

Aids and modifications are significant to people with VL. New technology is transforming the way people with VL can lives their lives. There are now applications available on smartphones which allow the user to recognize the denomination of currency, others that announce the current stop on public transportation and even apps allowing the person to ask questions about their surroundings based on a photo of their location. The costs of these accessibility

innovations have not been included in the analysis. As such the estimate of aids and modifications is likely conservative.

Persons living with VL may be eligible for several forms of government support including Disability Benefits and Disability Tax Credits, while informal caregivers may be eligible to receive Caregiver Credit. Welfare payments for Canadians living with VL or their caregivers were estimated to be $529.8 million in 2019, which led to an efficiency loss of $75.8 million in 2019.[vi] **The efficiency losses associated with these welfare payments amounted to $75.8 million.**

The degree of income support may vary by province. Data from the Canadian Survey of Disability found that 7% of people with VL in Yukon accessed disability benefits compared to 22% of people with VL in Nova Scotia.[56] Similarly rates of welfare recipients ranged from 6% in Alberta and British Columbia to 15% in Newfoundland and Labrador. Further research is needed to understand what factors might be influencing access to government support for people with VL.

Table 4.6 outlines the share of other costs of VL by province/territory in Canada. Ontario accounted for the largest share of other costs (39.4%), followed by Quebec (23.3%) and British Columbia (13.9%). A detailed summary of province/territory specific productivity costs is provided in Appendix B.

[vi] Welfare payments are a transfer of resources within the economy from one group of individuals to another group – in this case from taxpayers to people with VL. Given these payments are just a transfer from one group to another, there is no economic cost associated with the transfer. However, the act of redistributing resources (levying taxes to redistribute wealth) causes distortions in the economy, and the amount of goods and services purchased in the economy will be below the socially optimal level. For example, a higher effective taxation rate may mean that some people choose to prioritize more leisure time rather than working as much as they otherwise would have, which may result in a marginally less productive society. These distortions do impose costs on society and they are referred to in this report as efficiency losses.

Table 4.6: Total other costs of VL by province/territory, 2019

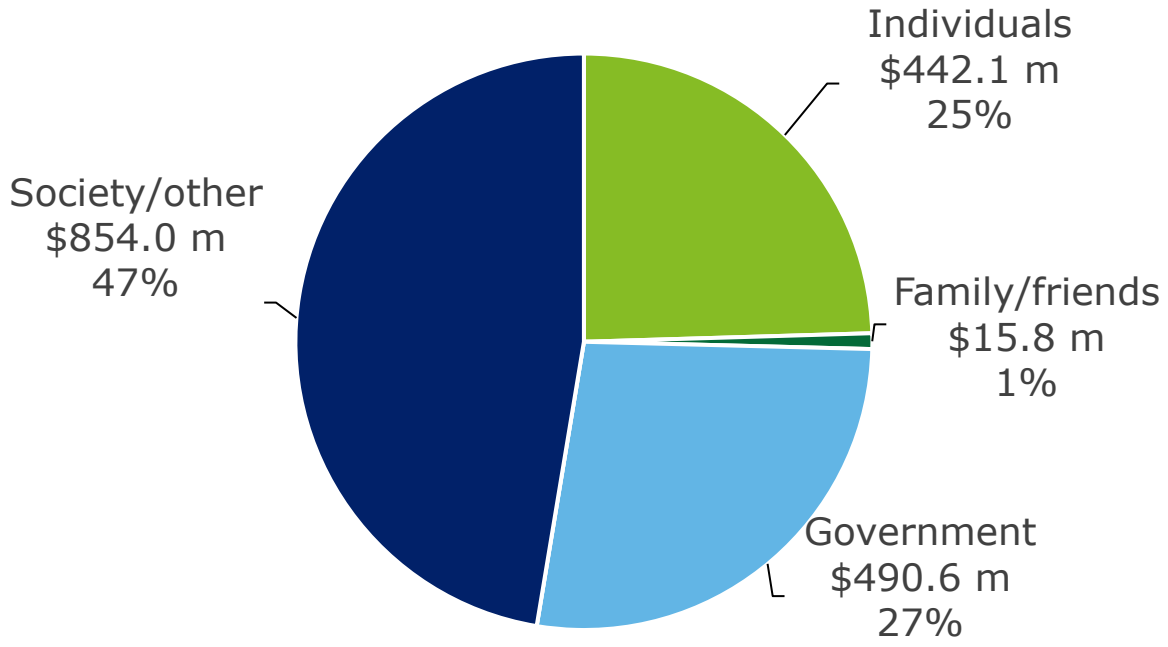
Province	Total cost ($ million)	Cost per person with VL ($)	Cost per capita ($)	Proportion of costs (%)
Ontario	711.0	1,526	49	39.4
Quebec	419.5	1,477	50	23.3
British Columbia	249.9	1,499	50	13.9
Alberta	185.9	1,504	42	10.3
Manitoba	60.2	1,433	44	3.3
Other	176.0	1,426	47	9.8

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Chart 4.7 outlines the other costs in 2019 by cost bearer. Society paid for the largest proportion of the costs ($854.0 million; 47%), followed by government ($490.6 million; 27%), individuals ($442.1 million; 25%) and family ($15.8 million; 1%).[vii]

[vii] The costs to government, individuals and family reported here do not account for transfer payments, which shifts some of the burden of these costs from individuals and their families/caregivers to government.

Chart 4.7: Other financial costs due to VL by cost bearer, 2019



Source: Deloitte Access Economics calculations.
Note: The costs to government, individuals and family reported here do not account for transfer payments, which shifts some of the burden of these costs from individuals and their families/caregivers to government. Society/other refers to the costs to the broader Canadian population who incur a burden through inefficiencies that arise due to the need to levy taxes to pay for government services.

While it was estimated that $166.4 million was spent on aids, equipment and modifications, and a further $84.9 million was spent on low vision rehabilitation services, Canadians living with VL may need further supports to help them to fully participate in society. Some of the challenges facing Canadians with VL include the significant out of pocket expenses associated with using aids and assistive devices. While programs such as the Ontario Assistive Devices Program cover 75% of aids and equipment costs, the outstanding 25% of costs may create financial barriers for some people. Further, there is no national standard for how assistive devices should be covered in Canada.

Increasing expenditure on programs to support Canadians with VL may in turn lead to reductions in financial costs such as productivity losses or costs from informal care. For example, rehabilitation services may increase independence and reduce the need for informal carers, and training with assistive technology may assist working age adults to further engage with the workforce.

4.4 Other costs not quantified

4.4.1 Depression and vision loss

Overall, the causal link between VL and depression is inconclusive and not well supported in literature. Most research studying the association between living with VL and depression measure depression using psychometric test scores, though this is not the only method used to diagnose depression.[57] Receiving a high score on psychometric tests indicates a person is likely to have depression and exhibit depressive symptoms.

A recent study investigating the association between VL and depression using the population from the CLSA did not find evidence that VL increased the risk of experiencing depressive symptoms.[58] The study was conducted using data from 30,097 Canadian residents aged 45 to 85 years. Depressive symptoms were measured using the Centre for Epidemiologic Studies Depression scale. This study, however, used presenting visual acuity of worse than 20/40, instead of the BCVA definition adopted in this report. A study based on the American population using BCVA as a measure of VL did not find a statistically significant correlation between VL and depression.[59] A meta-analysis comparing psychological wellbeing in visually impaired and unimpaired individuals did not find a strong decline in wellbeing among people with VL.[60] However, it was found that patients with AMD and DR, conditions which typically develop later in life, showed above-average declines in psychological wellbeing whereas declines in glaucoma patients were smaller than expected. This impact may differ from patients who are born with VL.

Some literature exists which demonstrate a significant association between VL and depression, however, the causality of the association was unclear and could not be explained by the authors.[61,62,63] It has been hypothesized that the effect of

living with a VL may have negative consequences on mental wellbeing as individuals living with a VL may have difficulty in adapting to the change in their abilities to perform daily activities (which again may differ for those who are born with VL). However, there also exists evidence that this effect may be mitigated by having strong social supports.[64]

Given the inconclusive evidence on the association between VL and depression, costs of depression attributable to VL have not been estimated in this report.

4.4.2 Motor vehicle crash and vision loss

Driving is a complex task that requires the ability to perceive objects and respond appropriately and timely to avoid road-related events. Drivers with impaired visual acuity and reduced contrast sensitivity as a result of their VL have difficulty in perceiving details of objects and the interpretation of road signals and objects (e.g. traffic lights).

Visual acuity testing is widely used – not only in Canada but globally – to test an individual's fitness to drive. Most research, however, shows that the correlation between visual acuity and motor vehicle crash risk is, 'at best, weak'.[65] Similarly, evidence on the correlation between eye health conditions, visual field loss, contrast sensitivity and crash risk is inconclusive, although statistically significant results have been reported in cohorts with severe symptoms such as glaucoma.[66,67]

While the evidence on the association between VL and crash risk is inconclusive, it is important to note that drivers with VL tend to adjust their driving behaviours. Research has shown that people with VL tend to drive fewer trips, avoid unfamiliar roads, reduce speed, and avoid driving at night to reduce and avoid the risk of crash.[64] Further, although the linkage between undiagnosed VL and motor vehicle crash leading to ED visits is not tracked or well understood, it may be possible there exists an association between the two factors which may contribute to ED admission and patient outcomes.

Despite the evidence suggesting there may be a greater risk of accidents occurring, a conservative approach was taken in this research and the potential costs of motor vehicle accident was

not quantified in this study due to the partial conflicting evidence. Further research is needed to be able to estimate the magnitude of these costs in Canada in the future.

5 Loss of wellbeing

People living with VL in Canada will experience a wide range of health-related impacts which may reduce their overall quality of life. The degree of impact on a person's wellbeing is tied to the severity of VL they experience. While mild VL may have a limited impact upon an individual, severe VL or blindness is likely to impact a person's day-to-day life, causing difficulties with completing daily activities without assistance, and possibly even worry and anxiety.

The wellbeing impact due to VL in 2019 was estimated to be $17.4 billion. The wellbeing cost was $7,678 per person with mild VL, $18,113 per person with moderate VL and $83,201 per person with severe VL. The per person wellbeing impact was higher for males due to a greater number of attributed deaths.

As shown in Table 5.1, Ontario accounted for the largest share of wellbeing losses (38.6%), followed by Quebec (23.8%) and British Columbia (14.0%). A detailed summary of province/territory specific productivity costs is provided in Appendix B.

Table 5.1: Total wellbeing costs of VL by province/territory, 2019

Province	Total cost ($ million)	Cost per person with VL ($)	Cost per capita	Proportion of costs (%)
Ontario	6,705	14,393	462	38.6
Quebec	4,135	14,564	490	23.8
British Columbia	2,422	14,525	480	14.0
Alberta	1,706	13,804	389	9.8
Manitoba	596	14,198	436	3.4
Other	1,787	14,481	481	10.3
Total/ average	**17,351**	**14,362**	**463**	**100.0**

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

The wellbeing cost of VL is skewed towards the elderly, with approximately 77% of the total burden incurred by people over the age of 50 years. A complete breakdown of the wellbeing impacts of VL is provided in Table 5.2.

Table 5.2: YLDs, YLLs and DALYs due to VL, 2019

Age group	YLDs	YLLs	DALYS	Cost ($ millions)
Male				
0-19	2,184	-	2,184	910.7
20-29	929	-	929	387.6
30-39	920	-	920	383.6
40-49	759	-	759	316.5
50-59	1,294	-	1,294	539.8
60-69	2,417	1,226	3,643	1,519.1
70+	5,629	4,785	10,413	4,342.9
Male total	*14,132*	*6,010*	*20,142*	*8,400.4*
Female				
0-19	2,090	-	2,090	871.8
20-29	864	-	864	360.5
30-39	911	-	911	379.9
40-49	884	-	884	368.8
50-59	1,399	-	1,399	583.5
60-69	2,480	822	3,302	1,377.0
70+	7,422	4,598	12,020	5,012.8
Female total	*16,050*	*5,420*	*21,470*	*8,954.2*
Total	**30,182**	**11,430**	**41,613**	**17,354.6**

Deloitte Access Economics estimates. YLDs = years of life lost due to disability, YLLs = years of life lost due to premature mortality, DALYs = disability adjusted life years. Note: Components may not sum to totals due to rounding.

6 Summary

The costs of VL are significant, particularly for the individuals and families who live with it. This report provides contemporary evidence of the cost of VL based on the latest available data (pre COVID-19 pandemic).

6.1 Total costs of vision loss in Canada

The cost of VL was estimated at $32.9 billion in Canada in 2019. This included $17.4 billion in reduced wellbeing, $9.5 billion in healthcare system costs and $6.1 billion in productivity losses and other financial costs. The financial cost of VL was estimated to be $12,886 per Canadian with VL. The breakdown of these costs is provided in Table 6.1.

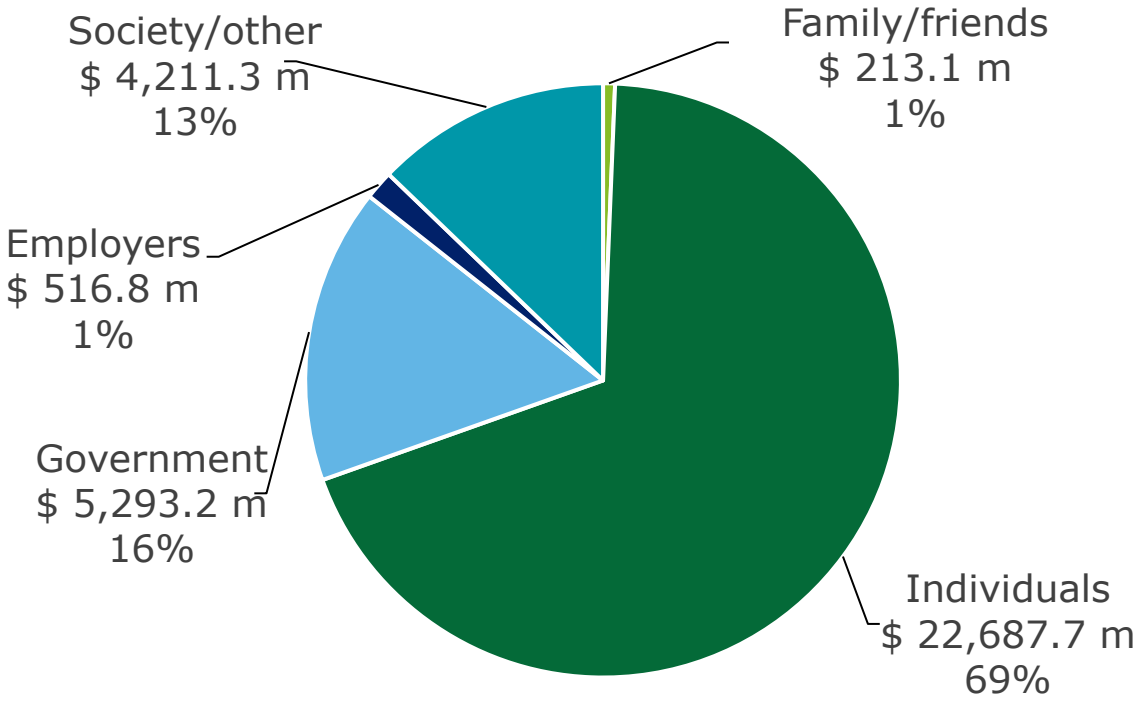
Table 6.1: Cost of VL in Canada by component, 2019

Component	Cost ($ millions)	Cost per person with VL ($)
Healthcare system costs	9,495.0	7,859
Productivity losses	4,270.1	3,535
Other costs	1,802.5	1,492
Total financial costs	**15,567.5**	**12,886**
Loss of wellbeing	**17,354.6**	**14,365**
Total costs	**32,922.1**	**27,251**

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Chart 6.1 outlines the total costs associated with VL in 2019 by cost bearer. Individuals bore the largest proportion of the costs ($22.7 billion; 69%), followed by government ($5.3 billion; 16%), society ($4.2 billion; 13%), employers ($516.8 million; 1%) and family ($213.1 million; 1%).

Chart 6.1: Total costs of VL in Canada, by cost bearer, 2019



Source: Deloitte Access Economics estimates.

Table 6.2 outlines the share of the cost of VL by province/territory in Canada. Ontario accounted for the largest share of costs (33.9%), followed by British Columbia (19.5%) and Quebec (18.5%). A detailed summary of province/territory specific costs is provided in Appendix B.

Table 6.2: Total costs of VL by province, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Cost per capita ($)	Share of economic cost (%)
Economic costs				
Ontario	6,323	13,573	436	40.6
Quebec	3,444	12,128	408	22.1
British Columbia	2,119	12,708	420	13.6
Alberta	1,790	14,481	408	11.5
Manitoba	507	12,084	371	3.3
Other	1,385	11,220	372	0.1
Total /average	*15,567*	*12,913*	*416*	*100.0*
Wellbeing costs				
Ontario	6,704.5	14,393	462	38.6
Quebec	4,135.1	14,564	490	23.8
British Columbia	2,422.1	14,525	480	14.0
Alberta	1,706.0	13,804	389	9.8
Manitoba	596.3	14,198	436	3.4
Other	1,787.4	14,481	481	0.1
Total / average	*17,351.5*	*14,393*	*463*	*100.0*

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Table 6.3 summarizes the costs of VL by age. The economic and wellbeing costs per person were lower for children aged 0 to 14 years, which occurs for two reasons: (1) severe VL is less

common in children compared to older adults, and (2) productivity losses are not captured for children. These costs may not tell the full story of the impact of VL on young Canadians. Further analysis is required to fully understand the impact of VL on children in terms of educational outcomes and social and economic costs later in life: such costs were not considered in this report.

The economic costs per person were highest for people aged 15 to 64 years due to the impact of productivity losses. Wellbeing costs per person were highest for people aged 65 years and over due to the greater proportion of people with severe VL.

Table 6.3: Total costs of VL by age group (years) and sex, 2019

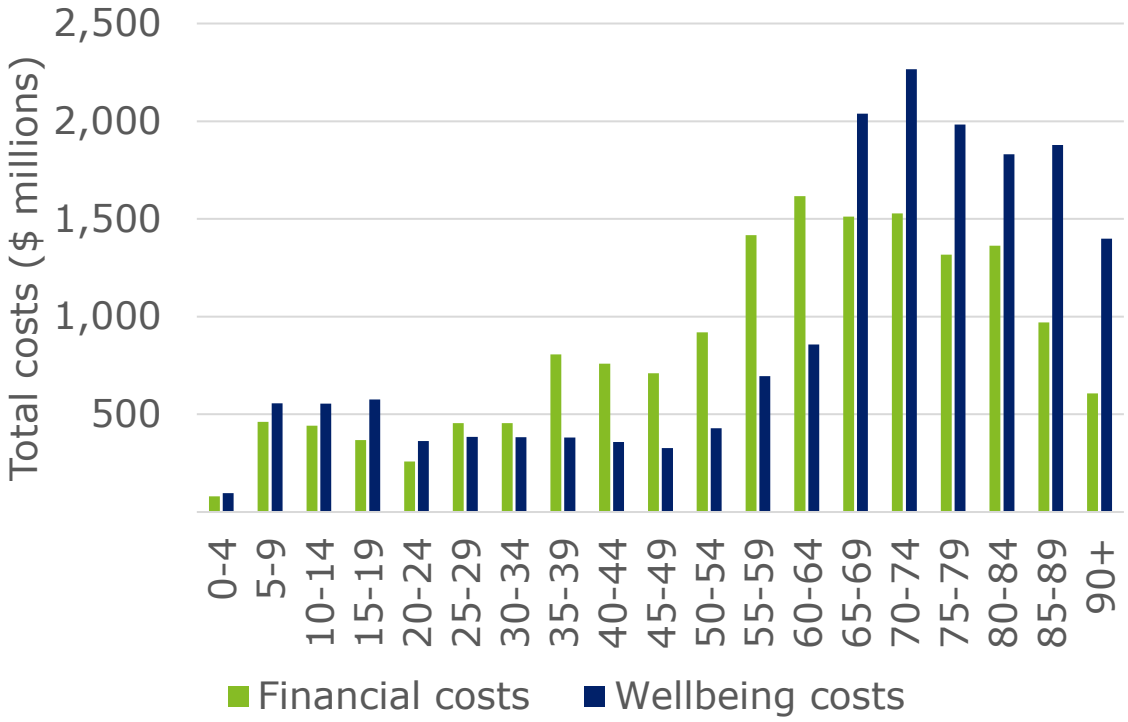
Age group (years)/ sex	Total ($ millions)	Per person ($)	Proportion of total cost (%)
Economic costs			
Male			
0-14	481.1	8,204	1.5
15-64	4,013.2	18,374	12.2
65+	3,174.0	10,977	9.6
Female			
0-14	460.6	8,185	1.4
15-64	3,579.5	15,822	10.9
65+	3,861.1	10,743	11.7
Wellbeing costs			
Male			
0-14	615.7	10,501	1.9
15-64	2,348.6	10,753	7.1
65+	5,436.1	18,800	16.5
Female			
0-14	591.0	10,502	1.8
15-64	2,405.5	10,632	7.3
65+	5,957.7	16,577	18.1

Source: Deloitte Access Economics estimates. Note: components may not sum to totals due to rounding.

Chart 6.2 shows the total economic and wellbeing costs of VL by age. Wellbeing costs were highest for people aged greater than 65, which largely reflects the number of deaths attributed to VL. However, these age groups also have a greater number

of people living with severe VL. Financial costs were higher than wellbeing costs for people of aged 35 to 64, due to the substantial productivity losses incurred by this age group. Financial costs remain high beyond working age due to increases in other financial costs such as residential and aged care costs and healthcare system costs.

Chart 6.2: Total economic costs and wellbeing costs of VL by age, $ million, 2019



Source: Deloitte Access Economics estimates.

Table 6.4 outlines the projected costs of VL in Canada in 2050. The estimates assume that the average cost per person of VL remains constant over time in real terms. The costs of VL are projected to be $56.0 billion[viii] by 2050, up from $32.9 billion in 2019. This is composed of $24.4 billion in financial costs and $31.6 billion in wellbeing costs. The costs presented in Table 6.4 have not been adjusted for inflation over time.

[viii] In 2019 dollars.

Table 6.4 Total costs of vision loss in Canada, 2019 and 2050, $ million

	Health system costs	Productivity costs	Other costs	Wellbeing costs	Total costs
2019	9,495.0	4,270.1	1,802.4	17,354.6	32,922.1
2050	15,613.3	5,598.8	3,166.6	31,619.8	55,998.5

Source: Deloitte Access Economics estimates.

6.2 Sensitivity analysis

One-way sensitivity analysis was applied to key parameters in the model to demonstrate the impact that changes to a particular parameter have on the outcomes in the model.

The results of the sensitivity analysis are shown in Table 6.5. A lower bound and upper bound sensitivity was applied to each parameter. The size of the change in parameter was based on standard errors or confidence intervals in literature relating to each parameter. For example, disability weights for mild, moderate and severe VL were varied based on confidence intervals presented by the Global Burden of Disease 2019.[68]

Table 6.5: One-way sensitivity analysis of selected parameters, $ billion

Scenario	Productivity costs	Other costs	Wellbeing costs	Total financial costs	Total costs
Base case	**4.3**	**1.8**	**17.4**	**15.6**	**32.9**
Presenteeism					
Lower (-6.0% presenteeism)	4.0	1.8	17.4	15.3	32.7
Upper (+6.4% presenteeism)	4.5	1.8	17.4	15.8	33.2
Reduced employment					
Lower (employment gap of 4.0% for mild VL, 21.0% moderate VL, 35.0% severe VL)	3.0	1.8	17.4	14.3	31.6
Upper (employment gap of 21.0% for mild VL, 38.0% moderate VL, 63.0% severe VL)	5.9	1.9	17.4	17.2	34.6
Informal care					
Lower (-3.8% informal care recipients)	4.1	1.8	17.4	15.4	32.7
Upper (+6.2% informal care recipients)	4.5	1.8	17.4	15.8	33.2

Scenario	Productivity costs	Other costs	Wellbeing costs	Total financial costs	Total costs
Value of a statistical life year					
Lower (-10.0% VSLY)	4.3	1.8	15.6	15.6	31.2
Upper (+15.0% VSLY)	4.3	1.8	20.0	15.6	35.6
Other costs					
Lower (-6.6% formal care and residential care recipients)	4.3	1.2	17.4	15.0	32.3
Upper (+2.4% formal care and residential care recipients)	4.3	2.0	17.4	15.8	33.1
Disability weights					
Lower (mild DW -55.0%, moderate DW -39.0%, severe DW -32.0%)	4.3	1.8	12.2	15.6	27.8
Upper (mild DW +82%, moderate DW +58%, Severe DW +40%)	4.3	1.8	24.8	15.6	40.4
All low combined	**2.6**	**1.2**	**11.0**	**13.2**	**24.2**
All high combined	**6.3**	**2.1**	**28.6**	**17.9**	**46.5**

Source: Deloitte Access Economics estimates. DW = disability weight.

The total costs of VL in Canada were estimated to range between $24.2 billion (all lower bound sensitivities combined) to $46.5 billion (all upper bound sensitivities combined).

6.3 Conclusion

This report shows the significant cost of VL for Canadian individuals, families, communities and governments. The findings from this research indicate the total overall loss of wellbeing due to living with VL in Canada was 41,613 DALYs, which is greater than the loss of wellbeing due to several other prominent conditions including eating disorders, malignant skin melanoma and upper respiratory infections in Canada.[69] Clearly, VL is life-changing and burdensome for those with lived experience. Given VL imposes costs across individuals, employers, governments and other parts of society, government, industry, patient groups and other stakeholders should extensively collaborate to ensure that individuals with VL are empowered, supported and integrated in society in ways that lessen the personal and financial strain of VL on their lives.

A substantial finding is that the cost of VL to the healthcare system is higher than cancer (neoplasms) and endocrine and related conditions (of which, diabetes is a subset).[34] Additional work is required to determine how best to invest in existing technologies and practices – such as greater screening for early stage disease through comprehensive eye exams – to reduce costs of VL. This would constitute an "upstream" approach to disease management, where early investment reduces significant "downstream" costs associated with more serious VL that has been left untreated or unchecked.

The evidence generated by this report suggests a number of key takeaways that can be grouped into three broad themes:

- Reducing the incidence and slowing the progression of VL by improving accessibility to eye health services, including eye examinations treatments
- Enhancing the quality of life for people living with VL through the use of assistive devices and rehabilitation services
- Enabling fundamental changes through a range of system-level strategies.

Reducing the incidence and slowing the progression of VL

This research has found the per person social and economic cost of mild VL is substantially lower than for severe VL ($19,140 vs $104,913 per person). This highlights that each increase in VL severity comes with a significant increase in financial burden on the individual, government and society. The aim is therefore to reduce the physical, psychological and economic impacts associated with a transition from mild and moderate VL to more damaging and costly forms of severe VL. Further, approximately 71% ($23.5 billion) of the financial and wellbeing costs of VL estimated in this report are preventable.[ix] This suggests that there are significant savings available to the Canadian economy and community more broadly if VL can be prevented.

Early diagnosis and treatment of eye diseases can minimize VL, and in some cases can restore lost vision.[3] Timely eye examinations are particularly important for:[70]

- Older adults as the prevalence of VL increases with age, particularly after the age of 55[71]
- Individuals who are either asymptomatic or have symptoms they do not recognize as being eye related[72]
- School-aged children who may experience great learning difficulties because of undiagnosed or uncorrected vision problems.[73]

While universal coverage of regular eye examinations may encourage timely detection, comprehensive eye examinations are not fully covered in all provinces, leading to different levels of access.[74] The benefits and costs of universal coverage of regular eye examinations for all age groups, as well as modes of delivery should be further investigated as current evidence suggests broad screening is likely to be cost effective.[75]

In addition to timely eye examination, accessibility of other care services in the care continuum, is essential for preventing VL or slowing and reversing the progression of VL. Wait times

[ix] Preventable costs of VL include non-healthcare system financial costs, the cost of falls and wellbeing costs.

for eye surgeries, most notably cataract surgery, have been increasing and the number of cataract surgeries in most provinces has not increased despite the growing and ageing population leading to greater demand for services. For example, recent data suggests the wait time for cataract surgery in Ontario was 93 days in 2019[55],[55] which is a substantial increase from 2014 when it was 69 days.[54] The increase in wait times may lead to more complicated and more costly cataract surgeries as a patient's condition progresses, which is further complicated by a greater risk of falls while patients wait for their surgery.[76] As evidenced in this report, the direct cost of falls due to VL is substantial at more than $105 million each year.

In the context of the aging population, there is an opportunity to incorporate eye care in aging-related strategies and programs, including falls-prevention programs. A holistic approach to care and diagnosis, where eye health is considered an essential element of overall wellbeing could help identify those who are at the greatest risk of VL and enable timely diagnosis and treatment. It is important that eye health services are accessible for all Canadians – regardless of race, gender, socioeconomic status, geography and other factors.

Increased investment into eye health, with particular emphasis on treatments with the potential to prevent VL or restore vision, will further contribute to reducing the incidence and progression of VL. Continual financial investment and support from government and other stakeholders can provide additional and timely management and treatment opportunities for those living with VL, including genetic and stem cell treatments, pharmaceutical therapies, surgical and non-surgical devices, devices that assist vision rehabilitation and diagnostic and screen initiatives. For example, research has estimated the introduction of anti-VEGF treatments led to a 50% reduction in the incidence of blindness due to neovascular AMD in the general population.[3] This has almost certainly led to a reduction in the burden of AMD on Canadian society since the societal costs associated with blindness estimated in this research greatly exceed the cost of treatment.[77]

As the majority of VL is either treatable or preventable[78], it is clear there exists a lack of awareness of the importance of maintaining eye health. It is paramount a national approach is taken to deliver robust health education and promotion campaigns to minimize preventable VL.

Enhancing the quality of life for people living with VL

Advancements in personal technologies such as smart phones have started to replace more traditional assistive technologies, emerging as invaluable devices for people with VL, whether it be in facilitating navigation and transportation or engaging in online conversations and enjoying books.[79] The cost for these, however, can be prohibitive for many. New partnerships and programs to enhance accessibility to assistive devices, could transform the lives of many people living with VL.

This report has found that VL is a barrier to employment and productivity at work and that a significant proportion of the cost of VL is cost from reduced employment and productivity. Supporting people with VL in getting a job and performing well at their job by encouraging inclusive workplaces would help raise the standard of living for people with VL and reduce dependence on families and government benefits.[80]

It should also be recognized that improving the quality of life of people living with VL extends far beyond accessibility to assistive devices or employment. It requires an inclusive approach to urban planning, software development, infrastructure developments, workplace benefit programs and many other domains. It is important that new accessibility movements be built from the ground-up as global ways of thinking and planning that envision accessibility and inclusiveness as foundations in collective projects, not as extraneous additions or afterthoughts. The creation of a truly accessible society—for not only VL but for other conditions as well—could have far-reaching and profound benefits.

Enabling fundamental changes through a range of system-level strategies

As outlined in this report, VL is a life-changing experience and has a significant cost not only to the people living with VL, but also their families and the broader Canadian society. The cost

of VL is also multi-dimensional, encompassing costs to the healthcare system, the Canadian productive capacity and a wide range of supporting industries. Improving eye health, therefore, is about cost-savings for public spending, improving productivity in the workplace, raising income and contributing to general and mental health, education and equity.

Improving eye health is a complex and multifaceted challenge that requires coordinated actions from all levels of the Canadian government in consultation with the VL community and its stakeholders. A national plan could be a first step in the right direction to ensure the best possible outcomes for Canadians who are blind or partially-sighted. A key consideration within any plan should be to implement a range of indicators to track eye health in Canada and progress against any plan to improve eye health. Further, a national population health study on the prevalence and causes of VL in Canada is needed so that effective strategies can be put in place to improve eye health. Eye health is essential for the full participation of people in society. It is an enabler for people to live a healthy, productive, and prosperous life.

Appendix A Technical appendix

A.1. Prevalence of vision loss

A.1.1. Overall prevalence of vision loss

Prevalence of VL has been estimated based on the evidence gathered from various research and data sources. A literature review was conducted to ensure the definitions of VL adopted in these research and data sources are aligned with the definition used in this report.

VL in people younger than 5 years

Prevalence of VL in people younger than 5 years was based on data from Varma et al (2017).[23] Varma et al (2017) undertook a descriptive study and reported statistics estimated based from two major population-based eye studies conducted in the United States of America (US) between 2003-11. VL was defined as decreased visual acuity (<20/50 in children 36 to 47 months of age or <20/40 in children 48 months of age or older) in the better-seeing eye. The findings from the study revealed that in 2020, 69% of children are projected to have VL from simple uncorrected RE, with the remaining 31% of children having VL in best-corrected vision (due to bilateral amblyopia and ocular disease). The major cause of VL for children younger than 5 years in the US was uncorrected RE. Age-adjusted prevalence of VL (corrected) was estimated to be 0.5% after removing VL caused by uncorrected RE, which was used in the modelling for this report.

VL in people aged 5-19 years

Prevalence of VL in people aged 5 to 19 years was based on the Canadian Health Measures Survey (CHMS) 2018-19 from Statistics Canada (2020).[81] The CHMS captures data for people aged 3 to 79 years living in the 10 provinces/territories.[x] The

[x] Limited data was made available which reports results for the older age groups, hence the Canadian Longitudinal Study on Aging (CLSA) was still used as the primary source as noted in the following sections.

survey focused on vision testing for children and older adults (excluding those aged 20 to 39 years), given that the prevalence of vision problems in children is relatively high, and since vision changes as people age.

Results from visual acuity tests administered as part of the CHMS showed that 2.6% of children aged 5 to 19 years have a VL that cannot be corrected to visual acuity of 20/40 or better. No specific differences by sex were noted, so 2.6% was applied to both groups in the modelling.

VL in people aged 20-44 years

Prevalence in people aged 20 to 44 years was based on data from Wittenborn et al (2013), which reported on results from the US NHANES.[25] The NHANES is a cross-sectional sample which captures the non-institutionalized US population and their health status.[25] The 2007-08 NHANES data captures visual acuity measurements which are used to estimate incidence and prevalence rates of adults with VL, low vision and legal blindness and is one of the few North American studies which comprehensively collects data across age groups. Wittenborn et al (2013) defines visual acuity thresholds for mild and moderate VL and blindness as worse than 20/40, worse than 20/80 and worse than 20/200 respectively, which differs slightly from the definitions in this report.[25]

It should be noted that relying on US prevalence rates may not give an accurate picture of the burden of VL in Canada given the differences between the two countries healthcare systems and demographic factors that effect vision. However, there were no specific Canadian data sources which could be used to estimate the prevalence of VL in people aged 20-44.

VL in people aged 45-84 years

The total prevalence of VL and blindness for people aged 45-84 years were derived from a study authored by Mick et al (2021) which analyzed the first wave of the comprehensive cohort of the CLSA.[26] The CLSA provides a unique opportunity to generate national-level estimates of VL in the Canadian population as visual acuity testing is included in the core battery of measures. The primary measure of vision in the study visual acuity was measured with binocular habitual

correction. In addition, the large sample size included in the CLSA provided an opportunity for sub-group analysis according to 5-year age categories, sex and severity of VL.

Aljied et al (2018) also described the prevalence of VL using data from the first wave of the CLSA, however these results were not stratified by age, sex or severity of impairment.[1] To derive prevalence estimates of VL for people aged 45-84 years, the prevalence rate of VL with pinhole correction disaggregated by province/territory was sourced from Aljied et al (2018) as shown in Table A.1.[1] Further breakdowns by sex and more specific age groups were informed by Mick et al (2021) and applied to the prevalence estimates reported by Aljied et al (2018).[1,26]

Table A.1: Prevalence rate of VL with pinhole correction disaggregated by age groups (45 - 75+ years)

Age group (years)	Prevalence (%)
45-54	1.3
55-64	2.8
65-74	6.9
75+	13.8

Source: Aljied et al (2018)[1], based on the CLSA.[26]

VL in people aged 85+

There are also no recent nationally representative data sources in Canadians aged 85 years and over. The IAPB modelling shows prevalence of VL and blindness continues to increase with age beyond 85 years of age, which has also been incorporated in the estimates in this report.

To estimate the prevalence of VL in people aged 85 and older, rate ratios sourced from the IAPB Vision Atlas was applied to the CLSA data in ages 80-84 years.[27] The IAPB brings together the latest data and evidence related to avoidable blindness and sight loss, utilising data from the estimates of the burden of VL by the Vision Loss Expert Group (VLEG).

A.1.2. Prevalence of vision loss by severity

For ages 0 to 19 years, overall severity was based on data from Varma et al (2016) which reports visual acuity based on examination from the National Health and Nutrition Examination Survey (NHANES) survey.[28] Severity splits for ages 20-44 years were based on Wittenborn et al (2013).[25] Where available, Mick et al (2021) was used to disaggregate severity of mild and moderate or worse VL for ages 45 and older given this source uses the CLSA database which is a Canadian-specific cohort.[26] In the absence of Canadian-specific severe VL data, the prevalence of severe VL was derived from data in Varma et al (2016).[28] Although this source uses a US population, the large sample size which includes data across all US states means the data captured is representative of different cohorts. The severity distribution of VL by age group and sex is shown in Table A.2.

Table A.2: Severity distribution of VL by age group and sex

Age (years) / sex	Mild (%)	Moderate (%)	Severe (%)	Total (%)
Male				
0-19	80.0	13.3	6.7	100.0
20-44	83.0	9.9	7.1	100.0
45-49	65.0	29.5	5.5	100.0
50-54	48.0	46.0	6.0	100.0
55-59	42.4	53.0	4.5	100.0
60-64	57.6	39.7	2.7	100.0
65-69	55.7	42.0	2.3	100.0
70-74	60.0	38.3	1.7	100.0
75-79	54.9	41.9	3.2	100.0
80-84	49.5	48.2	2.3	100.0
85+	45.4	51.1	3.5	100.0
Female				
0-19	80.0	13.3	6.7	100.0
20-44	83.0	9.9	7.1	100.0
45-49	39.1	56.1	4.8	100.0
50-54	57.1	37.5	5.4	100.0
55-59	59.1	37.5	3.4	100.0
60-64	52.7	44.4	2.9	100.0
65-69	55.9	41.8	2.4	100.0
70-74	53.5	44.7	1.7	100.0
75-79	55.8	40.9	3.3	100.0
80-84	52.7	44.9	2.4	100.0
85+	48.6	47.8	3.6	100.0

Source: Varma et al (2016)[28] and Mick et al (2021).[26]

A.1.3. Prevalence of vision loss by province/territory

Prevalence by province/territory was estimated by applying the prevalence rate at the national level to the province/territory population level.

A.1.4. Prevalence of vision loss by condition

Prevalence of moderate and severe VL by condition-specific causes was based on data from the IAPB Vision Atlas.[27] This included a systematic review and meta-analysis of population-based surveys of eye disease from 1980 to 2018 combined with data from Rapid Assessment of Avoidable Blindness (RAAB) studies by VLEG and the US National health and Nutrition Examination survey and the WHO study on Global Ageing and Adult Health. Visual acuity was measured as presenting VL or BCVA or both. The prevalence of mild VL by condition-specific causes was based on previous modelling undertaken conducted by Pezzullo et al (2018)[30], which compiled results from multiple sources to estimate the share of VL by cause for the United Kingdom (UK). VL was also measured using BCVA definitions used in this report.

Total condition estimates were disaggregated by five-year age groups. Within age groups, the relativities between the visual acuity groupings were used to separate total prevalence. The distribution of conditions disaggregated by severity, sex and age group is shown in Table A.3 and Table A.4.

Table A.3: Share of VL in Canada, 2019, by condition, severity, and age group for men

Severity / age group	AMD	Cataract	DR	Glaucoma	Other
Mild					
0-49	0.0	23.7	19.6	22.8	33.8
50-69	21.6	35.8	16.0	6.5	20.1
70-79	36.4	37.4	5.6	6.8	13.8
80+	46.6	35.5	1.3	10.1	6.4
Moderate					
0-49	18.9	0.4	0.0	3.1	77.5
50-59	1.9	41.4	7.0	2.0	47.7
60-69	4.0	45.6	6.4	4.6	39.3
70-79	4.5	57.6	4.8	6.1	26.9
80-89	4.0	64.9	3.3	6.6	21.2
90+	3.5	68.8	2.3	6.4	19.1
Severe					
0-49	9.4	0.1	0.1	6.0	84.4
50-59	4.1	20.8	10.3	7.4	57.5

Severity / age group	AMD	Cataract	DR	Glaucoma	Other
60-69	9.3	22.5	9.0	21.4	37.8
70-79	11.3	26.9	5.5	33.5	22.9
80-89	11.4	28.5	3.3	40.8	16.0
90+	11.9	30.9	2.3	42.6	12.3

Source: Deloitte Access Economics analysis based on International Agency for the Prevention of Blindness (2021)[27] and Pezzullo et al (2018).[30]

Table A.4: Share of VL in Canada, 2019, by condition, severity, and age group for women

Severity / age group	AMD	Cataract	DR	Glaucoma	Other
Mild					
0-49	0.0	23.7	19.6	22.8	33.8
50-69	21.6	35.8	16.0	6.5	20.1
70-79	36.4	37.4	5.6	6.8	13.8
80+	46.6	35.5	1.3	10.1	6.4
Moderate					
0-49	18.9	0.4	0.0	3.1	77.5

Severity / age group	AMD	Cataract	DR	Glaucoma	Other
50-59	1.8	41.5	8.2	1.7	46.9
60-69	3.7	46.1	7.3	3.8	39.1
70-79	4.1	58.9	5.3	4.9	26.8
80-89	3.6	67.0	3.4	5.3	20.7
90+	3.1	71.6	2.3	5.2	17.9
Severe					
0-49	9.4	0.1	0.1	6.0	84.4
50-59	5.2	15.5	22.1	4.7	52.4
60-69	13.9	18.4	18.9	14.0	34.9
70-79	19.7	25.0	11.7	23.6	20.0
80-89	21.4	28.8	6.6	29.9	13.2
90+	21.4	31.9	4.2	32.1	10.4

Source: Deloitte Access Economics analysis based on International Agency for the Prevention of Blindness (2021)[27] and Pezzullo et al (2018).[30]

A secondary focus of this study was to provide evidence on the number of people impacted by eye diseases which may lead to VL. As there are many conditions which may lead to VL, analysis of the prevalence of the four major eye conditions considered in this study was undertaken. The methodology to derive prevalence of cataract, AMD, DR and glaucoma is discussed in the following paragraphs. It is important to note that the analysis for each condition focused on age-related prevalence and ignored other types (e.g. juvenile cataract was excluded).

Cataract: age-specific prevalence rates were obtained from Congdon et al (2004)[82], who pooled data from several major international population eye studies. The prevalence of cataract was 17.2% in people aged 50 years and older, which is comparable to a recent meta-analysis by Hashemi et al (2020)[83]. Data from the earlier study were preferred as results were primarily drawn from studies with similar demographics to Canada.

- **AMD**: age-specific prevalence rates were taken from a meta analysis by Li et al (2019)[84], who analyzed data from several studies conducted in Europe.
- **DR**: In a meta-analysis by Yau et al (2012)[85], diabetic retinopathy occurs in 34.6% of people with diabetes. Age-specific prevalence of diabetes was taken from Statistics Canada (2018)[86], and further adjusted to include prevalence of undiagnosed diabetes (which represents approximately 20% of total cases of type 2 diabetes) using results from Rosella et al (2015)[87].
- **Glaucoma**: prevalence of glaucoma in people aged 40-80 years was obtained from Tham et al (2014)[88] who reported a pooled prevalence of 3.5%. The prevalence was adjusted by the age-specific rates reported by Klein and Klein (2013)[89], which were based on data compiled by the Eye Diseases Prevalence Research Group.

A.2. Mortality attributable to vision loss

To estimate the number of deaths due to VL, the hazard ratios from Ehrlich et al (2021)[31] and Zhang et al (2016)[32] were converted to a population attributable fraction (PAF), accounting for differences by severity.

Zhang et al (2016)[32] reported that the hazard ratio increased by 0.04 for every 0.1 unit increase in logMAR. This relationship was used to model hazard rates for mild, moderate and severe, which were estimated to be 1.16, 1.30 and 1.40 respectively. When weighted by prevalence, the overall hazard rate was estimated to be 1.22, which is comparable to data from high income countries with robust controls reported within Ehrlich et al (2021).[31]

The population attributable fraction (PAF) measures the contribution of a risk factor to a death. This is the proportional reduction in population mortality that would occur if VL did not occur. The population attributable fraction is calculated using the formula:

$$PAF = P_{VL}.\frac{HR_{VL}-1}{1+P_{VL}(HR_{VL}-1)};$$

where $P_{VL}$is the prevalence of VL and $HR_{VL}$is the hazard ratio of mortality.

The deaths attributable to VL were then estimated by applying the PAF to the general population mortality rates for people with VL in Canada. General population mortality rates were derived by dividing deaths by total population for each age group and sex, which were both sourced from Statistics Canada (2019).[24] Given the underlying samples were primarily drawn from older cohorts, with a mean age generally older than 65 years, it was assumed there is no additional mortality risk in people with VL below this age.

A.3. Healthcare system costs due to vision loss

A.3.1. Inpatient and ED care

In 2019, the total inpatient and ED visit expenditure was $152.3 million (see Table A.5). This includes patients who were:

- Admitted into public hospitals with VL as the primary diagnosis
- Visited public ED with VL as the primary diagnosis
- Admitted into hospital due to a fall caused by VL
- Visited public ED due to a fall caused by VL.

Table A.5: Cost of inpatient and ED costs, 2019

Cost component	Value ($ million)
Inpatient hospitalizations	22.4
ED visits	24.7
Inpatient hospitalization due to falls	10.3
ED visits due to falls	95.0
Total	**152.3**

Source: Deloitte Access Economics analysis based on CIHI (2019a)[33], Public Health Agency of Canada (2018)[34], CIHI (2019b)[35], Scuffham et al (2003)[36], Woolcott et al (2011)[37] and Parachute (2015)[38]. Note: Components may not sum to totals due to rounding.

Inpatient hospitalization

Hospitalization volumes and costs in 2019 were determined by using data from the Canadian Institute for Health Information (CIHI) Patient Cost Estimator which provides data by Case Mix Group (CMG).[33] The CMGs captured under conditions of the eye and adnexa include, extraocular intervention except lacrimal system, eye intervention with trauma/complication of treatment, lacrimal system intervention, lens extraction/insertion, major ophthalmology disorder, orbit/eyeball intervention, other ophthalmic intervention, other ophthalmology disorder, sclera/choroid/retina intervention without vitrectomy, and vitrectomy. Using data from the CIHI Patient Cost Estimator in 2019, there were an estimated 5,975 inpatients admissions nationally for VL.

In 2019, the total inpatient hospitalization expenditure with VL as the primary diagnosis was estimated to be $22.4 million. This was estimated by applying the total hospitalization volume for each CMG to the estimated average cost of each respective CMG. The inpatient hospitalization expenditure disaggregated by province/territory is shown in Appendix B.

Emergency department (ED) visits

There is currently no publicly available national data source in Canada which includes the total volume of ED visit. To estimate the total ED visit cost attributable to VL, a ratio of the estimated expenditure for ED visit to inpatient hospitalization for eye and related conditions was obtained from the Economic Burden of Illness in Canada 2010 report.[34] This ratio was 1.1 suggesting ED costs are 110% of inpatient hospitalization costs.

In 2019, the total ED visit expenditure with VL as a primary diagnosis was estimated to be $24.7 million. This was estimated by applying the total inpatient hospitalization expenditure to the ratio of the estimated expenditure for ED visit to inpatient hospitalization. It is acknowledged that some ED costs related to trauma/acute eye conditions may not necessarily lead to VL. However, these cases have not been excluded due to a lack of reasonable data.

Despite the lack of publicly available national data on ED visits, there exists some province/territory-level information on ED presentations. Alberta Health publishes ED visit volume where the primary diagnosis due to ED visit is related to 'diseases of the eye and adnexa'.[90] In Alberta, there were 26,051 emergency visits to a hospital and 1,377 inpatient hospitalizations attributed to 'diseases of the eye and adnexa' in 2019. Using cost data from Alberta health, the median cost of hospitalization visits (all conditions) was $5,305 and for ED visits (all conditions) this was $250.[91,92] Using the same methodology as described above, the ratio of the estimated expenditure for ED visits to inpatient hospitalization expenditure is 0.9, which means that ED costs are 10% less costly than inpatient hospitalization expenditure. While slightly lower, this value supports the ratio derived from the Economic Burden of Illness in Canada Report[34], and fluctuations across provinces are not unexpected.

A.3.2. Cost of falls

The CIHI (2019) estimates the number of individuals in Canada who experience a fall injury disaggregated by presentation type (inpatient or ED visit).[35] The fall types captured in the CIHI data includes unintentional falls due to fall from, out of or

through building or structure, fall on/from ladder or scaffolding, fall on/from stairs and steps, other fall from one level to another, slipping, tripping and stumbling and other/unspecified fall.

To determine the number of persons with a VL who experience a fall within this population, a PAF approach, which was derived from converting a relative risk to incidence rate, was applied to estimate the proportion of attributable falls.[xi,36] The relative risk estimate was derived from a meta-analysis of prospective studies investigating risk factors for falls among community-dwelling older people.[93] Risk factors considered in the analysis included history of falls, gait problems, Parkinson disease and hearing impairment and VL. The relative risk ratio for VL was 1.35, which means that those with VL had a 35% increased risk of falling compared to those with no VL.

Using this methodology, there were 1,669 falls due to VL that led to inpatient hospitalization and 15,403 falls due to VL that led to ED visits. The average unit cost of a fall by presentation type for inpatient hospitalization and ED visit was $6,168.6 and $1,102.2 respectively, which was sourced from literature.[38,93]

In 2019, the total inpatient hospitalization and ED visit for those with a VL who experience a fall injury was estimated to be $105.3 million. This was estimated by applying the incidence of falls attributable to VL to the average unit cost of a fall by presentation type, inflated to 2019 dollars.[37,38]

A.3.3. Outpatient care

Outpatient expenditure is incurred when a patient is not formally admitted into hospital. However, the patient receives medical care including services provided by a specialist (e.g. from an ophthalmologist), in an outpatient setting. In estimating the outpatient care expenditure, this component captures day surgery costs (e.g. for cataract surgeries) and payments to specialist physicians.

[xi] Formula for attributable risk = (prevalence of exposed in the population (relative risk of exposure)) / 1 + ((prevalence of exposed in the population (relative risk of exposure – 1)).

Publicly available national data on the volume and cost of cataract surgery was available from the Implantable Medical Devices in Canada report published by CIHI.[44] However, national data on the volume and cost of other eye surgeries was not publicly available. Using data published in the Implantable Medical Devices in Canada report, there were 412,583 cataract day surgeries in Canada in 2019, which totalled $613.9 million. The cataract day surgery volume and expenditure disaggregated by province/territory is shown in Appendix B.

In the absence of national volume and cost data for other eye surgeries, a ratio of the estimated aggregated hospital day surgeries expenditure for other diseases of the eye to cataract was obtained from the Economic Burden of Illness in Canada 2010 report.[34] This ratio was 0.4, which indicates that day surgeries expenditure for other diseases of the eye is 40% of the total expenditure for cataract day surgeries. It was assumed the ratio holds true in 2019, which would indicate the expenditure on other day surgeries in 2019 was approximately $231.2 million.

The CIHI National Physicians Database provides the volume of services and service expenditure delivered by ophthalmologists.[43] This database captures billing data (the full amount the physician billed the province for a particular fee-code item) and payment data (the amount that is paid to the physician).[xii] Two services categories are captured for visits to ophthalmologists which include consultation and visits, and procedures. Services captured under consultations and visits include major assessments and psychotherapy/counselling and for procedures this includes services such as major and minor surgeries and diagnostic/therapeutic services. As there were no data reported for Northwest Territories, Nunavut and Yukon, it was assumed that the average cost per capita is constant with provinces/territories which have reported data. After adjusting these data, there were an estimated 16,647,019 ophthalmic

[xii] Some costs where ophthalmologists may operate under other funding models (e.g. block funding) are excluded from the NPDB and so would not be captured in this report.

services delivered in 2019, of which 7,069,799 (42.5%) were for consultation and visits and 9,577,220 (57.3%) were for total procedures including surgeries. The total cost of ophthalmic services provided was estimated to be $1.1 billion in 2019, of which $388.6 million (36.2%) were for consultations and visits and $684.8 million (63.8%) were for procedures including surgeries. The total ophthalmic services and costs disaggregated by province/territory is shown in Appendix B.

In 2019, the outpatient care expenditure was estimated to be $1.9 billion. This was estimated by totalling the cost of day surgeries and ophthalmic services provided in Canada in 2019.

A.3.4. Pharmaceuticals

People living with VL use a range of ophthalmic medications to manage their condition including anti-VEGF therapy. IQVIA publishes data on the drug store and hospital pharmaceutical purchases in Canada.[40,41] **In 2019, the total ophthalmic drug expenditure was estimated to be $1.4 billion.** This does not include data for off-label non-ophthalmic pharmaceuticals as this data was not publicly available.

The Patented Medicine Price Review Board publishes prescription drug expenditure for the National Prescription Drug Utilization Information System (NPDIUS) public drug plans across Canada. This includes data on that total expenditure spent on anti-VEGF therapy, used to treat certain macular conditions that cause abnormal blood vessel growth and/or fluid leakage.[94] The Patented Medicine Price Review Board contains expenditure spent on anti-VEGFs for Alberta, New Brunswick, Newfoundland, Ontario, Prince Edward, Saskatchewan and Yukon as these provinces/territories have provided data to the NPDIUS Database at CIHI.[42] The NPDUIS database contains drug claims data from public drug programs across provinces/territories. Due to the design of public drug programs in Canada, only seniors and low-income families/individuals are covered in the database and so some expenditure on anti-VEGFs in these provinces may be excluded.

The Patented Medicine Price Review Board also publishes market trend data on the 10 top-selling biologics in Canada.[95] The market trend data was used to estimate anti-VEGFs expenditure for British Columbia, Manitoba, Northwest Territories, Nova Scotia Nunavut and Quebec by applying a population weighted average to the difference in anti-VEGF expenditure reported by the two Patented Medicine Price Review Board publications. The distribution of other ophthalmic drugs was assumed to follow the same distribution as anti-VEGFs. The total cost of anti-VEGF therapy was estimated to be $810.0 million (in 2018). This means that other ophthalmic drugs were estimated to cost $551.0 million.[xiii]

Table A.6: Cost of pharmaceuticals by medication type, 2019

Medication group	Value ($ million)
Anti-VEGFs	810.0*
Other ophthalmic drugs	551.0
Total	**1,361.0**

Source: Deloitte Access Economics analysis based on IQVIA (2019a)[40], IQVIA (2019b)[41] and PMPRB (2019).[42] Note: Components may not sum to totals due to rounding. * estimated for 2018 as data for 2019 were unavailable at the time of drafting the report.

A.3.5. Vision care

People living with VL require ongoing vision care. In 2019, there were 6,609 optometrists, 3,609 opticians and 1,246 ophthalmologists providing vision care in Canada.[96,97] The National Health Expenditure Database (NHEX) provides information on vision care services, which include expenditures for the professional services of optometrists and dispensing

[xiii] Estimated as the residual expenditure on ophthalmic pharmaceuticals after subtracting the anti-VEGF expenditure in 2018. Some growth in anti-VEGF in 2019 is likely to have occurred although data for 2019 were unavailable at the time of drafting the report.

opticians, as well as expenditure for eyeglasses and contact lenses.[46]

In 2019, the vision care expenditure, which includes services provided by optometrists, opticians, and dispensing of eyeglasses and contact lenses, was estimated to be $5.5 billion, based on NHEX data.

A.3.6. Visits to other health professionals

Persons living with VL utilize a range of health services aside from those offered from optometrists, ophthalmologists and opticians. This includes visits to other health professionals and health care providers including a family doctor or general practitioner.

The 2018 Canadian Community Health Survey (CCHS) provides useful information on consultations about mental health, however this information is limited in its use as it does not provide utilization data about consultations with other health professionals more broadly for those living with a VL.[98] The 2016 CCHS provides data on the number of comprehensive eye examinations for the Canadian population. However, this data is limited in its application as there are no questions which clarify the use of other health professionals for those with a VL.[99]

In the absence of country-specific utilization data, a targeted literature review was conducted to identify available data on other health professional use by those living with VL. The literature does not support any incremental use of other health professionals outside of services provided under vision care. It has been previously reported that those living with VL receive six general practitioner visits per year.[100] However, this study was based in a German population and the study design did not include a control group and therefore limits the applicability of this finding. Due to the lack of Canada-specific and consensus in the literature, expenditure for visits to other heath professional is not estimated in this report.

A.3.7. Medical research

Medical research costs represent the average annual value of all grants relating to VL that are active in 2019.

The value of medical research costs related to VL was estimated by filtering the grants database published by the Canadian Research Information System (2019)[39] for key words and summing the total value of funded grants and awards for fiscal year 2019 from Fighting Blindness Canada, Glaucoma Research Society of Canada and Vision Health Research Network.[101]

The Canadian Research Information System (2019) grants database was filtered by search terms which fall under the general categories of eye anatomy (e.g. retina, iris, etc.) condition specific names (e.g. glaucoma, retinitis pigmentosa, etc.) and general terms relating to VL (e.g. VL, blindness etc.).[xiv] Pluralization and the French equivalent of each key word were also searched in the Canadian Institutes of Health Research (CIHR) database to ensure all medical research grants in Canada falling under VL were captured in the CIHR database.

In 2019, the medical research costs related to VL was valued at $20.9 million, as shown in Table A.7.

[xiv] List of search terms include: low vision, vision loss, visual impairment, vision impairment, blindness, blindness and deafness, blind deaf disorder, blind deaf disorders, hearing and vision loss, retinal disease, retinal diseases, sensory disease, sensory disorder, ophthalmology, retina, iris, cornea, pupil, sclera, conjunctiva, macula, lens, optic nerve, fovea, eye, macular degeneration, age-related macular degeneration, glaucoma, cataract, diabetic retinopathy, diabetic macular edema, proliferative diabetic retinopathy, refractive error, strabismus, keratoconus, uveitis, presbyopia, photo receptor, photoreceptor, retinal ganglion cell, visual cortex, inherited retinal degeneration, retinitis pigmentosa, ocular imaging.

Table A.7: Medical research costs due to VL, 2019

Cost component	Value ($ million)
Medical research	20.9

Source: Deloitte Access Economics analysis based on Government of Canada (2021)[102], Fighting Blindness Canada (2019)[iv], Glaucoma Research Society of Canada (2019)[iv], Research Society of Canada (2019)[iv] and Vision Health Research Network (2019).[iv]

A.3.8. Capital and administration costs

Other costs associated with providing vision care include capital and administrative costs. The NHEX provides health expenditure by use of funds, which includes capital and administration costs.[46] The proportion of capital and administration costs to all other health expenditure was 6.2%. It was assumed that the proportion of capital and administrative costs to all other health expenditure would remain the same across all conditions and provinces/territories.

In 2019, capital and administration expenditure due to VL was estimated to be $549.7 million. This was estimated by applying the proportion of capital and administration expenditure relative to the remaining health expenditure (6.2%), to the estimated healthcare system expenditure excluding medical research expenditure.

A.4. Productivity losses

A.4.1. Reduced workforce participation

People with VL may be less likely to participate in the workforce compared to an otherwise similar person with no VL. This may be because their VL reduces their likelihood of finding new employment. To measure the impact of reduced workforce participation, the employment rates of the general population can be compared to the employment rates of the population with VL.

There is significant variation in employment rates for people with VL across Canadian and international literature. As such an average employment reduction was estimated based on the

literature in Table A.8. A limitation of this analysis was that the definition of VL was not consistent across all studies. For example, only McDonnall et al (2019)[103] and Cumberland and Rahi (2016)[104] relied on measured visual acuity data.

Table A.8: Employment outcomes for people with VL

Source	Mild	Moderate	Severe	Sample	Country	VL definition
McDonnall et al (2019) (NHANES)[103]	-8%	-38%	-61%	NHANES 1999-2008 (data pooled), mild based on 2008 survey analysis, definition of 20/40 to 20/60	USA	Measured visual acuity, by severity. This most closely aligns with our prevalence definition,
McDonnall et al (2019) (ACS)[103]			-43%	American Community Survey 2017	USA	Self-reported blind or has serious difficulty seeing
Harrabi et al (2014)[105]	-4%	-21%		World Health Survey, 219,048 participants from 59 countries	Global	Correlation between self-reported VL categories and mean logMAR scores were provided. The categories reported most closely aligned with mild VL and moderate VL.

Source	Mild	Moderate	Severe	Sample	Country	VL definition
Slade and Edwards (2015)[106]			-63%	1223 participants. 59% were registered blind.	UK	Either registered blind or registered partially sighted
Cumberland (2016)[104]	-21%	-24%		UK Biobank	UK	Measured logMAR, which most closely aligned with mild VL and moderate VL.
International Levels of Employment Survey (2018)[107]		-37%	-48%		Canada	
CNIB/World Blind Union Employment survey (2019)[107]		-27%	-35%		Canada	
Average	**-11%**	**-29%**	**-50%**			

Source: As noted.

The estimated reduction in employment rates for people with mild VL was 11%. Recent Canadian surveys indicate that this rate may be significantly higher. However, these surveys relied on self-reported data based on the Washington Group questions. There is international evidence to suggest that a significant proportion of people self-reporting 'some difficulty seeing' under this questionnaire (which is linked to mild or moderate VL) may have severe VL.[108] The findings in this report are consistent with the Lancet Global Health Commission which recently reported a 32.1% relative reduction in employment for moderate and severe vision impairment.[109] Despite this, further research linking employment outcomes to measured visual acuity is still needed.

The average employment reductions of 11% (mild VL), 29% (moderate VL) and 50% (severe VL) were applied to the working age population with VL. The total cost of reduced employment due to VL was estimated to be $3,170.8 million in 2019. The breakdown of these productivity losses is provided in Table A.9.

Table A.9: Productivity loss due to reduced employment in people with VL, 2019

Age group	Male	Female	Total
0-19	37.5	30.6	68.0
20-29	175.9	113.3	289.2
30-39	318.6	196.9	515.5
40-49	336.2	252.9	589.1
50-59	548.6	358.0	906.6
60-69	411.6	221.8	633.4
70+	113.5	55.4	168.9
Total	**1,941.9**	**1,228.9**	**3,170.8**

Source Deloitte Access Economics calculations.

A.4.2. Absenteeism

While many people with VL are employed, they may require additional time off from work because of their disability. Additional absences may be required to attend doctor and/or optometrist/ophthalmologist appointments, or because their disability necessitates additional time off. For example, VL is associated with increased fatigue, which may result in additional absenteeism.[110] The costs of absenteeism are measured by the total time off from work due to VL multiplied by the age-sex adjusted average wage.

Previous research into the cost of absenteeism in the population with VL has indicated an average of 4.1 days of absenteeism per person per year.[30,111] The most recent literature in this field discussed productivity losses amongst people with impaired vision in Portugal.[112] The study identified 71 working age adults of whom 92% had moderate VL or better. Twenty-eight (28) of these individuals experienced an average of 33 days of absenteeism. After removing participants with long term absenteeism (consecutive absence from work of three months or more), it was estimated that VL leads to absenteeism of 4.3 days per year.[xv]

Given the consistency of recent literature with previous estimates, it was assumed that the average employed Canadian with VL experienced 4.1 days of absenteeism due to their disability. **The estimated 4.1 days of absenteeism was applied to the working population with VL**. This resulted in a cost of absenteeism due to VL of $318.9 million in 2019. The breakdown of absenteeism losses is provided in Table A.10.

[xv] Employers will typically account for absenteeism through overtime employment of another employee. This employment typically attracts a premium to the average wage. It was assumed that a day of temporary absence attracts 2.5 hours of additional time from a manager (receiving a premium wage). These costs are included in the estimate of absenteeism.

Table A.10: Productivity loss due to absenteeism in people with VL, 2019

Age group	Male	Female	Total
0-19	7.4	7.2	14.6
20-29	23.4	18.1	41.5
30-39	33.5	24.2	57.8
40-49	29.9	22.8	52.7
50-59	35.5	32.9	68.4
60-69	37.4	23.4	60.8
70+	14.7	8.5	23.2
Total	**181.8**	**137.1**	**318.9**

Source Deloitte Access Economics calculations.

A.4.3. Presenteeism

People with VL may be less productive while at work compared to their colleagues without VL. Presenteeism costs are calculated by estimating the amount of productive time lost due to VL and multiplying this against average earnings.

A 2018 study in the Netherlands measured the self-reported work efficiency of employed people with VL compared to people without VL.[113] The study found that self-reported work efficiency was 9.6% lower in the visually impaired population. It is noted that the study population had worse visual acuity than is estimated in the general Canadian population. The study reported that 15% of participants had mild VL, 49% were low vision and the remaining 36% were blind. Given the higher severity of VL in the study's sample, it was assumed that the 9.6% presenteeism would only be incurred by people with moderate or severe VL.

There was limited data available to estimate any presenteeism costs for people with mild VL. It was assumed that no presenteeism losses were incurred by this cohort.

The estimated 9.6% presenteeism was applied to the working population with moderate or severe VL. The total cost of

presenteeism due to VL in 2019 was estimated to be $380.6 million. The breakdown of presenteeism losses is provided in Table A.11.

Table A.11: Productivity loss due to presenteeism in people with VL, 2019

Age group	Male	Female	Total
0-19	2.9	2.3	5.2
20-29	11.4	7.4	18.8
30-39	20.7	12.8	33.5
40-49	31.2	31.9	63.1
50-59	89.4	50.1	139.5
60-69	60.2	34.1	94.2
70+	17.6	8.7	26.3
Total	**233.3**	**147.2**	**380.6**

Source: Deloitte Access Economics calculations.

A.4.4. Premature mortality

There were an estimated 1,290 deaths due to VL in 2019 (see Section 3.2). This represents a productivity cost due to lost lifetime earnings. The cost of premature mortality was estimated based on the age and sex distribution of these deaths and incorporating employment rates and average lifetime earning for different age-sex groups. The premature mortality cost represents the present value of these foregone earnings.

Premature mortality also leads to additional search and hiring costs for replacement workers. These are estimated as the number of people with VL who die prematurely (by age and gender) multiplied by their chance of being employed multiplied by the search and hiring cost brought forward three years (three years reflects the estimated staff turn over rates).

Costs due to premature mortality due to VL in 2019 were estimated to be $110.0 million. The distribution of these costs by age and sex is provided in Table A.12.

Table A.12: Productivity loss due to premature mortality in people with VL, 2019

Age group	Male	Female	Total
65-69	11.0	3.1	14.1
70-74	11.8	3.1	14.9
75-79	12.6	3.7	16.2
80-84	14.1	4.7	18.8
85-89	15.1	6.1	21.1
90+	14.4	10.4	24.8
Total	**78.9**	**31.0**	**110.0**

Source: Deloitte Access Economics calculations.

A.4.5. Informal care costs

People with VL may require additional support in their everyday lives. This support may be provided by an informal caregiver, typically a spouse, friend or another member of the family. Though informal care is provided free of charge, the services are not free from an economic perspective. There is an opportunity cost to providing informal care, which is measured be what the caregiver could have earned had they been in the workforce.

Informal care costs were measured by estimating the additional hours of care provided to people because of their VL and multiplying this against age-sex adjusted earnings. The use of informal care in Canada has been estimated using data from the CLSA.[114] The study included more than 29,000 participants with data on visual acuity, of which 417 participants had VL. Only participants aged 45-85 years were included in the study, of which 15.1% of people with VL reported receiving some level of informal care compared to 8.3% of people with no VL. Using the difference in proportion from these two groups, it was estimated that 6.8% of people with VL received informal care because of their VL. To estimate the number of informal caregivers providing care to people living with VL, the 6.8% was applied to the estimated

prevalence of VL. There are approximately 100,000 informal caregivers for people with VL in 2019.

People with VL reported receiving 4.6 hours of informal care per week.[xvi] Applied to the total number of caregivers and adjusted to an annual rate, it was estimated that 23.8 million hours of informal care were provided to people with VL in 2019.

The estimated cost of informal care is likely conservative. A recent study of informal care in Portugal reported informal care use by 39.6% of participants with VL.[115] Similar rates of informal care have also been reported in the US and Australia.[116,117] With regard to hours of care received, the estimated 4.6 hours of informal care per week is closer to the lower bound when compared to other international literature.[116,118]

Based on these data, the total cost of informal care due to VL in 2019 was estimated to be $290.5 million in 2019.

Table A.13: Total cost of informal care due to VL, 2019

Age group	Male	Female	Total
0-19	20.9	20.0	40.8
20-29	9.0	8.3	17.3
30-39	8.8	8.7	17.6
40-49	7.1	7.7	14.8
50-59	10.4	13.2	23.6
60-69	24.8	24.8	49.6
70+	55.1	71.6	126.7
Total	**136.1**	**154.3**	**290.5**

Source: Deloitte Access Economics calculations.

[xvi] People with VL received 8.3 hours of care per week when they received care. It was estimated that care was provided for 28.8 weeks per year. This resulted in a weekly estimate of 4.6 hours of care.

A.5. Other costs

A.5.1. Private expenditure on aids, equipment and home modifications

People with VL may pay for a number of aids, equipment or home modifications because of their condition. These include items such as guide dogs, installing handrails in the bathroom, magnifying glasses, Global Positioning System (GPS), electronic mobility devices and other similar products used to assist persons living with VL.

The cost of aids and modifications for persons living with VL was estimated by using the:

- Proportion of persons living with VL that used each aid or modification
- Average utilization of each aid or modification per person living with VL
- Incremental unit cost of each aid or modification.

The utilization of aids and modifications was informed from three separate sources of survey data. A survey of 151 people living with an IRD in Canada informed the proportion of people using aids and modifications as well as the number of units used per year.[119] The 2017 Canadian Survey of disability was used as another point of comparison for the proportion of Canadians with a seeing disability using each type of aid or modification.[120] Finally data from 436 respondents to a 2019 survey by the CCB was incorporated into the analysis.[121] The final utilization and unit cost data for each aid and modification is available in Table A.14.

Based on these data, the cost of aids, equipment and home modifications due to VL in 2019 was estimated to be $166.4 million in 2019.

Table A.14: Utilization of aids and modifications by people with VL

Aids and modifications	Units/ year	Unit cost ($)	Proportion of VL population (%)
Guide dog	1	74,300	0*
Electronic mobility device	1	767	21
Portable note takers	1.6	739	3
Braille displays	3	278	3
Screen magnification	1.6	160	32
Spoken word processors	1.4	110	15
Screen reading	2.9	110	29
High vision lamps	3.5	80	21
Ergonomic adaptation at work	2.4	59	15
Ergonomic adaptations at home	1.7	59	15
Verbal calculators	4.2	49	13
Customized clocks or timers	2.9	48	19
Contrast enhancing filters	1.8	48	15
Large keyboards	6	40	11
Tactile or large print	7.8	36	28
White cane	1	34	41
Magnifiers	5.2	25	36
Books with enlarged font	2.6	20	27
Green or blue sunglasses	3.2	18	27
Book alternatives	4.3	16	49
Magnifying mirrors	1.4	15	11

Source: Deloitte Access Economics (2020)[119], CCB (2019)[121], Canadian Survey of Disability (2017).[56] * Based on 800 Canadians with VL using a guide dog in 2019.

A.5.2. Low vision rehabilitation services

Canadians living with VL may access additional support services, either through a rehabilitation or habilitation specialist, or a sight support volunteer. **It was estimated that the cost of low vision rehabilitation services due to VL was estimated to be $84.9 million.**

The estimated cost of low vision rehabilitation services was based on the annual expenditure of Vision Loss Rehabilitation Canada, Deafblind Community Services, Institut Nazareth et Louis-Braille and other Community-based programs and services. Specialists typically provide services related to essential skills of daily living, orientation, mobility and travel services and low vision assistive technology services.[122, 123, 124, 125]

A survey of people with VL from inherited retinal dystrophies showed approximately 8.6% accessed habilitation, rehabilitation or low vision specialists and 2.7% accessed additional services from a sight support volunteers.[119] The respondents to the survey indicated they typically accessed these services around 10 times per year.

A.5.3. Formal care

People with VL may have a higher need for care from a private nurse, or paid for assistance with activities such as childcare, housekeeping and shopping than people with no VL. These costs are paid out-of-pocket by the individual and are not subsidized by private health insurance or the government. **It was estimated that the total cost of formal care due to VL was $336.6 million.**

The cost of formal care for people with VL was estimated by determining the proportion of people with VL receiving formal care relative to the general population, the number of formal care hours received, and the unit cost per hour of formal care.

One study used data from the CLSA to determine that 13.3% of the VL population accessed formal care.[114] Relative to the

general population, it was estimated that 9.6% of people with VL accessed formal care for their VL. It was estimated that these people received an average of 138 hours of formal care annually.

The hourly cost of formal care was estimated to be $21 using the average hourly wage rates by occupation in the Annual Labour Force Survey published by Statistics Canada.[126]

A.5.4. Aged and home care

People with VL may have a higher need for access to residential care in cases where they can receive continuous care and supervision. Residential care is typically accessed by the elderly and as such, costs were assumed to only be incurred by people over the age of 65 years. It was estimated that there were 39,962 people with VL accessing residential care in 2019. **The total cost of residential care due to VL in 2019 was estimated to be $446.8 million.**

Data on the number of people with VL accessing residential care were informed from the CIHI.[127] There were 39,962 people accessing residential care with disease diagnoses of cataract, DR, glaucoma and macular degeneration. However, the data indicated that each person accessing residential care had an average of 5.8 disease diagnoses. To account for this the average cost of providing residential care was divided by 5.8 to estimate the cost of providing care for a single condition.

The cost of residential care in Canada was estimated to be $64,909 per person in 2019.[128] Adjusting for multiple conditions, it was estimated that the cost of caring for a person's VL was $11,181.

People with VL may also be more likely to access residential care earlier because of their VL. The likelihood of entering residential care because of VL has varied based on the controls for confounding factors. For example, data from the Blue Mountains Eye Study in Australia indicated a relative risk 1.8 times higher for people with VL.[129] A later study from the UK which controlled for additional factors such as other report major illnesses found no additional risk of admission associated with VL.[130]

A.5.5. Efficiency losses

Government payments to people with VL represent a transfer of resources within society. Though transfers within society are not an economic cost, there is an associated loss of efficiency. For the Canadian government to provide payments to people with VL, they effectively need to increase taxes on other people in society to achieve a budget neutral position. In other words, if VL could be avoided, the government would need to raise less taxation revenue.

Estimates of the efficiency losses associated with VL rely on knowledge of:

- The welfare payments to people living with VL and their carers (noting the cost of welfare payments themselves are not included in the cost of VL in Canada)
- Reduced taxation revenue from lower employment participation or greater absences and presenteeism
- Expenditure by government on other programs to support people with VL (e.g. healthcare system costs)
- The marginal excess burden of taxation.

Welfare payments

The cost of welfare payments themselves are not included in the cost of VL in Canada. However, there are efficiency losses that arise from raising and administering welfare payments. These efficiency losses are included in the analysis. Welfare payments for Canadians living with VL were estimated to be $529.8 million in 2019.

Persons living with VL may be eligible for several forms of government support, the:

- Canada Pension Plan Disability Benefit/Quebec Pension Plan Disability Benefit
- Disability Tax Credit.

Informal caregivers of Canadians with VL may be eligible to receive the Canada Caregiver Credit. The estimated entitlements for each type of payment are displayed in Table A.15.

Table A.15: Welfare payments received by persons living with VL ($ 2019) by welfare type

Type	Welfare	Entitlement ($)
Individual	Canada Pension Plan/ Quebec Pension Plan Disability Benefit	12,126.8
Individual	Disability Tax Credit	6,662.5
Caregiver	Canada Caregiver Credit	2,230.0 plus to a maximum of 7,140.0 per year

Source: Deloitte Access Economics (2020).[119]

No national data were available to estimate welfare recipients based on their VL. One study estimated the rate at which individuals with VL accessed the Ontario Disability Support Program.[131] It was assumed that this rate was representative of individuals accessing disability support in other Canadian provinces / territories. It is noted that the study accounted for comorbidities such as type II diabetes, and therefore the estimate reflects the number of people accessing welfare payments because of their VL.

Survey data from the 2019 study of Canadians with an IRD found that Canadians with VL were 3.4 times more likely to access the Canadian Disability Tax Credit than the Disability Benefit. This ratio was assumed to apply to the VL population more broadly when estimating the number of disability tax credit recipients.

Survey data from the 2019 study of Canadians with an IRD found that 6.6% of informal caregivers accessed government support payments. This proportion was assumed to apply to informal caregivers of Canadians with VL when determining the estimated caregiver payments.

Average taxation rate

Reduced earnings from lower employment participation and lower output result in reduced taxation revenue collected by the government. Alongside lower income taxation, there would also be a fall in indirect (consumption) taxes, as those with lower incomes spend less on the consumption of goods and services. Lost taxation revenue was estimated by applying an average personal income tax rate and average indirect taxation rate to lost earnings.

Applying these tax rates to the total productivity impacts (including informal care costs), the total lost individual income tax revenue was estimated to be $253.6 million (including lost caregiver taxes), while the total lost company tax revenue was estimated to be $116.7 million in Canada in 2019.

Marginal burden of taxation

The efficiency loss due to lost taxation revenue (given an assumption of no change in spending) or additional expenditure on government programs (e.g. health or welfare) can be estimated by applying the marginal burden of taxation to the total of lost taxation and government expenditures. This marginal burden was estimated to be 14.0%.[132]

The total efficiency losses associated with VL in 2019 were estimated to be $769.1 million, as shown in Table A.16.

Table A.16: Efficiency losses due to VL, 2019

Cost component	Total cost ($ million)	Resulting efficiency loss ($ million)
Welfare payments	529.9	75.8
Government programs (e.g. health)	3,907.5	558.8
Lost individual taxes	782.4	111.9
Lost caregiver taxes	67.4	9.6
Lost company taxes	91.2	13.0
Total	**5,378.4**	**769.1**

Source: Deloitte Access Economics calculations.

A.6. Loss of wellbeing

The value of lost quality of life due to VL in Canada in 2019 was estimated using the burden of disease methodology developed by the WHO, the World Bank and Harvard University.[133] The burden of disease methodology is a non-financial approach to quantifying the loss of wellbeing, where life and health are measured in terms of disability adjusted life years (DALYs). DALYs account for both years of life lost due to disability (YLDs) and years of life lost due to premature deaths (YLLs), and one DALY is equivalent to one year of healthy life lost.

DALYs can be converted into a dollar amount to estimate the value of lost quality of life due to VL through the use of the value of a statistical life year (VSLY). The VSLY is the value that society places on an anonymous life, which is an estimate of the value society places on reducing the risk of dying or avoiding certain health states and therefore living in better health.

The loss of wellbeing was quantified by estimating the loss of wellbeing by severity of VL, based on the Global Burden of Disease (GBD) definitions.[134] The GBD allocates a disability weight for various conditions (including VL) which estimates the severity of a disease on a scale from 0 (perfect health) to 1

(equivalent to death). The disability weights used in this analysis are provided in Table A.17.

Table A.17: Disability weights in the GBD, 2019

Severity level	Description	Disability weight
Presbyopia	Has difficulty seeing things that are nearer than three feet but has no difficulty with seeing things at a distance.*	0.011
Moderate VL	Has vision problems that make it difficult to recognize faces or objects across a room.	0.031
Severe VL	Has severe VL, which causes difficulty in daily activities, some emotional impact (for example worry), and some difficulty going outside the home without assistance.	0.184
Blindness	Is completely blind, which causes great difficulty in some daily activities, worry and anxiety, and great difficulty going outside the home without assistance.	0.187

Source: GBD (2019) *The disability weight for presbyopia was used to inform the disability weight for mild VL. There are other types of mild VL which would fit a different description but still have the same disability weight.

The GBD does not currently report a disability weight for mild VL. It was assumed that the disability weight for mild VL is approximate to the disability weight for presbyopia (near vision impairment). While there are other types of mild VL which do not align closely to the definition of near VL, it was assumed that the impacts would be comparable, noting it is expected the disability weight would be lower than for moderate VL. Therefore, a disability weight of 0.011 was applied to Canadians with mild VL.

The descriptions of moderate and severe VL in the GBD align with the definitions of moderate and severe VL used in this report. Thus, a disability weight of 0.031 was applied to people with moderate VL and 0.184 for severe VL.

As noted, DALYs can be converted into a dollar amount to estimate the value of lost quality of life due to VL through the use of the value of a statistical life year (VSLY). The VSLY is the value that society places on an anonymous life, which is an estimate of the value society places on reducing the risk of dying or avoiding certain health states and therefore living in better health. No national guidance on the empirical VSLY in Canada was found. As such, an estimated VSLY for North America was adopted, based on empirical data on the value of a statistical life published between 1995 and 2015.[68] After converting from USD to CAD and adjusting for inflation to 2019, the VSLY in Canada was estimated at $417,050.

Appendix B Province specific estimates

B.1. Prevalence cases by severity for each province/territory

Table B.1: Prevalence of VL in Alberta by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	6,347	1,058	529	7,934
15-64	18,098	6,196	1,500	25,794
65+	13,518	11,139	655	25,312
Total	*37,963*	*18,393*	*2,684*	*59,040*
Female				
0-14	6,080	1,013	507	7,600
15-64	18,139	6,508	1,451	26,097
65+	16,273	13,730	846	30,850
Total	*40,492*	*21,251*	*2,804*	*64,547*
Person				
0-14	12,427	2,071	1,036	15,534
15-64	36,237	12,703	2,951	51,891
65+	29,791	24,870	1,502	56,162
Total	*78,455*	*39,644*	*5,488*	*123,587*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.2: Prevalence of VL in British Columbia by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	5,625	938	469	7,032
15-64	20,207	7,529	1,663	29,399
65+	22,627	18,743	1,107	42,477
Total	*48,460*	*27,210*	*3,238*	*78,908*
Female				
0-14	5,360	893	447	6,701
15-64	21,055	8,331	1,658	31,043
65+	26,431	22,298	1,373	50,103
Total	*52,846*	*31,522*	*3,478*	*87,846*
Person				
0-14	10,986	1,831	915	13,732
15-64	41,262	15,860	3,321	60,442
65+	49,058	41,041	2,480	92,579
Total	*101,306*	*58,732*	*6,716*	*166,754*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.3: Prevalence of VL in Manitoba by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	1,991	332	166	2,489
15-64	5,485	1,903	454	7,841
65+	4,993	4,138	244	9,376
Total	*12,469*	*6,373*	*864*	*19,706*
Female				
0-14	1,923	320	160	2,403
15-64	5,521	2,021	439	7,981
65+	6,255	5,318	332	11,905
Total	*13,699*	*7,660*	*931*	*22,290*
Person				
0-14	3,914	652	326	4,892
15-64	11,006	3,923	893	15,822
65+	11,248	9,457	576	21,281
Total	*26,168*	*14,033*	*1,795*	*41,996*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.4: Prevalence of VL in New Brunswick by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	888	148	74	1,110
15-64	2,974	1,224	243	4,440
65+	3,837	3,124	183	7,143
Total	*7,699*	*4,495*	*499*	*12,694*
Female				
0-14	844	141	70	1,055
15-64	3,095	1,319	240	4,655
65+	4,651	3,920	241	8,812
Total	*8,590*	*5,380*	*552*	*14,522*
Person				
0-14	1,732	289	144	2,165
15-64	6,070	2,543	483	9,096
65+	8,488	7,044	424	15,955
Total	*16,290*	*9,876*	*1,051*	*27,216*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.5: Prevalence of VL in Newfoundland by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	581	97	48	726
15-64	2,013	842	164	3,020
65+	2,598	2,084	121	4,803
Total	*5,192*	*3,024*	*333*	*8,549*
Female				
0-14	549	91	46	686
15-64	2,123	922	165	3,211
65+	2,948	2,456	148	5,552
Total	*5,621*	*3,470*	*358*	*9,449*
Person				
0-14	1,129	188	94	1,412
15-64	4,136	1,764	329	6,230
65+	5,546	4,541	268	10,355
Total	*10,812*	*6,493*	*692*	*17,997*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.6: Prevalence of VL in Northwest Territories by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	68	11	6	85
15-64	194	70	16	281
65+	93	73	4	170
Total	*355*	*155*	*26*	*536*
Female				
0-14	68	11	6	85
15-64	193	68	16	276
65+	82	67	4	153
Total	*343*	*146*	*25*	*514*
Person				
0-14	136	23	11	170
15-64	387	138	32	557
65+	175	140	8	323
Total	*699*	*301*	*51*	*1,051*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.7: Prevalence of VL in Nova Scotia by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	1,070	178	89	1,338
15-64	3,717	1,498	303	5,519
65+	4,637	3,782	221	8,639
Total	*9,424*	*5,458*	*614*	*15,496*
Female				
0-14	1,020	170	85	1,275
15-64	3,962	1,648	308	5,918
65+	5,724	4,822	296	10,842
Total	*10,706*	*6,640*	*689*	*18,035*
Person				
0-14	2,090	348	174	2,613
15-64	7,679	3,146	612	11,437
65+	10,361	8,603	517	19,481
Total	*20,130*	*12,098*	*1,303*	*33,531*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.8: Prevalence of VL in Nunavut by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	93	16	8	117
15-64	154	44	13	211
65+	35	27	1	63
Total	*282*	*86*	*22*	*390*
Female				
0-14	91	15	8	114
15-64	151	43	12	206
65+	30	24	1	56
Total	*272*	*82*	*21*	*376*
Person				
0-14	184	31	15	231
15-64	304	87	25	417
65+	65	51	3	119
Total	*554*	*169*	*44*	*766*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.9: Prevalence of VL in Ontario by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	17,811	2,968	1,484	22,263
15-64	58,093	21,293	4,808	84,194
65+	58,378	48,547	2,869	109,794
Total	*134,282*	*72,809*	*9,160*	*216,251*
Female				
0-14	17,127	2,854	1,427	21,409
15-64	60,308	23,161	4,775	88,244
65+	73,645	62,407	3,871	139,923
Total	*151,079*	*88,423*	*10,073*	*249,575*
Person				
0-14	34,938	5,823	2,911	43,672
15-64	118,401	44,454	9,582	172,437
65+	132,023	110,955	6,739	249,717
Total	*285,361*	*161,232*	*19,233*	*465,826*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.10: Prevalence of VL in Prince Edward Island by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	189	32	16	237
15-64	599	234	49	882
65+	710	575	34	1,319
Total	*1,498*	*841*	*98*	*2,437*
Female				
0-14	188	31	16	235
15-64	633	258	49	940
65+	879	739	45	1,663
Total	*1,699*	*1,028*	*110*	*2,838*
Person				
0-14	377	63	31	471
15-64	1,231	492	99	1,822
65+	1,588	1,314	79	2,981
Total	*3,197*	*1,869*	*209*	*5,274*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.11: Prevalence of VL in Quebec by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	10,377	1,729	865	12,971
15-64	33,171	12,798	2,719	48,687
65+	38,140	31,363	1,848	71,351
Total	*81,688*	*45,890*	*5,432*	*133,009*
Female				
0-14	9,977	1,663	831	12,471
15-64	33,655	13,452	2,636	49,743
65+	46,733	39,530	2,450	88,712
Total	*90,365*	*54,644*	*5,917*	*150,926*
Person				
0-14	20,353	3,392	1,696	25,442
15-64	66,826	26,249	5,354	98,430
65+	84,873	70,892	4,298	160,063
Total	*172,052*	*100,534*	*11,349*	*283,935*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.12: Prevalence of VL in Saskatchewan by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	1,772	295	148	2,215
15-64	4,731	1,665	390	6,787
65+	4,373	3,663	217	8,253
Total	*10,876*	*5,623*	*755*	*17,254*
Female				
0-14	1,712	285	143	2,140
15-64	4,663	1,709	370	6,742
65+	5,455	4,661	293	10,409
Total	*11,830*	*6,655*	*806*	*19,290*
Person				
0-14	3,484	581	290	4,355
15-64	9,394	3,375	759	13,528
65+	9,827	8,323	511	18,661
Total	*22,706*	*12,278*	*1,560*	*36,544*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.13: Prevalence of VL in Yukon by severity, age and sex

Age group (years) / sex	Mild	Moderate	Severe	Total
Male				
0-14	54	9	5	68
15-64	171	64	14	249
65+	120	92	5	217
Total	*345*	*165*	*24*	*534*
Female				
0-14	50	8	4	62
15-64	178	70	14	263
65+	103	83	5	190
Total	*331*	*161*	*23*	*515*
Person				
0-14	104	17	9	130
15-64	349	134	28	512
65+	222	175	10	407
Total	*676*	*326*	*47*	*1,049*

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

B.2. Inpatient hospitalization cost disaggregated by province/territory

Table B.14: Inpatient hospitalization cost disaggregated by province/territory in Canada in 2019

Province / territory	Volume	Cost ($ million)
Alberta	1,477	6.3
British Columbia	585	2.2
Manitoba	269	1.0
New Brunswick	70	0.2
Newfoundland and Labrador	37	0.1
Northwest Territories	4	0.02
Nova Scotia	190	0.7
Nunavut	No information available	No information available
Ontario	1,586	5.3
Prince Edward Island	10	0.01
Quebec	1,396	5.0
Saskatchewan	344	1.3
Yukon	6	0.03
Total	5,975	22.4

Source: Deloitte Access Economics estimates based on CIHI Patient Cost Estimator (2018-19).[33]

B.3. Cataract day surgery volume and expenditure disaggregated by province/territory

Table B.15: Cataract day surgery volume and expenditure disaggregated by province/territory in Canada in 2019

Province / territory	Volume	Cost ($ million)
Alberta	52,401	78.0
British Columbia	62,691	93.3
Manitoba	13,133	19.5
New Brunswick	10,234	15.2
Newfoundland and Labrador	5,567	8.3
Northwest Territories	621	0.9
Nova Scotia	10,966	16.3
Nunavut	533	0.8
Ontario	140,501	209.1
Prince Edward Island	2,132	3.2
Quebec	96,763	144.0
Saskatchewan	16,480	24.5
Yukon	561	0.8
Total	**412,583**	**613.9**

Source: Deloitte Access Economics estimates based on CIHI Implantable Medical Devices in Canada Report (2018-19).[44]

B.4. Ophthalmic services and costs disaggregated by province/territory

Table B.16: Ophthalmic services and costs disaggregated by province/territory in Canada in 2019

Province / territory	Volume of services	Cost ($ million)
Alberta	2,220,385	146.5
British Columbia	2,962,490	200.8
Manitoba	276,641	27.9
New Brunswick	576,864	23.8
Newfoundland and Labrador	139,326	14.3
Northwest Territories	19,994	1.3
Nova Scotia	364,982	26.0
Nunavut	17,151	1.1
Ontario	6,619,781	354.2
Prince Edward Island	24,972	3.1
Quebec	2,706,911	236.9
Saskatchewan	699,483	36.4
Yukon	18,039	1.2
Total	**16,647,019**	**1,073.4**

Source: Deloitte Access Economics estimates based on CIHI National Physicians Database (2020).[43]

B.5. Healthcare system costs disaggregated by province/territory

Table B.17: Healthcare system costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	3,966.0	8,514	41.8
Quebec	2,044	7,199	21.5
British Columbia	1,281	7,681	13.5
Alberta	1,122	9,082	11.8
Manitoba	300	7,144	3.2
Saskatchewan	245	6,705	2.6
Nova Scotia	224	6,695	2.4
New Brunswick	169	6,220	1.8
Newfoundland and Labrador	87	4,852	0.9
Prince Edward Island	30	5,745	0.3
Northwest Territories	10	9,093	0.1
Nunavut	8	10,798	0.1
Yukon	7	6,969	0.1

Source: Deloitte Access Economics estimates.

B.6. Productivity costs disaggregated by province/territory

Table B.18: Productivity costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	1,534	3,293	38.5
Quebec	912	3,211	22.9
British Columbia	548	3,288	13.8
Alberta	452	3,654	11.3
Manitoba	137	3,267	3.4
Saskatchewan	119	3,258	3.0
Nova Scotia	106	3,147	2.7
New Brunswick	86	3,143	2.1
Newfoundland and Labrador	59	3,264	1.5
Prince Edward Island	17	3,138	0.4
Northwest Territories	5	4,478	0.1
Yukon	4	4,273	0.1
Nunavut	3	4,052	0.1

Source: Deloitte Access Economics estimates.

B.7. Other costs disaggregated by province/territory

Table B.19: Other costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	711.0	1,526	39.4
Quebec	419.5	1,477	23.3
British Columbia	249.9	1,499	13.9
Alberta	185.9	1,504	10.3
Manitoba	60.2	1,433	3.3
Saskatchewan	52	1,414	2.9
Nova Scotia	49	1,463	2.7
New Brunswick	39	1,443	2.2
Newfoundland and Labrador	25	1,369	1.4
Prince Edward Island	7	1,402	0.4
Northwest Territories	1	1,422	0.1
Yukon	1	1,368	0.1
Nunavut	1	1,369	0.1

Source: Deloitte Access Economics estimates.

B.8. Loss of wellbeing disaggregated by province/territory

Table B.20: Loss of wellbeing due to VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	6,705	14,393	38.6
Quebec	4,135	14,564	23.8
British Columbia	2,422	14,525	14.0
Alberta	1,706	13,804	9.8
Manitoba	596	14,198	3.4
Saskatchewan	521	14,255	3.0
Nova Scotia	491	14,655	2.8
New Brunswick	400	14,698	2.3
Newfoundland and Labrador	262	14,573	1.5
Prince Edward Island	77	14,523	0.4
Yukon	14	13,214	0.1
Northwest Territories	13	12,730	0.1
Nunavut	9	11,669	0.1

Source: Deloitte Access Economics estimates.

B.9. Total costs disaggregated by province/territory

Table B.21: Total financial and economic costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	6,322.8	13,573	40.6
Quebec	3,443.6	12,128	22.1
British Columbia	2,119.1	12,708	13.6
Alberta	1,789.6	14,481	11.5
Manitoba	507.5	12,084	3.3
Saskatchewan	424.5	11,617	2.7
Nova Scotia	387.1	11,545	2.5
New Brunswick	300.6	11,045	1.9
Newfoundland and Labrador	175.0	9,725	1.1
Prince Edward Island	55.5	10,526	0.4
Northwest Territories	16.0	15,232	0.1
Yukon	13.5	12,850	0.1
Nunavut	12.6	16,460	0.1

Source: Deloitte Access Economics estimates.

Table B.22: Total costs of VL by province/territory, 2019

Province	Total cost ($ millions)	Cost per person with VL ($)	Proportion of costs (%)
Ontario	13,027	27,966	39.6
Quebec	7,579	26,692	23.0
British Columbia	4,541	27,233	13.8
Alberta	3,496	28,285	10.6
Manitoba	1,104	26,283	3.4
Saskatchewan	945	25,872	2.9
Nova Scotia	878	26,199	2.7
New Brunswick	701	25,743	2.1
Newfoundland and Labrador	437	24,298	1.3
Prince Edward Island	132	25,048	0.4
Northwest Territories	29	27,962	0.1
Yukon	27	26,064	0.1
Nunavut	22	28,130	0.1

Source: Deloitte Access Economics estimates.

Endnote

[1] Rumaisa Aljied et al, 'Prevalence and determinants of visual impairment in Canada: Cross-sectional data from the Canadian Longitudinal Study on Aging' (2018) 53(3) *Canadian Journal of Ophthalmology* 291.

[2] Canadian Journal of Health Technologies, 2020, CADTH Recommends First Gene Therapy Treatment for Rare Form of Childhood Vision Loss, https://www.cadth.ca/news/cadth-recommends-first-gene-therapy-treatment-rare-form-childhood-vision-loss, accessed 23 April 2021

[3] Robert Finger et al, 'Anti-vascular endothelial growth factor in neovascular age-related macular degeneration – a systematic review of the impact of anti-VEGF on patient outcomes and healthcare systems', (2020) BMC Ophthalmology 20(294):1-14.

[4] Access Economics, *The cost of vision loss in Canada* (report commissioned by Canadian National Institute for the Blind and the Canadian Ophthalmological Society, 12 December 2008).

[5] CNIB Foundation 2019, What is Blindness?, https://cnib.ca/en/sight-loss-info/blindness/what-blindness?region=on, accessed 21 January 2021.

[6] Alan Cruess et al, 'The cost of vision loss in Canada. 2. Results' (2011) 46(4) *Canadian Journal of Ophthalmology* 315.

[7] Robert Campbell et al, 'Diabetes-induced eye disease among First Nations people in Ontario: a longitudinal, population-based cohort study' (2020) Canadian Medical Association Journal E282.

[8] Paul Mitchell et al, 'Age-related macular degeneration' (2018) 392(10153) *The Lancet* 1147.

[9] David Boyer et al, 'The pathophysiology of geographic atrophy secondary to age-related macular degeneration and

the complement pathway as a therapeutic target' (2017) 37(5) *Retina* 819.

[10] Vohar Yehoshua et al, 'Systemic complement inhibition with eculizumab for geographic atrophy in age-related macular degeneration: the COMPLETE study' (2014) 121(2) *Ophthalmology* 693.

[11] Brian Yaspan et al, 'Targeting factor D of the alternative complement pathway reduces geographic atrophy progression secondary to age-related macular degeneration' (2017) 9(395) *Science Translational Medicine* 1443.

[12] Canadian Agency for Drugs and Technologies in Health (CADTH) 2016, https://www.cadth.ca/sites/default/files/pdf/TR0009_anti-vegf-in-brief-e.pdf, accessed 15 March 2021.

[13] Yu-Chi Liu et al, 'Cataracts' (2017) 390 (10094) *The Lancet* 600.

[14] Wei Wang et al, 'Diabetic Retinopathy: pathophysiology and treatments' (2018) 19(6) *International Journal of Molecular Sciences* 1816.

[15] Michael Stewart et al, 'Current management of diabetic tractional retinal detachments' (2018) 66(12) *Indian Journal of Ophthalmology* 1751.

[16] Borja Corcostegui et al, 'Update on diagnosis and treatment of diabetic retinopathy: a consensus guideline of the Working Group of Ocular Health (Spanish Society of Diabetes and Spanish Vitreous and Retina Society)' (2017) *Journal of Ophthalmology* 1.

[17] David Antonetti et al 'Diabetic Retinopathy' (2012) 366(13) *New England Journal of Medicine* 1227.

[18] Jost Jonas et al, 'Glaucoma' (2017) 390(10108) *The Lancet* 2183.

[19] Khushwant Yadav et al, 'Glaucoma: Current treatment and impact of advanced drug delivery systems' (2019) 221 *Life Sciences* 362.

[20] Maberley et al, 'The prevalence of low vision and blindness in Canada' (2006) 20 *Eye* 341.

[21] Brien Holden et al, 'Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050' (2016) 123(5) *Ophthalmology* 1036.

[22] Tiffany Chan et al, 'Estimates of Incidence and Prevalence of Visual Impairment, Low Vision, and Blindness in the United States' (2018) 136(1) *JAMA Ophthalmology* 12.

[23] Rohit Varma et al, 'Visual Impairment in Preschool Children in the United States: Demographic and Geographic Variations From 2015 to 2060' (2017) 135(6) JAMA Ophthalmology 610

[24] Statistics Canada 2019, Population Projections for Canada (2018 to 2068), Provinces and Territories (2018 to 2043), https://www150.statcan.gc.ca/n1/pub/91-520-x/91-520-x2019001-eng.htm, accessed December 2020.

[25] John Wittenborn et al, 'The Economic Burden of Vision Loss and Eye Disorders among the United States Population Younger than 40 Years' (2013) 120(9) *Ophthalmology* 1728.

[26] Paul Mick et al, 'The Prevalence of Hearing, Vision, and Dual Sensory Loss in Older Canadians: An Analysis of Data from the Canadian Longitudinal Study on Aging' (2021) 40(1) Canadian Journal on Aging 1.

[27] The International Agency for the Prevention of Blindness (IAPB), The IAPB Vision Atlas 2021, https://www.iapb.org/learn/vision-atlas/about/, accessed 10 March 2021.

[28] Rohit Varma et al, 'Visual impairment and blindness in adults in the United States: demographic and geographic variations from 2015 to 2050' (2016) *134(7) JAMA ophthalmology* 802.

[29] Narayanan et al, 'Dry Eye Disease and Microbial Keratitis: Is There a Connection?' (2014) 11(2) *Ocul Sruf* 75.

[30] Lynne Pezzullo et al, 'The economic impact of sight loss and blindness in the UK adult population', (2018) 18(63) *BMC Health Services Research* 1.

[31] Joshua Ehrlich et al, 'Association between vision impairment and mortality: a systematic review and meta-analysis' (2021) S2214-109X(20) *The Lancet Global Health* 20549.

[32] Tong Zhang et al, 'The association between visual impairment and the risk of mortality: a meta-analysis of prospective studies' (2016) 70(8) *Journal of Epidemiology and Community Health* 836.

[33] Canadian Institute for Health Information (CIHI) 2019a, Patient Cost Estimator, https://www.cihi.ca/en/patient-cost-estimator, accessed 5 March 2021.

[34] Public Health Agency of Canada 2018, Economic burden of illness in Canada 2010, https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/science-research/economic-burden-illness-canada-2010/economic-burden-illness-canada-2010.pdf, accessed 5 March 2021.

[35] Canadian Institute for Health Information (CIHI) 2019b, Injury and Trauma Emergency Department and Hospitalization Statistics, 2018–2019, https://secure.cihi.ca/estore/productSeries.htm?pc=PCC1459, accessed 5 March 2021.

[36] Paul Scuffham et al, 'Incidence and costs of unintentional falls in older people in the United Kingdom' (2003) 57 *Journal of Epidemiology and Community Health* 740.

[37] John Woolcott et al, 'The cost of fall related presentations to the ED: A prospective, in-person, patient-tracking analysis of health resource utilization' (2011) 23(5) Osteoporosis International 1513.

[38] Parachute, 'The cost of Injury in Canada June 2015', https://parachute.ca/wp-content/uploads/2019/06/Cost_of_Injury-2015.pdf, accessed 5 March 2021.

[39] Government of Canada (2021), CIHR Canadian Research Information System, https://webapps.cihr-

irsc.gc.ca/cris/Search?p_language=E&p_version=CRIS, accessed 2 March 2021.

[40] IQVIA 2019a, 'Pharmaceutical trends: Top 10 Therapeutic Classes by Hospital Purchases, Canada, 2019' https://www.iqvia.com/-/media/iqvia/pdfs/canada/2019-trends/top10therapeuticclasseshospital_en_19.pdf?la=en&hash=2699F7C547DDA20A11462753EF0F2103, accessed 11 March 2021.

[41] IQVIA 2019b, 'Pharmaceutical trends: Top 10 Therapeutic Classes by Drug Store Purchases, Canada, 2019' https://www.iqvia.com/-/media/iqvia/pdfs/canada/2019-trends/top10therapeuticclassesdrugstore_en_19.pdf?la=en&hash=316013738A0528A4431292DDAB0178A3, accessed 11 March 2021.

[42] Patented Medicine Prices Review Board (PMPRB), CompassRx, 6th edition: Annual Public Drug Plan Expenditure Report, 2019, https://www.canada.ca/content/dam/pmprb-cepmb/documents/npduis/analytical-studies/compassrx-6th-edition/NPDUIS-CompassRx6th-2018-2019_en.pdf, accessed 24 February 2021.

[43] Canadian Institute for Health Information (CIHI) 2019c, 'National Physician Database metadata', https://www.cihi.ca/en/national-physician-database-metadata, accessed 27 February 2021.

[44] Canadian Institute for Health Information (CIHI) 2020, 'Implantable Medical Devices in Canada: Insights Into High-Volume Procedures and Associated Costs', accessed 5 March 2021.

[45] Canadian Institute for Health Information (CIHI) 2019d, Who is paying for these services?, https://www.cihi.ca/en/who-is-paying-for-these-services, accessed 9 March 2021.

[46] Canadian Institute for Health Information (CIHI) 2019f, National Health Expenditure Trends – Series H, https://www.cihi.ca/en/national-health-expenditure-trends, accessed 5 March 2021.

[47] Clinical Practice Guideline Expert Committee, 'Canadian Ophthalmological Society evidence-based clinical practice guidelines for the periodic eye examination in adults in Canada', (2006) (

[48] Campbell et al, 'Diabetes-induced eye disease among First Nations people in Ontario: a longitudinal, population-based cohort study', 8(2), *CMAJ OPEN* E282.

[49] Yaping Jin et al, 'Lack of government-funded optometric services is associated with reduced utilization of eye care providers and increased utilization of family doctors', 20(8) *Value in Health* 1034.

[50] Van Katwyk et al, 'Cost-Utility Analysis of Extending Public Health Insurance Coverage to Include Diabetic Retinopathy Screening by Optometrists' (2017) 20(8) *Value In Health* 1034.

[51] Yaping Jin et al, 'Lack of government-funded optometric services is associated with reduced utilization of eye care providers and increased utilization of family doctors', 20(8) *Value in Health* 1034.

[52] Van Katwyk et al, 'Cost-Utility Analysis of Extending Public Health Insurance Coverage to Include Diabetic Retinopathy Screening by Optometrists' (2017) 20(8) *Value In Health* 1034.

[53] Kiran et al, 'Unintended consequences of delisting routine eye exams on retinopathy screening for people with diabetes in Ontario, Canada' (2013) *CMAJ,* E167.

[54] Shicheng Jin et al, 'Distribution gaps in cataract surgery care and impact on seniors across Ontario', (2019) *Can J Ophthalmol 54*(4): 451-457.

[55] Tina Felfeli et al, 'Predicting the Ophthalmic Surgical Backlog as a Result of the COVID-19 Pandemic: A population-based study and microsimulation model to inform surgical recovery plans', *medRxiv* 2021.03.25.21254375; doi: https://doi.org/10.1101/2021.03.25.21254375.

[56] Statistics Canada 2017, Canadian Survey on Disability, 2017, https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2019035-eng.htm, accessed 24 March 2021.

[57] Emily Baron et al, 'Validation of the 10-item Centre for Epidemiological Studies Depression Scale (CES-D-10) in Zulu, Xhosa and Afrikaans populations in South Africa'. (2017) 17(6) *BMC Psychiatry* 1.

[58] Alyssa Grant et al, 'Visual Impairment, Eye Disease, and the 3-year Incidence of Depressive Symptoms: The Canadian Longitudinal Study on Aging' (2020) 28(1) *Ophthalmic Epidemiology* 77.

[59] Diane Zheng et al, 'Longitudinal relationships between visual acuity and severe depressive symptoms in older adults: the Salisbury Eye Evaluation study, Aging & Mental Health' (2016) 20(3) *Aging Mental Health* 295.

[60] Martin Pinquart et al, 'Psychological well-being in visually impaired and unimpaired individuals: A meta-analysis' (2011) 29(1) *British Journal of Visual Impairment* 27.

[61] Charles Frank et al, 'Longitudinal Associations of Self-reported Vision Impairment With Symptoms of Anxiety and Depression Among Older Adults in the United States' 2019 127(7) *JAMA Ophthalmology* 793.

[62] Hyo Choi et al, 'Visual impairment and risk of depression: A longitudinal follow-up study using a national sample cohort' (2018) 8(1) *Scientific Reports* 2083.

[63] Suzanne Cosh et al, 'The association amongst visual, hearing, and dual sensory loss with depression and anxiety over 6 years: The Tromsø Study', (2018) 33(4) *International Journal of Geriatric Psychiatry* 598.

[64] Hans-Werner Wahl, 'The Psychological Challenge of Late-Life Vision Impairment: Concepts, Findings, and Practical Implications' (2013) 278135 *Journal of Ophthalmology* 11.

[65] Birgitta Thorslund et al, 'Vision measurability and its impact on safe driving – a literature review' 9(1) (2016) *Scandinavian Journal of Optometry and Visual Science* 1.

[66] Blane A, 'Through the Looking Glass: A Review of the Literature Investigating the Impact of Glaucoma on Crash Risk, Driving Performance, and Driver Self-Regulation in Older Drivers' (2016) 26(1) *Journal of Glaucoma* 113.

[67] Gerald McGwin et al, 'Examining the association between age-related macular degeneration and motor vehicle collision involvement: a retrospective cohort study' 2013 97(9) *British Journal of Ophthalmology* 1173.

[68] Michael Schlander et al, 'New estimates of the willingness-to-pay for a statistical life year: a systematic review of the empirical economic literature' (2018) 21 *Value in Health* S111.

[69] Institute for Health Metrics and Evaluation, Global Burden of Disease Study 2019 (2020) http://ghdx.healthdata.org/record/ihme-data/gbd-2019-disability-weights, accessed 12 March 2021.

[70] Walter Delpero et al and the Canadian Ophthalmological Society Clinical Practice Guideline Expert Committee, 'Canadian Ophthalmological Society evidence-based clinical practice guidelines for the periodic eye examination in adults in Canada', (2007), *Can J Ophthalmol 42*:39-45.

[71] Medical Advisory Secretariat, 'Routine eye examinations for persons 20-64 years of age: an evidence-based analysis', (2006), *Ont health Technol Assess Ser* 6(15):1-81.

[72] Irving Elizabeth et al, 'Value of Routine eye Examinations in Asymptomatic Patients', (2016) *Optom Vis Sci* 93(7): 660-6.

[73] Falkenberg et al, 'Vision status of children aged 7-15 years referred from school vision screening in Norway during 2003-2013: a retrospective study', (2019) *BMC Ophthalmology* 19:180.

[74] FYIdoctors, Are Eye Exams in Canada Covered by the Government?, https://fyidoctors.com/en/blog/categories/health-and-

wellness/are-eye-exams-in-canada-covered-by-the-government, accessed 21 April 2021.

[75] Afua Asare et al, 'The Cost-Effectiveness of a School-Based Vision Screening Program to detect Amblyopia and Refractive Errors in Young Children Compared to Usual Care Screening in Ontario, Canada: An Economic Analysis' [Abstract], (2019) American Academy of Optometry, https://www.aaopt.org/detail/knowledge-base-article/the-cost-effectiveness-of-a-school-based-vision-screening-program-to-detect-amblyopia-and-refractive-errors-in-young-children-compared-to-usual-care-screening-in-ontario-canada-an-economic-analysis-339224-3232019, accessed 21 April 2021.

[76] Anna Palagyi et al, 'While we waited: incidence and predictors or falls in older adults with cataract' (2016) *Invest Ophthalmol Vis Sci 57*:6003-6010.

[77] Patented Medicine Prices Review Board (PMPRB), Market Intelligence Report: Anti-Vascular Endothelial Growth Factor (Anti-VEGF) Drugs for Retinal Conditions, 2017, http://www.pmprb-cepmb.gc.ca/view.asp?ccid=1416&lang=en, accessed 24 February 2021.

[78] Taylor et al, 'The economic impact and cost of visual impairment in Australia.' (2006) 90(3) *Br J Ophthalmol* 272-275.

[79] Martiniello et al, 'Exploring the use of smartphones and tablets among people with visual impairments: Are mainstream devices replacing the use of traditional visual aids?' (2019) *Assist Technology* 1-12.

[80] Lund Emily et al, 'A Systematic Review of Factors Related to Employment in Transition-Age Youth with Vision Impairments', (2020) 65(2) *Rehabilitation Psychology* 122-136.

[81] Statistics Canada 2020, Canadian Health Measures Survey 2018-2019, https://www150.statcan.gc.ca/n1/daily-quotidien/201214/dq201214d-eng.htm, accessed 10 March 2021.

[82] Nathan Congdon et al, the Eye Diseases Prevalence Research Group, 'Prevalence of Cataract and Pseudophakia/Aphakia Among Adults in the United States', (2004) *122 Arch Ophthalmol 487-494.*

[83] Hassan Hashemi et al, 'Global and regional prevalence of age-related cataract: a comprehensive systematic review and meta-analysis', (2020) *34 Eye* 1357-1370.

[84] Jeany Li et al, 'Prevalence and incidence of age-related macular degeneration in Europe: a systematic review and meta-analysis', (2019) *104 Br J Ophthalmology* 1077-1084.

[85] Joanne Yau et al, 'Global prevalence and major risk factors of diabetic retinopathy', (2012) *35 Diabetes Care* 556-564.

[86] Statistics Canada 2018, Diabetes, 2017, https://www150.statcan.gc.ca/n1/pub/82-625-x/2018001/article/54982-eng.htm, accessed April 2021.

[87] Laura Rosella et al, 'Prevalence of prediabetes and undiagnosed diabetes in Canada (2007-2011) according to fasting plasma glucose and HbA_{1c} screening criteria', (2015) *38 Diabetes Care* 1299-1305.

[88] Yih-Chung Tham et al, 'Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis', (2014) *121 Ophthalmology* 2081-2090.

[89] Barbara Klein and Ronald Klein, 'Projected prevalences of age-related eye disease', (2013) *54 Invest Ophthalmol Vis Sci* ORSF14-ORSF17.

[90] Alberta Health Interactive Health Data (HIDA) 2019, https://www.albertahealthservices.ca/about/Page13342.aspx, accessed 5 March 2021.

[91] Alberta Health Interactive Health Data (HIDA) 2019, Hospital Ambulatory Care Case Cost – CACS – 2018 version, http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectCategory.do, accessed 5 March 2021.

[92] Alberta Health Interactive Health Data (HIDA) 2019, Hospital Inpatient Care Case Cost – CMG+ - 2018 version, http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectCategory.do, accessed 5 March 2021.

[93] Deandrea et al, 'Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis' (2010) 21(5) *Epidemiology* 658.

[94] David Yorston, 'Anti-VEGF drugs in the prevention of blindness', (2014) 27(87) *Community Eye Health* 44.

[95] Patented Medicine Prices Review Board (PMPRB), Biologics in Canada, Part 1: Market Trends, 2018, https://www.canada.ca/content/dam/pmprb-cepmb/documents/reports-and-studies/chartbooks/biologics-part1-market-trends.pdf, accessed 5 March 2021.

[96] Canadian Institute for Health Information (CIHI) 2019e, Canada's health care providers, https://www.cihi.ca/en/canadas-health-care-providers, accessed 5 March 2021.

[97] Canadian Medical Association 2019, Ophthalmology Profile, https://www.cma.ca/sites/default/files/2019-01/ophthalmology-e.pdf, accessed 12 April 2021.

[98] Statistics Canada 2018, Canadian Community Health Survey (CCHS) – 2018, https://www23.statcan.gc.ca/imdb/p3Instr.pl?Function=assembleInstr&a=1&&lang=en&Item_Id=839130#qb839764, accessed 9 March 2021.

[99] Statistics Canada 2016, Canadian Community Health Survey (CCHS) – 2016, https://www23.statcan.gc.ca/imdb/p3Instr.pl?Function=assembleInstr&a=1&&lang=en&Item_Id=260675#qb270072, accessed 9 March 2021.

[100] Yuliya Chuvarayan, 'Economic burden of blindness and visual impairment in Germany from a societal perspective: a cost-of-illness study', (2019) *The European Journal of Health Economics*, 115.

[101] Fighting Blindness Canada, 2019, Funded Grants and Awards for Fiscal Year 2019 (July 1, 2018-June 30, 2019), https://www.fightingblindness.org/funded-grants-2019, accessed 2 March 2021.

[102] Government of Canada (2021), CIHR Canadian Research Information System, https://webapps.cihr-irsc.gc.ca/cris/Search?p_language=E&p_version=CRIS, accessed 2 March 2021.

[103] Michele McDonnall and Zhen Sui, 'Employment and unemployment rates of people who are blind or visually impaired: Estimates from multiple sources' (2019) 133(6) *Journal of Visual Impairment and Blindness* 481.

[104] Phillippa Cumberland and Jugnoo rahi, 'Visual function, social position, and health and life chances: the UK biobank study' (2016) 134(9) *JAMA ophthalmology* 959.

[105] Hanen Harrabi et al, 'Visual difficulty and employment status in the world' (2014) 9(2) *PloS one*

[106] Slade, J. & Edwards, R. (2015). My Voice 2015: The views and experiences of blind and partially sighted people in the. RNIB, London, UK.

[107] Data provided by Canadian National Institute for the Blind, April 2021.

[108] John Nesemann et al, 'Association of visual impairment with disability: a population-based study' (2021) *Eye* 1.

[109] Matthew Burton et al, 'The Lancet global health Commission on global eye health: vision beyond 2020' (2021) 9(4) *The Lancet Global Health* e489.

[110] Wouter Schakel et al, 'The association between visual impairment and fatigue: a systematic review and meta-analysis of observational studies' (2019) 39(6) *Opthalmic and Physiological Optics* 399.

[111] Keith Gordon et al, 'The cost of vision loss in Canada. 1. Methodology' (2011) 46(4) *Canadian Journal of Ophthalmology* 310.

[112] Ana Patricia Marques et al, 'Productivity losses and their explanatory factors amongst people with impaired vision' (2019) 26(6) *Opthalmic epidemiology* 378.

[113] Wouter Schakel et al, 'The economic burden of visual impairment and comorbid fatigue: a cost-of-illness study (from a societal perspective)' (2018) 59(5) *Investigative ophthalmology & visual science* 1916.

[114] Rumaisa Aljied et al, 'Visual impairment and the use of formal and informal home care in Canada: the Canadian Longitudinal Study on Aging' (2019) 54(3) *Canadian Journal of Opthalmology* 367.

[115] Ana Patricia Marques et al, 'The use of informal care by people with vision impairment' (2018) 13(6) *PLoS One* e0198631.

[116] Jordana K Schmier et al, 'Impact of visual impairment on use of caregiving by individuals with age-related macular degeneration' (2006) 26(9) *Retina* 1056.

[117] Jie Wang et al, 'Impact of visual impairment on use of community support services by elderly persons: the Blue Mountains Eye Study' (1999) 40(1) *Investigative ophthalmology & visual science* 12.

[118] Kathleen Melissa Ke, 'The direct, indirect and intangible costs of visual impairment caused by neovascular age-related macular degeneration' (2010) 11(6) *The European Journal of Health Economics* 525.

[119] Deloitte Access Economics, *The socioeconomic impact of inherited retinal dystrophies (IRDs) in Canada*, October 2020. Available at <https://www2.deloitte.com/au/en/pages/economics/articles/socioeconomic-impact-inherited-retinal-dystrophies-us-canada.html>.

[120] Sophia Liu et al, 'Visual impairment and the Ontario Disability Support Program' (2020) 55(3) *Canadian Journal of Ophthalmology* 212.

[121] Canadian Council of the Blind, A needs report on accessible technology summary report 2019, https://ccbnational.net/docs/A%20NEEDS%20REPORT%20(GCV)-april%2010-HR[1].pdf, accessed 10 March 2021.

[122] Canadian National Institute for the Blind, Non-consolidated Financial Statements of the Canadian National Institute for the Blind, Year ended March 31, 2019, https://cnib.ca/sites/default/files/2019-09/CNIB_Final_Word_FS_FINAL-s_980269.pdf, accessed February 2021.

[123] Deafblind Community Services, Financial Statements of Deafblind Community Services, Year ended March 31, 2019, https://deafblindservices.ca/wp-content/uploads/2019/08/DBCS_Final_Word_FS_FINAL-s_979577.pdf, accessed February 2021.

[124] Vision Loss Rehabilitation Canada, Financial Statements of Vision Loss Rehabilitation Canada, Year ended March 31, 2019, https://www.visionlossrehab.ca/Documents/Financials/VLRC_Final_Word_FS-2019.pdf, accessed February 2021.

[125] Institut Nazareth & Louis Braille 'Rapport annuel de gestion 2014-2015' (2015) http://www.inlb.qc.ca/wp-content/uploads/2015/07/Rapport-annuel-de-gestion-2014-2015-VF.pdf.

[126] Statistics Canada, 'Labour Force Survey (LFS)' (January 10, 2020), https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=1269489, accessed 10 March 2021.

[127] Canadian Institute for Health Information (CIHI), 'Profile of Residents in Residential and Hospital-Based Continuing Care, 2018-19' https://www.cihi.ca/en/profile-of-residents-in-residential-and-hospital-based-continuing-care-2018-2019, accessed 10 March 2021.

[128] Ake Blomqvist et al, 'Paying for the boomers: Longterm care and intergenerational equity' (2014) *CD Howe Institute Commentary*, 415.

[129] Jin Jin Wang et al, 'Visual impairment and nursing home placement in older Australians: the Blue Mountains Eye Study' (2003) 10(1) *Ophthalmic Epidemiology* 3.

[130] Jennifer Evans et al, 'Risk of admission to a nursing home among people with visual impairment in Great Britain' (2008) 126(10) *Archives of Ophthalmology* 1428.

[131] Sophia Liu et al, 'Visual impairment and the Ontario Disability Support Program' (2020) 55(3) *Canadian Journal of Ophthalmology* 212.

[132] Bev Dahlby et al, 'The Marginal Cost of Raising Tax Revenue: Implications for Tax Policy Options in Alberta' (2011) Working Paper, Department of Economics, University of Alberta.

[133] Murray C and Lopez A (1996) The Global Burden of Disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020, Volume 1, Global Burden of Disease and Injury Series, Harvard: Harvard School of Public Health.

[134] Institute for Health Metrics and Evaluation, Global Burden of Disease Study 2019 (2020) http://ghdx.healthdata.org/record/ihme-data/gbd-2019-disability-weights, accessed 12 March 2021.



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